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भारतीय मानक मसौदा

कास्ट आयरन बॉक्स एंगल प्लेटें – विशिष्टि

(IS 6232 *का पहला पुनरीक्षण*)

Draft Indian Standard

Cast Iron Box Angle Plates — Specification

(*First Revision of* IS 6232)

ICS 17.040.10

Engineering Metrology Sectional Committee, PGD 25	Last date for receipt of comment is: **31 May 2025**

FOREWARD

(*Formal clauses will be added later on*)

The box angle plates were originally covered along with angle plates in IS 2554 'specification for cast iron angle plates' consequent upon the revision of IS 2554. Box angle plates are being covered separately as now given in the present standard. In Annex A, the straightedge method of testing flatness of cast iron box angle plates has been incorporated.

This standard was first published in 1971. This first revision has been taken up to keep pace with the latest technological developments and international practices. In this revision the following major changes have been made:

a) CMM (Coordinate measuring machine) method for flatness testing has been added in Annex A, and
b) Reference clause has been updated.

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 : 2022 ‘Rules for rounding off numerical values (*second revision*).’ The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Preliminary Draft

CAST IRON BOX ANGLE PLATES — SPECIFICATION

(*First Revision*)

1 SCOPE

This standard specifies requirements for two grades of cast iron box angle plates.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

IS No	*Title*
IS 210 : 2009	Grey iron castings — specification (*fifth revision*)
IS 2013 : 1995	T - slots - dimensions and spacings (*third revision*)
IS 2220 : 1990	Engineering metrology — steel straightedges (*first revision*)
IS 2554 : 1971	Specification for cast iron angle plates (*first revision*)

3 DEFINITIONS

3.1 Working Faces

All faces, whether exterior or interior which are finished by any of the processes mentioned under **5.1** and **5.2**.

3.2 Tolerance on Flatness

The maximum permissible distance separating two imaginary parallel planes within which the surface under consideration can just be enclosed.

3.3 Tolerance on Squareness

The maximum permissible distance separating the two imaginary parallel planes within which the surface under consideration can just be enclosed. The imaginary parallel planes are perpendicular to the datum face in question.

3.4 Tolerance on Parallelism

The maximum permissible distance separating the two imaginary parallel planes within which the surface under consideration can just be enclosed. The imaginary parallel planes are parallel to the datum face in question.

4 MATERIAL AND HARDNESS

The box angle plates shall be made from close-grained cast iron conforming to Grade FG 220 or higher of IS 210. The box angle plates shall have a minimum hardness of 180 HB.

5 GRADES

5.1 There shall be two grades of box angle plates depending upon their accuracies namely, Grade 1 and Grade 2.

5.2 Box angle plates which are hand-scraped on all exterior faces and edges, and conforming to the accuracies specified in Table 2 shall be classified as Grade 1.

5.3 Box angle plates finished by a similar process or by planning or milling on all exterior faces, and conforming to the accuracies specified in Table 3 shall be classified as Grade 2.

6 DIMENSIONS

The recommended dimensions of box angle plates shall be as given in Table 1.

7 TOLERANCES

7.1 Grade 1 Box Angle Plates

Grade 1 box angle plates shall comply with the tolerances for flatness of exterior faces, squareness of adjacent faces and parallelism of opposite faces as specified in Table 2.

7.2 Grade 2 Box Angle Plates

Grade 2 box angle plates shall comply with the tolerances for flatness of exterior faces, squareness of adjacent faces and parallelism of opposite faces as specified in Table 3.

7.3 Matched Pairs

Matched pairs of box angle plates shall comply with tolerances equivalent to those shown in col 5 of Tables 2 and 3. The form, dimensions and positions of slots shall be the same on each plate of matched pair.

8 DESIGNATION

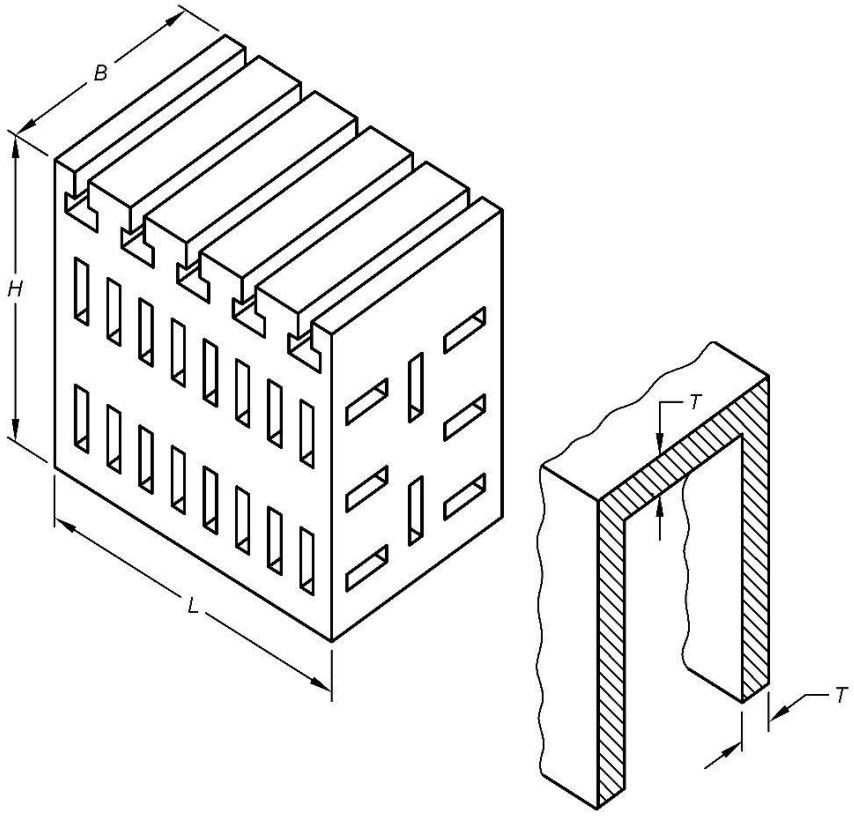
8.1 The designation of the box angle plates shall consist of its size number, the grade and the number of this standard.

Example:

A size 6 Grade 1 box angle plate shall be designated as:
Box Angle Plate 6 Gr 1 IS 6232

Table 1 Recommended General Dimensions for Box Angle Plates
(*Clause* 6)

All dimensions are in millimeter



Sl No.	Size No	*L*	*B*	*H*	*T**Min
(1)	(2)	(3)	(4)	(5)	(6)
i)	1	125	75	100	13
ii)	2	175	100	125	13
iii)	3	250	150	175	16
iv)	4	350	200	250	22
v)	5	450	300	350	22
vi)	6	600	400	450	25
*These minimum thicknesses apply to sides other than those incorporating T-slots, where T-slots are provided, these shall comply with IS 2013 and the thickness shall be increased proportionately.					

Table 2 Tolerance for grade 1 Box angle plates
(*Clause* 5.2,7.1 *and* 7.3)

All dimensions are in millimeters

Sl No.	Size No	Flatness of working Faces	Squareness of Adjacent Faces	Parallelism of opposite Working Faces
(1)	(2)	(3)	(4)	(5)
i)	1	0.005	0.010	0.013
ii)	2	0.005	0.013	0.015
iii)	3	0.008	0.015	0.018
iv)	4	0.008	0.018	0.020
v)	5	0.010	0.018	0.020
vi)	6	0.010	0.020	0.023

Table 3 Tolerance for grade 2 Box angle plates
(*Clause* 5.3,7.2 *and* 7.3)

All dimensions are in millimeters

Sl No.	Size No	Flatness of working Faces	Squareness of Adjacent Faces over H	Parallelism of Opposite Working Faces
(1)	(2)	(3)	(4)	(5)
i)	1	0.025	0.050	0.063
ii)	2	0.025	0.050	0.063
iii)	3	0.038	0.075	0.088
iv)	4	0.038	0.075	0.088
v)	5	0.050	0.100	0.113
vi)	6	0.050	0.100	0.113

9 GENERAL REQUIREMENTS

9.1 Stress Relief

After being cast and rough machined, the box angle plates shall be given a suitable heat treatment to relieve internal stress before being finished.

9.2 Bearing Area

Plates which are finished by hand-scraping shall have an area of high spots (bearing area) not less than 20 percent. A method of determining the bearing area is given in Annex A.

9.3 Defects

The material shall be sound and free from blow holes and porous patches except for such minor defects as may be repairable. Minor defects in the angle plates shall be repaired by plugging with the material of similar composition to that from which the angle plate is made. All sharp edges shall be removed.

9.4 The box angle plates shall be within the tolerances specified for tolerance on flatness and any departure from flatness shall be in the nature of concavity and not a convexity.

10 MARKING

Each box angle plate shall be legibly and permanently marked with the manufacturer's name or trade-mark, the grade of the plate and such other identification marks. The marking shall be such that it does not affect the accuracy of the plate.

11 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act,* 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

12 PACKING

During storage and transit, all finished surfaces and edges of the box angle plates shall be protected against climatic conditions by being covered with a suitable corrosion preventive preparation. The angle plates shall be packed according to the best trade practice.

ANNEX A
(*Clause* 9.2 *and Foreword*)

METHOD OF TESTING SURFACES

A-1 FLATNESS

A-1.1 The Use of a Sensitive Level

The best method which may be recommended for testing the flatness of surfaces from first principles is by means of a sensitive level. This method is not only applicable to surfaces of any size but the sensitivity of the test may easily be varied to suit the purpose in view.

A-1.2 The method of assessing the error in flatness of a surface by using a spirit level is to measure the contour of the surface along with number of lines which form a network covering the total surface. The measured contours are then, by means of calculation, all related to a common arbitrary plane, thus making it possible to assess the general overall errors of flatness of the surface The minimum requirement for this test is to measure a series of six symmetrically-spaced lines, namely, *ab, ac, cb, ad, bd* and cd as illustrated in Fig. 1.

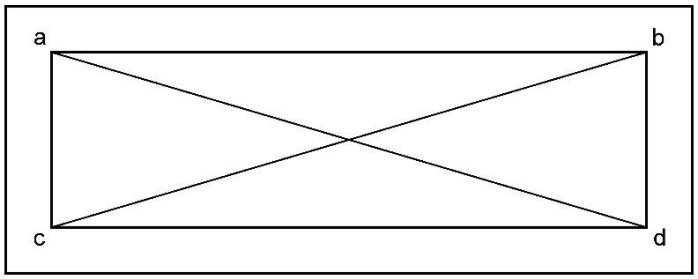


FIG. 1

A-1.3 Contours measured along additional lines will clearly give a greater number of points on the surface from which the errors of flatness of the surface may be assessed.

A-1.4 To determine the contour along any given line, the level is placed at one end of it and the position of one end of its bubble is read on its scale. The level is then advanced along the line through a distance equal to the span of its feet and second reading of the same end of the bubble is taken. In this way the level is advanced step by step along the line until the other end is reached; the level should then be moved backwards over the same path to obtain a check series of readings terminating at the starting position.

A-2 COMPARATIVE METHOD WITH THE SURFACE GAUGE

A-2.1 When a fairly large surface plate of good quality and known accuracy is available, it may be used as a basis for quicker tests on smaller plates up to size no. 1 as illustrated in Fig. 2. The smaller plate is placed upon the larger one with a small toolmaker's jack under each support. A sturdy surface gauge having a good flat base of ample size and fitted with 0.001 mm indicator is used as the comparator. This is placed upon the larger plate with the indicator resting on the smaller one. the contact point of the indicator being provided with a swiveling pad about 20 mm in diameter in order to straddle over the scraping marks.

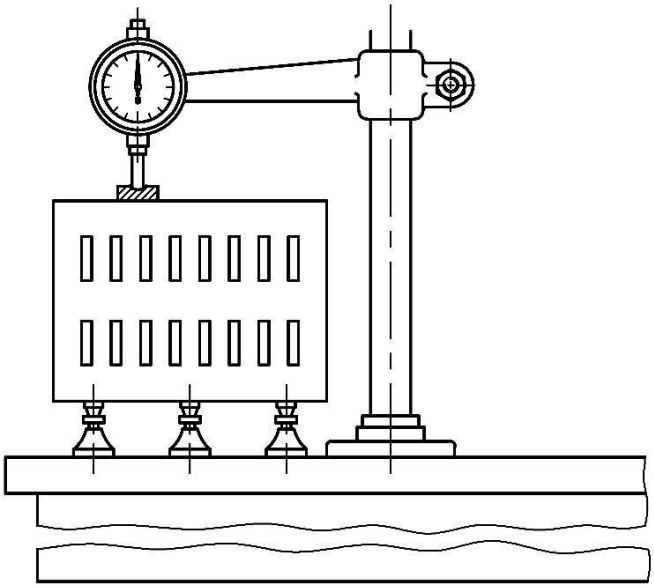


FIG. 2 COMPARATIVE METHOD WITH SURFACE GAUGE

A-2.2 Using the surface gauge and the jacks, the smaller plate is set parallel to the base in the regions above the three supporting feet. the surface gauge is then moved about so as to pass the indicator over the surface of the smaller plate. any variations in the indicator reading then gives a direct measurement of the errors in flatness of the smaller plate.

A-3. DETERMINATION OF THE PROPORTION OF BEARING AREA

A-3.1 In order to determine the proportion of the bearing area of a scraped plate, its surface is first blued and rubbed with another plate so that the small bearing areas are brought up clearly into view. A small glass plate* on which an area of 50mm × 50 mm has been ruled into 400 smaller squares (2.5mm × 2.5 mm) † is then placed upon the surface. Each small square is then observed in turn and a note made of the estimated fraction of its area (in tenths) which is occupied by a 'high spot' on the surface underneath.

A-3.2 The addition of all these fractions when divided by four gives the percentage of the bearing area of the surface over the region tested. The test may be repeated at other positions on the surface in order to obtain a fair average figure.

A-3.3 It may be mentioned that after testing a few plates by this method, the results obtained, coupled with the general appearance of the bearing areas, enable a fairly close estimate to be made of the proportion of bearing area of a plate merely from its general appearance.

A-4. STRAIGHTEDGE METHOD OF TESTING FLATNESS

A-4.1 Principle

The flatness of a surface can be determined by means of exploring generators for straightness and correlating them to a common plane. This can be done by employing a straightedge and slip gauges.

A-4.2 Procedure

Prior to the assessment of the flatness of any surface, the accuracy of straightness of the working faces of the straightedge with reference to a master surface must be determined by the method as detailed in Appendix A of IS 2220. The error in straightness of the straightedge has to be taken into account for computation of flatness.

The straightedge is placed on its edge over the surface to be assessed on two equal slip gauges supported at its minimum deflection points, which are apart by 5/9 total length, leaving an equal overhang at either end (*see* **3.4** of IS 2220), at positions AB, CD, BC and AD as shown in Fig. 3. The gap between the bottom working face of the straightedge and the test surface is measured by slip gauges. The readings are taken at the same pitch length as employed for checking the straightness of the straightedge. These readings are corrected according to the error in the straightedge. The corrected readings are then related to a common arbitrary plane by means of calculation and with reference to this arbitrary plane the flatness of the surface is assessed.

The length of the straightedge depends on the dimensions of the box angle plate. The recommended length of the straightedges are given in Table 4.

Table 4 Recommended Lengths of Straightedges
(*Clause* A-4.2)

All dimensions are in millimetres

Sl No.	**Size of Box Angle Plate**	**Dimensions L × B × H**	**Length of Straightedge According to IS 2220**	
			Working length	Total length
(1)	(2)	(3)	(4)	(5)
i)	1	125×75×100	160	180
ii)	2	175×100×125	300	340
iii)	3	250×150×175	300	340
iv)	4	350×200×250	500	540
v)	5	450×300×350	600	540
vi)	6	600×400×450	600	840

Example:

Measurement of flatness of the surface of a Cast Iron box angle plate of size 350 × 200 × 250 mm using Grade A straightedges of length 500 mm.

The straightness of the straightedge is checked using a master surface plate, with the straightedge supported at the points of minimum deflection, that is, at 120 mm from either end, on two equal slip gauges The readings in μm are noted with the help of slip gauges at pitch length of 75 mm. Actual readings are as shown in Fig. 3 The error in straightness of straightedges as shown in Fig 3, has to be taken into account for computation of flatness The straightedge is then placed on the box angle plate, on its edge supported by two equal slip gauges at its minimum deflection points Measurements are taken in two horizontal section *AB* and *CD* (along 350 mm side) and along two diagonals AD and *CB* The readings in μm taken at the same pitch lengths along sections *AB CD*, *AD* and *CB* are as follows.

These readings are computed as follows:

Section	*Actual Readings*	*Readings on Straight-edge*	*Corrected Values*	*Section*	*Actual Readings*	*Readings on straightedge*	*Corrected Values*
AB	0	0	0	AD	0	0	0
	25	1	+15		1	1	0
	35	3	+05		3	3	0
	2	2	0		1	2	−1
	0	0	0		0	0	0

CD	0 2 35 2 0	0 1 3 2 0	0 +1 +05 0 0	CB	0 1 2 1 0	0 1 3 2 0	0 0 1 1 0

The corrected values are manipulated to refer to a plane passing through 3 points on the face that is, passing *C, D* and *B.*

Along CB	*Along CD*	*Along AD*	*Along AB*	*Bringing E to 1 along AD*	*Bringing E to 1 along AB*	*Along CD*
0(C)	0(C)	0(A)	0(A)	0(D)	2(A)	0(C)
0	+1	0	+15	−0.5	0	+1
−(E)	+05	0(E)	+05	1(E)	05	+05
−1	0	−1	0	−25	05	0
0(B)	0(D)	0(D)	0(B)	−2(A)	0(B)	0(D)

Therefore, Flatness of the face of Maximum of minus reading + Maximum of plus reading the box angle plate

= 2.5 + 1

= 3.5 μm

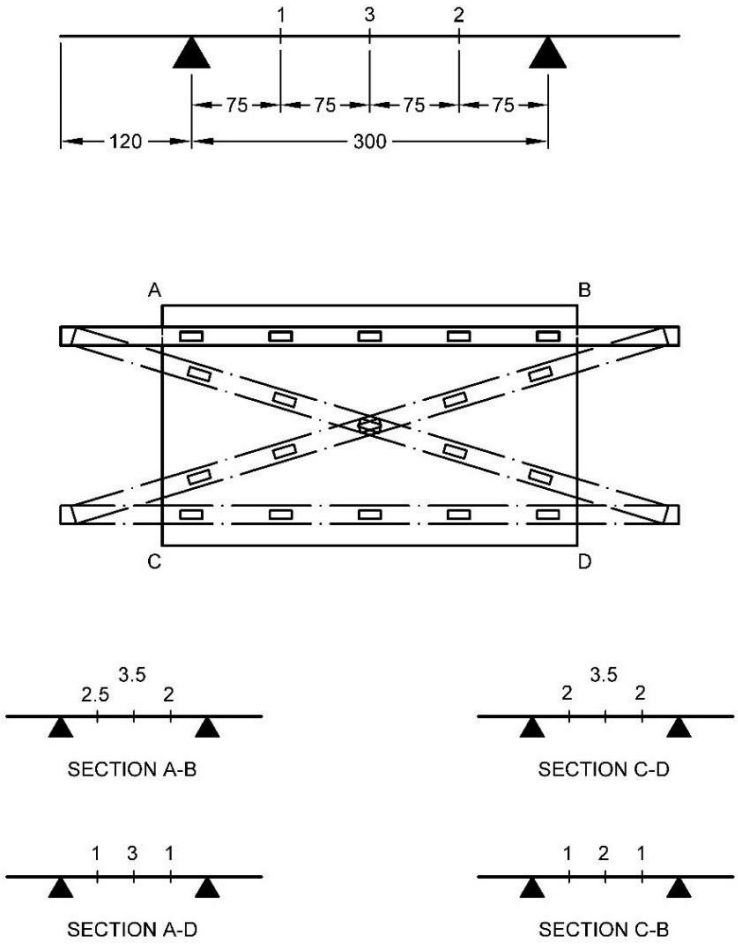


FIG. 3 STRAIGHTEDGE METHOD OF TESTING FLATNESS

A-5 FLATNESS, PERPENDICULARITY & PARALLELISM

A-5.1 The Use of a Coordinate measuring machine (Only for Grade 2 Cast iron box angle plates)

The flatness of surface can be determined by a Coordinate Measuring Machine (CMM) by establishing a reference plane and applying a suitable filter.

Perpendicularity and parallelity measurement can be done on a coordinate measuring machine, if the test item can be accommodated on it.

A-5.2 Procedure

Mount the cast iron box on the CMM table and align the surfaces to CMM coordinate system. Using CMM take the Co-ordinates on the surface of the cast iron box angle plates and evaluate the flatness by establishing a plane and suitable filter.

Set the datum by taking multiple points on the datum plane and measure the other surfaces to evaluate perpendicularity/parallelism.