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in the context of the European directives  
for interoperability of railway systems

Railway Group Standard

**GM/RT2463**

Issue One

Date February 2003

## Design and Operation of Wheelskates

Signatures removed from electronic version

### Synopsis

This document mandates the design features of wheelskates and the process for their acceptance for use on Railtrack controlled infrastructure. It also mandates the essential requirements for their operation.

### Submitted by

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Karl Reilly  
Standards Project Manager

### Authorised by

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Anne Blakeney  
Acting Controller, Railway Group Standards

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# Design and Operation of Wheelskates

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# Design and Operation of Wheelskates

## Part A

### A1 Issue record

Issue	Date	Comments
One	February 2003	Original Document

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 1 February 2003.

This document comes into force on 5 April 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.

This document does not supersede any other Railway Group Standards.

### A3 Scope of Railway Group Standards

The overall scope of Railway Group Standards is set out in Appendix 1 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 Railtrack PLC, Railway Safety, and the train and station operators who hold railway safety cases for operation on or related to infrastructure controlled by Railtrack PLC.

Railtrack PLC is known as Railtrack.

### A5 Health and safety responsibilities

In issuing this document, Railway Safety makes no warranties, express or implied, that compliance with all or any documents published by Railway Safety 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 Plant Engineer, Railway Safety

Haydn Peers, Principal Traction & Rolling Stock Engineer, Railway Safety

Jon Taylor, Principal Track & Structures Engineer, Railway Safety

Enquiries should be directed to Railway Safety – Tel: 020 7904 7518.

## **Design and Operation of Wheelskates**

### **A7 Supply**

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## **Design and Operation of Wheelskates**

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# Design and Operation of Wheelskates

## Part B

### B1 Purpose

This document mandates the design features of wheelskates and the process for their acceptance for use on Railtrack controlled infrastructure. It also mandates the essential requirements for their operation.

### B2 Application of this document

#### B2.1 To whom the requirements apply

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

#### B2.2 Compliance requirements

The design requirements (Part C) of this document shall be complied with no later than 5 April 2003 for wheelskates newly introduced to the network.

The requirements of sections D1 and D2 for new wheelskates shall be complied with from 5 April 2003.

The requirements of sections D1 and D2 shall be complied with by 2 August 2003 for all existing wheelskates.

The requirements of sections D3 and D4 shall be complied with by all users of wheelskates by 5 April 2003.

The requirements of sections C1 to C5 inclusive and section D1 of this document are within the scope of Vehicle Acceptance Body approval.

Action to bring existing wheelskates into compliance with the design requirements of this document is not required.

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.

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](#).

### B3 Definitions

#### Flange-back

That part of the vertical surface of a wheel which forms the inside face of the wheel rim above rail level and which is the reference face for specifying all wheel profile dimensions. It is also used as a datum face for maintenance checking of a wheelset (see Appendix 1, Figure 1A).

#### Flange-back spacing

The dimension between the two flange-back faces of a wheelset, measured parallel to the axle centreline, with the wheelset in the free (ie unloaded) condition (see Appendix 1, Figure 1B).

#### Flange height

The difference between the radius of the wheel at the tip of the flange and the radius of the wheel at the tread datum position (see Appendix 1, Figure 1A).

#### Flange toe

The convex portion of the outside face of the flange which makes contact with the toe of a facing switch blade (see Appendix 1, Figure 1C).

#### Maximum static working load

The maximum load the **wheelskate** is designed to transport, taking account of the effects of suspension unloading.

## Design and Operation of Wheelskates

### Permissible speed

The maximum speed permitted over a section of line as set out in the Sectional Appendix.

### S&C

Abbreviation for 'switches and crossings', that is track constructed from sets of switches and individual crossings to form connections between tracks.

### Tread datum

A circle around the tread, or a point of the cross section through the tread, which is 70 mm from the flange-back.

### Wheel profile

That part of the surface of the wheel or tyre between the flange-back and the outside face of the wheel or tyre.

### Wheelskate

A device for rescuing crippled vehicles where a wheelset is not fit to rotate, by lifting the affected wheelset and providing alternative support and guidance.

# Design and Operation of Wheelskates

## Part C – **Wheelskate** design and approval

### C1 **Wheelskate** design

#### C1.1 General

The design of a **wheelskate** shall take into account the range of vehicles with which the skate is to be compatible. Factors to be considered shall include axle load, new and worn wheel diameters and the space envelope limitation at the wheelset.

#### C1.2 Basis of operation

The operation of the wheelskates shall depend upon the use of wheels to support and guide the load. The use of skids for this purpose is not permitted.

#### C1.3 **Wheelskate** structure

##### C1.3.1 Design strength

The requirements for the design strength of the **wheelskate** shall be based upon BS 2573 in respect of permissible stresses, fatigue life and construction.

Part 1 of BS 2573 shall be used to determine the stresses of components in the **wheelskate**.

The requirements of GM/RT2100 are not applicable to the design of wheelskates.

##### C1.3.2 Proof strength

A **wheelskate** shall be designed to meet the following load cases:

- a) a maximum static vertical load multiplied by a factor of 1.3 (which takes account of forces generated by canted track, switches and crossings and track discontinuities)
- b) a lateral load which shall be assumed to be a maximum of 0.3 of the maximum static vertical load.

The stresses in the structural members generated by the above load cases shall not exceed the basic stress, as defined in BS 2573 (Part 1:1983), when multiplied by a duty factor of 0.95.

##### C1.3.3 Fatigue load cases

The fatigue stresses in the **wheelskate** shall not exceed those defined in BS 2573 (table 24) under the following conditions:

- a) maximum number of operating cycles of  $3.2 \times 10^4$
- b) a nominal load spectrum factor (as defined in BS 2573) of 1.0 applied to a load range from zero to the maximum static vertical load.

#### C1.4 Wheels and axles

Part 2 of BS 2573 shall be used for the determination of stresses in wheels and axles but clauses 8.7 to 8.11 inclusive of BS 2573 dealing with the wheel-rail interaction are not applicable. The requirements for wheel-rail interactions are set out in section C3.

Wheel material shall be in accordance with those specified in GM/RT2023 (to be superseded by GM/RT2466).

Wheelskates shall use independently rotating wheels, including wheels mounted on an 'axle', to avoid the generation of longitudinal wheel forces.

## Design and Operation of Wheelskates

### C1.5 Bearings

The design life of the bearings used in wheelskates shall be defined using a recognised and proven method, taking into account the following factors:

- a) radial and lateral loading
- b) additional load inputs due to the effects of predictable wheel-tread defects
- c) the full range of operating duties, rotating speeds and loads
- d) selection of bearing grease.

Suitable sealing shall be provided for the axle bearings to restrict ingress of foreign substances and loss of lubricants.

## C2 Gauging requirements

Wheelskates shall be designed such that recovered vehicles remain within their designed swept envelope. Methods of determining the parameters defining the size of railway vehicles are set out in [GM/RT2149](#).

The swept envelopes of wheelskates (excluding the area occupied by the wheels and any frame member adjacent to the wheels of the **wheelskate**) shall provide the following clearances:

- a) 75 mm vertically above the plane of the rails for a distance of 630 mm either side of the centre line of the track, under all conditions, taking account of all suspension movements and vertical curves
- b) 7.5 mm, under worst case conditions, to the area reserved for items intended to come in close proximity to trains (for example, conductor rails and AWS magnets) forming part of the lower structure gauge set out in [GC/RT5212](#).

Information on the space envelope requirements for wheelskates in relation to vehicle design is included in GM/RT2260.

## C3 Wheel-rail interaction requirements

### C3.1 Wheel loads

Practical constraints on the diameter of **wheelskate** wheels prevent the application of the normal rules for determining acceptable wheel loads for a given wheel diameter.

The effects of the resulting high contact stresses on the rail are mitigated by:

- a) the use of independently rotating wheels (see clause C1.4)
- b) restricting the operational speed of wheelskates (see section D4)
- c) the limited distances travelled by wheelskates (see section D3)
- d) the limited number of occasions on which wheelskates are used.

The vehicle being skated determines the effective wheel load limit of the **wheelskate**.

### C3.2 Height of wheel being carried

Wheelskates shall be designed so that the flange of the wheel being carried is clear of the head of the rail, without creating an unnecessarily heavy load from the vehicle suspension.

## Design and Operation of Wheelskates

### C4 Wheel geometry requirements

#### C4.1 Wheel profile

Wheels of wheelskates shall be manufactured and maintained to the P6 wheel profile. The requirements for this profile are set out on Drawing Number S8-C2-8006238 (see Appendix A of [GM/RT2026](#), to be superseded by [GM/RT2466](#)).

#### C4.2 Minimum wheel diameter

The design minimum wheel-tread diameter shall be not less than 200 mm. The scrapping limit of any wheel shall not be less than 187 mm. Tread diameter shall be measured at the tread datum.

#### C4.3 Flange-back spacing

The **wheelskate** design shall achieve a distance between the flange-backs across the wheels within the range 1360 - 1362 mm (see Appendix 1, Figure 1B).

#### C4.4 Wheel rim width

The width of the wheel rim measured between the flange-back and the outside face of the rim shall be within the range 127 - 140 mm (see Appendix 1, Figure 1A).

#### C4.5 Safety at obtuse crossings

Wheelskates cannot, by virtue of their design geometry, follow the usual requirements for safety at obtuse crossings. The effects of a possible derailment are mitigated by the application of the operating instructions required by section D2.

### C5 Acceptance by a Vehicle Acceptance Body

New wheelskates shall be subject to engineering acceptance by a Vehicle Acceptance Body (VAB).

The engineering assessment shall address all aspects of design, construction, testing, maintenance and condition of the **wheelskate** that could have an influence on its safety and safe operation. If necessary, the assessment shall include testing of the **wheelskate** under operational conditions.

The assessment shall review compliance with this Standard and the other documents, or specified parts of documents and their associated references, which are referred to in this Standard.

The assessment shall include a review of the Certificate of Conformance for Vehicle Maintenance. Certificates of Conformance for Vehicle Design and Vehicle Construction are not required for the acceptance of wheelskates.

When the VAB is satisfied that the **wheelskate** complies with all of the mandatory requirements for design and operation and the VAB is satisfied that it is in possession of a valid Certificate of Conformance for Vehicle Maintenance, it is permissible to issue a Certificate of Engineering Acceptance for the **wheelskate**.

## Design and Operation of Wheelskates

### Part D - Operational requirements

#### D1 Maintenance plans

##### D1.1 Certification of maintenance plans

Maintenance plans for wheelskates shall be subject to certification by a Certification Conformance Body (see section C5).

##### D1.2 Maintenance plan

The maintenance plan shall be in accordance with the relevant parts of [GM/RT2004](#). In particular, it shall address:

- a) the critical area of bearing lubrication prior to, during and following use
- b) the inspection of the **wheelskate** for damage prior to, during and following use
- c) maintenance of wheel wear limits.

The flange tip shall not be allowed to wear to such a shape as to cause a risk of a blade climbing derailment at a facing turnout. Specifically, the midpoint of a 5 mm radius concave arc with a chord length of 7 mm shall not touch or interfere at the transition between the worn face of the flange and the toe radius of the flange tip. This requirement applies both to sharply worn flanges and to flanges with toe radius build-up.

There are specific compliance requirements for section D1. See clause B2.2 for details.

#### D2 Operating instructions

##### D2.1 General requirements

Train operators shall have in place operating instructions for each design of **wheelskate** they use.

##### D2.2 Operating instructions

The operating instructions shall:

- a) state those vehicles or vehicle classes with which the **wheelskate** is compatible
- b) prescribe fitting instructions
- c) forbid the use of wheelskates with visible wheel tread damage
- d) define the maximum height to which the vehicle is to be jacked to maintain the vehicle within its designed swept envelope
- e) mandate fitment by competent staff
- f) state the safe operating speed of the **wheelskate** over plain line, switches and crossings (S&C) and raised check rails (see also section D4).
- g) include a warning to users on the risk of derailments when using the **wheelskate** at obtuse crossings.

Consideration shall be given to the special instructions for the movement of units fitted with track circuit actuators.

There are specific compliance requirements for section D1. See clause B2.2 for details.

## Design and Operation of Wheelskates

### D3 Movement of vehicles on wheelskates

A vehicle fitted with wheelskates shall be moved by towing or propelling if either:

- a) the use of the **wheelskate** or removal of the running gear results in the brake force being reduced to below 50%, or
- b) the handbrake of the vehicle or train formation is rendered ineffective.

All traction power on the defective wheelset shall be isolated before fitting a **wheelskate**.

It is permissible for the vehicle to be self-propelled if, after fitting wheelskates, sufficient traction power and more than 50% of the brake force is available. In this case the traction power to the affected wheelset shall be isolated.

Train operators shall minimise the length of journey of vehicles mounted on wheelskates.

In order to minimise the risk of derailment, train operators shall, where practicable, organise skated vehicle movements with the **wheelskate** in a trailing position.

### D4 Speed of vehicles fitted with wheelskates

#### D4.1 Running lines

On running lines, the maximum speed of any vehicle fitted with a **wheelskate** shall be limited to the safe operating speed indicated in the **wheelskate**'s operating instructions.

In addition, on running lines, the maximum speed of any vehicle fitted with a **wheelskate** shall be limited by the axle load as set out below:

Vehicle category	Vehicle design axle load	Maximum speed of <b>wheelskate</b>
Vehicles with bogies of three or more axles	Greater than 20 tonnes and less than or equal to 25.5 tonnes	20 mph
Vehicles with bogies of three or more axles	Up to 20 tonnes	25 mph
All other vehicles	Greater than 20 tonnes and less than or equal to 25.5 tonnes	25 mph
All other vehicles	Up to 20 tonnes	30 mph
All vehicles fitted with wheels having a design diameter of less than 250 mm	Any weight	20 mph

Where the permissible speed through curves and S&C is restricted to 30 mph or less, or at any obtuse crossing, the maximum speed of any vehicle fitted with a **wheelskate** shall be limited to 3 mph (walking pace).

#### D4.2 Yards and sidings

In yards and sidings the maximum speed of any vehicle fitted with a **wheelskate** shall be limited to 3 mph (walking pace).

# Design and Operation of Wheelskates

## Appendix 1

### Definition diagrams

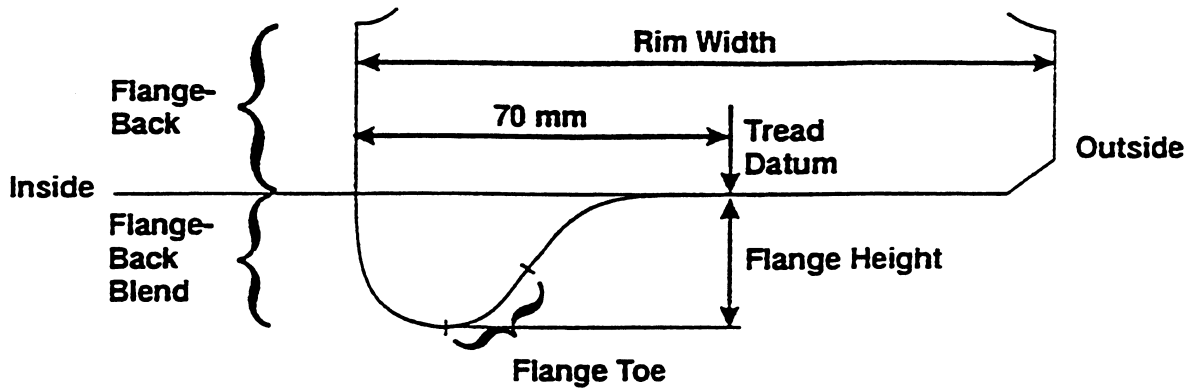


Figure 1A. Rim definitions

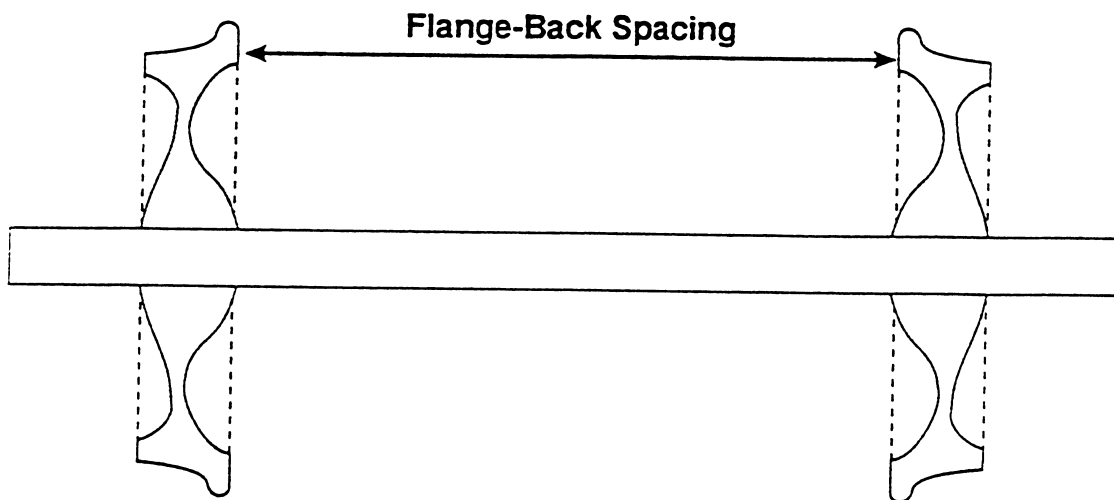


Figure 1B. Flange-back spacing

# Design and Operation of Wheelskates

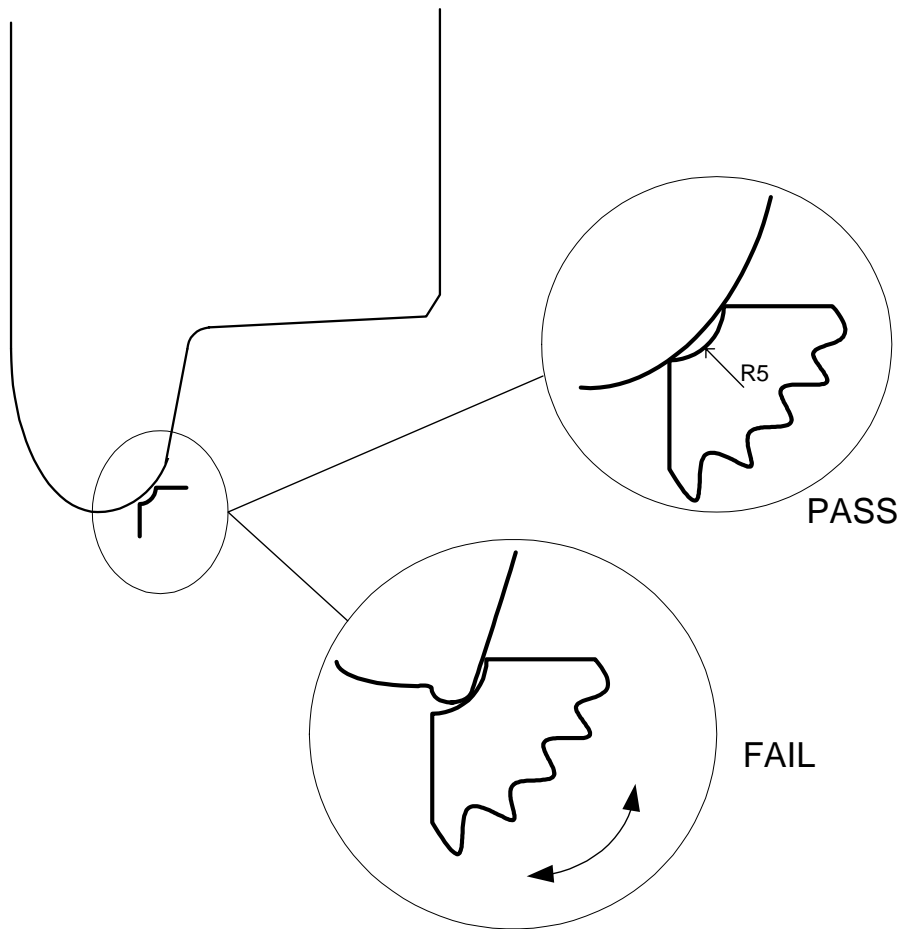


Figure 1C. Sharp flange and toe radius test

## Design and Operation of Wheelskates

### References

#### Railway Group Standards and other Railway Group Documents

<a href="#">GA/RT6001</a>	Railway Group Standards Change Procedures
<a href="#">GA/RT6004</a>	Temporary Non-Compliance with Railway Group Standards
<a href="#">GA/RT6006</a>	Derogations from Railway Group Standards
<a href="#">GC/RT5212</a>	Requirements for Defining and Maintaining Clearances
<a href="#">GM/RT2004</a>	Requirements for Rail Vehicle Maintenance
<a href="#">GM/RT2023</a>	Wheelset Manufacture
<a href="#">GM/RT2026</a>	Wheelsets: In Service Safety and Maintenance Attention
<a href="#">GM/RT2100</a>	Structural Requirements for Rail Vehicles
<a href="#">GM/RT2149</a>	Requirements for Defining and Maintaining the Size of Railway Vehicles
<a href="#">GM/RT2466</a>	Railway Wheelsets (due for publication 2003)
<a href="#">GM/RT2260</a>	Design for Recovery of Rail Vehicles (due for publication 2003)
<a href="#">GM/TT0089</a>	Geometric Interfaces between Railway Wheelsets and Track

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by Railway Safety.

#### Other References

**BS 2573 : 1983** Rules for the design of cranes

Part 1 Specification for classification, stress calculations and design criteria for structures

Part 2 Specification for classification, stress calculations and design criteria for mechanisms