
International Standard



3305

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Plain end welded precision steel tubes — Technical conditions for delivery

Tubes de précision en acier, soudés, à extrémités lisses — Conditions techniques de livraison

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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 3305 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*.

This second edition cancels and replaces the first edition (ISO 3305-1976), 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.

Plain end welded precision steel tubes — Technical conditions for delivery

1 Scope and field of application

This International Standard specifies the technical conditions for delivery of welded tubes with plain ends, manufactured from the grades of steel shown in table 2, with precision dimensional tolerances and in those dimensions shown in table 9 which have been selected from ISO 4200.

Tubes in accordance with this International Standard are used mainly for purposes where importance attaches to dimensional accuracy and, if required, small thicknesses and surface finish.

If such tubes are intended for use in hydraulic piping equipment, they shall be used only in the annealed or normalized delivery condition.

2 References

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

ISO 2604/3, *Steel products for pressure purposes — Quality requirements — Part 3: Electric resistance and induction-welded tubes.*

ISO 3545, *Steel tubes and tubular shaped accessories with circular cross-section — Symbols to be used in specifications.*

ISO 4200, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length.*

ISO 6892, *Metallic materials — Tensile testing.*

ISO 8492, *Metallic materials — Tubes — Flattening test.*¹⁾

ISO 8493, *Metallic materials — Tubes — Drift expanding test.*²⁾

3 Symbols

D	= Outside diameter of the tube
T	= Thickness of the tube wall
R_m	= Tensile strength in newtons per square millimetre
R_{eH}	= Upper yield strength in newtons per square millimetre

1) At present at the stage of draft. (Revision of ISO/R 202-1961 which remains in force until publication of ISO 8492.)

2) At present at the stage of draft. (Revision of ISO/R 166-1960 which remains in force until publication of ISO 8493.)

A	= Elongation after fracture, as a percentage, of original gauge length (L_0), $L_0 = 5,65 \sqrt{S_0}$
S_0	= Cross-sectional area of the gauge length
BK	= Cold-finished as-drawn
BKW	= Lightly cold-worked
GBK	= Annealed in controlled atmosphere
GZF	= Annealed in controlled atmosphere and descaled
NBK	= Normalized in controlled atmosphere
NZF	= Normalized in controlled atmosphere and descaled

4 Information to be supplied by the purchaser

4.1 Mandatory information

The purchaser shall state the following details in his enquiry and order:

- quantity;
- reference to this International Standard;
- grade of steel;
- required condition of tubes at delivery;
- outside diameter and thickness;
- length.

4.2 Optional conditions

Certain alternatives are permitted; other supplementary requirements may be specified and the purchaser shall state his requirements in his enquiry and order; if he does not do so, supply will be made at the option of the manufacturer.

4.3 Designation

The tubes shall be designated in the following sequence by

- the name of the product;
- reference to this International Standard;
- the grade of steel, the condition of tubes at delivery;
- the outside diameter and the thickness.

Example:

Welded precision steel tubes, in accordance with ISO 3305, in steel R37, annealed in a controlled atmosphere (GBK), of outside diameter 25 mm, thickness 2 mm, in random lengths, shall be designated as

Steel tubes ISO 3305-R37-GBK-25 × 2

5 Manufacturing processes

5.1 Steel-making processes and deoxidation

The tubes shall be manufactured from a steel produced by an open or electric hearth, or one of the basic oxygen steel-making processes.

The method of manufacture and deoxidation process is left to the option of the manufacturer.

At the purchaser's request, the supplier shall indicate the steel-making process and the deoxidation procedure used.

Rimmed steel is permitted for steel grades R28, R33 and R37.

5.2 Tube-making process

The tubes shall be manufactured from either hot- or cold-rolled steel strip longitudinally welded continuously by the passage of an electric current across the abutting edges without the addition of filler metal. They are normally cold-finished on both the inside and the outside surfaces. For certain applications, the tubes may be heat-treated. The condition of the tubes at delivery shall be chosen from table 1.

5.3 Heat treatment; delivery condition

The tubes are normally delivered in one of the conditions shown in table 1.

6 Chemical composition, mechanical properties and weldability

6.1 Chemical composition

6.1.1 Ladle analysis

On ladle analysis, the steel shall show the composition given in table 2, appropriate to the steel type specified.

Table 1 — Delivery condition

Description	Explanation	Symbol	Mechanical properties
Cold-finished/hard (cold-finished as-drawn)	No heat treatment after the last cold-finishing process. For this reason the tubes have only slight workability, concerning the extent of which no guarantee can be given.	BK	See table 3
Cold-finished/soft (lightly cold-worked)	After the last heat treatment, there is a light finishing pass (cold pass); with proper subsequent processing the tube can be cold-formed within certain limits (bending, expanding, etc.).	BKW	See table 4
Annealed	After the final cold-finishing process, the tubes are annealed in a controlled atmosphere.	GBK	See table 5
	After the annealing treatment, the tubes are descaled mechanically or chemically (pickled).	GZF	
Normalized	The tubes are heated to a temperature above the upper transformation point and cooled. Both stages of heat treatment are carried out in a controlled atmosphere.	NBK	See table 6
	After the normalization treatment, the tubes are descaled mechanically or chemically (pickled).	NZF	

Table 2 — Chemical composition on ladle analysis

Grade ¹⁾	C max.	Si max.	Mn max.	P max.	S max.
	%	%	%	%	%
R28	0,13 ²⁾	—	0,60	0,050	0,050
R33	0,16 ²⁾	—	0,70	0,050	0,050
R37	0,17 ²⁾	0,35	0,8	0,050	0,050
R44	0,21	0,35	1,2	0,050	0,050
R50	0,23	0,55	1,6	0,050	0,050

1) The designations used are provisional.
2) Rimmed steel may be used for steel grades R28, R33 and R37. If used for R33 and R37, the carbon content may be increased to 0,19 % max.

6.1.2 Product analysis

If a check analysis is required on tubes made from killed steel, the permissible deviations given in ISO 2604/3 apply.

6.2 Mechanical properties

6.2.1 The mechanical properties depend on the delivery condition. They are specified in tables 3, 4, 5 and 6.

For tubes delivered in the annealed condition, the yield stress may be taken as 50 % of the minimum tensile strength given in table 5 for the purpose of calculating the test pressure.

Table 3 — Mechanical properties in the cold-finished, as-drawn condition — BK

Grade	R_m min.	A min. on $5,65 \sqrt{S_0}$
	N/mm ²	%
R28	400	8
R33	420	6
R37	450	6
R44	520	5
R50	600	4

Table 4 — Mechanical properties in the lightly cold-worked condition — BKW

Grade	R_m min.	A min. on $5,65 \sqrt{S_0}$
	N/mm ²	%
R28	350	10
R33	370	10
R37	400	9
R44	450	8
R50	550	7

Table 5 — Mechanical properties in the annealed condition — GBK and GZF

Grade	R_m min.	A min. on $5,65 \sqrt{S_0}$
	N/mm ²	%
R28	270	30
R33	320	27
R37	340	26
R44	400	24
R50	480	23

Table 6 — Mechanical properties in the normalized condition — NBK and NZF

Grade	R_{eH} min.	R_m min.	A min. on $5,65 \sqrt{S_0}$
	N/mm ²	N/mm ²	%
R28	155	280	28
R33	195	320	25
R37	215	360	24
R44	255	430	22
R50	285	490	21

6.2.2 The tubes shall meet the appropriate requirements of the tests given in clause 9 (see tables 7 and 8).

6.3 Weldability

Tubes in the annealed or normalized condition are suitable for welding without special precautions. For cold-finished tubes which are welded or brazed, the mechanical properties in the heat-affected zone may be affected by the welding temperature.

7 Dimensions, masses and tolerances

7.1 Dimensions and masses

7.1.1 Diameters and thickness

The dimensions for outside and inside diameter and thickness are given in table 9.

7.1.2 Masses

The masses per unit length are given in ISO 4200.

7.1.3 Lengths

Concerning lengths, a distinction is drawn between:

- random lengths between 2 and 7 m: these are supplied if, when ordering, no special agreement is reached concerning tube length;
- exact length.

7.2 Tolerances

7.2.1 Diameter

The permissible variations on outside and inside diameter apply to cold-finished/hard and cold-finished/soft tubes, and are given in table 9. As a result of distortion during annealing, with annealed and normalized tubes, the variations in diameter are greater; the permissible values are as follows:

Thickness, T (mm)	Tolerance
Outside diameter, D (mm)	
$T/D \geq 1/20$	the values given in table 9
$T/D < 1/20$ and $T/D \geq 1/40$	1,5 times the values given in table 9
$T/D < 1/40$ and $T/D \geq 1/60$	twice the values given in table 9
$T/D < 1/60$	2,5 times the values given in table 9

It is not possible in all cases to apply simultaneously all three permissible variations for outside diameter, inside diameter and thickness. Tubes are generally ordered to outside diameter and thickness.