

Specification for

Heavy rolling stock for mineral haulage in mines

Confirmed
January 2011

Co-operating organizations

The Colliery Requisites Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

- Association of Mining Electrical and Mechanical Engineers
- British Electrical and Allied Manufacturers' Association
- British Iron and Steel Federation*
- Federation of Associations of Colliery Equipment Manufacturers
- Institution of Electrical Engineers
- Institution of Mechanical Engineers
- Institution of Mining Engineers
- Mechanical Handling Engineers' Association
- Ministry of Power*
- National Association of Colliery Managers
- National Coal Board*

The Government department and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

- British Steel Founders' Association
- National Association of Drop Forgers and Stampers
- Pit Tub and Mine Car Manufacturers' Association

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Foreword

This standard makes reference to the following British Standards:

BS 4, *Structural steel sections — Part 1: Hot-rolled sections.*

BS 15, *Mild steel for general structural purposes.*

BS 18, *Methods for tensile of metals.*

BS 24, *Railway rolling stock material — Part 3A: Laminated springs and spring steel — Part 3B: Helical and volute springs and spring steels — Part 6: Steel slabs, plates, sections, bars and rivets for locomotive boilers, locomotives, carriages and wagons.*

BS 275, *Dimensions of rivets ($1\frac{1}{2}$ in to $1\frac{3}{4}$ in diameter).*

BS 639, *Covered electrodes for the manual metal-arc welding of mild steel and medium-tensile steel.*

BS 693, *General requirements for oxy-acetylene welding of mild steel.*

BS 729, *Zinc coatings on iron and steel articles.*

BS 970, *Wrought steels (Blooms, billets, bars and forgings).*

BS 1449, *Steel plate, sheet and strip.*

BS 1452, *Grey iron castings.*

BS 1473, *Wrought aluminium and aluminium alloys for general engineering purposes. Rivet, bolt and screw stock for forging.*

BS 1476, *Wrought aluminium and aluminium alloys for general engineering purposes. Bars and sections.*

BS 1477, *Wrought aluminium and aluminium alloys for general engineering purposes. Plate.*

BS 1663, *Higher tensile steel chain Grade 40 (short link and pitched or calibrated) for lifting purposes.*

BS 1806, *Dimensions of toroidal sealing rings ("O" seals and their housings).*

BS 1856, *General requirements for the metal-arc welding of mild steel.*

BS 2772, *Iron and steel for colliery haulage and winding equipment — Part 2: Wrought steel — Part 3: 1.5 percent manganese steel castings for mine car couplers.*

BS 2901, *Filler rods and wires for inert-gas arc welding — Part 1: Gas-shielded tungsten-arc welding — Part 2: Wires for gas-shielded metal-arc welding.*

BS 2994, *Cold rolled steel sections.*

BS 3019, *General recommendations for manual inert-gas tungsten-arc welding — Part 1: Wrought aluminium, aluminium alloys and magnesium alloys.*

BS 3032, *Higher tensile steel shackles.*

BS 3100, *Steel castings for general engineering purposes: which includes.*

BS 592, *Carbon steel castings for general engineering purposes.*

BS 1456, *$1\frac{1}{2}$ per cent manganese steel castings.*

BS 1457, *Austenitic manganese steel castings.*

BS 3134, *Dimensions of tapered roller bearings.*

BS 3571, *General recommendations for manual inert-gas metal arc-welding — Part 1: Aluminium and aluminium alloys.*

BS 3673, *Spring retaining rings — Part 1: Carbon steel circlips.*

This British Standard has been prepared under the authority of the Colliery Requisites Industry Standards Committee, with the purpose of stating principles of design and specifying certain major components of mineral haulage rolling stock (60–200 ft³ capacity), generally known as “mine cars”, in coal mines in the United Kingdom. The specification is complementary to BS 3237 (which deals with light and medium rolling stock of capacity below 60 ft³, for mineral haulage in mines) and it is designed to cover a range of heavy rolling stock incorporating suspension gear, couplers and buffing gear, and wheel and axle assemblies (embodying taper roller bearings); also ancillary equipment such as tippler and retarder brackets, and brakes. Drop bottom and side tipping types, and special purpose vehicles such as containers operating on restricted circuits, are excluded. However, it is recommended that components from this standard be utilized for such vehicles, where applicable.

Comprehensive dimensions for a range of 21 cars are given in Table 1 and the preferred sizes representing general colliery usage in the U.K. are indicated.

In preparing standard requirements for the complete vehicle, care has been taken to avoid detail that would unnecessarily restrict design. Hence, the specification for components deals mainly with design principles and basic requirements essential to a product of good quality.

No provision is made for nipples for the pressure greasing of wheels (Figure 4 and Figure 5); it is modern practice to grease the bearings during original assembly and only to renew the grease at planned maintenance periods.

Attention is drawn to the serious hazard inherent in the use of aluminium or aluminium alloy in incandive atmospheres, particularly in mines in which the use of lamps or lights, other than permitted lights, is unlawful.

NOTE Where metric equivalents have been given (see Appendix D), the figures in British units are to be regarded as the standard. The metric conversions are approximate. More accurate conversions should be based on the tables in BS 350, Part 1, “*Conversion factors and tables*”.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 40, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard provides specification of materials, basic design requirements and constructional details, including specifications for individual components, for heavy rolling stock of “solid bottom” design, with capacities within the range 60 to 200 ft³, having approximate tonnage capacities of 1½ to 5 tons of coal, or 3 to 10 tons of stone (see Clause 2). Vehicles are of the type employing resilient suspension and having loose wheels incorporating precision bearings.

The dimensions and other requirements of the main components are presented on a basis of alternatives permissible for each size/load combination, so that selection may be made to produce an overall design, made up of standardized parts, as required for particular purposes or service conditions. This standard provides for rolling stock designed to carry different kinds of bulk materials, such as metalliferous ores, as well as for rolling stock primarily designed for coal or stone.

Part 1. General requirements

2 Capacities

The standard provides for the following nominal capacities of rolling stock:

Volumetric capacities (nominal values)	Approx. equivalent payload capacities	
	Coal	Stone
ft ³	ton	ton
60	1 ¹ / ₂	3
80	2	4
100	2 ¹ / ₂	5
120	3	6
140	3 ¹ / ₂	7
160	4	8
200	5	10

NOTE Coal payload equivalents are based on a nominal 40 ft³ to the ton and stone at 20 ft³ to the ton, assuming “flush” loading in each case.

The average weight/bulk ratio of different materials varies and the exact payload of the vehicle should be determined from figures obtained locally.

3 Vehicle types and dimensions

Table 1 provides alternative dimensions for the vehicle, for each nominal capacity, to afford satisfactory selection for a given requirement.

4 Designation (car reference)

Designation of vehicles shall be on the following basis, to provide car reference numbers:

- The number of this British Standard, i.e. BS 4073, followed by:
- The appropriate car serial number from column (1) of Table 1, followed by:
- The relevant estimated capacity (ft³) from column (2) of Table 1, e.g. BS 4073/11/102.

5 General finish and protective coating

Unless otherwise specified by the purchaser, *a* all surfaces of the car shall be cleaned and have the scale removed; and *b*, two coats of white paint, approved by the purchaser, shall be applied outside, and one applied inside, the body.

6 Inspection

The manufacturer shall maintain and make available all relevant records of quality control, inspection and testing of the items concerned (including calibration certificates for testing machines) and, if requested, shall supply copies to the purchaser or his representative.

7 Marking

Marking additional to that specified in Clause 4 shall be at the option of the manufacturer or, alternatively, as agreed between manufacturer and purchaser.

Table 1 — Car dimensions

(1) Car serial number	(2) Estimated capacity	(3) Rail gauge	Body dimensions (external)			(7) Height above rail unladen)	(8) Length over engaged couplers	(9) Wheel base
			(4) Width	(5) Depth	(6) Length			
	ft ³	ft in	ft in	ft in	ft in	ft in	ft in	ft in
1	60	2 0	3 0	2 9	7 3	3 11 ³ / ₄	8 0	3 0
2	61	2 6	3 3	2 8	7 3	3 10 ³ / ₄	8 0	3 0
3 ^a	62	2 6	3 3	3 2	6 3	4 4 ³ / ₄	7 0	2 6
4	81	2 0	3 0	3 0	9 3	4 4 ³ / ₄	10 0	3 9
5	85	3 0	3 9	2 6	9 3	3 8 ³ / ₄	10 0	3 9
6 ^a	83	2 6	3 3	3 2	8 3	4 6 ³ / ₄	9 0	3 6
7	80	3 0	3 9	3 0	7 3	4 4 ³ / ₄	8 0	3 0
8	100	2 6	3 6	2 10	10 3	4 2 ³ / ₄	11 0	4 3
9	100	3 0	3 9	2 8	10 3	4 0 ³ / ₄	11 0	4 3
10	100	2 6	3 6	3 2	9 3	4 6 ³ / ₄	10 0	3 9
11	102	3 0	3 9	3 0	9 3	4 4 ³ / ₄	10 0	3 9
12 ^a	102	3 0	4 0	3 2	8 3	4 6 ³ / ₄	9 0	3 6
13 ^a	122	2 6	3 6	3 2	11 3	4 6 ³ / ₄	12 0	4 6
14	124	3 0	3 9	3 0	11 3	4 4 ³ / ₄	12 0	4 6
15	121	3 0	4 0	3 0	10 3	4 4 ³ / ₄	11 0	4 3
16	134	2 6	3 6	3 2	12 6	4 6 ³ / ₄	13 3	5 0
17 ^a	138	3 0	4 0	3 2	11 3	4 6 ³ / ₄	12 0	5 0
18	160	3 0	4 0	2 4	12 3	4 8 ³ / ₄	13 0	5 0
19	162	3 0	4 0	3 8	11 3	5 0 ³ / ₄	12 0	4 6
20	201	3 0	4 0	4 2	12 3	5 6 ³ / ₄	13 0	5 0
21	200	3 0	4 0	3 10	13 3	5 2 ³ / ₄	14 0	5 6

NOTES on Table 1

1. *Designation*

Details for compiling the designation, including car serial number are stated in Clause 4.

2. *Rail gauge*

For any car specified for a rail gauge of 2 ft 0 in or 2 ft 6 in, a rail gauge of 2 ft 3 in may be substituted, provided that the body width exceeds the rail gauge by at least 9 in and not more than 12 in.

Where any car is required to run on track having a rail gauge which is not included in Table 1, the width of the underframe should be suitably modified.

3. *Body dimensions*

When designing cars for a capacity between the standard values given in Table 1, the designer should use the dimensions of the nearest suitable standard design, and should adjust the depth only in order to provide the capacity required. Where *increase* in depth is necessary, this should not exceed 4 in, to ensure stability of the car. For the carriage of stone or ores, the standard dimensions of width and length may be used with a reduced dimension for depth, possibly one-half.

Where the top edge of the car body is bent inwards to accommodate external top edge stiffeners, the car capacities as given in Table 1 will be affected.

4. *Height*

The height given in column 7 is the distance from rail level to the top of the car when the car is unladen.

5. *Length over buffers/couplers*

See Figure 1 showing “engagement length” and “full overall length”.

The length over buffer couplers is the length over buffers with buffers and drawbars unstrained, or the length between engagement centres in the case of automatic couplings. The distance between two car bodies, when coupler faces are buffed together and the springs are unstrained, is a minimum of 9 in (see columns 7 and 9). Alternatively, in exceptional cases, e.g. wide cars on small radius curves, this distance may be 12 in or 15 in. For vehicles with automatic couplers, the maximum overall disengaged length shall not exceed the engagement length by more than 4¹/₂ in.

6. *Wheel base*

The wheel base shall be not less than 40 per cent of the body length indicated in column 6.

7. *Track*

Where the track involves small radius curves and steep gradients, details should be stated at the time of the enquiry and order. Care should be taken to ensure that the centre of gravity of the laden vehicle will be appropriate to prevent tipping or overturning.

^a Indicates car sizes representing general colliery usage in the United Kingdom.

Part 2. Bodies and underframes

Section 1. Bodies

8 General

Bodies shall be of basically rectangular shape and of flat bottom design and shall be welded or riveted, at the option of the purchaser.

Bodies shall be designed and constructed so that there are no sharp edges or projections liable to cause personal injury.

9 Materials

Bodies shall be generally of mild steel to BS 15¹⁾, but by agreement with the purchaser they may be of accepted corrosion and/or abrasion resisting steels; mild steel galvanized after manufacture; or of aluminium alloy. When aluminium alloys are used the plate shall comply with grade HP 30-WP or HP 30-W of BS 1477²⁾ and sections with grade HE 30-WP or HE 30-W of BS 1476³⁾.

Galvanizing shall conform to the requirements of BS 729⁴⁾, except that where an alternative thickness of coating is required, it shall be specified in the enquiry and order.

Electrodes for welding mild steel shall comply with the requirements of BS 639⁵⁾. Filler rods for welding aluminium alloys shall comply with BS 2901⁶⁾, either Part 1 or Part 2 according to the welding process.

Steel rivets shall comply with BS 15¹⁾. Aluminium alloy rivets shall be of material to grade HR 30-W of BS 1473⁷⁾.

10 Dimensions

The side, end and bottom plate thickness shall be not less than $\frac{3}{16}$ in. The dimension of angle sections shall conform to BS 4, Part 1⁸⁾.

11 Design and construction

a) **Basic design requirements.** The overall dimensions of the body, in relation to the rail gauge and wheel base, shall be such as to maintain stability when running on the track.

The interior of the body shall be free from wheel hoods, well bottoms and corrugations, except that where additional stiffness is required in the longer cars there may be incorporated single centrally disposed corrugations in the side plates.

At all corners, i.e. at the junction of any two planes, there shall be a minimum internal radius of $4\frac{1}{2}$ in.

b) **Construction.**

i) **Joints.** All joints shall be of the lap or butt welded type, appropriate to particular requirements, the laps being arranged to give maximum protection for user personnel, i.e. side plates shall be on the outside of the joint between sides and bottom, and on the outside of the joint between sides and ends. In welded construction the minimum amount of lap shall be 1 inch and, in riveted construction, equivalent to four times the rivet diameter.

¹⁾ BS 15, "Mild steel for general structural purposes".

²⁾ BS 1477, "Wrought aluminium and aluminium alloys for general engineering purposes. Plate".

³⁾ BS 1476, "Wrought aluminium and aluminium alloys for general engineering purposes. Bars and sections".

⁴⁾ BS 729, "Zinc coatings on iron and steel articles".

⁵⁾ BS 639, "Covered electrodes for the manual metal-arc welding of mild-steel and medium-tensile steel".

⁶⁾ BS 2901, "Filler rods and wires for inert-gas arc welding". Part 1, "Gas-shielded tungsten-arc welding"; Part 2, "Wires for gas-shielded metal-arc welding".

⁷⁾ BS 1473, "Wrought aluminium and aluminium alloys for general engineering purposes Rivet, bolt and screw stock for forging".

⁸⁾ BS 4, "Structural steel sections". Part 1, "Hot rolled sections".

ii) *Welded construction.* The assembled unit shall be arc welded in accordance with BS 1856⁹⁾ or BS 3019¹⁰⁾, Part 1 or BS 3571¹¹⁾, Part 1 as appropriate.

All welds, both inside and outside, shall be continuous and made with a single pass, the size of the fillet being equivalent to the thickness of the thinnest plate, at the joint.

iii) *Riveted construction.* The plates at the joint shall be firmly drawn together and held by the use of service bolts, there being a service bolt in every third or fourth hole. The pitch of rivets shall be not less than four times the rivet diameter nor greater than 4 in plus four times the plate thickness. On work of this class it is the practice to use $\frac{1}{2}$ in diameter rivets conforming to BS 275¹²⁾ at a pitch of 4 in to $4\frac{1}{2}$ in. The holes for the rivets shall be punched or drilled and shall not exceed the diameter of the rivets by more than $\frac{1}{16}$ in. The rivets shall be heated uniformly without burning or excessive scaling and shall be of sufficient length to produce a head of the necessary size. The rivet heads inside the body shall be flattened in form and, where extra smoothness is required, they may be countersunk.

iv) *Reinforcement.* The body shall, at the top edge, be reinforced, by one of the following methods:

A. By unequal angle sections continuously welded to the inside, all the way round the body, by the toes of the angles, to form a triangular section, the wider flange being on the underside of the angle section. The welds shall be made with a single pass, the size of each weld being equivalent to the thickness of the plate. The size of the angle shall be normally in accordance with the following dimensions:

Capacity of car	Size of angle stiffener
60 ft ³ up to and including 80 ft ³	3 in $\times$ 2 in $\times$ $\frac{1}{4}$ in
above 80 ft ³ up to and including 200 ft ³	4 in $\times$ $2\frac{1}{2}$ in $\times$ $\frac{1}{4}$ in

By agreement between purchaser and manufacturer, the size of the angle may be varied to meet unusual conditions.

B. By folding over the body plates inwards to form an angular section equivalent in size to the appropriate dimensions given above, the wider flange being on the underside and the edge continuously welded.

C. By riveting a rolled steel flat or angle, of adequate strength, all round the outside of the body. Normally these stiffeners should not project beyond the width of the body, the size of the rivets being $\frac{1}{2}$ in diameter and pitched at approximately 6 in. This riveting procedure shall be as outlined for the riveting of joints in the body plates.

In any form of reinforcement of the top edge, adequate provision shall be made for continuation of the reinforcements at the vertical joints between the plates.

Section 2. Underframes

12 Materials

The materials shall be mild steel to BS 15¹³⁾, Grade 1. Longitudinal members shall be of standard channel section to BS 4¹⁴⁾, Part 1. Other components such as headstocks and intermediate cross members, coupler housings, tippler and retarder brackets, and horn guides shall be formed from rolled steel channel or angle to BS 4¹⁴⁾, Part 1, or of cold rolled steel section to BS 2994¹⁵⁾, or of suitable pressed mild steel section.

Welding electrode materials shall be as specified for the body.

Where false axles are required, they shall be of solid round section steel having a tensile strength within the range of 35/40 tonf/in², except that in special cases they may be of rolled steel channel to BS 4¹⁴⁾, Part 1, or of other suitable form.

⁹⁾ BS 1856, "General requirements for the metal-arc welding of mild steel".

¹⁰⁾ BS 3019, "General recommendations for manual inert-gas tungsten-arc welding". Part 1, "Wrought aluminium, aluminium alloys and magnesium alloys".

¹¹⁾ BS 3571, "General recommendations for manual inert-gas metal-arc welding". Part 1, "Aluminium and aluminium alloys".

¹²⁾ BS 275, "Dimensions of rivets ($\frac{1}{2}$ in to $1\frac{3}{4}$ in diameter)".

¹³⁾ BS 15, "Mild steel for general structural purposes".

¹⁴⁾ BS 4, "Structural steel sections". Part 1, "Hot-rolled sections".

¹⁵⁾ BS 2994, "Cold rolled steel sections".

13 Design and construction

a) **Basic design requirements.** The underframes shall be of rigid welded design, suitable for carrying the maximum payload imposed by the respective body capacities, and shall be suitable for adequately absorbing, without permanent deformation, the severe forces imposed upon them in normal service. The principal load carrying members are the longitudinal members referred to as “solebars”; the size of channel section shall be based upon the load to be carried and shall take into consideration the type of suspension gear used (see Clause 26), also the type of coupling and buffing gear to be fitted (see Clause 28).

b) **Construction.** The underframe shall be of all-welded construction and built up from two rolled steel channel solebars, with suitable headstocks and crossbars positioned to suit coupling requirements and connecting the solebars and coupler housings. For cars above 80 ft³ capacity and up to and including 200 ft³, additional cross-members shall be positioned in the frame, the ends of the members being connected to the solebars. False axles shall be carried through their anchorage members, to provide mechanical interference between the mating parts such that the securing welds are relieved of shear stress when in operation.

Welding shall be carried out in accordance with BS 1856¹⁶⁾. All welds, where practicable, shall be made in the flat position, shall be continuous, and be of adequate strength to meet service conditions.

Tippler engagement and retarder brackets, where required, shall be securely fastened to the longitudinal members. (For details of the components, see Clause 37).

Where the suspension requires horn guides, these shall be securely welded to the underframe. The design of horn guides is subject to variation according to the type of suspension used. A typical illustration of horn guides for use with laminated springs, and/or rubber block springing, is shown in Figure 2 and Figure 3.

Mine cars which are to be mechanically engaged by rams, creepers or retarders shall be fitted with false axles located as near to the car axles as practicable. The false axles shall, where practicable, be welded directly to the outer horn guide brackets. Where the position of the false axles makes it impracticable to fix them to the horn guide brackets, suitable separate brackets shall be provided. False axles shall be positioned to give the specified minimum clearance between the underside of these members and the head of the rail, when the cars are unladen.

All components shall be accurately made to templates, and positioned in a locating jig, to ensure that other components such as wheels, axles and axle-boxes, and coupler units can be interchangeably fitted after welding operations have been carried out, also to ensure that any future replacements for these items can be fitted and that they will operate satisfactorily.

Section 3. Attachment of body to underframe

14 Method of attachment

Bodies shall be either welded or riveted to the underframes, at the option of the purchaser and, in either method of attachment, the joint formed shall be of adequate strength in relation to the pulling and buffing loads likely to be met in service.

a) **Welding.** Welding electrode materials shall be as specified for the body.

The operation of welding shall be performed in the flat position, and the welds shall be of the fillet type, the size of the fillet being equivalent to the thickness of the body bottom plate. Welding shall be carried out in accordance with BS 1856¹⁶⁾, or BS 3019¹⁷⁾, Part 1, or BS 3571¹⁸⁾, Part 1, as appropriate.

At the discretion of the manufacturer, or as required by the purchaser, welds may be continuous or intermittent, being evenly positioned along the edges of the solebars, headstocks and crossbars, to spread the shearing stresses set up in service.

¹⁶⁾ BS 1856, “General requirements for the metal-arc welding of mild steel”.

¹⁷⁾ BS 3019, “General recommendations for manual inert-gas tungsten-arc welding”. Part 1, “Wrought aluminium, aluminium alloys and magnesium alloys”.

¹⁸⁾ BS 3571, “General recommendations for manual inert-gas metal-arc welding”. Part 1, “Aluminium and aluminium alloys”.

b) **Riveting.** Steel rivets shall comply with BS 15¹⁹⁾ and be of a diameter not less than $\frac{5}{8}$ in; the holes in the body and frame shall be not more than $\frac{1}{16}$ in greater than the rivet diameter.

The rivets shall be positioned along the solebars, headstocks and crossbars to spread the shearing stresses set up by the pulling and buffing impacts met in service.

The rivet heads may have a flattened form inside the body, or may be countersunk, at the option of the purchaser.

c) **Angle cleats.** If preferred, the body may be attached to the frame by means of angle cleats welded or riveted to the body and riveted to the webs of the frame channel members.

d) **Insulation — aluminium/steel.** Where an aluminium alloy body is to be attached to a mild steel underframe, these components shall be insulated from each other to avoid galvanic corrosion. Steel rivets shall be used and, before riveting, the holes in the aluminium alloy members shall be treated with a suitable insulating material, such as a phosphoric acid type etch primer. After the rivet has been driven, the head of the rivet and surrounding metal shall be thoroughly cleaned and coated with insulating material.

¹⁹⁾ BS 15, "Mild steel for general structural purposes".

Part 3. Wheels and axles

Section 1. Wheels

15 Materials and mechanical properties

- a) **Cast wheels.** The materials for castings shall be selected from the range specified below:
- i) *Carbon steel castings:* BS 592²⁰⁾, Grade C.
 - ii) *Pearlitic manganese steel castings:* BS 1456²⁰⁾, Grade B.
 - iii) *Austenitic manganese steel castings:* BS 1457²⁰⁾, (11 per cent manganese, minimum. Initial hardness 229 HB maximum).

Where mechanical tests²¹⁾ are required, they shall be specified by the purchaser, at the time of enquiry and order: test pieces shall be cast separately from, but heat-treated with the castings they represent.

- b) **Forged wheels.** The materials for forgings shall be selected from the range specified below:
- i) BS 970²²⁾; 080A35, 080A37, 080A40, 080A42 or 080M46, for wheels “as forged”, and having a tread profile hardness within the range 152/223HB.
 - ii) BS 970²²⁾; 080A40, for wheels through hardened and tempered, and having a hardness within the range 201/255HB.
 - iii) BS 970²²⁾; 080A32, for wheels locally hardened on the tread profile, and having a tread hardness within the range 201/255HB.

16 Dimensions and weights

The wheel diameter is the diameter measured at the root of the flange, i.e. where the tread meets the radius between tread and flange (see Figure 4 and Figure 5).

The dimensions of wheels shall comply with Figure 4 or Figure 5, as appropriate.

17 Heat treatment of cast wheels

- a) **Carbon steel and pearlitic manganese steel castings.** All castings shall be supplied suitably heat treated to give the required mechanical properties specified in the relevant standard. The method of heat treatment shall be at the discretion of the manufacturer, unless otherwise stipulated by the purchaser.
- b) **Austenitic manganese steel castings.** All castings shall be supplied in the heat treated condition, having been water quenched from a temperature of not less than 1 000 °C.

18 Fettling and dressing

All castings shall be properly fettled and dressed and all surfaces shall be satisfactorily cleaned for inspection purposes.

19 Freedom from defects

All castings shall be free from cracks and other injurious defects.

20 Rectification of castings

Minor defects which will not affect the mechanical strength or the performance of any wheel may be rectified by welding, where the manufacturer is able by so doing to provide a satisfactory casting.

²⁰⁾ Contained in the composite Standard BS 3100, “Steel castings for general engineering purposes”.

²¹⁾ For austenitic manganese steel, mechanical tests, where required, will be limited to bend tests, the details being agreed between purchaser and manufacturer.

²²⁾ BS 970, “Wrought steels (Blooms, billets, bars and forgings)”.

21 Eccentricity in the machined condition

The wheel tread profile shall be machined smooth. The eccentricity of the wheel tread, when rotated about the axle or journal centre shall not exceed ± 0.010 in²³⁾ when measured on radius.

22 Marking

Each wheel shall have the following information cast or forged in recessed characters of a size not less than $\frac{3}{8}$ in, in the back of the flange:

- i) The manufacturer's identification mark.
- ii) The letters "C", "PM", "M" or "F" to indicate carbon steel, 1.5 per cent manganese steel, austenitic manganese steel or forged steel respectively.

Section 2. Axles

23 Materials

- a) **Quality.** Axles shall be made from rolled or forged steel and shall have not less than the following mechanical properties:

Tensile strength	35 tonf/in ²
Elongation	13 per cent

A steel complying with BS 970²⁴⁾, 080M40 (normalized condition) is suitable for this purpose.

- b) When tests are required by the purchaser, this shall be stated in the enquiry and order. One per cent of the axle bars shall in such case be selected at random from the bulk, for testing purposes. Test pieces shall conform to BS 18²⁵⁾, Table 1 (gauge length = $5.65 \sqrt{S_0}$) and shall exhibit the above properties.

24 Dimensions

Axles shall comply with the dimensions stated in Figure 6.

Section 3. Wheel and axle assemblies

25 Wheel and axle assemblies

- a) **Wheel bearings.** The wheels shall be provided with tapered roller bearings of adequate capacity to withstand the axial and radial loads likely to be encountered in service. Dimensions and capacity ratings of a suitable range are given in Table 2 and Appendix A.

The bearings shall be packed with a suitable lime or lithium based grease.

Table 2 — Wheel, axle and bearing sizes

Total laden weight	Recommended wheel dia.	Axle dia	Journal dia.	Bearing		
				Bore	O/dia.	Abutment width
ton	in	in	in	in	in	in
5	12 or 14	2 $\frac{1}{2}$	2 $\frac{1}{4}$	2 $\frac{1}{4}$	4 $\frac{1}{4}$	1 $\frac{3}{32}$
4 $\frac{1}{2}$	12 or 14	2 $\frac{3}{4}$	2 $\frac{1}{2}$	2 $\frac{1}{2}$	4 $\frac{7}{16}$	1 $\frac{3}{16}$
6	14	3	2 $\frac{3}{4}$	2 $\frac{3}{4}$	4 $\frac{7}{8}$	1 $\frac{3}{16}$
7 $\frac{1}{2}$	14	3 $\frac{1}{4}$	3	3	5 $\frac{1}{2}$	1 $\frac{7}{16}$
9 $\frac{1}{2}$	14	3 $\frac{1}{2}$	3 $\frac{1}{4}$	3 $\frac{1}{4}$	5 $\frac{1}{2}$	1 $\frac{7}{16}$
11 $\frac{1}{2}$	14	3 $\frac{3}{4}$	3 $\frac{1}{2}$	3 $\frac{1}{2}$	6	1 $\frac{9}{16}$

²³⁾ In the case of austenitic steel to BS 1457 (contained in the composite standard BS 3100, "Steel castings for general engineering purposes"), the wheel tread profile shall be ground and this tolerance may be increased to ± 0.020 in.

²⁴⁾ BS 970, "Wrought steels (Blooms, billets, bars and forgings)".

²⁵⁾ BS 18, "Methods for tensile testing of metals".