TC 17

International Standard ISO 1005/7

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Railway rolling stock material — Part 7 : Wheelsets for tractive and trailing stock — Quality requirements

Matériel roulant de chemin de fer — Partie 7 : Essieux montés pour le matériel moteur et pour le matériel remorqué — Prescriptions de qualité

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1005/7 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in May 1981.

It has been approved by the member bodies of the following countries :

Austria	Italy	Sweden
Belgium	Japan	Switzerland
China	Korea, Dem. P. Rep. of	Tanzania
Czechoslovakia	Korea, Rep. of	Turkey
Egypt, Arab Rep. of	Netherlands	United Kingdom
Germany, F.R.	Poland	USSR
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Iran	South Africa, Rep. of	
Israel	Spain	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Canada
France
USA

Printed in Switzerland

Railway rolling stock material — Part 7 : Wheelsets for tractive and trailing stock — Quality requirements

1 Scope and field of application

1.1 This part of ISO 1005 specifies the requirements for the assembly by press fitting or shrink fitting onto axles of solid wheels, wheel centres, wheel centres complete with tyres, axle-mounted brake discs, dynamo pulleys, gear wheels, chain wheels and any other components specified by the purchaser[1] into complete wheelsets.[2]

It also specifies the dimensions and tolerances of the completed assembly and the conditions of inspection and supply.

NOTE — In many cases, the operations by which the components are made ready for assembly, such as the final machining operations of the wheel seats of the axles and of the bores of the wheels and the mounting of the tyres on the wheel centres, are carried out by the wheelset manufacturer and are consequently to be regarded as a part of the manufacture of the wheelset. However, the specifications for these operations and for the condition "ready for assembly" of the different components are, for the sake of clarity, covered in greater detail in the relevant International Standards.

1.2 This part of ISO 1005 includes requirements for both tractive and trailing wheel sets for all railway applications and applies to wheelsets of the following types of wheelset components :

Type of axle :

Outside or inside journal bearings
Cylindrical (or conical)[3] wheel seats
Plain-axle body or with seats for gear wheels, traction motor suspension, dynamo pulleys, chain wheels, brake discs or any other axle-mounted component

Type of wheel :

Solid — rolled, forged or cast
Tyred with rolled, forged (or cast)[3] disc wheel centres, or with (cast) spoked-wheel centres[3]

Type of axle box bearing :

Plain or roller

Type of traction motor (or final drive) bearing :

Plain or roller

1.3 In addition to this part of ISO 1005, the requirements of ISO 404 are applicable.

2 References

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

ISO 404, *Steel and steel products — General technical delivery requirements.*

ISO 1005/1, *Railway rolling stock material — Part 1 : Rough-rolled tyres for tractive and trailing stock — Quality requirements.*

ISO 1005/2, *Railway rolling stock material — Part 2 : Rough tyres for trailing stock — Dimensions and tolerances.*[4]

ISO 1005/3, *Railway rolling stock material — Part 3 : Axles for tractive and trailing stock — Quality requirements.*

ISO 1005/4, *Railway rolling stock material — Part 4 : Rolled or forged wheel centres for tyred wheels for trailer stock.*[5]

ISO 1005/6, *Railway rolling stock material — Part 6 : Solid wheels for tractive and trailing stock — Quality requirements.*

1) Here and throughout the text of this part of ISO 1005, the "Purchaser" is understood to mean the "Railway Administration or its nominated representative".

2) For the purposes of this document, a wheelset is defined as the complete unit constituted by the assembly of an axle and two complete wheels together with any gear-wheels, dynamo pulleys, brake discs or bearings, etc., which may be specified by the purchaser.

3) Wheelsets with the characteristics given in brackets are rare. If such wheelsets are ordered, deviations from or additions to the requirements of this part of ISO 1005 may be necessary. Such deviations and additions should be given in the order or its appended documents.

4) At present at the stage of draft. (Revision of ISO/R 1005/2-1969).

5) At present at the stage of draft. (Revision of ISO/R 1005/4-1969.)

ISO 1101/1, *Technical drawings — Geometrical tolerancing — Tolerances of form and of position — Part 1 : Generalities, definitions, symbols, indications on drawings.*[1)]

NOTE — Pending publication of the above-mentioned revisions as International Standards, it will be necessary for the relevant requirements contained therein to be agreed by the manufacturer and the purchaser.

3 Information to be supplied by the purchaser

The following information shall be supplied by the purchaser, in his enquiry and order, which shall be accompanied by the relevant drawings :

3.1 Which category the wheelset falls into relative to dimensional characteristics (see 4.2.4 and table 3) :

3.1.1 Whether required for

a) tractive wheelset;

b) trailing wheelset — passenger stock;

c) trailing wheelset — freight stock.

3.1.2 Which range the wheelset maximum operating speed falls into

$v \leqslant 100$ km/h
100 km/h $< v \leqslant$ 120 km/h
120 km/h $< v \leqslant$ 160 km/h
160 km/h $< v \leqslant$ 200 km/h
200 km/h $< v$

3.1.3 Whether tolerance category Y or Z of table 3 shall apply (observe 4.2.4).

3.2 What other axle mounted components are to be assembled (see 1.2 and 4.1.1) and the methods and/or specifications to be used.

3.3 If cold-rolling of the axle is required, specifying which parts of the axle are to be cold-rolled, i.e. wheel seat, gearwheel seat, etc.[2)] Cold-rolling of any part of the axle should be restricted to steels A0 and A1 of ISO 1005/3.

3.4 Whether burnishing of plain bearing journals is required for either the axle box bearings, or traction motor bearings, or final drive bearings.[2)]

3.5 The method to be used for assembly of the wheels, wheel centres, or assembled wheel centres and tyres, onto the axle (see 5.2.3.2).

3.5.1 If press fitting is specified :

3.5.1.1 The range of interference between seats and bores (see 4.1.2) and the range of pressing-on force P_f (5.2.3.3.5).

3.5.1.2 Whether or not the interference values shall be recorded (see 6.3.1).

3.5.2 If shrink fitting is specified :

3.5.2.1 The range of interference between seats and bores (see 4.1.2) and value of proving thrust P_p (see 6.4.3.1).

3.5.2.2 Whether the proving thrust test may be waived totally or partially (see footnote 4 in table 4).

3.6 Whether or not machining of the treads is required (see 5.4).

3.7 Which identification marks are to be applied [see 4.2.5.1 a), e) and f)] and where these shall be positioned (see 4.2.5.2).

3.8 Responsibility for the different inspections (see 6.1 and table 4, column 5).

3.9 Whether the electrical resistance is to be measured (see 4.2.2 and table 4) and, if so, whether it is to be recorded.

3.10 If balancing is required (see 4.2.3 and table 4), specifying the type of balancing and, where necessary, the admissible unbalance (see 4.2.3.2 and 4.2.3.3).

3.11 Any additional or alternative tolerances to those given in table 3 (see 4.2.4).

3.12 If final painting or other permanent protection against corrosion is required, specifying details (see 5.8).

4 Requirements

4.1 Components

4.1.1 General

The components shall possess in the "ready for assembly" condition [see ISO 1005/2[3)]] all the characteristics necessary for safe service behaviour of the wheelsets. The requirements to ensure these characteristics shall be specified as far as possible by reference to the relevant International Standards given in table 1.

1) At present at the stage of draft. (Revision of ISO/R 1101/1.)

2) An International Standard dealing with cold-rolling and burnishing is in preparation.

3) Other International Standards dealing with this condition are in preparation.

4.1.2 Interference between seats and bores

For the interference between seats and bores, a range of values shall be agreed between purchaser and manufacturer. Unless otherwise agreed, this shall be such that, under the conditions for assembly given in 5.2, the requirements for the proving thrust test (see 4.2.1, table 4, and 6.4.3.1) are complied with and that the selected range lies within the upper and lower limiting curves given in figures 1a) and 1b).

NOTES

1 Figures 1a) and 1b) give some deviation and tolerance grades in accordance with ISO/R 286, which meet the requirements of 4.1.2. The values are also tabulated in table 2.

2 The choice of an appropriate interference value from the ranges in figures 1a) and 1b), to meet the conditions for the pressing-on force, is partly dependent on the range of elasticity of the two materials fitted together, on the lubricant used, on the design of the fitted parts, on the roughness of the fitted surfaces, on the press-fitting speed, etc. Therefore, specification of close tolerance ranges for both interference and pressing-on force may cause assembly difficulties.

4.2 Wheelset

4.2.1 Mechanical characteristics

When the proving thrust test is applied (see 6.4.3.1 and table 4), the wheels shall not show any displacement on the axle.

4.2.2 Electrical resistance

The electrical resistance of each wheelset shall not exceed 0,01 Ω when tested in accordance with 6.4.3.2.

4.2.3 Balancing

4.2.3.1 When balancing is required (see 3.10) the dynamic unbalance for trailing wheelsets for passenger stock shall, unless otherwise specified at the time of enquiry and order, not exceed the following values when tested in accordance with 6.4.3.3.

Maximum operating speed v	Maximum dynamic unbalance[1)]
km/h	gm
$v \leq 100$	–
$100 < v \leq 120$	125
$120 < v \leq 200$	75
$v > 200$	50

1) Per wheel measured at the tread.

4.2.3.2 For tractive wheelsets and trailing wheelsets for freight, values of dynamic unbalance may be agreed at the time of enquiry and order.

4.2.3.3 If in special cases (see table 4, footnote 7) static unbalance tests are required, the values to be complied with are to be agreed at the time of enquiry and order.

4.2.4 Dimensional characteristics

The dimensional characteristics of the wheelset shall be as specified in the order and its appended documents.

The tolerances for the dimensional requirements shall, as far as appropriate, be specified by reference to one of the tolerance categories given in table 3, taking into consideration the information given in the following note.

NOTE – The compilation of an International Standard for material, testing and dimensional requirements of assembled wheel sets and of wheelset components is difficult because of the different ways in which railways have developed, in both the commercial and the operating sense, in various parts of the world. These different forms of development are characterized, for example, by railway systems in which freight services are integrated with intensive and perhaps high-speed passenger services and systems largely dedicated to the haulage of freight. The infrastructures of these two systems are normally different and this and commercial policy can determine the practice adopted by them in wheelset design both in terms of materials and dimensional characteristics.

The relevant parts of ISO 1005 acknowledge, or will in a future revision acknowledge, these differences by providing in the relevant clauses two categories of material and related quality testing requirements designated as testing categories A and B and two tolerance categories for dimensional requirements designated as Y and Z.

Category A corresponds to the material and quality testing requirements given in the present editions of ISO 1005/3 and ISO 1005/6. Category B will be considered in the revision of ISO 1005/6 and perhaps also in ISO 1005/3. The most obvious difference between these categories A and B is for solid wheels that the mechanical properties are specified

- in the case of category A, on the basis of tensile and impact tests;
- in the case of category B, on the basis of hardness tests.

The differences between the values of the tolerance categories Y and Z are given

- for wheelsets in this International Standard (see especially table 3);
- for solid wheels in ISO 1005/8.

Until now, it was impossible to clarify in detail the conditions under which the one or the other testing and tolerance category is preferable. As a general guide it shall, however, be noted

- that the combination of testing category A with tolerance category Y is principally applied on railway systems where frequent or high-speed passenger operation is predominant or where freight and passenger services are intensively integrated and
- that the combination of testing category B and tolerance category Z is principally applied on railways systems where freight operation is predominant and where freight and passenger services are less integrated.

The final choice of the combination of categories is at the discretion of the purchaser.

4.2.5 Identifying marks

4.2.5.1 The components parts of the wheelsets shall bear the identifying marks indicated in the particular specifications for the individual components. In addition to this, the wheelsets shall be cold stamped with blunt edged stamps (avoiding

character forms with acute angles) with characters of a height of 5 to 10 mm in order to identify :

a) The serial number.

The purchaser may indicate the type of serial number to be used and allocate groups of numbers.

b) The date of final inspection (acceptance).

Two figures for the month (e.g. February = 02) and the last two figures of the year of acceptance shall be stamped on. Stamping of the date of acceptance may, however, be omitted if the month and year of acceptance are the same as the month and year of the manufacture of the axle indicated on its end face.

c) The inspection stamp.

d) The brand of the particular workshop or factory which carried out the assembly of the wheelset. In addition, if so specified :

e) A symbol or number of the type of wheelset.

f) The purchaser's identifying mark.

4.2.5.2 Unless otherwise agreed, the marks shall be stamped on the same end face of the axle as that which carries the axle manufacturer's marks.

When there is insufficient space on the end face of the axle (for example in the case of roller-bearing axles), the marks may with the purchaser's agreement be stamped in an alternative position or on a metal sheet collar placed around the body of the axle, the ends of the collar being riveted or welded together.

5 Manufacture

5.1 General

The manufacturer shall advise the purchaser of the principal processes which will be used in completing the order. He shall advise the purchaser of any subsequent fundamental changes which he proposes to introduce and which may affect the quality of the wheelsets and seek his agreement (see 6.6.2).

5.2 Assembly of the wheelset components onto the axle

5.2.1 Preparatory work

Before assembly, the components shall have been prepared and inspected in accordance with the requirements of 6.2.

5.2.2 Assembly of accessory components

Before the wheels or wheel centres are assembled onto the axle, those components such as bearings, gear wheels, brake discs, dynamo pulleys, etc., which are to be fitted onto the axle in a position between the wheels, shall be assembled in accordance with the specifications in the order and the appended documents. Unless otherwise specified by the purchaser of the wheelsets or the manufacturer of such accessory components, the conditions for assembling the accessory components other than bearings, shall be identical to those given in 5.2.3 for solid or tyred wheels or wheel centres with the same form of hub bore.

5.2.3 Assembly of wheels or wheel centres

5.2.3.1 Position of the unbalance

In the case of wheels or wheel centres with marks for the position of the unbalance the two wheels or wheel centres provided for a wheelset shall be mounted such that their unbalance is situated in the same diametrical plane on the same side of the axle and, in the case of wheelsets with brake discs, opposite the unbalance of the brake disc.

5.2.3.2 Methods of assembly

Alternative methods of assembling the wheelset components onto the axle may be permitted at the purchaser's option (see 5.2.3.4.1). Assembly by press fitting (see 5.2.3.3) and assembly by shrink fitting (see 5.2.3.4) are specified in this International Standard. Other methods, e.g. assembly by use of oil injection or use of conical wheel seats, are possible and may be specified by agreement between the purchaser and the manufacturer; in these cases, the procedure to be adopted shall also be specified by the purchaser.

5.2.3.3 Press fitting

Where press fitting is specified in the order (see 3.5), or unless otherwise agreed, the press fitting assembly of the wheels, wheel centres or assembled wheel centres and tyres shall be carried out as follows :

5.2.3.3.1 The wheels, wheel centres, or assembled wheel centres and tyres shall, at the time of assembly, be at the same ambient temperature as the axle.

5.2.3.3.2 The wheel or wheel centre bore and the wheel seat on the axle shall be coated with a thin film of lubricant over their whole contact surface. The lubricant shall preferably be one of the following :

a) pure tallow;

b) vegetable oil (linseed, rape, colza);

c) vegetable oil + tallow;

d) vegetable oil + white lead;

e) vegetable oil + zinc oxide;

f) molybdenum disulphide.

The type of lubricant may be specified by the purchaser; if not, the lubricant used shall be stated by the manufacturer.

NOTE – The use of white lead and of zinc oxide is, for health reasons, not permitted in certain countries.

5.2.3.3.3 The wheel, wheel centre, or tyred wheel, shall be pressed gradually onto its seat by a hydraulic press, every precaution being taken to avoid deformation of the components and damage to any machined surfaces, especially journals.

The press shall incorporate a correctly calibrated force-indication device and automatic recorder producing a diagram of pressing-on force as a function of the displacement of the wheel, or wheel centre, relative to the wheel seat, throughout the pressing operation. This diagram shall be traced in indelible ink on a scale which is large enough to permit a precise determination of the value of the pressing-on force at any position on the curve.

5.2.3.3.4 Before the pressing-on force is applied, the recorder shall be adjusted to read zero. The force indicated by the diagram and the device (pressure gauge) shall begin to increase before the penetration of the wheel seat of the axle into the bore of the wheel, or wheel centre, reaches 20 mm. The diagram shall show the pressing-on force gradually and smoothly increasing with the displacement of the wheel, until a maximum is reached which shall not exceed the maximum value specified ($P_{f\,max.}$). This maximum recorder value shall not fall during the pressing-on operation by more than 50 kN, and any such fall shall not result in a value less than the minimum specified ($P_{f\,min.}$) nor occur prior to the final 25 mm of displacement (see 6.3.2 and the note in 5.2.3.3.5).

5.2.3.3.5 Taking into consideration the service conditions of the wheelset, the pressing-on conditions and the design of the wheel, wheel centres, or assembled wheel centre and tyre, from the total range

$$2{,}5\,D < P_f < 7{,}0\,D$$

where

P_f is the pressing-on force, in kilonewtons (measured during last 25 mm of displacement);

D is the wheel-seat diameter, in millimetres.

An appropriate tighter range of P_f (see the note) shall be agreed at the time of enquiry and order (see 3.5.1.1) so that a reliable fixing between wheel, or wheel centre and axle, is achieved.

NOTE — The value of the pressing-on force P_f obtained during the pressing-on operation depends not only on such factors as the amount of interference, lubrication, pressing-on speed, surface roughness, etc., but also on the design of the wheel or wheel centre and of the wheel seat. For example, the value of the pressing-on force, and thus the shape of curve, may be affected when surface zones with oil injection grooves or zones with varying hub thickness, i.e. position of web, become during the pressing operation coincident with the wheel seat. For such reasons, special choice of P_f or special agreements concerning the shape of the pressing-on force curve may be appropriate in certain design cases. This applies especially if the hub wall thickness is small or when the length of the wheel seat is smaller than its diameter. In selecting the specified tighter tolerance band, it is suggested that the tolerance range be, in kilonewtons, approximately 1,0 D for the lower values of P_f, 1,5 D for mid values of P_f, and 2,0 D for the higher values of P_f, chosen from the total range of 2,5 D to 7,0 D.

The pressing-on force for untyred wheel centres may, under otherwise comparable conditions, be approximately 10 % less than the pressing-on force for wheels.

5.2.3.3.6 If the final pressing-on force P_f is less than the minimum value specified by the purchaser but greater than 90 % of this value, or if it is greater than the maximum value specified by the purchaser but less than 110 % of this value, the manufacturer may check the press fitting in the presence of the purchaser (see table 4) by a proving thrust test in accordance with 6.4.3.1. If this test is satisfactory, the deviation of the final pressing-on force, from the specified range shall be tolerated.

5.2.3.4 Shrink fitting

5.2.3.4.1 Shrink fitting shall not be applied for the assembly of tyred wheel centres onto the axle except by prior agreement between manufacturer and the purchaser.

5.2.3.4.2 In order to obtain the advantages of shrink fitting, it is essential that oil-injection grooves [see ISO 1005/2[1)]] be incorporated.

5.2.3.4.3 When shrink fitting is specified in the order (see 3.5.2), the solid wheel or wheel centre shall be heated by an approved method to a uniform temperature not exceeding 250 °C for a sufficient length of time to ensure that the whole mass attains that temperature and the necessary expansion of the bore of the wheel or wheel centre is obtained, so allowing it to be placed on the axle. If the wheel or wheel centre is heated in a furnace, special care shall be taken to prevent oxidation of the wheel bore surface.

After removal from the heating medium, the wheel or wheel centre shall be wiped clean with a fluffless cloth, and if oil is used as the heating medium, all trace of the oil shall be removed. The seat on the axle for the wheel or wheel centre shall be clean and free from oil or grease, the wheel or wheel centre shall be positioned correctly onto the axle in its final position and left to cool in still air for sufficient time for the wheel to grip on the axle, after which the second wheel or wheel centre shall be assembled in the same manner.

As there is a relatively limited period available before the shrinkage is taken up by contraction, it is essential that jigs be used to maintain a positive location.

5.2.3.4.4 The shrink fitting shall, in accordance with 4.2.1, meet the requirements of the proving thrust test specified in 6.4.2.1 and 6.4.3.1.

1) An International Standard dealing with oil-injection grooves is in preparation.

5.3 Protection of recesses

Where a recess results from an overhang, e.g. the wheel or gear wheel over a stress-relieving groove, the recess shall be filled with an approved anticorrosion material as specified by the purchaser.

5.4 Machining of the treads

If machining of the treads is specified (see 3.6) and if this has not been carried out before assembly, the treads of the wheel shall be profiled in accordance with the order or its appended documents. Unless otherwise specified, the tolerance shall be as given in ISO 1005/2. [1)]

5.5 Correction of unbalance

When balancing is specified by the purchaser (see 3.10), any unbalance exceeding the maximum permitted limit (see 4.2.3) shall be reduced in accordance with the relevant clauses in ISO 1005/2 and ISO 1005/6.

5.6 Identification

After the components have been assembled, identification marks shall be stamped on in accordance with 4.2.5.

5.7 Rectification

5.7.1 Any rectification of wheelset components shall be carried out in accordance with the appropriate clauses of the International Standards referred to in table 1.

5.7.2 Incorrect assembly of a component may, with the purchaser's agreement be rectified by dismantling and reassembly of the component in question.

5.8 Protection against corrosion during service

The purchaser may specify a final painting or other permanent protection against corrosion during service of certain areas of the wheelset (see 3.12 and 5.3). The details of such protection shall be agreed at the time of enquiry and order.

6 Inspection

6.1 Responsibilities and type and date of inspection (see 3.8)

6.1.1 The purchaser shall specify in the order whether inspection to ensure compliance with the specified manufacturing methods (see clause 5) and with the quality requirements (see clause 4), is to be carried out either

a) under delegated inspection by the qualified department of the manufacturer, or

b) in the presence of the purchaser.

Unless otherwise specified in the order, the provisions of table 4, column 5, shall apply.

6.1.2 Delegation of inspection by the purchaser to the qualified department of the manufacturer does not preclude the purchaser's monitoring of the effectiveness of the control of manufacturing processes and of the testing and inspection methods. He shall be allowed to witness any of the tests made under the responsibility of the manufacturer or to inspect the records.

6.1.3 Any inspection for which the qualified department of the manufacturer is responsible shall be carried out before the final inspection by the purchaser, in order to comply with the conditions of 6.6.1.

6.1.4 Where the inspection remains the responsibility of the purchaser [see 6.1.1.b)], the date of submission for inspection shall be notified in writing. This notification shall state the number of wheelsets submitted for inspection, and the order number.

6.2 Inspection of the components

6.2.1 Before commencing assembly of the wheelsets it shall be established that all components have previously been inspected in accordance with the relevant specifications (see 4.1), that the results of the inspection conform to the specification of the order and appended documents and that there has been no deterioration.

6.2.2 Where certain component manufacturing operations, such as final machining of wheel seats or of wheel-hub bores and final profiling of the wheel treads, are part of the manufacturing process of the wheelsets, then these operations and their results shall be inspected in accordance with the corresponding International Standards (see table 1).

This may apply in particular to

a) checking of the appearance and dimensions (see 6.3.1);

b) magnetoscopic examination of axles;

c) balancing of wheels;

d) the hammer test (for wheelsets with tyred wheels) (see ISO 1005/2).

1) An International Standard dealing with tolerances is in preparation.

6.3 Inspection of manufacturing methods

6.3.1 Inspection of interference

The interference between the seat and bore of each fitting shall be inspected at room temperature. In the case of shrink fitting, records of the results of these measurements, numbered to correspond with the serial number of the assembly, shall be made available to the representative of the purchaser at the time of final inspection.

If so agreed at the time of enquiry and order (see 3.5.1.2), the interference value for press-fitting shall be recorded on the pressing-on force diagram.

6.3.2 Inspection of the pressing-on force

In the case of press-fitting, the original or copy of the pressing-on force diagram recorded in accordance with 5.2.3.3.3 and numbered to correspond with the serial number of the assembly shall be made available to the representative of the purchaser at the time of final inspection.

6.4 Inspection of the characteristics of the wheelsets

6.4.1 Types and number of tests or checks

Table 4 gives the types of tests and checks, whether these are mandatory or optional, and the number of wheelsets to be tested.

6.4.2 Condition of the wheelsets when submitted for inspection

6.4.2.1 When a proving thrust test is required, it may be carried out before such finishing operations as the machining of the treads, etc. Normally, the wheelset should not be subjected to this test earlier than 48 h after assembly; however, the manufacturer shall have the option of reducing this period.

6.4.2.2 Measurement of electrical resistance and unbalance and inspection of appearance and dimensions shall be carried out on wheelsets in the delivery condition before protective coatings other than as specified in 5.3 are applied.

6.4.3 Test methods

6.4.3.1 Proving thrust test

The proving thrust test, when required (see table 4, column 4), shall be carried out on a press similar to that used for press-fit assembly and incorporating a force-indicating and -recording device. The proving thrust force shall be exerted very gradually and evenly on the wheelset.

6.4.3.1.1 In the case of press-fitted wheels, wheel centres or tyred wheels, the proving thrust force shall, when using one of the lubricants given under 5.2.3.3.2, attain 1,2 times the value of the actual pressing-on force (P_f), but shall not exceed 7,0 D.

6.4.3.1.2 In the case of shrink-fitted wheels or wheel centres, the purchaser may specify, at the time of enquiry and order, a minimum value for the proving thrust force (P_p) (see 3.5.2.1). This value shall be in the range

$$3{,}0\ D \leqslant P_p \leqslant 7{,}0\ D$$

where

P_p is the proving thrust force, in kilonewtons;

D is the seat diameter, in millimetres.

If P_p is not specified in the order, the force shall be

— in the case of tractive wheelsets : $P_p = 6{,}0\ D$

— in all other cases : $P_p = 4{,}0\ D$

6.4.3.2 Electrical resistance test

The wheelset shall be placed on the supports of a calibrated apparatus which permits the measurement of the elecrical resistance between the treads of the two wheels. The apparatus shall have been previously approved by the purchaser.

6.4.3.3 Balancing of wheelsets

6.4.3.3.1 Dynamic balancing

The dynamic unbalance of the wheelset shall be measured at the tread of each wheel by means of a suitable device approved by the purchaser. The sensitivity of the device shall be such that an unbalance of at least one-fifth of the maximum value specified in 4.2.3.1 can be determined.

6.4.3.3.2 Static balancing

The static unbalance shall be measured by means of a suitable device approved by the purchaser. The axle of the wheelset to be tested rests on its journals or its labyrinth ring seats on the smooth, polished surfaces of the two horizontal supports of the device.

6.4.3.4 Checking appearance and dimensions

The appearance and dimensions shall be checked by suitable means made available by the manufacturer and previously approved by the purchaser. The dimensions shall be checked using gauges which are subject to regular calibration.

6.5 Conclusions of the inspection

6.5.1 If the inspection reveals that the manufacturing conditions were different from those specified in the order or its appended documents, the wheelsets in question may be rejected.

6.5.2 Any wheelset which fails to comply with the requirements of this International Standard (see table 4) shall be liable to rejection.

6.5.3 Rejected wheelsets may be re-submitted for acceptance after being rectified in accordance with 5.7 or in accordance with any other rectification procedures authorized by the purchaser.

6.6 Certification

6.6.1 The manufacturer shall provide, at or before the time of final inspection, all the relevant details of those checks and tests (see 6.2.2) for which he or his qualified department is responsible (see table 4, column 5).

6.6.2 Whether the inspection of manufacture is the responsibility of the manufacturer's qualified department or of the purchaser, the manufacturer shall certify that the manufacturing requirements of this International Standard have been complied with.

6.6.3 The following information shall also be included in the inspection certificate :

a) interference between seats and bores (see 3.5.1.2 and 6.3.1);

b) pressing-on force diagram (see 3.5.1.1 and 6.3.2);

c) proving thrust force diagram (see 3.5.2.1 and 6.4.3.1) and if the corresponding checks are specified in the order or its appended documents;

d) electrical resistance (see 3.9 and 4.2.2);

e) unbalance (see 3.10 and 4.2.3).

7 Delivery

7.1 Protection against corrosion during transport

After inspection and before storage or despatch, the wheelsets shall be protected against corrosion. Particular attention shall be given to those components not already protected or from which the protection has been removed during manufacture or handling. The method of protection and the areas to be coated shall be agreed at the time of enquiry and order.

NOTE — The efficiency of any protective coating is only of limited life especially under conditions of sea transport or in geographical regions of high humidity. Delivered wheelsets should be inspected immediately on arrival at their destination to see if a renewal of the protection is necessary.

7.2 Protection against mechanical damage during transport

After protection against corrosion, the wheelsets shall be effectively protected before despatch against mechanical damage, by a method agreed with the purchaser.

8 Guarantee

The conditions of guarantee clauses included in contracts shall be agreed between the manufacturer and the purchaser at the time of enquiry and order.

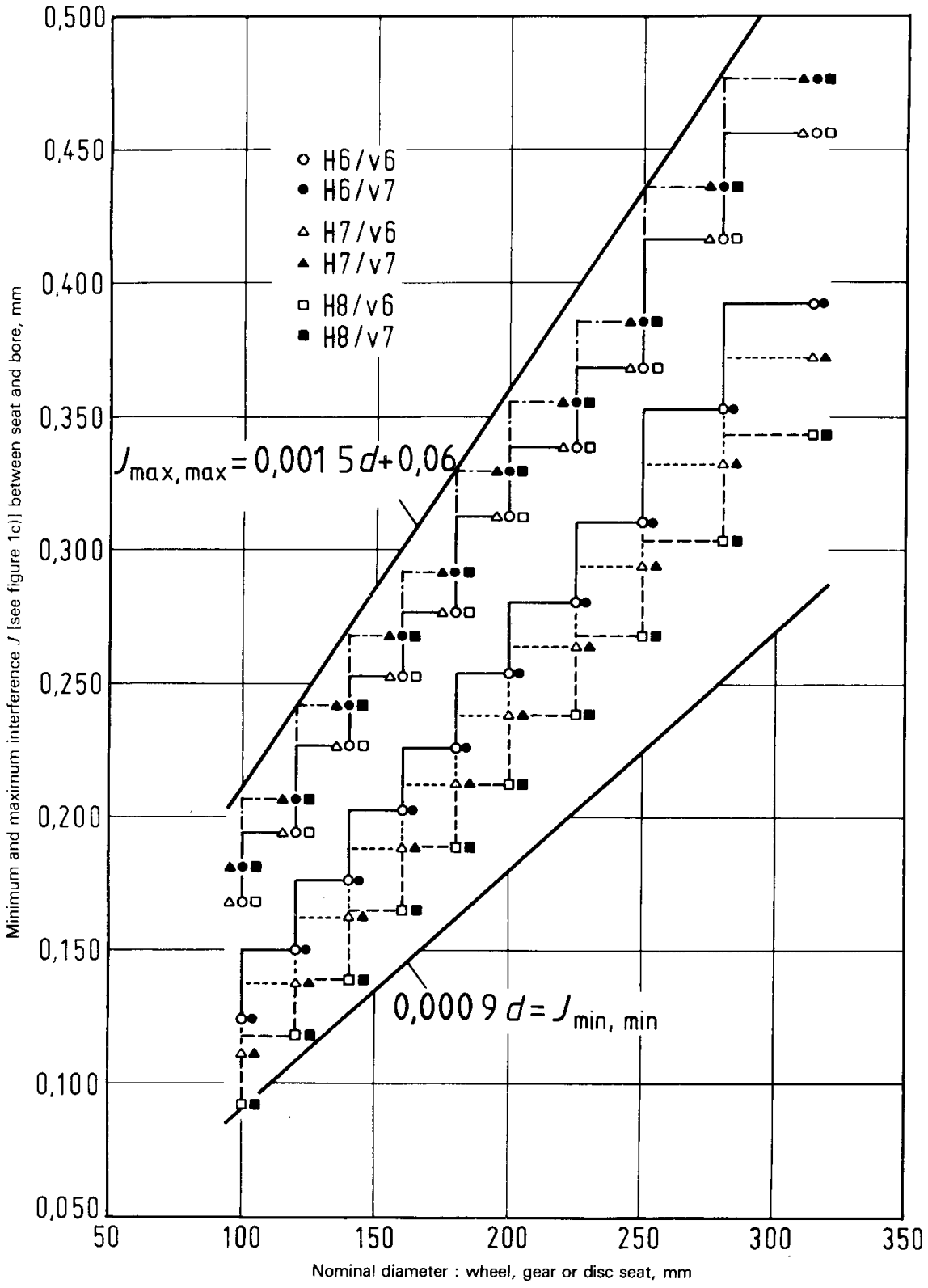

Figure 1a) — Interference between seats and bores of 100 to 300 mm diameter and corresponding tolerance grades for deviation grade v as given in ISO/R 286 [see 4.1.2 and figure 1c)]

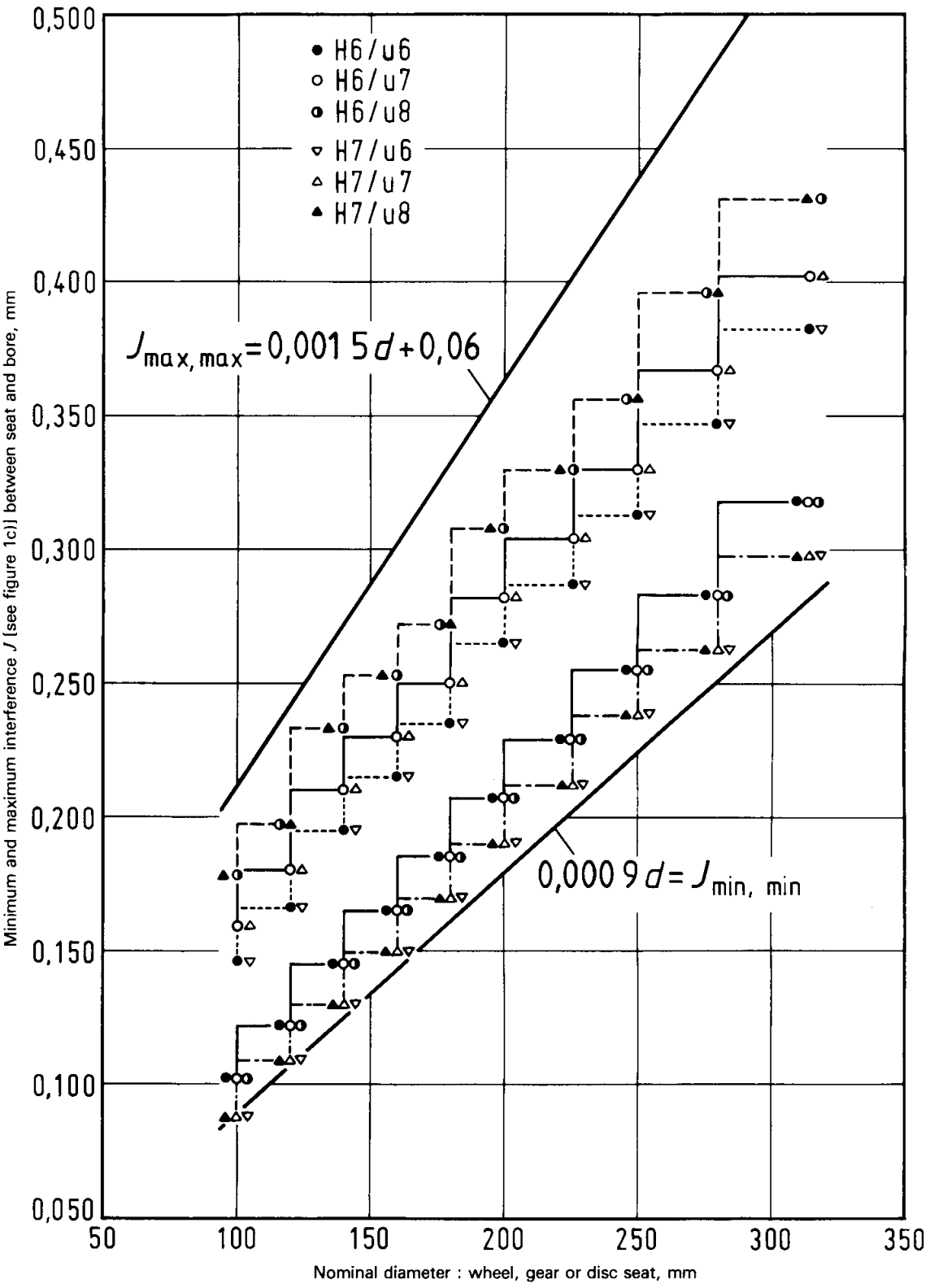

Figure 1b) — Interference between seats and bores of 100 to 300 mm diameter and corresponding tolerance grades for deviation grade u as given in ISO/R 286 (see 4.1.2 and figure 1c)]

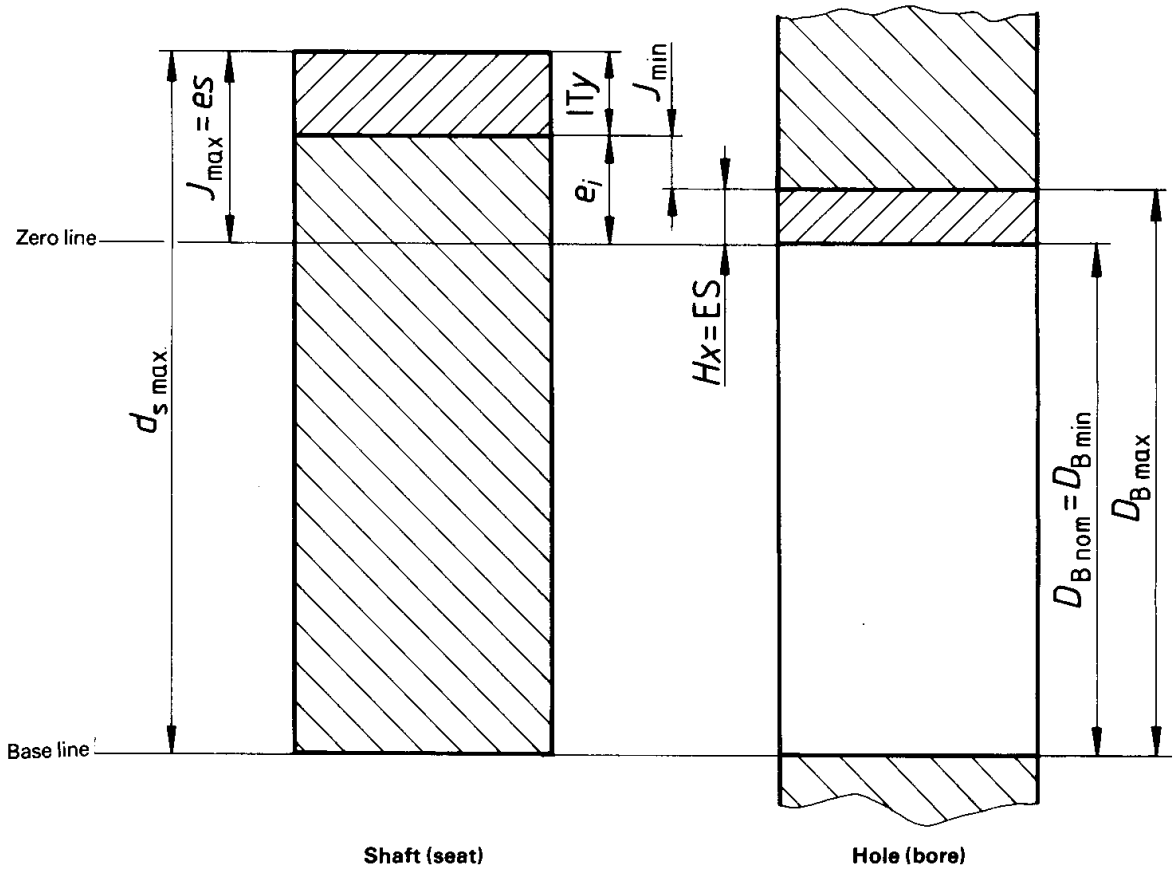

Figure 1c) — Key to the symbols used in table 2 and figure 1a) and 1b) for the deviation, tolerance and interference of seats and bores

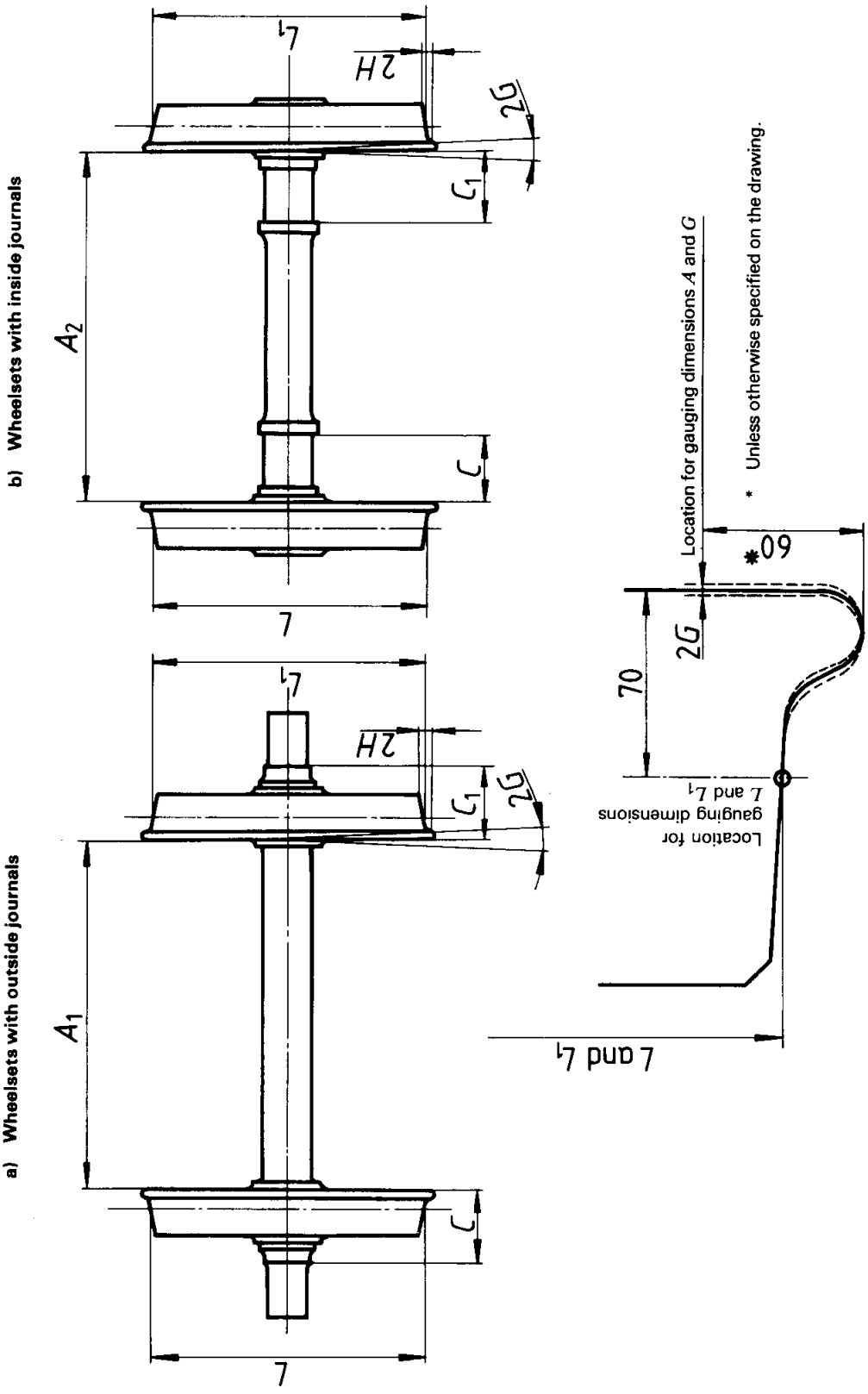

Figure 2 — Key to the symbols used in table 3 for wheelset tolerances

Table 1 — Requirements for the components of the wheelset[1)]

Component	Quality requirements	Dimensional requirements for "ready for assembly" condition
Axles	ISO 1005/3	2)
Solid wheels	ISO 1005/6	2)
Wheel centres	ISO 1005/4	ISO 1005/2
Tyres	ISO 1005/1	
Tyred wheels	ISO 1005/2	
Retaining rings, Gear wheels, Brake discs, Dynamo pulleys, Bearings	In the absence of International Standard for these components, the requirements shall be agreed at the time of enquiry and order.	

1) See the note in clause 2.

2) An International Standard dealing with the dimensional requirements for these components is in preparation.

Table 2 — Deviations, tolerances and interference of wheel seats and bores

1	2			3		4					5					6	7	8
Nominal and mininal bore diameter	Maximum bore diameter			Deviation of seat[1)] diameter							Interference between bore[1)] and seat[1)]						Seat[1)] diameter	
				Lower		Upper					Min.					Max.	Min.	Max.
$D_{B\,nom.}$ to $D_{B\,min.}$	$D_{B\,max.} = D_{B\,nom.} + \ldots$			$ei = J_{min.} + H_x$[4)]		$es = J_{max.}$[3)]					$J_{min..} = ei - H_x$[4)]					$J_{max.} = es$	$d_{s\,min.}$	$d_{s\,max.}$
mm	H6	H7	H8	u[2)]	v[2)]	u6	u7	u8	v6	v7	H6/u[2)]	H7/u[2)]	H6/v[2)]	H7/v[2)]	H8/v[2)]			
> 100 to 120	0,022	0,035	0,054	0,144	0,172	0,166	0,179	0,198	0,194	0,207	0,122	0,109	0,150	0,137	0,118	$J_{max.} = es$ (see column 4)	$d_{S\,min.} = D_{B\,nom.} + ei$ (see columns 1 and 3)	$d_{S\,max.} = D_{B\,nom.} + es$ (see columns 1 and 4)
> 120 to 140	0,025	0,040	0,063	0,170	0,202	0,195	0,210	0,233	0,227	0,242	0,145	0,130	0,177	0,162	0,139			
> 140 to 160	0,025	0,040	0,063	0,190	0,228	0,215	0,230	0,253	0,253	0,268	0,165	0,150	0,203	0,188	0,165			
> 160 to 180	0,025	0,040	0,063	0,210	0,252	0,235	0,250	0,273	0,277	0,292	0,185	0,170	0,227	0,212	0,189			
> 180 to 200	0,029	0,046	0,072	0,236	0,284	0,265	0,282	0,308	0,313	0,330	0,207	0,190	0,255	0,238	0,212			
> 200 to 225	0,029	0,046	0,072	0,258	0,310	0,287	0,304	0,330	0,339	0,356	0,229	0,212	0,281	0,264	0,238			
> 225 to 250	0,029	0,046	0,072	0,284	0,340	0,313	0,330	0,356	0,369	0,386	0,255	0,238	0,311	0,294	0,268			
> 250 to 280	0,032	0,052	0,081	0,315	0,385	0,347	0,367	0,396	0,417	0,437	0,283	0,263	0,353	0,333	0,304			
> 280 to 315	0,032	0,052	0,081	0,350	0,425	0,382	0,402	0,431	0,457	0,477	0,318	0,298	0,393	0,373	0,344			

1) The terms "bore" and "seat" used throughout this International Standard (identified in ISO/R 286 as "hole" and "shaft") stand for the wheel, gear and disc bores and the wheel gear and disc seats of the axle, respectively.

2) For all tolerance ranges.

3) $J_{max.} = ei + IT_y$ [IT_y = International tolerance grade y, where $y = 6$, 7 or 8; see figure 1 c)].

4) $x = 6$, 7 or 8 [see figures 1a), 1b) and 1c)].

Table 3 — Dimensional tolerances

1	2	3	4	5	6
Designation	**Symbol** (see figure 2)	**Application**	v [1]	**Tolerance** Category Y [2] mm	**Tolerance** Category Z [2] mm
Distance between the inside faces of the two wheels	A_1 A_2	All	All	Nom. $^{+2}_{0}$ Nom. $^{0}_{-2}$	
Difference between measured values of back face of flanges to abutment faces	$(C - C_1)$ or $(C_1 - C)$	All	All	< 1,0	
Total perpendicularity run-out [3] of the inside face of each wheel	2 G	Tractive wheelsets and trailing wheelsets of non-freight stock	< 120 > 120 < 160 > 160	< 1,0 < 0,8 < 0,5	< 2,3 } [4]
		All others	All	< 1,0	< 2,3
Total radial run-out [3] of the thread	2 H	All	< 120 > 120 < 200 > 200	< 0,5 < 0,3 [5]	< 0,75 } [4]
Difference between the thread diameter of the finished wheels on the same axle	$(L - L_1)$ or $(L_1 - L)$	All	< 120 > 120 < 200 > 200	< 1,0 < 0,5 < 0,3	< 1,0 } [4]

1) v = operating speed in kilometres per hour.

2) Observe the explanations in 4.2.4.

3) The geometrical term "run-out" is defined in ISO 1101/1.

4) It is recommended to consider the application of the tolerances of category Z carefully, if the operating speed is higher than 120 km/h (see also 4.2.4).

5) The tolerance should be agreed at the time of enquiry and order. The measurements should preferably be carried out using the journals as a datum.

Table 4 — Type and number of tests and checks

1	2	3	4	5	6
	Inspection	Type of tests or checks	Remarks 1)	2)	Number of wheelsets to be tested
1	Components	See 6.2. and 6.6.1			
2	Manufacture	Interference between seats and bores (see 4.1.2)	m	a	All
3		Pressing-on force diagram for press-fitted wheels (see 5.2.3.3.3 and 5.2.3.3.6)	m	a	All
4	Characteristics	Proving thrust test for (see 6.4.3.1)			
		press-fitted wheels	3)	b	3)
		shrink-fitted wheels	m	b	All 4)
5		Electrical resistance (see 4.2.2)	0 5)	a	All
6		Unbalance of the wheel set (see 4.2.3)			
6a		dynamic	0 6)	a	All
6b		static	0 7)	a	All
7		Appearance and dimensions (see 4.2.4)	m	b	All

1) m = mandatory tests; 0 = optional, i.e. tests or checks need only be carried out if specified in the order or its appended documents.

2) Unless otherwise agreed (see 6.1), the tests or checks shall be carried out either :

a) under delegated inspection by the qualified department of the manufacturer, or
b) in the presence of the purchaser.

3) See 5.2.3.3.6.

4) The requirements for a proving thrust for shrink-fitted wheels may be waived totally or partially at the discretion of the purchaser.

5) Usually only specified for wheelsets with tyred wheels.

6) Such tests are usually specified for wheelsets intended for operating speeds over 120 km/h.

7) Such tests are, if at all, usually only specified for wheelsets intended for operating speeds between 100 and 140 km/h.