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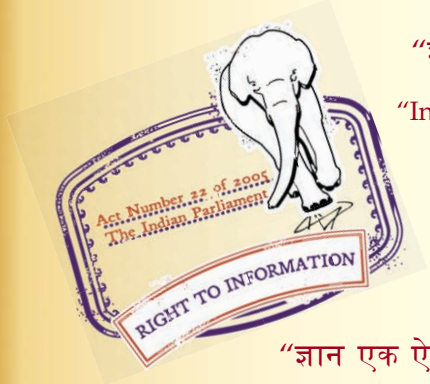
IS 736 (1986): Wrought aluminium and aluminium alloy plate for general engineering purposes [MTD 7: Light Metals and their Alloys]



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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS : 736 - 1986
(Reaffirmed 2001)

Indian Standard

SPECIFICATION FOR WROUGHT ALUMINIUM AND ALUMINIUM ALLOY PLATE FOR GENERAL ENGINEERING PURPOSES

(Third Revision)

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BUREAU OF INDIAN STANDARDS
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Gr 4 *December* 1987

Indian Standard

SPECIFICATION FOR WROUGHT ALUMINIUM AND ALUMINIUM ALLOY PLATE FOR GENERAL ENGINEERING PURPOSES

(Third Revision)

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Indian Standard

SPECIFICATION FOR WROUGHT ALUMINIUM AND ALUMINIUM ALLOY PLATE FOR GENERAL ENGINEERING PURPOSES

(Third Revision)

0. FOREWORD

0.1 This Indian Standard (Third Revision) was adopted by the Indian Standards Institution on 25 November 1986, 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 1966 and 1974. Further revision became necessary as number of new alloys which have found wide applications in engineering industries were required to be included. Tables on requirements for mechanical properties were reviewed and modified wherever necessary. The main modifications which have been made in this revision are as follows:

a) Aluminium of 99·6 percent purity and aluminium alloy 53000 have been added.

b) Code of alloy designations given in IS : 6051-1970* have been adopted in this standard. The relevant extract from the standard for designating wrought aluminium and aluminium alloys is given in Appendix A.

0.3 Some characteristic and typical uses of the alloys specified in this standard have been listed in Appendix B.

0.4 The major alloying elements have been printed in heavy type 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.

*Code of designation of aluminium and its alloys.
†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers the requirements for wrought aluminium and aluminium alloy plates for general engineering purposes.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions, as given in IS : 5047 (Part 1)-1986* and IS : 5047 (Part 2)-1979* shall apply.

2.1 Plate — Hot or cold rolled product of rectangular section, 6·0 mm thick and thicker. It may be either in straight length or in coil form. It has less control of surface finish and tolerance then applied to sheet.

2.2 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 relating to the supply of aluminium and aluminium alloy plate shall conform to IS : 10259-1982†.

4. FREEDOM FROM DEFECTS

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

5. CHEMICAL COMPOSITION

5.1 The chemical composition of the aluminium and aluminium alloys used for the plates shall be as per Table 1.

5.2 The chemical composition of the material shall be determined either in accordance with IS : 504-1963‡ or any other instrumental/chemical method of analysis. In case of dispute, the method specified in IS : 504-1963‡ shall be used as the referee method.

6. MECHANICAL PROPERTIES

6.1 The mechanical properties of the plate shall comply with the requirements given in Table 2.

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*Glossary of terms relating to aluminium and aluminium alloys:
Part 1 Unwrought and wrought metals (*second revision*).
Part 2 Plant and operations, thermal treatment, control and testing, finishing.

†General condition of delivery and inspection of aluminium and aluminium alloy products.

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

TABLE 1 CHEMICAL COMPOSITION OF WROUGHT ALUMINIUM AND ALUMINIUM ALLOY PLATES

(*Clauses* 0.4 *and* 5.1)

Composition limits are in percent maximum, unless shown otherwise.

Designation	Aluminium	Copper	Magnesium	Silicon	Iron	Manganese	Zinc	Titanium and/or Other Grain Refining Elements	Chromium	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
19800	99·8 *Min*	0·03	—	0·15	0·15	0·03	0·06	—	—	Cu+Si+Fe+Mn+Zn=0·2
19700	99·7 *Min*	0·03	—	0·2	0·25	0·03	0·06	—	—	Cu+Si+Fe+Mn+Zn=0·3
19600	99·6 *Min*	0·05	—	0·25	0·35	0·03	0·06	—	—	Cu+Si+Fe+Mn+Zn=0·4
19500	99·5 *Min*	0·05	—	0·3	0·4	0·05	0·1	—	—	Cu+Si+Fe+Mn+Zn=0·5
19000	99·0 *Min*	0·1	0·2	0·5	0·7	0·1	0·1	—	—	Cu+Mg+Si+Fe+Mn+Zn=1·0
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*	
24345 Alclad	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*	
31000	Remainder	0·1	0·1	0·6	0·7	0·8-1·5	0·2	0·2	0·2	
40800	98·0 *Min*	0·2	0·1	0·6-0·95	0·6-0·95	0·1	0·2	0·2	—	
51000-A	Remainder	0·2	0·5-1·1	0·6	0·7	0·2	0·25	—	0·1	
51000-B	Remainder	0·2	1·1-1·8	0·6	0·7	0·2	0·25	—	0·1	
52000	Remainder	0·1	1·7-2·6	0·6	0·7	0·5	0·2	—	0·25	Cr+Mn 0·5
53000	Remainder	0·1	2·8-4·0	0·6	0·7	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	
55000	Remainder	0·1	4·5-5·5	0·6	0·7	0·5	0·2	0·2	0 25	Cr+Mn=0·5
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	

NOTE — 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, it should be agreed to between the purchaser and the supplier.

*Titanium and/or other grain refinery elements and/or chromium may be present at the option of the supplier provided the total content does not exceed 0·3 percent.

TABLE 2 MECHANICAL PROPERTIES OF WROUGHT ALUMINIUM AND ALUMINIUM ALLOY PLATES

(*Clause* 6.1)

Designation	Condition*	0·2 Percent Proof Stress, MPa, *Min*	Tensile Strength, MPa		Elongation on 50 mm Gauge Length, Percent, *Min*	
			Min	*Max*	Over 6·0 mm Up to and Including 12·5 mm	Over 12·5 mm Up to and Including 25·0 mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)
19800	M	—	55	—	30	30
	O	—	—	90	34	34
	H2	—	85	110	8	—
19700	M	—	60	—	30	30
	O	—	—	95	34	34
	H2	—	90	115	8	—
19600	M	—	60	—	28	28
	O	—	—	100	30	30
	H2	—	95	125	7	—
19500	M	—	65	—	28	28
	O	—	—	100	30	30
	H2	—	100	135	7	—
19000	M	—	70	—	28	28
	O	—	70	110	28	28
	H2	—	110	140	7	—
24345	M	—	150	—	10	10
	O	—	—	240	12	10
	W	225	390	—	12	10
	WP	310	405	—	7	5
24345 Alclad	M	—	150	—	10	10
	O	—	—	240	12	10
	W	230	375	—	12	10
	WP	345	420	—	7	5
31000	M	—	95	—	23	23
	O	—	90	130	22	23
	H2	—	130	180	5	—
40800	M	—	90	—	28	28
	O	—	85	120	30	30
	H2	—	120	160	7	—
51000-A	M	—	105	—	20	20
	O	—	95	145	22	22
	H2	—	140	190	4	—
51000-B	M	—	135	—	17	17
	O	—	125	170	19	19
	H2	—	170	—	4	—

(*Continued*)

TABLE 2 MECHANICAL PROPERTIES OF WROUGHT ALUMINIUM AND ALUMINIUM ALLOY PLATES — *Contd*

Designation	Condition*	0·2 Percent Proof Stress, MPa, *Min*	Tensile Strength, MPa		Elongation on 50 mm Gauge Length, Percent, *Min*	
			Min	*Max*	Over 6·0 mm Up to and Including 12·5 mm	Over 12·5 mm Up to and Including 25·0 mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)
52000	M	—	190	—	12	12
	O	60	175	215	18	18
	H2	160	200	255	5	—
53000	M	—	215	—	12	12
	O	85	205	265	16	16
	H2	190	280	325	5	—
54300	M	125	280	—	12	12
	O	115	270	340	16	16
	H2	275	355	—	5	—
55000	M	125	275	—	—	—
	O	100	265	355	16	16
	H2	275	355	—	5	—
64430	M	—	110	—	12	12
	O	—	—	150	15	15
	W	115	200	—	15	15
	WP	240	285	—	8	8
65032	M	—	110	—	12	12
	O	—	—	150	15	15
	W	110	200	—	15	15
	WP	235	280	—	8	8
74530	W (Naturally aged for 30 days)	160	265	—	8	8
	WP	255	305	—	7	7

NOTE 1 — 1 MPa = 1 N/mm² = 0·102 kgf/mm².

NOTE 2 — Properties in M temper are for information only.

**Conditions*

M As manufactured.
O Annealed.
H2 Strain hardened and partially annealed.
W Solution heat-treated and naturally aged.
WP Solution heat-treated and precipitation treated.

6.2 The tensile test shall be carried out and proof stress determined thereby in accordance with IS : 1816-1979*.

6.3 The tensile test piece shall be of rectangular section and having the dimensions as given in IS : 1816-1979* with a gauge length of 50 mm. The test piece shall be cut transverse to the direction of rolling for plates 300 mm wide and over, and parallel to the direction of rolling for plates under 300 mm wide. When the width of the material to be tested is insufficient to permit preparation of the standard tensile test piece, a piece of the full width of material may be used.

7. CONDITION

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

8. DIMENSIONS AND TOLERANCES

8.1 The dimensions of plate and their tolerances shall be as specified in IS : 2677-1979‡.

9. SELECTION OF TEST SAMPLES

9.1 Plate of Aluminium or Non-Heat-Treatable Aluminium Alloys — Material of the same thickness, produced in the same way, and of the same nominal composition shall be grouped into batches of not more than 4 000 kg.

9.1.1 The supplier shall sample each batch at such rate that he may, on the results of the mechanical tests on the samples, certify that the material conforms to this standard.

9.1.2 Before the test samples are cut-off, they shall be marked to identify them with the batch they represent. The test samples shall be taken from the material as supplied and shall not be further annealed or mechanically worked (except for preparing the test piece) before being tested. The test samples may be out from the margins of the material before cutting it to size.

9.2 Plate of Heat-Treatable Aluminium Alloys — One test sample shall be cut from a plate, from each heat-treatment batch. Before the test samples

*Method for tensile test for light metals and their alloys (*first revision*).
†Temper designations of aluminium and its alloys.
‡Dimensions for wrought aluminium and aluminium alloys, plates and hot rolled sheets (*first revision*).

are cut off, they shall be marked to identify them with the heat-treatment batch they represent.

9.2.1 For material supplied in M condition, the test samples shall be tested in the O, W or WP condition, after heat-treatment as appropriate or as specified by the purchaser. The test samples, after heat-treatment, shall not be mechanically worked (except for straightening and preparing the test piece) before being tested.

9.2.2 Material in the O condition, when heat-treated, may be expected to have properties of the order of 15 MPa less than the specified properties for the W or WP conditions as appropriate.

9.2.3 For material supplied in the W condition the test samples shall be tested in the condition as supplied, unless the purchaser has specified that he requires the test samples to be tested in the WP condition. The test samples shall not be mechanically worked (except for preparing the test piece) before being tested. The test samples may be cut from the margins of the material before cutting it to size.

9.2.4 For material supplied in the 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 for preparing the test piece) before being tested. The test samples may be cut from the margins of the material before cutting it to size.

10. RETESTS

10.1 Should any of the test pieces first selected fail to pass the mechanical test, two further samples from the same batch shall be selected for testing.

10.2 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.

10.3 Should the test pieces from both these additional samples pass, the batch represented by the test samples shall be deemed to comply with this standard. Should the test pieces from either of these additional samples fail, the batch represented by the test samples shall be deemed not to comply with this standard.

11. MARKING

11.1 Each package/coil of plate(s) may be suitably marked for identification, with the name of the manufacturer, grade and condition of the material and batch number. The supplier shall furnish a certificate that the material supplied complies with the requirements of this specification.

11.1.1 The material may also be marked with the Standard Mark.

NOTE — 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 Standard 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 BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

APPENDIX A

(*Clause* 0.2)

EXTRACT FROM IS : 6051-1970 CODE FOR DESIGNATION OF ALUMINIUM AND ITS ALLOYS

A-1. IDENTIFICATION OF ELEMENTS

A-1.1 Elements shall be identified by the group number indicated against each in Table 3.

TABLE 3 ELEMENT NUMBER DESIGNATIONS

ELEMENT	GROUP NUMBER
Unalloyed aluminium (wrought and cast form)	1
Copper	2
Manganese	3
Silicon	4
Magnesium	5
Magnesium silicide (Mg_2Si)	6
Zinc	7
Other elements (such as nickel, titanium, chromium, lead, bismuth, etc)	8
Unassigned	9

A-2. FIVE-DIGIT SYSTEM [FOR WROUGHT ALUMINIUM ALLOY ALUMINIUM (UNALLOYED)]

A-2.1 Wrought Aluminium Alloys

First Digit	*Second Digit*	*Third, Fourth and Fifth Digits*
First digit identifies the major alloying element	Second digit indicates rounded off mean value of the percentage of the major alloying element, except for Group 4 containing silicon, when the digit refers to the mean percentage halved and rounded off; and for Group 6 containing magnesium silicide, the digit refers to five times the mean magnesium percentage rounded off	Third, fourth and fifth digits identify the minor alloying elements in the descending order of their percentage and in the case of same alloy, percentage in the serial order except for Group 6 containing the intermetallic compound (Mg_2Si) when the third digit refers to either magnesium or silicon which is in excess of that required for magnesium silicide (that is 1·7 which is the ratio of Mg to Si). For balanced compositions, the third digit will be zero. In case of high purity aluminium base alloy, the fifth digit will be 1.

Example:

Alloying Elements and Their Mean Percentage	*Designation*
Cu 1·5, Si 1·0, Mg 0·85	22450
Mn 1·2	31000
Si 5·2	43000
Mg 4·4, Mn 0·75	54300
Mg 0·65, Si 0·50	63400
Mg 0·65, Si 0·50 (EC Grade)	63401
Mg 0·95, Si 0·95	65400

A-2.2 Wrought Aluminium (Unalloyed)

First Digit	*Second Digit*	*Third and Fourth Digits*	*Fifth Digit*
First digit is always shown as 1 representing unalloyed aluminium* (wrought)	Second digit is always shown as 9, the unit digit of 99 minimum purity percentage	Third and Fourth digits indicate the decimal purity percentage	Fifth digit indicates variants, if any. *Example*: EC Grade Aluminium shown as 1

Example:

Alvminium Purity, Percent	*Designation*
Al 99·99	19990
Al 99·5	19500
Al 99·5 (EC Grade)	19501
Al 99·0	19000

*Unalloyed aluminium by convention or definition is not less than 99·0 percent aluminium.

APPENDIX B

(*Clause* 0.3)

CHARACTERISTICS AND TYPICAL USES OF ALLOYS

Designation	*Characteristics*	*Available Forms*	*Typical Uses*
19800 and 19700	High purity aluminium having good corrosion resistance	Sheet, plate and wire	Jewellery, decorative and novelty anodized items, auto trim, reflectors, breweries and some chemical plants
19600	High purity aluminium more resistant to corrosion than other alloys	Sheet, plate, extrusion, tube, wire, rolled rod and forgings	Corrosion resistant cladding on stronger alloys, impact extruded containers, food, chemical brewing and processing equipment, tanks and pipes, marine fitting, reflectors, pressed and anodized utility items, jewellery and cable sheathing
19500	High purity aluminium more resistant to corrosion than other grades	Sheet, plate, extrusion, tube, wire, rolled rod and forgings	Similar to 19600
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, good and brewing industries; packaging; cooking utensils. Sheet metal work, architectural and builder's hardware spun/pressed holloware, deep drawn parts, cladding, welding wire, electrical appliances

(*Continued*)

CHARACTERISTICS AND TYPICAL USES OF ALLOYS — *Contd*

Designation	*Characteristics*	*Available Forms*	*Typical Uses*
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 applications of clad sheets and extrusions and armaments
31000	Stronger and harder than 19000 but has good workability, weldability and corrosion resistance	Sheet, plate, extrusion, wire, tube and forgings	General purpose alloy for moderate strength applications, pressure vessels, irrigation tubing, heat exchangers, utensils and pressure cookers, roofing sheets, pilfer proof and detonator caps, air-conditioning ducting fan blades and vehicle panelling
40800	Strength comparable to alloy 31000 and ductility comparable to alloy 19000. This alloy is fine grained and has excellent drawability	Sheet and plate	Vehicle panelling, fan blades and other applications same as of grades 19000 and 31000 except those for bright anodizing purposes, utensils/holloware, containers and closures, detonator caps
51000-A	Stronger than alloy 31000, and has excellent finishing characteristics. It can be readily shaped by pressing and forming	Sheet and plate	Appliances and utensils, architectural trims, consumers durable with attractive anodized finishes

51000-B	Strength greater than 51000-A	Sheet and plate	Architectural applications; high anodizing quality kitchen ware and cooking utensils, consumer durables; bathroom fittings, auto trim, airconditioner and TV housing; chemical equipment, marine applications and refrigerator trim
52000	Ductile in 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, domestic appliances
53000	Same as 52000	Sheet, plate, extrusion, tube, wire and rolled rod	Welded structures, cryogenic applications, structural marine applications, rail and road tank cars, rivets and missile components
54300	Same as 52000	Sheet, plate, extrusion and forgings	Similar to 53000
55000	Same as 52000	Sheet, plate, wire and forgings	Shipbuilding and other applications demanding moderately high strength with good corrosion resistance; rivets, zippers, welding wire, etc

(*Continued*)

CHARACTERISTICS AND TYPICAL USES OF ALLOYS — *Contd*

Designation	*Characteristics*	*Available Forms*	*Typical Uses*
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	Sheet, plate, extrusion, tube, forgings and wire	Similar to 64430
74530	Medium strength self-ageing weldable alloy. It does not require heat-treatment after hot working or welding. Excellent welding characteristics and good formability. Good corrosion resistance when compared with other high strength aluminium-zinc alloys	Sheet, plate, extrusion and forgings	Stressed structural applications requiring welding such as bridges, chequered plates, dump-truck bodies, pressure vessels, rail coaches, etc

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 331 01 31, 331 13 75 Telegrams: Manaksanstha (Common to all Offices)

Regional Offices:	*Telephone*
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	331 01 31 331 13 75
*Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola, CALCUTTA 700054	36 24 99
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	2 18 43 3 16 41
Southern : C. I. T. Campus, MADRAS 600113	41 24 42 41 25 19 41 29 16
†Western : Manakalaya, E9 MIDC, Marol, Andheri (East), BOMBAY 400093	6 32 92 95
Branch Offices:	
'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001	2 63 48 2 63 49
‡Peenya Industrial Area 1st Stage, Bangalore Tumkur Road BANGALORE 560058	38 49 55 38 49 56
Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, BHOPAL 462003	6 67 16
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	5 36 27
53/5, Ward No. 29, R.G. Barua Road, 5th Byelane, GUWAHATI 781003	3 31 77
5-8-56C L. N. Gupta Marg (Nampally Station Road), HYDERABAD 500001	23 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	6 34 71 6 98 32
117/418 B Sarvodaya Nagar, KANPUR 208005	21 68 76 21 82 92
Patliputra Industrial Estate, PATNA 800013	6 23 05
T.C. No. 14/1421, University P.O., Palayam TRIVANDRUM 695035	6 21 04 6 21 17
Inspection Offices (With Sale Point):	
Pushpanjali, First Floor, 205-A West High Court Road, Shankar Nagar Square, NAGPUR 440010	2 51 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 — 27 68 00

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007 — 89 65 28

‡Sales Office in Bangalore is at Unity Building, Narasimharaja Square, Bangalore 560002 — 22 36 71

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