Designation: E 1089 – 86 (Reapproved 2001)

Standard Test Method for Water Penetration of Flat Plate Solar Collectors by Uniform Static Air Pressure Difference[1]

This standard is issued under the fixed designation E 1089; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the resistance of flat plate solar collectors to water penetration when water is applied to their outer surfaces with a static air pressure at the outer surface higher than the pressure at the interior of the collector.

1.2 This test method is applicable to any flat plate solar collector.

1.3 The proper use of this test method requires a knowledge of the principles of pressure and deflection measurement.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary information is contained in Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*

E 331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference[2]

E 823 Practice for Nonoperational Exposure and Inspection of a Solar Collector[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *specimen, n*—the entire assembled unit as submitted for test.

3.1.2 *test pressure difference, n*—the specified difference in static air pressure across the specimen expressed as pascals or pounds-force per square foot.

3.1.3 *water leakage, n*—penetration of water into the inner surfaces of the test specimen under specified conditions of air pressure difference across the specimen during a 15-min test period.

4. Summary of Method

4.1 The test consists of either of the following:

4.1.1 Sealing the test specimen into or against one face of a test chamber, supplying air to or exhausting air from the chamber at the rate required to maintain the test pressure difference across the specimen, while spraying water onto the outdoor face of the specimen at the required rate and observing any water leakage,

4.1.2 Alternately exhausting air from the interior of the collector to create the pressure differential, or

4.1.3 Any other method that can create a similar pressure difference.

5. Significance and Use

5.1 The rain spray test described in 8.1 as Method A is based upon Test Method E 331 which is intended for use in the evaluation of exterior windows, curtain walls, and doors. This test method is intended to supplement the water spray test in Practice E 823 that does not include the effects of wind-driven rain. This method includes the use of a pressure differential to enhance the penetration of water into the assembly being tested. This type of pressure differential can occur with many types of solar collector mounting configurations. In the case of solar collectors that form a building element, for example, a roof, this pressure differential will be caused by differences of pressure inside and outside the building. In the case of solar collectors mounted on standoffs or racks, this pressure differential will be caused by positive and negative wind forces acting simultaneously on faces of the collector.

5.2 Water leakage due to joint expansion can be influenced by several factors, including: the specific collector design and materials used, the test specimen temperature, and the water spray temperature (Note 1), in addition to the pressure differential. The temperature conditions will vary in outdoor exposure. The test temperatures should be selected to be representative of outdoor conditions where the collectors will be used.

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[1] This test method is under the jurisdiction of ASTM Committee E44 on Solar, Geothermal, and Other Alternative Energy Sources and is the direct responsibility of Subcommittee E44.05 on Solar Heating and Cooling Subsystems and Systems.

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[2] *Annual Book of ASTM Standards*, Vol 04.07.

[3] *Annual Book of ASTM Standards*, Vol 12.02.

NOTE 1—Water spray temperatures are likely to range from 4.5°C to 29.4°C (40 to 85°F).

6. Safety Precautions

6.1 Glass breakage will not normally occur at the small pressure differences applied in this test. Excessive pressure differences may occur, however, due to error in operation or when the apparatus is used for other purposes such as structural testing. Therefore, exercise adequate precautions to protect personnel.

7. Test Specimen

7.1 The test specimen shall consist of a complete air or liquid collector panel assembly with openings sealed or vented that are not normally exposed to rain.

8. Preparation of Apparatus

8.1 *Method A*—The collector shall be mounted in the apparatus illustrated in Fig. 1 or any arrangement of equipment capable of creating similar test conditions. The water-spray system shall have nozzles spaced to wet those areas vulnerable to water leakage. For additional details on construction and calibration of the water-spray system, consult Test Method E 331. The test consists of sealing the solar collector into or against one face of a test chamber and supplying air to or exhausting air from the chamber at a rate required to maintain the test pressure difference across the collector, while spraying water onto the face of the collector at the required rate.

NOTE 2—Wind machines may be preferable for creation of the pressure differential in cases where the test specimen configuration does not permit the use of the apparatus described in 8.1 and 8.2.

8.2 *Method B*—The water spray system shall be identical to that provided in Method A. The pressure differential shall be applied by exhausting air from the interior of the collector case.

8.3 *Balance*, having an accuracy of at least 50 g (0.1 lb) and a capacity sufficient to weigh the collector shall be used.

NOTE 3—Testing using Method A has shown that weight gains of more than 300 g (0.6 lb) are common as a result of water leakage in many collectors.[4]

9. Procedure

9.1 *Step 1*—Weigh the test specimen.

9.2 *Step 2*—Mount the specimen in the test apparatus with the glazing exposed to the water spray, and remove any sealing material or construction that is not normally a part of the assembly as installed in or on a building. Inlet, outlet, and vent ports not normally exposed to rain shall be vented to outside the test chamber or sealed. Measure the temperature of the surfaces of the test specimen exposed to the water-spray.

9.3 *Step 3*—Adjust the water spray 60 cm^3/m^2 S to provide an uniformly distributed spray at the rate of 60 cm^3/m^2S (5.3 US gal/ft^2·h) over the entire collector top surface.

9.3.1 Apply an air-pressure difference of 480 Pa (10 lbf/ft^2) ± 10 % head of water.

9.3.2 Maintain air-pressure difference and water spray for 15 min. Measure the temperature (Note 4) of exposed surfaces of the solar collector immediately after the start of the test and before ending the test. Measure the inlet water temperature.

NOTE 4—Measure temperature on side frame and glazing. Cover with tape or silicone rubber.

9.3.3 Remove the air-pressure difference and stop the water spray.

9.4 *Step 4*—Dry exterior collector surfaces, and weigh the collector. Observe and record the points of water penetration into the collector interior.

9.4.1 *Alternate*—Disassemble collector, and look for evidence of leakage such as presence of water or wet materials.

9.5 *Step 5*—Mount the collector in the test apparatus to expose the opposite side; or the water-spray system may be moved outside the test chamber and a negative pressure applied in the test chamber.

NOTE 5—This step applies only to collectors that are exposed to wind-driven rain on their back surface or edges.

9.5.1 Repeat Steps 3 and 4 with a water-spray and air-pressure difference of ½ the values 30 cm^3/m^2S (2.65 gal/ft^2·h) and 240 Pa (5 lbf/ft^2)) ± 10 %.

10. Report

10.1 Report the following information:

10.1.1 Date of test and date of the report.

10.1.2 Identification of the specimen (manufacturer, source of supply, dimensions, model, type, materials, and other pertinent information).

10.1.3 A statement or tabulation of pressure difference or differences exerted across the specimen and water application rates during the test, the water temperature, test specimen temperature at the start and before the end of the test.

10.1.4 A record of all points of water penetration to the inner surface of the test specimen, and of water leakage as defined in 3.3.

10.1.5 A record of the mass of the specimen before and after the test.

10.1.6 A statement that the test or tests were conducted in accordance with this test method, or a complete description of any deviation from this test method.

10.2 If several identical specimens of a component are tested, the results for all specimens shall be reported, each specimen being properly identified, particularly with respect to distinguishing features or differing adjustments.

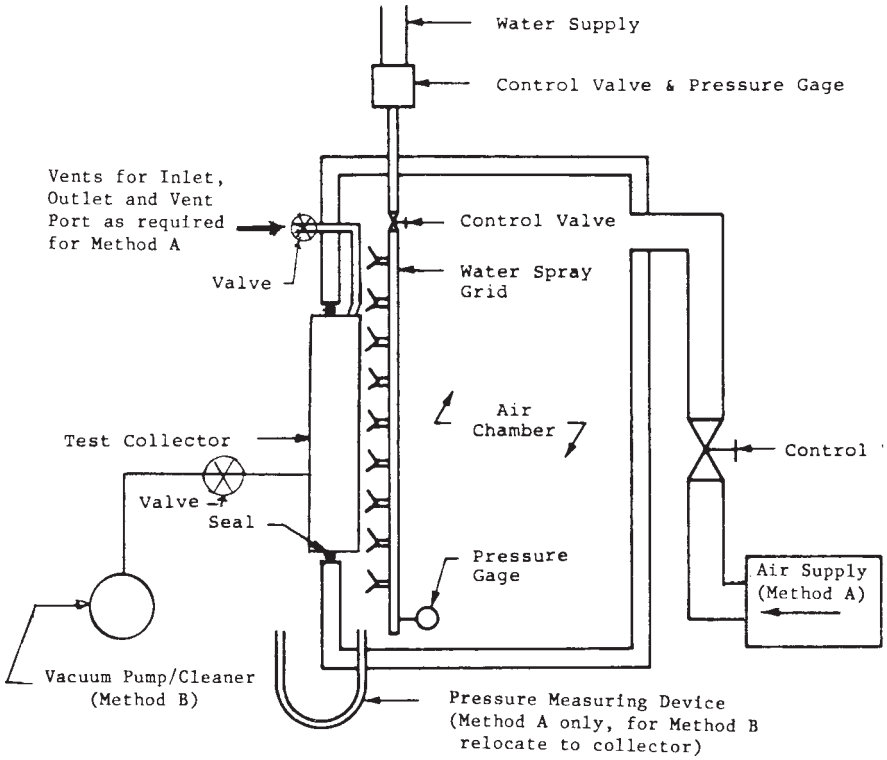
11. Precision and Bias

11.1 No statement is made either on the precision or bias of this test method for measuring water leakage since the result merely states whether there is conformance to the criteria specified for success.

12. Keywords

12.1 flat plate solar collectors; rain spray; water spray; water penetration; uniform static air pressure difference

[4] Street, W. G., Skoda, L. F., and Cattaneo, L. E., "Laboratory Investigations of Provisional Flat Plate Solar Collector Testing Procedures: Rain, Thermal Cycling and Structural," National Institute of Standards and Technology Report (in preparation).



NOTE 1—For a negative pressure system, the water-spray grid would be located outside the chamber and the air supply would be replaced by an air-exhaust system.

FIG. 1 Apparatus for Rain Test