BRITISH STANDARD

BS 5892 :
Part 2 : 1992

Railway rolling stock materials

Part 2. Specification for forged and rolled wheel centres

Matériel roulant de chemin de fer
Partie 2. Corps de roues laminés ou forgés — Spécifications

Eisenbahnbetriebsmittel
Teil 2. Geschmiedete und gewalzte Radkörper

BSI STANDARDS

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Iron and Steel Standards Policy Committee (ISM/-) to Technical Committee ISM/69, upon which the following bodies were represented:

British Railways Board
British Steel Industry
London Underground Ltd.
Ministry of Defence
Railway Industry Association of Great Britain

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Contents

Foreword

This Part of BS 5892 was prepared under the direction of the Iron and Steel Standards Policy Committee and supersedes BS 5892 : Part 2 : 1987, which is withdrawn. BS 5892, which covers railway rolling stock material, is published in the following six Parts.

Part 1 Specification for axles for traction and trailing stock

Part 2 Specification for forged and rolled wheel centres

Part 3 Specification for monobloc wheels for traction and trailing stock

Part 4 Specification for forged and rolled tyres

Part 5 Specification for steel bars for retaining rings for tyred wheels

Part 6 Specification for wheelsets for traction and trailing stock

The format of this Part of BS 5892 has been revised to incorporate the requirements for dimensional tolerancing for wheel centres which were previously included in BS 5892 : Part 6. This Part of BS 5892 is related to ISO 1005-4; however, it has not been possible to obtain equivalence. It is also related to UIC 812-1.

BS 5892 : Parts 1, 3, 4 and 6 have also been revised to ensure consistency with the requirements of this Part.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

Enquiries as to the availability of third party certification schemes will be forwarded to BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Specification

1 Scope

This Part of BS 5892 specifies requirements for the manufacture, inspection and testing of forged and/or rolled wheel centres in the unmachined, part machined or ready for assembly condition for traction and trailing stock. This Part of BS 5892 includes requirements for the dimensions, tolerances, and surface finish that are to be adopted unless otherwise specified in the design drawing.

NOTE. The titles of the publications referred to in this Part of BS 5892 are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 5892 the following definitions apply.

2.1 unmachined

Condition of a wheel centre that is forged and/or rolled having undergone no machining operation but is in the heat treatment condition specified (see **4.2**).

2.2 part machined

Condition of a wheel centre that is finish machined with the exception of the bore and the rim section.

2.3 ready for assembly

Condition of a wheel centre that has received all machining operations required for assembly.

2.4 normal speed

Operational speed up to and including 200 km/h.

2.5 high speed

Operational speed greater than 200 km/h.

3 Information to be supplied by the purchaser

The following information to be supplied by the purchaser in the enquiry and order shall be fully documented:

(a) the number of this British Standard, i.e. BS 5892 : Part 2;

(b) a fully dimensioned drawing of the wheel centre;

(c) the type of heat treatment required (see **4.2**);

(d) the degree of finish (see **4.3**);

(e) the type of inspection quality assurance system required (see clause **7**);

(f) whether a statement giving the cast analysis and/or results of mechanical or other tests is required (see clause **12**);

(g) whether any special marking is required (see clause **6**);

(h) the method of protection against corrosion and mechanical damage (see clause **13**).

4 Classification and heat treatment

4.1 Grade of steel

The steel used in the manufacture of wheel centres shall have the composition given in table 1.

4.2 Heat treatment condition

The wheel centres shall be supplied in one of the following conditions (see item (c) of clause **3**):

(a) untreated, which shall be designated by the letter U;

(b) normalized or normalized and tempered, which shall be designated by the letter N.

4.3 Degree of finish

Wheel centres shall be supplied in one of the following degrees of finish (see clause **2** and item (d) of clause **3**):

(a) unmachined;

(b) part machined;

(c) ready for assembly.

5 Manufacture

5.1 Steelmaking

The wheel centres shall be made from steel produced by the electric process or the basic oxygen process.

The steel shall be killed in the furnace or in the ladle and treated to ensure that the finished wheel centres have a grain size of 5 to 8 as determined by the method in appendix F of BS 4490 : 1989. Ingots shall be bottom poured.

5.2 Manufacture of wheel centres

The wheel centres shall be hot forged and/or rolled from one of the following:

(a) ingots; or

(b) rolled or forged bars; or

(c) continuously cast bars.

Table 1. Chemical composition

Cast composition									
C max.	Si max.	Mn max.	P max.	S max.	Cr max.	Cu max.	Mo max.	Ni max.	V max.
%	%	%	%	%	%	%	%	%	%
0.33	0.40	0.90	0.05	0.05	0.30	0.30	0.15	0.40	0.05

All feedstock materials shall be inspected to ensure that visible defects are removed prior to the manufacture of wheel centres. The ingot or bar sections shall be rough shaped and punched using a forging hammer or press and finally shaped by forging or rolling.

Precautions shall be taken during hot working to ensure that material is not damaged by overheating or by grain growth due to high finish working temperatures.

NOTE. Generally, forging should not be done at temperatures above 1260 °C and should terminate between 850 °C and 1000 °C.

The manufacturer shall carry out a post-rolling treatment on wheel centres to ensure freedom from the formation of hydrogen cracks (flakes).

5.3 Appearance

The wheel centres shall be free from forging or rolling defects. The surface shall not show any mark other than those specified in clause **6** (see also **5.7**).

5.4 Identification of the wheel centres during manufacture

All ingots, rolled bars, concast bars and forged wheel centres shall be marked at each stage of manufacture so that before delivery each wheel centre can be identified as specified in clause **6**. Where the identification marks are stamped, and differ from the final identification marks specified in clause **6**, they shall not be visible on the finished wheel centre after machining.

5.5 Heat treatment

When heat treatment is specified (see item (c) of clause **3**), the heat treatment operations shall be carried out at a uniform temperature so as to ensure uniformity of structure of comparable parts of the same wheel centre and of wheel centres from the same batch (see **8.2**). Details of temperatures and times shall be recorded and shall be available for inspection by the purchaser.

5.6 Dimensions

Unless otherwise specified by the purchaser, the machining allowances and dimensional tolerances shall be those given in tables 2 and 3 (see also figures 1 and 2).

Table 2. Machining allowances and dimensional tolerances

Part	Designation	Symbol for machining allowance	Symbol for dimension	Unmachined		Part machined		Ready for assembly
				Machining allowance	Tolerance	Machining allowance	Tolerance	Tolerance
				mm	mm	mm	mm	mm
Rim	External diameter	A	a	5	+12 −0	3	+2 −0	+0.2 −0
	Width	B	b	5	+8 −0	3	+2 −0	+0 −0.5
	Internal diameter	C	c_1, c_2	3	+0 −10	—	+3 −3	+0 −6
Hub	External diameter	D	d_1, d_2	8	+20 −0	—	+5 −5	+5 −5
	Length	E	e	10	+10 −0	3	+2 −0	+3 −0
	Internal diameter	F	f	12	+0 −20	5	+0 −3	1), 2)
Web	Thickness at the connection with the rim	G	g	5	+10 −0	—	+5 −0	+5 −0
	Centre position	H	h	5	+10 −0	—	+5 −0	+5 −0
	Thickness at the connection with the hub	I	i	6	+10 −0	—	+5 −0	+5 −0

1) The tolerance on diameter and the interference value to ensure the required fit on the axle should be sufficient to comply with BS 5892 : Part 6.

2) See also table 3.

Table 3. Ready for assembly surface finishes and dimensions

Designation	Surface finish max.	Dimension
	μm	mm
Radius at axle bore entry end	—	3
Hub bore	3.2[1]	—
Hub end faces	12.5	—
Hub end face (bearing surface)	1.6	—
Cylindricity of hub bore[2]	—	0.03
Cylindricity of rim[2]	—	0.4
Rim	3.2	—

[1] Minimum sampling length is 8 mm.

[2] Cylindricity is as defined in BS 308 : Part 3.

NOTE. In the ready for assembly condition, whilst every effort should be made to ensure size conformity, it is permissible, unless otherwise specified, for the internal hub bore dimension to be tailored to a specific axle. However, the maximum size deviation from the drawing should be no more than 0.5 mm such that in all instances the assembly requirements specified in BS 5892 : Part 6 are achieved.

The bore of the wheel centre shall be perpendicular to the plane of the wheel and concentric with the rim within the run-out requirements of the finished assembly as defined in BS 5892 : Part 6.

The bore shall not have a lead-in taper.

Provision shall be made for wheel centre removal by means of the oil injection method. The oil groove and the injection hole parameters shall be in accordance with figure 2. The edges of the oil groove and the oil injection holes shall be blended out to remove sharp corners.

5.7 Removal of surface defects

Rectified surfaces shall have no heat cracking and be within specified tolerances and surface finishes and be smoothly blended into the surrounding area.

Magnetic particle inspection shall be used to ensure that the defect is completely eliminated.

Rectification by welding, chemical deposition of metal, metal spraying or by use of local heating shall not be carried out.

6 Manufacturer's brand marks

Unless the purchaser indicates that special marking is required (see item (g) of clause 3) each wheel centre shall be identified by the manufacturer with stamp marks in the position shown in figure 3. The markings shall include the following:

(a) the number of this British Standard, i.e. BS 5892-2[1];

(b) the manufacturer's mark;

(c) the cast number;

(d) the heat treatment condition, U or N;

(e) the date of manufacture (month and last two figures of the year of production);

(f) the inspector's mark.

7 Inspection

The inspection of wheel centres shall be undertaken in one of the following ways (see item (e) of clause 3):

(a) by the purchaser or his nominated representative, who shall inspect the wheel centres ordered and witness any of the tests; or

(b) by delegation of the responsibility for the inspection by the purchaser to the manufacturer; or

(c) within the application of a quality assurance system (see BS 5750 and the foreword).

8 Type and number of tests

8.1 Type of test

The type and number of tests to be carried out shall be in accordance with table 4. The tests shall be made on wheel centres in the specified degree of finish (see item (d) of clause 3).

8.2 Test unit, subdivision into batches and number of test pieces

The test unit for the various types of test shall be in accordance with table 4. For the purpose of testing, the wheel centres shall be grouped in batches. Each batch shall comprise wheel centres produced from the same cast and having undergone a similar heat treatment, if applicable.

[1] Marking BS 5892-2 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

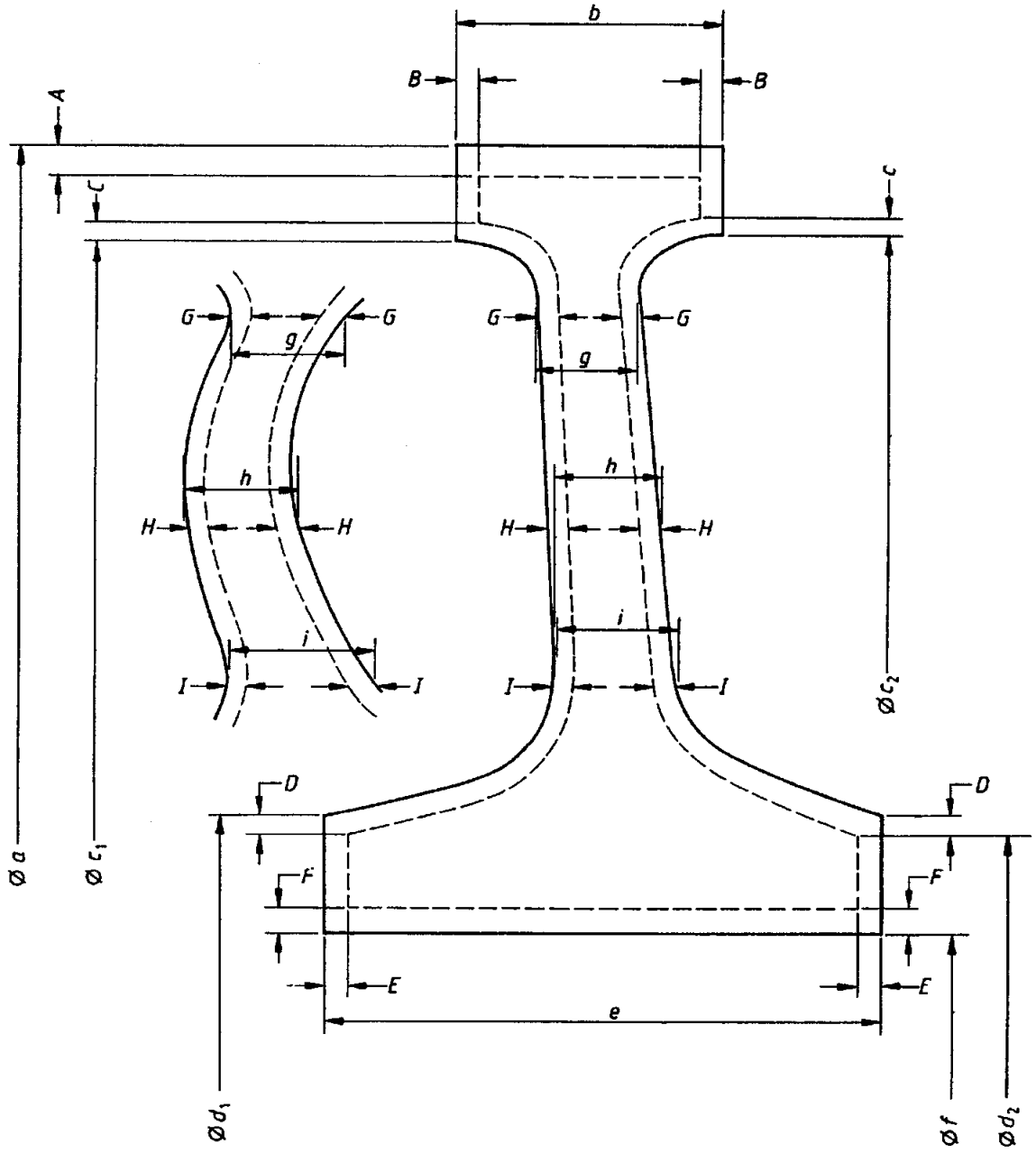
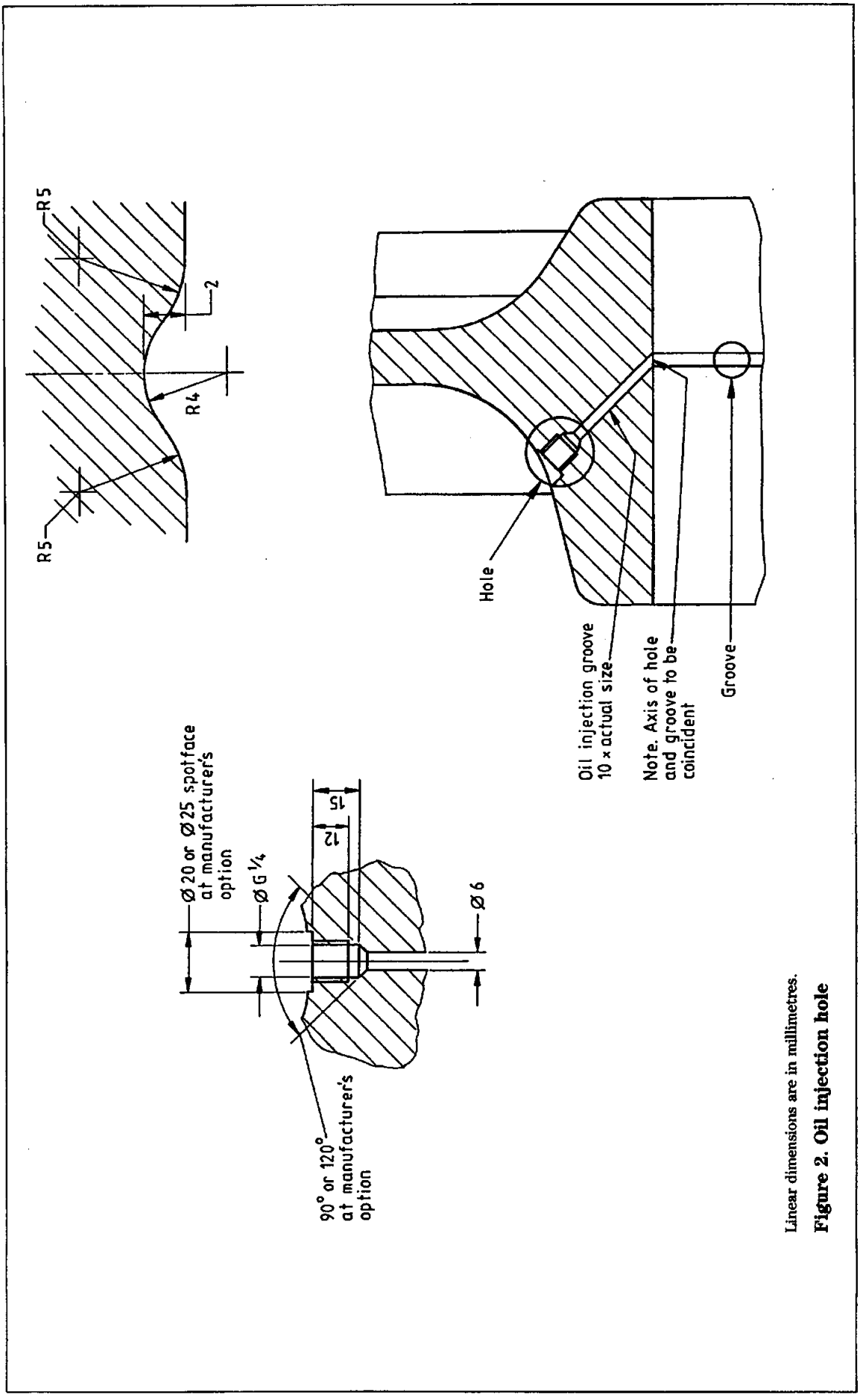
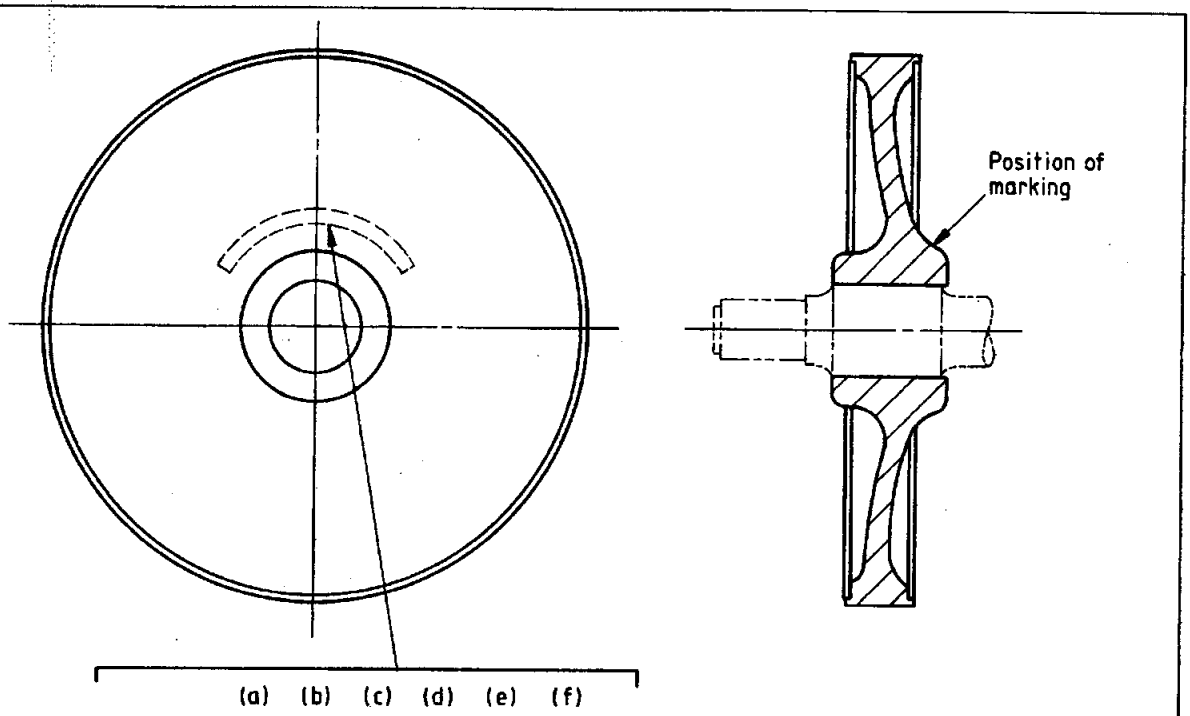


Figure 1. Key to the symbols used in table 2



Linear dimensions are in millimetres.

Figure 2. Oil injection hole



(a) The number of this British Standard, i.e. BS 5892-2;

(b) the manufacturer's mark;

(c) the cast number;

(d) the heat treatment condition, U or N;

(e) the date of manufacture (month and last two figures of the year of production);

(f) the inspector's mark.

Figure 3. Position of brand marks on wheel centres

Table 4. Type and number of tests

Requirements	Test unit	Number of wheel centres per batch to be subjected to the checks and tests for batches of	
		Up to 250	Over 250
Cast chemical analysis	s	—	—
Tensile test	ch	1	2
Dimensions and appearance	All	100 %	100 %
Surface finish	All	100 %	100 %

Key

s signifies steel from the cast;

ch signifies wheel centres from the same cast having undergone a similar heat treatment (see 8.2);

All signifies that every wheel centre is a test unit

NOTE. It is permissible to include wheel centres of different size and shape within a batch.

The number of wheel centres per batch to be subjected to the tests, the number of tests per wheel centre and the condition of the wheel centres when submitted for testing, shall be in accordance with table 4.

8.3 Sampling and preparation of samples and test pieces

8.3.1 *General*

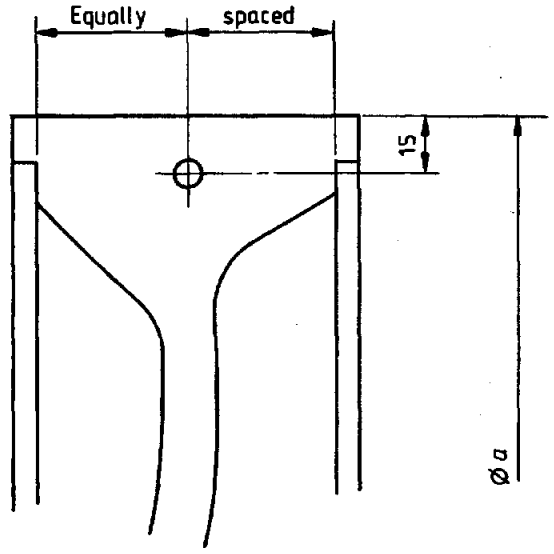
The axle(s) intended for testing, selected at random from the batch, shall be identified by indelible stamping.

This identification shall be maintained throughout testing (see 5.4).

8.3.2 *Tensile test*

One test piece shall be selected from the sample wheel centre at the position shown in figure 4.

The test piece shall be prepared in accordance with BS EN 10002-1.



Dimension is in millimetres.

Figure 4. Position and direction within wheel centre rim of tensile test piece

8.4 Surface condition

The manufacturer shall carry out surface condition checks to ensure that the wheel centres are in accordance with table 3.

8.5 Dimensional checks

The manufacturer shall carry out dimensional checks to ensure that the wheel centres are in accordance with tables 2 and 3.

9 Test methods

9.1 Chemical analysis

NOTE. It is permissible to use any recognized method for the determination of cast analysis.

In cases of dispute the analysis shall be carried out in accordance with BS 6200.

9.2 Tensile test

The tensile test shall be carried out in accordance with BS EN 10002-1.

9.3 Checking of surface condition

Machined surfaces shall be assessed for surface finish using the methods given in BS 1134 : Part 1 or by the use of comparison specimens (see BS 2634 : Part 1).

9.4 Checking of dimensions

The dimensional checks shall be carried out using appropriate measuring instruments forming part of a measurement and calibration system in accordance with BS 5781.

10 Test results

10.1 Chemical analysis

The cast composition shall be as stated in table 1.

10.2 Mechanical properties

The tensile properties determined on test pieces prepared in accordance with **8.3.2** and tested in accordance with **9.2** shall be in accordance with the values given in table 5 for the appropriate condition.

Table 5. Heat treatment condition and mechanical properties

Heat treatment in delivery condition (see note)	Tensile strength R_m	Elongation A min.[1]
	N/mm^2	%
U	500 to 650	18
N	520 to 650	20

[1] A is the percentage elongation after fracture on gauge length $L_o = 5.65\sqrt{S_o}$, where S_o is the original cross-sectional area of the test piece.

Key

U denotes untreated (as rolled);

N denotes normalized or normalized and tempered (see **4.2**)

10.3 Surface condition

The degree of finish of the machined areas of each axle shall be in accordance with table 3. The machined areas shall be free from any mechanical bruising, corrosion or electrical damage.

10.4 Dimensions

The dimensions shall be as specified on the drawing and the tolerances shall be as specified in tables 2 and 3.

10.5 Retests

If the tensile test fails to comply with **10.2**, twice the original number of test pieces shall be selected for retesting, at least one of which shall be taken from the wheel centre from which the original test sample was taken, unless that item has been withdrawn by the manufacturer. The mechanical properties obtained from the test pieces prepared from the further test samples shall comply with **10.2**. Should any of the retests fail, the material represented shall be deemed not to comply with this Part of BS 5892.

The manufacturer shall have the right to heat treat or reheat treat the batch and to re-submit it for testing.

11 Conclusion of inspection

After final inspection all accepted wheel centres shall be stamped by the purchaser's inspector or the delegated authority to signify conformance. The inspector's marks shall be placed adjacent to the manufacturer's marks in accordance with item (f) of clause **6**.

12 Certification

If required (see item (k) of clause **3**), the manufacturer shall supply a statement of the cast analysis of the steel and the results of the other tests, as required to indicate conformance with this Part of BS 5892.

Records of all tests shall be traceable to the cast and heat treatment batch (see **8.2**) and shall be available for examination.

13 Protection in transport

13.1 Protection against corrosion

After inspection, and before storage or despatch, all finished machined surfaces shall be protected against corrosion.

The method for protection shall be as specified by the purchaser (see item (h) of clause **3**).

NOTE. Applied protective coatings are only of limited life especially under conditions of sea transport or in geographical regions of high humidity. Therefore, the delivered wheel centres should be inspected, immediately on arrival at their destination, to determine whether a renewal of the protection is necessary.

13.2 Protection against mechanical damage

The finished machined portions, especially the bores of the wheel centres, shall be provided, before despatch, with protection against mechanical damage.

The method for protection shall be as specified by the purchaser (see item (h) of clause **3**).

Publication(s) referred to

BS 308	Engineering drawing practice Part 3 Recommendations for geometrical tolerancing
BS 1134	Assessment of surface texture Part 1 Methods and instrumentation
BS 2634	Specification for roughness comparison specimens Part 1 Specification for turned, ground, bored, milled, shaped and planed specimens
BS 4490	Methods for micrographic determination of the grain size of steel
BS 5750	Quality systems Part 1 Specification for design/development, production, installation and servicing Part 2 Specification for production and installation Part 3 Specification for final inspection and test
BS 5781	Measurement and calibration systems
BS 5892	Railway rolling stock materials Part 6 Specification for wheelsets for traction and trailing stock
BS 6200	Sampling and analysis of iron, steel and other ferrous metals
BS EN 10002	Tensile testing of metallic materials Part 1 Method of test at ambient temperature
ISO 1005-4[1)]	Railway rolling stock material — Part 4 : Rolled or forged wheel centres for tyred wheels for tractive and trailing stock — Quality requirements
UIC 812-1[1)]	Technical specification for the supply of forged or rolled wheel centres for tyred wheels for trailing stock; Quality prescriptions

[1)] Referred to in the foreword only.

BS 5892 :
Part 2 : 1992

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