भारतीय मानक
Indian Standard

IS 12933 (Part 2) : 2025

सौर सपाट पट्टिका संग्राहक — विशिष्टि

भाग 2 घटक

(तीसरा पुनरीक्षण)

Solar Flat Plate Collector — Specification

Part 2 Components

(Third Revision)

ICS 27.160

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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Renewable Energy Sources Sectional Committee, MED 04

FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Renewable Energy Sources Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1990 and subsequently revised in 1992 and 2003. This standard is being revised again to keep pace with the latest technological developments and international practices. Also, in this revision, the standard has been brought into the latest style and format of Indian Standards, and references of Indian Standards, wherever applicable have been updated. BIS certification marking clause has been modified to align with the revised *Bureau of Indian Standards Act*, 2016. In this revision all the amendments have been incorporated.

In this revision attempt has been made to remove restrictions in use of material for various components like cover plate, collector box and its insulation, etc, requiring the collector to meet the performance requirements and keeping rooms for innovations and improvements.

In order to facilitate the reference and use, this standard has been published in various parts. The other parts in this series are:

Part 1 Requirements (*third revision*)

Part 3 Measuring instruments (*first revision*)

Part 4 of this standard which covered performance requirements and acceptance criteria for solar flat plate collectors was subsequently withdrawn and its contents incorporated in Part 1.

The composition of the Committee, responsible for the revision of this standard is given at Annex B.

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.

Indian Standard

SOLAR FLAT PLATE COLLECTOR — SPECIFICATION

PART 2 COMPONENTS

(Third Revision)

1 SCOPE

1.1 This Indian Standard (Part 2) specifies the requirements for various components of solar flat plate collector for water heating.

1.2 This standard does not apply to the following:

a) Collector in whom heat transfer fluid may change phase (that is, heat pipe collectors and steam generating collectors);

b) Concentrating collectors, used in a system designed to generate mechanical energy/electricity;

c) Collectors in which the thermal storage unit is an integral part of the collector so that the collection and the storage processes cannot be separated;

d) Unglazed flat plate collector;

e) Installation or mounting of solar collectors; and

f) Tracking mechanism of the sun following collector system.

2 REFERENCES

The standards listed in Annex A 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 these standards.

3 TERMINOLOGY

For the purpose of this standard, the terminology and definitions given in IS/ISO 9488 shall apply, in addition to the following:

3.1 Cover Plate — A cover plate in solar collectors refers to a transparent or translucent material that covers the front surface of the collector, typically made of glass or a high-transparency plastic. The purpose of the cover plate is to allow sunlight to enter the collector while preventing heat loss from the absorber plate inside. It acts as a barrier against wind, dust, and moisture, maintaining the efficiency and performance of the solar collector.

3.2 Solar Transmittance — It is a measure of the amount of solar radiation that passes through a material or surface. It quantifies the fraction of incident solar radiation that is transmitted through the material, expressed as a percentage or a decimal value between 0 and 1.

SECTION 1 COVER PLATE

4 MATERIAL

The cover plate shall be of tempered/toughened glass [*see* IS 2553 (Part 3)]. The solar transmittance of the cover plate shall be minimum 85 percent at near normal incidence. The glass shall be free from bubbles and rough surface and shall satisfy the requirements given in 5.

5 TEST

5.1 Transmittance Test

5.1.1 Transmittance test is performed at the end of test sequence recommended in **4** of IS 12933 (Part 5).

5.1.2 The cover glass of the solar collector shall be removed and mounted on a test frame facing due south. The tilt of the cover glass shall be kept, so as to facilitate measurement of solar radiation on the glass surface near normal incidence. In no case, the angle of incidence shall deviate more than 15° from the normal incidence.

5.1.3 The global solar radiation shall be measured using a pyranometer on the surface of glass cover for a period of 5 min and the values shall be integrated. Just after, similar measurements of the global solar radiation shall be made at the same inclination through the glass cover for a duration of next 5 min and the values shall be integrated.

The ratio of the integrated values of the global solar radiation received through the glass cover and that received without glass cover shall be calculated. This ratio shall represent transmittance value for the cover glass.

5.1.4 This test shall be carried out on a clear sunny day and near solar noon, so as to minimize the effect of diffuse and reflected components of solar irradiance on the value of transmittance of the cover glass.

SECTION 2 COLLECTOR BOX

6 MATERIAL

6.1 The collector box shall be made of any of or any combination of the following materials:

a) Aluminum alloy conforming to IS 737 or IS 733;

b) Fibre glass conforming to IS 10192;

c) CRCA steel sheet conforming to IS 513 (Part 1);

d) Galvanized steel sheets conforming to IS 277, continuously pre-painted galvanized steel sheets conforming to IS 14246; and

e) HRC steel sheets conforming to IS 1079.

NOTE — The materials listed are to be considered as only typical and indicative of minimum requirements of material properties. Use of materials having better properties is not prejudiced by the details provided above. Materials for components in contact with each other do not entail corrosion.

6.2 The minimum thickness of the materials, specified in **6.1**, shall be as given below:

Sl No.	*Material*	*Thickness, Min* mm
(1)	(2)	(3)
i)	Aluminium:	
	a) Channel section for sides	1.4
	b) Sheet for bottom	0.45
	c) Support for glass retaining	1.2
	d) Sheet for entire body	1.0
ii)	Fibre glass	3.0
iii)	Galvanized/stainless steel sheet:	
	a) Channel section for sides	1.00
	b) Sheet for bottom	0.40
	c) Support for glass retaining	0.80
	d) Sheet for entire body	0.80
iv)	CRCA/HRC	0.91

7 WORKMANSHIP AND FINISH

7.1 All the surfaces shall be smooth and free from roughness, raised spots, scale or any other surface defects. Sharp edges and corners shall be rounded off.

7.2 The collector box, when made of CRCA or HRC sheets, shall be given corrosion resistance coating on both sides. These coatings may be of the following types and if used shall satisfy the requirements given against each.

The collector box, if painted, shall meet the requirements of IS 101 (Part 5/Sec 2).

7.3 Resistance to Abrasion

7.3.1 The apparatus required for paint scratch test shall be as given in Fig. 1 of IS 5116. It comprises a steel ball of 1 mm diameter, which is fixed at the end of a counterpoised arm. The arm is kept horizontal.

7.3.2 The above apparatus shall be applied to the surface under test. The ball shall be moved after loading with not less than 1 500 g at a speed of 3 cm/s to 4 cm/s relative to the surface. If the indicator bulb lights, the surface is deemed to have been penetrated. For metallic paints, a visual examination of the scratch shall be necessary in order, to determine whether the film has been penetrated. The finish is deemed to have failed if the scratch has jagged edges, is greater than 1 mm wide, or penetrates the film. The ball shall be cleaned after each test.

8 FABRICATION

8.1 For aluminium boxes, inert arc welding or gas brazing may be used to weld the side channels at the corners. Bottom sheet may be joined with spot welding or riveting or self-threaded stainless steel screws. The screwed/riveted joints shall be made leak proof by sealing paste of polysulphide rubber based or silicon rubber based or epoxy based compound. Use of self-locking joints is also acceptable.

Sl No.	*Base Material*	*Type of Coating*	*Thickness*	*Test to be Qualified*
(1)	(2)	(3)	(4)	(5)
i)	Steel	a) Painting	80 µm, *Min*	Resistance to abrasion as per 7.3 and for flexibility and adhesion as per 7.2.
ii)		b) Electroplated zinc coating (*see* IS 1573)	40 µm, *Min*	a) Thickness as per **9.2.1** of IS 1573. b) Adhesion test a per **9.3** of IS 1573.
iii)		c) Powder coating	40 µm, *Min*	Resistance to abrasion as per 7.3.

8.2 Fibre glass boxes shall be constructed in a single mould without any joint. Boxes shall have metal strips embedded wherever stainless steel screws are to be fixed for mounting the glass.

8.3 A box shall be made of CRCA/HRC/galvanized steel/stainless steel as specified in 6.2 through welding/riveting. The riveted joints shall be made leak proof by sealing paste as per 8.1.

SECTION 3 ABSORBER

9 ABSORBER

9.1 The absorber shall consist of risers, headers, and sheets for absorber.

9.1.1 The absorber may be of copper, aluminium, stainless steel, or mild steel with proper protective coating. The thickness of the sheets shall be chosen, so as to ensure adequate strength and stability against the pressures to prevent swelling, distortion, or ruptures.

9.1.2 There are two types of absorber, namely:

a) with selective coating; and

b) with non-selective coating.

Absorber shall conform to the temperature test performed in accordance with 9.1.4.

9.1.3 The exposed side of the absorber when painted, shall be degreased and suitable primer shall be used prior to the application of paints (preferably mat black stoving enamel paint). The paint shall satisfy the requirements of withstanding temperature as given in 9.1.4 without showing any damage or discoloration.

9.1.4 *Temperature Test*

A sample piece of the absorber having a minimum area of 400 cm^2 shall be heated in an oven at temperature of 175 °C for 2 h. After heating, the sample shall be taken out from the oven and cooled at room temperature. The cooled sample shall be inspected visually for damages, if any. There shall not be any appearance of blistering/rupture/peeling off, of the coated/painted surface and of weakening of the bonding between absorber sheet and risers/headers.

9.2 Riser and Header

9.2.1 *Static Pressure Leakage Test*

Riser and header assembly designed for working pressure up to 2.5 kgf/cm^2 shall be tested for leakage at a minimum hydraulic pressure of 5 kgf/cm^2. For the system designed for higher pressure than 2.5 kgf/cm^2, the assembly shall be tested at a pressure 1.5 times the maximum operating collector pressure. This test shall be performed in accordance with **5.3** of IS 12933 (Part 5).

9.2.2 *Bonding between Riser and Sheet*

9.2.2.1 Full length of all risers shall be welded with absorber sheet. In case of brazing/ soldering/ultrasonic or TIG welding of continuous nature, the unbrazed/unsoldered portion should not exceed more than 10 percent of the length of riser. For brazing/soldering, minimum 60 percent tin solder or suitable brazing material shall be used. The flux used for soldering/brazing shall be non-greasy.

9.2.2.2 In case of bonding of aluminium sheet and copper tube, rolled bond/pressure bond absorber joint/use of ultrasonic or laser welding shall be accepted.

9.2.3 Fluid passages may not be in the form of riser and header configuration, but these shall be subjected to pressure testing and other performance requirements.

SECTION 4 COLLECTOR BOX INSULATION

10 BACK AND SIDE INSULATION

10.1 Insulation shall be provided at back and sides. Thermal resistance (R) of insulation material shall be minimum 0.96 m^2 °C/W for back insulation and minimum 0.48 m^2 °C/W for side insulation. This shall be derived after determining thermal conductivity (K) value at 100 °C mean temperature in accordance with IS 3346.

NOTES

1 Thermal resistance (R) value shall be derived by the equation $R = L / K$.

2 Where L is thickness of insulation material and K is thermal conductivity. Thermal conductivity shall be determined at 100 °C mean temperature in accordance with IS 3346.

10.2 Aluminium foil shall be used for covering the back as well as side insulation.

SECTION 5 GASKETS AND GROMMETS

11 MATERIALS

11.1 Gaskets used for sealing the glass with collector box may be of neoprene/silicon/EPDM rubber channel section.

11.2 Grommets for sealing the collector box and header joint may be one of the following types and shall fit properly so that no dust can pass through the joints.

a) Neoprene rubber;

b) EPDM;

c) Silicon rubber; and

d) In-situ formation of any of the above material.

12 TEST

12.1 Grommets and gaskets shall conform to the thermal shock test given in **12.1.1**.

12.1.1 *Thermal Shock Test*

The sample of gasket and grommets shall be kept in an electric oven at a temperature of 125 °C for 4 h. After heating, the samples shall be taken out and cooled in air for 2 h and shall again be put in the oven at 125 °C for 4 h. The sample shall be taken out and cooled and shall be inspected for any appearance of cracks or brittleness.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 101 (Part 5/ Sec 2) : 1988	Methods of sampling and test for paints, varnishes and related products: Part 5 Mechanical tests, Section 2 Flexibility and adhesion (*third revision*)
IS 277 : 2018	Galvanized steel strips and sheets (plain and corrugated) — Specification (*seventh revision*)
IS 513 (Part 1) : 2016	Cold reduced carbon steel sheet and strip: Part 1 Cold forming and drawing purpose (*sixth revision*)
IS 733 : 1983	Specification for wrought aluminium and aluminium alloy bars, rods and sections (for general engineering purposes) (*third revision*)
IS 737 : 2024	Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes — Specification (*fifth revision*)
IS 1079 : 2017	Hot rolled carbon steel sheet, plate and strip — Specification (*seventh revision*)
IS 1573 : 1986	Specification for electroplated coatings of zinc on iron and steel (*second revision*)
IS 2553 (Part 3) : 2019	Safety glass — Specification: Part 3 Solar applications
IS 3346 : 1980	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot-plate method) (*first revision*)
IS 5116 : 2020	Domestic and commercial equipment for use with LPG — General requirements (*fourth revision*)
IS/ISO 9488 : 2022	Solar energy — Vocabulary (*first revision*)
IS 10192: 1982	Specification for synthetic resin bonded glass fibre (SRBGF) for electrical purposes
IS 12933 (Part 5) : 2003	Solar flat plate collector — Specification Part 5 Test methods (*second revision*)
IS 14246 : 2024	Continuously pre-painted galvanized steel sheets and strips — Specification (*second revision*)

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ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

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Solar Thermal Federation of India, Pune	SHRI JAIDEEP N. MALAVIYA
The Energy and Resources Institute, New Delhi	SHRI N. K. RAM
In Personal Capacity (*C*-103-*A, JVTS Garden Chattarpur Extension, New Delhi*-110074)	SHRI ATAM KUMAR
In Personal Capacity (*Dindigul, Tamil Nadu*-624622)	SHRI S. MURUGAPOOPATHI
BIS Directorate General	SHRI KUMAR ANIMESH, SCIENTIST 'E'/DIRECTOR AND HEAD (MECHANICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices: *Telephones*

Central : 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002 { 2323 7617

Eastern : 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091 { 2367 0012 2320 9474

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019 { 265 9930

Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113 { 2254 1442 2254 1216

Western : 5th Floor/MTNL CETTM, Technology Street, Hiranandani Gardens, Powai, Mumbai 400076 { 2570 0030 2570 2715

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