
International Standard



1005/3

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Railway rolling stock material — Part 3 : Axles for tractive and trailing stock — Quality requirements

Matériel roulant de chemin de fer — Partie 3 : Essieux-axes pour le matériel moteur et pour le 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 1005/3 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	Iran	Romania
Bulgaria	Italy	Spain
China	Japan	Sweden
Czechoslovakia	Korea, Dem. P. Rep. of	Switzerland
Egypt, Arab Rep. of	Korea, Rep. of	Turkey
Finland	Netherlands	United Kingdom
Germany, F.R.	New Zealand	USSR
Hungary	Poland	Venezuela

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

Australia
Belgium
France
India
South Africa, Rep. of

This International Standard cancels and replaces ISO Recommendation R 1005/3-1969, of which it constitutes a technical revision.

Railway rolling stock material — Part 3 : Axles 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 axles for tractive and trailing stock of unalloyed and alloyed steels in accordance with table 1 and clause 4.

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 643, *Steels — Micrographic determination of the ferritic or austenitic grain size*.²⁾

ISO 5948, *Railway rolling stock material — Ultrasonic acceptance testing*.

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 degree of finish (see 4.3);
- e) if a check analysis is required (see 5.1.2);
- f) if a microstructure test for uniformity and grain size is required (see 5.2.2.2 and table 3);
- g) the types of tests to be carried out (see 5.2.2.3, 7.3.1, 7.7.3.5, 7.8.5 and table 3);
- h) the dimensional characteristics (see 5.4.1);
- j) if any special marking is required (see 5.5);
- k) the conditions of inspection required (see 7.1);
- m) if special preparation and sampling of test pieces is required (see 7.7.2);
- n) the method of protection against corrosion (see 8.1);
- p) if the conditions of guarantee are to be agreed (see clause 9).

4 Classification

The axles shall be specified in the order or its appended documents according to the grade of steel used, the heat-treatment condition of delivery and the degree of finish and any optional tests or inspection required (see table 3, column 4).

4.1 Steel grades

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

- a) unalloyed steels A1 and A2;
- b) alloyed steels A3 and A4.

1) Under revision.

2) At present at the stage of draft. (Revision of ISO/R 643.)

4.2 Types of heat-treatment condition on delivery

The axles shall be supplied

- a) untreated [no symbol¹⁾] — all grades, or
- b) normalized or normalized and tempered (symbol N) — grades A1 and A2, or
- c) quenched and tempered (symbol T) — grades A1, A2, A3 and A4.

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 may be as follows :

- a) rough-forged or rough-rolled when the axle has been obtained by hot-forging or rolling, may or may not have been subjected to consecutive heat treatment, and has not yet undergone any machining whatsoever;
- b) rough-machined, when the axle has received no final machining, but has been rough-machined on all or only certain portions which have to be machined;
- c) half-finished, when the axle has received final machining on certain sections which have to be machined and are considered as finished, the other portions indicated as rough-machined, having received no final machining;
- d) finished, when all portions of the axle having to be machined have undergone their final machining.

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

Grade of steel	Chemical composition ¹⁾ , (m/m) max.									Heat-treatment in delivery condition ²⁾	Mechanical properties ³⁾			
	C	Si	Mn	P	S	Cr	Cu	Mo	V		R_e ⁴⁾ N/mm ² min.	R_m N/mm ²	A % min.	KU J min. ⁵⁾
A1 ⁶⁾	0,40	0,50	1,20	0,04	0,04	0,30	0,30	0,08	0,05	N	300	520 to 650	22	25
										T	350	550 to 700	24	40
A2	0,50	0,50	1,20	0,04	0,04	0,30	0,30	0,08	0,05	N	360	600 to 750	17	20
										T	390	620 to 770	19	25
A3	0,40	0,50	1,60	0,04	0,04	0,50	0,30	0,40	0,10	T	420	650 to 800	19	40
A4	0,30	0,50	0,80	0,04	0,04	1,20	0,30	0,35	0,10	T	420	650 to 800	19	40

1) See 5.1.1.

2) N = normalized or normalized and tempered, T = quenched and tempered (see 4.2, footnote 1, and 7.7.2, paragraph 2).

3) R_e = yield strength (see footnote 4), R_m = tensile strength, A = percentage elongation after fracture ($L_o = 5,65\sqrt{S_o}$), KU = impact strength for ISO U-notch test piece at 20 °C. 1 N/mm² = 1 MPa.

4) 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 $R_{p0,2}$ or, where the measured value is under 600 N/mm², the 0,5 % total elongation proof stress $R_{t0,5}$ is equal to or greater than the value specified for R_e .

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

6) If this steel is ordered in the untreated (hot-rolled or hot-forged) condition under the grade designation A0 instead of A1, then no tests on heat-treated test pieces (see table 3) are to be carried out and the following mechanical properties apply to the delivery condition :

$R_e = 280$ N/mm² min., $R_m = 500$ to 650 N/mm², $A = 20$ % min., $KU = 20$ J min.

1) With the exception made in table 1, footnote 6, the following applies where the untreated condition is ordered :

a) The purchaser may specify an analysis range. In this case, the responsibility for the attainment of the required mechanical properties is that of the works carrying out the heat treatment.

b) If any analysis range is not ordered, the manufacturer should ensure, to the purchaser's satisfaction, that axles which are delivered in the untreated condition for subsequent heat treatment, are capable of meeting the mechanical properties specified in table 1.