

Revised

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

**ISO RECOMMENDATION
R 431**

**SPECIFICATION FOR ELECTROLYTIC COPPER WIRE BARS,
CAKES, SLABS, BILLETS, INGOTS AND INGOT BARS**

1st EDITION

March 1965

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BRIEF HISTORY

The ISO Recommendation R 431, *Specification for Electrolytic Copper wire Bars, Cakes, Slabs, Billets, Ingots and Ingot Bars*, was drawn up by Technical Committee ISO/TC 26, *Copper and Copper Alloys*, the Secretariat of which is held by the Deutscher Normenausschuss (DNA).

Work on this question by the Technical Committee began in 1959 and led, in 1960, to the adoption of a Draft ISO Recommendation.

In September 1962, this Draft ISO Recommendation (No. 530) 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:

Australia	Greece	Spain
Belgium	India	Sweden
Burma	Italy	Switzerland
Canada	Japan	Turkey
Chile	Netherlands	U.A.R.
Denmark	Poland	United Kingdom
Finland	Portugal	U.S.A.
France	Rep. of South Africa	U.S.S.R.
Germany	Romania	Yugoslavia

No member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in March 1965, to accept it as an ISO RECOMMENDATION.

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SPECIFICATION FOR ELECTROLYTIC COPPER WIRE BARS, CAKES, SLABS, BILLETS, INGOTS AND INGOT BARS

1. SCOPE

This ISO Recommendation is intended as a specification covering electrolytic copper wire bars, cakes, slabs, billets, ingots and ingot bars.

NOTE. — Copper under this specification corresponds to the designation "ETP", as shown in ISO Recommendation R 197, *Classification of Coppers*.

2. CHEMICAL COMPOSITION

The copper in all shapes should have a minimum purity of 99.90 per cent, silver being counted as copper.

NOTE. — By agreement between the manufacturer and the purchaser, the addition of silver up to 0.1 per cent will be considered within the specification, silver being counted as copper in the chemical analysis.

3. CHEMICAL ANALYSIS

NOTE. — Upon development of the ISO Recommendation* on electrolytical determination of copper, giving an internationally acceptable method of chemical analysis, it is desired to include a provision that analysis for determining minimum purity of the copper should be made in accordance with that method.

4. RESISTIVITY

The copper should have a resistivity in ohm · gramme per square metre ($\Omega \cdot \text{g}/\text{m}^2$), at a temperature of 20 °C (68 °F) (annealed), not exceeding the following values:

TABLE 1
Values of copper resistivity

Form of copper	Use	Resistivity $\Omega \cdot \text{g}/\text{m}^2$
Wire bars		0.153 28
Cakes, slabs and billets	{ for electrical use (when specified on order) other uses	0.153 28
		0.156 94
Ingots and ingot bars		0.156 94

NOTE. — These values refer to mass resistivity. For conversion to volume resistivity, the density should be taken as 8.89 g/cm³. The value of 0.153 28 $\Omega \cdot \text{g}/\text{m}^2$ at 20 °C (68 °F) is the international annealed copper standard value for the resistivity of annealed copper equal to 100 per cent conductivity, as defined by the international Annealed Copper Specification. Other resistivity-conductivity relationships are listed in Table 2, page 6.

* At present at the stage of Draft proposal.

TABLE 2

Equivalent values for conductivity and resistivity for copper at 20 °C (68 °F)

Quantities	Units	Values
Conductivity	I A C S	100.00 per cent
	siemens* $\frac{\text{m}}{\text{mm}^2}$	58.00
Volume resistivity	ohm $\frac{\text{circular mil}}{\text{ft}}$	10.371
	ohm $\frac{\text{mm}^2}{\text{m}}$	0.017 241
	microhm $\frac{\text{in}^2}{\text{in}}$	0.678 79
	microhm $\frac{\text{cm}^2}{\text{cm}}$	1.724 1
Mass resistivity	ohm $\frac{\text{lb}}{\text{mile}^2}$	875.20
	ohm $\frac{\text{g}}{\text{m}^2}$	0.153 28

* 1 siemens = $\frac{1}{\text{ohm}}$.

5. RESISTIVITY TEST

Samples for the resistivity test should be hot-rolled and cold-drawn into wire approximately 2 mm (0.08 in) in diameter, which should be annealed at approximately 500 °C (932 °F) for a minimum time of one half hour.

6. PHYSICAL DEFECTS

Wire bars, cakes, slabs and billets should be substantially free from shrink holes, cold sets, pits, sloppy edges, concave tops and other similar defects in set or casting. This requirement should not apply to ingots or ingot bars, in which physical defects are of minor consequence.

7. SIZES AND SHAPES OF WIRE BARS

One size of mould should be used for casting 90 to 105 kg (200 to 230 lb) wire bars, the bottom width of this bar to be 89 mm ($3\frac{1}{2}$ in), the nominal masses being 90 and 102 kg (200 and 225 lb) (see Fig. 1, page 8).

One size of mould should be used for casting 109 to 136 kg (240 to 300 lb) wire bars, the bottom width of this bar to be 102 mm (4 in), the nominal masses being 113, 125 and 136 kg (250, 275 and 300 lb) (see Fig. 2, page 9).

All bars should be 1372 mm (54 in) in length. The side draft or taper should be 9.5 mm (3/8 in) in 102 mm (4 in); i.e., 4.8 mm (3/16 in) in 102 mm (4 in) on each side of the bar. The radius of the corners at the bottom of the bars should be 16 mm (5/8 in). The end taper at the bottom should be 152 mm (6 in) in over-all length and approximately 51 mm per 305 mm (2 in/ft). The end taper of the side should be approximately 57 mm per 305 mm (2 1/4 in/ft) and the end of the bar should be approximately 86 mm (3 3/8 in) in depth at the point.

8. PERMISSIBLE VARIATIONS IN MASS AND DIMENSIONS

A permissible variation of ± 5 per cent in mass or ± 6 mm (1/4 in) in any dimensions from the manufacturer's published list or the purchaser's specified size should be considered good delivery provided, however, that wire bars may vary in length ± 1 per cent from the listed or specified length, and cakes may vary ± 3 per cent from the listed or specified size in any dimension greater than 203 mm (8 in). The height of wire bars should be that measured at the highest point. The mass of copper, in ingots and ingot bars should not exceed that specified by more than 10 per cent, but otherwise its variation is not important.

9. MARKING

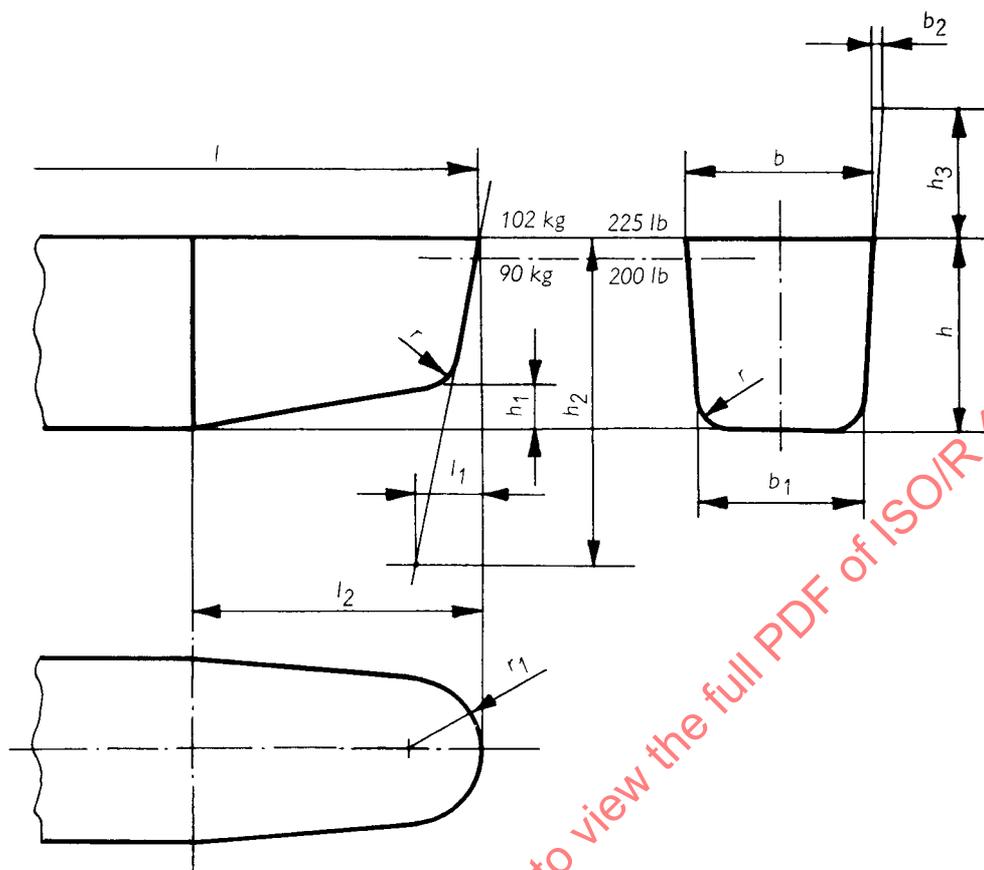
All wire bars, cakes, slabs and billets should be clearly stamped with the manufacturer's brand and furnace charge or production number. Ingots and ingot bars should have a brand stamped or cast in, but need have no furnace charge mark.

10. LOTS

The manufacturer should endeavour to arrange lots so that, as far as possible, each should contain pieces from but one furnace charge, in order to facilitate testing by the purchaser.

FIGURE 1

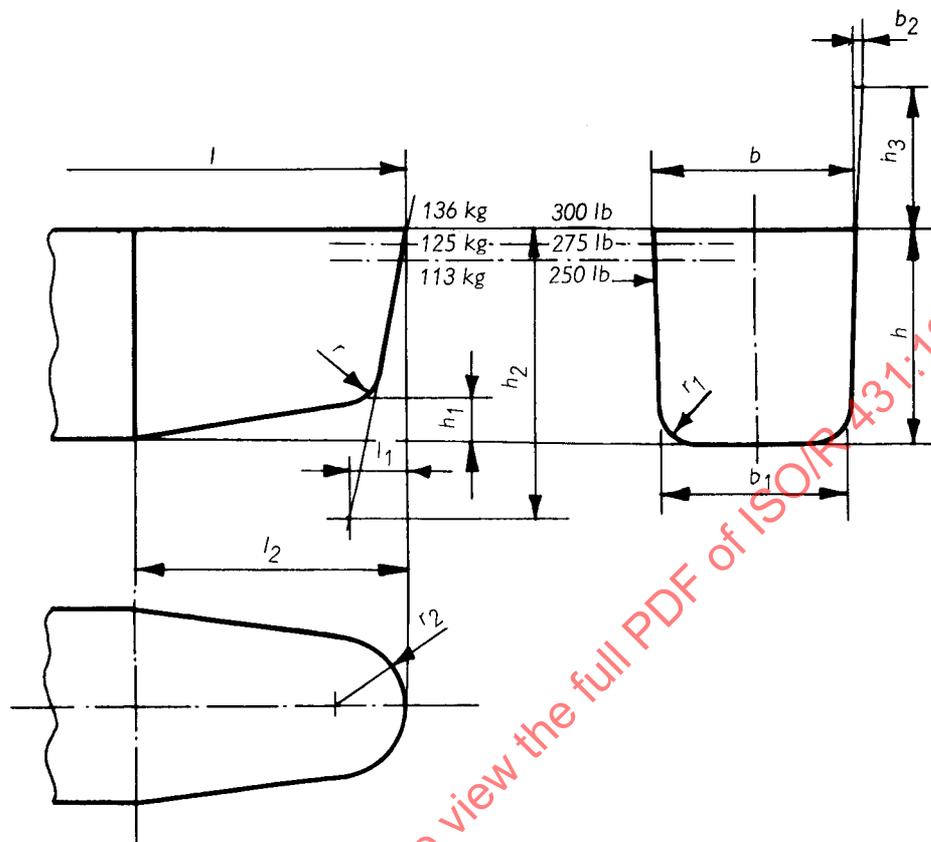
Copper wire bars of 90 and 102 kg (200 and 225 lb)



Dimension	Mass 90 kg (200 lb)		Mass 102 kg (225 lb)	
	mm	in	mm	in
r	16	$\frac{5}{8}$	16	$\frac{5}{8}$
r_1	38	$1\frac{1}{2}$	38	$1\frac{1}{2}$
h	92	$3\frac{5}{8}$	102	4
h_1	25	1	25	1
h_2	305	12	305	12
h_3	102	4	102	4
b	98	$3\frac{7}{8}$	98	$3\frac{7}{8}$
b_1	89	$3\frac{1}{2}$	89	$3\frac{1}{2}$
b_2	4.8	$\frac{3}{16}$	4.8	$\frac{3}{16}$
l	1372	54	1372	54
l_1	57	$2\frac{1}{4}$	57	$2\frac{1}{4}$
l_2	152	6	152	6

FIGURE 2

Copper wire bars of 113, 125 and 136 kg (250, 275 and 300 lb).



Dimension	Mass 113 kg (250 lb)		Mass 125 kg (275 lb)		Mass 136 kg (300 lb)	
	mm	in	mm	in	mm	in
r	25	1	25	1	25	1
r_1	16	$\frac{5}{8}$	16	$\frac{5}{8}$	16	$\frac{5}{8}$
r_2	38	$1\frac{1}{2}$	38	$1\frac{1}{2}$	38	$1\frac{1}{2}$
h	102	4	111	$4\frac{3}{8}$	121	$4\frac{3}{4}$
h_1	25	1	25	1	25	1
h_2	305	12	305	12	305	12
h_3	102	4	102	4	102	4
b	111	$4\frac{3}{8}$	111	$4\frac{3}{8}$	111	$4\frac{3}{8}$
b_1	102	4	102	4	102	4
b_2	4.8	$\frac{3}{16}$	4.8	$\frac{3}{16}$	4.8	$\frac{3}{16}$
l	1372	54	1372	54	1372	54
l_1	57	$2\frac{1}{4}$	57	$2\frac{1}{4}$	57	$2\frac{1}{4}$
l_2	152	6	152	6	152	6