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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 1005 / I

RAILWAY ROLLING STOCK MATERIAL

TYRES FOR TRAILER STOCK

1st EDITION

March 1969

For each individual country the only valid standard is the national standard of that country.

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BRIEF HISTORY

The ISO Recommendation R 1005/I, *Railway rolling stock material – Tyres for trailer stock*, was drawn up by Technical Committee ISO/TC 17, *Steel*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led, in 1967, to the adoption of a Draft ISO Recommendation based on a corresponding UIC* code.

In January 1968, this Draft ISO Recommendation (No. 1375) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Austria	India	Spain
Belgium	Israel	Sweden
Canada	Italy	Switzerland
Colombia	Korea, Rep. of	Thailand
Czechoslovakia	Netherlands	Turkey
Denmark	New Zealand	U.A.R.
Finland	Norway	United Kingdom
France	Portugal	Yugoslavia
Germany	Romania	
Hungary	South Africa, Rep. of	

Three Member Bodies opposed the approval of the Draft :

Chile
Japan
U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in March 1969, to accept it as an ISO RECOMMENDATION.

* Union Internationale des Chemins de fer (International Union of Railways).

ISO Recommendation R 1005/I March 1969

RAILWAY ROLLING STOCK MATERIAL

TYRES FOR TRAILER STOCK

1. SCOPE

This ISO Recommendation applies to the manufacture of rough-rolled tyres of non-alloy steel for trailer stock.

2. CLASSIFICATION

The two classes of steel specified in this ISO Recommendation are designated

– class BV 1
– class BV 2

3. CHEMICAL COMPOSITION

The tyres should be manufactured from non-alloy steel* of the following chemical purity :

phosphorus	$\leqslant 0.05$ %
sulphur	$\leqslant 0.05$ %
phosphorus + sulphur	$\leqslant 0.09$ %

4. MECHANICAL PROPERTIES

4.1 Tensile strength R_m

The tensile strength for the two classes of steel should be as follows :

– class BV 1 : between 60 and 72 kgf/mm^2 ;
– class BV 2 : between 70 and 84 kgf/mm^2 .

Narrower ranges coming within the limits shown above may be used if indicated on the order.

4.2 Coefficient of quality C

The coefficient of quality (defined in Table 1on the following page) should be as follows :

– tyres which have not been normalised : $C \geqslant 95$ with $A \geqslant 8$ % on a test piece having a gauge length $L_o = 5.65\sqrt{S_o}$, for class BV 2;
– normalised tyres : $C \geqslant 109$.

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* For this steel, the content of elements other than carbon should not exceed the following limits :

manganese	1.20 %	molybdenum	0.05 %
silicon	0.50 %	vanadium	0.05 %
nickel	0.30 %	copper	0.30 %
chromium	0.30 %		

TABLE 1

L_o	C
$8.16\sqrt{S_o}$	$R_m + 2.5A$
$5.65\sqrt{S_o}$ *	$R_m + 2.2A$
$4\sqrt{S_o}$	$R_m + 2A$

* This formula should preferably be adopted.
The other formulae are retained provisionally.

where

L_o is the gauge length used to measure the elongation after fracture, expressed in millimetres;

S_o is the cross-sectional area of the gauge length of the test piece, expressed in square millimetres;

R_m is the tensile strength, expressed in kilogrammes-force per square millimetre;

A is the percentage elongation after fracture.

4.3 Resistance to impact

The tyre should be able to withstand consecutive blows which cause, without breaking or cracking, a decrease f in internal diameter, expressed in millimetres :

$$f \geqslant 0.56 \frac{D^2}{R_m e}$$

where

D is half the sum of the internal and external diameters of the tyre tested, expressed in millimetres;

R_m is the minimum specified tensile strength, expressed in kilogrammes-force per square millimetre;

e is the thickness of the tyre tested, expressed in millimetres.

4.4 Notched bar impact strength KCU

(Applicable only when the tyres are in the normalized condition).

The notched bar impact strength should be as follows :

– class BV 1 : KCU at + 20 °C $\geqslant$ 3 kgf.m/cm^2;
class BV 2 : KCU at + 20 °C $\geqslant$ 2 kgf.m/cm^2.

4.5 Brinell hardness

The difference between the extreme Brinell hardness values of tyres from the same cast should not be more than 30 HB units.

5. PHYSICAL CHARACTERISTICS

5.1 Macrostructure

The sulphur print obtained should not reveal worse faults than those shown in the prints contained in the album forming an Annex to this ISO Recommendation.

5.2 Soundness and appearance

The tyres should be sound throughout and without cracks, blow-holes, inclusions, flaws, burrs, lack of metal, laps, or any other defect detrimental to their use.

6. DIMENSIONAL CHARACTERISTICS

6.1 Tolerances on the dimensions

The tyres should be produced in accordance with standards or drawings, insofar as the form and dimensions and the tolerances on these are concerned. If no tolerances are given, these should be in accordance with ISO Recommendation R 1005/II, *Railway rolling stock material – Rough tyres for trailer stock – Dimensions and tolerances.*

6.2 Mass

In the case of all tyres, any increase in mass resulting from the margin between the dimensional tolerances should not be paid to the supplier; tyres should be invoiced on their theoretical mass, calculated assuming a relative density of 7.85 for the steel, and rounded off to the nearest kilogramme above when the decimal portion is 0.5 or more, or to the nearest kilogramme below when the decimal portion is less than 0.5.

7. IDENTIFYING MARKS

Each tyre should be stamped with the identifying marks defined in the standard or in the drawing, and in particular with

- the number of the cast,
- the manufacturer's mark,
- if applicable, the consecutive number of the tyre,
- the number of the month and the last two figures of the year of manufacture,
- the class of steel (BV 1 or BV 2).

Example : 2320 – XY – 4355 – 2.69 – BV 2

These identifying marks should be hot-stamped immediately after rolling, to a depth of 3 to 4 mm using stamps with blunt edges, on the flat outer surface of the tyre, so that they will not be subsequently removed during the re-turning of the tread.

Next to the identifying marks, a circular recess 20 mm in diameter should be made to a depth of 2 mm, for the purpose of accommodating the accepting inspector's stamp.

8. STEELMAKING PROCESS

The tyres should be made from steel produced by the open hearth or electric process; however, the purchaser may allow other processes which he regards as equivalent.

9. MANUFACTURE OF THE TYRES

9.1 The tyres should be manufactured in accordance with the manufacturer's choice, either

- from ingots, each cut to provide two or more tyres, or
- from cut blooms.

Individual ingots, of special shape and uncut, may only be used with the formal agreement of the purchaser on the order.

9.2 When ingots are used, the top end cropping should be sufficient to ensure that, if a pipe exists

- its greatest transversal dimension does not exceed 30 mm,
- it does not extend beyond an imaginary cylinder concentric to the ingot and equal to 75 mm diameter.

When blooms are used, the cropping should be sufficient to completely eliminate the defective section at the top and bottom of the ingot.

9.3 Surface flaws observed on the ingot sections or the blooms should be completely removed, or, if this is not possible, the defective sections should be discarded.

9.4 The ingot or bloom sections should be forged and punched by means of a power hammer or a press; they should be roughed by means of a power hammer, press or roughing mill.

The punched out portion should be such that

- diameter is not less than 150 mm,
- mass is equal to 5 % at least of the mass of the rough tyre.

If these operations leave burr, it should be removed before rolling.

9.5 During re-heating before hot working, and during hot working itself, the temperature of the ingot or bloom sections, or of rough tyres, should never exceed 1250 °C.

Rolling should be completed at a temperature between 900 and 1000 °C.

9.6 After forging, rolling, finishing and stamping of identifying marks, the tyres should

- in general, be left to cool to ambient temperature, sheltered from draughts, preferably in a covered cooling pit or under a cover, especially in the case of class BV 2 steel; or
- if specified on the order, or if required by the manufacturer, be normalized* after having been allowed to cool without special precautions being taken.

The normalizing treatment of a cast of tyres can also be carried out by mutual agreement between the manufacturer and the purchaser, for the purpose of improving unsatisfactory mechanical properties; in this case, the properties obtained after this operation should conform to those required for normal annealed tyres.

9.7 Generally speaking, all the operations described above should be performed with the greatest care, and in such a way as to ensure the structural homogeneity of the various parts of the same tyre, and that of the tyres from the same cast.

10. REMOVAL OF SURFACE DEFECTS

Surface defects may be eliminated by removing metal with either a machine tool or grinding wheel, provided that the dimensional tolerances are maintained.

A blowpipe may not be used for removing these surface defects.

Any treatment which is carried out with the object of hiding a defect should be strictly forbidden and should result in the rejection of the complete order.

11. SUBMISSION FOR ACCEPTANCE

11.1 During production

11.1.1 The accepting inspector should verify compliance with the requirements of section 9 in relation to the cropping :

- on ingot sections, by visual examination of the cross-section of the cut, during checking;
- on blooms, by macroscopic inspection of the two ends of each bloom;
- on individual ingots, by visual examination of the top end of the ingots after cropping.

The purchaser may permit these verifications to be carried out by the supplier, not in the presence of the inspecting agent.

11.1.2 The accepting inspector should be able to verify the temperature of the rough tyres, that of the tyres after rolling, and that of the furnaces used for the heat treatment.

For this purpose he should have at his disposal

- correctly calibrated optical pyrometers (sighted on the inside surface of the punched hole) to verify the temperature of the blooms and that of the finished tyres, immediately after rolling;
- the charts of correctly calibrated recording pyrometers, to check the temperature of the furnace used for the heat treatment.

The purchaser may dispense with certain or even all of the above-mentioned checks, if he considers this advisable.

* Normalizing should be understood to mean leaving the tyres to cool after rolling until they have reached ambient temperature, then heating them uniformly to a temperature above that of the transformation point, and maintaining them at that temperature for a sufficiently long period, before leaving them to cool in still air sheltered from draughts.

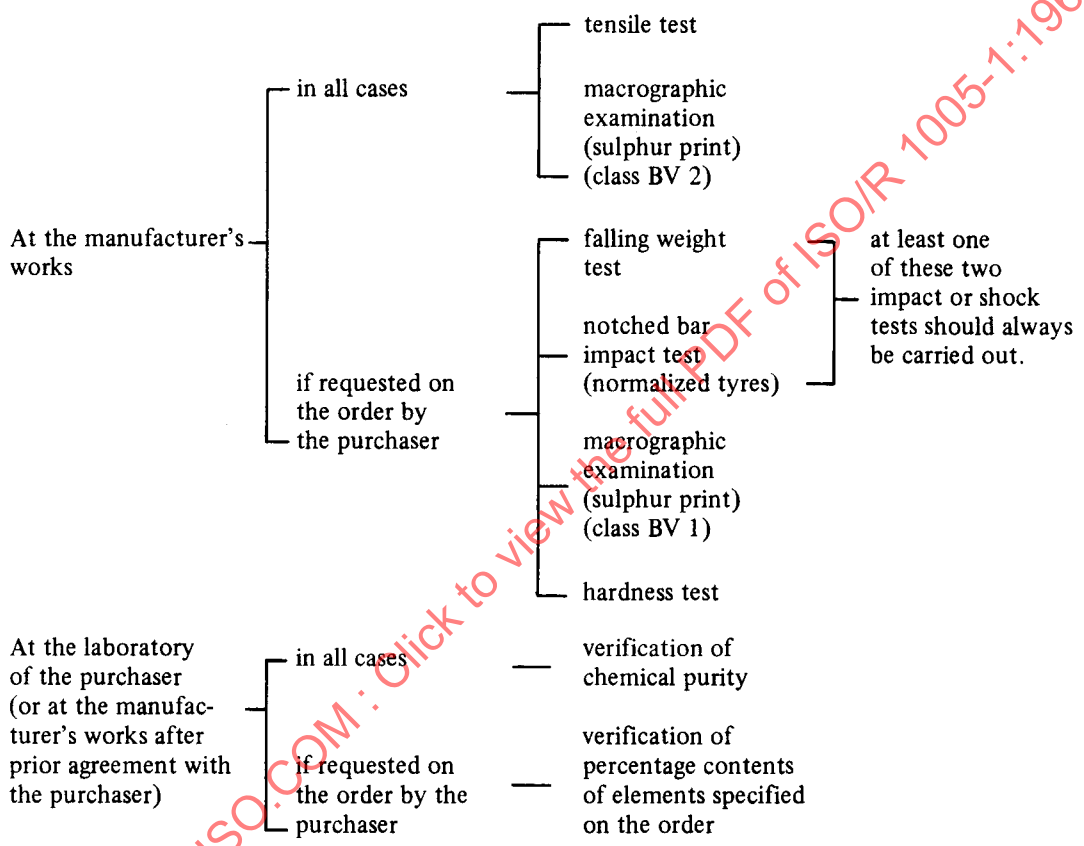
11.2 Finished tyres ready for delivery

The tyres should be submitted for acceptance grouped according to their cast; each cast may include tyres of different types.

Tyres from the same cast, having received the same heat treatment and presented at the same time, form a lot.

12. TYPES AND NUMBERS OF TESTS

The tyres should be subjected to the following verifications and tests :



The falling weight test, tensile test, notched bar impact test and macrographic examination should be performed on the number of tyres indicated in Table 2.

TABLE 2

Number of tyres in lot	Number of tyres to be tested
⩽ 50	1
51 to 100	2
> 100	3

The purchaser may, if he thinks this advisable, reduce the numbers as follows :

- the number of tyres for test taken from lots of between 51 and 65 tyres from 2 to 1;
- the number of tyres for test taken from lots of between 100 and 130 tyres from 3 to 2.

The chemical analysis should be performed on one tyre per cast, the tyre being one of those selected in accordance with Table 2.

The Brinell hardness test should be performed on each tyre.

13. INTERPRETATION OF TESTS – ADDITIONAL TESTS

Any characteristic which does not comply with the specified requirements can result in the rejection of the corresponding lot.

If the purchaser agrees to additional tests, the number of tyres to be submitted to these tests should be defined by special agreement between the supplier and the purchaser.

14. SELECTION AND PREPARATION OF SAMPLES AND TEST PIECES

14.1 Selection of sample

From each lot submitted, the accepting inspector should designate the tyre or tyres for the tests and stamp them. He marks on each of them the sample section from which the test pieces are to be taken.

Where the falling weight test is specified, the sample section should be selected from one of the least deformed parts of the tyre subjected to this test.

14.2 Number and position of test pieces

14.2.1 *Tensile test*. A test piece should be taken from the sample section; it should be adjacent to one of the ends of the section and should be at the point shown in Figure 1.

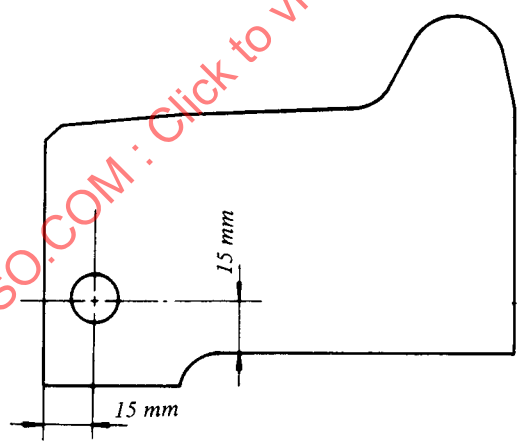


FIG. 1 – **Position of sample for the tensile test**

14.2.2 *Macrographic examination*. A slice of approximately 1 cm thickness and including the entire cross-section of the tyre should be taken from the part adjacent to that where the test piece for the tensile test is situated in the sample section.

14.2.3 *Notched bar impact test*. Three test pieces should be taken from the positions shown in Figure 2 at the extreme opposite end of the sample section from that from which the tensile test piece was taken.

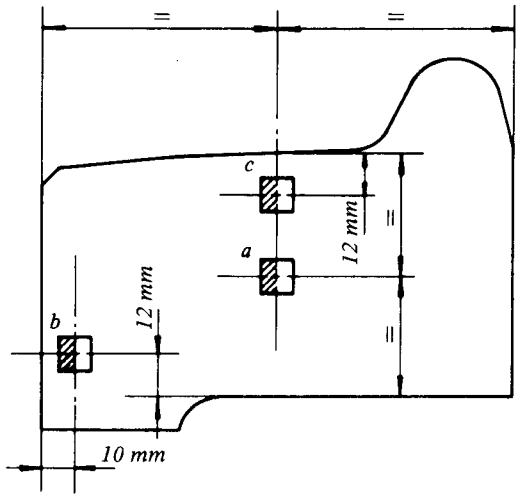


FIG. 2 – Positions of samples for the impact test

14.2.4 *Brinell hardness test*. A ball impression should be made on the flat surface opposite the flange, near to the identifying marks.

14.2.5 *Chemical analysis*. Unless stated to the contrary on the order, a sample representing the average composition of a complete section of one of the test tyres and weighing at least 50 g should be taken.

14.3 Stamping, cutting up and preparation of test pieces

The accepting inspector should stamp the tyre section intended for the macrographic examination; he should also stamp, before cutting up takes place, one end of each of the tensile and impact test pieces.

The marking of the impact test pieces should include a clear identification of those longitudinal faces of the test pieces which, in the tyre, were parallel to the tangent plane of the bore.

The cutting up of the sample and the machining of the test pieces should take place completely cold and precautions should be taken so that these operations do not produce any surface work hardening or appreciable heating of the metal.

After machining, if scratches left by the tool make it likely that the results of the test may be affected, the scratches should be eliminated either by passing through a grinding machine (with abundant spraying) or by polishing with a fine rasp and emery paper, provided that the method of rectification adopted maintains the dimensions and the form of the test piece within the tolerances specified for the corresponding test.

One flat surface of the section for the macrographic examination should be ground.

The test pieces should retain the stamp marks of the accepting inspector.

15. TESTING

15.1 Falling weight test

15.1.1 *Test piece*. The test piece should be a complete tyre.

15.1.2 *Test method*. The falling weight test should be carried out by means of a guided hammer.

The hammer should be symmetrical in mass and shape in relation to the guides. It should weigh 1000 kg.

The striking face of the hammer should terminate in a cylindrical section with a radius not exceeding 100 mm, and the axis of which is horizontal and in the plane of the two guides.

The centre of gravity of the hammer should be placed as low as possible in the plane of the guides and equidistant from the two guides.

The height of the guided section of the hammer should be appreciably greater than the distance between the two guides.

The guides should be absolutely rigid, even and vertical; they should be so arranged that friction caused by the falling hammer is reduced to a minimum.

The trip gear should not produce any side movement in the hammer during its release.

The anvil block and its foundation should have a mass of at least 25 times that of the hammer; the mass of the metal anvil block should not be less than 10 000 kg.

Before each drop takes place, the tyre for testing should be positioned vertically beneath the trip. The work done by each blow of the falling hammer, expressed in kilogramme-force metres, should be at least 15 times the mass of the tyre, expressed in kilogrammes.

After each blow, the decrease in internal vertical diameter should 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 for testing should be between 10 and 25 °C.

After the final blow the tyre should be notched and broken.

15.1.3 *Results to be obtained* : see clause 4.3.

15.2 Tensile test

15.2.1 *Test piece*. The tensile test piece should comply with the requirements of ISO Recommendation R 82, *Tensile testing of steel.*

The gauge length should be calculated, in principle, by means of the formula

$$L_o = 5.65 \sqrt{S_o}$$

The following gauge lengths can, however, be adopted provisionally :

$$L_o = 8.16 \sqrt{S_o}$$

$$L_o = 4 \sqrt{S_o}$$

15.2.2 *Test method*. The tensile test should be carried out in accordance with ISO Recommendation R 82.

15.2.3 *Results to be obtained* : see clauses 4.1 and 4.2.

15.3 Macrographic examination

15.3.1 *Test piece*. The test piece should be the section of the tyre defined in clause 14.2.2.

15.3.2 *Method*. A sheet of gelatine silver bromide paper, saturated in water containing 2 % by volume of pure sulphuric acid, should be applied to the ground and degreased face of the section for at least 3 minutes.

15.3.3 *Results to be obtained* : see clause 5.1.

15.4 Notched bar impact test

15.4.1 *Test piece*. The test piece should comply with the requirements of ISO Recommendation R 83, *Charpy impact test (U-notch) for steel*.

The axis of the cylinder forming the bottom of the notch should be perpendicular to the faces of the test piece which, in the tyre, were parallel to the tangent plane of the bore.

15.4.2 *Test method*. The impact test should be conducted in accordance with ISO Recommendation R 83.

15.4.3 *Results to be obtained* : see clause 4.4.