Railway Wheelsets

Synopsis
This document contains mandatory requirements which are to be met during the design of wheelsets and associated components; inspection and testing of railway wheelsets at all stages of manufacture; use, repair and overhaul of railway wheelsets. It also mandates the requirements for a wheelset policy to ensure continued safe use of railway wheelsets.

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Published by:
Rail Safety and Standards Board
Evergreen House
160 Euston Road
London NW1 2DX

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Part A

A1 Issue record

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This document will be updated when necessary by distribution of a complete replacement.

A2 Implementation of this document

The publication date of this document is 7 June 2003.

This document comes into force on 2 August 2003.

The dates by which compliance with the requirements of this document is to be achieved are set out in Part B2. Where those dates are later than the date on which this document comes into force, this is to give Railway Group members additional time to plan and commence implementation so as to achieve full compliance by the dates set out in Part B2.

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## A3 Scope of Railway Group Standards

The overall scope of Railway Group Standards is set out in Appendix A of GA/RT6001. The specific scope of this document is set out in Part B2.

## A4 Responsibilities

Railway Group Standards are mandatory on all members of the Railway Group* and apply to all relevant activities that fall into the scope of each individual’s Railway Safety Case. If any of those activities are performed by a contractor, the contractor’s obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where a contractor is a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in the Safety Case.

* The Railway Group comprises Network Rail Infrastructure Limited, Rail Safety and Standards Board Limited, and the train and station operators who hold railway safety cases for operation on or related to infrastructure controlled by Network Rail Infrastructure Limited.

Network Rail Infrastructure Limited is known as Network Rail.

Rail Safety and Standards Board Limited is known as RSSB.

## A5 Health and safety responsibilities

In issuing this document, RSSB makes no warranties, express or implied, that compliance with all or any documents published by RSSB is sufficient on its own to ensure safe systems of work or operation. Each user is reminded of its own responsibilities to ensure health and safety at work and its individual duties under health and safety legislation.
A6 Technical content

The technical content of this document has been approved by:

Haydn Peers, Principal Traction and Rolling Stock Engineer, RSSB

Jon Taylor, Principal Track and Structures Engineer, RSSB

Enquiries should be directed to RSSB – Telephone: 020 7904 7518.

A7 Supply

Controlled and uncontrolled copies of this document may be obtained from the Industry Safety Liaison Department, Rail Safety and Standards Board, Evergreen House, 160 Euston Road, London NW1 2DX.
Part B

B1 Purpose

This Standard contains the mandatory requirements which are to be met during the design of wheelsets and associated components; inspection and testing of railway wheelsets at all stages of manufacture; use, repair and overhaul of railway wheelsets to ensure that the wheelset geometry is compatible at all times with acceptable rail and track geometry. It also mandates the requirements for a wheelset policy to ensure continued safe use of railway wheelsets.

In addition, this document sets out the design requirements for axle bearings that are an integral part of the overall safe performance of a railway wheelset.

B2 Application of this document

B2.1 To whom the requirements apply

This document contains requirements that are applicable to RSSB and duty holders of the train operator category of Railway Safety Case.

B2.2 Compliance requirements

B2.2.1 Trains

Except for specific compliance requirements set out below, the requirements of this document shall be complied with no later than 4 June 2005.

The following are carried forward from the requirements mandated in the superseded document GM/RT2451:

All solid axles not previously subject to magnetic particle inspection at overhaul shall have been tested by:

Locomotives and wagons 1 May 2005
Shunting locomotives and other vehicles 1 May 2007

With the exception of G3.2.3 mandated upon RSSB the requirements of this document are within the scope of Vehicle Acceptance Body approval.

Action to bring existing railway wheelset designs into compliance with the requirements of section Part D and section F2 of this document is not required.

The exception is that where vehicles are being modified in the area covered by the scope of this document, the requirements shall be applied so far as is reasonably practicable.

B2.2.2 RSSB

The requirements of clause G3.2.3 is be complied with no later than 5 June 2004.

B2.2.3 General compliance requirements

After the compliance dates, or after the date by which compliance is achieved (if earlier), Railway Group members shall not deviate from the requirements set out in this document.

Until the compliance dates, or the date by which compliance is achieved (if earlier), the applicable requirements of the predecessor document shall continue to be met (see Part A for details).

Where it is considered not reasonably practicable to comply with the requirements set out in this document, authorisation not to comply shall be sought in accordance with GA/RT6001, GA/RT6004 or GA/RT6006.

B2.3 Exclusions from the application of this document

The contents of this document apply to RIV vehicles except for clauses C2.2, E2.3.1, E2.3.2, E2.13, E3.1.4, F3.6, F5.2.1, F6.2.1, G2.1.1, G2.1.2, G2.2, G2.4.2, G2.6.14, G3.1.1, G3.2.1 and Appendix 3. Alternative arrangements apply to RIV vehicles that contain equivalent requirements.
Except for the requirements set out in clauses G2.2, G2.3, G2.6.1, G2.6.12 to G2.6.15 and Appendix 3 the contents of this document do not apply to rail mounted maintenance machines and road-rail vehicles as set out in GM/RT2402 and GM/RT1300 respectively. The requirements for these are set out in GM/RT2402 and GM/RT1300.

B2.4 Supporting documents
This document will be supported by a RSSB Approved Code of Practice GM/RC2566 Recommendations for Railway Wheelsets, due for publication in August 2003.

B2.5
This document has yet to be fully analysed for conformity with the Technical Specification for interoperability relating to the rolling stock subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Directive 96/48/EC (High Speed TSI). Where conflicts are identified between this document and the High Speed TSI, GE/RT8050 sets out the course of action to be followed.

B3 Definitions

AAR
Association of American Railroads.

Approved procedure
A procedure written by a technically competent authority that has been approved within the Certificate of Conformance for Vehicle Maintenance by a Vehicle Acceptance Body as set out in GM/RT2000.

Axlebox
The structure, including cartridge bearing adaptor, which houses, or is in contact with, the axle journal bearing and provides an interface with the bogie and/or suspension arrangement.

Axle run-out
The total radial displacement measured at the centre of the axle when it is rotated on rollers supporting the wheelset bearing journals.

Certificate of competence [in non-destructive testing]
A certificate of competence is the qualification given to operatives after training, and when an appropriate examination has been passed in one or more of the following areas: eddy current testing, penetrant testing, magnetic testing, general ultrasonic testing, ultrasonic testing of railway axles, radiographic testing.

Change
A process where a component is removed and a new or overhauled part is fitted in its place.

Change of use
Where a wheelset is fitted to a different design of vehicle to that originally intended by the wheelset designer, or where the vehicle is to be used in a different way, which alters the loads experienced by the wheelset.

Check
Determine a particular nominated condition before, during or after repair or overhaul.

Clean
Use an approved method to remove all dirt, deposits, corrosion products, oil, grease-based compounds and protective coatings which are not correctly adhering to the surface, for example, loose paint.

Cold stamping
Alpha-numeric stamping performed on the component whilst it is at ambient temperature.
Completion of journey
The depot, siding, platform line or other authorised place where the train:

a) reaches its destination

b) is required to have a vehicle attached or detached

c) is required to terminate short of its destination as a result of defective on-train equipment or other operational reason.

Defect / defective
Any fault(s) in a component, or assembly, which may prevent the component, or assembly, from fulfilling its design purpose.

Design life
The total time or distance over which a wheelset is intended to provide a defined standard of performance while subject to a pre-defined regime of maintenance, repair and overhaul.

Direct supervision
Supervision involving the presence on site of the supervisor, where the supervisor by virtue of greater experience and higher qualifications maintains responsibility for the activity being undertaken.

Drag brake
A partial brake application that is sustained for a period of time to hold the speed of a train constant when descending a falling gradient.

Examine
Use of visual methods to determine the general condition of a component or assembly.

Failure
Any occasion on which a wheelset develops a defect, that has the potential to cause or contribute to a derailment.

Freight train
Vehicles designed and used for carrying payloads which do not include people.

Gauge
Determine a nominated dimension by using suitable measuring equipment.

Hollow axles
An axle that has a hole through its centre by means of which the axle is subject to a routine, internal, non-destructive testing process.

Hot stamping
Alpha-numeric stamping performed on the component whilst it is in the red-hot state during manufacture.

Inspect
Determine conformity to required standards.

Integral disc braked wheel
A wheel where the wheel web itself acts as the friction surface for the brake pad.

Interference fit
The shrink or press fit between a wheel centre and a tyre or between the axle and any item, other than a wheelset bearing.

Longitudinal indication
A linear indication obtained when carrying out non-destructive testing which lies parallel to the longitudinal axis of the axle or which is less than 45° out of parallel.
Magnetic particle inspection
Magnetic particle inspection (MPI) is a method of detecting surface, or near surface, discontinuities in magnetisable materials by the generation of a magnetic flux within the material and the application of suitable ferromagnetic particles to the surface, so as to render the discontinuity visible.

Maintenance
The routine process of examination, inspection, measurement and lubrication which, together with the completion of identified repairs, ensures the wheelset remains safe throughout its current service life.

Manufacture
All the processes and assembly operations which culminate in the production of a completely new wheelset.

Monobloc wheel
A wheel comprising a hub, a wheel web and rim with the full wheel tread profile manufactured from a single piece of steel as a single entity.

Non-destructive testing
Non-destructive testing (NDT) is the process of examination of a wheelset to enable its integrity to be assessed by a means which does not compromise the service life or the design life of the wheelset.

Non-passenger vehicle
Vehicles such as locomotives, power cars, driving van trailers and on-track machines that do not carry people other than operational staff in the course of their duties.

On-track machine
Any rail-mounted machine, whose primary function is for the renewal, maintenance, inspection or measurement of the infrastructure, meeting the requirements of GM/RT2400 and permitted by the Rule Book to be moved, either self-propelled or in train formation, outside a possession. This definition includes all vehicles classified as on-track machines in accordance with clause 6.4 of GM/RT2000 issue 2.

Overhaul
Any attention given to the wheelset when it is removed from a vehicle or bogie and when an interference fit is broken.

Overheated wheel / tyre
A wheel or tyre which is running, or has run, at a temperature higher than that allowed for in the design. This may be due to a dragging brake or where the bearing has been running hot or other abnormal circumstance.

Passenger vehicle
Vehicles designed and used for carrying passengers who are fare-paying customers.

Personnel vehicles
Vehicles used for the carriage of non-operational staff, including contractors.

Power cars
A non-passenger vehicle which provides, as its principal function, traction power for a trainset of which it is an integral part.

Rail mounted maintenance machine
Rail mounted maintenance machine (RMMM) is a vehicle that can travel on-rail under its own power system. Such vehicles are not allowed to operate, work or travel outside possessions.
Retaining ring (Gibson)
A split ring of material used to retain the tyre on the wheel centre.

Re-manufacture
All the processes and assembly operations which culminate in the production of a wheelset which incorporates a new axle but also incorporates re-used components.

Repair
The physical attention given to the wheelset to enable it to remain safe throughout its current service life. Such attention does not require the breaking of any interference fit.

Regolamento Internazionale Veicoli
Regolamento Internazionale Veicoli (RIV) are, for the purposes of this document, vehicles registered for international traffic, (not foreign registered vehicles in internal traffic, where the origin and destination are both within the UK, and not UK registered vehicles).

Road-rail vehicle
A vehicle that can travel on the road and also travel on rail by virtue of a rail wheel guidance system under its own power meeting the requirements of GM/RT1300. Such vehicles are not allowed to operate outside possessions.

Roll-over
A burr of extruded material forming on the outer rim side of the wheel during service by plastic deformation.

Rolling contact fatigue
A series of fine, typically closely spaced cracks in the centre of the wheel tread which eventually form a complete circumferential band of cracks but may be more extensive.

Service life
The time or distance over which a wheelset safely continues to meet defined technical standards before overhaul is required.

Sharp flange
A sharp corner on the flange tip.

Technically competent authority
A company, or person, having proven competence in a particular technology or process and being independent of the company requiring the services of the technically competent authority.

Thermal crazing
A pattern of fine, superficial cracks in the wheel tread or web caused by the thermal, rubbing input from the brake block or pad.

Toe radius build-up
Extruded material on the flange tip.

Transverse indication
A linear indication obtained when carrying out NDT which lies transverse to the longitudinal axis of the axle, or which lies at an angle of 45° or greater measured to the longitudinal centre-line.

Tread run-out
The total radial displacement measured at the wheel tread when the wheelset is rotated on rollers supporting the wheelset bearing journals.
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Tyred wheel
A wheel which comprises at least a wheel centre and a separately manufactured tyre.

UIC
Union Internationale de Chemins de Fer.

Ultrasonic testing
Ultrasonic testing is a process in which high frequency sound waves are transmitted through materials such that the reflections can be analysed to find imperfections in the material. Ultrasonic axle testing (UAT) is when the process is applied to railway axles.

Wheel centre
The wheel hub, web and rim on which a tyre is fitted.

Wheelset
A complete unit comprising an axle and two complete wheels together with any gear wheels, brake discs, etc, but without axle bearings and their end caps, spacers, seals and other associated fittings. Figure 1 of this document identifies the relevant features of both tyred and monobloc wheels.

Wheelset database
A documented, maintained set of up-to-date data for each wheelset design, and each type of vehicle.

Wheelset management
All aspects of manufacture, assembly, handling, service use, examination, testing, inspection, maintenance, repair, overhaul and disposal which the train operator shall actively require and control.

Wheel wobble
The total axial displacement of the wheel tread when the wheelset is rotated, measured at the flange back.

B4 Principles

The running gear should guide the train safely along the track.

The factors for consideration should include:

a) compatibility of the wheel and rail interface.

... 

h) the risk and effects of component failure, particularly of wheelsets and bearings.

...
Part C  Engineering policy for wheelsets

C1  Introduction
This section is a descriptive introduction to Part C. It does not contain mandatory requirements.

Part C contains the policy requirements for wheelsets that are to be operated on Network Rail controlled infrastructure. It covers both the principles adopted by the train operator to ensure continued safe operation of railway wheelsets and how those principles are to be implemented to meet the requirements of this document.

The policy is the means by which the train operator demonstrates how the safety of wheelsets in their control are to be managed. The policy is to be referenced in the applicable Railway Safety Case. Also, the applicable Railway Group Standards are to be identified and how compliance is to be achieved with these standards.

The engineering policy for wheelsets is to indicate the practices that are to be adopted with regard to specific responsibilities of the train operator. The means by which these are to be addressed is to be included in the policy.

The train operator’s maintenance plan(s) is to include details of how the wheelsets under their control are to be maintained. The plan(s) is to identify the maintenance instructions and procedures, together with the periodicity of routine examinations for the vehicle classes being operated.

C2  Scope of the train operators wheelset engineering policy

C2.1 Railway Safety Case requirements
Each train operator shall have a documented wheelset engineering policy, setting out how all wheelsets that fall within the scope of that train operator’s responsibility are managed to ensure that each wheelset complies with relevant Railway Group Standards, is fit for purpose and safe to operate. The scope of a wheelset engineering policy shall include all vehicles operated or hauled by a train operator, including those owned by third parties. It is permitted to delegate tasks required to formulate or implement the policy but responsibility for the adherence to policy and for the effectiveness of the policy shall remain with the train operator.

C2.2 Maintenance plan
RIV vehicles are excluded from the requirements of this section.

C2.2.1 The train operator shall produce a maintenance plan which includes the wheelset examinations as set out in this document. The plan shall detail the frequency of the examinations or the occasions when an examination is required. The requirements for certification of the maintenance plan are set out in GM/RT2004.

C2.2.2 The maintenance plan shall identify all specifications and procedures for wheelset maintenance, which shall be applied at a frequency adequate to ensure that the wheelset is at all times in compliant condition with no exceedance of limits or tolerances.

C2.2.3 The maintenance plan shall identify all processes used on a wheelset, including examination, inspection and testing.

C2.3 Data records
The policy shall detail arrangements to ensure that the wheelset data records are established and maintained, such that each wheelset/vehicle application is completely documented. The minimum contents of the wheelset data records are given in Appendix 1.
C2.4 Audit and review
The policy shall define the arrangements for the regular review of the policy and its subsidiary procedures, specifications and instructions, together with a regular audit of their application.

C2.5 Special examinations
The policy shall include provision for special examinations where this is indicated by service history.

C2.6 NDT testing
The policy shall require that wheelsets and wheelset components are only to be tested by operators, facilities and equipment that have been certificated. The procedures used shall be specific to the wheelset/vehicle application and the procedure shall have been validated.

C2.7 Provision of services and equipment
The policy shall detail the arrangements to ensure that wheelsets are only procured from the list of qualified suppliers held by RSSB. Where wheelsets are procured through an agent, the source of the original supply shall meet the requirements of GM/RT2470. The specific arrangements for qualification of suppliers of wheelsets and/or components for wheelsets for use on wheelsets are set out in GM/RT2470.

Further requirements for the provision of other safety-critical material and services are set out in GM/RT2450 and the requirements for NDT applications are set out in GM/RT2005.

C2.8 Wheelset traceability
The train operator shall ensure the traceability of each wheelset and that complete records are maintained with regard to each wheelset.

C2.9 Handling and care of wheelsets
Wheelsets which are not in service under vehicles and components prior to assembly shall be protected, stored, handled and transported in a manner which is not detrimental to the wheelset/component life. Processes prohibited on wheelsets are set out in Appendix 6.

C2.10 Loose wheelset identification
Wheelsets that are not fitted to a vehicle shall be clearly and durably labelled at all times. Appendix 2 sets out the labelling requirements.

C2.11 Wheelset failures
All wheelset failures (as set out in section B3) shall be recorded. The failed wheelset shall be placed in quarantine, and identified for possible further examination and tests in accordance with the requirements of this document.
Part D Design

D1 Introduction

This section is a descriptive introduction to Part D. It does not contain mandatory requirements.

Part D mandates the criteria and constraints to be considered when designing wheelsets. Lists of factors to be considered in wheelset design have been included to assist the designer. These are not exhaustive and other factors are to be considered as necessary.

It is necessary to demonstrate that new, unconventional or novel features incorporated into a wheelset design satisfy the requirements set out in this section.

Every axle is to be capable of being fully tested by a suitable NDT technique. The NDT procedure is to be validated on a full-size axle, complete with wheels and other interference fit components as appropriate.

D2 Wheelset and wheelset component and axlebox design philosophy

D2.1 Methodology

Axles, wheels, wheel centres, tyres, axleboxes, gearwheels, final drive units and brake discs shall be designed using predictions of service loads so that the fatigue life is not finite. The brake disc fasteners shall have a life commensurate with the life of the brake disc and not be re-used when removed at overhaul or maintenance. Wheelset components shall have lives commensurate with the wheelset duty life.

For axles, the design objectives shall include the requirement that in-service stresses never exceed the upper limit related to a formal recognised design method. For other wheelset components, a fatigue damage tolerant approach is permissible. All designs shall include a factor of safety. All component designs shall incorporate safety factors appropriate to the uncertainties of the assumptions made.

For monobloc wheels only, it is permissible to reduce the rim thickness at the final re-profiling such that the fatigue life 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. In calculating the predicted fatigue life due cognisance shall be taken of, but not limited to:

a) the steel cleanliness levels
b) the permitted defects in the wheel rim, in accordance with clause F2.2.3(b) of this document
c) residual stress distribution in the worn wheel
d) transient loading at the tread corner when negotiating switches and crossings.

D2.2 Wheelset component fatigue life

The design life of components mounted on the wheelset, not specifically identified in this document, shall be greater than the time and/or distance between specified maintenance/overhaul periods for the wheelset.

D2.3 Consistent design, manufacture and maintenance philosophies

The definition of load cases, material condition and properties, allowable stresses and maintenance regime for each component shall be mutually consistent.
**D2.4 Material properties**
The permissible stresses shall be consistent with the physical and fatigue properties of the material.

**D2.5 Corrosion protection**
Details of the wheel and axle surface coating and corrosion protection system, as specified for the wheelset design, shall be included on the wheelset drawings.

**D2.6 Wheelset electrical continuity**
The wheelset shall be designed and tested to meet the requirements of BS 5892, Part 6.

**D2.7 Innovation / development**
Where new or improved design methods, manufacturing processes or materials become available which conflict with any of the requirements of this document, then before use, each and every novel feature shall be tested and proven by a technically competent authority and the results documented. It is then permissible to use such features following authorisation to do so in accordance with the requirements set out in clause B2.2.3.

**D2.8 Materials**
The materials permitted to be used in the manufacture of wheelset are identified in Part F of this document.

**D3 Axle**

**D3.1 Axle design**
Axles shall be designed using a recognised proven method taking account of, as a minimum, the following:

a) maximum operational speed and cant deficiency

b) maximum stresses that satisfy non-finite fatigue life requirements

c) characteristic of loads applied to the axle, including vehicle loads, track inputs, wheel tread damage, transmission components and forces, braking forces, effects of wheel-slide and wheel-slip systems, etc

d) loading regimes which could adversely affect the axle life, such as torsional vibrations

e) the geometry between the axle features

f) the effects of interference fits on the axle

g) all potential stress concentrations and method of their elimination, for example, surface finish, geometry

h) the material and heat treatment process to be used

i) manufacture process including surface finish

j) compatibility with non-destructive testing techniques that are to be applied to the axle during its life

k) effects of impact damage to the axle surface

l) effects of corrosion where the protective coating has been damaged

m) effects of thermal and mechanical interaction between the brake disc and the mounting on the axle.

The above list is not-exhaustive.
The additional design requirements shall take into account all predictable fatigue loads and all other factors that influence the design life or the factor of safety. The risks of any axle design failing shall be no worse than an equivalent axle in operation on Network Rail controlled infrastructure.

D3.2 Axle design and corrosion protection compatibility

The axle design shall take account of the corrosion protection system defined in the design documentation. It is permissible to have no corrosion protection, provided that the axle design is consistent with this policy.

D3.3 Axle NDT

The axle design shall make provision for NDT inspections at manufacture and during its service life.

D4 Wheel

D4.1 Wheel design

All new vehicles shall be fitted with monobloc wheels. The requirements of clause D2.1 apply to the design of monobloc wheels. Alternative wheels, for example tyred wheels or resilient wheels, shall be permitted only via an application in accordance with the requirements set out in clause B2.2.3.

The design process shall cover all the proof and fatigue loads and other design factors predictable throughout the required design life.

Wheel design shall include assessment of the most severe thermal loadings induced through braking. This shall include drag braking and the most severe repeated braking cycle to be experienced by the vehicle, including an additional stop to represent peak thermal loading during the cycle.

As a minimum the following effects shall be taken into account, in addition to those considered for the axle in clause D3.1:

a) thermal effects on the wheel to axle fit
b) thermal strains imposed by friction brake components
c) the full range of wheel dimensions permitted
d) effects of thermal and mechanical interaction between the brake disc and the mounting on the wheel.

D4.2 Rim width

The wheel rim width requirements are set out in clause G2.2.

D4.3 Selection of tread profiles

The tread profile shall be selected only from those that have been accepted for use on Network Rail controlled infrastructure, as listed in Appendix 3. The tread profile shall be selected to suit the vehicle and suspension design, taking account of the effect on the wheel rail interface.

D4.4 Introduction of new profile designs

If a profile other than one of those identified in Appendix 3 is required, a non-compliance in accordance with clause B2.2.3 is required. New tread profiles shall satisfy the requirements for flange height and thickness as set out in this document and the limitations on track forces as set out in GM/TT0088. Additional guidance included in the supporting technical commentary GM/RC2513.

When submitting an application in accordance with clause B2.2.3, additional data, including a drawing, shall be provided for inclusion in a revision to Appendix 3 of this document.

D4.5 Wheel to axle fit

Wheels shall be shrunk or pressed onto the axle using a method permitted by BS 5892, Part 6.
D4.6  Wheel balancing
The wheel design shall make provision for balancing using a method that does not require creation of holes in the wheel, such a method is defined in BS 5892, Part 3.

D5  Axlebox

D5.1  Axlebox design
The requirements of clause D2.1 apply to axlebox design. Additional requirements relating to the axlebox design are set out in GM/RT2100. The design process shall cover all the proof and fatigue loads and other design factors predictable throughout the required design life.

In addition to those applicable effects listed for the axle in clause D3.1, the axlebox, as a minimum, shall:

a)  ensure adequate location of the wheelset
b)  ensure accurate alignment of the wheelset in longitudinal, lateral and yaw orientation within the vehicle/bogie
c)  be compatible with track mounted hot axle bearing detection equipment, as set out in GE/RT8014
d)  maintain its integrity in the event of a bearing failure.

D5.2  UAT access
The axlebox and/or end covers shall be designed to facilitate access to the axle for UAT inspection.

D6  Axle bearings

D6.1  Axle bearing considerations
The axle bearing design life shall be determined using a recognised proven method, taking the following factors into account, as a minimum:

a)  radial, lateral and torsional loading, including mechanical loads appropriate to the input from track and vehicle
b)  additional load inputs due to the effects of predictable wheel tread defects, for example, wheel flats
c)  the loads that can be attributed to the accumulated tolerance in the assembly and parasitic forces that can be produced within the suspension arrangement
d)  the full range of operating duties, rotating speeds and loads
e)  selection of bearing grease, taking into account increasing water content of the grease over time
f)  climatic conditions
g)  thermal inputs.

D6.2  Bearings / axlebox sealing
Sealing shall be provided for the axle bearings to restrict ingress of water and other foreign substances, and loss of lubricants.

D6.3  Axle bearing electrical damage
Arrangements shall be in place to control the risk of axle bearing failure through the passage of electrical current. It is permissible to include axle current return brushes.
D7   Brake disc

D7.1   Brake disc design considerations
Where fitted, the brake discs shall be designed to meet the requirements of clause D2.1. The process shall cover all the proof and fatigue loads and other design factors predictable throughout the required design life. The thermal and mechanical loads transmitted to the mounting arrangement shall be consistent with those used in the wheel and/or axle design, as identified in clauses D4.1 and D3.1 respectively.

As a minimum the following effects shall be taken into account:

a) mechanical loads appropriate to the input from track and vehicle
b) centrifugal loads, for example on fasteners of split discs
c) localised and bulk thermal inputs
d) braking loads
e) effects of thermal and mechanical interaction between the brake disc and the mounting on the wheel or axle.

D8   Wheelset assembly

D8.1   Security
All wheel, or axle, mounted components shall be designed to remain secure for the service life of the wheelset or those components. This security shall be assured over the full temperature ranges.

D8.2   Interference fits
Wheels, and other components that are secured to the axle by interference fit, shall be designed to remain secure over the appropriate temperature ranges.

D8.3   Back-to-back dimension
Wheelsets shall be designed to have a back-to-back dimension, as set out in clause G2.3.

D9   Wheelset design validation

D9.1   Validation requirements
All new designs of wheelset shall be fully tested using methods appropriate to the application to demonstrate that it satisfies the requirements set out in this document. Evidence that the requirements of this document have been met shall be submitted as part of the vehicle engineering acceptance.

D9.2   New, novel and unconventional features
Wheelset designs which embody new, unconventional or novel design features, new materials and/or new manufacturing processes shall be fully tested in accordance with clause D9.3. Prior to testing on Network Rail controlled infrastructure, practical and theoretical methods shall be used to demonstrate that the wheelset is safe to use at all times during any experiment, trial or development testing.

These trials shall be complete and have demonstrated that the wheelset design and manufacture conform to safety and service requirements to the satisfaction of a technically competent authority before the wheelset is accepted for regular or service use.
D9.3 Validation methods

All new designs of wheelset, or existing designs new to operation on Network Rail controlled infrastructure, shall be validated. Acceptable methods of validation to prove the integrity and suitability of a wheelset are:

a) full-scale fatigue tests at the maximum stress ranges used in the design calculations with a load regime no less onerous than that experienced in service

b) fatigue life prediction calculations using stress ranges and various effects as in a) above including thermal loadings, where appropriate, and the material properties obtained from tests on specimens machined from an actual component or accredited, published data for the same grade of material produced in a manner similar to that of the component, with either:
   i) strain history under service loads, obtained from strain-gauged tests, used as an input to fatigue life calculations, or
   ii) service trials to gather stress and strain histories for use in fatigue life calculations

c) satisfactory service on a major railway system under operating conditions equivalent to those prevailing in the United Kingdom with evidence to show that the requirements of this document are met and that the operating conditions are equivalent.

Wheels subject to thermal loads shall be required to demonstrate that the tread is dimensionally stable under the most extreme thermal braking load case and do not move axially.

D10 Design requirements for non-destructive testing

D10.1 Axle design for NDT

All new features in axles, and all new designs of axles, shall be shown to be capable of being fully tested using NDT techniques. A technically competent authority shall validate NDT procedures through practical means to demonstrate that all defects which are critical, as specified during the design, are detectable using the approved procedure both before entry into service and during service, as set out in GM/RT2005.

D10.2 NDT Procedures

An NDT procedure shall be produced specifically for each wheelset / vehicle application. The train operator shall ensure that a validated procedure is available for all the components to be tested. The procedure shall recognise limitations of the methods which can be adopted, the areas to be examined and the desired defect level which can be detected by the procedure. The desired defect level shall be either:

a) the minimum which can be detected using a particular technique both for the axle body and for specific critical axle areas, which can be achieved without generating excessive noise levels, or

b) that set by the design and fatigue consideration when the wheelset is designed or during subsequent analysis by a technically competent authority.

D10.3 NDT procedure approval

The approval of NDT procedures for wheelset and wheelset component testing shall be performed by personnel qualified in accordance with GM/RT2005.
D10.4   NDT inspection periodicity
The train operator shall obtain from the designer of a new axle a recommended NDT periodicity based on the minimum crack size which can be found reliably by the approved NDT procedure and the crack growth rate predictions based on the stresses to be experienced by the axle. The periodicity of NDT shall be such that a defect insufficiently large to be detected at one examination does not propagate to a critical size before the next examination.

D11   Geometric interfaces

D11.1   Safety at obtuse crossings
Vehicles / wheelset arrangements shall comply with the ‘low speed rule’ set out in Appendix 7 under all loading conditions. This rule covers the low speed operation over crossings on curves with applied lateral forces from external sources such as the wind and adversely canted track.

Where the diameter of a wheel, when fully worn, is 660 mm or greater, and the chosen tread profile is in accordance with Appendix 3, it is permissible to assume that this rule is satisfied.
Part E  In-service inspections and rectification

E1  Introduction

This section is a descriptive introduction to Part E. It does not contain mandatory requirements.

Part E deals with the safety requirements that are to be applied by the train operator to wheelsets whilst in-service. This includes routine maintenance, inspection, examination and testing that are to be applied between overhauls and repairs. The examinations and inspections are to be of sufficient frequency such that the wheelsets are maintained within the criteria specified in this document and therefore fit for purpose. Wheelsets are to receive appropriate remedial action to ensure they remain compliant with the requirements of this document. The train operator is to undertake special examinations as conditions and service history require.

E2  Examination and inspection

E2.1  Safety examination

E2.1.1  The objective of the safety examination is to determine, by visual examination, that the wheelset is safe to remain in service.

The vehicle maintenance plan shall identify the frequency and content of planned safety examinations and the requirements to undertake specific safety examinations under defined circumstances to maintain the safety of wheelsets.

Wheelsets shall 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

Additionally, wheelsets shall 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 Urgent Safety Related Defect Reports (see GE/RT8250).

E2.1.2  It is permissible for the scope of an examination to be vehicle or wheelset specific. The examination content shall include those elements listed in Appendix 4 that are applicable to the scope of the specific examination being undertaken. All observations shall be recorded.

E2.1.3  Wheelsets observed with cracks, damage, overheating, thermal crazing, wear, movement of an interference fit or other deficiency shall be assessed by measurement or gauging, as set out in Appendix 4, to determine whether the limits specified in Part G of this document have been infringed.
All gauges and measuring equipment shall be calibrated.

Defective wheelsets shall be rectified in accordance with an approved procedure before being authorised for further service.

**E2.2 Tread profile damage**

The train operator shall ensure that wheelsets are regularly inspected for tread damage. When such tread damage is found it shall be measured, reported and recorded. Where it exceeds the limits set out in Part G of this document the wheelset shall be withdrawn from service and rectified or be sent for repair.

Where the damage is such that it is not specifically detailed by this document, advice and appropriate action shall be sought from a technically competent authority before the wheelset is repaired or overhauled or returned to service.

**E2.3 Tread profile limits**

**E2.3.1**

The train operator shall ensure that wheelsets 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.

The profile limits are set out in Part G and Appendix 3 and shall be checked using an appropriate gauge to determine acceptability of the profile. Flange height and flange thickness shall be measured as shown in Figure 12. Wheel profiles shall be rectified before the profile limits are infringed, including the limits for tread roll-over, rim distortion or false flange (see Figures 13, 14 and 21). Remedial action shall be in accordance with an approved procedure. This section does not apply to RIV vehicles.

Where the profile is outside permitted limits, or where there is tread roll-over, rim distortion or false flange (see Figures 13, 14 and 21), remedial action shall be taken in accordance with an approved procedure. This section does not apply to RIV vehicles.

**E2.3.2**

The train operator shall have inspection and maintenance processes that ensure the wheel geometry is always within the defined limits. As part of the routine inspection, as required by Part C of this document, the train operator shall require sufficient frequency of measurement to ensure that wheel diameters and tread profile, including uneven tread profile wear, are maintained within the limits set out in this document at all times. This section does not apply to RIV vehicles.

**E2.4 Associated components**

When visually examining the wheelset, other components attached to the wheelset shall be examined at the same time:

a) Axleboxes and bearings shall be externally examined for damage, missing components, grease/oil loss, water ingress, signs of having run hot. Any indication of these or a suspect bearing shall require further investigation.

b) Brake discs and integral disc braked wheels shall be examined for security and completeness. A check shall be made that thermal cracking, distortion and wear are within the limits set out in the applicable specification.

**E2.5 Hot axle box**

Where a wheelset has been reported as having a hot box or bearing, then it shall be visually examined in accordance with the requirements set out in section E2.1 and clause E2.4.

Plain bearings reported for having run hot shall be examined to ascertain whether there has been copper penetration into the journal. If copper penetration is suspected then the axle to be scrapped in accordance with clause F4.4.2.

Any deficiencies shall be corrected before the wheelset is returned to service.
E2.6 Overheated wheel
Where a wheel has overheated or is suspected of overheating, then the wheel shall be examined in accordance with the requirements of Part G and Appendix 4, particularly checking the back-to-back dimension.

E2.7 Corrosion protection
The train operator is responsible for maintaining the integrity and quality of the corrosion protection of the wheelset at all times. Damaged corrosion protection systems shall be repaired to an approved procedure.

E2.8 Managing wheelsets off vehicles
No wheelset shall be used when;

a) any dimension or damage exceeds the limits prescribed in this document

b) a prohibited process has been applied to the wheelset, as set out in Appendix 6 of this document

c) other aspect of the wheelset which can influence safety is outside the limits prescribed by this document

The train operator shall ensure that any such wheelset is quarantined, clearly labelled and referred for investigation, repair, overhaul or scrap, as appropriate. The overhauler / repairer of a defective wheelset shall be advised of the reason for rejection and whether any particular investigations are required. Before an axle is scrapped it shall be subject to NDT, as required by clauses F4.4.6 and F4.4.7.

E2.9 Replacement wheelsets

E2.9.1 When a wheelset requires replacement, the diameter of the replacement wheelset shall be within the limits set for compatibility with the other wheelsets on the vehicle, as set out in clause G2.1.4.

E2.9.2 Replacement wheelsets shall have valid NDT certification, as set out in section E3. The requirements for any wheelset change are set out in clause E3.2.

E2.9.3 The full records relating to a wheelset shall be updated, including entries on computer systems, before the wheelset is despatched from the depot or site at which it has been removed from a vehicle.

E2.10 Collision and derailment
Wheelsets that have been involved in a collision, struck an object on the track or derailment, shall be inspected for damage in accordance with the requirements of sections E2.1, Part G and Appendix 4, specifically including the following:

a) measurement of back-to-back dimension

b) NDT axle examination.

It is permissible to rectify minor damage to a wheelset arising from a collision or derailment. Rectification shall be in accordance with an approved procedure either through an existing maintenance plan or through a new specific procedure. The repaired area shall be confirmed defect free using an approved NDT procedure by certificated operatives.

Wheelsets with minor tread damage (following collision or striking an object on the track) and with no visible damage to the axle, are excluded from the requirements to undertake an axle NDT examination.

Wheelsets that cannot be rectified shall be removed from service and sent for overhaul.
Railway Wheelsets

E2.11 Requirements for old axles
Wheelsets over 40 years old are permitted only to continue in use subject to continuation of meeting the required tests and examinations as set out in this document. The maintenance plan shall ensure that:

a) such wheelsets are subject to NDT at a periodicity half that of similar axles less than 40 years old
b) the axle is identified with an ‘X’ stamped in front of the manufacturing / assembling contractors code
c) the wheelset database is updated to recognise the increased frequency of NDT.

E2.12 Wheelset change of application

E2.12.1 Before any change in the duty of a wheelset type is permitted, for example under a different type of vehicle, the train operator shall undertake a documented review of the implications of the proposed changes. The review shall assess the risks to the wheelset, the track and the interface between the two. Any change of use shall not increase the risk of operating the wheelset above that of a newly designed wheelset. Any change of NDT periodicity shall be in accordance with clause E3.3.

Where changes affect the mandatory standards, including change of wheelset duty, then the vehicles shall be re-certificated in accordance with GM/RT2000.

E2.12.2 Before a change of use is implemented, including where the wheelset is under the same vehicle, all wheelsets fitted to the vehicle shall comply with the specified NDT interval in accordance with the applicable NDT procedure for that vehicle.

E2.13 Wheelsets used in corrosive applications
The train operator's policy shall contain provisions to ensure that where a wheelset regularly comes into contact with materials that contaminate or cause corrosion of the axle, it shall be inspected by NDT at a frequency to ensure that defective wheelsets are withdrawn from service. This frequency of NDT shall be maintained, even after a change of use to a less corrosive cargo, until the axle is overhauled, stripped of protective coating and subjected to MPI or a similarly sensitive method of NDT. This clause does not apply to RIV vehicles.

E2.14 Design or material change

E2.14.1 Where the design or specification of wheelsets or components has changed since the originals were made, it is permissible to use existing wheelsets for the remainder of their life.

E2.14.2 The train operator shall establish the standard or specification to be used for the manufacture of replacement wheelsets or components.

E3 NDT inspection

E3.1 NDT requirements
Every wheelset shall be subject to regular NDT in accordance with sections D10 and F5 of this document. The NDT periodicity shall be specific to the vehicle type, wheelset type and duty cycle.

E3.2 NDT periodicity
Wheelsets shall be subject to NDT inspection in accordance with the periodicity set out in the relevant maintenance plan(s). It is permissible for the testing periodicity to be either time or distance based but in any event the period between testing shall not be greater than eight years.
E3.3 Change in NDT periodicity
The NDT periodicity shall only be changed when authorised by a technically
competent authority following a technical review. Such amendments shall be
incorporated into re-certificated maintenance plan(s) and wheelset data records.
This clause does not apply to RIV vehicles.

E4 Wheelset re-profile
E4.1
The wheelset tread profiles shall be machined in accordance with the
requirements as set out in section F6 of this document and the designated profile
for the wheelset selected from those accepted for use on Network Rail controlled
infrastructure, as set out in Appendix 3.

E5 Records
E5.1 Recording of examinations results
Records of all visual examinations, inspections, measurements and NDT results
shall be recorded and maintained in accordance with section G3 and Appendix 5
of this document. A copy of relevant details shall accompany a wheelset
despached for repair or overhaul.

E6 Advice of wheel
damage to the
infrastructure controller
The train operator shall advise the infrastructure controller of wheelset damage
that may have adversely affected the track over which it has been operating.
These are to include wheelsets that have been withdrawn from service for:

a) false flange exceeding the limits defined in clause G2.6.16
b) wheel flats that exceed criteria for immediate withdrawal from service, as set
   out in clause G2.6.2

c) tread run-out that exceed criteria for immediate withdrawal from service, as
   set out in clause G2.6.3.

The train operator shall identify the vehicle, the train formation it had been
operating within and the routes on which it had been operating prior to being
withdrawn from service.
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Part F  Manufacture, repair and overhaul

F1  Introduction

This section is a descriptive introduction to Part F. It does not contain mandatory requirements.

Part F deals with the manipulative processes associated with wheelsets.

The manufacturing section identifies the permitted materials for wheelset components, together with the material sampling and testing requirements. All new designs of wheels are of the monobloc type and balanced by machining of the inner rim to an approved procedure. The wheelset and its components are to be manufactured in accordance with the designer’s specification and the requirements of this document. The requirements of branding are detailed with relevant information included in the overhaul and repair section of this document.

The section on overhaul and repair defines the requirements for examination, rectification and re-assembly of wheelsets. Throughout all of the repair processes the wheelset and wheelset components identification are to be maintained and the wheelset clearly identified with the train operator’s requirements.

The results of NDT examination of scrapped axles prior to being destroyed are to be included in the NDT data required by RSSB.

F2  Wheelset and component manufacture

F2.1  Wheelset and component materials

F2.1.1  Axle material

Axles shall be manufactured to the requirements of BS 5892, Part 1. The approved grades of steel are BS 5892, Part 1, Grade A1T and Grade A4T. The approved UIC materials are UIC811-1 Grade A1T or A1N. The tests and optional tests detailed in BS 5892, Part 1 shall be specified in the design documentation.

F2.1.2  Monobloc wheel material

Monobloc wheels shall be manufactured to the requirements of BS 5892, Part 3. The approved grades of steel for particular applications are:

<table>
<thead>
<tr>
<th>Wheel type</th>
<th>BS 5892, Part 3</th>
<th>UIC812-3 standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight, integral brake disc wheel</td>
<td>R7E</td>
<td>R7E</td>
</tr>
<tr>
<td>Freight, cheek mounted brake disc wheel</td>
<td>R8E</td>
<td>R8E</td>
</tr>
<tr>
<td>Other freight wheels</td>
<td>R7T or R8T</td>
<td>R7T or R8T</td>
</tr>
<tr>
<td>All passenger vehicle and other wheels</td>
<td>R8T</td>
<td>R8T</td>
</tr>
</tbody>
</table>

F2.1.3  Wheel centre material

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

F2.1.4  Tyre material

Tyres shall be manufactured to the requirements of BS 5892, Part 4. The approved grades of steel and their recommended applications are:

<table>
<thead>
<tr>
<th>Application</th>
<th>BS 5892, Part 4</th>
<th>UIC810-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy tread braking duty</td>
<td>B6E</td>
<td>B6E</td>
</tr>
<tr>
<td>Other applications</td>
<td>B5E</td>
<td>B5E</td>
</tr>
</tbody>
</table>
F2.1.5 Hydrogen content
All wheels, tyres, wheel centres and axles shall be made from vacuum argon degassed steel. A hydrogen content of 2 ppm shall not be exceeded.

F2.1.6 Retaining (Gibson) ring material
Retaining rings shall be manufactured to the requirements of BS 5892, Part 5.

F2.1.7 Alternative materials
Further grades of steel shall only be added to the recognised material lists when approved by a technically competent authority; it is then permissible to use them subject to prior authorisation to do so in accordance with the requirements set out in clause B2.2.3.

F2.1.8 Component material
Any wheelset components not described above shall be manufactured to the requirements of the appropriate British Standard. The materials and processes shall be selected and controlled to ensure that the finished components perform their intended duty safely.

F2.1.9 Replacement components
New replacement components shall be either of specified proprietary supply or manufactured to the relevant design drawing for the particular wheelset.

F2.1.10 Branding
All monobloc wheels, wheel centres, tyres and axles shall be legibly branded in stages as the component is made, machined and finally assembled, as set out in section F3 of this document.

F2.2 Routine component testing during or after manufacture
The testing requirements set out in clauses F2.2.1 to F2.2.5 are to be applied during the manufacturing process for each wheelset component as necessary.

F2.2.1 Axle testing
Axles shall be subject to testing as set out in BS 5892, Part 1. Axles shall be subject to all of the optional requirements of BS 5892, Part 1 to ensure the safety and integrity of the axle.

All axles shall be subject to MPI over the whole surface area, excluding the axle ends, after finish machining and prior to the fitment of any components, as set out in section F5 of this document. BS 5892 Part 1, Option (j) shall be applied.

The material sampling requirements are set out in clause F2.2.5.

F2.2.2 Wheel centre and retaining ring material testing
The material sampling requirements are set out in clause F2.2.5.

F2.2.3 Monobloc wheel testing
Monobloc wheels shall be subject to the tests, including the optional tests, listed in BS 5892, Part 3 relating to:

a) Uniformity of rim hardness (BS 5892, Part 3, 8.3.6.1).

b) Ultrasonic test (BS 5892, Part 3, 8.3.7). The wheel rims shall be ultrasonically tested for internal defects. It is permitted to ultrasonically test the wheel rim using the method specified in UIC 812-3. The rejection criteria for the defect level shall be dependent upon the application as follows:

i) wheelsets operating up to 200 km/h – defect larger than 2 mm

ii) wheelsets operating above 200 km/h – defect larger than 1 mm.

Testing axial and radial directions the dead zone shall be no greater than 10 mm from the test surface.
c) Residual stress for rim chilled wheels (BS 5892, Part 3, 10.6). The material sampling requirements are set out in clause F2.2.5.

F2.2.4 Tyre testing
Tyres shall be subject to the tests and optional requirements of BS 5892, Part 4 to ensure the safety and integrity of the tyre. It is permitted to ultrasonically test the tyre using the method specified in UIC 812-3 with a defect ≥2 mm being a cause for rejection. The ultrasonic testing dead zone shall be no greater than 10 mm from the test surface.

The material sampling requirements are set out in clause F2.2.5.

F2.2.5 General material properties
Unless otherwise specified, 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.

The axle and wheels shall be tested in accordance with Appendix 8 to demonstrate that the steel microstructure and cleanliness are acceptable.

F2.3 Assembly of wheelset
The wheelset shall be assembled in accordance with BS 5892, Part 6. All components used during the re-assembly shall meet the applicable specifications.

Wheelsets shall be inspected and measured in accordance with BS 5892 and be visually inspected. The following inspections shall be included:

a) back-to-back dimension, as set out in clause G2.3 of this document
b) tread profile, as defined by the customer.

F2.4 Assembly of other components
Other components, bearings, axleboxes, brake discs, etc shall be fitted to the wheelset in accordance with an approved procedure. The installation of these components shall not damage or affect the integrity of the assembled wheelset.

F2.5 Balancing
Assembled wheelsets shall be dynamically balanced to the requirements of BS 5892, Part 6 and clause G2.12 of this document. When this is not physically possible, the equivalent out of balance shall be demonstrated to be within the specified tolerance by calculation.

The balance requirements for new monobloc wheels shall be achieved by eccentric machining the wheel inner rim in accordance with the requirements of BS 5892 Part 3 and to an approved procedure.

F2.6 Wheelset testing
Wheelset NDT inspection requirements are set out in section F5. The axle shall be demonstrated to be free of defects.

The NDT inspection shall demonstrate that the axle body is transparent to ultrasound. A test for ultrasonic opacity shall be specified as part of the ordering management for the axle as set out in BS 5892, Part 1 and UIC 811-1.

F2.7 Electrical resistance
The wheelset electrical resistance requirements are set out in clause F4.6.12 of this document.
**F2.8 Corrosion protection (where required)**

After completion of all tests on the wheelset, the corrosion protection shall be completed or added, as required by the design specification, in accordance with the appropriate specifications and procedures.

Additionally, radial white lines shall be painted on tyred wheels in accordance with an approved procedure.

Areas left unpainted for ultrasonic testing shall be protected with approved material which is transparent to ultra-sound. Overhangs and other moisture traps shall be treated with an approved rust preventative.

**F2.9 Cleaning and protection**

All materials used for cleaning, protection or as part of a process, shall be fit for purpose and incapable of damaging the wheelset.

**F2.10 Branding legibility**

After a surface coating has been applied to the wheelset, branding shall be checked for legibility.

**F2.11 Labelling**

At the successful completion of testing, the wheelset shall have attached a durable label with the information, as set out in Appendix 2. The label(s), including its method of attachment, shall not damage the wheelset or the surface coating.

**F2.12 Records**

The train operator shall require the manufacturer to make and retain records of tests and assembly details, as set out in section G3 of this document.

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**F3 Branding requirements**

**F3.1 Unique identification**

Each new axle shall be provided with a unique serial number, allocated from the wheelset assembler’s own series of numbers. Particular attention shall be given to the inclusion of the wheelset assembler’s code, the arrangements for which are set out in GM/RT2470 and administered by RSSB. An axle shall not be given the number of a previously scrapped axle.

**F3.2 General stamping requirements**

The wheelsets shall be branded by stamping using equipment approved by a technically competent authority as being suitable for use on railway wheelsets. The size and depth of stamping shall be such that the data is clearly legible when the appropriate surface coating or protection is applied at any stage of the wheelsets life. The branding shall be carried out in a way that does not create stress raising features such as sharp corners or notches. 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.

**F3.3 Axle branding**

**F3.3.1 Forged axle identification**

Axles in the as-forged condition shall be branded, as set out in Figure 2. The stamping shall be at one end only and shall be light but legible.

**F3.3.2 Axle end branding**

Before the wheel seat is finish machined the markings, except for the inspector’s stamp, shall be recorded for inclusion in the records associated with the finished axle. The branding shall be applied by cold stamping at one end only as soon as the areas to be stamped have been finish machined in the positions shown by:

- a) roller bearing axle, as shown in Figure 3
- b) plain bearing axle, as shown in Figure 4
c) roller bearing axle with thrust pads, as shown in Figure 5

d) plain bearing axle with thrust pads, as shown in Figure 6.

The branding shall be applied at the gear wheel end of a driven axle.

Axles supplied in the finish machined condition shall have the brandings as required in clause F3.3.1 and Figure 2 stamped onto the axle end. This branding shall be identified by the use of ‘&’ either side of the additional information, for example ‘& SP 95 SC5761 &’.

F3.3.3 Axle end additional branding
Assembled axles shall have the axle end additionally branded as shown in:

a) Figure 5 for roller bearing axles
b) Figure 6 for plain bearing axles.

The branding shall be dressed to remove any raised burrs. For hollow axles, where the end cap is not removed for ultrasonic inspection of the axle, it is permissible to etch additional branding inside in the bore.

F3.4 Monobloc wheelset branding
F3.4.1 Monobloc branding
Monobloc wheels shall be branded by stamping during manufacture, as shown in Figure 7, wheel rims that have been ultrasonically tested shall include ‘UT’ in the branding. The cast identity shall be hot stamped. Where practicable the oil injection plug shall be machined on the same radial line as the branding.

F3.4.2 Monobloc wheelset branding
When assembled onto an axle, both monobloc wheels shall be branded on the inside face of the wheel, as shown in Figure 8. Where the inside face branding is not practicable, because of the proximity of a gearwheel for example, then it is permitted to stamp on the outside of the wheel only, at the same radial and circumferential location. The branding shall be diametrically opposite the branding on the rim applied during manufacture.

F3.5 Tyred wheelset branding
F3.5.1 Wheel centre branding
Wheel centres shall be branded during manufacture, as shown in Figure 9. Preferably the cast identity shall be hot stamped but cold stamping is permissible. The other data shall be cold stamped. When machined, the oil injection plug shall be located diametrically opposite the branding.

F3.5.2 Tyre branding
Tyres shall be branded during manufacture, as shown in Figure 10. The manufacturer’s code, year of manufacture and cast identity shall be hot stamped. The branding shall be below any last turning groove which may be present and shall not intrude into the chamfer machined at the edge of the wheel tread. The edge of the wheel tread shall not contain any notches or other stress raising features.

F3.5.3 Assembled tyre branding
When a tyre is fitted to a wheel centre the additional information, as shown in Figure 11, items 11, 12 and 5, shall be cold stamped onto the tyre in the position shown.

F3.5.4 Tyred wheelset branding
When assembled onto an axle, both tyred wheels shall be additionally branded on the inside face of the wheels, as shown in Figure 11. Where the inside face branding is not practicable, because of the proximity of a gearwheel for example, it is permitted to brand the outside face adjacent to the brands applied during manufacture. The branding shall be diametrically opposite the branding on the tyre.
F3.5.5 Material grades
The following grade of material codes shall be used when branding wheels, wheel centres and tyres. The branding requirements are as set out in this document.

<table>
<thead>
<tr>
<th>GRADE OF MATERIAL</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.R. SPEC. 107</td>
<td>A</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108B</td>
<td>B</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108C</td>
<td>C</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108D</td>
<td>D</td>
</tr>
<tr>
<td>B.R. SPEC. 100/108E</td>
<td>E</td>
</tr>
<tr>
<td>B.R. SPEC. 167(C52TS)</td>
<td>F</td>
</tr>
<tr>
<td>B.R. SPEC. 118A</td>
<td>H</td>
</tr>
<tr>
<td>B.S. 5892 Pt 4</td>
<td>Grade B5</td>
</tr>
<tr>
<td>I.S.O. 1005 Pt 1</td>
<td>Grade B6</td>
</tr>
<tr>
<td>U.I.C. 810-1</td>
<td>Grade R7E</td>
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<td>Grade R7T</td>
</tr>
<tr>
<td>I.S.O. 1005 Pt 1</td>
<td>Grade R8E</td>
</tr>
<tr>
<td>U.I.C. 810-1</td>
<td>Grade R8T</td>
</tr>
<tr>
<td>B.S. 5892 Pt 3</td>
<td>Untreated</td>
</tr>
<tr>
<td>I.S.O. 1005 Pt 6</td>
<td>Normalised</td>
</tr>
</tbody>
</table>

F3.6 Other branding regimes
It is permitted to mark by stamping wheelsets and components of wheelsets in accordance with UIC regulations 810 to 813 or, for wheelsets designed to Association of American Railroads (AAR) criteria, AAR regulations as set out in the AAR Manual of Standards and Recommended Practices: Section G: Wheel and Axle Manual of that document. The requirements for the serial number, set out in clause F3.1 of this document, apply. Wheelsets shall not have labels or bands attached as a means of identification as an alternative to branding; the arrangements contained in UIC813, clause 4.2.5.2, paragraph 2 are not permitted. This clause does not apply to RIV vehicles.

F4 Overhaul and repair

F4.1 Specification and procedures
F4.1.1 Identification of work
The train operator shall advise the repairer or overhauler of the identity and type of wheelset, and the vehicle under which it operates, before any work commences.

The train operator shall ensure that the repairer or overhauler is supplied with the relevant drawings and specifications. If there are differences between the wheelset and the relevant drawing, then the train operator shall require the repairer or overhauler to ensure that there is no safety degradation as a
consequence. A technically competent authority shall be consulted if there is any doubt.

F4.1.2 Approved procedures
The train operator shall ensure that the repairer or overhauler uses approved procedures and specifications for all work carried out on the wheelset. These shall be consistent with the maintenance plan for the vehicle-wheelset combination.

Any changes to procedures or specifications shall be the subject of a documented review by a technically competent authority. The change shall be implemented only where there is no increase in the risk to safety.

F4.1.3 Advice to repairer and overhauler
The train operator shall advise the repairer or overhauler of any requirements for special investigations, before work commences.

F4.1.4 Traceability
The wheelset and its components shall be identified and labelled at all times. The process shall ensure that each component is traceable and that the correct procedures are applied. On completion of the repair or overhaul the wheelset shall be labelled, as set out in Appendix 2.

F4.2 Wheelset condition assessment
F4.2.1 Quarantine
Train operators shall require that wheelsets awaiting inspection are held in a quarantine area to ensure that they cannot be used. Wheelsets in quarantine shall not be cleaned until:

a) the visual inspection has been carried out
b) the repair/overhaul procedure has been agreed by the train operator.

The quarantine area shall be protected to avoid deterioration of the wheelset and/or loss of evidence.

F4.2.2 Visual examination
Prior to repair or overhaul the wheelset shall be visually examined before cleaning or dismantling. Only the parts that can be seen without removing components shall be examined. This examination shall include all of the aspects listed in Appendix 4. Where there is any sign of movement of interference fits, any cracks are found or the examination suggests that other factors are outside the limits set out in Part G, then the wheelset shall be subject to overhaul. Calibrated gauges shall be used to measure dimensions, wear and damage in support of the visual examination.

When surface texture is specified a stylus type instrument is preferred for measurement, but comparative gauges are permitted as necessary. The objective of the examination is to confirm, or otherwise, that the wheelset is safe to be used in service.

F4.2.3 Cleaning
Before overhaul, and where required for repair, the wheelset shall be cleaned by a method which is not detrimental to the wheelset or attached components and which does not hinder any tests which may be required. To prevent damage from cleaning materials, bearings and other wheelset components shall be protected and apertures sealed. Washing sprays shall not be directed at the axlebox/bearing assemblies or seals. The preferred method of cleaning is grit blasting using approved materials and an approved procedure.

Damaged surface coatings on the axle body shall be rectified in accordance with an approved procedure. Where there is any damage to the surface coating of the axle or to more than 10% of the protective surface coating of other wheelset components, then the surface coating on the axle body and/or the wheelset
component shall be removed completely using grit blasting or another approved process. Otherwise the surface coating shall only be removed where required by the proposed testing procedure.

F4.2.4  Tread measurement
Wheelsets with damage and wear that exceeds the limits set out in Part G shall require remedial action as set out in section F6 of this document. Flange height and flange thickness shall be measured, as shown in Figure 12. Where there is any tread roll-over, rim distortion or false flange (see Figures 13, 14 and 21) remedial action shall be taken as set out in section F6 of this document and in accordance with an approved procedure.

F4.2.5  Axle end flatness
Prior to repair or overhaul and at other times as required to ensure safety, the axle end flatness shall be determined. Surface condition and flatness shall be within the limits set out in Part G of this document. Where the flatness is outside the limits, then action shall be taken to rectify discontinuities.

F4.2.6  Bearing check
Where the axlebox is not to be removed, the bearing shall be checked for freedom of rotation, excessive end-float, unusual noise and integrity of seals. Where a defect is identified, the axlebox shall be removed and the bearing and axlebox assembly shall be overhauled according to an approved procedure. Suspect bearings shall be investigated to ascertain the nature of the defect, recording the results.

F4.2.7  Component security check
Where components, such as brake discs, gearwheels and suspension tubes, are not to be removed as part of the repair or overhaul procedure, they shall be checked for security, integrity, damage and defects. Any problems shall be dealt with using an applicable procedure.

F4.2.8  Check for cracks in wheels
When accessible, the wheel web and wheel web holes shall be inspected for corrosion, cracks and damage, in particular those wheels that are known to be susceptible to failure. Any of these in excess of the limits set out in Part G shall be dealt with by a relevant procedure.

F4.2.9  Wheel web balance weight holes examination
The wheel web balance weight holes shall be proved crack free by MPI or a process with an equivalent level of sensitivity in accordance with an approved procedure. The number and spacing of balance weight holes shall not adversely affect the structural integrity of the wheels.

F4.2.10  Wheel rim balance weight inspection
Wheel rim balance weights shall be securely attached to the wheel. The number and spacing of tapped holes shall not adversely affect the structural integrity of the wheels.

F4.2.11  Other component examination
The condition of other components attached to the wheelset, such as axleboxes, brake discs, suspension tubes, etc, shall be assessed when the wheelset is being examined, where there is an effect on the wheelset performance.

F4.2.12  Record results
The results of all visual and physical examinations shall be recorded.
F4.3 Minimum attention
The minimum attention for any wheelset shall be:

a) visual examination, as set out in clause F4.2.2

b) wheelset dimensional check (including tread profile, wheel diameter and back-to-back dimension) as set out in clause F4.2.2

c) NDT inspection, as set out in section F5 and results recorded in accordance with section F4.6

d) remedial attention to any previously recorded defects and those found by a), b) or c) above. In particular, where the wheelset back-to-back dimension falls outside the acceptable range, both wheels or wheel centres shall be changed unless one wheel is clearly distorted.

Where the defects found cannot be rectified by an approved repair, the wheelset shall be overhauled.

F4.4 Inspection of axle when stripped of components
F4.4.1 Axle seat damage
Axle seats shall be free of all scores, burrs, etc, which could act as a crack initiator and would cause loss of oil injection pressure or spurious NDT results. It is permitted to machine imperfections out of the axle where it can still meet relevant dimensional limits.

F4.4.2 Axle damage
The axle shall be free of weld spatter and electric arc damage. The axle shall be free of physical damage in excess of that set out in Part G of this document. Where there is evidence of copper penetration the axle shall be scrapped.

F4.4.3 Axle dimensions
The axle shall meet all dimensional requirements given in the applicable specification, including convex corner radii on seats.

F4.4.4 Axle run-out
Before an axle can be used or re-used it shall be demonstrated that the axle run-out is within the limits set out in BS 5892, Part 6 for new wheelsets. The datum for the run-out is the journal surface. Where the limits are exceeded the axle shall be scrapped or recovered by means of approved processes.

F4.4.5 NDT of partially stripped axles
At overhaul all solid axles that have been partially dismantled shall be subject to MPI, as set out in clause F5.2.1 of this document.

F4.4.6 Management of defective axles
Where cracks, damage or corrosion infringe limits, as set out in Part G, the wheelset shall be repaired, overhauled or scrapped. Until action is taken the wheelset shall be kept in quarantine. Where the axle is to be scrapped and the requirements of clause F4.4.7 have been met, the journal surface shall be mutilated so that it cannot be used, reclaimed or repaired.

F4.4.7 NDT of defective axles
Before an axle is mutilated and scrapped it shall be subject to NDT. The objective is to ensure that a complete record is kept of all NDT failures. Where the NDT shows the presence of flaws or cracks, these shall be recorded and reported, as set out in section F4.7 of this document. A clear NDT result shall be included in the overall statistics, as set out in Part G.

F4.5 Recovery of axles
F4.5.1 Skimming
Where allowed by the relevant drawing and dimensions, it is permitted to skim an axle to remove shallow surface damage, corrosion and cracks. The axle shall be subject to MPI after machining to determine that there are no residual defects.
F4.5.2 Polishing
Except for wheel seats, it is permitted to remove or reduce by rectification longitudinal defects, as set out in BS 5892, Part 1, sections B3 and B4. Polishing shall be undertaken in accordance with an approved procedure. After polishing, the axle shall be subject to MPI or another approved procedure to demonstrate it is free of defects. Axles having unacceptable longitudinal defect shall be scrapped.

Rectification of axle defects shall be limited such that there is no adverse effect on the axle design life.

F4.6 Re-assembly of wheelsets
F4.6.1 New and used components
The re-manufacture of wheelsets with used components, or a combination of new and used components, is permitted subject to meeting the requirements of this document. Where the axle is new it shall have a unique identity, as set out in clause F3.1 and shall not be given the number of the scrapped axle it replaces. The number shall be branded on the axle to the requirements of this document. 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.

F4.6.2 Prohibited components
The following components shall not be re-used once removed from a wheelset:

a) tyres once removed from a wheel centre
b) Gibson rings
c) brake disc security bolts
d) balance weight bolt
e) un-overhauled axle bearings
f) axle end cap-locking plates
g) except for seals designed for re-use that have been examined and found serviceable, any gaskets or rubbing seals fitted to the axle end, axle box end or any axle end equipment.

Consideration shall be given to the inherent risk before re-using any component which may have a limited life.

F4.6.3 Wheelset unique identification
At overhaul and re-assembly of wheelsets, the train operator shall ensure that:

a) the axle serial number is checked to establish that it is not duplicated
b) the branding conforms to the requirements of this document.

Where the number is not unique, has no assembler’s code or is in any way deficient, the train operator shall require the latest assembler to allocate an axle serial number from its own number series. The number shall be branded on the axle according to the requirements of this document. The wheelset records shall be endorsed, recording both the new serial number and the replaced serial number.

F4.6.4 Removal of branding codes
When it is necessary to erase the existing branding on a wheel, the marks shall be peened out and erased by filing. The new or reinstated data shall be cold stamped in the relevant location, as required by this document.
F4.6.5 Assemblers identification
When the wheelset is repaired or overhauled by a different contractor from the original assembling contractor, then on re-assembly the latest assembler's code shall be stamped on the axle end, see Figures 5 and 6, or stamped to conform to AAR requirements, as appropriate.

F4.6.6 Wheel branding
On re-assembly the monobloc wheels shall be branded as set out in section F3.4 or UIC or AAR requirements, as appropriate, and tyred wheels shall be branded, as set out in section F3.5 or UIC requirements. The latest assembler's code shall be added where the wheel is not new and where the wheelset has been repaired or overhauled by a different contractor from the original assembler.

F4.6.7 New tyre branding
When a wheel centre is re-tyred the new tyre shall have the branding completed as is shown in Figure 11 (items 11, 12 and 5), or UIC requirements.

F4.6.8 Axle geometry codes
The axle geometry codes set out below shall be included in the axle branding for the following axles:

- a) axles reclaimed by modifying their geometry
- b) replacement axles where the geometry of the new axle differs from the original, due to the inclusion of transition radii, stress relief grooves, etc.

<table>
<thead>
<tr>
<th>CODE</th>
<th>RECLAIMED AXLE GEOMETRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Re-profiled</td>
</tr>
<tr>
<td>G</td>
<td>Stress relieving grooves added</td>
</tr>
<tr>
<td>G1</td>
<td>25 mm (1 inch) stress relieving grooves added</td>
</tr>
<tr>
<td>WG</td>
<td>Wide stress relieving grooves added.</td>
</tr>
</tbody>
</table>

F4.6.9 Assembly of wheelset
The wheelset shall be assembled, as set out in clauses F2.3 to F2.11 of this document. To facilitate re-assembly of wheel and wheel centres, oil injection facilities shall be incorporated, where they are not already present, in accordance with the relevant drawing.

F4.6.10 Wheelset dimensions
Once assembled, in addition to the requirements of clause F2.6, the wheel diameters shall be measured. Where the dimensions or diameter differences exceed the limits set out in section G2.1 and clause G2.3 or those contained in the train operator's wheelset database (see Appendix 1), then action shall be taken to rectify the situation using an approved procedure.

F4.6.11 Balancing
After overhaul the wheelset shall be balanced, and repaired wheelsets having replacement brake discs shall be balanced, if this is required by the relevant specification. The balance requirement is the same as for new wheelsets, as set out in clause F2.5 of this document.

F4.6.12 Electrical testing
At manufacture and during overhaul, electrical resistance testing of wheelsets shall be undertaken to assist track circuit actuation.

F4.6.13 Changes to processes
The train operator is permitted to authorise the repairer or overhauler to replace any process with an equivalent process, provided that an engineering review is undertaken and the replacement process has the approval of a technically
Railway Wheelsets

competent authority, prior to implementation and incorporated into the applicable maintenance plan(s). The requirements for maintenance plans are set out in GM/RT2004.

F4.7 Records
F4.7.1 Records retained
The train operator shall require the repairer or overhauler to make and retain complete records of examinations, measurements, tests, work done and assembly details, as set out in section G3 of this document.

F4.7.2 NDT records
The results of all NDT tests shall be recorded and reported with a level of detail, as set out in section G3. Permanent evidence of any defects found and a positive indication of axles tested and found clear shall be maintained.

F4.7.3 Record updating
The full records relating to a wheelset shall be updated, including entries on computer systems, before the wheelset is despatched from the contractor's works. Records of wheelsets held in store shall be maintained at all times.

F4.7.4 Records availability
Train operators shall ensure that suppliers of NDT services keep full records to demonstrate compliance both with this document, the NDT requirements set out in GM/RT2005 and the procedures, in addition to results of individual tests. The records, which shall be available for inspection by the train operator, shall include relevant facility certificates, operator certificates and work experience records, calibration evidence and equipment approval documentation.

F4.7.5 NDT records summary
The train operator shall require that companies carrying out NDT on wheelsets provide to RSSB a summary report of all wheelset inspections. The information shall be in a form agreed between the train operator and RSSB and as a minimum shall include for each vehicle type and axle type, the number tested in total, the number which were clear and the number of failures. The location of the defect causing failure of the axle is to be identified and the total number of defects in the wheel seat, axle journal and axle body shall be included. Such summary reports shall be provided to RSSB every three months. The minimum requirements for summary reports are identified in Appendix 9.

F4.7.6 Advice of inspections
The train operator shall require that advice is provided by the inspecting company of any NDT failure of a wheelset within seven days of the inspection. The advice shall be provided to both the train operator and RSSB in a format agreed between the train operator and RSSB. Failure reports shall be maintained by the train operator for five years from the date on which the wheelset or axle is scrapped.

F5 Non-destructive testing processes

F5.1 Testing requirements
F5.1.1 The NDT technique and procedure applied to a wheelset shall have been validated for that wheelset. All axles shall be free of:

a) surface breaking transverse cracks or crack like indications
b) surface breaking longitudinal cracks or crack indications in excess of the limits set out in clause G2.11.3
c) non-surface breaking defects greater than defined in BS 5892
d) any characteristic that causes the axle to be opaque to ultrasound.
F5.1.2
Whatever tests are carried out on wheelsets or wheelset components during repair or overhaul, every wheelset which is subject to a UAT regime shall undergo a full UAT in accordance with the appropriate procedure after assembly and before being fitted to a vehicle.

The ultrasonic test of the assembled wheelset with a solid axle shall include, as a minimum, all the techniques which are carried out during the NDT regime in service. Where alternative, specialist scanning is not required, as a minimum requirement, the following techniques shall apply:

a) a far-end scan using the relevant procedure to inspect the integrity of the whole axle length and, in particular, the integrity of the axle between the wheel seats and to demonstrate the ultrasound transparency of the axle

b) a near-end scan using the relevant procedure to inspect the integrity of the axle at the inner section of the wheel seat, transition radii and between the axle end and the wheel seat

c) relevant high-angle scans using the relevant procedures to inspect the integrity of the axle under the wheel seat, under other interference interfaces and other areas not covered by a) or b) above.

The ultrasonic test of a hollow axle shall be a complete test of the axle using the approved equipment and procedures for the particular design of axle.

F5.1.3
After testing the axle and wheelset, surface protection shall be reinstated, to the requirements set out in clause F2.8 of this document.

F5.2   MPI at manufacture and overhaul

F5.2.1
All solid axles shall be subject to MPI, or an equivalent approved inspection process, at:

a) manufacture

b) wheelset overhaul.

During a wheelset overhaul the MPI inspection or equivalent approved inspection process shall be carried out without risk of damage to, or permanent magnetisation of, other components.

MPI shall not be carried out on axles where bearings are fitted which cannot be demagnetised in situ.

Journal surfaces, seats for wheels, gear wheels, suspension tubes and other interference fit components shall be subject to MPI when exposed. Although it is not necessary to remove all components at overhaul, consideration shall be given to exposing the entire surface for testing.

Axles fitted with suspension tubes that are not removed at overhaul shall have the earth return tracks examined using an approved NDT technique.

Where the axle is subject to a UAT inspection regime the completed, re-assembled, wheelset shall be subject to UAT using the approved procedure before it is released for service use or storage.

This clause does not apply to axles from RIV vehicles or hollow axles which are subject to internal NDT.

F5.2.2
After MPI the residual magnetism in the axle shall be measured and rectified, if necessary, as set out in GM/RT2005.
F5.3  Suspect signal in service

F5.3.1
During NDT any transverse indication shall be treated as if it were a crack and be subject to a detailed investigation. Care shall be taken to ensure that spurious indications are avoided. An axle with a confirmed crack shall be withdrawn from operation. It is permissible for a technically competent authority to classify the NDT results as a suspect signal and advise the train operator to authorise continued operation, as set out in clause F5.3.3 of this document.

F5.3.2
During NDT any longitudinal indications shall be assessed. If the indications exceed the limits given in BS 5892, Part 1, section B3, then they shall be considered to be an NDT failure and the axle shall be withdrawn. A technically competent authority is permitted to classify the NDT result as a suspect signal and advise the train operator to authorise continued operation, as set out in clause F5.3.3.

F5.3.3
Where a technically competent authority determines that the NDT signal is not associated with a crack but is caused by a non-hazardous defect, it is permissible to return the wheelset to service. The wheelset shall be subject to an increased frequency of NDT examination to monitor the suspect signal for change. The revised inspection arrangements and results shall be documented.

F5.4  Defective wheelsets

F5.4.1
All wheelsets found by NDT to be defective shall be dealt with by a defined procedure. As a minimum this procedure shall require that the wheelset:

a) be withdrawn from service

b) records are updated

c) be clearly and durably labelled as being unfit for service

d) be placed in quarantine

e) be referred for overhaul for assessment and further investigation, as required.

It is permissible to mutilate the axle to prevent inadvertent re-use.

F5.4.2
The train operator shall ensure that all axles which are cracked, with cracks measured deeper than 2 mm or longer than 5 mm, are metallurgically and physically examined by a technically competent authority no later than eight weeks after the discovery of the crack and that the results of the examination are recorded. A copy of the examination record and results are to be provided to the train operator and RSSB within four weeks of the examination. An example of a summary report is shown in Appendix 10.

F5.5  Alternative techniques

The requirement for NDT detailed in this document shall be complied with unless an alternative, approved procedure is used.

For an alternative, approved procedure to be acceptable a technically competent authority shall analyse the procedure and demonstrate that the probability of detection of the minimum crack size, for the NDT inspection periodicity of the axle, is at least as good as that of the procedure being replaced or MPI, whichever is the better; then it is permissible to use them subject to prior authorisation to do so in accordance with the requirements set out in clause B2.2.3.

F5.6  Fitment to vehicles

The requirements for NDT of wheelsets before use in service are set out in clause E2.9.2 of this document.
F6  Wheelset profiling

F6.1  Profiling equipment
Wheelset profile alignment and the surface finish produced shall meet the requirements set out in clauses G2.6.1 and G2.9 of this document. The alignment and surface finish of tread profiles produced on a lathe shall be checked at least once a day and on the first wheelset machined after changing or change of the lathe settings, for example template, program, etc.

F6.2  Wheelset tread profile requirements
F6.2.1
The profile designated for the wheelset-vehicle combination in the wheelset database shall be selected only from those accepted for use on Network Rail controlled infrastructure as listed in Appendix 3, or those specified for RIV registered vehicles and applied to each wheelset to tolerances as set out in section G2.9.

F6.2.2
When a wheelset is re-profiled the limits for re-profiling shall be specified by the train operator but they shall not exceed the limits set out in Appendix 3. The diameter difference between wheels on the same axle shall not exceed the limits set out in clause G2.1.3. The tread run-out and wheel wobble shall be within limits set out in clause G2.4.2 of this document.

F6.2.3
When re-profiling, sufficient material shall be removed consistent with the removal of all cracks, cavities and hard spots and the creation of the profile designated for use on the wheelset/vehicle combination. It is permitted to leave up to 1 mm of wear on the flange back.

F6.2.4
When re-profiling the wheel treads, the bearings and other components shall be protected.
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Part G  Wheelset dimensions and limits

G1  Introduction
This section is a descriptive introduction to Part C. It does not contain mandatory requirements.

Part G contains information regarding wheelset condition and acceptance criteria. This part is referenced from the preceding parts of the document for information that is common to different aspects of a wheelset life cycle.

G2  Wheelset criteria

G2.1  Wheel diameter
G2.1.1  Scrapping size
The diameter of the wheel, as measured at the tread datum, shall not be less than the scrapping size defined in the wheelset database. This clause does not apply to RIV vehicles.

G2.1.2  Inspection limits
The train operator shall establish diameter limits to be applied at the appropriate examination which ensure that the wheelset always meets the requirements set out in clause G2.1.1. This clause does not apply to RIV vehicles.

G2.1.3  Diameter difference between wheels on the same axle
The maximum variation between wheel diameters following profiling for wheels on the same axle is to be in accordance with the requirements of BS 5892, Part 6, Table 2.

G2.1.4  Diameter difference between wheelsets within bogie/vehicle
Wheel diameter differences between axles are constrained for some vehicles. The train operator shall ensure the requirements are set out in the wheelset database and that the wheel diameters always meet the requirements.

G2.2  Rim width
The width of the wheel rim or tyre, that is distance between the flange back and the outside face of the rim, shall be within the range 127-150 mm. This section does not apply to RIV vehicles. The recommended wheel rim width is 135 mm.

G2.3  Back-to-back dimension
The back-to-back dimension shall be within the range:

All new, re-wheeled or re-tyred wheelsets with outside bearings 1360-1362 mm
Re-profiled and in-service wheelsets with outside bearings 1360-1363.3 mm
Low track force 13 bogie (LTF 13) wheelset with inside bearings 1360-1362 mm
Any wheelset with inside bearings, except LTF13 wheelsets 1358-1360 mm

G2.4  Axle and tread run-out
G2.4.1  Limits for axle run-out
The axle run-out, see Figure 17, shall not at any time exceed the maximum value for new wheelsets set out in BS 5892, Part 6.
G2.4.2 Limits for tread run-out and wheel wobble
When new, or following re-wheeling or re-tyring, neither the tread run-out nor the wheel wobble, see Figures 15 and 16, shall exceed the values set out in the following table:

| All vehicles permitted to operate at speeds greater than 125 mph and up to and including 140 mph | Maximum tread run-out (mm) | Maximum wheel wobble (mm) |
| Locomotives and coaching stock operating at speeds up to and including 125 mph | 0.20 | 0.30 |
| Freight vehicles operating at speeds greater than 75 mph and up to and including 100 mph | 0.30 | 0.40 |
| Freight vehicles operating at speeds between 60 and 75 mph | 0.40 | 0.50 |
| Freight vehicles operating at speeds up to and including 60 mph | 0.50 | 0.50 |
| All other vehicles | As BS 5892, Part 6 |

Table G1 Tread run-out and wheel wobble limits
When a wheelset is re-profiled the maximum tread run-out shall be as set out in Table G1 and the allowed wheel wobble shall be a maximum of 0.75 mm for all vehicles.

RIV vehicles are permitted to have up to 0.75 mm wheel wobble at any time.

Resilient wheels are permitted to have a maximum wheel wobble of:

<table>
<thead>
<tr>
<th>Maximum wheel wobble (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>When new, re-wheeled or re-tyred</td>
</tr>
<tr>
<td>When re-profiled</td>
</tr>
</tbody>
</table>

Table G2 Resilient wheel wobble limits

G2.5 Wheel centre geometry
All wheel centres shall meet the criteria identified below, otherwise the requirements of BS 5892, Part 2 apply:

a) outside diameter shall not be less than nominal diameter minus 5 mm (nominal diameter is recorded in the wheelset database)

b) centre rim run-out less than 0.6 mm

c) surface texture of all surfaces of the rim less than 3.2 μm

d) width of rim not less than nominal minus 2.5 mm

e) machined rim profile to comply with the relevant drawing

f) no corrosion after any shallow corrosion up to 0.2 mm deep has been removed by an approved process
g) no indentations greater than 2.5 mm across

h) no raised edges or burrs. Material standing proud of the surface shall be removed using an approved process. Material below the surface shall not be removed.

To achieve the above criteria, machining with a minimum depth of cut is permitted providing that minimum dimensions, as shown on the relevant drawing, are not transgressed. Welding, using an approved procedure, is permitted in the wheel centre bore.

G2.6 Wheel tread and flange profile
G2.6.1 Inspection criteria
The tread, when newly profiled, shall meet the requirements set out in BS 5892, Parts 3 and 6 and be free of visible defects, cracks and cavities, flats and spalling.

When in service some damage is permissible, as set out in the following clauses G2.6.2 to G2.6.3. The train operator shall establish dimensional limits to ensure that the safety limits set out in Appendix 3 are not infringed between examinations. The limits shall include the minimum rim and tyre thickness. The train operator shall ensure that the required dimensions and tolerances are specified for each wheelset / vehicle combination and that these dimensions are recorded in the wheelset database. Where RRVs and RMMMs have wheel profiles other than specified in Appendix 3 the flange heights shall not be less than 28 mm nor exceed 36.5 mm at any stage in the wheel profile life.

G2.6.2 Flats
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 follows:

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Wheel flat length</th>
<th>Vehicle to be taken out of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any vehicle permitted to operate above 125 mph and up to 140 mph</td>
<td>Above 60 mm Above 40 mm to 60 mm 30 to 40 mm</td>
<td>Immediately On completion of the journey. The speed shall be limited to 125 mph until the vehicle is taken out of service Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Passenger or personnel vehicles operating at speeds up to and including 125 mph</td>
<td>Above 60 mm 40 to 60 mm</td>
<td>Immediately Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Non-passenger vehicles, locomotives, power cars, driving van trailers, on-track machines, rail mounted maintenance machines, road-rail vehicles</td>
<td>Above 60 mm 40 – 60 mm</td>
<td>Immediately On completion of the journey</td>
</tr>
<tr>
<td>Freight vehicles up to 17.5 tonnes axle load</td>
<td>Above 80 mm 60 to 80 mm</td>
<td>Immediately On completion of the journey. The speed to be restricted to 60 mph</td>
</tr>
</tbody>
</table>
### Table G3  Wheel flat criteria

For vehicles fitted with wheels smaller than 660 mm, the small wheel criteria set out in GM/RT1300 shall apply.

#### G2.6.3 Tread run-out

Where the presence of tread run-out is established, either by visual inspection or measurement, action shall be taken as in Table G4.

### Table G4  Tread run-out criteria

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Tread run-out</th>
<th>Vehicle to be taken out of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any vehicle permitted to operate above 125 mph and up to 140 mph</td>
<td>Above 1.3 mm 0.7mm to 1.3 mm</td>
<td>Immediately Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Passenger or personnel vehicles operating at speeds up to and including 125 mph</td>
<td>Above 3.0 mm 1.3 mm to 3.0 mm</td>
<td>Immediately Within 24 hours of the fault being found</td>
</tr>
<tr>
<td>Non-passenger vehicles, locomotives, power cars, driving van trailers and on-track plant</td>
<td>Above 3.0 mm 1.3 mm to 3.0 mm</td>
<td>Immediately On completion of the journey</td>
</tr>
<tr>
<td>Freight vehicles up to 17.5 tonnes axle load</td>
<td>Above 5.0 mm 3.0 mm to 5.0 mm</td>
<td>Immediately On completion of the journey. The speed to be restricted to 60 mph</td>
</tr>
<tr>
<td>Freight vehicles equal to or over 17.5 tonnes axle load</td>
<td>Above 4.0 mm 2.0 mm to 4.0 mm</td>
<td>Immediately On completion of the journey. The speed to be restricted to 60 mph</td>
</tr>
<tr>
<td>Other vehicles</td>
<td>Above 4.0 mm 2.0 mm to 4.0 mm</td>
<td>Immediately On completion of the journey. The speed to be restricted to 60 mph</td>
</tr>
</tbody>
</table>
G2.6.4 Permitted speed for recovery of vehicles
When flats, or tread run-out are found, and in order to move the vehicle to where the defect can be rectified, the requirements shown in Table G5 shall be applied:

<table>
<thead>
<tr>
<th>Damage</th>
<th>Speed restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat length longer than 100 mm</td>
<td>Tread run-out greater than 8.0 mm</td>
</tr>
<tr>
<td></td>
<td>A vehicle shall not be moved except to clear the running line and at a maximum speed of 5 mph or with the use of a wheelskate. Further movement shall be with the authorisation of a technically competent authority and the infrastructure controller.</td>
</tr>
<tr>
<td>Flat length 70 mm - 100 mm long</td>
<td>Tread run-out 5.0 mm to 8.0 mm</td>
</tr>
<tr>
<td></td>
<td>Speed restriction of 35 mph.</td>
</tr>
<tr>
<td>Flat length up to 70 mm long</td>
<td>Tread run-out 3.0 mm to 5.0 mm</td>
</tr>
<tr>
<td></td>
<td>Speed restriction of 60 mph.</td>
</tr>
</tbody>
</table>

Table G5  Speed limits for recovery of vehicles with wheel flats

G2.6.5 Inspection after identification of wheel flat and tread run-out
Tread damage in excess of the criteria requiring immediate removal from service, as set out in clauses G2.6.2 and G2.6.3, can have caused underlying damage to the wheelset and other parts of the vehicle, including bearings, suspension, etc. The operator shall ensure that the wheelset having received such damage is sent for overhaul. Wheelsets with damage that requires removal from service either at the end of the journey or within 24 hours shall be rectified by re-profiling the tread.

G2.6.6 Tread roll-over and rim face bulging
When newly profiled there shall be no tread roll-over, see Figure 13. Up to 5 mm of roll-over is permitted in-service but no cracks in the roll-over shall extend into the tread or the rim face. When newly profiled the outside face of the rim of the wheel or tyre shall be flat to within ±0.25 mm.

In service local tread collapse in the form of a bulge in the rim face in excess of 2 mm see Figure 14 is not permitted and such a feature shall cause the wheelset to be withdrawn from service within 24 hours of the fault being identified.

G2.6.7 Cracks
Where cracks are found in the transition between tread and rim, on the outside face of the rim, in the flange or in any roll-over (see Figures 13 and 18), then the wheelset shall be withdrawn from service immediately. Any move to a repair facility shall be at a speed restricted to less than 45 mph.

G2.6.8 Thermal crazing and rolling contact fatigue cracking
The maximum length of multiple cracks caused by rolling contact fatigue or thermal crazing on the tread braked wheels or integral disc braked wheels shall be assessed by measurement and recorded. Limits for permissible cracks shall be set out in the appropriate maintenance procedure for the specific wheelset design / vehicle application and shall not exceed those specified in clause G2.6.9 and G2.6.10.

G2.6.9 Multiple cracks
Where multiple small cracks are found in the tread and one of the cracks exceeds 40 mm in length the wheelset shall be withdrawn from service within 24 hours of the fault being identified.

G2.6.10 Isolated cracks
Where an isolated crack longer than 30 mm is found in the tread, the vehicle shall be withdrawn from service immediately. Where an isolated crack longer than
20 mm is found in the tread, the wheelset shall be withdrawn from service within 24 hours of the fault being found.

G2.6.11  Tread cavities
Where a cavity, or cavities, is found in the wheel tread, then these shall be measured. The wheelset shall be withdrawn from service within 24 hours of either of the following faults being found:

a) any single cavity greater than 15 mm long circumferentially around the wheel

b) any two cavities, separated by less than 50 mm, having a total length in excess of 15 mm circumferentially around the wheel.

G2.6.12  Tread discontinuities
There shall be no wear of the profile which creates discontinuities in the profile shape of the tread or the flange. There shall be no circumferential step in the flange profile greater than 1.5 mm (see Figure 19). A wheelset with such features shall be withdrawn from service within 24 hours of the fault being found.

G2.6.13  Minimum flange radius
There shall be no convex radius between the flange back and the flange root of the wheel which is less than 10 mm when the wheel is newly profiled or 5 mm at any other time (see Figure 19 & 20) when gauged by a concave arc of 5 mm radius having a chord length of 7 mm. A wheel profile with a radius less than this value shall be withdrawn from service within 24 hours of the fault being found. Flange wear may produce either sharp flange or toe radius build-up – both are unacceptable flange profiles.

G2.6.14  Flange angle
The nominal flange angle on a newly profiled tread shall be in the range 68° - 70° except for P5 profiles where 60° is permissible. This clause does not apply to RIV vehicles.

G2.6.15  Flange back
No point in the flange back blend shall be closer to the vehicle centre-line than the flange back.

G2.6.16  False flange
A false flange (see Figure 21) shall not exceed 2.0 mm. The details of the incident shall be passed immediately to the infrastructure controller (see section E6).

G2.6.17  Inner rim damage
Wheels shall be scrapped where damage on the inner surface of the rim exceeds 4 mm in depth. No damage with sharp, internal angles shall be permitted. It is permitted to grind out damage less than 4 mm deep by grinding 1 mm deeper than the damage and blending in the hollow over a length of five times the depth. The rim shall then be proved defect-free by MPI.

Wheels with inner rim damage caused by the application of wheel lathe ‘drive dogs’ shall be examined for tread run-out and assessed in accordance with the criteria set out in clause G2.6.3.

G2.6.18  Maximum force
Where it is established, for example by wheel impact load detection equipment, that any defect in a wheel produces a total vertical force of more than 350 kN per wheel, the wheelset shall be examined at the first available location and action to be taken in accordance with the infrastructure controllers’ instructions.

G2.7  Tyre security
G2.7.1  Dimension X
Locomotive wheels, except where fitted with coaching stock derivative wheels, shall have no gap between the tyre snip end and the wheel centre. Carriage and coaching stock derivative wheels are permitted to have a gap of up to 1 mm (see Figure 1 for dimension X).
G2.7.2 Retaining ring (Gibson) gap
There shall be no continuous gap between the retaining ring and the rolled down section of the tyre or between the retaining ring and the vertical face of the wheel centre. Intermittent gaps of up to 0.5 mm are permitted, provided they do not extend in total for more than 50% of the retaining ring circumference.

G2.7.3 Retaining ring (Gibson) end gap
The retaining ring shall be formed from a single piece of steel, with the ends separated by no more than 3 mm. No make up pieces shall be permitted.

G2.8 Wheel web and bore condition
G2.8.1 Surface condition
The wheel web surface, the part between the hub and the rim, shall meet the requirements of BS 5892, Part 3 and have:

a) a surface texture on all machined surfaces of less than 6.3 \( \mu \)m

b) no corrosion after any shallow corrosion has been removed by using an approved procedure

c) no indentations greater than 2.5 mm deep

d) no raised edges or burrs which cannot be removed by an approved procedure. The procedure shall blend the repair into the adjacent surface with no undercut and no local overheating.

G2.8.2 Integral brake disc
Wheels having integral brake discs shall have webs no thinner than those defined in the applicable maintenance specification. Integral brake discs shall not have cracks and surface texture that exceeds the criteria specified in the appropriate maintenance and overhaul specifications. The surface texture shall be less than 3.2 \( \mu \)m. It is permitted to machine the web in accordance with an approved procedure.

G2.8.3 Holes in webs
Holes in the wheel web shall have a geometry and surface finish as shown in the relevant drawing or as shown in Figure 22, whichever is the more stringent. Such holes shall have no cracks emanating from them, as determined by MPI or another approved procedure.

G2.8.4 Bore condition
The wheel bore shall have:

a) no scoring with raised edges or burrs or sheared material

b) a surface condition less than 3.2 \( \mu \)m

c) corner radii less than 3 mm

d) a parallel and cylindrical tolerance to 0.05 mm

e) thrust bearing and seal mating faces with a surface texture less than 1.6 \( \mu \)m.

Any scoring of the bore shall not be such as to cause loss of oil injection pressure or generate suspect signals in any UAT test. It is permitted to remove raised edges using an oilstone.

It is permissible to build up the bore of wheel centres by welding using pre-heat and an approved procedure. After machining, the bore shall be subject to NDT.

G2.9 Wheel tread profile alignment and symmetry
When newly turned, the wheel tread profiles on each wheel shall be aligned.
Wheel diameters shall be within limits set out in section G2.1 and the profile shall be accurate to a nominal ± 0.25 mm. The tread run-out shall not exceed the limits set out in clause G2.4.2.

G2.10 Axle condition
G2.10.1 Corrosion
In assessing axle corrosion the extent and depth shall be taken into account. All corroded areas shall be subject to a special inspection by MPI, or equivalent approved method, and where cracks are indicated the axle shall be dealt with by an appropriate procedure or scrapped.

An axle designed to operate with no surface coating or protection shall be examined to ensure that the corrosion which is present is both shallow and even. Deep corrosion or an isolated area of corrosion is not permitted and shall be removed using an approved procedure.

For axles which are to be protected by a surface coating, even where MPI or an equivalent approved method shows that the axle is clear, the corrosion shall still be unacceptable where it:

a) is located in any transition area
b) is concentrated at a particular point, that is a corrosion pit, particularly where it has a ring of red/brown staining
c) is greater than 1 mm deep or longer than 30 mm circumferentially or 50 mm axially
d) cannot be removed by polishing up to 1 mm deep
e) occurs at more than 10 points on the axle.

Where allowed by the overhaul or repair procedures it is permissible to machine the axle to remove corrosion. The nature and location of the corrosion shall be recorded and rectified. Following machining, the axle shall be subject to MPI, or another approved procedure, to demonstrate that no cracks are present in the axle surface.

G2.10.2 Damage
Physical damage or marking of the axle shall be unacceptable where it results in:

a) sharp indentations
b) circumferential damage, such as scoring.

Where an approved maintenance procedure permits, surface damage may be removed (see clause F4.5.2). Following removal the axle shall be subject to MPI, or another approved procedure, to demonstrate it is free of defects.

G2.10.3 Axle ends
The axle end shall be flat with no burrs, sharp edges or grooves in the surface other than permitted lettering, as shown in Figures 3 to 6, and shall meet the following surface and geometric requirements:

a) surface texture of the end face less than 3.2 µm
b) flatness/run-out of end face less than 0.08 mm.

It is permitted to use an oilstone to remove burrs and sharp edges.

Where the end face is re-machined to accommodate an axial thrust pad the surface texture shall be reduced to a value less than 0.8 µm and the complete geometry of the axle end shall be reinstated.
G2.10.4 Journal dimensions
The journal dimensions shall be within the limits shown on the relevant drawings or in BS 5892, Part 1.

G2.10.5 Seat condition
Seats for interference fit components shall have no fretting and a surface texture of less than 3.2 µm.

G2.10.6 Seat tolerances
All mating surfaces (seats for bearings and interference fit components) shall be parallel and cylindrical tolerances not exceeding 0.025 mm. Any taper, within the permitted tolerance, shall be such that interference increases as the component is pushed on.

G2.11 Damage to wheelset
G2.11.1 Longitudinal defects
Axles with longitudinal defects that are unable to be rectified in accordance with clause F4.5.2 shall be scrapped.

G2.11.2 Axle cracks
No transverse cracks in the axle shall be permissible. Clause F4.4.6 sets out the actions required when such cracks are found.

G2.11.3 Other defects
Any damage not detailed in this document shall be assessed by a technically competent authority and action shall be taken to rectify the damage or scrap the defective component.

G2.12 Wheelset balancing
Wheelsets shall be dynamically balanced to the new wheelset requirements of BS 5892, Part 6 when new, re-tyred, repaired or overhauled when this is practicable and required by the relevant procedure. Where balancing is not practical, specific attention shall be given to minimising tread run-out.

Wheelsets that operate at speeds in excess of 125 mph and up to 140 mph shall have wheelset out of balance less than 50 gram.metres.

G3 Record keeping
G3.1 Records to ensure traceability
G3.1.1 Extent of records
The train operator shall require that records are kept which ensure that wheelsets and wheelset components are traceable and that a complete history of each wheelset and wheelset component is maintained. The minimum requirements are set out in Appendix 5. In addition to build, repair and overhaul information and the service history, all NDT results shall be recorded and retained. This clause does not apply to RIV vehicles.

G3.1.2 Mileage estimate
When a wheelset is subject to NDT or when the wheelset is sent for overhaul or repair, the train operator shall provide details, or estimates, of miles run since the last NDT. The mileage shall be entered into the wheelset records.

G3.1.3 Record retention
Full wheelset records shall be kept for five years after the scrapping date of the wheelset.

G3.2 Responsibility for record keeping
G3.2.1 Wheelset record keeper
The train operator shall be responsible for ensuring that a complete record is maintained of all the data for each wheelset applicable to the vehicles that they operate. It is permitted for the data to be retained at different locations.
Wheelset records shall be made available to all Railway Group members, their appointees and others at the discretion of RSSB. This clause does not apply to RIV vehicles.

**G3.2.2 NDT record summary**
The train operator shall ensure that full details of every wheelset NDT are recorded. Clear results shall be passed to RSSB in summary form in accordance with clause F4.7.5. If a wheelset is failed by NDT, then the full details shall be obtained by the train operator and copied to RSSB, as set out in clause F4.7.6 & F5.4.

**G3.2.3 NDT record database**
RSSB shall maintain a database containing basic information on all the NDT records of axles. The data collected shall be analysed by RSSB to identify trends in axles defects. RSSB shall make available the database for examination by all Railway Group members or their appointees.
Figure 1  Diagrams identifying parts of the wheel
### Railway Wheelsets

#### As forged condition axle markings

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Manufacturing contractor’s code (refer to GM/RT2470 for codes).</td>
</tr>
<tr>
<td>3</td>
<td>Year of manufacture.</td>
</tr>
<tr>
<td>4</td>
<td>Cast identity.</td>
</tr>
<tr>
<td>5</td>
<td>Inspector’s stamp (optional).</td>
</tr>
</tbody>
</table>

Figure 2  As forged condition axle markings

#### Branding on finish machined roller bearing axles

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>For ready identification of 140 mm diameter journals from 5½” diameter journals (freight vehicles only):</td>
</tr>
<tr>
<td></td>
<td>a)  Stamp the number 140 on both ends</td>
</tr>
<tr>
<td></td>
<td>b)  Paint both ends with white paint to BR Catalogue No 28/44300.</td>
</tr>
<tr>
<td>7</td>
<td>Axle serial number (from assembling contractor’s number allocation).</td>
</tr>
<tr>
<td>8</td>
<td>Axle geometry code, if applicable, to be cold stamped after the serial number.</td>
</tr>
</tbody>
</table>

Figure 3  Branding on finish machined roller bearing axles
Figure 4   Branding on finish machined plain bearing axle

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Axle serial number (from assembling contractor’s number allocation).</td>
</tr>
<tr>
<td>8</td>
<td>Axle geometry code, if applicable, to be cold stamped after the serial number.</td>
</tr>
</tbody>
</table>
5 Inspector’s stamp (optional).

7 Axle serial number (from assembling contractor’s number allocation).

8 Axle geometry code, if applicable, to be cold stamped after the serial number.

9 Original assembling contractor’s code (refer to GM/RT2470).

12 Latest subsequent assembling contractor’s code (refer to GM/RT2470). To be used when a wheelset has been repaired or overhauled by a different contractor from the original assembling contractor.

Figure 5 Axle end branding of roller bearing wheelsets
5 Inspector’s stamp (optional).
7 Axle serial number (from assembling contractor’s number allocation).
8 Axle geometry code, if applicable, to be cold stamped after the serial number.
9 Original assembling contractor’s code (refer to GM/RT2470).
12 Latest subsequent assembling contractor’s code (refer to GM/RT2470). To be used when a wheelset has been repaired or overhauled by a different contractor from the original assembling contractor.

Figure 6 Axle end branding of plain bearing wheelsets
1 Grade of material.
2 Manufacturing contractor’s code (refer to GM/RT2470 for codes).
3 Year of manufacture.
4 Cast identity.
5 Inspector’s stamp (optional).
13 Ultrasonic code, wheel rims that have been ultrasonically tested shall be stamped UT.

Figure 7 Branding on monobloc wheels during manufacture
5 Inspector's stamp (optional).

7 Axle serial number (from assembling contractor's number allocation).

8 Axle geometry code, if applicable, to be cold stamped after the serial number.

9 Original assembling contractor's code (refer to GM/RT2470).

10 Tyre profile.

11 Date of assembly of wheelset.

12 Latest subsequent assembling contractor's code (refer to GM/RT2470). To be used when a wheelset has been repaired by a different contractor from the original assembling contractor.

Figure 8  Branding on monobloc wheels after assembly
Railway Wheelsets

Figure 9  Branding on wheel centre during manufacture

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grade of material.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Manufacturing contractor’s code (refer to GM/RT2470 for codes).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Year of manufacture.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cast identity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Inspector’s stamp (optional).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Oil injection plug

Brandin
1 Grade of material.
2 Manufacturing contractor's code (refer to GM/RT2470 for codes).
3 Year of manufacture.
4 Cast identity.
5 Inspector's stamp (optional).

Figure 10  Branding on tyres during manufacture
5 Inspector’s stamp (optional).
7 Axle serial number (from assembling contractor’s number allocation).
8 Axle geometry code, if applicable, to be cold stamped after the serial number.
9 Original assembling contractor’s code (refer to GM/RT2470).
10 Tyre profile.
11 Date of assembly of tyre or wheel centre as applicable.
12 Latest subsequent assembling contractor’s code (refer to GM/RT2470). To be used when a wheelset has been repaired by a different contractor from the original assembling contractor.

Figure 11 Branding on tyres and wheels following assembly
Key

W = Flange thickness (new)
Y = Flange height (new)
X = Flange thickness (worn)
Z = Flange height (worn)
A = Flange thickness datum - 13 mm for UK profiles
    - 10 mm for UIC profiles

Figure 12  Flange height and thickness (new and worn)
Railway Wheelsets

Figure 13  Wheel tread roll-over

Figure 14  Wheel rim distortion
Railway Wheelsets

Figure 15   Wheel wobble

Location for gauging dimension 'G'

L and L1

H = tread run-out
G = wheel wobble
L-L1 = wheel diameter difference

Figure 16   Wheel tread radial run-out

H = tread radial run out
Railway Wheelsets

Figure 17   Datum for measuring axle body run-out, tread run-out and wheel wobble

Wheelsets with outside journals

Wheelsets with inside journals

Figure 18   Critical areas for cracks in wheel tread

Outside face of rim
Transition from tread to rim
Flange
Roll-over
Railway Wheelsets

$R_{\text{min}} = 5 \text{ mm}$

Max step = 1.5 mm

Figure 19  Step in flange and sharp flange

$R_{\text{min}} = 5 \text{ mm}$

Figure 20  Toe radius build-up
This dimension is not to exceed 2.0 mm

Figure 21  Diagram of false flange

Surface to have no scoring, pitting, indentations, burs or sharp edges.

Figure 22  Wheel web hole geometry
Appendix 1

(The content of this Appendix is mandatory)

**Minimum contents for a wheelset database**

The train operator shall maintain a paper or computer-based set of data for each wheelset-vehicle design combination. As a minimum the data shall include:

a) wheelset type  
b) vehicle application  
c) the required wheel profile  
d) the nominal back-to-back dimension  
e) the scrapping diameter of the wheel  
f) any allowable exceptions to the nominal diameter difference allowed between the wheels on the same axle  
g) the allowable diameter difference for the wheels on different axles under the same vehicle  
h) the acceptable maximum flange height  
i) the acceptable minimum flange thickness  
j) the minimum rim or tyre thickness  
k) for small wheels, less than 660 mm diameter, the maximum allowable flat size  
l) the NDT procedure chart  
m) the NDT periodicity  
n) the nominal wheel centre diameter (for tyred wheels).
Appendix 2
(The content of this Appendix is mandatory)

Requirements for labelling of loose wheelsets

When a wheelset has been assembled or when an overhaul or repair has been completed a durable label shall be attached to the wheelset. The method of attachment shall be secure and shall avoid any type of damage to the wheelset or its protective coating.

The label(s) shall clearly show the following information:

a) contractor’s identification
b) wheelset catalogue number, where applicable
c) wheelset serial number (axle unique number)
d) overhaul/repair date
e) UAT date or other NDT date
f) UAT/NDT operator(s) name(s)
g) warranty expiry date if applicable
h) axle bearing manufacture date *
i) axle bearing overhaul date *
j) axle bearing fitting date *
k) axle bearing serial number *.

(*) NOTE: for both bearings on the axle).

When a wheelset has been removed from a vehicle for overhaul or repair a durable label shall be securely attached to the wheelset.

The label shall clearly show the following information:

a) catalogue or part number
b) wheelset serial number
c) reason for removal from vehicle
d) requirements for particular tests or examinations
e) estimate of miles run since the last NDT examination.
Appendix 3
(The content of this Appendix is mandatory)

Mandatory wheelset profile limits

The dimensions shown below are the limits of wheel tread wear for acceptance for service on Network Rail controlled infrastructure.

This Appendix does not apply to RIV vehicles.

The profiles for steam locomotives shall be defined by individual assessment, useful information is contained in MT276.

The new flange height and thickness dimensions shown in Table A3.1 have been rounded from the dimensions derived from the profile drawings; where greater accuracy is required the dimensions and tolerances on the drawings shall be used.

<table>
<thead>
<tr>
<th>Tread profile</th>
<th>Drawing number / specification</th>
<th>Flange thickness details (mm)</th>
<th>Flange height details (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>As new (W)</td>
<td>Minimum (Worn) (X)</td>
</tr>
<tr>
<td>P1</td>
<td>S8 C2-8006234</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>P5</td>
<td>S8-C2-8003908</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>P6</td>
<td>S8-C2-8006238</td>
<td>28.5</td>
<td>24</td>
</tr>
<tr>
<td>P8</td>
<td>S8-C2-8006239</td>
<td>28.5</td>
<td>24</td>
</tr>
<tr>
<td>P9</td>
<td>S8-C2-8006240</td>
<td>25</td>
<td>21 (18)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See Note 2</td>
<td></td>
</tr>
<tr>
<td>P10</td>
<td>F-C-00234</td>
<td>31</td>
<td>27</td>
</tr>
<tr>
<td>P11</td>
<td>C1-C1-9016365</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>RD9</td>
<td>A1-C1 8700150</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>Eurostar</td>
<td>NF.F01-115 (1/40 profile &amp; 135 mm rim)</td>
<td>32.5</td>
<td>26</td>
</tr>
</tbody>
</table>

Table A3.1 Flange height and thickness by tread profile

Note 1: For datum points at which flange thickness and height are measured (see Figure 12).

Note 2: The dimensions in brackets are applicable if the Datum Face V of the tread profile is used for measurements (see Figure 12).
Note 3: For the following profiles the dimension 13 mm in Figure 12 is reduced to 10 mm:

a) Eurostar (NF.F01-115)
b) P10 where the vehicle is in international traffic (see Note 4).

Note 4: For vehicles fitted with P10 this dimension is reduced to 24 mm where the 10 mm dimension in Note 3 is used. If the dimension is less than 27 mm all the other UIC requirements set out in UIC leaflet 510-2 shall be checked and these shall be met.
Appendix 4
(The content of this Appendix is mandatory)

List of key tasks in wheelset examination

The following is a list of examinations and inspections that shall be undertaken on the wheelset as required for continued safe operation. These tasks shall 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.

The list includes a range of measurements to be undertaken in the assessment of wheelset condition and conformance with the limits specified in Part G of this document. All measurement equipment and gauges shall be calibrated.

4.1 General

The wheelset shall be examined for integrity, including:

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 shall not exceed the requirements of the appropriate maintenance specification. Tread conditions in excess of the criteria shall be removed 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 all 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.

This list is not exhaustive.

Checks shall be made for damage to, or missing, oil injection hole plug.

4.2 Axle specific

The axles shall be examined for:

a) flame cutting damage, weld spatter or electric arc damage
b) integrity of the axle surface coating
c) axle end threaded holes for damage, when the holes are exposed for reasons other than the visual inspection
d) axle end faces for raised edges, 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.

This list is not exhaustive.
Where the examination identifies deficiencies in the axle condition, then measurements shall be undertaken to confirm the extent of defects, such as axle body run-out, surface texture, back-to-back, etc.

4.3 Tread specific
Where the visual inspection of the tread profile suggests that it is worn or damaged, the train operator shall:

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. Applicable to wheelsets operating in accordance with RIV regulations.
f) examine the profile for grooving, false flange, flange step etc are within allowable limits.

4.4 Tyred wheel specific
The tyres shall 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*.

The items marked with an asterisk will usually only be applied at repair or overhaul when the wheelset is dismantled.

4.5 Other components
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.
Appendix 5
(The content of this Appendix is mandatory)

Records to be retained

Records shall be retained, including the items listed below as a minimum.

5.1 For the assembly
a) assembler identification (where not embodied in the axle number)

b) date of assembly
c) previous assemblers
d) previous assembly dates
e) dimensional details relating to interference fits
f) pressing on loads for wheels, gearwheels and axle-mounted brake discs
g) record of test loads to check security of interference fit, as required by BS 5892, Part 6, section 4.2.1

h) wheel press recorder chart
i) wheel tread profile.

5.2 For the axle
a) axle manufacturer

b) year of axle manufacture
c) axle geometry code
d) axle cast number
e) class of axle material
f) axle serial number
g) axle wheel seat diameters
h) axle journal diameters
i) date of NDT test
j) type of NDT test and reference to the procedure
k) expiry date of test.

Result of test, including description and measurements of any defect found (crack length, depth and orientation) and record of areas of the axle covered by the test. The means used to measure depth shall be stated.

NDT operator's name and signature.
5.3 For each wheel or wheel centre
   a) wheel manufacturer
   b) year of wheel manufacture
   c) wheel cast number
   d) class of wheel material
   e) bore diameter
   f) outside diameter
   g) date of NDT test on wheel, wheel centre and/or holes in same
   h) type of NDT test
   i) result of test including description and measurements of any defects found
      (crack, length, depth and orientation)
   j) NDT operator's name and signature.

5.4 For each tyre
   a) tyre manufacturer
   b) year of tyre manufacture
   c) tyre cast number
   d) class of tyre material
   e) outside diameter
   f) bore diameter
   g) date of fitment to wheel centre
   h) date of NDT test after fitment to wheel centre
   i) NDT operator's name and signature
   j) result of test including a description and measurements of any defects found.

5.5 Vehicle/storage data
   a) class and number of vehicle to which wheelset is installed and the position of
      the wheelset on the vehicle
   b) location of wheelset not fitted to vehicle.

5.6 Scrapping details
   a) date scrapped
   b) reason for scrapping.

5.7 Repair/overhaul work
   Progress record cards.

5.8 Service/maintenance/inspection
   Dimensional measurements outside limits set out in this document.
Appendix 6
(The content of this Appendix is mandatory)

Prohibited processes on wheelsets

The following shall be prohibited at all times:

a) the use of power tools on an axle or component or any part of the wheelset which is 'ready for assembly' or at any time other than as part of an approved process

b) welding, brazing or other thermal process, except where it is set out in an approved procedure

c) action which would cause flame cutting debris or weld spatter to fall on a wheelset or component

d) attachment of an electrical connection or current return, not allowed for by the wheelset design, other than those needed to carry out MPI or welding using an approved procedure or electrical testing, as set out in clause D2.6 and clause F4.6.12

e) use of any tool which could cause notches other than in accordance with an approved procedure, pits or other markings on the axle or wheelset components

f) the application of grease to axle and suspension tube bearings to any extent prior to testing for smooth rotation

g) any action which could have an adverse effect on the safety of the wheelset

h) hand grinding to remove sharp flanges except to facilitate recovery.
Appendix 7

(The content of this Appendix is mandatory)

Obtuse crossings – ‘low speed rule’

To ensure the safe operation of wheelsets through obtuse crossings the ‘low speed rule’ shall be satisfied. The derailment risk is assessed by the wheelset lateral displacement when passing through a crossing gap. Too much will result in contact with the tip of the point rail (L2 in Figure Appendix 7.1) on a part of the flange where there may be insufficient contact angle to ensure guidance into the correct path. The acceptable magnitude of the sideways displacement for a given wheel profile is defined, at low speed, on the basis that the flange contact angle is greater than 45°.

The ‘low speed rule’ requires that the following inequality shall be met:

\[ L_{uc}\psi_o + \Delta_{slip} + 5 L_{ug} < \Delta_{crit} \]  \hspace{1cm} (1)

where:
- \( L_{uc} \) is the unchecked length \( \text{m} \)
- \( \psi_o \) is the steady-state angle of attack \( \text{mm} \)
- \( \Delta_{slip} \) is the lateral slip distance \( \text{mm} \)
- \( L_{ug} \) is the unguided length \( \text{m} \)
- \( \Delta_{crit} \) is the allowable sideslip \( \text{mm} \)

The most critical of these terms is the lateral slip distance. The vehicle types most at risk are two axled high-sided vehicles with low axle loads.

Two cases of wind loading and track cant shall be considered:

a) a wind speed of 25 m/s and zero track cant

b) a wind speed of 17.5 m/s combined with an adverse track cant of 3°.

The resultant external lateral force on the vehicles is then given by the greater of:

\[ F_{ext} = 0.46 A_w \]

or

\[ F_{ext} = 0.23 A_w + 0.05 W \]  \hspace{1cm} (2)

where:
- \( A_w \) is the area exposed to the wind \( \text{m}^2 \)
- \( W \) is the total vehicle weight \( \text{kN} \)
- \( F_{ext} \) is the resultant lateral body force \( \text{kN} \)

Compliance with the inequality (1) shall be at the crossing angles identified in Table A7.1.
The procedure for applying formula (1) is as follows:

Step 1 Determine the value of $\Delta_{crt}$, the maximum permissible sideways displacement in the gap for the wheel profile chosen, refer to Figure A7.2.

Step 2 Choose the crossing angle to be considered.

Step 3 Determine the unchecked length $L_{uc}$ for the crossing angle being considered, refer to Table A7.1.

Step 4 Determine the unguided length $L_{ug}$ for the crossing angle and wheel diameter being considered, refer to Figure A7.3.

Step 5 Determine the minimum curve radius $R_{min}$ for the crossing angle being considered, refer to Table A7.1.

Step 6 Determine the steady state angle of attack of the leading wheelset, assuming the vehicles to be running on a constant curve of radius equal to the minimum permissible radius for the crossing angle being considered. Assume a wheel/rail friction coefficient of 0.1, a track gauge of 1438 mm (nominal gauge plus 6 mm maintenance allowance) and full allowable wheel flange wear. Add to this calculated angle of attack value an allowance for the permissible wheelset yaw misalignment tolerance in the vehicle to give the $\Psi_o$ value to substitute in formula (1). In determining the steady state angles of attack of the wheelsets, the external lateral forces on the vehicles should be neglected.

Step 7 Superimpose on the steady state curving situation in step 6 an external force applied to the vehicle body of $F_{ext}$ as determined by formula (2). Calculate the value of $\Delta_{slip}$ for the leading wheelset which would occur if its flange force were suddenly removed, assuming a wheel/rail friction coefficient of 0.1.

Step 8 Check that the inequality of formula (1) is satisfied.

Step 9 Repeat steps 2 to 8 for the remaining crossing angles.

The vehicle design shall minimise the generation of lateral loads by buffers and drawgear and by other inter-vehicle constraints. The possibility of braking systems causing wheel locking is be minimised to avoid the occurrence of exceptionally low lateral adhesion levels.

The vehicle design shall minimise the generation of lateral loads

<table>
<thead>
<tr>
<th>Crossing angle (1 in N)</th>
<th>Gap (67 N) mm</th>
<th>Stagger (1391/2 N) mm</th>
<th>Unchecked length $L_{uc}$ m</th>
<th>Minimum curve radius $R_{min}$ m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 8.0</td>
<td>536</td>
<td>87</td>
<td>0.449</td>
<td>500</td>
</tr>
<tr>
<td>1 in 7.5</td>
<td>502</td>
<td>93</td>
<td>0.409</td>
<td>400</td>
</tr>
<tr>
<td>1 in 6.5</td>
<td>433</td>
<td>107</td>
<td>0.326</td>
<td>240</td>
</tr>
<tr>
<td>1 in 5.5</td>
<td>371</td>
<td>126</td>
<td>0.245</td>
<td>160</td>
</tr>
</tbody>
</table>

Table A7.1 Obtuse crossing data
Railway Wheelsets

**Figure A7.1** Obtuse crossing layout

**Figure A7.2** Definition of $\Delta_{\text{crit}}$
Figure A7.3  Unguided length (as a function of wheel diameter and crossing angle)
Appendix 8
(The content of this Appendix is mandatory)

Material cleanliness requirements

8.1 Microstructure
The microstructure shall be ferrite and pearlite, having a grain size between 5 and 8 as determined by the method in Appendix F of BS 4490; 1989, as required by BS 5892 Pt 1 & 3. The sampling rate shall be at least two components from batch sizes greater than 250 and at least one component from batch sizes up to 250.

8.2 Micrographic cleanliness
The cleanliness is measured by micrographic examination, as defined in sections 8.3 and 8.4. Maximum values of thick series inclusions to be obtained are set out in Table A8.1. Thin series inclusions are not taken into account.

<table>
<thead>
<tr>
<th>Type on inclusions</th>
<th>Category 1</th>
<th>Category 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thick series (maximum)</td>
<td>Thin series (maximum)</td>
</tr>
<tr>
<td>A (Sulphides)</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>B (Aluminates)</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>C (Silicates)</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>D (Globular oxides)</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>B+C+D</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Table A8.1 Maximum value of inclusions measured by micrographic examination

8.3 Location of the micrographic sample
The examination fields for axle and wheels are given below:

a) Axle, the examination field is shown in Figure A8.1. The examination shall be made in a 200 mm² plane, perpendicular to arrow F, at mid-radius of the solid axles or at mid-distance between external and internal surface of hollow axles. The test pieces shall be taken from the largest axle section.

b) Wheel, the examination field is situated in the shaded area of Figure A8.2. Its centre ‘F’ is situated 15 mm below the tread.

8.4 Test method
Cleanliness level determination shall be in accordance with ISO 4967, method A. The criteria for category 2 are applicable to wheelsets operating up to and including 125 mph and category 1 is applicable to wheelsets operating above 125 mph.
Figure A8.1 Examination field of an axle

Figure A8.2 Examination field in the wheel rim
Appendix 9
(The content of this Appendix is mandatory)

NDT record summary
The train operator shall provide the following information to RSSB for entry onto the NDT record database.

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Axle type and catalogue number</td>
<td></td>
</tr>
<tr>
<td>Number of axles tested</td>
<td></td>
</tr>
<tr>
<td>Number of axles tested clear</td>
<td></td>
</tr>
<tr>
<td>Number of axles failed</td>
<td></td>
</tr>
<tr>
<td>Number with defects in journal</td>
<td></td>
</tr>
<tr>
<td>Number with defects in wheel seat</td>
<td></td>
</tr>
<tr>
<td>Number with defects in axlebody</td>
<td></td>
</tr>
<tr>
<td>Number of suspect signals</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 10
(The content of this Appendix is mandatory)

**Defective axle record**

The train operator shall provide the following information to RSSB for entry onto the NDT record database.

<table>
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<tr>
<th>Information</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Axle serial number</td>
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<tr>
<td>Axle type</td>
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</tr>
<tr>
<td>Date of manufacture</td>
<td></td>
</tr>
<tr>
<td>Material and grade</td>
<td></td>
</tr>
<tr>
<td>Vehicle</td>
<td></td>
</tr>
<tr>
<td>Vehicle number</td>
<td></td>
</tr>
<tr>
<td>Bogie</td>
<td>Type</td>
</tr>
<tr>
<td></td>
<td>Suspension type</td>
</tr>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Defect details</td>
<td>Location</td>
</tr>
<tr>
<td></td>
<td>Wheel seat</td>
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<tr>
<td></td>
<td>Bearing journal</td>
</tr>
<tr>
<td></td>
<td>Other seat</td>
</tr>
<tr>
<td></td>
<td>Axle body</td>
</tr>
<tr>
<td></td>
<td>Transition</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance of defect to end of axle</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Length</td>
</tr>
<tr>
<td></td>
<td>Depth</td>
</tr>
<tr>
<td>Orientation – angle to axial centre line</td>
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</tr>
<tr>
<td>Origin of defect</td>
<td>Corrosion</td>
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<td></td>
<td>Mechanical damage</td>
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<td>Material defect</td>
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<td></td>
<td>Electrical</td>
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<td>Investigation report number</td>
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<tr>
<td>History</td>
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<td></td>
<td>Last test date</td>
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<td></td>
<td>Mileage</td>
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<tr>
<td></td>
<td>Suspect signal</td>
</tr>
</tbody>
</table>
Railway Wheelsets

References

Railway Group Standards and Other Railway Group Standards
GA/RT6001 Railway Group Standards Change Procedures
GA/RT6004 Temporary Non-Compliance with Railway Group Standards
GA/RT6006 Derogations from Railway Group Standards
GE/RT8014 Hot Axle Bearing Detection
GE/RT8050 Process for dealing with issues between Railway Group Standards and TSIs for High-Speed Operation
GE/RT8250 Safety Performance Monitoring and Defect Reporting of Rail Vehicles, Plant and Machinery
GM/RC2513 Commentary on Permissible Track Forces for Railway Vehicles
GM/RC2566 Recommendations for Railway Wheelsets (to be published)
GM/RT1300 Engineering Acceptance of Road-Rail Vehicles
GM/RT2000 Engineering Acceptance of Rail Vehicles
GM/RT2004 Requirements for Rail Vehicle Maintenance
GM/RT2005 Certification Processes for NDT Operatives, Equipment & Facilities used for inspecting Rail Vehicles
GM/RT2100 Structural requirements for Railway Vehicles
GM/RT2400 Engineering Acceptance and Design of On-Track Plant
GM/RT2402 Engineering Acceptance of Rail Mounted Maintenance Machines
GM/RT2450 Qualification of Suppliers of Safety-Critical Engineering Products and Services
GM/RT2470 Wheel Supplier Qualification
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Other References
BS 4490 Method of magnetic flaw detection of the grain size of steel
BS 5892-Parts 1 – 6 Railway Rolling Stock Materials
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UIC510-2 Trailing Stock Conditions Concerning the Use of Wheels of Various Diameters with Running Gear of Different Types
UIC810 Technical Specification for the Supply of Rough Tyres for Tractive and Trailing Stock
UIC811 Technical Specification for the Supply of Axles for Tractive and Trailing Stock
UIC812 Technical Specification for the Supply of Forged or Rolled Wheel Centres for Tyred Wheels For Tractive and Trailing Stock
UIC813 Technical Specification for the Supply of Wheelsets for Trailing Stock
MT276 Examination Schedule for Preserved Steam Locomotives Running on BR Lines