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INTERNATIONAL STANDARD ISO 2937

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Plain end seamless steel tubes for mechanical application

Tubes sans soudure, en acier, à extrémités lisses pour usages mécaniques

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FOREWORD

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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 2937 was drawn up by Technical Committee ISO/TC 5, *Metal pipes and fittings,* and circulated to the Member Bodies in February 1973.

It has been approved by the Member Bodies of the following countries :

Austria	Israel	Sweden
Belgium	Italy	Switzerland
Bulgaria	Mexico	Thailand
Canada	Netherlands	Turkey
Denmark	Norway	United Kingdom
Finland	Portugal	U.S.S.R.
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The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
Germany

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Plain end seamless steel tubes for mechanical application

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of hot-finished seamless steel tubes for mechanical and general engineering purposes.

These tubes are intended for use with or without subsequent machining operations.

2 REFERENCES

ISO 336, *Plain end steel tubes, welded or seamless — General table of dimensions and masses per unit length.*

ISO 375, *Steel — Tensile testing of tubes.*

ISO/R 404, *General technical delivery requirements for steel.*

ISO 2566/I, *Steel — Conversion of elongation values — Part I : Carbon and low alloy steels.*

ISO 2605, *Steel products for pressure purposes — Quality requirements — Part 2 : Wrought seamless tubes.*[1)]

3 DESIGNATION FOR THE ORDER

The tubes shall be designated by reference to this International Standard, giving the grade of steel, outside diameter and thickness, quantity required and, in the case of exact lengths, the value imposed.

Example : Tubes according to ISO 2937, steel grade TS 1, 60,3 mm D, 5 mm thick, . . . kg.

In addition to the above, the purchaser shall state the following details :

a) procedure for tests;

b) documents to be provided.

If the purchaser has special requirements concerning heat treatment, surface protection and packing, these shall also be stated.

1) At present at the stage of draft.

4 MATERIAL

4.1 Steelmaking process

The steel shall be produced by the open hearth, electric or one of the basic oxygen processes. Other processes may be used by agreement between the purchaser and the manufacturer. If he so requests, the purchaser shall be informed of the steelmaking process used.

4.2 Deoxidation

The steel grades TS 1, TS 4 and TS 9 may be semi-killed. Grades TS 18 and C 35 shall be fully killed.

5 MANUFACTURE OF THE PRODUCT

The tubes shall be manufactured by a seamless process.

6 CONDITION OF PRODUCT AT DELIVERY

The tubes are normally delivered in the hot-finished condition and with properties in accordance with table 3. If required, however, by agreement between the purchaser and manufacturer, a normalizing or other heat treatment may be carried out.

7 CHEMICAL COMPOSITION

7.1 Ladle analysis

The steel shall show on ladle analysis the composition given in table 1 appropriate to the steel grade specified.

TABLE 1 – **Chemical composition (ladle)**

Grade	C %	Si %	Mn %	P % max.	S % max.
TS 1	⩽ 0,16		0,30 to 0,70	0,050	0,050
TS 4	⩽ 0,17	⩽ 0,35	0,40 to 0,80	0,045	0,045
TS 9	⩽ 0,21	⩽ 0,35	0,40 to 1,20	0,045	0,045
TS 18	⩽ 0,23	⩽ 0,35	0,80 to 1,50	0,045	0,045
C 35	0,32 to 0,39	0,15 to 0,40	0,50 to 0,80	0,035	0,035

NOTE – Grades TS 1, TS 4, TS 9 and TS 18 are in accordance with ISO 2605. Grade C 35 is in accordance with document ISO/TC 17/SC 4 N 505.

7.2 Product analysis

If a check analysis on the product is required, the permissible deviations given in table 2 apply to the ladle analysis specified in table 1.

TABLE 2 – **Permissible deviations from the specified composition**

Element	Maximum of specification range	Permissible deviation from the specified composition
C	⩽ 0,40	± 0,03
Si	⩽ 0,50	± 0,05
Mn	⩽ 2,0	± 0,10
P	⩽ 0,050	+ 0,005
S	⩽ 0,050	+ 0,005

NOTE – The deviations, other than when maxima only are specified, apply either above or below the specified limits of the range but not both above and below for the same element from different sample products from the same cast. When maxima only are specified, the deviations are positive only.

8 MECHANICAL AND TECHNICAL PROPERTIES

8.1 Mechanical properties

The tubes shall conform to the requirements of table 3.

TABLE 3 – **Mechanical properties**

Grade	R_{eL} min.		R_m		Elongation min. A % on $5{,}65\sqrt{S_o}$
	N/mm^2	kgf/mm^2	N/mm^2	kgf/mm^2	
TS 1	195	20	320 to 440	33 to 45	25
TS 4	215	22	360 to 480	37 to 49	24
TS 9	235	24	410 to 530	42 to 54	22
TS 18	285	29	490 to 610	50 to 62	21
C 35	275	28	540 to 660	55 to 67	20

8.2 Weldability

Steel grades TS 1, TS 4, TS 9 and TS 18 are generally regarded as being weldable. Precautions are usually required in welding steel grade C 35. However, the general weldability of these steels cannot be guaranteed as the behaviour of the steels during and after welding is dependent not only on the steels but also on the size of the tubes, the welding conditions and the final use for which the steel is employed.

9 APPEARANCE

The tubes shall have a mill finish corresponding to the manufacturing process employed and the heat treatment given. Ends shall be cut nominally square with the axis of the tube and be free from burrs.

The requirements concerning surface defects, rectification and internal defects given in 8.1, 8.2 and 8.3 of ISO/R 404 apply.

10 DIMENSIONS AND TOLERANCES

10.1 Dimensions

The dimensions shall be in accordance with the values shown in table 4.

TABLE 4 — **Nominal dimensions**

Dimensions in millimetres

Outside diameter *D*	Thickness *a*																							
	3,2	3,6	4,0	4,5	5,0	5,4	5,9	6,3	7,1	8,0	8,8	10	11	12,5	16	20	25	30	36	40	45	50	55	60	65
33,7 38 42,4																									
48,3 60,3 76,1																									
88,9 101,6 114,3																									
139,7 168,3 193,7																									
219,1 244,5 273																									
323,9 355,6 406,4																									

10.2 Tolerances

10.2.1 *Outside diameter*

According to ISO D_2 : ± 1 % with a minimum of ± 0,5 mm.

10.2.2 *Thickness*

a) $\frac{a}{D} \leqslant 3$ % according to ISO T_1 : ± 15 %

b) $3 < \frac{a}{D} \leqslant 10$ % according to ISO T_2 : ± 12,5 %

c) $\frac{a}{D} > 10$ % $\begin{cases} D \leqslant 168{,}3 \text{ according to ISO } T_2 : \pm 12{,}5\ \% \\ D > 168{,}3 \text{ according to ISO } T_3 : \pm 10\ \% \end{cases}$

where

a is the specified thickness in millimetres;

D is the specified outside diameter, in millimetres.

10.3 Straightness

The deviation from straightness shall not exceed 1,5 in 1 000 when measured over the total length of each tube. Closer straightness tolerances may be agreed between the purchaser and manufacturer.

10.4 Mass

The theoretical masses per metre are obtained by the calculation method laid down in ISO 336, with the tolerances :

± 10 % per tube,

± 7,5 % per load above 10 t.

10.5 Lengths

Unless otherwise stated by the purchaser, the tubes will be supplied in random lengths.

If exact lengths are required, the precise value must be stated by the purchaser at the time of ordering, in which case exact lengths shall be supplied with a tolerance on the stated length as follows :

6 m long and over : $^{+\ 15}_{0}$ mm

less than 6 m : $^{+\ 10}_{0}$ mm

11 TESTS

The purchaser shall indicate in his enquiry and order which of the five verification procedures listed in clause 4 of ISO/R 404 shall be followed.

The following tests shall be carried out :

- visual inspection;
- tensile test.

11.1 Visual inspection

Each tube shall be subjected to visual inspection.

11.2 Tensile test

11.2.1 *Sampling*

The test pieces shall be taken from test samples cut from the ends of the tubes at the following rate :

- for $D < 101,6$ mm : one test per batch of 400 tubes;
- for $D \geqslant 101,6$ mm : one test per batch of 200 tubes.

If the number of tubes is less than 400 or 200 respectively, this part of a batch shall be treated as one batch.

A batch is a convenient quantity of tubes of the same size and the same grade and steel condition such that a suitable number of tubes taken at random for the purpose of testing will adequately represent the batch as a whole.

From each tube selected for testing, one test piece shall be prepared.

The test piece may be taken longitudinally or transversely at the option of the manufacturer and the dimensions shall comply with ISO 375.

11.2.2 *Procedure*

The tensile test shall be carried out at room temperature in accordance with ISO 375. In this test, the tensile stength R_m, the yield stress R_{eL} and the elongation A in per cent shall be determined and the values obtained shall correspond to those of table 3.

The percentage elongation shall be reported with reference to a gauge length of $5,65\sqrt{S_o}$. If other gauge lengths are used, the corresponding elongation on $5,65\sqrt{S_o}$ shall be obtained by reference to ISO 2566/I. In cases of dispute, a gauge length of $5,65\sqrt{S_o}$ shall be used.

12 RE-TESTS

The requirements of 6.5 and 7.6 of ISO/R 404 apply.

13 DOCUMENTS

The purchaser shall state at the time of enquiry and order which of the documents permitted by clause 4 of ISO/R 404 are to be provided.

14 MARKING

14.1 The tubes shall be legibly marked to show :

a) the manufacturer's mark;

b) the identification symbol for the grade of steel.

14.2 For tubes of small diameter which are delivered in bundles, the information in 14.1 may be marked on a label fixed securely to the bundle or crate in which they are sent.

15 PROTECTION FOR TRANSPORT

Unless otherwise agreed between the purchaser and manufacturer, the tubes may be supplied without protection or with the manufacturer's standard mill protection.

16 PACKING

Packing shall be agreed between the purchaser and manufacturer.