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ISO RECOMMENDATION

R 1005/V

RAILWAY ROLLING STOCK MATERIAL

CAST WHEEL CENTRES IN NON-ALLOY STEEL

FOR TYRED WHEELS FOR TRAILER STOCK

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BRIEF HISTORY

The ISO Recommendation R 1005/V, *Railway rolling stock material – Cast wheel centres in non-alloy steel for tyred wheels 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. 1379) 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	Hungary	Romania
Belgium	India	South Africa, Rep. of
Canada	Israel	Spain
Colombia	Italy	Sweden
Czechoslovakia	Korea, Rep. of	Switzerland
Denmark	Netherlands	Turkey
Finland	New Zealand	U.A.R.
France	Norway	United Kingdom
Germany	Portugal	Yugoslavia

Two Member Bodies opposed the approval of the Draft:

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/V March 1969

RAILWAY ROLLING STOCK MATERIAL

CAST WHEEL CENTRES IN NON-ALLOY STEEL

FOR TYRED WHEELS FOR TRAILER STOCK

1. SCOPE

This ISO Recommendation applies to the manufacture of cast spoked or solid web wheels, in non-alloy steel, rough-cast, rough-machined, half-finished or fully finished*, for trailer stock, and which are to be tyred.

2. CLASSIFICATION

This ISO Recommendation covers one class of cast wheel centres only, designated A 40 M 1.

3. CHEMICAL COMPOSITION

Wheel centres should be manufactured from non-alloy steel** of the following chemical purity :

phosphorus $\leqslant 0.06\ \%$

sulphur $\leqslant 0.05\ \%$

In the case of steel produced by the acid converter process, the following percentage may be accepted :

phosphorus $\leqslant 0.08\ \%$

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* The terms are defined as follows :

(*a*) *Rough-cast.* A wheel centre obtained by moulding and casting and which, having to be subsequently machined, has not yet undergone any machining whatsoever.

(*b*) *Rough-machined.* A wheel centre having received no final machining, but having been rough-machined on all or certain portions which have to be machined.

(*c*) *Half-finished.* A wheel centre having received final machining on certain portions which have to be machined.

(*d*) *Fully finished.* A wheel in which all portions having to be machined have undergone their final machining.

** 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 %		

4. MECHANICAL PROPERTIES

4.1 Tensile strength R_m

The tensile strength of the wheel centres should be between 40 and 50 kgf/mm^2.

4.2 Coefficient of quality C

The coefficient of quality (as defined in Table 1) of the wheel centres should be

$$C \geqslant 95$$

TABLE 1

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

* 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 wheel centres should be able to withstand consecutive blows which cause a permanent deflection of the machined surface of the boss equivalent to at least 10 % of the length of the spokes or of the radial length of the web without incurring flaws, cracking or breaking.

5. PHYSICAL CHARACTERISTICS

5.1 Soundness and appearance

The wheel centres should be entirely free of piping, blowholes, cracks, lack of metal, or any defect detrimental to their use.

The skin of the components should be free from pronounced roughness.

The finish of machined surfaces should comply with the indications shown on the drawings or comparison specimens.

5.2 Texture

The fractures of tested wheels and of test pieces should show a fine-grained homogeneous structure without trace of brilliant crystals, thereby proving the metal to be free from segregations and satisfactorily normalized.

During machining, no defect should be revealed either in wheel centres delivered as machined or in wheel centres intended for testing.

5.3 Static balance

(To be verified only on half-finished or fully finished wheel centres for which only the rough-machined bore remains to be brought to the final dimension).

The out-of balance of the wheel centre should be capable of correction by a balance weight attached to the wheel centre at a distance of 500 mm from the centre and having a maximum mass of 250 g.*

The radial position and value of the residual out-of-balance should be stamped on the rim as indicated in the standards or drawing.

* For certain vehicles, the work sheets can specify a balance weight for the wheel centres having a maximum mass less than that given above.

6. DIMENSIONAL CHARACTERISTICS

The wheel centres should be manufactured in accordance with the information given in the standards or drawings relating to the shape and dimensions and the tolerances on these.

Failing any specific indications, the machining allowances and tolerances should be those given in Table 2.

TABLE 2

Allowances and tolerances in millimetres

		Unmachined parts			Rough-machined parts		Fully finished parts
		Machining allowances in the event of subsequent machining on the consignee's premises	Tolerances		Machining allowances (when ready for delivery)	Tolerances	Tolerances
			In the event of subsequent machining on the consignee's premises	When maintained in the black condition			
Rim	External diameter	8	+ 8 + 0	—	4	+ 2 + 0	as shown on the drawing
	Width	8	+ 6 + 0	—	4	±1	
	Internal diameter	6	- 0 - 8	- 0 - 8	—	—	
	Out-of-round	—	3	—	—	1	
	Buckle	—	3	—	—	1	
Hub	External diameter	10	+ 8 + 0	+ 8 + 0	—	—	
	Maximum eccentricity	—	5	5	—	—	
	Internal diameter	12	- 0 - 10	—	5	- 0 - 2	
	Width	15	+ 5 + 0	—	3	+ 2 + 0	
Web	Position of the web	—	3	4	—	—	2
	Thickness at the connection with the rim	6	+ 6 + 0	+ 6 + 0	—	—	+ 2 + 0
	Thickness at the connection with the hub	6	+ 6 + 0	+ 6 + 0	—	—	+ 2 + 0
Spokes	Width	—	—	±2	—	—	
	Thickness	—	—	±2	—	—	

7. IDENTIFYING MARKS

Each wheel centre should bear the identifying marks defined in the standard or drawing, and in particular

- the number of the cast,
- the manufacturer's mark,
- the type number,
- the number of the month and the last two figures of the year of manufacture,
- the category of the steel.

The marks should be made at the foundry.

However, when the wheel centre is to be delivered rough-machined, half-finished, or fully finished, and if the final position indicated on the drawing for the identifying marks is machined, it can be accepted that the cast number alone is marked on the rough wheel centre as it comes from the foundry. The other identifying marks should then be stamped on the wheel centre on its delivered state, the cast number itself being re-stamped, if required, on a machined surface.

Cold-stamping on a machined surface can also be carried out in other cases, provided the purchaser agrees.

Example : 835 – XY – 348522 – 2 . 69 – A 40 M 1

8. STEELMAKING PROCESS

The wheel centres should be made from steel produced in a converter, or by the open hearth or electric process.

9. MANUFACTURE OF THE WHEEL CENTRES

Each wheel centre should have cast onto it at the foundry, one or more test blocks for the texture test.

Where the casting of test blocks is specified, these should be attached to certain wheel centres.

The wheel centres should be dressed, fettled, and cleaned of all detachable oxide, and all runners, gates, rises and shrinkage heads should be removed.

After casting, the wheel centres should be normalized* in order to refine the metal and to eliminate residual stresses. The wheel centres should be normalized by cast or portion of a cast.

In general, all these operations should be carried out with the greatest care and in such a way as not to interfere with machining and to ensure the satisfactory appearance of the wheel centres and the homogeneity of structure of the various points of the same wheel centre and that of the wheel centres of the same cast.

* Normalizing should be understood to mean leaving the wheel centres to cool after casting 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.

10. REMOVAL OF SURFACE DEFECTS

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

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.

However, slight filling-in may be carried out if the purchaser has given his prior agreement and provided that it is followed by normalizing.

11. SUBMISSION FOR ACCEPTANCE

11.1 During manufacture

The accepting inspector should be provided with the charts of correctly calibrated recording pyrometers in order to check the temperature of the furnace used for the heat treatment.

The purchaser may dispense with the temperature verifications specified above, if he thinks this advisable.

11.2 Wheel centres

The wheel centres should be submitted for acceptance for the first time after normalizing, while still in the rough state, for the selection of test blocks and the carrying out of tests.

They should again be submitted when ready for delivery, rough-cast, rough-machined, half-finished or fully finished.

The wheel centres should be submitted grouped in casts. Wheel centres submitted for acceptance together from the same cast should be grouped into the same batch.

If the tensile test pieces are not taken from the rim, the batch should comprise at least three wheel centres cast with an attached test block.

12. TYPES AND NUMBERS OF TESTS

The wheel centres should be subjected to the following inspections and tests :

- At the manufacturer's works
  - in all cases
    - tensile test
    - texture test on test piece
  - when specified by the purchaser in the order
    - deflection test
    - texture test on a wheel centre
    - verification of static balancing
- At the laboratory of the purchaser (or at the manufacturer's works, after prior agreement with the purchaser)
  - when specified by the purchaser in the order
    - verification of chemical purity
    - verification of content of constituents specified in the order.

The tensile and deflection tests, the texture test on a wheel centre and the verification of static balancing should be carried out on the number of wheel centres indicated in Table 3 on the following page.

TABLE 3

Number of wheel centres in the batch	Number of wheel centres to be tested	Number of wheel centres of which static balancing is verified
⩽ 100	1	10 % of the number of the batch, rounded to the number above, unless otherwise specified in the order
> 100	2	

The chemical analysis should be carried out on one wheel centre per cast taken from those indicated in the table for the tests.

The texture test on a test piece should be carried out on each wheel centre.

13. INTERPRETATION OF THE TESTS – ADDITIONAL TESTS

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

However, if the purchaser agrees to additional tests, the number of wheel centres to be submitted to these tests should be defined by special agreement between the supplier and the purchaser.

When the result of the texture test is unsatisfactory, the corresponding wheel centres should be submitted to a second normalizing. If a second texture test piece has not been provided for on the wheel centres, a wheel centre selected from those which have undergone this second normalizing should itself be subjected to the texture test.

14. SELECTION AND PREPARATION OF SAMPLES AND TEST PIECES

14.1 Selection of sample

The accepting inspector should select at random from each batch submitted the wheel centre or centres for test and, where applicable, the test blocks for the tensile test and stamp them.

If it is necessary to select the tensile test piece from a test block, although the defelction test or the texture text on a wheel centre is required, the wheel centre or centres for the latter should be selected from those which have no test block.

14.2 Number and position of test pieces

14.2.1 *Tensile test.* If deflection tests or texture tests on a wheel centre are required, and if the dimensions of the rim are sufficient, a test piece should be taken from the wheel centre which has been subjected to these tests, at the position indicated in Figure 1.

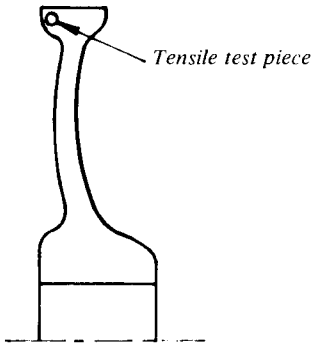

FIG. 1

In other cases, a test piece should be taken from a test block.

The position of the latter in relation to the wheel centre to which it is attached should be left to the discretion of the manufacturer, unless otherwise indicated in the order.

The axis of the test piece should be equidistant from three of the large sides of the test block if the latter is prismatic; it should coincide with the axis of the test block if the latter is cylindrical.

14.2.2 *Texture test on a test piece.* The position of the test piece in each wheel centre should be left to the discretion of the manufacturer.

14.2.3 *Chemical analysis.* The sample should be a piece of the tensile test piece weighing at least 50 g.

14.3 Stamping, cutting up and preparation of test pieces

The test pieces should be cut, stamped and marked in accordance with the indications of the accepting inspector.

The cutting up of the sample and the machining of the test pieces should be carried out when they are cold and taking precautions such that there is no surface work hardening or appreciable heating of the metal.

After machining, if the scratches left by the tool make it likely that the results of the test may be affected, these 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.

Each test block should be attached to a wheel centre and should remain attached to it until the normalizing treatment is completed. Its mould should consist of the same sand and be made in the same way as that of the wheel centre.

The form of the test block should be left to the manufacturer, but its minimum thickness, at the part from which the tensile test piece is taken, should not be less than 25 mm.

The test piece for the texture test should be notched on one face only and as close as possible to the edge. The depth of this notch should be less than one quarter of the thickness of the wheel centre or the test piece.

The wheel centre for the deflection test should be machined to the working dimensions, without, however, taking into account either

the exact value of the offset of the boss in relation to the rim, or

the chamfer of the rim.

The bore, however, should be machined 10 mm over size.

The wheel centre for the texture test on a wheel centre should be subjected to the following operations, where applicable after the deflection test :

- in the case of spoked wheel centres : four spokes situated on two perpendicular diameters should be notched level with the rim and boss;

- in the case of solid web wheel centres : the latter should be notched by two circular cuts made with a tool on either side of the web, at the commencement of the fillet connecting the web with the boss. The cuts should be made with a diamond point chisel and their cumulative depth should be not more than one quarter of the thickness of the web in this portion of the wheel centre.

The test pieces and the sample intended for the chemical analysis should retain the stamps of the accepting inspector.