International Standard 1005/4

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Railway rolling stock material — Part 4 : Rolled or forged wheel centres for tyred wheels for tractive and trailing stock — Quality requirements

Matériel roulant de chemin de fer — Partie 4 : Corps de roues laminés ou forgés pour roues bandagées pour matériel moteur et matériel remorqué - Prescriptions de qualité

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1005/4 was prepared by Technical Committee ISO/TC 17, *Steel*.

It cancels and replaces ISO Recommendation R 1005/4-1969, of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Railway rolling stock material — Part 4 : Rolled or forged wheel centres for tyred wheels for tractive and trailing stock — Quality requirements

1 Scope and field of application

1.1 This part of ISO 1005 specifies requirements for the manufacture and supply of rolled or forged wheel centres for tractive and trailing stock, which are suitable for tyring and are made of unalloyed steels in accordance with table 1 and clause 4. Spoked wheel centres are not covered by this part of ISO 1005.

1.2 The quality requirements for tyres are given in ISO 1005/1 and the quality requirements for forged and rolled wheel centres are given in this part of ISO 1005. Quality requirements for cast wheel centres, if required, shall be subject to agreement between purchaser and manufacturer.

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

2 References

ISO 83, *Steel — Charpy impact test (U-notch).*

ISO 377, *Selection and preparation of samples and test pieces for wrought steel.*

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

ISO 1005, *Railway rolling stock material*

- *Part 1 : Rough-rolled tyres for tractive and trailing stock — Quality requirements.*

— *Part 2 : Tyres, wheel centres and tyred wheels for tractive and trailing stock — Dimensional, balancing and assembly requirements.*

ISO 6892, *Metallic materials - Tensile testing.*

3 Information to be supplied by the purchaser

The purchaser shall supply the following information in his enquiry and order:

a) the number of this part of ISO 1005;

b) the grade of steel (see 4.1 and table 1);

c) the type of heat treatment (see 4.2 and 6.5);

d) the degree of finish (see 4.3);

e) if a check analysis is required (see 5.1.2);

f) the dimensions of the wheel centre (see 5.4);

g) whether, in the case of finished wheel centres, the position and amount of residual static unbalance shall be marked (see 5.2.3);

h) if any special marking is required (see 5.5);

j) the conditions for machining and the elimination of unbalance (see 6.6);

k) the type of inspection required (see clause 7);

m) if special preparation and sampling of test pieces is required (see 7.7.2 and 7.7.3);

n) the methods of protection against corrosion and mechanical damage (see 8.1 and 8.2);

p) if the conditions of guarantee are to be agreed (see clause 9).

4 Classification

The wheel centres shall be specified in the order or its appended documents according to the grade of steel, the heat-treatment condition of delivery, the degree of finish and the type of inspection required.

4.1 Steel grades

This part of ISO 1005 covers steel grades C1, C2 and C3 having the characteristics given in table 1.

4.2 Types of heat-treatment condition of delivery

The wheel centres shall be supplied:

a) untreated (no symbol); or

b) normalized or normalized and tempered (symbol N).

Irrespective of the heat-treatment condition specified, where no effective degassing has been carried out, suitable precautions, which may include for example slow cooling, shall be taken to avoid the formation of flakes (hydrogen cracking). If so requested, the representative of the railway authority shall be informed of the precautions taken.

4.3 Degree of finish

This part of ISO 1005 differentiates in accordance with ISO 1005/2 between the degrees of finish specified in 4.3.1 to 4.3.6.

4.3.1 Unmachined

This indicates the "black" as-forged or as-rolled condition without any subsequent machining other than that which may have been carried out by the manufacturer to enable the wheel centre to conform to the required standard.

4.3.2 Rough machined

This indicates the condition in which the wheel centre has received no final machining, but has been rough machined on all or only certain portions which have to be machined.

4.3.3 Half finished

This indicates a condition in which the wheel centre 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.

4.3.4 Finished

This indicates the condition in which all portions of the wheel centre which are required, by the order or the drawing, to be machined have undergone all machining operations other than those normally carried out by the manufacturer immediately before mounting the wheel centre on the axle, i.e. final finishing operation of the bore and, in the case of wheel centres which are to be tyred subsequent to mounting on the axle (see ISO 1005/2), perhaps the rim.

4.3.5 Ready for assembly

This indicates the wheel centre condition in which all necessary machining operations have been carried out.

For clarity this part of ISO 1005 differentiates between

a) wheel centres ready for assembly of the tyre;

b) wheel centres ready for assembly to the axle.

4.3.6 Unless otherwise agreed at the time of enquiry and order, the following degree of finish shall apply:

— hub and web: unmachined

— rim and bore: rough machined

5 Requirements

5.1 Chemical composition

5.1.1 The maximum contents of the various elements are given in table 1. These values apply to the cast analysis.

5.1.2 If a product analysis is required, this shall be stated on the enquiry and order. In this case, the results of product analysis may deviate from the requirements in table 1 by the values given in table 2.

5.2 Physical properties

5.2.1 Appearance

Those parts remaining black shall blend smoothly into the machined portions.

The finish of the machined surfaces, if any, shall be in accordance with ISO 1005/2 or the order or its appended documents.

The surfaces of the wheel centres shall not show any marks other than in the positions specified in the order or its appended documents.

5.2.2 Soundness

The wheel centres shall be sound throughout and without any defects detrimental to their use.

5.2.3 Weight distribution — Balancing

If specified in the order or its appended documents, the position and amount of the residual static unbalance of finished wheel centres shall be suitably marked (see 5.5.2).

5.3 Mechanical properties

The mechanical properties of the wheel centres shall be those shown in table 1.

5.4 Dimensional characteristics

5.4.1 The dimensions of the wheel centres shall be given in the order or its appended documents.

5.4.2 The tolerances on dimensional requirements and the permitted machining allowances shall be as specified in ISO 1005/2.

5.5 Manufacturer's brand marks

5.5.1 Each wheel centre shall be supplied with stamped marks as specified on the order or its appended documents.

Unless otherwise specified, each wheel centre shall receive the following marks:

a) manufacturer's mark;

b) cast number;

c) grade of steel and heat-treatment condition (see 4.2);

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

e) the inspector's mark.

Observe 5.5.2.

Unless otherwise specified, the position and the type of the marks shall be as follows:

The marks appertaining to a) to d) shall be made on the outside face of the hub. Stamps with acute angled character forms shall not be used (see 6.4).

5.5.2 If according to 5.2.3 the position and amount of the residual static unbalance shall be marked, the marking shall, unless otherwise agreed, be carried out as follows:

The position of the unbalance shall be indicated by suitable colour paint in a radial stripe of about 15 mm width. The unbalance value, expressed in gram metres, shall be shown by painted numbers below the end of the stripe.

6 Manufacture

6.1 Steelmaking process

The wheel centres shall be made from steel produced by open hearth, electric arc or basic oxygen processes; other processes may be used by agreement between the manufacturer and the purchaser.

The steel shall be killed in the furnace or in the ladle and shall be bottom poured or continuously cast, unless otherwise agreed.

6.2 Manufacturing process

Wheel centres shall be manufactured from ingots or blooms capable of producing two or more wheel centres after removal of discards. Special individual ingots may only be used with the prior agreement of the purchaser. Cropping shall be sufficient to eliminate defective sections of the ingot. Any superficial defects shall be completely removed before or during working. Any sections which are to be rolled or forged into wheel centres and which are not completely sound shall be dealt with in accordance with 6.3. The sections of ingots or blooms shall be forged, pierced and rough shaped by a hammer or press. They shall be finally shaped by rolling or by drop forging supplemented by sizing if necessary. The finished rolled or forged wheel centres shall comply with 5.4.

Suitable precautions shall be taken during hot working to ensure that material is not damaged by excessive temperatures (overheating) or by grain growth due to cessation of work at high temperatures. Generally, forging should not be done at temperatures above 1 260 °C and should terminate between 850 and 1 000 °C. After forging or rolling, sizing where applicable and stamping the identification marks, the wheel centres shall be left to cool in still air. If the steel has not been degassed, suitable precautions shall be taken to avoid the formation of flakes (see 4.2).

6.3 Removal of defective sections

Defective sections which do not comply with the soundness characteristics specified in 5.2.1 and 5.2.2 shall be removed before or during the manufacture of the wheel centres.

6.4 Identification of the wheel centres during manufacture

All ingots, sections and wheel centres shall be suitably marked at each stage of manufacture so that before delivery each wheel centre can be identified as specified in 5.5. Where punched identification marks differ from the final identification marks defined in 5.5, they shall be sufficiently shallow not to remain visible on the finished wheel centre.

6.5 Heat treatment

The wheel centres shall undergo the heat treatment specified in the order or its appended documents (see 4.2).

6.6 Machining and elimination of unbalance

The condition for machining shall be chosen so that the wheel centres comply with the requirements for surface quality and tolerances for the dimensional requirements.

Unless otherwise specified, correction of unbalance shall be obtained by machining off-centre of the fillet between the web and the rim, on the flange side (see figure 1). The thickness of the metal removed shall not exceed 4 mm and the dressed surface shall be carefully blended into the adjacent surfaces.

Under no circumstances may additional weights be attached.

Drilling of holes for balancing is not permitted for wheel centres of tractive stock. Prior agreement by the purchaser shall be obtained if this method of balancing is to be used for wheel centres for trailing stock.

6.7 Removal of surface defects

6.7.1 Authorized repairs

With the exception of those finish-machined surfaces on which no rectification is permitted, superficial defects may be eliminated prior to static balancing by chipping or machining or by soft grinding, provided that no heat cracking is produced

and that the tolerances for the dimensional requirements are maintained and that, where necessary, it is ensured that any defect is completely eliminated by an appropriate means, for example by a magnetoscopic test.

6.7.2 Unauthorized repairs

Any welding, gas torch treatment, heating, electric burns, filling by metallization, electrolytic or chemical deposits, etc. and any retouching with the object of concealing a defect, are not permitted and shall result in the rejection of the complete batch.

7 Inspection

7.1 Responsibilities and type of inspection

The purchaser shall specify in the order whether inspection to ensure compliance with manufacturing methods (see clause 6) and with the quality requirements (see clause 5) 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, his representative or a body designated by him.

Unless otherwise specified in the order, the provisions of table 3, column 5, shall apply.

Delegation of inspection by the purchaser to the qualified department of the manufacturer does not remove the right of the purchaser to monitor the effectiveness of the manufacturing controls and of the testing and inspection methods.

In this respect, he shall be allowed to witness any of the tests made under the responsibility of the manufacturer and to inspect the recorded results.

7.2 Inspection of manufacture

Whether the inspection of manufacture is the responsibility of the manufacturer's qualified department or of the purchaser, 7.2.1 and 7.2.2 shall apply.

7.2.1 The manufacturer shall advise the purchaser of the principal process which will be used in completing the order, and shall advise the purchaser of any subsequent fundamental changes which he proposes to introduce and which may affect the quality of the wheel centres and seek prior agreement.

If the inspection remains the responsibility of the purchaser, his representative shall be allowed to inspect the manufacturing processes used in order to ensure compliance with the requirements of this part of ISO 1005.

7.2.2 The manufacturer shall, at the time of submission for acceptance, certify that the manufacturing requirements of this part of ISO 1005 have been complied with.

7.3 Inspection of the characteristics of the wheel centres

7.3.1 Types of tests

Table 3 specifies the types of tests to be carried out.

7.3.2 Test unit and subdivision into batches

The appropriate test unit for each type of test is given in table 3, column 7.

For acceptance testing, wheel centres shall be grouped in batches. Each batch shall be formed of wheel centres produced from the same cast and having undergone the same heat treatment. It may include wheel centres of a different shape provided that, in the case of wheel centres for tractive stock, all the wheel centres in the batch are of the same nominal diameter and the same rim section.

7.3.3 Condition of wheel centres when submitted for inspection

When submitted for inspection, the condition of wheel centres shall comply with the requirements of table 3, column 6.

7.4 Submission for inspection by the purchaser

7.4.1 The purchaser [see 7.1b)] shall be notified in writing (see 7.5.2) of the date of submission for inspection, stating the number of wheel centres in each batch and the order reference number.

7.4.2 If the inspection, which in accordance with table 3 is to be carried out after machining, is the responsibility of the purchaser [see 7.1b)], then the manufacturer may submit the material in two stages:

a) after the final heat treatment but before machining, and

b) in the final delivery condition.

7.5 Certification

7.5.1 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 part of ISO 1005 have been complied with. The final test certificate shall also include the results of the following tests:

- chemical analysis
- tensile test
- impact test, if required

7.5.2 The manufacturer shall provide the relevant certificate for those tests and checks for which he is responsible, at the following times:

a) at the time of delivery, if he has the delegated responsibility for all tests; or

b) at the time of the first submission for inspection (see 7.4.2), if for that part of the testing he has the delegated responsibility.

7.6 Number of checks and tests

The number of wheel centres per test unit to be subjected to the checks and the number of tests per wheel centre shall be in accordance with table 3, columns 8 to 10.

7.7 Sampling and preparation of samples and test pieces

7.7.1 Sampling

After indentifying the batch, the inspector shall select at random the wheel centre(s) intended for testing and indelibly stamp them. The inspector shall indicate on each of these wheel centres the area (see figure 2) from which the test pieces shall be taken.

7.7.2 Preparation of samples and test pieces

Unless otherwise specified, the conditions of preparation of samples and test pieces shall be carried out in accordance with the requirements of ISO 377, with the following additional requirement.

The samples and test pieces shall retain the inspector's identification marks and stamps, and may not be altered except in his presence.

7.7.3 Number and position of test pieces

Test pieces shall be taken from the previously marked sample sections, and shall be stamped for identification by the responsible inspector.

7.7.3.1 Product analysis

Unless otherwise specified in the order or its appended documents, one of the following samples shall be taken from one of the test wheel centres:

— at least 50 g of millings representing the average of a radial section of the wheel centre

— or, as for example in the case of spectrographic analysis, a sample from the tensile test piece.

7.7.3.2 Tensile test

One test piece shall be taken from each test wheel centre as shown in figure 2. The test pieces shall be prepared in accordance with the requirements of ISO 6892, the test piece preferably having a diameter of at least 10 mm with a gauge length of five times the diameter.

7.7.3.3 Impact test (U-notch)

Three test pieces shall be taken from the sample at the positions shown in figure 2. The impact test pieces shall be marked to identify their longitudinal surfaces which are parallel to section AA (see figure 2). The test pieces shall be prepared in accordance with the requirements of ISO 83. The axis of the cylindrical bottom of the notch shall be parallel to diameter AA in figure 2.

7.7.3.4 Static unbalance

The test piece shall consist of the finished wheel centre.

7.8 Test methods

7.8.1 Chemical analysis

The chemical analysis shall be carried out in accordance with the methods defined by the corresponding International Standards or by any other appropriate methods. In case of dispute, only test methods recommended by ISO shall be used.

7.8.2 Tensile test

The tensile test shall be carried out in accordance with the requirements of ISO 6892.

7.8.3 Impact test (with U-shaped notch)

The impact test shall be carried out in accordance with the requirements of ISO 83.

7.8.4 Static balance

The residual unbalance of wheel centres shall be checked by means of a suitable device agreed by the purchaser.

7.8.5 Checking of the appearance

The appearance shall be checked by visual inspection before delivery.

7.8.6 Checking of dimensions

The dimensions shall be checked in accordance with the requirements of ISO 1005/2.

7.9. Conclusion of the inspection

Any result not conforming with the required standard shall result in the rejection of the corresponding test unit subject to the requirements of ISO 404.

Before delivery, all accepted wheel centres shall be marked by the inspector after the final inspection and the inspector's marks shall be placed adjacent to the manufacturer's marks.

7.10 Retests

Unless otherwise agreed, the requirements for retests in ISO 404 shall apply.

8 Delivery

8.1 Protection against corrosion during transport

After inspection and, before storage or despatch, at least all finished machined parts of the accepted wheel centres shall be protected against corrosion by a method agreed with the purchaser.

NOTE — The efficiency of any protective coatings is 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 see if a renewal of the protection is necessary.

8.2 Protection against mechanical damage during transport

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

9 Guarantee

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

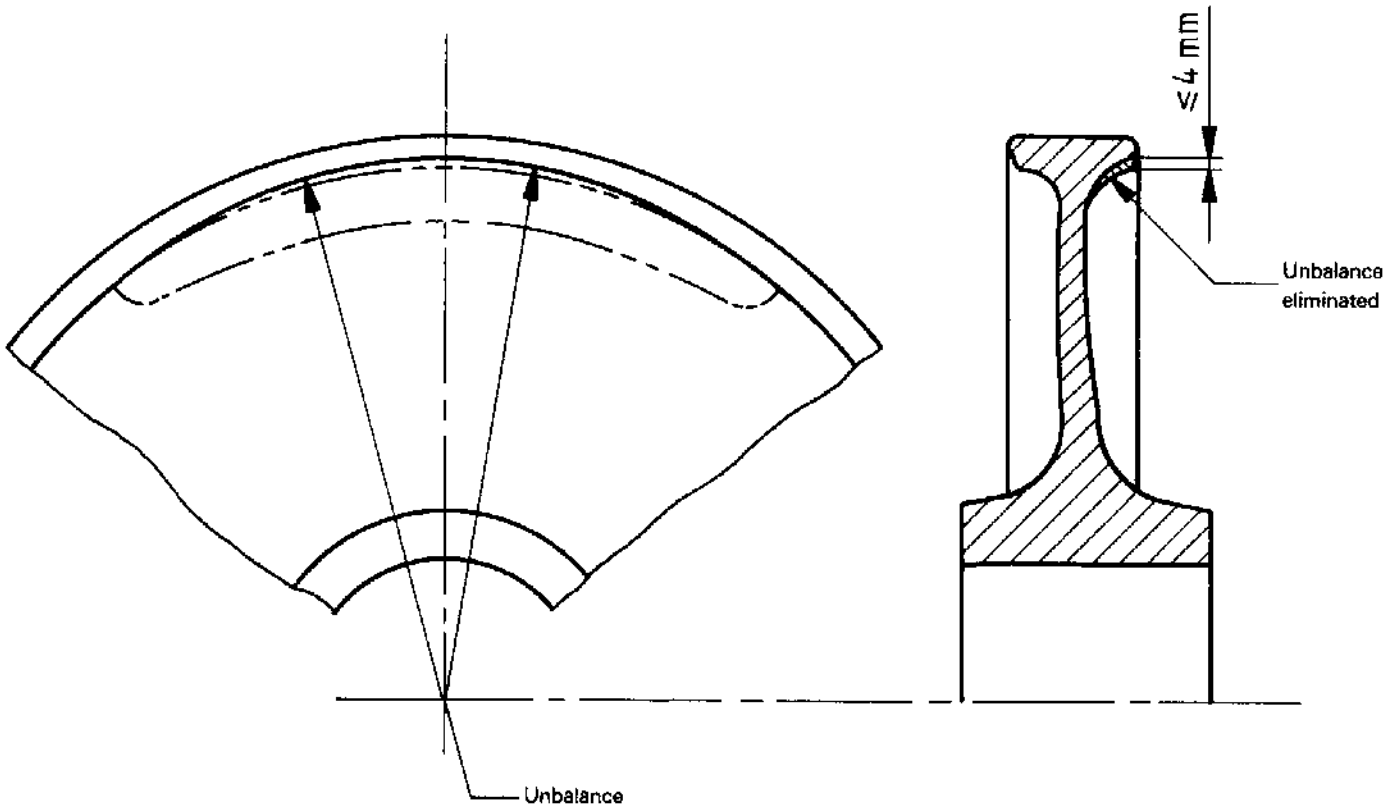

Figure 1 — Correction of unbalance

Dimensions in millimetres

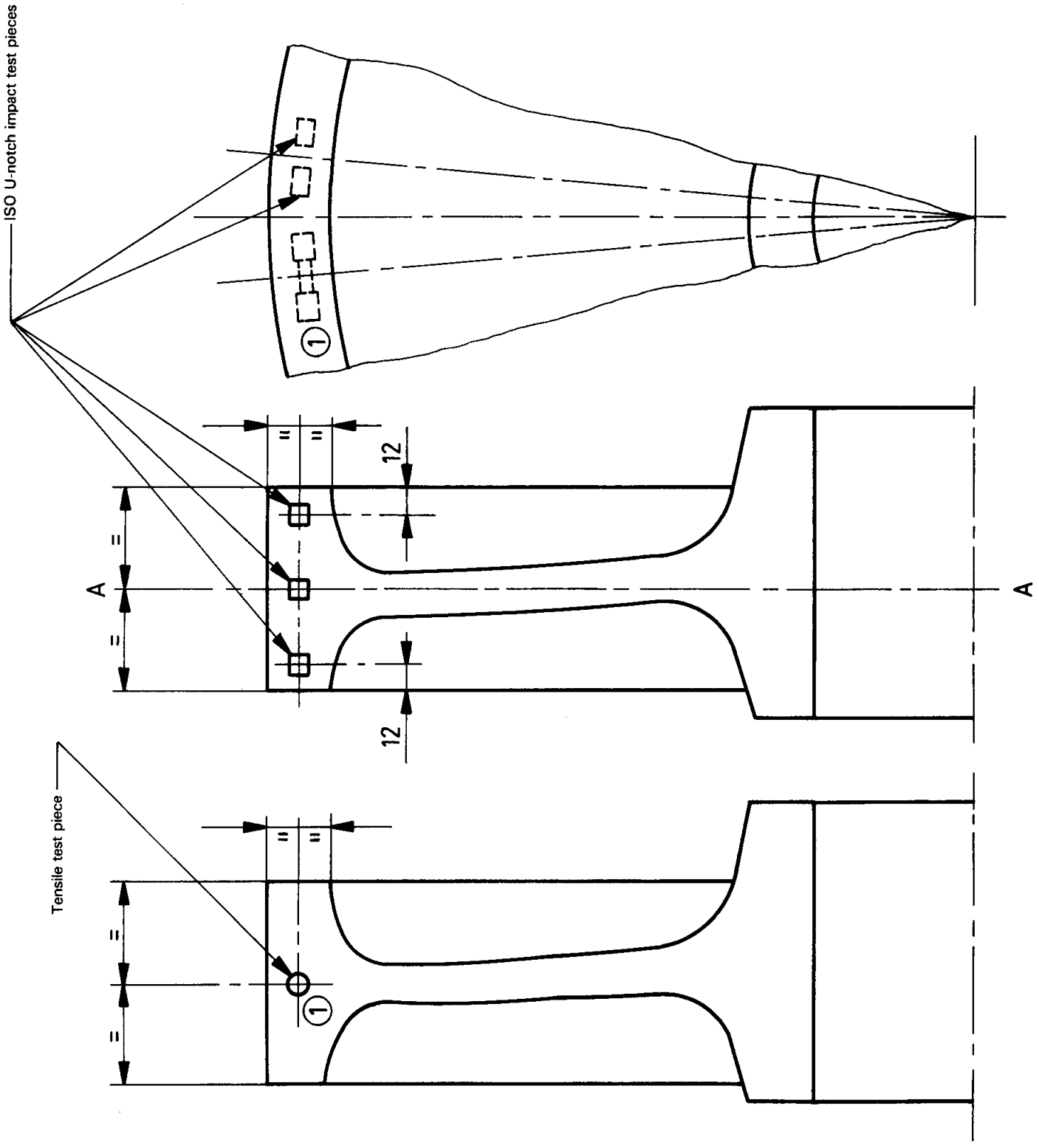

Figure 2 — Position of tensile and impact test pieces

Table 1 — Grades of steel, chemical compositions, types of heat-treatment in delivery condition and mechanical properties [1]

Grade of steel	Chemical composition [2], % (*m/m*), max.					Heat-treatment in delivery condition	Mechanical properties [5]			
	C	Si	Mn	P	S		R_e [6] N/mm² min.	R_m N/mm²	A % min.	KU [7] J min.
C1	—	0,50	1,20	0,040	0,040	— [3]	For documentary purposes	410 to 490	24	—
						N [4]		410 to 490	27	35
C2	—	0,50	1,20	0,040	0,040	— [3]		500 to 650	18	—
						N [4]		520 to 650	20	25
C3	0,70	0,50	0,90	0,040	0,040	— [3]		800 to 940	7	—
						N [4]		800 to 940	10	10

1) Steel grades designated by hardness requirements (see the revision of ISO 1005/6) may also be ordered according to this part of ISO 1005.

2) Cast analysis (see 5.1).

3) Untreated (as rolled or forged).

4) Normalized or normalized and tempered.

5) R_e is the yield stress; R_m is the tensile strength; A is the percentage elongation after fracture ($L_o = 5.65\sqrt{S_o}$); KU is the impact strength for the ISO U-notch test piece at 20 °C.

6) The requirement for R_e shall be regarded as complied with if either the upper yield stress R_{eH} or the 0,2 % non-proportional proof stress $R_{p\,0,2}$ or, where the measured value is under 600 N/mm², the 0,5 % total elongation proof stress $R_{t\,0,5}$ is equal or greater than the value specified for R_e.

7) Mean value of three tests. One of the individual results may be lower than the minimum as specified in the table, provided that it is not less than 70 % of this minimum value.

Table 2 — Permissible deviations between the specified cast analysis and product analysis

Element	Maximum value specified for cast analysis, % (*m/m*)	Permissible deviation in the product analysis, % (*m/m*)
Carbon	0,70	+ 0,03
Silicon	0,50	+ 0,04
Manganese	1,20	+ 0,08
Phosphorus	0,040	+ 0,005
Sulfur	0,040	+ 0,005

Table 3 — Type and number of tests

1	2	3	4	5	6	7	8	9	10
	Heat treatment in delivery condition [1]	**Types of checks and tests**	**Remarks**			**Test unit** [5]	**Number of wheel centres per batch to be subjected to the checks and tests**		**Number of tests per wheel centre**
			[2]	[3]		[4]	Total number of wheel centres in a batch		
							< 250	> 250	
1	All	Chemical analysis [6]	m	a		c	1	1	1
2	N	Tensile test	m	b	h	c, h	1	2	1
3	—	Tensile test	m	b	f	c	1	2	1
4	N	Impact test (KU)	o	b	h	c, h	1	2	3
6	N	Static balancing	o [7]	a	f	w	10 %	10 %	1
7	All	Appearance and dimensions	m	a	f	w	100 %	100 %	1

1) N indicates normalized or normalized and tempered, — indicates untreated (see 4.2).

2) m indicates mandatory tests; o indicates optional tests.

3) The checks and tests shall be carried out
   a) under delegated inspection by the manufacturer's qualified department (see ISO 404), or
   b) in the presence of the purchaser.

4) h indicates that the test shall not be carried out before the specified heat-treatment;
   f indicates that the acceptance tests shall be carried out in the final delivery condition.

5) c indicates wheel centres from the same cast;
   c, h indicates wheel centres from the same cast and heat-treatment batch (see 7.3.2);
   w indicates that the wheel centre is the unit.

6) See 5.1.

7) Only applicable to finished wheel centres (see 4.3.4).