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JIS E 4502-2 : 2001

**Axles for railway rolling stock—
Dimensional requirements**

ICS 45.040

Descriptors : railway vehicle components, axles, dimensional measurement

Reference number : JIS E 4502-2 : 2001 (E)

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Land, Infrastructure and Transport through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. By this establishment, **JIS E 4502 : 1989** was withdrawn and replaced by both Standards of **JIS E 4502-1** *Axles for railway rolling stock—Quality requirements* and **JIS E 4502-2** *Axles for railway rolling stock—Dimensional requirements*.

In this establishment, for the purpose of developing Japanese Industrial Standard harmonized with International Standard, the corresponding International Standard, **ISO 1005-9 : 1986** *Railway rolling stock material—Part 9 : Axles for tractive and trailing stock—Dimensional requirements* was entirely introduced, and in consideration of avoiding users' confusion being faced with the drastic revision of the conventional **JIS E 4502 : 1989** to which users have been used for the last ten and several years, the requirements of the conventional **JIS** are described as “items added” and “contents added” to the bare minimum of the range, enabling users to have a larger choice.

JIS E 4502 series contain the following parts.

JIS E 4502-1 *Part 1 : Axles for railway rolling stock—Quality requirements*

JIS E 4502-2 *Part 2 : Axles for railway rolling stock—Dimensional requirements*

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In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Axles for railway rolling stock— Dimensional requirements

Introduction This Japanese Industrial Standard specifies the dimensional requirements of axles for railway rolling stock as **JIS E 4502-2 : 2001** *Axles for railway rolling stock—Dimensional requirements* by reviewing the conventional **JIS E 4502 : 1989** *Axles for railway rolling stock* entirely from a view point of conforming with the corresponding **ISO** Standard.

The conventional **JIS E 4502 : 1989** consisted of one standard into which quality requirements and dimensional requirements are incorporated, but since the corresponding **ISO** Standard consists of two parts, **ISO 1005-3 : 1982** *Railway rolling stock material—Part 3 : Axles for tractive and trailing stock—Quality requirements* and **ISO 1005-9 : 1986** *Railway rolling stock material—Part 9 : Axles for tractive and trailing stock—Dimensional requirements*, as a result of promoting conformity with the International Standard system (adoption of International Standard drafting rules, introduction of part number system), the quality requirements and the dimensional requirements are specified.

1 Scope and field of application

1.1 This Standard specifies the following unless otherwise agreed between the manufacturer and the purchaser.

- a) The dimensional requirements⁽¹⁾ in the various stages, shown in Figure 1 (see Table 1) and Figure 2 (see Table 2), see also **5.1**.
- b) The surface roughness, shown in Figure 2 (see Table 3), see also **5.2**, of axles for tractive and trailing stock.

Note (1) The term “dimensional requirements” covers machining allowances, dimensional tolerances and tolerances of form and position.

1.2 The quality requirements for axles for railway rolling stock are given in **JIS E 4502-1**.

1.3 In addition to the requirements of this Standard, the general technical delivery requirements of **ISO 404 : 1992** *Steel and steel products—General technical delivery requirements* apply.

1.4 The dimensional requirements and surface finishes of heavy vehicle axles (i.e. exceeding 22 000 kg axle-load) or of axles for speeds under 100 km/h shall be subject to agreement between the purchaser and manufacturer at the time of enquiry and order.

Remarks : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are **IDT** (identical), **MOD** (modified), and **NEQ** (not equivalent) according to **ISO/IEC Guide 21**.

ISO 1005-9 : 1986 *Railway rolling stock material—Part 9 : Axles for tractive and trailing stock—Dimensional requirements (MOD)*

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For undated references, the latest editions of the standards indicated below shall be applied.

ISO/R 286 : 1900 *ISO system of limits and fits—Part 1 : General, tolerances and deviations*

ISO 404 : 1992 *Steel and steel products—General technical delivery requirements*

ISO 468 : 1982 *Surface roughness—Parameters, their values and general rules for specifying requirements*

ISO 1101 : 1983 *Technical drawings—Geometrical tolerancing—Tolerancing of form, orientation, location and run-out—Generalities, definitions, symbols, indications on drawings*

JIS B 0021 *Geometrical product specification (GPS)—Geometrical tolerancing—Tolerancing of form, orientation, location and run-out*

JIS B 0401-1 *ISO system of limits and fits—Part 1 : Bases of tolerances, deviations and fits*

JIS B 0601 *Surface roughness—Definitions and designation*

JIS B 0621 *Definitions and designations of geometrical deviations*

JIS E 4501 *Railway rolling stock—Design methods for strength of axles*

JIS E 4502-1 *Axles for railway rolling stock—Quality requirements*

JIS E 4504 *Wheelsets for railway rolling stock—Quality requirements*

3 Information to be supplied by the purchaser The purchaser shall supply the following information regarding dimensional and roughness requirements in his enquiry and order:

- a) the number of this Standard;
- b) a dimensioned drawing;
- c) in which speed range it is intended that the axle will operate, i.e. normal (*N*) or high speed (*H*);
- d) the degree of finish (see Clause 4);
- e) the dimensional requirements and surface finishes (see 1.4) and roughness values if they deviate from this Standard;
- f) the roughness values if R_y is to be used [see Table 3, Note (16)];
- g) if specific geometrical tolerances are required (see 5.1.3.2 and 6.1);
- h) if one of the optional verifications is required (see 6.1 and Table 2).

4 Terms for the degree of finish⁽²⁾ The various conditions of axle and stages of manufacture referred to in this Standard are given in 4.1 to 4.5.

4.1 Unmachined For forged or rolled axles, “unmachined” indicates the “black” axle with no subsequent machining other than that which may be carried out by the manufacturer to enable the axle to conform to the required standard.

4.2 Rough machined In accordance with **JIS E 4502-1**, “rough machined” indicates a condition in which the axle has received no final machining, but has been rough machined on all, or only certain portions, which have to be machined.

4.3 Half finished In accordance with **JIS E 4502-1**, “half finished” indicates a condition in which the axle has received final machining on certain portions which have to be machined and are considered as finished, whereas other portions are unmachined or rough machined.

4.4 Finished In accordance with **JIS E 4502-1**, “finished” indicates the axle condition in which all portions of the axle which are required, by the order or drawing, to be machined have undergone all machining operations other than those normally carried out by the wheelset manufacturer immediately before mounting the wheel on the axle, for example finishing of wheelseat.

4.5 Ready for assembly “Ready for assembly” indicates the axle condition in which all necessary machining operations have been carried out.

Note (2) As for terms of finish degree, there are definitions of terms used commonly at the time of enquiry and order. The terms of “rough-machined” and “half-finished” referred here correspond commonly to those of “material” or “half-finished” while the term of “finished” and “ready for assembly” correspond to that of “half-finished” or “finished”. The comparison table regarding these terms shall be as shown in Annex 1 (informative).

5 Requirements Unless otherwise agreed between the manufacturer and the purchaser, the following shall apply.

5.1 Dimensional requirements

5.1.1 For “unmachined” portions of axles, the dimensional requirements shall be as indicated on Figure 1 and in Table 1.

5.1.2 For “rough machined” and “half finished” portions of axles, the dimensional requirements shall be agreed between the manufacture and the purchaser at the time of enquiry and order.

5.1.3 For “finished” portions of axles (see 4.4) and for axles in the “ready for assembly” condition (see 4.5), the dimensional requirements shall be as indicated in Table 2 and in 5.1.3.1 and 5.1.3.2.

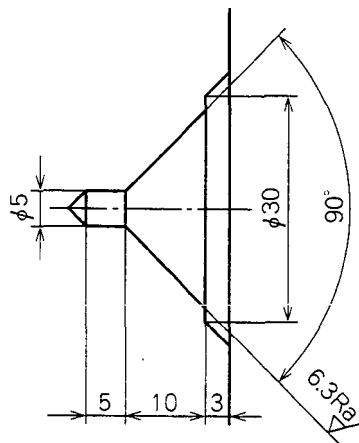
5.1.3.1 The manufacturer shall take care that for all relevant geometrical characteristics the tolerances are maintained such that, when the wheels are assembled on to the axles (see **JIS E 4504**) the tolerance values of the wheelset as required in **JIS E 4504** are achieved without further machining.

5.1.3.2 If in special cases, despite the difficulties mentioned in **6.1**, instead of the requirements of **5.1.3.1** specific geometrical tolerances of the axles are required for the compliance of the axle with the order, this shall be agreed at the time of enquiry and order. In this case, the geometrical tolerances shown in Table 2 shall apply, unless otherwise agreed.

5.2 Surface roughness Unless otherwise agreed, the arithmetic mean deviation of the profile, R_a , for machined surfaces in the “finished” and “ready for assembly” conditions shall be as indicated on Figure 2 and in Table 3.

5.3 Turning centers The axles shall, in “finished” and “ready for assembly” conditions, have turning centers machined in accordance with the purchaser’s order or drawing accompanying the order.

Unit : mm



Typical example of center hole

6 Inspection

6.1 Dimensional characteristics Where in Tables 1 and 2, last column, an “m” is indicated, the verification of the corresponding dimensional requirement is mandatory. Because of the practical difficulties of verification of certain dimensional values under production conditions, the dimensional characteristics for which an “o” is indicated in the last column of Table 2 shall only be verified if agreed between the manufacturer and the purchaser at the time of enquiry and order (see also **5.1.3.2**). Definition of the various geometrical tolerance terms are given in **ISO 1101 : 1983** or **JIS B 0021** and **JIS B 0621**.

6.2 Surface roughness If compliance with the requirements for the surface roughness is to be verified, the number of axles to be inspected and all other necessary details shall be agreed between the manufacturer and the purchaser at the time of enquiry and order.

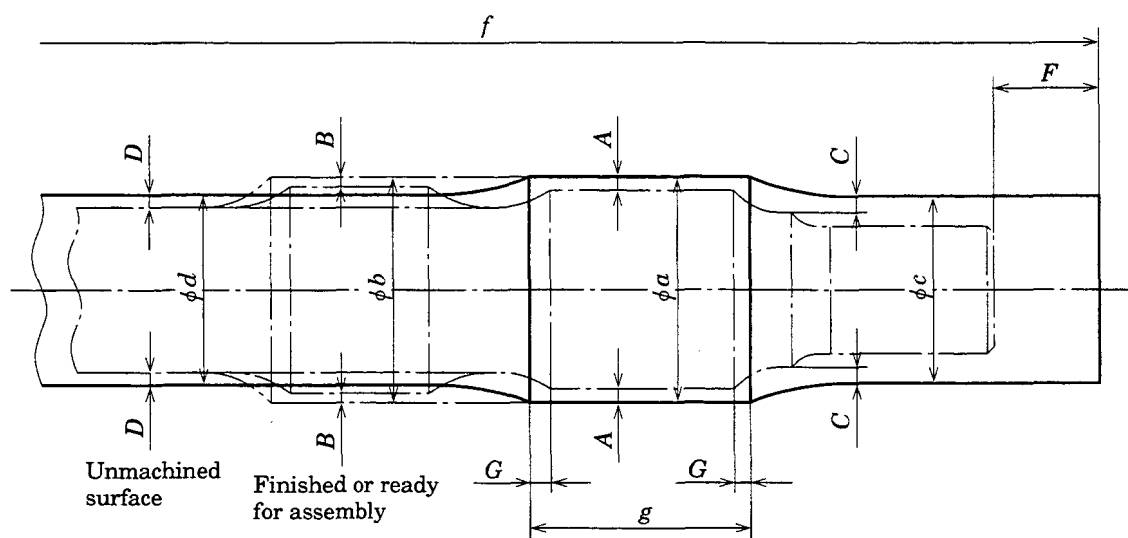


Figure 1 Symbols for dimensional characteristics, specified in Table 1 for unmachined portions of forged or rolled axles

Table 1 Dimensional requirements for “unmachined”⁽³⁾ forged and rolled⁽⁴⁾ axles

Designation	Symbol in Figure 1	Machining allowance (mm)	Tolerance (mm)	Verification ⁽⁵⁾
Wheel seat diameter	<i>A</i>	5 ⁽⁶⁾		m
	<i>a</i> ⁽⁷⁾		+15 0	m
Gear wheel seat diameter, motor suspension bearing seat diameter, etc.	<i>B</i>	5		m
	<i>b</i> ⁽⁷⁾		+15 0	m
Abutment and journal diameter	<i>C</i>	5		m
	<i>c</i>		+15 0	m
Axle body diameter	<i>D</i>	5		m
	<i>d</i>		+15 0	m
Length	<i>F</i>	15		m
	<i>f</i>		+140 0 ⁽⁸⁾	m
Wheel seat length (also other seats, for example gear wheel seat, motor suspension bearing seats)	<i>G</i>	20		m
	<i>g</i>		+30 0	m
Straightness ⁽⁹⁾				— ⁽⁹⁾

Notes ⁽³⁾ Term is defined in 4.1.

⁽⁴⁾ In the case of axles manufactured from rolled bars, the machining allowance and the tolerance value for symbols *A-a*, *B-b*, *C-c* and *D-d* are understood to apply to the larger diameter.

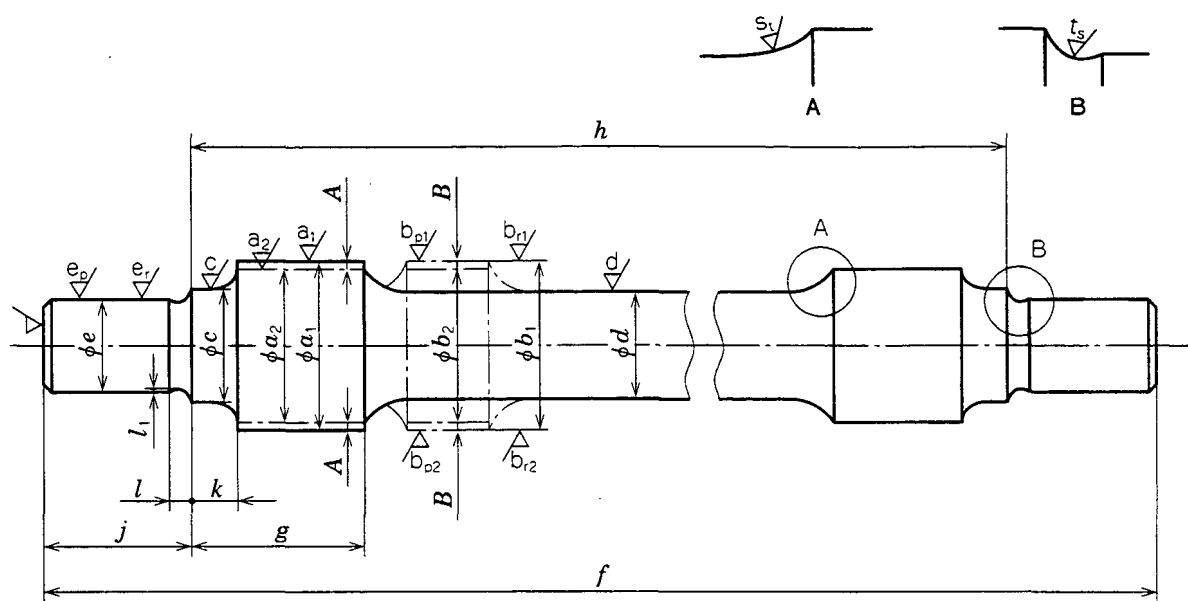
⁽⁵⁾ m is mandatory.

⁽⁶⁾ Where a provision for “oversize” wheel seats is required, the machining allowance should be increased by the appropriate amount; if the provision is required but the amount is not specified, the machining allowance shall be 10 mm.

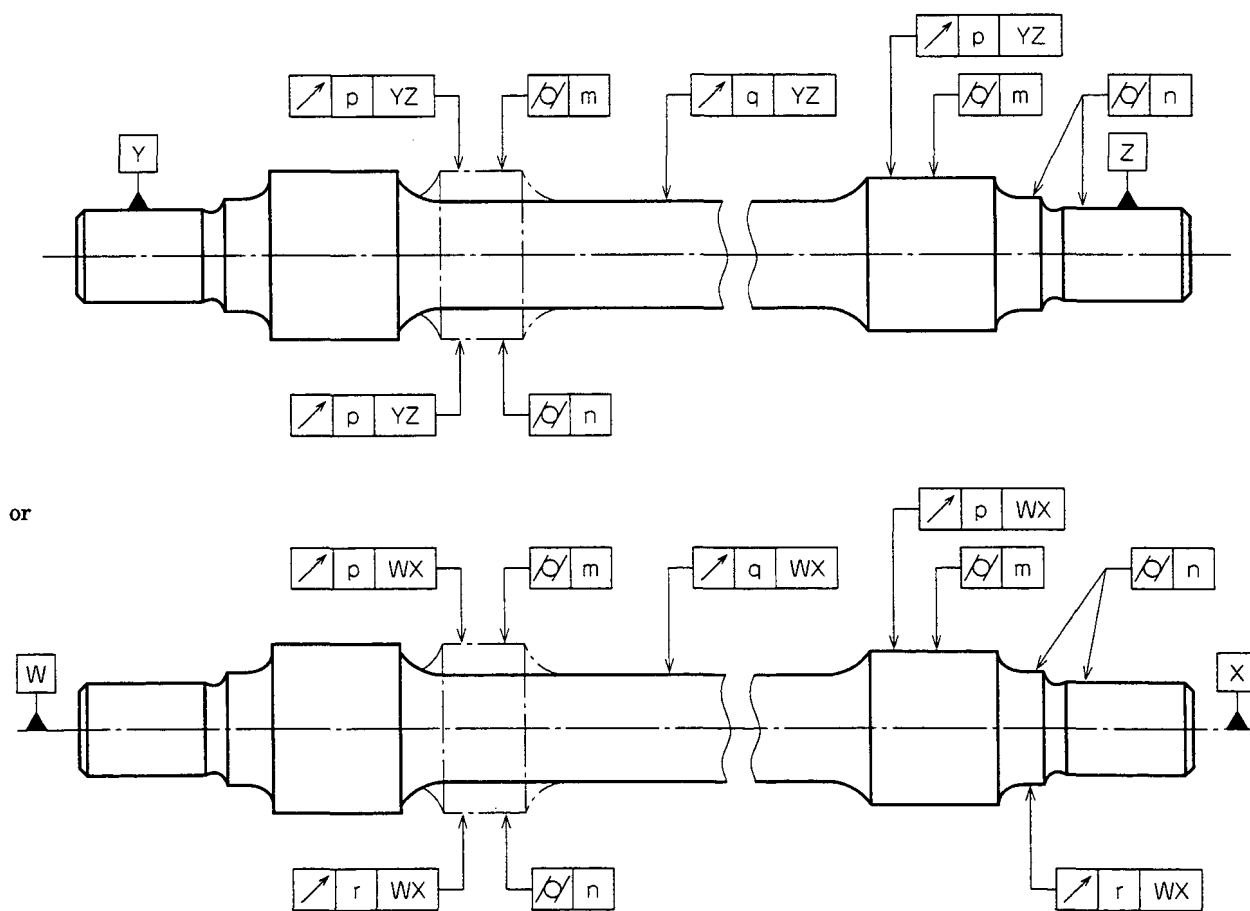
⁽⁷⁾ It is usual to forge the wheel seat and the gear wheel seat to the same diameter. In this case, the tolerance value is understood to apply to the large diameter only.

⁽⁸⁾ Normally “unmachined” axles are supplied with sawn ends, in this condition, the appropriate tolerance would be $^{+10}_0$.

⁽⁹⁾ The unmachined axle should, within the limitations of forging, be straight; in this condition, the accurate checking of this parameter is difficult and therefore no tolerance value for straightness is given. However, the manufacturer shall ensure that the unmachined axles are sufficiently straight to enable the finished axle to be produced from a rough forging, or rolling, to the minimum tolerance values given in the table.



a) Symbols for the dimensional characteristics and surface roughness for “finished” and for “ready for assembly” of axles



b) Geometrical tolerances relative to datum WX or YZ for “finished” and for “ready for assembly” of axles

Figure 2

Table 2 Dimensional requirements⁽¹¹⁾ for “finished” portions⁽¹⁰⁾ and for the condition “ready for assembly”⁽¹⁰⁾ of axles

Designation	Symbol in Figure 2 a) and b) for		Tolerances (mm)				Verifica- tion ⁽¹²⁾
			Finished		Ready for assembly		
	dimen- sional toler- ances	geo- metrical toler- ances	Normal speeds	High speeds	Normal speeds	High speeds	
Wheel seat diameter	a_1		$+2$ 0	$+2$ 0	—	—	m
	a_2		—	—	— ⁽¹³⁾	— ⁽¹³⁾	m
Gear wheel seat diameter, motor suspension bearing seat diameter, etc.	b_1		$+2$ 0	$+2$ 0	—	—	m
	b_2		—	—	— ⁽¹⁴⁾	— ⁽¹⁴⁾	m
Abutment diameter	c		± 0.25 ⁽¹⁴⁾	± 0.25 ⁽¹⁴⁾	± 0.25 ⁽¹⁴⁾	± 0.25 ⁽¹⁴⁾	m
Axle body diameter	d		$+2$ 0	$+2$ 0	$+2$ 0	$+2$ 0	m
Journal diameter (roller)	e_r		— ⁽¹⁴⁾	— ⁽¹⁴⁾	— ⁽¹⁴⁾	— ⁽¹⁴⁾	m
Journal diameter (plain)	e_p		± 0.1	—	± 0.1	—	m
Length of axle	f		± 1	± 1	± 1	± 1	m
Wheel seat length (including abutment; also other seats, for example gear wheel)	g		0 -1	0 -1	0 -1	0 -1	m
Length over abutments	h		± 0.5	± 0.5	± 0.5	± 0.5	m
Journal bearing seat length	j		± 0.5 ⁽¹⁴⁾	± 0.5 ⁽¹⁴⁾	± 0.5 ⁽¹⁴⁾	± 0.5 ⁽¹⁴⁾	m
Abutment length	k		$+1$ 0	$+1$ 0	$+1$ 0	$+1$ 0	m
Groove at journal to abutment transition (where applicable)	l		— ⁽¹³⁾	— ⁽¹³⁾	— ⁽¹³⁾	— ⁽¹³⁾	m
	l_1		— ⁽¹³⁾	— ⁽¹³⁾	— ⁽¹³⁾	— ⁽¹³⁾	
Wheel seat cylindricity (also motor bearing seats)		m	—	—	0.015 ⁽¹⁵⁾	0.015 ⁽¹⁵⁾	m
Journal and abutment cylin- dricity		n	0.015	0.015	0.015	0.015	m
Wheel seat run-out (also gear wheel seat) relative to datum WX or YZ		p	1.5	1.5	0.05	0.03	o
Axle body run-out relative to datum WX or YZ		q	0.5	0.3	0.5	0.3	o
Journal and abutment run-out relative to datum WX (also motor bearing seats relative to datum WX or YZ)		r	0.05	0.03	0.05	0.03	o

Notes ⁽¹⁰⁾ Terms as defined in 4.4 and 4.5.

- (¹¹) The machining allowance A on wheel seat (also B if gear wheel seat is required) to be 3 mm, i.e. $a_1 - a_2 = 6$ mm. For tractive stock, the machining allowance, A and B, on the wheel seat shall be 5 mm.
- (¹²) m is mandatory; o is optional.
- (¹³) According to the drawing and relevant documents (see **JIS E 4504** and **ISO/R 286 : 1900** or **JIS B 0401**).
- (¹⁴) According to the specification of the supplier of the bearings or customer.
- (¹⁵) Any slight taper within the permitted tolerance shall be such that the smaller diameter is at the outer end, i.e. entry to the bore of the wheel on assembly.

Table 3 Average surface roughness for “finished”(¹⁶) and “ready for assembly”(¹⁶) axles

Designation	Symbol [see Figure 2 a)]	Arithmetic mean deviation of the profile(¹⁷), R_a (μm)	
		Finished condition	Ready for assembly condition
Wheel seat diameter	a_1	$< 12.5^{(18)}$	—
	a_2	—	0.8 to 1.6(¹⁸)
Gear wheel seat or motor bearing (roller) seats	b_{r1}	0.8 to 1.6(¹⁸)	—
	b_{r2}	—	0.8 to 1.6(¹⁸)
Motor bearing (plain) seats	b_{p1}	$< 0.8^{(18)}$	—
	b_{p2}	—	$< 0.8^{(18)}$
Abutment diameter	c	$< 1.6^{(18)}$	$< 1.6^{(18)}$
Axle body diameter	d	$< 6.3^{(18)}$	$< 6.3^{(18)}$
Journal (roller)	e_r	$< 0.8^{(18)}$	$< 0.8^{(18)}$
Journal (plain)	e_p	$< 0.8^{(18)}$	$< 0.8^{(18)}$
Axle end face and chamfer	f	$< 6.3^{(19)}$	$< 6.3^{(19)}$
Inner transition radii to wheel seats	s_t	$< 1.6^{(18)(20)}$	$< 1.6^{(18)(20)}$
Stress relieving grooves	t_s	$< 0.8^{(18)}$	$< 0.8^{(18)}$

Notes (¹⁶) Terms as defined in 4.4 and 4.5.

- (¹⁷) If the maximum height of the profile, R_y , (see **ISO 468 : 1982** or **JIS B 0601**), is used, the values shall be agreed between the interested parties.
- (¹⁸) As measured in direction of longitudinal axis.
- (¹⁹) As measured in direction of vertical axis.
- (²⁰) For trailer axles, an arithmetical deviation of the profile $R_a \leq 3.2 \mu\text{m}$ may be applied with the agreement of the customer.