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Standard Practice for Installation and Service of Solar Domestic Water Heating Systems for One- and Two-Family Dwellings[1]

This standard is issued under the fixed designation E 1056; 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.

ϵ^1 NOTE—Keywords were added editorially in October 1995.

1. Scope

1.1 This practice provides descriptions of solar domestic water heating systems and sets forth installation and service practices in new and existing one- and two-family dwellings to help ensure adequate operation and safety.[2,3]

1.2 This practice applies regardless of the fraction of heating requirement supplied by solar energy, the type of conventional fuel used in conjunction with solar, or the heat transfer fluid (or fluids) used as the energy transport medium. However, where more stringent requirements are recommended by the manufacturer, these manufacturer requirements shall prevail.

1.3 The values stated in inch-pound units are to be regarded as the standard.

1.4 *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.* For specific precautionary statements, see Sections 6 and 7.

2. Referenced Documents

2.1 *ASTM Standards:*

E 772 Terminology Relating to Solar Energy Conversion[4]

2.2 *SMACNA Standards:*

Medium Pressure Duct Construction Standards[5]

Fibrous Glass Duct Construction Standards[5]

Flexible Duct Performance and Installation Standards[5]

2.3 *NFPA Standard:*

NFPA 321 Basic Classifications of Flammable and Combustible Liquids[6]

2.4 *ANSI Standard:*

Z 21.22 Relief Valves and Automatic Gas Shut Off Devices for Hot Water Supply Systems[7]

3. Terminology

3.1 *Definitions:*

3.1.1 *auxiliary energy subsystem, n*—in solar energy application, equipment using nonsolar energy sources to supplement or backup the output provided by a solar energy system. **(E 772)**

3.1.2 *flash point, n*—of a liquid, the minimum temperature at which it gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid within the vessel as specified by appropriate test procedure and apparatus. (See Terminology E 772 and NFPA 321.)

3.1.3 *heat transfer fluid, n*—(*1*) in solar energy systems, a liquid or gas that passes through the solar collector and carries the absorbed thermal energy away from the collector. (*2*) any fluid that is used to transfer thermal energy between subsystems in solar energy systems. **(E 772)**

3.1.4 *operating conditions, extreme, n*—unusual physical conditions to which a component or system may be exposed and for which it is not designed or intended to withstand, nor is it required to withstand by a local regulatory agency. **(E 772)**

3.1.5 *operating conditions, normal, n*—the usual range of physical conditions (for example, temperature, pressure, wear and tear, weather) for which the component or system was designed. **(E 772)**

3.1.6 *solar energy system, active, n*—a solar energy system that uses mechanical equipment (pumps, fans), that is not an integral part of a structure, to collect and transfer thermal energy, either to the point of use or to be stored for later use. **(E 772)**

3.1.7 *solar water heating systems, direct, n*—a solar water heating system in which the potable water passes directly from

[1] This practice is under the jurisdiction of ASTM Committee E-44 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] Dikkers, R., "Performance Criteria for Solar Heating and Cooling Systems in Residential Buildings," Department of Housing and Urban Development and National Bureau of Standards, September, 1982.

[3] Hollander, P. E., "Installation Guidelines for Solar DHW Systems in One- and Two-Family Dwellings," Franklin Research Center, U. S. Goverment Printing Office, April 1979.

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

[5] Available from Sheet Metal and Air Conditioning Contractors National Assoc. (SMACNA), 8224 Old Courthouse Rd., Tysons Center, VA 22180.

[6] Available from National Fire Protection Assoc., Batterymach Park, Quincy, MA 02269.

[7] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

the water supply, through the collectors and storage, to the residential hot water supply. **(E 772)**

3.1.8 *solar energy system, drainback, n*—a solar energy system in which the heat transfer fluid is drained out of the collector and exposed piping, and into a storage tank, a holding tank, or expansion tank in order to protect the collector and piping from damage due to freezing. **(E 772)**

3.1.9 *solar energy system, draindown, n*—a solar energy system in which the heat transfer fluid is drained out of the collector and exposed piping to an external drain in order to protect the collector and piping from damage due to freezing. **(E 772)**

3.1.10 *solar water heating system, indirect, n*—a solar water heating system in which a closed circulation loop isolates one fluid from contact with others in the system. This closed loop may contain a nonpotable fluid. **(E 772)**

3.1.11 *solar energy system, thermosiphon, n*—a solar energy system in which the heat transfer fluid circulates by convection as the less dense, warm fluid rises and is displayed by the denser, cooler fluid. **(E 772)**

3.1.12 *solar water heating system, tank absorber, n*—Solar Domestic Hot Water (SDHW) system in which solar radiation is absorbed by the surface of the storage tank, which is usually installed in an insulated housing whose sunward side is glazed. Such systems are also referred to as "batch" or "breadbox" heaters.

3.1.13 *weather conditions, extreme, n*—environmental conditions that are rare in a local climatic region (which have occurred no more than once during the past 30 years).

3.1.14 *weather conditions, normal, n*—the (actual or anticipated) range of environmental conditions (rain, snow, hail, wind, temperature, pollution) that typically occur in a local climatic region over several years. **(E 772)**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *accessible, adj*—permitting close approach that may require removal or opening of an access panel, door, or similar obstruction.

3.2.2 *durability, n*—the ability (of a system or component) to operate properly as long as intended.

3.2.3 *potable water, n*—water that is free of impurities in amounts sufficient to cause disease or harmful physiological effects and conforming in its bacteriological and chemical quality to the regulations of the public health authority having jurisdiction.

3.2.4 *reliability, n*—the ability (of a system or component) to operate properly when required.

3.2.5 *SDHW, n*—solar domestic hot water.

3.2.6 *shall, vi*—a mandatory requirement necessary to provide minimum operation and safety.

3.2.7 *should, vi*—a recommended method or component to provide improved performance and effectiveness.

3.2.8 *toxic, adj*—any substance (other than a radioactive substance) that has the capacity to produce personal injury or illness to man through ingestion, inhalation, or absorption through any body surface, or any substance producing a lethal dose in half (LD50) of white rats when ingested as a single dose of less than 10 g/kg of body mass.

4. Significance and Use

4.1 This practice is intended to serve as a guide to manufacturers, distributors, installers, contractors, regulatory officials, and owners. It is not intended to specify detailed methods of testing, installation, or servicing for the system or any of its components.

4.2 This practice sets forth those methods and components necessary for minimum operation and safety. It also suggests methods for improved operation and effectiveness.

5. System Components and Control Functions

5.1 This section covers the system components and related control functions that are required to collect, transport, store, and convert the solar energy for typical domestic hot water systems.

5.2 Table 1 shows the recommended system components and related control functions that are required for solar domestic hot water systems. Numbers in Figs. 1-7 refer to components in Table 1.

5.3 Freeze protection is a necessary subsystem for most SDHW systems. Each type of system in Figs. 1-7 provide freeze protection by the use of specific components or the nature of the system operation. One option for providing freeze protection for each system is illustrated in Figs. 1-7 (see 6.2 for other acceptable options). Options may be combined.

6. Installation and Servicing

6.1 This section outlines recommended installation and servicing minimum practices needed to provide an effective SDHW system operation.

6.2 *Freeze Protection*:

6.2.1 SDHW systems installed in climates where freezing can occur shall be protected.

6.2.1.1 *Antifreeze Chemicals*—Freeze protection may be accomplished through the use of chemicals either as or in the heat transfer fluid.

6.2.1.2 *Automatic Draining*—Freeze protection may be accomplished through the use of system controls which automatically allow heat transfer fluids to drain from parts of the system exposed to freezing temperatures, as in the draindown or drainback systems. Electrically operated valves shall drain the system when there is a power outage (that is, fail safe).

6.2.1.3 *Automatic Recirculation*—Freeze protection may be accomplished through the use of system controls which automatically circulates heat transfer fluids through the system when outdoor temperatures reach predetermined levels. This freeze protection does not operate during periods of power outage unless an auxiliary source of power is provided. This freeze protection system is not recommended for use in areas with frequent or severe freeze conditions, and may increase the heat loss of the system during off periods.

6.2.1.4 *Manual Draining*—Freeze protection may be accomplished through the use of system controls which allow an operator to manually drain the system of heat transfer fluids. Caution should be exercised when depending on this method of freeze protection since it requires human attention for proper operation. Failure to operate the system properly may result in considerable damage.

6.2.1.5 *Low Wattage Electric Resistance Heating*—Freeze