International Code Council (ICC) & Solar Rating and Certification Corporation (SRCC) & Association of Pool and Spa Professionals (APSP)

SOLAR POOL & SPA HEATING & COOLING SYSTEM STANDARD

BSR/ICC 902/SRCC 400-201x

FOREWORD

At this time, the majority of solar pool heating systems are retrofitted to existing pools, for which the use of solar heating was not usually anticipated. Since there is a wide variation in pumps, filters, valves, etc. which are installed in pool systems around the country, it is not possible to establish a standard addressing the entire circulation system where a solar pool heating system is installed. Therefore, this standard addresses the portion of the system containing the solar pool heating system alone.

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CHAPTER 1
APPLICATION AND ADMINISTRATION

SECTION 101
GENERAL

101.1 Purpose. This standard sets minimum requirements for the performance, design, and installation of solar energy systems for heating water used within pools, wading pools and spas. This standard will apply to both residential and commercial systems, both direct and indirect heating systems and systems installed in both new and existing pools and spas.

SECTION 102
SCOPE

102.1 Scope. This document applies to solar heating and cooling systems used with all residential and commercial swimming pools, wading pools and spas.

103 REFERENCED DOCUMENTS

103.1 Reference documents. The codes and standards referenced in this standard shall be considered to be part of the requirements of this standard to the prescribed extent of each such reference. Chapter 7 contains a complete list of all referenced standards.

CHAPTER 2 DEFINITIONS

201 GENERAL

201.1 General. For the purpose of this standard, the terms listed in Section 202 have the indicated meaning.

201.2 Undefined terms. The meaning of terms not specifically defined in this document or in referenced standards shall have ordinarily accepted meanings such as the context implies. Where a definition does not appear herein, informative reference is made to ISO 9488.

201.3 Interchangeability. Words, terms and phrases used in the singular include the plural and the plural the singular.

201.4 Building Codes. Solar pool heating and cooling systems shall comply with all applicable codes and regulations in force at the installation site.

202 DEFINED TERMS

ACCESS (TO). That which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction [see also “Ready access (to)”].

APPROVED. Acceptable to the code official or other authority having jurisdiction.

AUXILIARY HEATING EQUIPMENT. Equipment utilizing energy other than solar to supplement the energy provided by the solar energy system.

BACKFLOW. The flow of water or other fluids, mixtures or substances into the distribution pipes of a potable water supply from any source except the intended source.

CLOSED LOOP. Refers to systems in which the fluid in the solar loop circulates between the solar collector(s) and a heat exchanger and is not drained from the system, nor is it supplied to the pool, during normal operation.

CONTROLLER. Any device which regulates the operation of the solar energy system or component.

DESIGN LIFE. The intended useful operational life of a *solar energy system* or component as defined by the Supplier.

DRAIN-BACK. *Solar energy systems* in which the fluid in the solar collector loop is drained from the collector into a holding tank under prescribed circumstances.

DRAIN-DOWN. Solar energy systems in which the fluid in the solar collector is drained from the system to an approved disposal area under prescribed circumstances.

DRAINAGE SLOPE. The designed downward slope of installed piping or other components toward drain points.

FREEZE TOLERANCE LIMIT. Minimum outdoor temperature at which a given solar thermal system can be operated without permanently damaging system components or performance, as specified by the Supplier.

HEAT EXCHANGER. A device that transfers heat from one medium to another.

DOUBLE WALL HEAT EXCHANGER. A *heat exchanger* design in which a single failure of any fluid barrier will not cause a cross connection or permit backflow of heat transfer fluid between two separate fluid systems.

SINGLE WALL HEAT EXCHANGER. A *heat exchanger* design in which a single failure of any fluid barrier will cause a cross connection or permit backflow of heat transfer fluid between two separate fluid systems.

IN SERVICE CONDITIONS. The conditions to which a system and its components will be exposed.

INSTALLATION MANUAL. Comprehensive procedures and directions, set forth by the system supplier/licensee, for installation of a solar system, which address all commonly encountered installation situations.

LABELED. Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the code official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

MANUAL. The total documentation package provided by the supplier to the purchaser that describes the general operation and maintenance procedures of the system.

MANUAL DRAIN. Refers to systems which are not or cannot be plumbed in such a way that the solar loop fluid drains out of the piping automatically, and a provision is made for manual draining as a freeze protection method.

NO FLOW CONDITION. A condition where thermal energy is not transferred from the collector by means of flow of *heat transfer fluid*.

NON-FOOD GRADE. Any fluid that is not designated as a *food grade fluid.*

OPERATION AND MAINTENANCE MANUAL. The total documentation package to be provided by the supplier to the owner which describes the general operation and maintenance procedures of the system. The manual will include a parts list, a system diagram, a description of major components, and other features required by this document.

PACKAGED. A standard system which is sold complete and may contain some or all of the following: collectors, collector mounting hardware, couplings, valves, sensors, controls, etc.

READY ACCESS (TO). That which enables a device, appliance or equipment to be directly reached, without requiring the removal or movement of any panel, door or similar obstruction and without the use of a portable ladder, step stool, or similar device [see "Access (to)"].

SIGNIFICANT DETERIORATION. Deterioration that results either in the creation of a hazard or a debilitating decrease in performance.

SOLAR THERMAL COLLECTOR. Components in a *solar energy system* that collect and convert solar radiation to thermal energy.

SOLAR COLLECTOR LOOP. The portion of the *solar energy system* that transports the *heat transfer fluid* in the form of gas or liquid through the *solar energy collector*.

STORAGE TANK. Unfired vessel designed to store fluid.

SUBSYSTEM. A separable, functional assembly of components.

SUPPLEMENTAL HEATING EQUIPMENT. Equipment utilizing energy other than solar to supplement the energy provided by the solar energy system.

SYSTEM (ALSO REFERRED TO AS SOLAR SWIMMING POOL OR SPA HEATING OR COOLING SYSTEM, OR SOLAR POOL OR SPA HEATER). A unit or package of components designed to provide solar heated or cooled water to swimming or spas pools.

THIRD-PARTY TESTED. Procedure by which an *approved* testing laboratory provides documentation that a product, material or system conforms to specified requirements.

TOXIC FLUIDS. Fluids which are poisonous or irritating in nature or composition.

WATER HAMMER. **A** pressure surge that occurs when fluid or other incompressible fluid flow is suddenly stopped in a pressurized piping system.

203 SYMBOLS

CHAPTER 3
GENERAL REQUIREMENTS

SECTION 301
GENERAL

301.1 General. *Systems* shall comply with Sections 301 through 30x.

SECTION 302
SYSTEM DESIGN REQUIREMENTS

302.1 Operating limits. Means shall be provided to protect all *system* components within the design limits of temperature and pressure as specified by the manufacturer.

302.1.1 Vacuum-induced pressure protection. Components of the *system* shall be protected against the maximum vacuum that could occur within the *system*.

302.1.2 Thermal shock protection. The *system* shall be able to withstand sudden changes in temperature.

302.1.3 Water hammer. Where an incompressible liquid is used as the *heat transfer fluid* and quick-closing valves are employed in the design, the piping system shall be able to control or withstand the effects of water hammer.

302.1.4 Protection from overheating. The *system* shall be able to withstand *stagnation* without degradation of performance and with no maintenance. This requirement includes conditions that occur during loss of electric power to the *system*.

302.1.5 Freezing. Freeze protection. Protection from freezing temperatures shall be provided for all *system* components subject to damage. The supplier shall specify a *freeze tolerance limit* for each *system*. *Systems* shall comply with Section 302.1.5.1 through 302.1.5.3.

Exception: *Systems* installed in a location that has no record of an ambient temperature below 5°C (41°F) shall be exempted from the requirements of this paragraph, except the specification of a freeze tolerance limit.

302.1.5.1 Water exposed to freezing temperatures. *Systems* installed where water is exposed to freezing temperatures a minimum of two freeze protection mechanisms shall be provided on each system. Manual intervention in accordance with 302.15 shall be considered as one mechanism. Other acceptable mechanisms include but are not limited to thermal mass (protection, but protection is limited to the thermal capacitance of the system), automatic draining, closed-loop recirculation (with uninterruptible power supply).

302.2 Ambient operating limits. *Systems* shall withstand ambient air temperatures.

302.3 Thermal expansion. *System* design, components and subassemblies shall include provisions for the thermal contraction and expansion of *heat transfer fluids* and *system* components that will occur over the manufacturer(s) specified design temperature range.

302.4 Pressure drop . The maximum pressure drop of *systems* shall be limited to levels that will not exceed the manufacturer's design specifications or adversely impact *system* performance and longevity.

302.x Vibration. Maximum vibrations in the *system* shall be limited to levels that will not exceed design specifications, produce a hazardous condition or damage the *system*, structure, pool or spa.

302.5 System isolation. Isolation valves shall be provided with access and installed to allow *systems* to be isolated from the pool or spa or other systems. The normal operating position shall be marked on a permanent indelible label affixed to each isolation valve.

302.6 Auxiliary heating equipment. Where used, *auxiliary heating equipment* shall be *listed* and *labeled* by a recognized *third party listing agency*.

302.7 Thermosiphon prevention. Means shall be provided to control energy losses caused by thermosiphonage.

302.8 Access. *Access* shall be provided to *system* components requiring maintenance or adjustment in accordance with manufacturer's instructions.

302.9 Protection from leaks. *Systems* shall be designed and installed to be leak-free under the manufacturer's operating conditions. The installation manual shall provide a clear procedure to check for leaks in the *system.*

Comment [SM1]: Define?

302.10 Materials. *Systems* shall be constructed from materials that are non-toxic to humans; that are generally or commonly regarded to be impervious and enduring; that will withstand the design stresses; and will provide leak-free performance.

302.10.1 Protection from ultraviolet radiation. *System* components and materials that are exposed to ultraviolet radiation shall not be adversely affected by this radiation to the extent that their function will be impaired beyond design specifications during their *design life*.

302.10.2 Airborne pollutants. *System* components and materials that are exposed to airborne pollutants such as ozone, salt spray, SO_2 or NO_x shall not be adversely affected by these pollutants to the extent that their function will be impaired beyond design specifications during their *design life*.

302.10.3 Incompatible materials. Incompatible materials shall be isolated or treated to prevent degradation to the extent that their function could be impaired under in-service conditions during their *design life*.

302.10.4 Fluid compatibility. Fluids intended for contact with system materials shall not corrode or otherwise adversely affect *system* materials to the extent that their function will be impaired beyond design specifications during the system *design life*.

302.10.5 Contamination. Materials designed to contact pool or spa water within *systems* shall not leach contaminants to the water and shall conform to NSF 50, Chapter 3.

302.11 Protection of structure. *Systems* shall not compromise the safety of associated structures.

~~305~~302.11.1 Penetration of structural members. Where penetrations are required in structural members to accommodate passage of components, such modified structural members shall comply with the ~~plumbing~~ building codes ~~and mechanical code~~ adopted by the authority having jurisdiction, or in the absence of such code, the International ~~Plumbing~~ Building Code and International ~~Mechanical~~ Residential Code, as applicable.

~~305~~302.11.2 Protection from thermal deterioration. Building materials adjacent to *system* equipment shall not be exposed to elevated temperatures that could accelerate their deterioration.

302.11.3 Weatherproofing. Roof and wall penetrations shall be flashed and sealed in accordance with local building code requirements to prevent the entry of water, rodents and insects. In the absence of such code, the International Building Code and International Residential Code, as applicable.

302.11.4 Structural support. Neither wind loading, including uplift, nor the additional weight of filled collectors and tanks, shall exceed the live ~~or dead~~ load ratings of the building, roof, roof anchorage, foundation or soil. The design load shall be as specified by the codes in force at the installation site and shall include an additional load for snow accumulation for applicable locations. System components, including but not limited to tanks and collectors, shall be installed to withstand anticipated seismic loads in accordance with ASCE 7-10.

302.12 Mechanical protection. ~~System equipment and components exposed to vehicular traffic shall be protected from damage.~~ *Storage tanks* and pool heating equipment shall not be installed in a location where subject to mechanical damage unless protected by *approved* barriers.

302.13 Buried components. System components and materials that are intended to be buried in soils shall be protected from degradation under in-service conditions to ensure that their function is not impaired during the system *design life.*

~~**302.14 Fire rating.**~~

302.1.5 Freeze protection. Protection from freezing temperatures shall be provided for all system components subject to damage. The supplier shall specify a *freeze tolerance limit* for each system. Solar thermal systems shall comply with Section 302.1.5.1 through 302.1.5.3.

Exception: Systems installed in a location that has no record of an ambient temperature below 5°C (41°F) shall be exempted from the requirements of this paragraph, except the specification of a freeze tolerance limit.

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302.1.5.1 Water exposed to freezing temperatures.
For solar thermal systems where water is exposed to freezing temperatures, a minimum of one freeze protection mechanisms shall be provided on each system. Manual intervention in accordance with Section 302.5.2 shall be considered as one mechanism. Other acceptable mechanisms include but are not limited to thermal mass (protection, but protection is limited to the thermal capacitance of the system), automatic draining, and closed-loop recirculation (with uninterruptible power supply).

302.1.5.2 Manual intervention freeze protection. For solar thermal systems that rely on manual intervention for freeze protection, not less than one freeze protection mechanism shall be provided to protect components from freeze damage under all conditions, including in the event of power failure. Acceptable manual intervention actions include but are not limited to:

1. Draining: A system in which components and/or piping are subject to damage by freezing shall have the proper fittings, pipe slope and collector design to allow for manual gravity draining and air filling of the affected components and piping. Sagging shall not interfere with collector draining. System components shall be sloped in accordance with the requirements in Table 302.1.5.1.

SYSTEM COMPONENT	SLOPE REQUIREMENTS
Collector Headers	Sloped to drain or perfectly level
Collector Footers	Sloped to drain or perfectly level
Risers	Minimum 2 cm vertical drop for each meter of horizontal length (1/4 inch per foot)
Supply and Return Piping	Sloped to drain or perfectly level

2. Valve position adjustments: Valves must be labeled in accordance with Section 302.1.5.3.

302.1.5.3 Labeling. A conspicuously placed label shall be attached to the system explaining how the system is protected from freezing and what actions are required to prevent freeze damage and further leakage if rupture occurs. For systems that rely on manual intervention for freeze protection, this label shall indicate the *freeze tolerance limit* below which manual intervention is required and the procedure to be followed.

SECTION 303
COLLECTORS

303.1 Collectors. Solar thermal collectors used in conjunction with *systems* shall comply with ICC 901/SRCC 100.

303.1.1 Location. Solar thermal collectors shall not obstruct or interfere with the operation of any doors, windows or other building components requiring operation or access. Ground mounted systems shall be located in accordance with local zoning and property maintenance code requirements.

303.1.~~3~~ 2 Shading. The location and orientation of collectors shall be such that they are not shaded by external obstructions or each other more than the specified period allowed in the design.

303.2 Mounting devices. Collectors shall be installed to maintain tilt and azimuth to design conditions. Collectors shall be supported to prevent sagging in accordance with manufacturers requirements.

303.2.1 Wind and seismic loading. Collectors shall be mounted to resist wind loading and uplift and anticipated seismic loading in accordance with the collector manufacturers specifications and local codes.

303.2.2 Combustibility. Where mounted on or above a roof covering, mounting devices shall be constructed of non-combustible materials in accordance with the code adopted by the authority having jurisdiction, or in the absence of such code, the International Building Code and International Residential Code, as applicable~~International Building Code or International Residential Code, as applicable.~~

303.2.~~4~~ 3 Corrosion. Mounting devices and fasteners shall be constructed from corrosion resistant materials. Incompatible materials shall be isolated in accordance with Section 302.10.

~~**303.2.5 Ground mounting.**~~

303.2.~~6~~ 5 Loading. Collector supports shall not impose stresses on the collectors beyond design specifications. Structural supports shall be selected and installed in such a manner that thermal expansion of the collector and piping will not cause damage to the collector structural frame or the building.

END – 1/4/2016

SECTION 304
PIPING AND JOINTS

304.1 General. Piping shall be installed in accordance with relevant local plumbing codes, or manufacturers recommendations where codes are not established.

304.2 Pipe material. Where unglazed solar collectors are used, transport piping strength shall be, at a minimum, Schedule 40 PVC. All pipework must be able to withstand the stagnation temperatures that may be generated in the collectors. Glazed collectors routinely reach temperatures which exceed the recommended limit for PVC piping, therefore when glazed solar collectors are used copper or CPVC piping is required for at least five feet before the inlet to the solar collector array(s) and for at least 20 feet on the outlet of the array(s).

304.3 Piping configuration and layout. The system supplier shall provide comprehensive directions for correctly piping the solar pool heating or collector system. The directions shall address the following:

1. Proper piping for single bank systems
2. Proper piping for multiple bank systems
3. Proper piping for multiple banks at different elevations
4. Pipe sizing and material
5. Location of vacuum reliefs
6. Maximum number of panels per bank
7. Maximum length of mat-type solar collector
8. Recommended flow rates
9. Direct versus reverse return piping
10. Drain line or manual drain locations
11. Pipe slope (if needed)
12. Paint specification (if any)

304.4 Piping support. Piping shall be installed and supported in accordance with the code adopted by the authority having jurisdiction, or in the absence of such code, the International Swimming Pool and Spa Code (ISPSC). Hangers shall provide support and maintain slope of pipes as required. Hangers or supports for insulated pipes and components shall be designed to not compress or damage the insulation material. Hangers shall not cause galvanic corrosion of the hanger or the pipe.

Comment [SM2]: Can piping be mounted on the exterior of structures, roofing, over gutters, siding, etc? What is support interval in this situation (ISPSC does not address).

304.5 Ground mounted piping. Piping to ground-mounted solar thermal collectors used in solar pool and spa heating systems shall be installed so as not to create a hazard to pedestrians or pool users. Piping crossing pool decks and pedestrian areas shall be protected from damage.

304.6 Joints and Connections. Joints and connections shall be of an *approved* type. Joints and connections shall be listed for the pressure of the hydronic system. Joints between different piping materials shall be made with *approved* adapter fittings.

304.7 Insulation.

Comment [SM3]: Insulation requirements?

SECTION 305
VALVES AND PORTS

305.1 Valves. Valves used in solar pool heating and cooling systems shall…

305.1.1 Three-way valves.

305.1.2 Motorized valves

305.1.3 Check valves

305.2 Ports. Ports used in solar pool heating and cooling systems shall…

305.2.1 Inlet and outlet ports

INLETS AND OUTLETS

310.1 General. *Systems* shall…

SECTION 309
PUMPS

309.1 General. *Systems* shall…

SECTION 307
AUXILIARY HEATING EQUIPMENT

307.1 General. *Systems* shall…

Comment [SM4]: Address the connection of the system to pools. Can pipes dip directly over the side of the pool into the water?

SECTION 308
STORAGE TANKS

308.1 General. *Systems* shall…

SECTION 306
CONTROLS AND GAUGES

306.1 General. *Controller subsystems* shall facilitate installation, startup, operation, shutdown and maintenance of the solar energy system. The *controller subsystem* shall include provisions for bypass, adjustment and override as established in a design evaluation in accordance with the requirements of this standard. Safety controls shall not have provision for bypass or override. Operational controls and means of disconnect and their function shall be labeled and readily accessible in accordance with the NFPA 70. Wires and connections, sensors, pneumatic lines, hydraulic lines or other means for transmitting sensor outputs to control devices shall be sufficiently protected from degradation or from introducing false signals as a result of environmental or system operating conditions.

306.2 Sensors. Sensors shall be installed in accordance with the *controller subsystem* design.

306.3 Wiring identification. Control circuit wiring and terminals shall be identified in accordance with the NFPA 70.

306.4 Temperature rating for sensor wiring. Sensor wire shall be rated in accordance with NFPA 70.

306.5 Flow measurement. The system shall include devices for the measurement of flow through the *system*.

306.6 Pressure measurement.

306.7 Temperature measurement.

SECTION 311
INDIRECT SYSTEMS

311.1 General. *Systems* shall…

311.1.1 Fluids

311.1.2 Heat Exchangers

CHAPTER 4
POOL AND SPA INTEGRATION

SECTION 401
GENERAL

401.1 General. *Systems* shall not diminish the operation or ability of a pool or spa's recirculation system to function adequately, per local codes and the pool or spa manufacturer's requirements.

401.2 Recirculation system connection. Solar pool heating and cooling systems shall…

401.3 Enclosures.

401.4 Backflush.

Comment [SM5]: Address the connection of the system to pools. Can pipes dip directly over the side of the pool into the water?

Comment [SM6]: Must connections be made to recirc systems? Can solar pool heating systems have dedicated inlets/outlets?

Comment [SM7]: Commentary: This is one of the most common ways solar systems are damaged in the field. Improper backflushing may result in debris or diatomaceous earth being deposited in the solar collectors, rendering them inoperable and/or subjecting them to damage from water freezing due to incomplete draining.

CHAPTER 5

SYSTEM AND COMPONENT SIZING

SECTION 501
GENERAL

501.1 General. Pumps, piping, fans, ducts and other components shall be sized to carry the heat transfer fluid at design flow rates over the *design life* without operational impairment, erosion and corrosion.

501.2 Procedure. The sizing procedure and recommended *system* design provided by the system supplier shall be consistent with the estimated *system* performance claims as represented to the owner. These claims must be in the owner's manual in the form of the sizing guide linked to performance claims.

501.3 Software-based sizing. Where software is used for system sizing, F-Chart software or equivalent shall be used. Unless specific data is provided, the following assumptions will be made:

1. Pool temperature must be at least 26.7°C (80°F) from May through September and at least 25°C (77°F) from October through April
2. Wind speed shall be zero
3. Pool depth shall be 1.2 m (4 ft)
4. Pool area shall be 41.8 m^2 (450 ft^2)
5. No shading
6. Pool blanket used half time

Comment [SM8]: Should this allow for the length of the swimming season for that location?

CHAPTER 6
TESTS

SECTION 601
GENERAL

601.1 General.

SECTION 506
TEST METHODS

601.2 Leakage test method. The pressure integrity test of the system shall be conducted in accordance with the following procedure. The piping components pass the test where observable pressure change has not occurred.

1. The pressure gauge shall be attached to the exit port of the pump station and the outlet shall be sealed.
2. The supply side shall be filled with unheated water.
3. The test pressure shall be 1110 kPa Gauge (160 PSIG).
4. Hydraulic pressure shall be applied to the inlet port until the gauge indicates the test pressure has been reached.
5. The inlet pressure port shall be closed and the pressure is monitored for 15 minutes.
6. The final pressure shall be recorded.

Comment [SM9]: Is this a design test or a field test after installation? Or leave to the code?

601.3 Pressure drop test method.

CHAPTER 7
SYSTEM MANUALS

SECTION 701
GENERAL

701.1 General. A manual or manuals shall be provided with each solar pool heating and cooling system. The manual shall contain the name and address of the system supplier, the system model name or number and shall describe the operation of the system and its components and the procedures for installation, operation and maintenance in accordance with this chapter.

701.2 Fluids. The manuals shall identify *heat transfer fluid(s)* used in the solar pool heating and cooling system and state whether or not the fluid(s) are toxic or hazardous. Proper procedures for handling, safe disposal, and first aid shall be provided for each non-water fluid. A technical data sheet shall be provided for each non-water fluid or additives for water used in the system. Procedures shall be described for maintaining the heat transfer fluid's chemical composition at levels to prevent beyond design specifications deposits on the heat transfer surfaces, corrosion of the heat transfer surfaces and loss of freeze resistance. Recommended inspection and test intervals for the heat transfer fluid shall be provided.

Comment [SM10]: Include only if indirect systems are included.

701.3 Hazards. The manuals shall provide warning against health and safety hazards that could arise in the operation and maintenance of the system and shall fully describe the precautions that must be taken to avoid these hazards.

701.4 Warranty coverage. The manuals shall provide a full description of the warranty coverage on the system. The manual shall describe what actions the purchaser must undertake to obtain warranty coverage. Warranties shall conform to federal and, when applicable, state requirements. All warranties must be clearly stated. Requirements for validation of warranties and procedures for warranty claims must be specified.

Comment [SM11]: From Original Document: **301.6 Warranties.** A copy of the manufacturer's product warranty, including evidence to support the justification for extended warranty periods must be submitted. Extended warranty periods are defined as those more than twice the time the exact product design and, in the case of solar collectors constructed from plastic, EPDM, or TPE, the exact same material formulation has been in satisfactory use in the field. Evidence submitted to support extended warranties shall include documentation of the product's date of introduction to use in the field and length of satisfactory service.

701.5 Schematic diagrams. One or more schematic diagrams of a typical installed system shall be provided with or within manuals, including the following, as applicable:

1. pool and/or spa(s)
2. filter(s)
3. collector(s)
4. control sensor(s) (if applicable)
5. controller (if applicable)
6. pump time clock (if applicable)
7. pump(s)
8. heat exchanger (if applicable)
9. valves
10. vacuum relief
11. freeze protection equipment or strategies
12. instrumentation interface location(s)

The system supplier shall provide guidance to the designer and/or installer regarding freeze protection strategies. Specifically, if the solar collectors, piping, or balance of system components are subject to damage from freezing conditions, the system supplier shall identify piping configurations or other freeze protection strategies designed to prevent damage to the system.

Comment [SM12]: Commentary: It is not the intent of this criterion to require the provision of complete, detailed system installation specifications where those specifications would be project-specific.

Two different examples of measurement capability include (but are not limited to):

- A flow sensor or sensor port could be installed in the collector loop and corresponding instructions for its use described in the installation manual.
- One temperature sensor or sensor port (such as a P/T plug capable of accommodating an insertion thermometer) could be installed in the pipe returning water from the collector system. The use of temperature measurement ports to determine whether there is adequate flow through the collector system would then be described in the installation manual.

SECTION 702
INSTALLATION MANUAL

702.1 General. The manuals shall include an explanation of the physical and functional requirements of the system and its components and the general procedures for their proper installation. The instructions shall describe the interconnection requirements of the various subsystems and components and their interface requirements with the building and the site. Installation instructions shall prescribe installation complying with the building code, plumbing code, mechanical code, and fire code adopted by the authority having jurisdictions, or in the absence of such codes, shall comply with the *International Building* Code, *International Plumbing Code, International Mechanical Code,* and *International Fire Code.*

SECTION 703
OPERATION MANUAL

703.1 General. Operation Manuals shall:

1. Clearly describe the operation of the solar energy system, explaining the function of each subsystem and component. Include a system diagram showing the components and their relationships in the typical installed system and list the system manufacturer's design flow range in each collector bank.

2. Describe major components in a separate section or by enclosing descriptive material furnished by the supplier of the components.

3. Describe procedures for system start-up, routine maintenance and special conditional operations such as drain-down.

4. Specify fill weights, pressure ratings and temperature ratings for servicing and routine maintenance of the system.

5. Specify temperature, pressure and flow conditions expected at various access points to allow simple operational checks and troubleshooting. The installation manual shall include instructions for making and interpreting the measurements.

6. Include instructions for isolating different sections of the system in emergency situations and shall include instructions for leaving the system unattended and unused for long periods of time.

7. Indicate the *freeze tolerance limit* and freezing control measures and include the statement: "Freeze tolerance limits are based upon an assumed set of environmental conditions." Where the freezing point of the fluid in an exposed part of the system is above the freeze tolerance limit specified for the system, the following statement shall be provided: "Extended periods of cold weather, including ambient air temperatures above the specified limit, might cause freezing in exposed parts of the system. It is the owner's responsibility to protect the system in accordance with the Supplier's instructions if the air temperature is anticipated to approach the specified freeze tolerance limit."

8. Be provided at the installation site

Comment [SM13]: From Original Document: An Operation and Maintenance Manual or manuals shall be provided with each SSPH system. The manual shall contain the name and address of the supplier and the system model name or number and shall describe the operation of the system and its components and the procedures for operation and maintenance. The Operation and Maintenance Manual may consist in part of a series of instruction sheets provided by the various subsystem and component manufacturers. It may be a single manual, or installation instructions may be separate from operation and maintenance. Its size and complexity should be consistent with the need for descriptive information.
301.5.1 Operation Instructions. The Operation and Maintenance Manual shall describe clearly the operation of the SSPH system, explaining the function of each subsystem and component. The manual shall include a system diagram showing the components and their relationships in the typical installed system.
The manual shall describe procedures for system startup, shutdown, routine maintenance and special conditional operations such as drain-down, if appropriate.
301.5.2 Maintenance Plan. The Operation and Maintenance Manual shall include a comprehensive plan for maintaining the specified performance of the SSPH system. The plan shall include a schedule and description of procedures for ordinary and preventive maintenance, where applicable. In particular, the plan shall address the procedure for isolating the solar system when performing a backflush on the pool filtering system. Where applicable, the system supplier shall make available a warning label designed for installation on or near the pool filter which alerts the owner to specific backflushing instructions, or which directs the owner to refer to the pertinent section of the Operation and Maintenance Manual.

703.2 Maintenance. The Operation Manual shall include a comprehensive plan for maintaining the specified performance of the solar pool heating or cooling system over the *design life* of the system. The plan shall include a schedule and description of procedures for ordinary and preventive maintenance including cleaning of collector exterior surfaces. The manual shall describe minor repairs and provide projections for component replacement.

703.3 Service and replacement parts. The manual shall include a parts list with a sufficient description of each part for ordering a replacement. Parts, components and equipment required for service, repair or replacement shall be commercially available or available from the system or subsystem supplier. The manual shall list on the same page of both the installation and operation manuals the make and model of all options for the following components: solar collector, solar storage tank, pump, piping material, controller, heat exchanger, and heat transfer fluid. This page shall also include temperature, pressure, and flow conditions expected at system monitoring points to allow simple operational checks. The number and piping connection arrangement of the solar collectors shall be included. The manual shall include contact information for not less than one company in close geographic proximity to the purchaser that offers service for the system.

703.4 Freeze Protection Instructions. The Operation Manual shall include measures to be taken to prevent freeze damage to solar collectors and/or components. If the system relies on manual draindown or other owner-initiated measure(s) to prevent freezing during periods of sub-freezing weather, specific directions for such measures must be set forth.

703.5 Troubleshooting. The Operation Manual shall include measures to be taken by the end user to make simple diagnosis of reason(s) for improper or defective operation and corrective actions to be taken.

Comment [SM14]: Commentary: Freezing during clear night sky conditions often can occur at temperatures higher than 32^{o}F (0^{o}C). Owners should be made aware of that possibility.

Comment [SM15]: Commentary: This criterion is intended to minimize down-time, relieve owner frustration and reduce the need to call for service and/or repair.

CHAPTER 8
REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title. The application of the referenced standards shall be as specified in Section 103.1.

ISO 9488-1999 “Solar Energy – Vocabulary”

ICC 901/SRCC 100-2015 Solar Thermal Collector Standard

ICC 900/SRCC 300-2015 Solar Thermal System Standard

International Pool and Spa Code (ISPSC), 2015

International Residential Code (IRC), 2015

International Building Code (IBC), 2015

National Fire Protection Association (NFPA) No. 70-2014, “National Electrical Code”