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IS 733 (1983): Wrought Aluminium and Aluminium Alloy Bars, Rods and Sections (for General Engineering Purposes) [MTD 7: Light Metals and their Alloys]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

SPECIFICATION FOR
WROUGHT ALUMINIUM AND ALUMINIUM
ALLOY BARS, RODS AND SECTIONS
(FOR GENERAL ENGINEERING PURPOSES)

(*Third Revision*)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

SPECIFICATION FOR WROUGHT ALUMINIUM AND ALUMINIUM ALLOY BARS, RODS AND SECTIONS (FOR GENERAL ENGINEERING PURPOSES) (*Third Revision*)

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Indian Standard

SPECIFICATION FOR WROUGHT ALUMINIUM AND ALUMINIUM ALLOY BARS, RODS AND SECTIONS (FOR GENERAL ENGINEERING PURPOSES)

(Third Revision)

0. FOREWORD

0.1 This Indian Standard (Third Revision) was adopted by the Indian Standards Institution on 25 August 1983, after the draft finalized by the Light Metals and Their Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first issued in 1956 and subsequently revised in 1967 and 1975. Further revision became necessary as three new materials were required to be included as they found wide application in different industries. The main modifications made in the standard are as follows:

- a) A new high strength alloy 76528 has been included.
- b) Aluminium of 99.6 purity 19600 has been included and the chemical compositions of 19000 and 19500 aluminium have been modified to align them with the requirements of IS : 2590-1979*.
- c) For both heat-treatable and non-heat treatable alloys, the properties in the 'O' temper have been specified as maximum.

0.3 Some characteristics and typical uses of the alloys covered in the standard have been listed in Appendix A.

0.4 The major alloying elements have been printed in bold face in the chemical composition (*see* Table 1).

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Primary aluminium ingots for remelting for general engineering purposes (*first revision*).

†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers requirements for wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 5047- (Part 1)-1979 to IS : 5047 (Part 3)-1979* shall apply. Some of the important definitions are reproduced below for ready reference.

2.1.1 *Bars* — Any solid section other than round, that is long in relation to cross section and whose width or greatest distance between parallel faces is greater than 6 mm.

2.1.2 *Rod* — A round solid section which is long in relation to cross section having a diameter greater than 6 mm.

2.1.3 *Regular Solid Section* — A solid rolled, drawn or extruded section other than round, polygonal or rectangular, which can be conveniently divided into approximate rectangles with measurable dimensions, for example, angles, channels, tees, etc.

2.1.4 *Irregular Solid Section* — A solid rolled, drawn or extruded section, the profile of which cannot be divided readily into approximate rectangles or measurable dimensions.

2.1.5 *Heat-Treatment Batch* — A quantity of material of one alloy, of the same dimensions and produced in the same way, solution-treated and subsequently precipitation-treated in one furnace load. More than one heat treatment batch may comprise a furnace load.

3. SUPPLY OF MATERIAL

3.1 General requirements for the supply of aluminium and aluminium alloy products shall conform to IS : 1387-1967†.

4. FREEDOM FROM DEFECTS

4.1 The material shall be sound and free from harmful defects.

4.2 For aluminium copper and aluminium-zinc-magnesium-copper alloys, which are susceptible to peripheral grains coarsening, the permissible limit of 'coarse grain' envelope shall be as agreed to between the manufacturer and the purchaser.

*Glossary of terms relating to aluminium and aluminium alloys:

Part 1 Unwrought and wrought metals (*first revision*).

Part 2 Plant and operations, thermal treatment, control, testing and finishing.

Part 3 Geometrical properties and tolerances, structural and surface defects.

†General requirements for the supply of metallurgical materials (*first revision*).

5. CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

5.1 The chemical composition and mechanical properties of the bars, rods and sections shall comply with the requirements of Tables 1 and 2 respectively.

5.1.1 The chemical analysis of the material shall be carried out either in accordance with IS : 504-1963* or by any other suitable instrumental method of analysis. In case of any dispute, the method specified in IS : 504-1963* shall be used as the referee method.

5.1.2 Mechanical test shall be carried out as specified in 9.

6. CONDITION

6.1 The material shall be supplied in the condition as specified by the purchaser. While specifying the condition, the temper designations as laid down in IS : 5052-1969† shall be followed.

7. DIMENSIONS AND TOLERANCES

7.1 The dimensions of bars, rods and sections and their tolerances shall be as laid down in IS : 3965-1981‡.

8. SELECTION OF TEST SAMPLES

8.1 Bars, rods and sections of the same dimensions, produced in the same way, and of the same composition, shall be grouped into lots as follows:

<i>Diameter or Equivalent Cross Section</i>		<i>Aluminium and Non-heat Treatable Alloys</i>	<i>Heat-Treatable Aluminium Alloys</i>
Over	Up to and Including		
mm	mm	kg	kg
—	10	500	1 000
10	20	1 000	2 000
20	50	1 500	2 000
50	—	2 000	2 000

*Methods of chemical analysis of aluminium and its alloys (*revised*).

†Temper designation of aluminium and its alloys.

‡Dimensions for wrought aluminium and aluminium alloys, bar, rod and section.

8.2 One test sample shall be cut from a bar, rod or section selected from each lot.

8.2.1 In the case of heat-treatable aluminium alloys the test sample may be cut from a heat-treatment batch, if it is less than a lot.

8.2.2 Before any of the test samples are cut off, they shall be marked to identify them with the lot or heat-treatment batch they represent.

8.3 In the case of aluminium and non-heat treatable aluminium alloys the test samples shall be taken from the material as supplied, and shall not be annealed or mechanically worked (except by straightening and machining to the shape of the test piece) before they are tested.

8.3.1 In the case of heat-treatable aluminium alloys for materials supplied in the M or O condition, the test samples shall be heat-treated and tested in the W or WP condition, as specified by the purchaser. The test samples, after heat treatment, shall not be mechanically worked (except by straightening and machining to the shape of the test piece) before they are tested.

8.3.2 Material supplied in the W condition may be expected to have the mechanical properties of the W and WP conditions on appropriate heat treatment.

8.3.3 For material supplied in the W condition, the test samples shall be tested in the condition as supplied in the straightened and stretched condition, unless the purchaser has specified that he required the test sample to be tested in the WP condition. The test samples shall not be mechanically worked (except by straightening and machining to the shape of the test piece) before they are tested.

8.3.4 For materials in the P or WP condition, the test samples shall be tested in the condition as supplied. The test samples shall not be further heat-treated or mechanically worked (except by straightening and machining to the shape of the test piece) before they are tested.

9. MECHANICAL TEST

9.1 Tensile Test — The tensile test shall be carried out and the proof stress determined thereby in accordance with IS : 1816-1979*.

10. RETESTS

10.1 Should any one of the test pieces first selected fail to pass the mechanical test, two further samples from the same lot shall be selected for testing, one of which shall be from the coil or length from which the original test sample was taken, unless the coil or length has been withdrawn by the supplier.

*Method for tensile test for light metals and their alloys (*first revision*).

TABLE 1 CHEMICAL COMPOSITION OF WROUGHT ALUMINIUM AND ALUMINIUM ALLOY BARS RODS AND SECTIONS FOR GENERAL ENGINEERING PURPOSES

(Clauses 0.4 and 5.1)

(Composition limits are in percent maximum unless shown otherwise)

DESIG- NATION	ALUMINIUM	COPPER	MAGNE- SIUM	SILICON	IRON	MANGA- NESE	ZINC	TITANIUM AND/OR OTHER GRAIN REFINING ELEMENTS	CHROMIUM	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
19000	99.0 <i>Min</i>	0.1	—	0.5	0.6	0.1	—	—	—	Ti + V = 0.07; Total impurities = 1.00
19500	99.5 <i>Min</i>	0.05	—	0.3	0.4	0.05	—	—	—	Ti + V = 0.07; Total impurities = 0.50
19600	99.6 <i>Min</i>	0.05	—	0.25	0.35	0.03	—	—	—	Ti + V = 0.05; Total impurities = 0.40
24345	Remainder	3.8-5.0	0.2-0.8	0.5-1.2	0.7	0.3-1.2	0.2	*0.3	*0.3	
24534	Remainder	3.5-4.7	0.4-1.2	0.2-0.7	0.7	0.4-1.2	0.2	0.3	—	
43000	Remainder	0.1	0.2	4.5-6.0	0.6	0.5	0.2	—	—	
46000	Remainder	0.1	0.2	10.0-13.0	0.6	0.5	0.2	—	—	
52000	Remainder	0.1	1.7-2.6	0.6	0.5	0.5	0.2	0.2	0.25	Cr + Mn = 0.5
53000	Remainder	0.1	2.8-4.0	0.6	0.5	0.5	0.2	0.2	0.25	Cr + Mn = 0.5
54300	Remainder	0.1	4.0-4.9	0.4	0.7	0.5-1.0	0.2	0.2	0.25	
63400	Remainder	0.1	0.4-0.9	0.3-0.7	0.6	0.3	0.2	0.2	0.1	
64423	Remainder	0.5-1.0	0.5-1.3	0.7-1.3	0.8	1.0	—	—	—	
64430	Remainder	0.1	0.4-1.2	0.6-1.3	0.6	0.4-1.0	0.1	0.2	0.25	
65032	Remainder	0.15-0.4	0.7-1.2	0.4-0.8	0.7	0.2-0.8	0.2	0.2	0.15-0.35	Either Mn or Cr shall be present
74530	Remainder	0.2	1.0-1.5	0.4	0.7	0.2-0.7	4.0-5.0	0.2	0.2	
76528	Remainder	1.2-2.0	2.1-2.9	0.5	0.7	0.3	5.1-6.1	0.2	0.20-0.28	

NOTE 1 — It is the responsibility of the supplier to ensure that any element not specifically limited is not present in an amount such as is generally accepted as having an adverse effect on the product. If a purchaser's requirements necessitate limits for any element not specified these should be agreed to between the supplier and the purchaser.

NOTE 2 — Major alloying elements have been printed in bold face type.

*Titanium and/or other grain refining elements and/or chromium may be present at the option of the supplier provided the total content does not exceed 0.3 percent.

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TABLE 2 MECHANICAL PROPERTIES OF WROUGHT ALUMINIUM AND ALUMINIUM ALLOY BARS, RODS AND SECTIONS (EXTRUDED) FOR GENERAL ENGINEERING PURPOSES

(Clause 5.1)

DESIGNATION	CONDITION	SIZE (DIAMETER OR MINOR CROSS SECTIONAL DIMENSION), mm		0.2 PERCENT PROOF-STRESS		TENSILE STRENGTH		ELONGATION PERCENT Min, ON 50 mm, OR 5.65 $\sqrt{S_0}$ GAUGE LENGTH
				Min MPa	Max MPa	Min MPa	Max MPa	
				Over	Up to and Including			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
19000	M*	—	—	20	—	65	—	18
	O	—	—	—	—	—	110	25
19500	M*	—	—	18	—	65	—	23
	O	—	—	—	—	—	100	25
19600	M*	—	—	17	—	65	—	23
	O	—	—	—	—	—	95	25
24345	M*	—	—	90	—	150	—	12
	O	—	—	—	175	—	240	12
	W	—	10	225	—	375	—	10
		10	75	235	—	385	—	10
		75	150	235	—	385	—	8
		150	200	225	—	375	—	8
	WP	—	10	375	—	430	—	6
		10	25	400	—	460	—	6
		25	75	420	—	480	—	6
		75	150	405	—	460	—	6
	150	200	380	—	430	—	6	

(Continued)

TABLE 2 MECHANICAL PROPERTIES OF WROUGHT ALUMINIUM AND ALUMINIUM ALLOY BARS, RODS AND SECTIONS (EXTRUDED) FOR GENERAL ENGINEERING PURPOSES — Contd

IS : 733 - 1983

DESIGNATION	CONDITION	SIZE (DIAMETER OR MINOR CROSS SECTIONAL DIMENSION), mm		0.2 PERCENT PROOF-STRESS		TENSILE STRENGTH		ELONGATION PER- CENT Min, ON 50 mm OR $5.65 \sqrt{S_0}$ GAUGE LENGTH
		Over	Up to and Including	Min	Max	Min	Max	
				MPa	MPa	MPa	MPa	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
24534	M*	—	—	90	—	150	—	12
	O	—	—	—	175	—	240	12
	W	—	10	220	—	375	—	10
		10	75	235	—	385	—	10
		75	150	235	—	385	—	8
150	200	225	—	375	—	8		
43000	M*	—	15	—	—	90	—	18
	O	—	15	—	—	—	130	18
46000	M*	—	15	—	—	100	—	10
	O	—	15	—	—	—	150	12
52000	M*	—	150	70	—	160	—	14
	O	—	150	—	—	—	240	18
53000	M*	—	50	100	—	215	—	14
		50	150	100	—	200	—	14
	O	—	150	—	—	—	260	16
54300	M*	—	150	130	—	265	—	11
	O	—	150	125	—	—	350	13
63400	M*	—	—	—	—	110	—	13
	O	—	—	—	—	—	130	18
	W	—	150	80	—	140	—	14
		150	200	80	—	125	—	13

	P	—	25	110	—	150	—	7
	WP	—	150	150	—	135	—	7
		150	200	130	—	150	—	6
64423	M*	—	—	—	—	120	—	10
	O	—	—	—	125	—	215	15
	W	—	—	155	—	266	—	13
	WP	—	—	265	—	330	—	7
64430	M*	—	—	80	—	110	—	12
	O	—	—	—	—	—	150	16
	W	—	150	120	—	185	—	14
		150	200	100	—	170	—	12
	WP	—	5	255	—	295	—	7
		5	75	270	—	310	—	7
		75	150	270	—	295	—	7
		150	200	240	—	280	—	6
65032	M*	—	—	50	—	110	—	12
	O	—	—	—	115	—	150	16
	W	—	150	115	—	185	—	14
		150	200	100	—	170	—	12
	WP	—	150	235	—	280	—	7
		150	200	200	—	245	—	6
74530	W	—	6	220	—	255	—	9
	(Naturally aged for 30 days)	6	75	230	—	275	—	9
		75	150	220	—	265	—	9
	WP	—	6	245	—	285	—	7
		6	75	260	—	310	—	7
		75	150	245	—	290	—	7
76528	O	All Sizes		—	—	—	290	10
	WP	—	6	430	—	500	—	6
		6	75	455	—	530	—	6
		75	150	430	—	500	—	6

NOTE — MPa = 1 N/mm² = 0.102 kgf/mm².

*Properties in M temper are only typical values and are given for information only.

10.1.1 For heat-treatable alloys the supplier shall have the right if he so desires, to reheat-treat the material before the two further samples are selected.

10.1.2 Should the test pieces from both these additional samples pass, the lot represented by the test samples shall be deemed to comply with the requirements of mechanical properties. Should a test piece from either of these additional samples fail, the lot represented by the test samples shall be deemed not to comply with this standard.

11. MARKING

11.1 Each lot of bar, rod or section shall be suitably marked for identification, with the name of the manufacturer, alloy designation and condition of the material. If required by the purchaser, the supplier shall furnish a certificate that the material supplied complies with the requirements of this specification.

11.2 BIS Certification Marking

The product may also be marked with **Standard Mark**. The supplier's certification (*see 11.1*) shall be implied if the material is certified under the **Standard Mark**.

11.2.1 The use of the **Standard Mark** is governed by the provisions of the **Bureau of Indian Standards Act, 1986** and the **Rules and Regulations** made thereunder. The details of conditions under which the licence for the use of **Standard Mark** may be granted to manufacturers or producers may be obtained from the **Bureau of Indian Standards**.

APPENDIX A

(Clause 0.3)

CHARACTERISTICS AND TYPICAL USES OF ALUMINIUM ALLOYS

DESIGNATION	CHARACTERISTICS	AVAILABLE FORMS	TYPICAL USES
19000	Commercially pure aluminium. Very ductile in annealed or extruded condition. Excellent resistance to corrosion	Sheet, Plate, Extrusion, Tube, Wire and Forgings	Panelling and moulding, refrigeration tubing, equipment for chemical, food and brewing industrial packaging; cooking utensils. Sheet metal work, architectural and builder's hardware, spun/pressed hollow ware, deep drawn parts, cladding, welding wire, electrical appliances
19500	High purity aluminium more resistant to corrosion than other alloys	Sheet, Plate, Extrusion, Tube, Wire Rolled Rods and Forgings	Corrosion resistant cladding on stronger alloys impact extruded containers; food, chemical brewing and processing equipments; tanks and pipes; marine fittings; reflectors; pressed and anodized utility items, jewellery, and cable sheathing
19600	do	do	do
24345	Combines high strength with fair ductility in the solution treated condition, when forming can be done and parts subsequently aged	Sheet, Plate, Extrusion, Tube, Wire and Forgings	Heavy duty forgings, structures where high mechanical properties are of utmost importance, aircraft application of clad sheets, extrusions and armaments
24534	Strong alloy that is aged naturally at room temperature after solution treatment and has fair ductility in this condition	Extrusion, Tube, Wire, Rolled Rod, and Forgings	Stressed parts in aircrafts and other structures where high strength is of primary consideration

(Continued)

DESIGNATION	CHARACTERISTICS	AVAILABLE FORMS	TYPICAL USES
43000	It is easily formed and blends itself well to welding, brazing and soldering	Wire and Rolled Rod	Filler wire for welding
46000	do	do	Filler wire for brazing
52000	Ductile in the soft condition, but work hardens rapidly, becoming extremely tough. Has high resistance to corrosive attack especially in marine atmosphere	Sheet, Plate, Extrusion, Tube, Wire and Forgings	Panelling and structures, sheet metal work and domestic appliances, marine applications like sheathing/lining of boat bottom, etc
53000	do	Sheet, Plate, Extrusion, Tube and Wire and Rolled Rod	Shipbuilding; rivets; pressure vessels and other processing tanks, cryogenics, and welded structures
54300	do	Sheet, Plate, Extrusion, and Forgings	Welded structures, cryogenic applications, structural marine applications, rail and road tank cars, rivets and missile components
63400	Suitable for intricate extruded sections of medium strength. Forms well in W condition. Highly corrosion resistant	Extrusion, Tube, Wire, Rolled Rod and Forgings	Architectural uses, such as window/door-frames, wall facings, partitions, hand rails, etc, and other similar applications where surface finish is important and medium strength would suffice
63401	do	do	Bus bar application
64401	do	do	Conductor application
64423	Stronger than 64430 and has superior machinability	Extrusions	Applications requiring good strength and machinability such as missile machinery components

64430	Medium — strength alloy with good mechanical properties, corrosion resistance and weldability	Sheet, Plate, Extrusion, Tube, Wire and Forgings	Structural applications of all kinds, such as road and rail transport vehicles, bridges, cranes, roof trusses, rivets, etc. Cargo containers, milk containers, deep-drawn containers, and flooring
65032	Medium strength alloy similar to 64430	do	Similar to 64430
74530	Medium strength self-ageing weldable alloy. It does not require heat treatment after hot working for welding. Excellent welding characteristics and good formability. Good corrosion resistance when compared with other high strength aluminium zinc alloy	Sheet, Plate, Extrusion and Forgings	Stressed structural applications requiring welding, such as bridges, chequered plates, dump-truck bodies, pressure vessels and rail coaches, etc
76528	High-strength alloy	Extrusion	Stressed structural applications capable of being used at low temperature

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Gangotri Complex, 5th Floor, Bhadbhada Road, T.T. Nagar, BHOPAL 462003 55 40 21

Plot No. 62-63, Unit VI, Ganga Nagar, BHUBANESHWAR 751001 40 36 27

Kalaikathir Buildings, 670 Avinashi Road, COIMBATORE 641037 21 01 41

Plot No. 43, Sector 16 A, Mathura Road, FARIDABAD 121001 8-28 88 01

Savitri Complex, 116 G.T. Road, GHAZIABAD 201001 8-71 19 96

53/5 Ward No.29, R.G. Barua Road, 5th By-lane, GUWAHATI 781003 54 11 37

5-8-56C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001 20 10 83

E-52, Chitaranjan Marg, C- Scheme, JAIPUR 302001 37 29 25

117/418 B, Sarvodaya Nagar, KANPUR 208005 21 68 76

Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226001 23 89 23

NIT Building, Second Floor, Gokulpat Market, NAGPUR 440010 52 51 71

Patliputra Industrial Estate, PATNA 800013 26 23 05

Institution of Engineers (India) Building 1332 Shivaji Nagar, PUNE 411005 32 36 35

T.C. No. 14/1421, University P. O. Palayam, THIRUVANANTHAPURAM 695034 6 21 17

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‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square, BANGALORE 560002 222 39 71

AMENDMENT NO. 1 DECEMBER 2006

TO
IS 733 : 1983 SPECIFICATION FOR WROUGHT
ALUMINIUM AND ALUMINIUM ALLOY BARS,
RODS AND SECTIONS (FOR GENERAL
ENGINEERING PURPOSES)

(Third Revision)

(Page 11, Table 2, col 7, Condition WP) — Substitute '185' for '135'.

(MTD 7)