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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Hollow steel bars for machining

ERRATUM

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In table 4, line $D = 132$, Series 4, the value of a should be "26" instead of "25".

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Hollow steel bars for machining

Barres creuses en acier, pour usinage

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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 2938 was drawn up by Technical Committee ISO/TC 5, *Metal pipes and fitting,* and circulated to the Member Bodies in February 1973.

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

Australia	India	Romania
Austria	Israel	South Africa, Rep. of
Belgium	Italy	Sweden
Bulgaria	Mexico	Switzerland
Canada	Netherlands	Thailand
Denmark	New Zealand	Turkey
Finland	Norway	United Kingdom
France	Portugal	U.S.S.R.

The Member Body of the following country expressed disapproval of the document on technical grounds :

Germany

Printed in Switzerland

Hollow steel bars for machining

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of thick-walled seamless hollow steel bars intended for the manufacture of tubular and annular machined parts.

2 REFERENCES

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.*

3 DESIGNATION FOR THE ORDER

The hollow bar shall be designated by reference to this International Standard, giving the grade of steel, the condition of the steel, outside and inside diameters, quantity required and, in the case of exact lengths, the value imposed.

Example : Hollow bar according to ISO 2938, steel grade 1, normalized, D 63 mm, ID 32 mm,. . . kg, in random lengths.

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 normalizing, surface protection and packing, these shall also be stated.

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 shall be fully killed.

5 MANUFACTURE OF THE PRODUCT

The hollow bars shall be manufactured by a seamless process and may be hot or cold finished at the option of the manufacturer.

6 CONDITION OF PRODUCT AT DELIVERY

6.1 Hollow bars 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 the manufacturer, a normalizing or other heat treatment may be carried out.

6.2 Unless otherwise agreed in the enquiry and order, cold-finished hollow bars shall be supplied in the normalized condition.

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 %	S %
1	⩽ 0,20	⩽ 0,50	⩽ 1,6	⩽ 0,045	⩽ 0,045
2	0,32 to 0,39	0,15 to 0,40	0,50 to 0,80	⩽ 0,035	⩽ 0,035

NOTE – Grade 2 is in accordance with Grade C 35 e of 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 hollow bars shall conform to the requirements of table 3.

For heat treatment other than normalizing, the properties should be agreed between the purchaser and the manufacturer at the time of enquiry and order.

TABLE 3 – **Mechanical properties**

Grade	Delivery condition	Thickness	R_{eL} min.		R_m		Elongation min. A % on $5{,}65\sqrt{S_o}$
		mm	N/mm²	kgf/mm²	N/mm²	kgf/mm²	
1	Hot finished	⩽ 16	335	34	490 to 610	50 to 62	21
		16 to 30	315	32	490 to 610	50 to 62	21
		> 30	295	30	490 to 610	50 to 62	21
	Normalized	⩽ 16	345	35	490 to 610	50 to 62	21
		16 to 30	325	33	490 to 610	50 to 62	21
		> 30	315	32	490 to 610	50 to 62	21
2	Hot finished	⩽ 16	275	28	490 to 640	50 to 65	21
		> 16	265	27	490 to 640	50 to 65	21
	Normalized	⩽ 16	275	28	490 to 610	50 to 62	21
		> 16	265	27	490 to 610	50 to 62	21

8.2 Weldability

Steel of grade 1 is generally regarded as being weldable. Precautions are usually required in welding steel of grade 2. However, the general weldability of these steels cannot be guaranteed as the behaviour of the steels during and after welding is dependent on the size of the hollow bar, the welding conditions and the final use for which the steel is employed.

9 APPEARANCE

The hollow bars 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 hollow bar 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**

Values in millimetres

D	Series 1		Series 2		Series 3		Series 4		Series 5	
	ID	*a*	ID	*a*	ID	*a*	ID	*a*	ID	*a*
32	—	—	—	—	20	6	—	—	16	8
36	25	5,5	—	—	20	8	—	—	16	10
40	28	6	—	—	25	7,5	—	—	20	10
45	32	6,5	—	—	28	8,5	—	—	20	12,5
50	36	7	—	—	32	9	—	—	25	12,5
56	40	8	—	—	36	10	—	—	28	14
63	50	6,5	45	9	40	11,5	36	13,5	32	15,5
71	56	7,5	50	10,5	45	13	40	15,5	36	17,5
75	60	7,5	56	9,5	50	12,5	45	15	40	17,5
80	63	8,5	56	12	50	15	45	17,5	40	20
85	67	9	61	12	55	15	50	17,5	45	20
90	71	9,5	67	11,5	63	13,5	56	17	50	20
95	75	10	69	13	63	16	56	19,5	50	22,5
100	80	10	75	12,5	71	14,5	63	18,5	56	22
106	85	10,5	80	13	71	17,5	63	21,5	56	25
112	90	11	85	13,5	80	16	71	20,5	63	24,5
118	95	11,5	90	14	80	19	71	23,5	63	27,5
125	100	12,5	95	15	90	17,5	80	22,5	71	27
132	106	13	98	17	90	21	80	25	71	30,5
140	112	14	106	17	100	20	90	25	80	30
150	125	12,5	118	16	106	22	95	27,5	80	35
160	132	14	122	19	112	24	100	30	90	35
170	140	15	130	20	118	26	110	30	100	35
180	150	15	140	20	125	27,5	112	34	100	40
190	160	15	150	20	132	29	118	36	106	42
200	160	20	—	—	140	30	—	—	112	44
212	170	21	—	—	150	31	—	—	125	43,5
224	180	22	—	—	160	32	—	—	132	46
236	190	23	—	—	170	33	—	—	140	48
250	200	25	—	—	180	35	—	—	150	50

NOTE — As stated in section 3, hollow bars are usually designated by the outside and inside diameters. The thickness *a* is given in table 4 for information.

10.2 Tolerances

Dimensionsal variations shall not exceed the following values :

– outside diameter : $^{+\ 2\ \%}_{0}$ with a minimum of 1 mm

– thickness : the minimum thickness shall be not more than 5 % below the nominal thickness No maximum.

10.3 Machined sizes

The manufacturer shall inform the purchaser of the maximum clean outside diameter and the minimum inside diameter that can be machined from each hollow bar size when chucking true to the outside or inside diameter, and the maximum length of the machined component for which these machined sizes apply.

The manufacturer shall also inform the purchaser of the average mass per unit length for each hollow bar size.

10.4 Straightness

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

10.5 Lengths

Unless otherwise stated by the purchaser, hollow bars 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 : $^{+\ 15\ mm}_{0}$

over 3 m long and less than 6 m : $^{+\ 10\ mm}_{0}$

less than 3 m long : by agreement.

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 to an extent according to 11.2.

11.1 Visual inspection

Each hollow bar shall be subjected to visual inspection.

11.2 Tensile test

11.2.1 *Sampling*

The tensile test shall be carried out on a longitudinal test piece, the dimensions of which shall conform to the requirements of ISO/R 375.

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

– for $D < 100$ mm : one test per batch of 400 hollow bars;

– for $D \geqslant 100$ mm : one test per batch of 200 hollow bars.

If the number of hollow bars 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 hollow bars of the same size and the same grade and steel condition such that a suitable number of hollow bars taken at random for the purpose of testing will adequately represent the batch as a whole.

11.2.2 *Procedure*

The tensile test shall be carried out at room temperature in accordance with ISO 375. In this test, the tensile strength 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 hollow bars shall be legibly marked to show :

a) the manufacturer's mark;

b) the identification symbol for the grade of steel.

14.2 For hollow bars 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 hollow bars may be supplied without protection or with the manufacturer's standard mill protection.

16 PACKING

Packing shall be agreed between the purchaser and manufacturer.