

BS 5892-8:2012



BSI Standards Publication

Railway rolling stock materials

**Part 8: Railway applications —
Wheelsets and bogies — Powered
and non-powered wheelsets with
inboard bearings — Product
requirements**

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 24, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 June 2012. It was prepared by Technical Committee RAE/3, *Railway rolling stock material*. A list of organizations represented on this committee can be obtained on request to its secretary.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

0 Introduction

This British Standard specifies the wheelset assembly and finished product characteristics that do not arise from a choice of design parameters, such as diameters, interferences, materials – they are verified during either qualification or delivery of the product (see Clause 4). It also gives guidance and recommendations on:

- a) qualification procedures (see Annex C); and
- b) delivery conditions (see Annex D).

1 Scope

This British Standard specifies requirements for the assembly of powered and non-powered wheelsets with inboard bearings comprising elements conforming to the following standards.

- a) BS 8535 for axle design.
- b) BS EN 13261 or BS 5892-1 for axles.
- c) BS EN 13262 or BS 5892-3 for wheels.

NOTE Some characteristics are specified as a function of Category 1 or of Category 2.

- *Category 1 is applicable for wheelsets whose operating speed is to exceed 200 km/h.*
- *Category 2 is applicable for wheelsets whose operating speed is not to exceed 200 km/h, and comprises two sub-categories:*
 - *Category 2a is applicable when the operating speed is to be up to and including 120 km/h;*
 - *Category 2b is applicable when the operating speed is to exceed 120 km/h, but is not to exceed 200 km/h.*

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 5892-1, *Railway rolling stock materials – Part 1: Specification for axles for traction and trailing stock*

BS 5892-3, *Railway rolling stock materials – Part 3: Specification for monobloc wheels for traction and trailing stock*

BS 5892-6, *Railway rolling stock materials – Part 6: Specification for wheelsets for traction and trailing stock*

BS 8535, *Railway applications – Wheelsets and bogies – Powered and non-powered axles with inboard bearings – Design method*

BS EN 13261, *Railway applications – Wheelsets and bogies – Axles – Product requirements*

BS EN 13262, *Railway applications – Wheelsets and bogies – Wheels – Product requirements*

3 Assembly of components

3.1 General

All elements which are to comprise the assembled wheelset shall meet the geometric requirements of the applicable standards (see Scope); and the wheels and the axle shall be in the “ready for assembly” condition.

The elements comprising the wheelset can be shrink-fitted or press-fitted. The interferences to be used for fitting shall be as specified by the designer of each element to be fitted and shall be a function of the characteristics of the element material and the forces and torque to be transmitted by the fitting. This interference shall be specified according to the geometric tolerances of the axle seats specified in the axle product standard (see Scope).

During assembly of components prior to fitting wheels on the axle:

- a) allowance shall be made for shrinkage at axle seats due to other nearby interference fits (e.g. gearwheels and other bearings); and
- b) the level of interference between bearings and their shafts or housings shall be checked to ensure that it is within the specified tolerances.

Unless otherwise specified by the wheel designer, the interference values for wheel fittings specified in 3.2 shall be used.

For shrink-fitting, the whole of each wheel shall be heated to a temperature not exceeding 250 °C. If a different heating method is used, proof shall be provided that there has been no effect on the wheel characteristics as defined in BS EN 13262 or BS 5892-3.

If a different heating method is used, this shall be the subject of an agreement between the customer and the supplier. As part of this agreement, the supplier shall demonstrate at least that the axle and wheel characteristics as defined in the wheel and axle standards (see Scope) are not modified by the fitting. Then, the mechanical resistance of the assembly (see 4.1) shall be demonstrated and the traceability documents for each fitting shall be defined so as to give the same type of information as recommended in D.5.

The static imbalance of the two wheels of each wheelset shall be within the same diametric plane and on the same side of the axle. The static imbalance of the gear wheels and brake discs shall be in the same plane as those of the wheels, but on the opposite side of the axle.

3.2 Interference between axle wheel seat and wheel hub bore

Unless otherwise specified by the wheel designer, the following interference values j shall be met:

- a) for shrink-fitting: $0.0009 \text{ dm} \leq j \leq 0.0015 \text{ dm}$;
- b) for press-fitting: $0.0010 \text{ dm} \leq j \leq 0.0015 \text{ dm} + 0.06$

where dm is the mean diameter in mm.

3.3 Press-fitting diagram

3.3.1 Results to be achieved

NOTE For press fitting, the force-displacement curve gives confidence that the fitting has not damaged the contact surfaces and that the specified interference has been effective.

The shape of the press fitting curve to be obtained shall be as specified in Annex A.

The final fitting force, in MN, is a function of the force F specified in 4.1.1 and shall be within the range:

$$0.85 F < \text{final fitting force} < 1.45 F$$

This force shall be independent of any special pressing force to secure inboard components, i.e. bearings.

If there is any anomaly in the press-fitting diagram (See Annex A) or the final fitting-on force achieved exceeds the maximum value specified ($1.45 F$) by not more than by 10%, then mechanical resistance shall be tested in accordance with 4.1.

3.3.2 Measurement method

The press used for the wheelset assemblies shall have a calibrated system to plot the diagram of the force value at each position of the element to be fitted obtained during the displacement of the latter on the axle.

The abscissa scale of displacement shall be at least equal to 0.5 times the actual displacement of the element to be fitted. The ordinate scale of force shall allow the force to be read at each point of the curve with an accuracy of 0.025 MN, using a force sensor with an accuracy of 0.01 MN. The abscissae and ordinates can be reversed.

In the case of point recording, at least one point shall be plotted per mm of relative displacement of the elements to be fitted and per 0.025 MN variation in force.

4 Wheelset characteristics

4.1 Mechanical resistance of the assemblies

4.1.1 Results to be achieved

In order to be able to transmit forces and torques between the fitted elements, the assemblies shall, when tested in accordance with 4.1.2, withstand an axial force F for 30 s without any displacement between one element and another.

This force F shall be as specified by the designer of the element to be fitted.

Unless otherwise specified by the designer, the value of the force F in MN for wheels shall be:

$$F = 4 \times 10^{-3} dm$$

$$\text{when } 0.8 dm < L < 1.1 dm$$

where:

dm is the mean diameter of the seat in mm; and

L is the length of the fitting in mm.

4.1.2 Test method

The test shall be carried out on a press equipped with a device to record forces.

The force shall be applied gradually up to F between one of the faces of the fitted component hub and the axle.

For press-fitted wheels, the test shall be carried out at least 48 h after fitting.

For shrink-fitted wheels, the test shall be carried out when the wheels and axle have returned to the same temperature after the fitting.

For shrink-fitted wheels where the wheel is used to retain the bearing, the test shall be carried out before the final location of the wheel (e.g. within 10 mm of final position of the wheel) (see note).

NOTE This is to prevent the bearing being affected by the heated wheel prior to the mechanical resistance test and then prior to the subsequent final press assembly.

4.2 Fatigue characteristics

4.2.1 General

The rotational bending fatigue limit value shall be demonstrated for the approval process (see Annex C) to ensure the permissible axle seat stresses are achieved for application of BS 8535.

NOTE 1 These fatigue characteristics are not the same for a solid axle as for a hollow axle. This is the result of the axle bore effect on stress distribution.

The tests shall be carried out on machines capable of creating rotating bending stresses in the area where it is necessary to initiate a crack.

For each limit F_3 and F_4 , it shall be verified on three test pieces that no crack has appeared after 10^7 cycles of a load creating a surface stress equal to F_3 or F_4 .

NOTE 2 The fatigue limit F_4 is verified by testing during qualification. The fatigue limit F_5 can be calculated using the ratios $F_4/F_5 = 1.17$ and $F_3/F_5 = 1.276$.

NOTE 3 The fatigue characteristics F_1 and F_2 of the axle are specified in BS 8535.

4.2.2 Fatigue test pieces

4.2.2.1 The area of the test piece where any crack initiates shall have a geometry, environment and surface condition representative of the axle under consideration.

For the fatigue testing of a wheelset, one wheel or test piece with similar dimensions (particularly the hub) shall be press-fitted or shrink-fitted on the wheel seat. The interference shall conform to 3.2.

NOTE 1 It is not mandatory to use a wheelset as the test piece. An example test piece is shown in Figure 1 and Figure 2.

NOTE 2 This test piece is designed with a diameter ratio, $\varnothing$ wheel seat (185)/ $\varnothing$ body (171) of 1.08. This diameter ratio is chosen in order to ensure verification of the assembly against fatigue resistance of the wheelset. If ever cracks occur, they will appear on the wheel seat and not on the body. Higher diameter ratios (lower than 1.12) can be used for all steel grades in this British Standard, but there is a risk that the cracks appear in the body radius:

- *with high ratios, there is a risk that the cracks appear in the body radius;*
- *with low ratios, there is a risk that the required stress on the wheel seat might not be reached.*

This ratio value might not be valid for other steels not identified in this British Standard.

Figure 1 Drawing of the test piece geometry required for fatigue tests

