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GLAZED FLAT-PLATE SOLAR COLLECTORS WITH WATER AS THE HEAT-TRANSFER FLUID—METHOD FOR TESTING THERMAL PERFORMANCE

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THE FOLLOWING SCIENTIFIC, INDUSTRIAL, CONSUMER AND GOVERNMENTAL organization and departments were officially represented on the committee entrusted with the preparation of this standard:

Australian Electrical and Electronic Manufacturers Association

Australian Federation of Consumer Organizations Inc.

Australian Gas Association

CSIRO, Division of Energy Technology

Department of Consumer Affairs, N.S.W.

Department of Employment and Labour Relations, Qld

Department of Housing and Construction

Department of Industrial Relations, N.S.W.

Department of Mines and Energy, N.T.

Department of Public Works, W.A.

Electricity Supply Association of Australia

Energy Authority of New South Wales

Engineering and Water Supply Department, S.A.

Gas and Fuel Corporation of Victoria

International Solar Energy Society

Master Plumbers and Mechanical Services Association of South Australia Inc.

Master Plumbers and Mechanical Services Association of Victoria

Metal Trades Industry Association of Australia

Plastics Institute of Australia Incorporated

Solar Energy Industries Association of Australia

State Energy Commission of Western Australia

Trade Practices Commission

University of Melbourne

University of New South Wales

This standard, prepared by Committee CS/28, Solar Water Heaters, was approved on behalf of the Council of the Standards Association of Australia on 16 February 1982, and was published on 19 May 1982.

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This standard was issued in draft form for comment as DR 80146.

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PREFACE

This standard was prepared by the Association's Committee on Solar Water Heaters, as one of a series of standards relating to solar hot water systems, in response to a request from the Australian and New Zealand section of the International Solar Energy Society.

The committee is undertaking preparation of methods of test for complete solar hot water systems (incorporating collector, container and controls), but it also has recognized the need for a test to measure the thermal characteristic of the flat-plate collectors commonly used in these systems.

In view of the extensive work done by the CSIRO, Division of Mechanical Engineering, in developing such collector test methods, it was agreed that the CSIRO tests should form the basis of this standard, and the assistance received therefrom is gratefully acknowledged.

CONTENTS

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard

for

GLAZED FLAT-PLATE SOLAR COLLECTORS WITH WATER AS THE HEAT-TRANSFER FLUID—METHOD FOR TESTING THERMAL PERFORMANCE

FOREWORD

The test method described in this standard is conducted outdoors using naturally occurring climatic conditions, and the test has been arranged so as to minimize the effects of uncontrolled variables.

The test method described in this standard is based on that described in CSIRO Division of Mechanical Engineering Technical Report TR 9, 'An Experimental Facility to Test Flat-plate Solar Collectors Outdoors', by P. Pott and P.I. Cooper. This test method will produce results which are similar to those arrived at using the appropriate sections of ASHRAE 93-77 (ANSI B198.1—1977), Methods of Testing to Determine the Thermal Performance of Solar Collectors. The thermal time-constant of a solar collector is not required to be measured since in system design it makes very little difference (less than 1 percent) whether it is taken into account or neglected.* The measurements required in this test method are substantially the same as those of ASHRAE 93-77, but the data reduction is more rigorous as are the requirements for the conditions during a test point period.

*See Klein, Duffie & Beckman, *Journal of Engineering for Power*, TRANS ASME, p.109 April 1974, 'Transient Consideration of Flat Plate Solar Collectors'.

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SECTION 1. SCOPE, APPLICATION AND DEFINITIONS

1.1 SCOPE. This standard sets out a method for determining the thermal performance characteristic of glazed flat-plate solar collectors operating with water as the heat-transfer fluid. This thermal performance characteristic may be used to estimate the performance of the collector when subjected to different ambient conditions and load requirements. It can also be used as a basis for rating different collectors.

1.2 APPLICATION. The test method described is intended for use on types of glazed collector commonly known as flat-plate collectors, which transfer incident solar energy, as heat, to water passing through the collector.

1.3 DEFINITIONS. For the purpose of this standard, the following definitions apply:

1.3.1 Absorber—a device within a collector for absorbing radiant energy and transferring this energy, as heat, into a fluid.

NOTE: The fluid is water in this standard.

1.3.2 Collector—a device containing an absorber.

1.3.3 Collector aperture—the net area available for transmission of solar radiation through the outer air/cover interface.

1.3.4 Collector cover—the material covering the collector aperture to provide thermal and environmental protection.

1.3.5 Flat-plate collector—a non-concentrating collector in which the absorber is essentially planar.

1.3.6 Pyranometer—a radiometer used to measure the total solar radiation incident upon a surface per unit time per unit area. This energy includes the direct radiation, the diffuse sky radiation and the solar radiation reflected from the ground.

1.3.7 Residence time—the time for an element of heat-transfer fluid to travel from the collector inlet to the collector outlet. It is calculated as the total volume of heat-transfer fluid in the absorber and headers divided by the volumetric flow rate.

1.3.8 Steady state—the state of a flat-plate collector under constant flow rate when the inlet and outlet temperatures of the water, and the temperature difference, do not vary by more than $\pm 0.1°$ C and the total solar radiation by more than 10 W/m^2, during a test point period.

1.3.9 Test point period—the time over which collector operating data are taken to establish an efficiency point for the conditions existing during that time period.

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