

IAPMO/ANSI S1001.1-2013 (R2019)

Design and Installation of Solar Water Heating Systems



American National Standard

Approval of an American National Standard requires verification by the American National Standards Institute (ANSI) that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Published by

International Association of Plumbing and Mechanical Officials (IAPMO)

5001 East Philadelphia Street, Ontario, California, 91761, USA

1-800-854-2766 • 1-909-472-4100

Visit the IAPMO Online Store at: www.IAPMOstore.org

Visit the IAPMO Standards website at: www.IAPMOstandards.org

Copyright © 2012-2013 by

International Association of Plumbing and Mechanical Officials (IAPMO)

All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without prior written permission of the publisher.

Printed in the United States of America

Contents

Preface

IAPMO Solar Standards Committee

IAPMO S1001 Technical Subcommittee

- 1** **Scope**

- 2** **Reference Publications**

- 3** **Definitions and Abbreviations**
 - 3.1 Definitions
 - 3.2 Abbreviations

- 4** **Design Requirements**
 - 4.1 General
 - 4.2 Temperature Control
 - 4.3 Stagnation
 - 4.4 Protection from Over-Pressure and Over-Temperature
 - 4.5 Isolation
 - 4.6 Thermal Contraction and Expansion
 - 4.7 Auxiliary Heating Equipment
 - 4.8 Thermosiphon Losses
 - 4.9 Heat Transfer Fluid System Sizing
 - 4.10 Vacuum Protection
 - 4.11 Corrosion and Degradation
 - 4.12 Collectors
 - 4.13 Tanks
 - 4.14 Pumps and Control Systems Design
 - 4.15 Plumbing and Piping Design
 - 4.16 Component Substitution

- 5** **Reliability and Durability**
 - 5.1 Thermal Degradation, Thermal Shock, and Cycling Stresses
 - 5.2 Solar Radiation Degradation
 - 5.3 Extreme Conditions
 - 5.4 Freeze Protection
 - 5.5 Materials and Heat Transfer Fluid Compatibility
 - 5.6 Deterioration of Fluids
 - 5.7 Soil-Related Degradation
 - 5.8 Deterioration of Gaskets, Sealants, and Hoses
 - 5.9 Water Hammer
 - 5.10 Sound and Vibration Control

6 Safety

- 6.1 Protection of Electrical Components
- 6.2 System Failure Prevention
- 6.3 Combustibles
- 6.4 Entrapped Air
- 6.5 Materials in Contact with Potable Water
- 6.6 Toxic Fluids
- 6.7 Liquid Flash Point
- 6.8 Water Delivery Temperature Control
- 6.9 Pressure Relief
- 6.10 Heated Components

7 Installation

- 7.1 General
- 7.2 Component Installation
- 7.3 Access
- 7.4 Building Penetrations
- 7.5 Water Damage
- 7.6 Supporting Structures
- 7.7 Protection from Thermal Deterioration

8 Operation and Servicing

- 8.1 Operation Indicators
- 8.2 Waste Disposal
- 8.3 Maintenance and Servicing
- 8.4 Permanent Maintenance Accessories
- 8.5 Minimum Maintenance Requirements

9 Markings, Identification, and Additional Literature

- 9.1 Fluid Handling Instructions
- 9.2 Exposed Areas
- 9.3 Single-Wall Heat Exchangers
- 9.4 Identification of Piping
- 9.5 Manuals

Preface

This is the first edition of IAPMO/ANSI S1001.1, *Design and Installation of Solar Water Heating Systems*. The Florida Solar Energy Center Standard FSEC Standard 104-10 was used in the development of this Standard.

This Standard was developed by the IAPMO S1001 Technical Subcommittee and approved by the IAPMO Solar Standards Committee in accordance with the *ANSI Essential Requirements: Due process requirements for American National Standards and IAPMO Policies and Procedures for Consensus Development of American National Standards*. This Standard was approved as an American National Standard on November 26, 2013.

Notes:

- (1) *The use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- (2) *This standard was developed in accordance with the IAPMO procedures accredited as meeting the criteria for American National Standards and it is an American National Standard. The IAPMO Standards Committee that approved this Standard was balanced to assure that individuals from competent and concerned interests had an opportunity to participate. During its development, this Standard was made available for public review, thus providing an opportunity for additional input from industry, academia, regulatory agencies, and the public at large.*
- (3) *This Standard was developed by consensus, which is defined as substantial agreement; consensus implies much more than a simple majority, but not necessarily unanimity. It is consistent with this definition that a member of the relevant IAPMO Standards Committee can be included in the committee roster and yet not be in full agreement with all sections of this Standard.*
- (4) *Although the intended primary application of this Standard is stated in its scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
- (5) *IAPMO Standards are subject to periodic review and suggestions for their improvement will be referred to the relevant IAPMO Standards Committee. To submit a proposal for change to this Standard, you may send the following information to the International Association of Plumbing and Mechanical Officials, Attention Standards Department, at standards@IAPMOstandards.org or, alternatively, at 5001 East Philadelphia Street, Ontario, California, 91761, and include "Proposal for change" in the subject line:*
 - (a) *standard designation (number);*
 - (b) *relevant section, table, or figure number, as applicable;*
 - (c) *wording of the proposed change, tracking the changes between the original and the proposed wording; and*
 - (d) *rationale for the change.*
- (6) *Requests for interpretation should be clear and unambiguous. To submit a request for interpretation of this Standard, you may send the following information to the International Association of Plumbing and Mechanical Officials, Attention Standards Department, at standards@IAPMOstandards.org or, alternatively, at 5001 East Philadelphia Street, Ontario, California, 91761, and include "Request for interpretation" in the subject line:*
 - (a) *the edition of the standard for which the interpretation is being requested;*
 - (b) *the definition of the problem, making reference to the specific section and, when appropriate, an illustrative sketch explaining the question;*
 - (c) *an explanation of circumstances surrounding the actual field conditions; and*
 - (d) *the request for interpretation phrased in such a way that a "yes" or "no" answer will address the issue.*
- (7) *Interpretations are processed in accordance with IAPMO's accredited standards development procedures. IAPMO issues written replies to inquiries concerning interpretation of technical aspects of this Standard.*
- (8) *IAPMO accepts responsibility only for those interpretations of this Standard issued in accordance with the accredited IAPMO policies and procedures, which precludes the issuance of interpretations by individuals.*

- (9) IAPMO does not “approve,” “rate,” or “endorse” any item, construction, proprietary device, or activity.
- (10) Attention is drawn to the possibility that some of the elements of this Standard may be the subject of patent rights. IAPMO is not to be held responsible for identifying any or all such patent rights. Users of this Standard are expressly advised that determination of the validity of any such patent rights is entirely their responsibility.
- (11) IAPMO does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this Standard, and does not undertake to insure anyone utilizing this Standard against liability for infringement of any applicable patents, nor assumes any such liability. Users of this Standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their responsibility.
- (12) Participation by federal or state agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this Standard.

IAPMO Solar Standards Committee

L. Nelson	IAPMO Ontario, California, USA	<i>Chair (Non-Voting)</i>
M. Dunlop	Florida Solar Energy Center Cocoa, Florida, USA	
R. Gillespie	Caleffi North America Milwaukee, Wisconsin, USA	
W. Guiney	Johnson Controls Milwaukee, Wisconsin, USA	
E. Murray	Aztec Solar Sacramento, California, USA	
P. Outram	SunEarth Inc. Fontana, California, USA	
P. Redgate	Ameco Solar Inc. Paramount, California, USA	
V. Woodruff	Insource Renewables Pittsfield, Maine, USA	
A.I. Murra	IAPMO Ontario, California, USA	<i>Secretary</i>
K.C. Thompson	IAPMO Ontario, California, USA	<i>Staff Liaison</i>

IAPMO S1001 Technical Subcommittee

L. Nelson	IAPMO Ontario, California, USA	<i>Chair</i>
C. Beebe	Beam Engineering Boston, Massachusetts, USA	
B. Byrom	Alternate Energy Technologies Green Cove Springs, Florida, USA	
T. Dinkel	SunReports Inc. San Francisco, California, USA	
M. Dunlop	Florida Solar Energy Center Cocoa, Florida, USA	
R. Gillespie	Caleffi North America Milwaukee, Wisconsin, USA	
B. Gravely	Holocene Technologies Raleigh, North Carolina, USA	
A. Mauchlen	Enerworks Inc. Woodstock Ontario, Canada	
S. Morner	Sustainable Engineering Group LLC Madison, Wisconsin, USA	
E. Murray	Aztec Solar Sacramento, California, USA	
P. Outram	SunEarth Inc. Fontana, California, USA	
E. Skiba	Apricus Inc. Branford, Connecticut, USA	
N. Stimmel	Pacific Gas & Electric San Francisco, California, USA	
J. Thornton	Thermal Energy System Specialists (TESS) Madison, Wisconsin, USA	
C. DeJong	ASTM International West Conshohocken, Pennsylvania, USA	<i>Liaison</i>

A.I. Murra

IAPMO
Ontario, California, USA

Staff Liaison

K.C. Thompson

IAPMO
Ontario, California, USA

Secretary

IAPMO S1001.1-2013(R2019)

Design and Installation of Solar Water Heating Systems

1 Scope

1.1

This Standard specifies requirements for the design and installation of pre-engineered solar water heating systems intended to be installed as stand-alone systems or in conjunction with auxiliary water heaters, including component selection and sizing criteria.

1.2

This Standard does not cover

- (a) existing water heating equipment;
- (b) systems engineered for discrete or site-specific applications;
- (c) performance and durability testing of collectors or solar water heating system components; and
- (d) design and installation of solar photovoltaic systems.

1.3

The requirements of this Standard are not intended to prevent the use of alternative materials or methods of construction, provided such alternatives meet the intent and requirements of this Standard.

1.4

In this Standard,

- (a) "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the standard;
- (b) "should" is used to express a recommendation but not a requirement;
- (c) "may" is used to express an option or something permissible within the scope of the standard; and
- (d) "can" is used to express either a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.5

SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application but each unit system is to be used independently. Combining values from the two measurement systems can result in non-conformance with this Standard.