STANDARD

ANSI/ASHRAE Standard 93-2010 (RA 2014)
(Reaffirmation of ANSI/ASHRAE Standard 93-2010)

Methods of Testing to Determine the Thermal Performance of Solar Collectors

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NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

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FOREWORD

ASHRAE Standard 93 provides a test procedure whereby solar energy collectors can be tested both indoors and outdoors to rate the collectors in accordance with their thermal performance and to determine their time constants and the variations in their efficiency with changes in the angle of incidence between the sun's direct rays and the normal to the collector aperture. The standard carefully defines its applicability to both liquid-cooled nonconcentrating and concentrating collectors and collectors that use air as the heat transfer fluid.

First published in 1986, the Standard 93 was reaffirmed in 1991 and again in 2003. This revision of the standard brings it into agreement with ISO Standard 9806-1. The test procedure for performance remains the same as in previous editions, but additional methods for calculating performance efficiency from the recorded data have been added. Whereas performance was previously calculated based on gross area and inlet fluid temperature, in this edition of the standard three new methods of calculation are provided. Now performance can be calculated based upon (1) gross area and average fluid temperature, (2) absorber area and inlet fluid temperature, and (3) absorber area and average fluid temperature. In addition, the way in which the heat-capacity time constant is determined has also been changed to align in with ISO 9806-1. In earlier editions this constant was determined by exposing the collector to thermal stabilization, then covering it. The heat capacity was found as function of how quickly the collector cooled. In this edition, however, the collector is covered to achieve thermal stabilization and then it is uncovered under exposure. The heat capacity is found as a function of how quickly the collector heats up. Finally, various editorial corrections have been made, and the standard's references have been updated to the most recent editions.

This is a reaffirmation of Standard 93-2010. This standard was prepared under the auspices of ASHRAE. It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interests of obtaining uniform guidelines throughout the industry.This version of the reaffirmation has no changes.

1. PURPOSE

The purpose of this standard is to provide test methods for determining the thermal performance of solar energy collectors that use single-phase fluids and have no significant internal energy storage.

2. SCOPE

2.1 This standard applies to nonconcentrating and concentrating solar collectors in which a fluid enters the collector through a single inlet and leaves the collector through a single outlet.

2.1.1 Collectors containing more than one inlet and more than one outlet may be tested according to this standard provided that the external piping or ducting can be connected so as to provide effectively a single inlet and a single outlet.

2.2 The heat transfer fluid may be either a liquid or a gas but not a mixture of the two phases.

2.3 This standard contains methods for conducting tests outdoors under natural solar irradiance and for conducting tests indoors under simulated solar irradiance.

2.4 This standard provides test methods and calculation procedures for determining steady-state and quasi-steady-state thermal performance, time, and angular response characteristics of solar collectors.

2.5 This standard is not applicable to those collectors in which the thermal storage unit is an integral part of the collector to such an extent that the collection process and the storage process cannot be separated for the purpose of making measurements of these two processes.

2.6 This standard does not apply to:

(a) those unglazed solar collectors that can be tested in accordance with ASHRAE Standard 96-1980 (RA 89)[1] and

(b) those collectors in which the heat transfer fluid changes phase and the leaving transfer fluid contains vapor. However, a suggested test procedure is given in Appendix I for those phase-change collectors with an integral heat exchanger that conform to the descriptions in Sections 2.1 and 2.2 of this standard.

3. DEFINITIONS AND NOMENCLATURE

3.1 Definitions

absorber: the absorber is that part of the solar collector that receives the incident radiation energy and transforms it into thermal energy. It may possess a surface through which energy is transmitted to the transfer fluid; however, the transfer fluid itself can be the absorber.

absorber area: the absorber area is the total heat transfer area from which the absorbed solar irradiance heats the transfer fluid or the area of the absorber medium if both transfer fluid and solid surfaces jointly perform the absorbing function.

air mass: the air mass is the ratio of the mass of atmosphere in the actual earth-sun path to the mass that would exist at sea level if the sun were directly overhead.

angle, acceptance: the angular zone within which radiation is accepted by the receiver of a concentrator. Radiation is said to be accepted because radiation incident within this angle reaches the absorber after passing through the aperture.