IS 5897 (1985): Aluminium and aluminium alloy welding rods and wires and magnesium alloy welding rods [MTD 11: Welding General]

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Indian Standard

SPECIFICATION FOR ALUMINIUM AND ALUMINIUM ALLOY WELDING RODS AND WIRES AND MAGNESIUM ALLOY WELDING RODS

(First Revision)

UDC 621·791·042 : 669·71/·72

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Indian Standard

SPECIFICATION FOR ALUMINIUM AND ALUMINIUM ALLOY WELDING RODS AND WIRES AND MAGNESIUM ALLOY WELDING RODS

(First Revision)

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Indian Standard

SPECIFICATION FOR ALUMINIUM AND ALUMINIUM ALLOY WELDING RODS AND WIRES AND MAGNESIUM ALLOY WELDING RODS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 June 1985, after the draft finalized by the Welding General Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1970. However, a revision was felt necessary in the light of experience gained during the past few years. An attempt has been made to provide a larger spectrum of filler metals for welding of certain new types of alloys coming into the market. The major modifications, which have been made in this revision are as follows:

a) Rationalization of diameters of rods and wires;

b) Incorporation of a new classification system for aluminium and its alloys;

c) Deletion of S-GI and S-GIA grades of aluminium filler rods and wires;

d) Inclusion of three new types of filler rods and wires, namely S-Al 19000, S-Al 26398 and S-Al 55380;

e) Changes in the chemical composition limits of a few minor elements (namely Fe, Mn and Zn) of the filler rods and wires designated by S-Al 53000 and S-Al 55000 (old designation: S-NG 5 and S-NG 6) ; and

f) Inclusion of usability test and the provision of retest.

The modifications (b) to (d) have been proposed in order to align this standard with IS : 739-1977*.

*Specification for wrought aluminium and aluminium alloy wire for general engineering purposes (*second revision*).

0.3 This standard is one of the series of standards covering comprehensively the requirements of the filler rods and wires for inert gas arc welding and covers the wires and rods for aluminium and magnesium alloys. The other standards in the series cover the filler rods and wires for inert gas welding of the following:

a) Corrosion and heat-resisting chromium-nickel steels;

b) Copper and copper alloys;

c) Structural steels (370-510 N/mm^2, *Min*); and

d) Nickel and nickel alloys.

0.4 The diameters of wires and dimensions of spools have been based on appropriate ISO Recommendations.

0.5 This standard keeps in view the manufacturing and trade practices being followed in the country in this field. Assistance has also been derived from the following publications:

ISO 546-1975 Lengths and tolerances for drawn or extruded filler rods for welding supplied in straight lengths. International Organization for Standardization.

ISO 864-1975 Solid wires for gas-shielded metal-arc welding of mild steel. International Organization for Standardization.

BS 2901 : Part 4 : 1983 Filler rods and wires for gas shielded arc welding. Part 4 Aluminium and aluminium alloys and magnesium alloys. British Standards Institution.

0.6 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.

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1. SCOPE

1.1 This standard prescribes the requirements of bare solid filler rods and wires for welding aluminium and aluminium alloys and filler rods for welding magnesium alloys by inert gas tungsten arc welding (TIG) or gas metal arc welding (MIG) processes. The chemical composition of the filler rods and wire is also specified.

1.1.1 The standard does not specify the chemical composition and the mechanical properties of the weld deposit.

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

1.2 The rods and wires specified in this standard are all suitable for use with argon or helium or mixture of these gases.

2. TERMINOLOGY

2.1 For the purpose of the standard, the definitions given in IS : 812-1957* shall apply.

3. SUPPLY OF MATERIAL

3.1 The general requirements relating to supply of filler rods and wires for inert gas arc welding shall be as laid down in IS : 1387-1967†.

4. DIMENSIONS AND TOLERANCES

4.1 The diameters of rods and wires shall be as specified in Table 1. The tolerances appropriate to the specified diameters are also given.

TABLE 1 DIAMETERS AND TOLERANCES

FORM	DIAMETER	TOLERANCES	
		Plus	Minus
	mm	mm	mm
Wire	0·6	0·01	0·03
	0·8	0·01	0·04
	1·0	0·01	0·04
Wire and rod	1·2	0·01	0·04
	1·6	0·01	0·04
	2·0	0·01	0·07
	2·4	0·01	0·07
	3·2	0·01	0·07
Rod	4·0	0·01	0·07
	5·0	0·01	0·07

4.2 Length of Rods (Cut Lengths) — Rods less than 2·5 mm in diameter shall be supplied in lengths of 500 or 1 000 mm. Rods 2·5 mm and larger in diameter shall be supplied in lengths of 1 000 mm. Lengths other than these two may be supplied by agreement between the purchaser and the manufacturer.

4.2.1 Tolerance on length shall be ±5 mm.

5. SPOOL FOR WIRE

5.1 The size and type of spool on which the particular diameter of wire is to be supplied shall be agreed to between the purchaser and the

*Glossary of terms relating to welding and cutting of metals.
†General requirements for the supply of metallurgical materials (*first revision*).

manufacturer and shall conform to the appropriate dimensions and mass given in Fig. 1 and Tables 2 and 3.

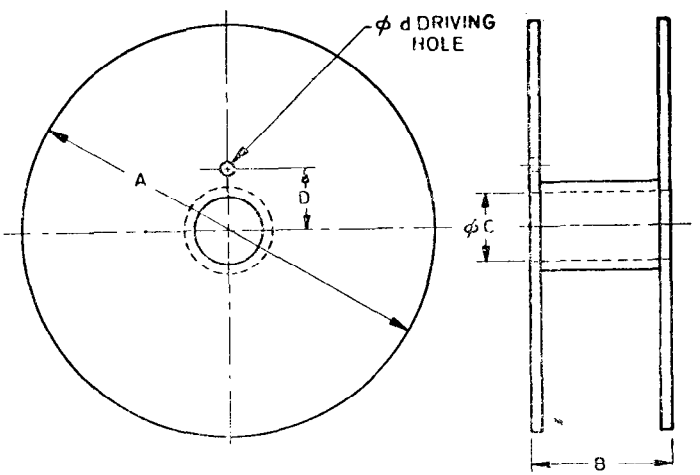

FIG. 1 SPOOL

5.2 The flanges of spools shall be sufficiently robust to avoid deformation during normal usage.

NOTE — The barrel diameter for spools should be as large as possible to permit satisfactory feeding of the wire into the welding equipment.

6. REELING CONDITIONS

6.1 The wire shall be closely wound in layers on the spools in one continuous length and shall be free from kinks, waves, sharp bends or twists; it shall be free to unwind without restriction. For a single spool, the materials shall be of the same cast.

6.1.1 The outer layer of wire shall be not closer to the flange periphery than the value given in Table 4 for appropriate flange diameter.

7. CONDITIONS OF RODS AND WIRES

7.1 Finished filler rods and wires shall have a smooth finish free from surface imperfections, corrosion products, grease, excess oxide or other foreign matter which would adversely affect the properties of the weld or the operation of the welding equipment.

7.2 Temper and Cast of Wire — The temper and cast of wire shall be as agreed to between the purchaser and the manufacturer.

TABLE 2 DIMENSIONS AND TOLERANCES FOR SPOOLS FOR ALUMINIUM, MAGNESIUM AND THEIR ALLOY FILLER WIRES

(*Clause* 5.1 *and* Fig. 1)

All dimensions in millimetres.

A		*B*		*C*		*D*		*E*	
Diameter	Tolerance	Width	Tolerance	Diameter	Tolerance Minus	Distance Between Axes	Tolerance Minus	Diameter	Tolerance Minus
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
100	±2	45	+0 −2	16 0	+1·0 −0	—	—	—	—
300	±5	103	+0 −3	50·5	+2·5 −0	44·5	±0·5	10	+1 −0
435	±5	103	+0 −3	50·5	+2·5 −0	44·5	±0·5	10	+1 −0

TABLE 3 NOMINAL MASS FOR ALUMINIUM AND ALUMINIUM ALLOY WIRE ON SPOOLS

(*Clause* 5.1)

Wire Diameter	Mass in kg for Wire on Spools Having Flange Diameters of		
mm	100 mm	300 mm	450 mm
0·8	0·5	5·0	
1·0	0·5	6·5	1
1·2 and 1·6	0·5	6·5	5
2·4		6·5	15

TABLE 4 DISTANCE BETWEEN OUTER LAYER OF WIRE AND FLANGE PERIPHERY

(*Clause* 6.1.1)

Flange Diameter	Distance Between Outer Layer of Wire and Flange Periphery
mm	mm (*Min*)
100	3
300	6
435	10

8. CLASSIFICATION

8.0 The filler rods and wires are classified on the basis of their chemical composition.

8.1 In the classification of filler rods and wires for welding aluminium and aluminium alloys (for example S-Al 19500) given in Table 5, the alphabet '*S*' denotes bars solid rod or wire. The symbol Al is used to denote aluminium alloy. The last part, that is, the 5 digit number denotes the IS designation of the material as specified in IS : 739-1977* based on its chemical composition.

8.2 In the classification of filler rods for welding magnesium alloy (for example S-Mg 1) the alphabet '*S*' denotes the base solid welding rod. The symbol Mg is used to denote maganesium alloy. The digit used indicates the particular chemical composition as specified in Table 6.

*Specification for wrought aluminium and aluminium alloy wire for general negineering purposes (*second revision*).

TABLE 5 CHEMICAL COMPOSITION OF ALUMINIUM AND ALUMINIUM ALLOYS FILLER RODS AND WIRES

(*Clauses* 8.1 *and* 9.1)

(Composition limits are in percent maximum unless otherwise stated)

Designation		Aluminium	Copper	Magnesium	Silicon	Iron	Manganese	Zinc	Titanium and/or Other Grian Refining Elements	Chromium	Remarks
New	Old										
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
S-A1 19000	S-G1 C	99·0 *Min*	0·1	0·2	0·5	0·7	0·1	0·1	—	—	Cu + Mg + Si + Fe + Mn + Zn = 1·0
S-A1 19500	S-G1 B	99·5 *Min*	0·04	—	0·3	0·4	0·05	0·1	—	—	Cu + Si + Fe + Mn + Zn = 0·5
S-A1 26398	—	Remainder	5·8-6·8	0·02	0·2	0·30	0·2-0·4	0·1	0·1-0·2	—	—
S-A1 31000	S-NG 3	Remainder	0·1	0·1	0·6	0·7	0·8-1·5	0·2	0·2	0·2	Ti + Cr = 0·2
S-A1 43000	S-NG 21	Remainder	0·1	0·2	4·5-6·0	0·6	0·5	0·2	—	—	—
S-A1 53000	S-NG 5	Remainder	0·1	2·8-4·0	0·6	0·5	0·5	0·2	0·2	0·25	Cr + Mn = 0·5
S-A1 55000	S-NG 6	Remainder	0·1	4·5-5·5	0·6	0·5	0·5	0·2	0·2	0·25	Cr + Mn = 0·5
S-A1 55380	—	Remainder	0·1	5·0-5·5	—	—	0·6-1·0	0·2	0·05-0·20 (Ti only)	0·05-0·20	Si + Fe = 0·4

NOTE — For S-A1 43000 if iron exceeds 0·45 percent, manganese content shall not be less than one-half iron content.

TABLE 6 CHEMICAL COMPOSITION FOR MAGNESIUM ALLOY FILLER RODS

(*Clauses* 8.2, 9.2 *and* B-1.1)

(Composition limits are in percent maximum unless otherwise stated)

DESIGNATION	MAGNESIUM	ALUMINIUM	ZINC	MANGANESE	COPPER	SILICON	IRON	NICKEL	CALCIUM	REMARKS
S-Mg 1	Remainder	9·0-10·5	1·0	0·15-0·4	0·15	0·30	0·03	0 01	—	Cu+Si+Fe +Ni=0·40
S-Mg 2	Remainder	5 5-8·5	1·5	0·15-0·4	0·05	0·05	0·03	0 005	—	—
S-Mg 3	Remainder	2 5-3·5	0·6-1·4	0·15-0·7	0·05	0·30	0·005	0 005	0·30	—
S-Mg 4	Remainder	0·08	0·03	1·0-2·0	0·02	0·05	0·03	0·005	0·02	—

9. CHEMICAL COMPOSITION

9.1 The chemical composition of aluminium and aluminium alloy filler rods and wires shall be as given in Table 5. The chemical analysis shall be done as specified in IS : 504-1963*.

NOTE — A table giving the suitability of these filler rods and wires for welding various aluminium alloys is given in Appendix A for information.

9.2 The chemical composition of magnesium alloy filler rods shall be as given in Table 6. The analysis shall be carried out as agreed to between the purchaser and the supplier.

NOTE — The application of magnesium alloy welding rods is given in Appendix B for information.

9.3 The manufacturer shall carry out analysis from each cast of the material and when required by the purchaser, shall supply a certified cast analysis report.

9.3.1 If required by the purchaser, adequate quantity of rods or wires representating each cast shall be made available to perform a check analysis and ensure that the chemical composition conforms to the specified requirements.

10. METHOD OF SAMPLING

10.1 The location and the method of sampling shall be agreed to between the supplier and the purchaser.

10.2 The area to be sampled shall be from the combined transverse sections obtained by bundling the rods or wires after cutting into suitable lengths, or by folding. The area shall be cleaned by grinding or picking. The sample shall be collected by milling out the area.

10.2.1 When heat treatment is required to reduce the hardness of the sample piece before machining, the annealing temperature and time shall be kept to a minimum and a suitable discard of the decarburized surface layer shall precede collection of the sample for analysis.

11. USABILITY TEST

11.1 If required by the purchaser, the filler rod or wire shall be tested by making a short run of welding in the downhand position on the surface of a test plate of 300×150 mm of appropriate thickness compatible with the diameter of the wire being tested.

11.2 Upon welding, the molten metal shall flowfreely and uniformly and shall produce a weld bead of uniform appearance, free from cracks and other deleterious defects.

*Method of chemical analysis of aluminium and aluminium alloys (*revised*).

11.3 The length of such runs shall be at least 75 mm for TIG welding process and at least 150 mm for MIG welding process. The material of the test plate and the technique of welding shall be specified by the manufacturer.

12. RETEST

12.1 If a filler rod or wire fails to meet the requirements prescribed in 9 and 11, two additional tests shall be carried out to meet such requirements.

13. PACKING

13.1 The filler rods shall be suitably packed to guard against damage, contamination or deterioration during storage, transit or inspection.

13.2 The filler wires in spools shall be heat sealed in plastic bags and packed in individual cartons of suitable construction to protect the wires. In case of 100 mm diameter flange spools an outer carton containing a number of individual cartons shall be used for the purpose of transit and storage.

14. MARKING

14.1 Each package of rods and each spool of wire shall be clearly marked with the following informations:

a) IS designation of the product;

b) Name and address of the manufacturer;

c) Trade designation of the product;

d) Size and weight of the rods and wires;

e) Batch number; and

f) Special information, if any, related to welding or storage of rods and wires in question.

14.1.1 The package of the spool may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Mark) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

APPENDIX A

(*Clause* 9.1)

APPLICATION OF ALUMINIUM AND ALUMINIUM ALLOY FILLER RODS AND WIRES

A-1. The application of aluminium and aluminium alloy filler rods and wires for welding various parent alloys is given in Table 7 for information.

A-1.1 For the characteristrics, forms and typical uses of the various grades of wrought aluminium and aluminium alloys, a reference may be made to Appendix A of IS : 739-1977*.

A-1.2 To use Table 7, select the alloys to be welded (parent alloy) from the top row and the left-hand column of the table. The recommended filler material is given where the vertical and horizontal columns meet. Alternative filler material which will give satisfactory results is given in parentheses.

APPENDIX B

(*Clause* 9.2)

APPLICATION OF MAGNESIUM ALLOY WELDING RODS

B-1. PARENT MAGNESIUM ALLOYS

B-1.1 Mg1, Mg2, Mg3 and Mg4 represent parent magnesium alloys having chemical composition similar to that of filler rods S-Mg1, S-Mg2, S-Mg3 and S-Mg4 respectively given in Table 6. The parent alloys can be in the cast or wrought form.

B-2. APPLICATION

B-2.1 The application of magnesium alloy filler rods for welding various parent alloys is given in **B-2.1.1** to **B-2.1.4** for information.

B-2.1.1 S-Mg1 filler rods can be used for welding of parent alloys Mg1 in cast as well as cast to wrought form to alloys Mg2 and Mg3.

B-2.1.2 S-Mg2 filler rods can be used for welding of alloys similar to Mg2 and Mg3 in wrought form.

B-2.1.3 S-Mg3 filler rods can be used for welding of alloys of similar composition (Mg3) only for better joint efficiency under stressed condition.

B-2.1.4 S-Mg4 filler rods can be used for welding of similar alloys (Mg4).

*Specification for wrought aluminium and aluminium alloy wire for general engineering purposes (*second revision*).

TABLE 7 APPLICATION OF ALUMINIUM AND ALUMINIUM ALLOY FILLER RODS AND WIRES

(*Clause* A-1 and A-2)

PARENT ALLOYS	55380	55000	63400, 64430, 65032, 65400	53000 54300	52000	31000	19500	19000
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
19000	S-A1 55380	S-A1 55000	S-A1 43000 (S-A1 53000)	S-A1 55000 (S-A1 53000)	S-A1 55000 (S-A1 53000)	S-A1 43000 (S-A1 55000 S-A1 19000)‡	S-A1 43000 (S-A1 55000 S-A1 19500 S-A1 19000)‡	S-A1 43000 (S-A1 55000 S-A1 19000)
19500	S-A1 55380	S-A1 55000	S-A1 43000 (S-A1 55000)	S-A1 55000 (S-A1 53000)	S-A1 55000 (S-A1 53000)	S-A1 43000 (S-A1 53000, S-A1 19000)‡	S-A1 43000 (S-A1 55000, S-A1 19500 S-A1 19000)‡	
31000	S-A1 55380	S-A1 55000	S-A1 43000 (S-A1 55000)	S-A1 55000 (S-A1 52000)	S-A1 55000 (S-A1 53000)	S-A1 43000 (S-A1 55000 S-A1 31000)†		
52000	S-A1 55380	S-A1 55000	S-A1 55000 (S-A1 53000)	S-A1 55000 (S-A1 53000)	S-A1 55000 (S-A1 53000)			
53000 54300	S-A1 55380	S-A1 55000	S-A1 55000	S-A1 55000				
63400, 64430, 65032, 65400	S-A1 55380	S-A1 55000	S-A1 43000 (S-A1 55000*) (S-A1 53000†)					
55000	S-A1 55380	S-A1 55000						
55380	S-A1 55380							

*For better colour matching after anodizing.
†For pipe welding.
‡For corrosive conditions.

(*Continued from page* 2)

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