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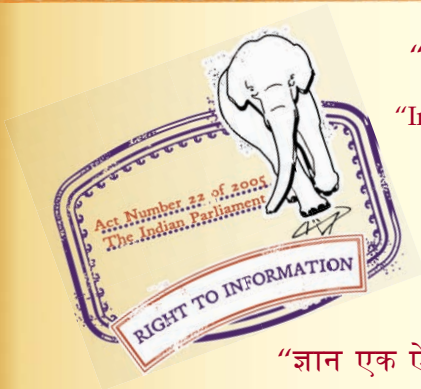
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“Knowledge is such a treasure which cannot be stolen”



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# *Indian Standard*

## SPECIFICATION FOR FLAT TRANSPARENT SHEET GLASS

( *Third Revision* )

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

# Indian Standard

## SPECIFICATION FOR FLAT TRANSPARENT SHEET GLASS

### ( Third Revision )

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# *Indian Standard*

## SPECIFICATION FOR FLAT TRANSPARENT SHEET GLASS

### ( *Third Revision* )

#### 0. FOREWORD

**0.1** This Indian Standard ( Third Revision ) was adopted by the Bureau of Indian Standards on 16 June 1987, after the draft finalized by the Glassware Sectional Committee had been approved by the Chemical Division Council.

**0.2** This standard was first published in 1965 under the title 'Transparent sheet glass ( selected quality )' and revised in 1971 by enlarging its scope and amalgamating IS : 1761-1960\* with it. This standard was again revised in 1977 in order to give a systematic qualitywise classification and a rational series of nominal thickness of sheet glass in order to cover the entire range of production.

**0.3** In this revision, Table 1 for nominal thickness has been modified. To upgrade the standard, Table 2 has been modified and allowable cluster of defects has been specified in Table 2 A, the central area in AA quality glass has been increased, the table for intensity of scratches, rubs and crush, and the determination of thickness of sheet glass and test for waviness have been modified.

**0.4** In the formulation of this standard, due weightage has been given to international coordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from the following publications:

12-GP-2 a-1970 Standard for glass, sheet, flat, clear. Canadian Government Specification Board, Canada.

DD-G-451 c-1968 Federal specification for glass, plate, sheet, figures ( float, flat, for glazing, corrugated, mirrors and other uses ). Federal Supply Service, USA.

JIS R 3202-1981 Float and polished Plate Glasses, Japanese Industrial Standard, Japan.

**0.5** For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated,

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\*Specification for transparent sheet glass for glazing and framing purposes.

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 and methods of sampling and test for flat transparent sheet glass for use in the manufacture of photographic plates, projection slides, silvered glass mirrors, toughened or laminated safety glasses and for glazing and framing purposes.

## **2. TERMINOLOGY**

**2.0** For the purpose of this standard, the following definitions and those given in IS : 1382-1981† shall apply.

**2.1 Glass** — An inorganic product of fusion which has cooled to a rigid condition without crystallizing. It is typically hard and brittle, and has a conchoidal fracture. It may be colourless or tinted and transparent to opaque. Masses or bodies of glass may be tinted, translucent or opaque by the presence of dissolved, morpuous or crystalline material. Glass that does not contain such added materials is termed as 'clear' glass, even though the finished product may not be transparent in the ordinary sense as a result of the pattern furnished (wired, corrugated, figured).

**2.2 Sheet Glass** — Transparent, flat glass having glossy, fire-finished, apparently plane and smooth surfaces, but having a characteristic waviness of surface.

**2.3 Central and Outer Areas — AA Quality** — In the case of AA quality sheet glass, area enclosed by an ellipse or circle whose major and minor axis or diameter should not exceed  $\frac{2}{3}$  the length and width of the outside of sheet glass, the remaining area being considered as the outer area.

**2.3.1 Central and Outer Areas — A and B Qualities** — In the case of A and B quality sheet glass, area enclosed by an ellipse or circle whose major and minor axis or diameter do not exceed  $\frac{1}{2}$  the length and width of the outside of sheet glass; the remaining area being considered as the outer area.

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

†Glossary of terms relating to glass and glassware (first revision).



**2.4 Crush** — A lightly pitted area resulting in a dull grey appearance over the region.

**2.5 Digs** — Deep short scratches.

**2.6 Dirt** — A small particle of foreign matter embedded in the glass surface.

**2.7 Gaseous Inclusions** — Elongated bubbles in sheet glass.

**2.8 Knot** — A transparent area of incompletely assimilated glass having an irregular knotty or tangled finish.

**2.9 Lines** — Fine cords or strings, usually on the surface of sheet glass.

**2.10 Open Gaseous Inclusions** — Elongated bubbles at the surface of sheet glass which are open leaving a cavity in the finished surface.

**2.11 Ream** — Inclusions within the glass or layers or strings of glass which are not homogeneous with the main body of the glass.

**2.12 Rubs** — Abrasion of the glass surfaces producing a frosted appearance. A 'rub' differs from a 'scratch' in having appreciable width.

**2.13 Scratches** — Any marking or tearing of the surface produced in manufacturing or handling, appearing as though it were done by a sharp or rough instrument.

**2.14 Smoke** — Streaked areas appearing as slight discoloration.

**2.15 Stones** — Any crystalline inclusion embedded in the glass.

**2.16 Strings** — Transparent lines appearing as though a thread of glass had been incorporated into the sheet.

**2.17 Sulphur Stain** — A surface defect in sheet glass, in the form of streaky lines or multi-coloured blemishes caused by sulphur dioxide, if present in kiln atmosphere.

**2.18 Wave** — Defect resulting from irregularities of the surface of glass making objects viewed at varying angles appear wavy or bent.

**2.19 Intensity of Scratches, Rubs and Crush** — When looking through glass and perpendicular to it, using daylight without direct sunlight, or with background light suitable for observing each type of defect, the visibility of the defects will be within the specified distance limits (see 5.2) :

<i>Intensity</i>	<i>Distance limit</i>
Faint	Shall not be detectable beyond 50 cm.
Light	Detectable between 50-100 cm but not beyond 100 cm.
Medium	Detectable between 100-150 cm but not beyond 150 cm.
Heavy	Detectable beyond 150 cm.

**2.20 Intensity of Reams, Strings and Lines** — When evaluated using the shadowgraph, the intensities of these defects are defined as having shadowgraph read out at distances greater than or equal to the following ( see 5.4 ) :

<i>Intensity</i>	<i>Distance</i>
Light	7.5 cm
Medium	5.0 cm
Heavy	2.5 cm

**2.21 United CM** — Half the perimeter of the glass sheet.

### 3. CLASSIFICATION

**3.1 Sheet glass shall be classified into the following 4 qualities :**

- a) *AA Quality or Special Selected Quality ( SSQ )* — Intended for use where superior quality of safety glass, high quality mirrors, photographic plates, projection slides, etc.
- b) *A Quality or Selected Quality ( SQ )* — Intended for selected glazing, manufacture of mirrors, safety glass, etc.
- c) *B Quality or Ordinary Quality ( OQ )* — Intended for glazing and framing purposes ; and
- d) *C Quality or Greenhouse Quality ( GQ )* — Intended for green house glazing, production of frosted glass, strips for flooring, etc.

### 4. REQUIREMENTS

**4.1 Material** — Sheet glass shall be flat, transparent and clear as judged by the unaided eye. It may, however, possess a light tint, when viewed edge-wise.

**4.1.1** It shall be free from any cracks.

**4.2 Dimensions** — Nominal thickness, range of thickness and dimensional tolerance on cut sizes (length and width) of sheet glass shall be as prescribed in Table 1.

**4.2.1** If agreed between the purchaser and the supplier, thickness other than those specified in Table 1 may be supplied. In such cases, range of thickness and tolerance on cut size shall be those which are applicable to immediate lower thickness specified in Table 1.

**TABLE 1 NOMINAL THICKNESS, RANGE OF THICKNESS OF SHEET GLASS AND DIMENSIONAL TOLERANCE ON CUT SIZES**  
( *Clauses 4.2 and 4.2.1* )

SL No. ( 1 )	NOMINAL THICKNESS ( 2 ) mm	RANGE OF THICKNESS ( 3 ) mm	DIMENSIONAL TOLERANCE ON CUT SIZES ( 4 ) ± mm
i)	1.0	0.85 — 1.15	1.5
ii)	1.5	1.35 — 1.65	1.5
iii)	2.0	1.80 — 2.20	1.5
iv)	3.0	2.80 — 3.20	1.5
v)	3.5	3.30 — 3.70	2.0
vi)	4.0	3.80 — 4.20	2.0
vii)	5.0	4.70 — 5.30	2.0
viii)	5.5	5.20 — 5.80	2.0
ix)	6.3	5.90 — 6.70	2.0
x)	8.0	7.50 — 8.50	3.0
xi)	10.0	9.50 — 10.50	3.0
xii)	12.0	11.00 — 13.00	3.0
xiii)	15.0	13.50 — 16.50	4.0
xiv)	19.0	17.00 — 21.00	4.0
xv)	25.0	22.00 — 28.00	5.0
xvi)	32.0	28.50 — 35.50	6.0

**4.3 Distribution of Allowable Defects** — Sheet glass shall not have defects greater than those specified in Table 2.

**4.3.1 Allowable Cluster of Defects** — Sheet glass shall not have cluster of defects more than those specified in Table 2 A.

## 5. TESTS

**5.1 Thickness** — Thickness of sheet glass shall be measured as prescribed in Appendix B.

**5.2 Scratches, Rubs and Crush** — Place the sample of sheet glass in a vertical position approximately 50 cm from the viewer's position and look through it using either daylight without direct sunlight or a background light suitable for observing each type of defect ( *see 2.19* ).

**NOTE** — The distance of the viewer from the sample shall be adjusted as specified in 2.19 to ascertain the intensity of scratches, rubs and crush.

**5.3 Bow** — Depending on the side on which bow is present, stand the sample vertically on a wooden plank. Stretch a thread edge to edge. Measure the longest perpendicular distance from the thread to the surface of sheet glass facing the thread and express it as percentage of the length of sheet glass from edge to edge along the thread.

**5.4 Reams, Strings and Lines** — Focus a light projector with a 500 W lamp and an objective lens with an approximate 5 cm aperture and about 30 cm focal length on a flat white projection screen placed about 760 cm from the light source in a dark room. Place the sheet glass in a vertical position parallel to the screen between the light and the screen. Move the glass slowly towards the screen with a vertical oscillating motion. The shadowgraph read out is the distance at which the distortion just blends with the general shadow of the glass on the screen ( see 2.20 ).

**TABLE 2 DISTRIBUTION OF ALLOWABLE DEFECTS IN SHEET GLASS**  
( *Clauses 4.3 and A-2.2* )

SL No.	DEFECTS	'AA' QUALITY		'A' QUALITY		'B' QUALITY		REMARKS
		CENTRAL	OUTER	CENTRAL	OUTER	CENTRAL	OUTER	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Gaseous inclusion, max size, mm	1.0	2.0	3.0	6.0	12.0	18.0	Separated by at least 30.0 cm
ii)	Opaque gaseous inclusion, max size mm	Nil	0.5	3.0	6.0	6.0	12.5	Separated by at least 60.0 cm
iii)	Knots, dirt and stones*, max size, mm	Nil	1.0	1.0	1.0	1.5	2.0	Separated by at least 60.0 cm
iv)	Scratches, cubs and frush	Faint	Faint	Faint	Light	Light	Medium	Separated by atleast 60.0 cm ( see 2.19 )
v)	Bow, per-cent, max	0.25	0.25	0.5	0.5	1.0	1.0	( see 5.3 )
vi)	Reams, Strings and lines	Light	Light	Light	Light	Medium	Heavy	( see 2.20 and 5.4 )
vii)	Waviness, mm	10	10	15.0	15.0	20.0	20.0	( see Appendix A )
viii)	Sulphur stains	Nil	Nil	Nil	Nil	Inconspicuous	one allowed	
ix)	Corner breakage and chip	Not more than nominal thickness of sheet glass		Not more than nominal thickness of sheet glass		Not more than nominal thickness of sheet glass		

NOTE — 'C' quality sheet glass may have defect of any size or intensity but shall have no stones or knots which may cause breakage.

\*There shall be none which hinders serviceability for automobile industry.

**TABLE 2A ALLOWABLE CLUSTER OF DEFECTS MENTIONED UNDER  
SL. NO. (i), (ii) AND (iii) OF TABLE 2**

SL. NO.	QUALITY OF SHEET GLASS	CENTRAL AREA	OUTER AREA
(1)	(2)	(3)	(4)
i)	AA	Nil	One cluster of maximum 3 defects comprising only one from (iii) and 2 from either (i) or (ii), or one each from (i) and (ii) in an optional circle of 30 cm dia
ii)	A	One cluster of maximum 3 defects comprising only one from (iii) and 2 from either (i) or (ii), or one each from (i) and (ii) in an optional circle of 30 cm dia	One cluster of maximum 5 defects of any type mentioned in (i), (ii) and (iii) but the presence of stone should not be more than one in an optional circle of 30 cm dia
iii)	B	do	One cluster of maximum 6 defects of any type mentioned in (i), (ii) and (iii) but the presence of stone should not be more than one in optional circle of 30 cm dia

## 6. PACKING AND MARKING

**6.1 Packing** — Sheet glass shall be packed as agreed to between the purchaser and the supplier.

**6.2 Marking** — Packages containing sheet glass shall be marked with the following :

- Name and quality ( *see* 3.1 ) of the material;
- Nominal thickness and cut size ( *see* 4.2 );
- Name of the manufacturer or his recognized trade-mark, if any; and
- Code or serial number to enable the lot to be traced from records.

### 6.2.1 The packages 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.

## 7. SAMPLING

7.1 Representative samples of the material shall be drawn and adjudged for conformity with this specification as prescribed in Appendix C.

# APPENDIX A

[ Table 2, Sl No. ( vii ) ]

## TEST FOR WAVINESS

### A-0. GENERAL

A-0.1 Waviness is judged by the amount of distortion of a projected vertical straight line when the sheet glass is moved through its length and width in a plane parallel to that of the projection screen.

### A-1. APPARATUS

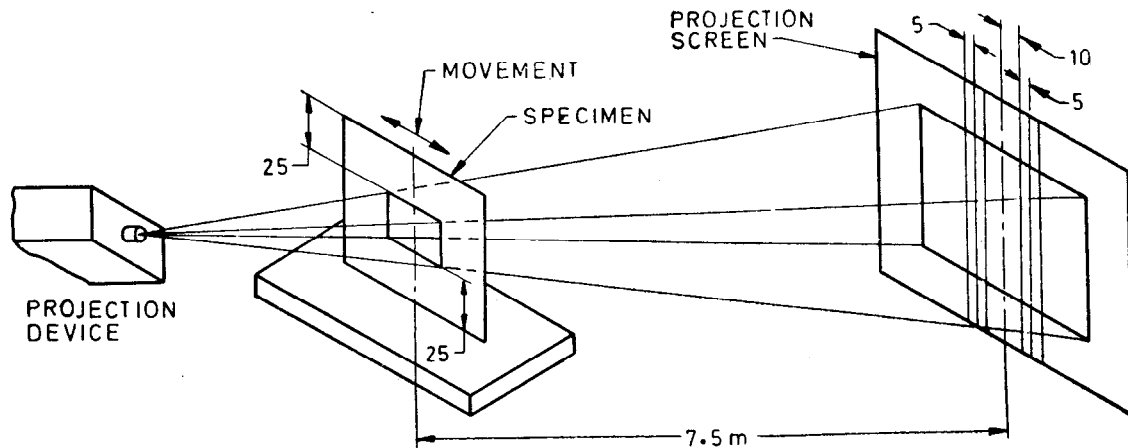
A-1.1 The apparatus consisting of a projector and screen is set up as shown in Fig. 1.

### A-2. PROCEDURE

A-2.1 Draw one vertical straight central line on the projection screen and draw 3 straight lines on either side of this central line so that all the lines are parallel and the distances of the 3 lines from the central line on either side are 10'0, 15'0 and 20'0 mm respectively. Project one straight line from the projector so that it coincides with the central line. Next place the specimen between the projector and the projection screen at a distance of 7.5 m from the latter with the plane of the sample perpendicular to the projected light flux.

A-2.1.1 Move the specimen in a plane parallel to that of the screen and examine the distortion of the projected line image over all the portions except 25 mm from the boundary of the specimen. Furthermore, turn the specimen through 90 degrees within the same plane and repeat the test.

A-2.2 The sample shall be taken as having satisfied the requirement of the test if the distortion of the projected line on the screen does not exceed the values prescribed in Table 2 for respective qualities of sheet glass.



All dimensions in millimetres.

FIG 1. SET-UP FOR TESTING WAVINESS IN SHEETS GLASS

## APPENDIX B

( Clause 5.1 )

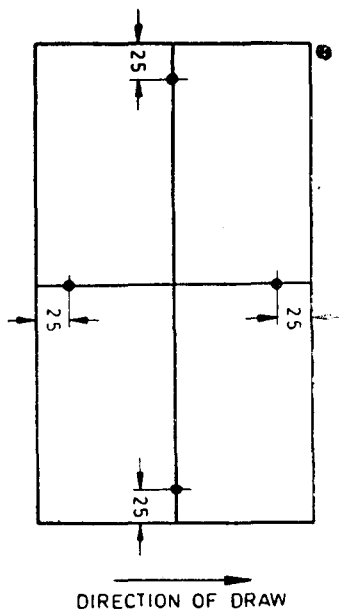
### DETERMINATION OF THICKNESS OF SHEET GLASS

#### B-1. APPARATUS

B-1.1 Screw Calipers — with an accuracy of 0.01 mm.

#### B-2. PROCEDURE

B-2.1 Marking of Points — Divide the rectangular sheet into 4 equal segments as shown in Fig. 2.



All dimensions in millimetres.

FIG. 2 DETERMINATION OF THICKNESS

B-2.2 Measurement of Thickness — Measure the thickness of the glass sheet using screw calipers at all the four points, 1, 2, 3 and 4 as shown in Fig. 2. The individual thickness at each of the four points shall be within the range of nominal specified thickness.



## APPENDIX C

( Clause 7.1 )

## SAMPLING OF FLAT TRANSPARENT SHEET GLASS

## C-1. SCALE OF SAMPLING

**C-1.1 Lot** — In a single consignment, all the sheets of glass of the same quality and nominal thickness and belonging to the same batch of manufacture shall constitute a lot.

**C-1.2** Samples shall be tested separately from each lot for ascertaining conformity of sheet glass to the requirements of this specification.

**C-1.3** The number of sheets to be sampled from a lot for this purpose shall depend on lot size and shall be in accordance with col 1 and 3 of Table 3. If the sheets are packed in boxes or cartons, at least 20 percent of them, subject to minimum of 2 boxes shall be selected at random and opened for taking out the samples. From each selected box or carton, approximately equal number of sheets shall be selected from the top, middle and the bottom portions to give the required sample size.

TABLE 3 SCALE OF SAMPLING AND CRITERIA FOR CONFORMITY  
( Clauses C-1.3, C-2.1, C-2.1.1, C-2.2 and C-2.3 )

LOT SIZE	FOR DISTRIBUTION OF VISUAL DEFECTS						NOMINAL THICKNESS AND TOLERANCE ON CUT SIZES	SAMPLE SIZE FOR TESTING WAVINESS	
	Stage	Sample Size	Com- bined Size	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Up to 100	First	8	8	0	2	2	5	9	2
	Second	8	16						
101 to 300	First	13	13	0	3	4	8	1	3
	Second	13	26						
301 to 500	First	20	20	1	4	5	13	1	4
	Second	20	40						
501 to 1 000	First	32	32	2	5	7	20	2	5
	Second	32	64						
1 001 and above	First	50	50	3	7	9	30	3	6
	Second	50	100						

**C-1.3.1** In order to ensure the randomness of selection of sheets from the lot, procedures given in IS : 4905-1968\* may be followed.

## **C-2. NUMBER OF TESTS AND CRITERIA FOR CONFORMITY**

**C-2.1 Distribution of Visual Defects and Colour ( Except Waviness ) —** Sample sheets selected in C-1.3 shall be examined for the requirements of colour and distribution of visual defects in two stages as shown in col 2 of Table 3. A glass sheet failing to satisfy any of these requirements shall be considered as defective. If the number of defective sheets found in the sample in the first stage is less than or equal to the corresponding number given in col 5 of Table 3, the lot shall be accepted. If it is equal to or greater than the corresponding number given in col 6 of Table 3, the lot shall be rejected without any further testing.

**C-2.1.1** If the number of defective sheets found in the sample in the first stage lies between  $C_1$  and  $C_2$ , a second such sample of the size prescribed in col 3 of Table 3 shall be taken and examined for colour and visual defects. The lot shall be considered as conforming to these requirements if the combined number of defectives in the first and second stage is less than the corresponding number  $C_3$  given in col 7 of Table 3; otherwise the lot shall be rejected.

**C-2.2 Nominal Thickness and Tolerance on Cut Size —** The lot, which has satisfied the requirements given in C-2.1, shall be examined for these requirements. The sample sheets required for testing these characteristics shall be selected from those examined under C-2.1 and found satisfactory. The sample size for these tests shall be as given in col 8 of Table 3. The lot shall be considered to have met these requirements, if the number of defective sheets found in the sample is less than or equal to the corresponding number  $C_4$  given in col 9 of Table 3.

**C-2.3 Waviness —** The lot, which has satisfied the requirements given in C-2.1 and C-2.2, shall be finally tested for waviness. The sample size for this purpose shall be as given in col 10 of Table 3. The sample sheets required for this testing shall be selected from those tested under C-2.2 and found satisfactory. The lot shall be considered to have satisfied the requirements for waviness if none of the sample sheets selected according to col 10 of Table 3 is found defective.

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\*Methods for random sampling.

( Continued from page 2 )

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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, Bhadhbhada 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
5-8-56 C. 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 27 68 00  
Street, Calcutta 700072

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

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