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IS 5082 (1998): Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes [MTD 7: Light Metals and their Alloys]



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“Knowledge is such a treasure which cannot be stolen”



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भारतीय मानक

विद्युत अनुप्रयोग के लिये एल्यूमीनियम और एल्यूमीनियम मिश्र  
बार, छड़ें, नलिकायें, सेक्शन, प्लेटें और चद्दरें

( दूसरा पुनरीक्षण )

*Indian Standard*

**WROUGHT ALUMINIUM AND ALUMINIUM  
ALLOY BARS, RODS, TUBES, SECTIONS,  
PLATES AND SHEETS FOR ELECTRICAL  
APPLICATIONS**

( *Second Revision* )

ICS 77.150.10; 29

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

## FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Light Metals and Their Alloys Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1969 and subsequently revised in 1981. In this revision the following modifications have been made:

- a) Other forms like plates, sheets have been added.
- b) Clauses on chemical composition, mechanical properties and dimensional tolerances have been modified.
- c) Clauses on electrical properties have been modified.

For the purpose of deciding whether 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 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

# WROUGHT ALUMINIUM AND ALUMINIUM ALLOY BARS, RODS, TUBES, SECTIONS, PLATES AND SHEETS FOR ELECTRICAL APPLICATIONS

( *Second Revision* )

## 1 SCOPE

1.1 This standard specifies requirements for wrought aluminium and aluminium alloy bars, rods, tubes, sections, plates and sheets for electrical applications, prescribing their chemical composition, mechanical properties and electrical resistivity/conductivity.

1.1.1 This standard is applicable to:

- a) extruded bars and rods above 6 mm diameter; extruded angles, channels, other sections and profiles including tubes, hollow sections of thickness, 3 mm and above.
- b) rolled — plates, sheets of 3 mm and above thickness.

## 2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
504 : 1963	Method of chemical analysis of aluminium and its alloys ( <i>revised</i> )
1608 : 1995	Mechanical testing of metals — Tensile testing
2673 : 1979	Dimensions for wrought aluminium and aluminium alloys, extruded round tube
2676 : 1981	Dimensions for wrought aluminium and aluminium alloy sheet and strip ( <i>first revision</i> )
2677 : 1979	Dimensions for wrought aluminium and aluminium alloy plates and hot rolled sheets ( <i>first revision</i> )
2678 : 1987	Dimensions for wrought aluminium and aluminium alloy drawn round tube ( <i>second revision</i> )
3965 : 1981	Dimensions for wrought aluminium and aluminium alloy bar, rod and section ( <i>first revision</i> )

<i>IS No.</i>	<i>Title</i>
5047	Glossary of terms relating to aluminium and aluminium alloys:
(Part 1) : 1986	Part 1 Unwrought and wrought metals ( <i>second revision</i> )
(Part 2) : 1979	Part 2 Plant and operations, thermal treatment, control and testing, finishing
(Part 3) : 1979	Part 3 Geometric properties and tolerances, structural and surface defects
5052 : 1993	Aluminium and its alloys—Temper designations ( <i>first revision</i> )
6051 : 1970	Code for designation of aluminium and its alloys
6477 : 1983	Dimensions for wrought aluminium and aluminium alloys extruded hollow section ( <i>first revision</i> )
10259 : 1982	General conditions for delivery and inspection of aluminium and aluminium alloy products
11035 : 1984	Method for spectrographic analysis of wrought aluminium alloys

## 3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 5047 (Part 1), (Part 2) and (Part 3) shall apply.

## 4 SUPPLY OF MATERIAL

General requirements relating to the supply of material shall conform to IS 10259.

## 5 FREEDOM FROM DEFECTS

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

5.1.1 Slight discolouration due to heat treatment shall not be cause for rejection.

## 6 CHEMICAL COMPOSITION

6.1 The material covered in this standard shall be of two grades, that is 19501 and 63401 and their chemical composition shall be as per Table 1.

6.2 The chemical composition shall be determined either by the method specified in IS 504 or by any other established instrumental/chemical method. In case of dispute chemical method given in IS 504 shall be used as referee method.

## 7 CONDITIONS OF SUPPLY

The material shall be supplied in any one of the following conditions as specified by the purchaser:

### Condition

M	As manufactured
H1	Quarter Hard

H2	Half Hard
W	Material which has been solution treated
WP (range 1)	Material which has been solution treated and precipitation treated
WP (range 2)	

## 8 MECHANICAL TEST

8.1 The tensile test shall be carried out in accordance with IS 1608 and the value obtained shall comply with the appropriate requirements of Table 2.

### 8.2 Bend Test

The bend test shall be carried out only for flat extruded sections up to 12 mm thickness. One test specimen of suitable length from each lot shall be bent through an angle of 90° over a mandrel, having a radius as specified in Table 3. After bending, no crack shall be visible on the outer surface of the bend.

**Table 1 Chemical Composition of Wrought Aluminium and Aluminium Alloy for Electrical Applications**  
(Clause 6.1)

Designation	(Percentage Composition maximum, unless shown otherwise)											Remarks
	Aluminium	Copper	Magnesium	Silicon	Iron	Manganese	Zinc	Titanium	Chromium	Others		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	Each (11)	
19501	99.50 <i>Min</i>	0.04	—	0.15	0.35	0.02	0.02	—	0.02	0.03	0.10	Ti+V=0.02
63401	Remainder	0.05	0.4-0.9	0.3-0.7	0.50	0.03	0.10	0.10	0.03	0.03	0.10	—

**Table 2 Mechanical and Electrical Properties of Wrought Aluminium and Aluminium Alloys for Electrical Applications**  
(Clauses 8.1 and 9.1.1)

Alloy	Temper Designation	Tensile Strength <i>Min</i> , Mpa	0.2 Percent Proof Stress <i>Min</i> , Mpa	Percent Elongation on 5.65 $\sqrt{S_0}$ <i>Min</i>	Electrical Conductivity at 20°C, <i>Min</i>	Maximum Electrical Resistivity at 20°C ohm-mm/mm <sup>2</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
19501	M	60	—	25	60.0% IACS	0.028 74
	H1	85	—	10	60.0% IACS	0.028 74
	H2	95	—	6	60% IACS	0.028 74
63401	W	140	80	12	—	—
63401	WP( range 1)	170	135	12	56.5% IACS	0.030 52
63401	WP( range 2)	200	170	10	55.0% IACS	0.031 35

### NOTE

1 MPa = 1 N/mm<sup>2</sup> = 0.102 kg/mm<sup>2</sup>.

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

If required, the cross-section shall be calculated from the mass and length of a straight test piece taking density 2.705 for grade 19501 and 2.700 for grade 63401.

## 9 ELECTRICAL RESISTIVITY OR ELECTRICAL CONDUCTIVITY

9.1 The electrical resistivity shall be determined on either unmachined or machined test pieces by direct measurement. For determining electrical resistivity, reference may be made to IS 3635.

OR

The electrical conductivity in percent IACS shall be determined by the test method based on Eddy Current Measurement as given in the Annex A.

9.1.1 The measurement of resistance shall be carried out to an accuracy of at least  $\pm 1$  percent. The length of the samples selected for this test shall be sufficient to give the accuracy required and shall be suitable for the method of testing employed. The maximum resistivity values when measured at room temperature and converted at 20°C by means of the appropriate constant shall be as given in the Table 2.

OR

The minimum conductivity values when measured at room temperature shall be as given in Table 2.

### NOTES

#### 1 IACS

#### International Annealed Copper Standard

The value 0.017 241 ohm, mm<sup>2</sup>/metre at 20°C is resistivity of annealed copper equal to 100 percent conductivity.

1 % IACS = 0.58 MS/m where MS/m — Megasiemen per metre

2 Unless otherwise specified for the condition of material by the purchaser the material of alloy 63401 shall be supplied in WP range 1 condition.

**Table 3 Flatwise Bending Radii**  
( Clause 8.2 )

Alloy	Temper Designation	Thickness (t) mm	Minimum Inside Bend Radius
19501	M, H <sub>1</sub> and H <sub>2</sub>	Up to 12.0 Max	1 × thickness
63401	WP (range 1)	3.0 to up to and including 9.5	1 × thickness
63401	WP (range 1)	Above 9.5 to 12.0	1.5 × thickness
63401	WP (range 2)	3.0 to up to and including 9.5	2 × thickness
63401	WP (range 2)	Above 9.5 to 12.0	2.5 × thickness

## 10 DIMENSIONAL TOLERANCES

10.1 Dimensional tolerances of the material shall be as laid down in the Indian Standards indicated below:

- |                          |         |
|--------------------------|---------|
| a) Bar, rod and sections | IS 3965 |
| b) Extruded tube         | IS 2673 |
| c) Drawn tube            | IS 2678 |
| d) Hollow sections       | IS 6477 |
| e) Rolled sheets         | IS 2676 |
| f) Roiled plates         | IS 2677 |

10.2 In case of material not covered by the above Indian Standards, the tolerances shall be agreed to between the supplier and the purchaser. The tolerances shall be based, as far as possible, on those of similar material given in the above standards.

## 11 SELECTION OF TEST SAMPLES

### 11.1 Extruded Product

- a) The material of the same dimensions produced in the same way and of the same composition shall be grouped into lots as follows :

Diameter or Equivalent Cross-section		Mass	
Over	Up to and Including	Grade 19501	Grade 63401
mm	mm	kg	kg
(1)	(2)	(3)	(4)
—	20	1 000	2 000
20	50	1 500	2 000
50	—	2 000	2 000

- b) *Rolled Product* — Material of the same thickness, produced in the same way and of same nominal composition shall be grouped into a lot of not more than 4 000 kg.

11.1.1 In case of Grade 63401 material supplied in WP (range 1) condition, each heat treatment batch shall constitute a lot, even if the batch size happens to be less than the lot size given in 11.1. If the heat treatment batch size is more than the lot size given in 11.1 the material shall be grouped into lots as specified in 11.1.

### 11.2 Test Sample

For each lot, one test shall be conducted in respect of tensile strength. Bend test shall be conducted only for flat extruded sections up to 12 mm. For the purpose of the mechanical test, the samples shall be taken as follows.

11.2.1 In the case of Grade 19501, 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.

11.2.2 In the case of Grade 63401, material supplied in WP (range 1) condition one test sample shall be selected from each lot, as given in 11.1.1 or fraction thereof. These samples shall be tested in the as supplied condition and 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).



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

**11.3** For electrical resistivity or electrical conductivity test, one test sample shall be selected from each lot, as given in 11.1.1 or fraction thereof.

## 12 RE-TEST

**12.1** If any test samples fail to comply with any of the requirements, whether electrical or mechanical, two additional samples from the same lot shall be selected, one of which shall be from the material from which the original test sample was taken, unless those materials have been withdrawn by the supplier. The test pieces for the re-test shall be cut from these additional samples. Should the test pieces from both the additional samples satisfy requirements of the electrical resistivity or electrical conductivity and mechanical tests, the lot represented by these samples shall be deemed to comply with the standard. Should the test pieces from either of the two samples fail, the lot represented shall be deemed not to comply with the standard.

## 13 PACKING AND MARKING

### 13.1 Packing

The material shall be properly and acquittal bundled, crated or otherwise packaged to protect it against injury in ordinary handling and transportation. The type of packing shall be left to the discretion of the manufacturer, unless otherwise agreed to.

### 13.2 Marking

Each bundle or package shall bear the name or trade-mark of the manufacturer, condition, size and grade of the material.

**13.2.1** The material may also be marked with the Standard Mark.

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

## ANNEX A

(Clause 9.1)

### ELECTRICAL CONDUCTIVITY DETERMINATION BY EDDY CURRENT METHOD

The electrical conductivity in percent IACS shall be determined by using an equipment based on the eddy current principle. The measurement of conductivity shall be carried out to an accuracy of  $\pm 1.0$  percent by this method, conductivity of materials like flats, sections, tubes hollow sections, plates, sheets can be easily determined.

The test sample shall have a reasonably flat surface so as to achieve a minimum contact area as recommended. In case of curved or uneven surface, it shall be made flat by any convenient and technically suitable method. Thickness of the flat surface shall not be less than that recommended by the instrument manufacturer. Before commencement of the test, the equipment shall be allowed to warm up as per the equipment operating manual. Then it shall be calibrated using at least two standard samples of known conductivity, one on the lower and the other on

the higher side of the equipment measuring range. Generally these standard samples are provided by the manufacturer with the equipment. The calibration shall be rechecked at the completion of actual measurement so as to ensure proper functioning of the equipment.

Keep the test pieces alongwith the standard samples and equipment for at least 1 h for the equalisation of temperature, hence there shall be no need to apply any temperature correction to the conductivity value obtained in percent IACS.

Before taking the readings, ensure that there is a proper contact between the detector probe and the test piece surface. For accuracy of measurement, the proper contact is essential. Take readings at 4-5 places and the best one shall be reported.

## Bureau of Indian Standards

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### Amendments Issued Since Publication

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**AMENDMENT NO. 1 SEPTEMBER 1999**  
**TO**  
**IS 5082 : 1998 WROUGHT ALUMINIUM AND**  
**ALUMINIUM ALLOY BARS, RODS, TUBES, SECTIONS,**  
**PLATES AND SHEETS FOR ELECTRICAL**  
**APPLICATIONS**

*( Second Revision )*

*( Page 2, Table 2, col 5, heading )* — Substitute 'Percent Elongation on  $5.65\sqrt{S_0}$  or 50 mm Gauge Length' for 'Percent Elongation on  $5.65\sqrt{S_0}$ '.

*( Page 3, clause 9.1.1, Note 2, third line )* — Substitute '2' for '1'.

( MTD 7 )

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