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International Standard 1005/1

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Railway rolling stock material — Part 1 : Rough-rolled tyres for tractive and trailing stock — Quality requirements

Matériel roulant de chemin de fer — Partie 1 : Bandages bruts laminés pour matériel moteur et pour matériel remorqué — Prescriptions de qualité

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

International Standard ISO 1005/1 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in November 1980.

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

Austria	Irak	Spain
Bulgaria	Italy	Sweden
Canada	Japan	Switzerland
China	Korea, Dem. P. Rep. of	Turkey
Czechoslovakia	Korea, Rep. of	United Kingdom
Egypt, Arab Rep. of	Netherlands	USA
Finland	New Zealand	USSR
Germany, F.R.	Poland	Venezuela
Hungary	Romania	
Iran	South Africa, Rep. of	

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

Australia
Belgium
France
India

This International Standard cancels and replaces ISO Recommendation R 1005/1-1969, of which it constitutes a technical revision.

Printed in Switzerland

Railway rolling stock material — Part 1 : Rough-rolled tyres for tractive and trailing stock — Quality requirements

1 Scope and field of appliation

1.1 This part of ISO 1005 specifies requirements for the manufacture and supply of rough-rolled tyres for tractive and trailing stock of unalloyed steels in accordance with table 1 and clause 4.

NOTE — Another International Standard for rough-rolled tyres is in preparation (see table 1, note 7).

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

2 References

ISO 82, *Steel — Tensile testing.*

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

ISO/R 377, *Selection and preparation of samples and test pieces for wrought steel.* [1)]

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

ISO/R 1005/2, *Railway rolling stock material — Part 2 : Rough tyres for trailer stock — Dimensions and tolerances.* [1)]

ISO 5498, *Railway rolling stock material — Ultrasonic acceptance testing.*

ISO 6506, *Metallic materials — Hardness test — Brinell test.*

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

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 International Standard;

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 dimensions of the tyre (see 5.4);

e) if microstructure examination is required (see 5.2.2.1 and table 2);

f) whether the chemical composition may be verified by cast analysis (see 5.1);

g) if macroscopic and macrographic tests are required (see 5.2.2.2, 5.2.2.3 and table 2);

h) if special ultrasonic examination is required (see 5.2.2.4 and table 2);

j) if a restricted Brinell hardness range is required (see 5.2.3 and table 2);

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

m) if a special production process is required (see clause 6);

n) if special inspection is required (see clause 7);

p) if a falling weight or impact test is required (see table 2, note 7);

q) if special preparation and sampling of test pieces is required (see 7.7.2 and 7.7.3.1);

r) if any protection against corrosion is required (see clause 8);

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

4 Classification

The tyres shall be specified in the order or its appended documents according to the grade of steel used, the heat-treatment condition of delivery and any optional tests or inspection required (see table 2, column 4).

1) Under revision.

4.1 Steel grades

This International Standard specifies the following grades of steel in accordance with the properties given in table 1 :

B1 — B2 — B3 — B4 — B5 — B6.

4.2 Types of heat-treatment condition on delivery

The tyres shall be supplied

a) untreated (no symbol) — grades B1 and B2 with no impact properties specified, or

b) normalized or normalized and tempered (symbol N) — grades B1 — B2 — B3 and B4, or

c) immersion quenched and tempered (symbol T) — grades B5 and B6.

Irrespective of the heat-treatment condition ordered, 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

The degree of finish on delivery is rough rolled.

5 Requirements

5.1 Chemical composition

The maximum contents of the various elements are given in table 1. These values apply to the product analysis. If the purchaser agrees, the manufacturer may verify the composition by cast analysis instead of by product analysis.

5.2 Physical properties

5.2.1 Appearance

The tyres shall be free from burr and flash. The surface shall not show any mark other than in the positions specified in the order or its appended documents. Brinell hardness testing impressions may, however, be left on the surface of the rim.

5.2.2 Soundness

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

5.2.2.1 Microstructure

If an examination of the microstructure for quenched and tempered tyres is agreed at the time of enquiry and order, then the requirements for the structure shall also be agreed (see 7.7.3.5).

5.2.2.2 Macroscopic appearance

After polishing, examination of the surface shall reveal no discontinuity.

5.2.2.3 Macrographic appearance

The sulphur print shall not reveal any faults worse than those shown in the prints contained in the album appended to this part of ISO 1005.[1)]

5.2.2.4 Ultrasonic flaw detection test

5.2.2.4.1 When the comparison method of ultrasonic flaw detection testing is to be used as specified in 7.8.9 and ISO 5948, and if the order does not specify details of the acceptance standard, the following shall apply :

Tyres giving rise to no more than 10 defect signals in the rim for which the ratio of the amplitude of the defect signal or supplementary echo to that of the backwall echo of an adjacent sound zone does not exceed 0,25, shall be accepted, provided that there is at least 15 mm between two adjacent defect signals.

5.2.2.4.2 For tests using the distance-gain-size (DGS) method (see ISO 5948), the acceptance standard shall be agreed in the absence of an appropriate International Standard.

5.2.3 Uniformity of hardness

If stated in the order, the difference between the extreme hardness values obtained on tyres of the same grade of steel of similar dimensions, coming from the same batch, shall not exceed 30 HB.

5.3 Mechanical properties

The mechanical properties of the tyres shall be as specified in table 1.

5.4 Dimensional characteristics

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

5.4.2 Tolerances on dimensions and shape, and the permitted machining allowances, shall be as specified in ISO/R 1005/2.

5.5 Manufacturer's brand marks

The marks with their specified dimensions shall be hot-stamped in the positions given in national standards or the order or its appended documents.

1) The album will be incorporated in this document at the time of final publication.

Unless otherwise specified, each tyre 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.

Unless otherwise specified, the marks shall be hot-stamped immediately after rolling, with a height of 8 to 10 mm and a depth of approximately 4 mm, on the plane face situated on the side opposite the flange of the tyre and in such a way as to remain after successive re-turning of the tread. Stamps with acute-angled character forms shall not be used (see 6.4).

6 Manufacture

6.1 Steelmaking process

The tyres 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, unless otherwise agreed.

6.2 Manufacturing process

At the manufacturer's option, the tyres are produced either

— from cropped ingots capable of producing two or more tyres, or

— from cropped blooms.

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 surface defects shall be completely removed before or during manufacture; if this is not possible, the defective sections shall be discarded (see 6.3). The sections of ingots or blooms shall be forged and punched with a forging hammer or a press; they shall be rough shaped by means of a forging hammer, press or roughing mill and finally shaped by rolling supplemented by sizing if necessary. The finished rolled tyres shall comply with 5.4.

The amount of the punched-out portion shall be sufficient for the removal of serious segregations. If these operations leave burrs, which may adversely affect the further manufacture or the use of the tyre, these burrs shall be removed before rolling.

Suitable precautions shall be taken during hot working to ensure that material is not damaged by excessive temperatures (over-heating) 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 of identification marks, the tyres 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.

6.4 Identification of the tyres during manufacture

All ingots, sections and tyres shall be suitably marked at each stage of manufacture so that before delivery each tyre 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 tyre.

6.5 Heat treatment

After forming and marking, the tyres shall undergo, where applicable, the heat treatment specified in the order or its appended documents. As a general rule, the different heat-treatment operations shall be carried out in such a way as to ensure uniformity of structure of comparable parts of the same tyre and of tyres from the same batch (see 4.2).

6.6 Removal of surface defects

6.6.1 Authorized repairs

Surface defects may be eliminated by removal of metal by chipping or machining or by soft grinding, provided that no heat cracking is produced and that the dimensional tolerances are maintained.

Any ovality of tyres when formed and heat treated which does not exceed 6 mm, may be corrected by cold-forming operations without renewal of the heat treatment. If the ovality exceeds 6 mm, hot rectification shall be carried out and all such tyres shall be subjected to a second heat treatment identical to the first.

6.6.2 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

7.1.1 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 2, column 5 shall apply.

7.1.2 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 reponsibility of the manufacturer and to inspect the recorded results.

7.2 Inspection of manufacture

7.2.1 Whether the inspection of the manufacture is the responsibility of the manufacturer's qualified department or of the purchaser, the following shall apply :

7.2.1.1 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 tyres, and seek his 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 and the prior agreement.

7.2.1.2 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 (see 7.5).

7.3 Inspection of the characteristics of the tyres

7.3.1 Types of test

Table 2 specifies the types of test to be carried out and whether they are mandatory or optional.

7.3.2 Unit of test and subdivision into batches

The appropriate unit for each type of test is given in table 2, column 7.

For acceptance testing, the tyres shall be grouped in batches. Each batch shall be formed of tyres produced from the same cast and having undergone the same heat treatment. It may include tyres of different dimensions.

7.3.3 Condition of the tyres when submitted for inspection

When submitted for inspection, the condition of the tyres shall comply with the requirements of table 2, column 6.

7.4 Submission for inspection by the purchaser

The purchaser [see 7.1.1 b)] shall be notified in writing (see 7.5.2) of the date of submission for inspection, stating the number of tyres per type in each batch and the order reference number.

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 or falling weight test (see table 2, note 7).

7.5.2 The manufacturer shall provide the relevant certificates 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), if for that part of the testing he has the delegated responsibility.

7.6 Number of checks and tests

The number of tyres per test unit to be subjected to the checks and the number of tests per tyre are given in table 2, columns 8 to 10.

7.7 Sampling and preparation of samples and test pieces

7.7.1 Sampling

After identifying the batch, the inspector shall select at random the tyre(s) intended for testing and indelibly stamp them.

He shall outline on each of these tyres a sample segment (see figure 1) from which the test pieces shall be taken.

If the falling weight test is required by the order, the marking of sample sections of the tyre(s) shall be carried out after this test has been done and the sample section shall be taken from one of the least deformed parts of the tyre.

7.7.2 Preparation of samples and test pieces

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

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

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

7.7.3.1 Chemical analysis

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

— at least 50 g of millings representing the average of a radial section of the tyre, or

— especially in the case of spectrographic analysis, one sample from the tensile test piece.

7.7.3.2 Falling weight test

The test piece consists of the sample tyre in the heat-treatment condition of delivery.

7.7.3.3 Tensile test

One test piece shall be selected from the sample at the position shown in figure 1.

The test piece shall be prepared in accordance with the requirements of ISO 82, the test piece preferably having a diameter of at least 10 mm with a gauge length of 5 × diameter.

7.7.3.4 Impact test (U-notch)

Three test pieces shall be taken from the sample at the positions shown in figures 1 and 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 (see figure 2).

7.7.3.5 Microstructure examination

If an examination of the microstructure for quenched and tempered tyres is agreed at the time of enquiry and order, then the position of the test piece shall also be agreed.

7.7.3.6 Macroscopy and macrography

The test piece shall consist of a radial slice through the whole cross-section of the tyre with one surface ground or polished sufficiently to eliminate machining marks and to obtain a clear macrographic image.

7.7.3.7 Hardness

Each tyre to be tested (see table 2) shall be subjected to a Brinell hardness test on the plane face opposite the flange. The position selected for identation shall be on a circumference of a radius 35 mm greater than that of the largest bore of the tyre (see figure 3). This position shall be prepared by grinding in order to remove any decarburized material.

7.7.3.8 Ultrasonic test

The test piece shall consist of the tyre after heat treatment. Unless otherwise agreed, it shall, in accordance with ISO 5948, be scanned on the plane face of the rim situated on the side of the flange.

7.8 Test method

7.8.1 Chemical analysis

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

7.8.2 Falling weight test

The falling weight test shall be carried out using a guided hammer. The hammer shall be symmetrical in mass and shape in relation to the guiding plane. Its mass shall be 1 000 kg. The nose of the hammer shall be cylindrical with a radius less than or equal to 100 mm the axis of which is horizontal and in the guiding plane. The centre of gravity of the hammer shall be placed as low as possible in the guiding plane and on the vertical line equidistant from the two guides. The height of the guided part of the hammer shall be appreciably greater than the distance between the guides. The guides shall be rigid, even and vertical; they shall be so arranged that friction, during the fall of the hammer, is reduced to a minimum. The trip gear shall not produce any side movement of the hammer during its release. The anvil and its base shall have a mass of at least 25 times that of the hammer; the mass of the metal anvil shall not be less than 10 000 kg.

Before each test, the tyre to be tested shall be placed vertically below the falling weight apparatus. The work done by each blow of the hammer, expressed in joules, shall be at least equal to 150 times the mass of the tyre, expressed in kilograms.

After each blow, the decrease in internal vertical diameter shall be measured by means of an adjustable gauge graduated in millimetres.

The final blow may be adjusted in relation to the reduction in inside diameter to be obtained.

The temperature of the tyre being tested shall be between 10 and 30 °C.

When a manufacturer does not possess the necessary equipment for carrying out a falling weight test under conditions specified in this International Standard, the test may be replaced by another falling weight test which has been adapted for his own installations and where the conditions have been agreed between the purchaser and the manufacturer.

7.8.3 Tensile test

The tensile test shall be carried out in accordance with the requirements of ISO 82.

7.8.4 Impact test (U-notch)

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

7.8.5 Microstructure examination

The details of microstructure examination shall be agreed at the time of enquiry and order.

7.8.6 Macroscopic examination

The polished surface of the test piece shall be examined with a magnification of not more than 5.

7.8.7 Macrographic examination

If the examination defined in 7.8.6 is satisfactory, the macrographic image of the test piece is obtained by applying to its polished and degreased surface a sheet of gelatine silver bromide paper, first saturated in water containing 2 % by volume of pure sulphuric acid, and leaving for at least 3 min.

7.8.8 Brinell hardness

The Brinell hardness test shall be carried out in accordance with the requirements of ISO 6506.

7.8.9 Ultrasonic flaw detection test

The ultrasonic flaw detection test shall be carried out in accordance with the requirements of ISO 5948.

For ultrasonic flaw detection tests using the comparison method (see ISO 5948), the sensitivity shall be adjusted in such a way that the height of the first backwall echo is 50 mm.

7.8.10 Checking of the appearance

The appearance shall be checked by visual inspection before delivery.

7.8.11 Checking of dimensions

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

7.9 Conclusion of the inspection

Any defects in appearance or dimensions shall result in rejection of the tyre. The same shall apply to any ultrasonic examination revealing defects greater than those which may be tolerated. Any other result not conforming to the required standard shall entail rejection of the corresponding batch subject to the requirements of ISO 404.

Before delivery, all accepted tyres shall be marked by the inspector carrying out the final inspection and the inspector's marks shall be placed in the same position as the manufacturer's marks.

7.10 Retests

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

8 Delivery

Before storage or dispatch, the accepted tyres need only receive a protection against corrosion if required in the order or its appended documents.

In such cases, the method of protection against corrosion shall be 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 tyres should be inspected immediately on arrival at their destination to see if a renewal of the protection is necessary.

9 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.

Table 1 — Grade of steel[1], chemical composition, heat treatment in delivery condition and mechanical properties

Grade of steel[1]	Chemical composition[2], % (*m*/*m*) max.										Heat treatment in delivery condition[3]	Mechanical properties[4]			
	C	Si	Mn	P	S	Cr	Cu	Mo	Ni	V	(Cr + Mo + Ni)		R_{eH} or $R_{p0,2}$[5] N/mm² min.	R_m N/mm²	A % min.	KU J min.[6]	Falling weight test
B1	0,48	0,50	1,20	0,040	0,040	0,30	0,30	0,08	0,30	0,05	0,60	—	For documentary purposes	600 to 720	12	—	The tyre shall be able to withstand under successive impact without breaking or cracking a reduction in internal diameter of f mm, where $f \geqslant 5{,}6 \frac{D^2}{R_m \times e}$ [7]
												N		600 to 720	18	15	
B2	0,58	0,50	0,90	0,040	0,040	0,30	0,30	0,08	0,30	0,05	0,60	—		700 to 820	9	—	
												N		700 to 820	14	10	
B3	0,60	0,50	1,10	0,040	0,040	0,30	0,30	0,08	0,30	0,05	0,60	N		750 to 880	12	10	
B4	0,70	0,50	0,90	0,040	0,040	0,30	0,30	0,08	0,30	0,05	0,60	N		800 to 940	10	10	
B5	0,60	0,50	0,80	0,040	0,040	0,30	0,30	0,08	0,30	0,05	0,60	T		800 to 920	14	15	
B6	0,65	0,50	0,90	0,040	0,040	0,30	0,30	0,08	0,30	0,05	0,60	T		920 to 1 050	12	10	

1) When selecting a steel from table 1, an important factor may be the risk of thermal damage arising from the use of brakes on the tread or from wheel slip. In cases of repeated braking at relatively high speeds, the purchaser should bear in mind that steels with a high carbon content will be more sensitive to thermal cracking than steels with lower carbon content. However, it should be noted that steels with a higher carbon content have a greater strength and wear resistance. Where specifications have been developed primarily to give wear resistance, they may differ considerably in approach from this International Standard. It is intended to prepare a separate International Standard with corresponding steels and material requirements for such service conditions where wear resistance is of primary importance.

2) Product analysis or cast analysis (see 5.1).

3) — = untreated (as rolled); N = normalized or normalized and tempered; T = quenched and tempered.

4) R_{eH} = upper yield stress; $R_{p0,2}$ = 0,2 % proof stress (non proportional elongation); R_m = tensile strength; A = percentage elongation after fracture ($L_0 = 5{,}65\sqrt{S_0}$); KU = impact strength for ISO U-notch test piece at 20 °C. 1 N/mm² = 1 MPa.

5) If the measured 0,5 % total elongation proof stress $R_{t0,5}$ of the steel is not greater than 600 N/mm² then $R_{t0,5}$ may be given instead of R_{eH} or $R_{p0,2}$.

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

7) D is half the sum of the inside and outside diameters of the tyre, in millimetres; R_m is the specified minimum tensile strength, in newtons per square millimetre; e the thickness of the tyre tested, in millimetres.