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भारतीय मानक मसौदा

**सौर सपाट पट्टिका संग्राहक — विशिष्टि
भाग 1 अपेक्षाएँ**

[आई एस 12933 (भाग 1) का तीसरा पुनरीक्षण]

DRAFT *Indian Standard*

**SOLAR FLAT PLATE COLLECTOR — SPECIFICATION
PART 1 REQUIREMENTS**

[*Third Revision* of IS 12933 (Part 1)]

ICS 27.160

Renewable Energy Sources Sectional
Committee, MED 04

Last date for receipt of comments
is **14 March 2025**

FOREWORD

(Formal clause to be added later)

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 the second revision attempt has been made to align it with relevant ISO Standards ISO 9806 (Parts 1 and Part 2) keeping in view that domestic solar thermal equipment industry may gear up with international requirement to compete globally in this area to enter global market. By this consideration, the following new tests have been added in line with ISO Standard:

- a) External thermal shock test (exposure to sudden rain storms);
- b) Internal thermal shock test (sudden intake of cold heat transfer fluids on hot sunny days);
- c) Time constant test (reproduction of solar energy in zero and then measuring the time for specified quantity. This information would be useful for water heating system designers and for field installations); and
- d) Incident angle modifier test.

Impact resistance test has been substantially upgraded.

The heat loss factor $F_R U_L$ has been reduced from $6.0 \text{ W/m}^2 \text{ }^\circ\text{C}$, *Max* to $5^\circ \text{ W/m}^2 \text{ }^\circ\text{C}$, *Max* to improve the performance of the collector.

In order to facilitate the reference and use, this standard is one of a series of solar flat plate collector standards. Other standards are as follows:

<i>IS No.</i>	<i>Title</i>
IS 12933	Solar flat plate collector — Specification
(Part 2) : 2003	Components (<i>second revision</i>)
(Part 3) : 2003	Measuring instruments (<i>first revision</i>)
(Part 5) : 2003	Test methods (<i>second revision</i>)

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.

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.

SOLAR FLAT PLATE COLLECTOR — SPECIFICATION
PART 1 REQUIREMENTS

(*Third Revision*)

1 SCOPE

1.1 This Indian Standard (Part 1) specifies the requirements 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 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 given below:

<i>IS No.</i>	<i>Title</i>
IS 12933	Solar flat plate collector — Specification
(Part 2) : 2003	Components (<i>second revision</i>)
(Part 5) : 2003	Test methods (<i>second revision</i>)
IS/ISO 9488 : 2022	Solar energy — Vocabulary (<i>first revision</i>)

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 Solar Flat Plate Collector — A solar flat plate collector is a type of solar thermal collector designed to harness solar energy for heating purposes. It consists of a flat, rectangular or square-shaped panel typically made of metal or other suitable materials, with a transparent cover (glazing) on top. Inside the collector, there is an absorber plate, often made of a dark-colored material with high thermal conductivity, such as copper or aluminum.

3.2 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.

3.3 Thermal Efficiency — It refers to the ratio of useful energy output to the total energy input, typically expressed as a percentage. It quantifies how effectively a system converts input energy into useful work or heat.

3.4 Time Constant — The time required for a first order system to have its output change by 63.2 percent of its final change in output following a step change in its input.

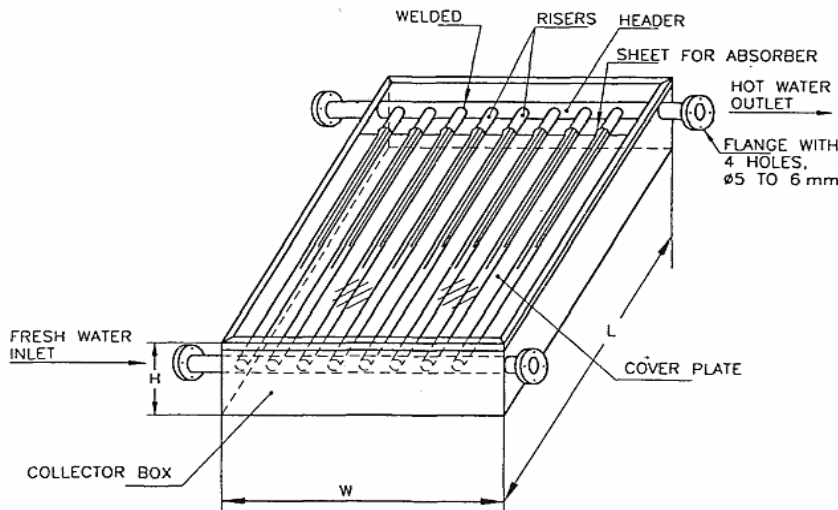
3.5 Incident Angle Modifier — It is a factor used to account for the angle at which sunlight strikes the surface of a solar collector relative to the perpendicular (normal) direction.

4 COMPONENTS

The components of solar flat plate collector shall be as specified in IS 12933 (Part 2).

5 SHAPE AND DIMENSIONS

Illustrative shape and dimensions of the flat plate collector (sizes a, b, and c) may be as given in Fig. 1. Any other size and shape not mentioned in Fig. 1 may also be used provided other components are made in consonance.



<i>Sl No.</i> (1)	<i>Size</i> (2)	<i>Length (L)</i> (3)	<i>Breadth (W)</i> (4)	<i>Height (H)</i> (5)
i)	a	1 860 ± 10	1 240 ± 10	100 ± 10
ii)	b	2 120 ± 10	1 040 ± 10	100 ± 10
iii)	c	2 050 ± 10	930 ± 10	100 ± 10

All dimensions in millimetres.

FIG. 1 SOLAR FLAT PLATE COLLECTOR

6 ASSEMBLY AND WORKMANSHIP

6.1 The entire assembly shall be free from surface defects. All sharp edges and corners shall be rounded off. The exposed surfaces shall be properly made corrosion resistant.

6.2 The insulation shall be provided in such a way that no slippage occurs when collector is installed at an angle.

6.3 The cover plate shall be fixed with the collector box through gasket which could provide an effective seal against water and dust between the collector box and cover and also to protect the cover plate from damage during its thermal expansion.

6.4 The solar collector shall be so assembled, that replaceable components are accessible for repair or replacement at site in accordance with the manufacturer's instructions.

7 TESTS

Fully assembled unit of solar collector along with the following components is required to carry out full-scale tests contained in this standard.

- a) One piece of absorber with riser having total minimum area of 400 cm²;
- b) One piece of grommet;
- c) One piece of gasket/sealant of about 300 mm length;
- d) Two numbers of matching flanges/unions;
- e) Three numbers of flange blanks/plugs for closing the header ends;
- f) A manufacturer's certificate in respect of R-value of insulation material;
- g) Information regarding maximum operating temperature and pressure; and
- h) One piece of each type of collector box material measuring 150 mm × 90 mm *Min.*

7.1 Routine Test

7.1.1 *Static Pressure Leakage Test*

7.1.1.1 *Requirement*

Collector shall be hydraulically tested for leakage in accordance with clause **5.3** of IS 12933 (Part 5).

7.1.1.2 *Acceptance criteria*

No pressure drop shall occur. There shall not be any appearance of swelling, distortion or ruptures in the risers and headers.

7.2 Type Tests

7.2.1 *Outdoor No Flow Exposure Test*

7.2.1.1 *Requirement*

The collector shall be subjected to solar radiation exposure under outdoor conditions with no fluid flow (that is, in stagnation) in accordance with clause **5.2** of IS 12933 (Part 5).

7.2.1.2 *Acceptance criteria*

There shall be no:

- a) Appearance of any sign of degradation of rubber material;
- b) Out gassing from the insulation material;
- c) Discolouration or peeling of coating/paint; and
- d) Deposition of water vapour, dust or any other material inside the cover plate when inspected visually.

7.2.2 External Thermal Shock Test

7.2.2.1 Requirement

The collector shall be subjected to external thermal shock in accordance with clause **5.4** of IS 12933 (Part 5).

7.2.2.2 Acceptance criteria

On visual inspection, there shall not be any appearance of:

- a) Cracking or distortion of the sealants, grommets, coating/paint and any other component; and
- b) Condensation or water penetration inside the solar collector.

7.2.3 Internal Thermal Shock Test

7.2.3.1 Requirement

The collector shall be subjected to internal thermal shock in accordance with clause **5.5** of IS 12933 (Part 5).

7.2.3.2 Acceptance criteria

On visual inspection, there shall not be any appearance of:

- a) Any cracking;
- b) Distortion; and
- c) Deformation in any part of the collector.

7.2.4 Rain Penetration Test

7.2.4.1 Requirement

The collector shall be subjected to spray of water on all surfaces in accordance with clause **5.6** of IS 12933 (Part 5).

7.2.4.2 Acceptance criteria

On visual inspection, there shall be no appearance of any ingress of water into the collector.

7.2.5 Impact Resistance Test

7.2.5.1 Requirement

The collector shall be subjected to impacts of steel ball from different test, heights in accordance with clause 5.7 of IS 12933 (Part 5).

7.2.5.2 Acceptance criteria

There shall be no breakage of glass cover.

7.2.6 Thermal Efficiency Test

7.2.6.1 Requirement

The solar collector shall be subjected to thermal efficiency test in accordance with clause 6.4 of IS 12933 (Part 5).

7.2.6.2 Acceptance criteria

The collector characteristics shall conform to the following:

- a) $(F_R U_L) \leq 5.5 \text{ W/m}^2 \text{ }^\circ\text{C}$, this test requirement shall be applicable with effect from 1 January 2007 until then $(F_R U_L) \leq 6.0 \text{ W/m}^2 \text{ }^\circ\text{C}$ shall continue; and
- b) $F_R(\tau\alpha) \geq 0.68$.

7.2.7 Determination of the Time Constant

The solar collector shall be subjected to thermal tests for determination of effective thermal capacity and time constant in accordance with clause 6.5 of IS 12933 (Part 5). The value of time constant shall be reported along with the test conditions for the guidance for use in manufacturing/system design/field installation. This requirement shall be applicable with effect from 01 January 2008 as adequate testing facility to carry out this test is not available in the country at present.

7.2.8 Incident Angle Modifier Test

The solar collector shall be subjected to thermal tests for determination incident angle modifier using either of the two methods given in clause 6.6 of IS 12933 (Part 5). The value of incident angle modifier shall be reported along with graphical presentation. This requirement shall be applicable with effect from 01 January 2008 as adequate testing facility to carry out this test is not available in the country at present.

8 INSTRUCTION MANUAL

The manufacturer shall provide with the collector an instruction manual containing the following minimum information:

- a) Schematic diagram of the solar collector and a domestic hot water system;
- b) Instructions for installation (including mounting details) and use and safety precautions;

- c) Instructions for repair and maintenance including causes for common failures, such as dust ingress on glass cover, peeling of paint, scaling, damaged sealant, gasket and grommets and their remedies; and
- d) List of service outlets.

9 MARKING

9.1 Each flat plate collector shall be affixed with a nameplate with the following information.

- a) Manufacturer's name, address and recognized trademark, if any;
- b) Serial number;
- c) Maximum working pressure, in kg/cm²;
- d) Values of $F_R(\tau\alpha)$ and $F_R U_L$ (if these values are better than those given in **7.2.6.2**), the specified values shall also be given in this case;
- e) Absorber material, surface coating (selective/non-selective), weight of the empty collector;
- f) Month and year of manufacture; and
- g) Country of manufacture.

9.2 BIS Certification Marking

9.2.1 The solar flat plate collector may also be marked with the Standard Mark.

9.2.2 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 product(s) may be marked with the Standard Mark.

10 PACKING

Collectors shall be packed as agreed to between the purchaser and the supplier.