

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



SOLAR POOL & SPA HEATING & COOLING SYSTEM STANDARD

ICC/APSP 902/SRCC 400-201x Public Comment Draft #1

FOREWORD

Solar pool heating systems make use of thermal energy derived from solar sources to heat or cool water used in pools in spas. This can be used to either augment a more traditional pool heater utilizing energy sources like electricity or natural gas, or it can be used alone as the sole source. In some very warm climates, solar thermal systems can be used to help to cool pools and spas at night, where warm water is circulated through solar thermal collectors radiating to a cooler night sky.

This standard sets forth minimum standards for protecting the life, health and safety of the pool or spa user and general public. It also establishes requirements addressing minimum durability, function, serviceability and protection of associated structure and pool or spa. The standard is intended for use with a comprehensive set of codes and standards governing the construction of pools and spas, adjacent structures and mechanical systems. Throughout the document, where they do not exist at a given installation location, it calls for the use of current I-Code Family of Codes to be used as the basis for safe installation. The document also relies on effective processes of permitting, plan review and inspection to ensure that all solar pool and spa heating and cooling systems are installed in conformance with the requirements of local codes, this standard and the manufacturer's requirements.

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 and cooling water used within pools, wading pools and spas. This standard will apply to both residential and commercial systems, both *direct* and *indirect systems*.

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

SECTION 102 APPLICABILITY

102.1 Applicability. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern. Where, in any specific case, different sections of this standard specify different materials, methods of construction or other requirements, the most restrictive shall govern.

102.2 Referenced codes and standards. The codes and standards referenced in this standard shall be those that are listed in Chapter 7 and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference. Where differences occur between provisions of this standard and the referenced standards, the provisions of this standard shall be the minimum requirements.

102.3 Other laws. The provisions of this standard shall not be deemed to nullify any provisions of local, state or federal law.

102.4 Application of references. References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this standard.

CHAPTER 2 DEFINITIONS

SECTION 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.

SECTION 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 (ALSO REFERRED TO AS AUXILIARY HEATERS). Equipment utilizing energy other than solar to augment the energy provided by solar energy.

COLLECTOR (ALSO REFERRED TO AS SOLAR THERMAL COLLECTOR). Component(s) in a *system* that collect and convert solar radiation to thermal energy.

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 manufacturer.

DIRECT SYSTEM (ALSO REFERRED TO AS OPEN LOOP). *System* in which the fluid supplied to the *solar thermal collector(s)* is supplied directly to the load under normal operation without the use of a *heat exchanger*.

DRAINBACK. *System* in which the fluid in the *solar loop* is drained from the *collector* into a holding tank or the pool or spa under prescribed circumstances.

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 manufacturer.

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.

HEAT TRANSFER FLUID. Air, water, or other fluid that is used to transfer thermal energy between *collectors* and other components in a system.

INDIRECT SYSTEM (ALSO REFERRED TO AS CLOSED LOOP). Solar thermal system in which the *heat transfer fluid* in the *solar loop* circulates between the *solar thermal collector(s)* and a *heat exchanger* and during normal operation such fluid is not drained from the *system* and is not supplied to the load.

INSTALLATION MANUAL. Comprehensive procedures and directions, set forth by the system supplier/licensee, for installation of a solar energy *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 DRAIN. Refers to systems which are not or cannot be plumbed in such a way that the *heat transfer fluid* drains out of the piping automatically, and a provision is made for draining the *system* manually as a freeze protection method.

OPERATION 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.

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)"].

SOLAR LOOP. The portion of the solar energy system that transports the *heat transfer fluid* to and from the *solar thermal collector*.

STAGNATION. The *solar thermal collector* temperature at which the energy gain is balanced by heat loss.

STORAGE TANK. Pressurized or unpressurized unfired vessel designed to store fluid.

SYSTEM (ALSO REFERRED TO AS SOLAR SWIMMING POOL OR SPA HEATING OR COOLING SYSTEM, OR SOLAR POOL OR SPA HEATER). An assemblage of components designed to heat or cool water for swimming pools or spas by solar thermal means, excluding pool recirculation components.

THIRD-PARTY CERTIFICATION AGENCY. An *approved* agency operating a product or material certification system that incorporates initial product testing, assessment and surveillance of a manufacturer's quality control system.

THIRD-PARTY CERTIFIED. Certification obtained by the manufacturer indicating that the function and performance characteristics of a product or material have been determined by testing and ongoing surveillance by an *approved third-party certification agency*. Assertion of certification is in the form of identification in accordance with the requirements of the *third-party certification agency*.

CHAPTER 3 GENERAL REGULATIONS

SECTION 301 GENERAL

301.1 General. *Direct and indirect systems* shall comply with this section.

301.2 Building Codes. *Systems* shall comply with all applicable codes and regulations in force at the installation site. Electrical equipment and systems shall comply with NFPA 70 or CSA C22.1, as applicable.

301.3 Third-party certification. Products and materials used within *systems* shall be *listed* by a *third-party certification agency* as complying with the referenced standards.

301.4 Pool or spa safety. *Systems* shall not diminish the operation or ability of a pool or spa to function safely, as defined by applicable codes and regulations in force at the installation site and the pool or spa manufacturer's requirements.

301.4.1 Turnover rate. *Systems* shall not reduce the flowrate within a pool or spa's recirculation system during any operational condition, to a level below the turnover rate required by the authority having jurisdiction.

301.5 Protection of structure. *Systems* shall not weaken or impair the safe operation of buildings or structures in accordance with local codes.

301.6 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.

301.7 Backflow. Means shall be provided to prevent the backflow of nonpotable fluids, solids or gases into the potable water system through cross-connections or any other piping connections to the system in accordance with local codes. Where no local codes exist, backflow protection shall be provided in accordance with the *International Plumbing Code* or the *International Residential Code*, as applicable.

301.8 Discharge and disposal. Where waste water from *systems* installed on swimming pools or spas or backwash from dedicated *system* filters discharge to the *approved* point of disposal, the discharge shall be through an indirect waste pipe by means of an *air gap*. All waste fluids associated with systems shall be disposed of in accordance with local codes and regulations.

301.9 Protection against auto-ignition of combustibles. Combustible materials used in solar equipment shall be provided with minimum clearance in accordance with the requirements of local codes and the manufacturer's instructions. Where no local codes exist, clearances shall be as provided in accordance with the *International Mechanical Code* or the *International Residential Code*, as applicable.

SECTION 302 GENERAL SYSTEM DESIGN

302.1 General. *Direct and indirect systems* shall be designed in accordance with the requirements of this section.

302.1 Materials. The materials of components, accessories and subassemblies used for *systems* shall be compatible with the environment in which they are installed. The materials shall be capable of fulfilling the design, installation and intended use requirements of this standard.

302.1.1 Protection from ultraviolet radiation. *System* components and materials that are exposed to ultraviolet radiation shall not be adversely affected by this radiation during their *design life*. Components used outdoors shall be *listed* for use in outdoor locations.

302.1.2 Airborne pollutants. *System* components and materials that are exposed to airborne pollutants such as ozone, salt spray, SO₂ 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*.

302.1.3 Material compatibility. Assemblies of different materials shall be chemically and mechanically compatible for their intended use and environment.

302.1.4 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*.

302.1.5 Finish. Materials that come into contact with the pool user shall be finished, so that they do not constitute a cutting, pinching, puncturing or abrasion hazard under casual contact or intended use.

302.2 Contamination. *Systems* shall be designed to prevent the introduction or conveyance of contaminants or foreign materials into the pool or spa during normal, *drainback*, or backflushing operations.

302.3 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.

302.4 Thermal expansion. *Systems*, components and subassemblies shall include adequate provisions for the thermal contraction and expansion that will occur over the manufacturer(s) specified design and ambient temperature ranges.

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

302.5 Entrapped air. Means shall be provided for air and gas removal from the piping system.

Exception: Where allowed by system design, including but not limited to integral collector storage (ICS), direct thermosiphon, or *drainback* systems.

302.6 Outlet temperature. Water temperatures supplied by the *system* to the pool or spa shall not exceed 120°F (49°C) under normal operating conditions.

302.7 Suction entrapment avoidance. *Systems* shall provide suction entrapment avoidance for pools and spas in accordance with APSP/ICC 7 and APSP/ICC 16.

302.8 Auxiliary heating equipment. Where installed as part of a *system*, *auxiliary heating equipment* shall be *listed* and *labeled* by a recognized *third party listing agency*, and shall comply with Section 406.

302.9 Fluid system sizing. Pumps, piping 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.

302.9.1 Water velocity. The water velocity in solar pool heating system piping shall not exceed 8 feet (2.4 m) per second, or as specified by the manufacturer, whichever is lower.

Exception: Where the system includes a dedicated suction inlet installed within the pool or spa, the water velocity in the suction piping shall be as required by Section 302.7.

302.9.9.2 Controls. *Systems* shall include features or controls to facilitate installation, startup, operation, shutdown and maintenance of the solar energy system.

302.10 Operating conditions. Means shall be provided to protect the *system* and all components within the design limits of fluid temperature and pressure and ambient conditions as specified by the manufacturer and the requirements of this section.

302.10.1 Static pressure. Static fluid pressures in the solar pool heating system shall not exceed the maximum pressure rating of any component during normal operation or *stagnation* conditions.

302.10.2 Overheating and stagnation. The *system* shall be able to withstand prolonged periods of *stagnation* without degradation of performance with no maintenance, and without endangering the building or its occupants. The expected *stagnation* temperature effects shall include consideration of worst case roof and ambient temperatures. This requirement includes conditions that occur during loss of electric power to the *system* or failure of any of the system components.

302.10.3 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. A freeze protection mechanism shall be provided on each system. Acceptable mechanisms include but are not limited to *draindown*, thermal mass that is limited to the thermal capacitance of the system, *drainback* and closed-loop recirculation.

Exception: Systems installed in a location that has no record of an ambient temperature below 41°F (5 °C) in the last 100 years, shall not be required to

provide freeze protection mechanisms. The *freeze tolerance limit* shall be specified regardless of whether a freeze protection mechanism is supplied.

302.10.3.1 Manual intervention freeze protection. Where manual intervention is used for freeze protection, the *system* 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 of any portion of the collector shall not interfere with *collector* draining. *System* components shall be sloped in accordance with the requirements in Table 302.10.3.1.

TABLE 302.10.3.1 SLOPE REQUIREMENTS FOR MANUAL INTERVENTION

SYSTEM COMPONENT	SLOPE REQUIREMENTS
<i>Collector</i> Headers	Sloped to drain or perfectly level
<i>Collector</i> Footers	Sloped to drain or perfectly level
Risers	Minimum one-fourth unit vertical in 12 units horizontal (2-percent slope)
Supply and Return Piping < 2 inches	Sloped to drain.
Supply and Return Piping ≥ 2" inches	Sloped to drain or perfectly level.

For SI: 1 inch = 25.4 mm, 1 inch per foot = 83.33 mm/m

302.10.3.2 Drainback. When a gravity-driven *drainback* system is employed for freeze protection, all heat transfer fluid in *collectors*, piping and components outside of conditioned space shall drain fully and automatically upon deactivation of the *system* pump. An *approved* means of vacuum relief shall be provided for *drainback* systems.

302.10.3.3 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.

302.11 Pressure relief. Each portion of the system where excessive pressures can develop shall have a pressure relief device to ensure that no section can be valved off or otherwise isolated from a relief device.

302.12 Labels. Where labels are required, they shall comply with the following:

1. Labels shall be permanently affixed.
2. Labels shall not be hand-written.
3. Labels shall have sufficient durability to withstand the environment.

SECTION 303 DIRECT SYSTEM DESIGN

303.1 General. *Direct systems* shall be designed in accordance with the requirements of Section 302.

SECTION 304 INDIRECT SYSTEM DESIGN

304.1 General. *Indirect systems* shall be designed in accordance with the requirements of this section and Section 302.

304.2 Heat exchangers. *Double wall heat exchangers* shall be required for *indirect systems*. *Double-wall heat exchanger* design shall be such that any failure of a barrier will allow the discharge of *heat transfer fluid* or potable water to the atmosphere. The discharge shall be readily observable and in accordance with Section 301.8.

Exception: *Single wall heat exchangers* shall be permitted when in compliance with both of the following:

1. Fluids containing only components that are food grade are used in the system.
2. The maximum operating pressure of the nonpotable *heat transfer fluid* within the *heat exchanger* is less than the normal operating pressure of the potable water system.

304.3 Gauges. *Indirect systems* shall incorporate a minimum of one pressure gauge and a minimum of one flow indicator. The required pressure gauge shall be installed upstream of the *heat exchanger*.

304.4 Heat transfer fluids. *Heat transfer fluids* used within *indirect systems* shall comply with the requirements in this section.

304.4.1 Food grade fluid additives. Any food grade fluid used as a heat transfer fluid containing additives shall be *listed* and *labeled* by a *third-party certification agency* to the appropriate section of the Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Parts 174–186.

304.4.2 Combustible and flammable fluids. The storage, piping and handling of combustible and flammable fluids shall conform to the requirements of the *International Fire Code*.

304.4.3 Flash point. The flash point of a *heat transfer fluid* shall exceed by a minimum of 50°F (28°C), the design maximum no-flow temperature to be reached by the fluid in the *collector*. The flash point shall be determined in accordance with the *International Fire Code*. In systems using a gaseous heat transfer fluid, a flammable gas shall not be used.

304.4.4 Toxicity. The use of toxic fluids, as defined by Title 15 of the Federal Hazardous Substances Act or Chapter 60 of the *International Fire Code*, shall be prohibited.

304.4.5 Fluid labeling. *Systems* shall be provided with labels indicating *heat transfer fluid* classes used as defined in Section 202. Fluids shall not be used that change the original classification of the system.

304.4.6 Pressure relief. Automatic pressure relief devices shall be set to open at not greater than the maximum design pressure or as limited by code and shall drain to a *code-approved* point or heat transfer fluid vessel.

304.5 Service Ports. Suitable connections shall be provided for indirect *solar loops* at readily accessible location(s) for filling, draining and flushing *heat transfer fluids*.

CHAPTER 4 COMPONENTS AND EQUIPMENT

SECTION 401 GENERAL

401.1 General. Components and equipment comprising *systems* shall comply with the requirements in this section, as applicable.

SECTION 402 COLLECTORS

402.1 General. *Collectors* installed within the *system* shall be *listed* and *labeled* in accordance with the relevant sections of ICC 901/SRCC 100, and shall be installed in accordance with the manufacturer's installation requirements and this section.

402.1.1 Collector isolation. Means shall be provided to isolate the *collector* for servicing, *draindown* freeze protection or emergencies. Valves used to comply with the requirements of this section shall comply with Section 404.

402.1.2 Roof protection. *Collectors*, mounts and associated components installed on and adjacent to roofing surfaces shall not damage or impair the function of the roof.

402.1.3 Ground-mounting. *Systems* and components installed at ground level shall be installed and located in accordance with local code requirements, as applicable, and manufacturer's installation instructions.

402.1.4 Collector arrays. Where multiple *collectors* are connected in arrays, flow in the

collectors shall be balanced using reverse return plumbing, flow balancing valves or as specified by the manufacturer. The number of *collectors* interconnected into a bank shall be limited to the maximum specified by the *collector* manufacturer.

402.1.5 Lightning protection. Lightning protection shall be provided for *collectors* where required by NFPA 70 or CSA C22.1 and manufacturer's instructions.

402.2 Collector mounting devices and structures. *Collectors* shall be installed to maintain tilt and azimuth to design conditions. *Collectors* shall be supported in accordance with the *collector* manufacturer's requirements and the following section.

402.2.1 Collector loading. *Collectors* shall be mounted and fastened to resist anticipated loading, including, but not limited to, wind, seismic and snow loading in accordance with the *collector* manufacturer's specifications and local codes. *Collector* supports shall not impose stresses on the *collectors* beyond design specifications.

402.2.2 Fasteners. System installation instructions shall specify the fasteners to be used with a mounting device or structure where the fastener is not provided. Where nuts are used in mounting devices they shall have a self-locking mechanism intended to prevent the nut from loosening.

402.2.3 Materials. Mounting devices and fasteners shall be constructed from corrosion resistant materials. Incompatible materials shall be isolated in accordance with Section 302.1.3.

402.2.4 Expansion and contraction of supports. 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.

SECTION 403 PIPING AND JOINTS

403.1 General. Piping and fittings shall comply with applicable local codes and manufacturer's installation instructions for the specific application.

403.1.1 Materials. All piping and fittings shall be able to withstand the *stagnation* temperatures without degradation of performance and with no maintenance.

403.1.2 Protection of piping. Piping and fittings exposed to UV radiation shall be protected from degradation in accordance with manufacturer's recommendations. Exterior piping and fittings subject to corrosion shall be protected from degradation.

403.1.3 Underground piping. Piping installed underground shall meet the requirements of local code and the manufacturer's instructions.

403.1.4 Piping for ground-mounted collectors. 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.

403.2 Piping support. Piping shall be supported in accordance with this section.

403.2.1 General. Means shall be provided to support pressure and non-pressure piping and maintain the slope of gravity-drained pipes as required. Pipe supports shall be designed to not compress or damage insulation material where used. Pipe supports shall be of materials that are compatible with the piping and will not promote galvanic action. Pipe supports shall be of a type and interval specified by local code and manufacturer's instructions.

403.3 Joints and connections.

Joints shall be made in accordance with manufacturer's instructions and applicable codes.

403.4 Insulation. Pipe insulation installed outdoors shall be protected from ultraviolet radiation and moisture damage and shall be *approved* for outdoor use.

SECTION 404 VALVES AND PORTS

404.1 General. Valves used in *systems* shall be suitable for the operating temperature and pressure, compatible with the connected piping and shall comply with the following sections.

404.1.1. Access. Valves shall be accessible for operation and maintenance.

404.2 Two and three-way valves. Two-way and three-way valves shall be full-port. Piping adjacent to valves shall be *labeled* with the direction of flow.

404.3 Check valves. Piping adjacent to check valves shall be *labeled* with the direction of flow and function.

404.4 Pressure relief devices. Automatic pressure relief devices shall be set to open at no more than the maximum design pressure or as limited by code and shall drain to a safe location in accordance with Section 301.8.

404.5 Vacuum relief valves. Vacuum relief valves shall comply with ANSI Z21.22.

SECTION 405 DEDICATED AND BOOSTER PUMPS

405.1 General. Dedicated and booster pumps installed within *systems* shall comply with this section. Pool and spa recirculation pumps shall not be subject to these requirements, and shall comply with local codes and the pool or spa manufacturers installation instructions.

405.1.1 Isolation valves. Shutoff valves shall be installed on the suction and discharge sides of dedicated and booster pumps in *systems* to facilitate servicing. Such valves shall be provided with *access*.

405.1.2 Safety. The design, construction, and installation of pumps and component parts shall be in accordance with the pump manufacturer's specifications.

405.1.3 Location. Pumps and motors shall be accessible for inspection and service in accordance with the manufacturer's specifications. Pumps installed in pits shall be elevated above the pit overflow height.

405.1.4 Motor performance. Motors shall comply with UL 1004-1, UL 1081, CSA C22.2 No. 108 or the relevant motor requirements of UL 1563 or CSA C22.2 No. 218.1, as applicable.

405.2 Dedicated pumps. Dedicated pumps for solar thermal pool heating systems with dedicated suction inlets shall comply with this section and 302.7.

405.2.1 Collector protection. A cleanable strainer, skimmer basket, filter or screen shall be installed upstream of dedicated pumps, to remove solids, debris, hair, lint and other material that could prevent or inhibit system operation. Filters shall comply with Section 408.

405.2.2 Emergency shutoff switch. An emergency shutoff switch shall be provided to disconnect power to all dedicated pumps within the system. Emergency shutoff switches shall be: provided with *access*; located within sight of the pool or spa; and located not less than 5 feet (1524 mm) horizontally from the inside walls of the pool or spa.

405.3 Booster pumps. Booster pumps for solar thermal pool heating systems shall comply with this section and 405.1.

405.3.2 Pump interlock. Each booster pump shall be interlocked with the pool or spa recirculation system pump to prevent operation when the recirculation system is not in operation.

SECTION 406 AUXILIARY HEATING EQUIPMENT

406.1 General. *Systems* including one or more multiple *auxiliary heaters* shall comply with this section.

406.2 Installation. *Auxiliary heaters* shall comply with applicable local code requirements. In the absence of such codes, *auxiliary heaters* shall comply with the *International Swimming Pool and Spa Code*.

406.3 Listed and labeled. *Auxiliary heaters* shall be *listed* and *labeled* in accordance with the applicable standard listed in Table 406.3

TABLE 406.3

AUXILIARY WATER HEATERS

DEVICE	STANDARD
Electric water heater	UL 1261, UL 1563 or CSA C22.2 No. 218.1
Gas-fired water heater	ANSI Z21.56/CSA 4.7a
Heat pump water heater	UL 1995, AHRI 1160, CSA C22.2 No. 236

406.4 Priority. Systems that employ both solar thermal and *auxiliary heating equipment* shall be designed to give the solar thermal portion priority in providing heat to the pool or spa allowing minimal use of the *auxiliary heating equipment* to meet the required setpoint temperature.

406.5 Shutdown. The power to electric heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater, mounted on the exterior of the heater or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the setting of the *auxiliary heater* thermostat. Such switches shall be in addition to a circuit breaker for the power to the *auxiliary heater*. The means for disconnecting an electric hot water supply system from its energy supply shall comply with NFPA 70 or CSA C22.1, as applicable. For all other types of *auxiliary water heaters*, a separate valve shall be provided to shut off the fuel supply. The valve shall comply with the mechanical code adopted by the authority having jurisdiction, or in the absence of such code, the *International Mechanical Code* or the *International Fuel Gas Code*. Gas-fired *auxiliary heaters* shall not be equipped with continuously burning ignition pilots.

SECTION 407 STORAGE TANK

407.1 General. When used, pressurized *storage tanks* shall comply with ICC 900/SRCC 300.

SECTION 408 FILTERS AND STRAINERS

408.1 General. Where dedicated filters and strainers are installed within the *system* they shall comply with the requirements of this section.

408.1.1 Access. Filters shall be accessible for inspection and maintenance. Filters and strainers shall consist of a cleanable or replaceable element or elements that can be accessed without removing the filter body from the system.

408.1.2 Indicator. Filters shall utilize a pressure gage or other *approved* method to provide indication when a filter requires servicing or replacement.

408.1.3 Isolation. Filters shall be installed with a shutoff valve upstream of the filter to allow for isolation during maintenance. Shutoff valves shall comply with Section 404.

SECTION 409 CONTROLS

409.1 General. *Controllers* governing the operation of *systems* shall comply with the requirements in this section. Electrical *controllers* shall comply with NFPA 70 or CSA C22.1 and be *listed* and *labeled* to UL 60730-1, UL 873 or CSA E60730-1, as applicable.

409.1.1 Bypass and override. *Controllers* shall be prohibited from bypassing or overriding safety functions.

409.1.2 Labeling and access. Operational controls and means of disconnect and their function shall be *labeled* and readily accessible in accordance with the NFPA 70 or CSA 22.1, as applicable. If plugged into an outlet, the plug shall be *labeled* with a warning that the *controller* shall not be unplugged.

409.1.3 Protection. Controls, sensors and connections shall be protected from degradation, damage and corrosion. 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. Connections shall be made using connectors *listed* for wet locations.

409.1.4 Control panels. Industrial control panels shall be *listed* and *labeled* to UL 508A.

409.2 Sensors. Sensors shall be appropriate for use with the *controller*, securely attached and installed in accordance with the installation requirements of the sensor and *controller* manufacturer.

409.3 Wiring. Control circuit wiring and terminals shall be identified in accordance with NFPA 70 or CSA C22.1, as applicable. Sensor wire shall be temperature and fire-rated in accordance with NFPA 70 or CSA C22.1, as applicable. Wiring and connectors installed in outdoor locations shall be *approved* for such use. All wiring shall be sized, secured and supported in accordance with NFPA 70 or CSA 22.1, as applicable.

SECTION 410 GAUGES

410.1 General. Gauges and measurement devices installed in a *system* shall meet the requirements of this section. Gauges shall provide readings encompassing the normal range of the system's operation.

410.1.1 Temperature measurement devices. Temperature measurement devices shall provide readings in increments a maximum of 1°F (0.56°C).

410.1.2 Pressure measurement devices. Pressure measurement devices shall provide readings in increments a maximum of 2 psi (13.8 kPa).

410.1.3 Flow detection devices. Flow detection shall be provided by one of the following permanently installed methods:

1. Flow meter: A flow meter shall be installed per manufacturer's specifications in an readily visible location.
2. Flow confirmation method: Laminated instructions for the verification of sufficient flow using one of the following techniques are present at the site.
 - a) Filter pressure sensor or gauge will show a pressure change when the *solar loop* is engaged.
 - b) The flow diverter rotates when the *controller* engages the *solar loop*.
 - c) Other *approved* flow indication device or method.

SECTION 411 EXPANSION TANKS

411.1 General. Where expansion tanks are used to provide thermal expansion control in accordance with Section 302.1.5, expansion tanks used in a *solar loop* shall be sized to allow for compensation of pressure and volume increase caused by accumulation of thermal energy during operating, *stagnation*, and no-flow conditions.

411.1.1 Compatibility. Thermal expansion tank components shall be compatible with the heat transfer fluid and rated for the fluid temperature and pressure at design conditions.

411.1.2 Sizing. Expansion tank volume shall be determined in accordance with ICC 900/SRCC 300.

SECTION 412 HEAT EXCHANGERS

412.1 General. Where *heat exchangers* are used, they shall comply with the requirements of this section.

412.2 Isolation. *Heat exchangers* installed within *systems* shall be capable of being bypassed or isolated for the purposes of maintenance or repair.

412.3 Labeling. *Heat exchangers* shall be *labeled* to indicate the *heat exchanger* type as follows:

1. “Single-wall without leak protection”
2. “Double-wall with no leak protection”
3. “Double-wall with leak protection”

SECTION 413 THERMOSTATIC MIXING VALVES

413.1 General. Where master thermostatic mixing valves are installed as part of a system, they shall comply with ASSE 1017. The thermostatic mixing valve shall be placed upstream of *auxiliary heating equipment* not rated for solar storage temperatures.

SECTION 414 PHOTOVOLTAIC EQUIPMENT

414.1 General. Where photovoltaic modules are utilized as part of a *system* they shall be *listed* to UL 1703, IEC 61215 or IEC 61646, as applicable. Photovoltaic modules shall be installed in accordance with all applicable codes.

414.2 Inverters and power conditioners. Inverters and power conditioners utilized as part of a *system* shall be *listed* to UL 1741.

414.3 Heating elements. Metal-sheathed heating elements used as part of photovoltaic water heating *collectors* shall be *listed* and *labeled* to UL 1030.

CHAPTER 5 SYSTEM AND COMPONENT SIZING

SECTION 501 GENERAL

501.1 General. Pumps, piping 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 Sizing Procedure. The sizing methodology shall be consistent with the performance of the *collector*, and with common industry practice.

501.3 Software-based sizing. Where software is used for *system* sizing, weather information from the Typical Meteorological Year 3 (TMY3) or equivalent shall be used. Site-specific information shall be used for the purpose of sizing *systems* for pools.

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CHAPTER 6 SYSTEM MANUALS

SECTION 601 GENERAL

601.1 General. A manual or manuals shall be provided with each solar pool heating and cooling system. The manuals 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.

601.1.1 Fluids. The manuals shall identify *heat transfer fluid(s)* used in the solar pool heating and cooling system. Proper procedures for handling, storage, 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.

601.1.2 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 shall be taken to avoid these hazards.

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

SECTION 602 INSTALLATION MANUAL

602.1 General. The *installation manual* 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 swimming pool, building code, plumbing code, mechanical code, fire code and electrical code adopted by the authority having jurisdictions, or in the absence of such codes, complying with the current versions of the *International Swimming Pool and Spa Code*, *International Building Code*, *International Residential Code*, *International Plumbing Code*, *International Mechanical Code*, *International Fire Code* and *National Electrical Code (NEC)*, respectively.

602.2 Installation instructions. The manual shall include and explanation of the physical and functional requirements of the system and its components and the general procedures for their proper installation. The *installation manual* shall:

1. Provide instructions for the connection and interface of *collectors* to supports, mounting structures and roofing surfaces.
2. Guidance for the orientation and tilt of the *collectors* to maximize performance.
3. Address local solar resource access and the effects on system performance.
4. List balance of system components required to install the system, along with minimum specifications for each.
5. Identify piping configurations or other freeze protection strategies designed to prevent damage to the system, where applicable.
6. Describe control system installation, testing and programming, as applicable.

602.2.1 Piping configuration and layout. The *installation manual* shall provide comprehensive directions for correctly piping the *system*. The directions shall address the following:

1. Proper piping for single bank systems and multiple bank systems, as applicable.
2. Maximum length and number of *collectors*.
3. Pipe and fitting size and type.
4. Location, size and type of valves
5. Drain line and *manual drain* locations
6. Pipe slope, support and insulation
7. Thermal expansion control methods.

602.2.2 Schematic diagrams. One or more generic schematic diagrams of *approved* system configurations shall be provided with or within manuals, including the following elements, as applicable:

1. Pool and/or spas
2. Filters
3. *Collectors*
4. Control sensors
5. *Controllers* and control panels
6. Gauges and measurement devices
7. Pump time clocks

8. Pumps
9. Heat exchangers
10. Valves
11. Freeze protection equipment
12. *Auxiliary heaters*
13. *Storage tanks*
14. Master thermostatic mixing valves.
15. Fill and drain ports
16. Flow direction arrows.

602.3 Commissioning and testing. The *installation manual* shall provide all necessary instructions for testing and commissioning of systems to ensure proper installation and prepare it for regular use.

602.3.1 Leakage testing. A minimum 15 minute leak test of the system shall be performed using a procedure and at a pressure specified by the manufacturer.

602.3.2 Flow verification. A procedure for verification of operational flow by qualified service personnel shall be provided for commissioning and trouble-shooting.

602.3.3 Checklist. A commissioning checklist for the system shall be provided.

SECTION 603 OPERATION MANUAL

603.1 General. The manufacturer's *operation manual(s)* shall be provided with each system. *Operation manuals* shall clearly describe the operation of the *system*, explaining the function of each subsystem and component. The *operation manual(s)* shall:

1. Require a schematic provided by the installer, showing the *system* components as installed at the time of commissioning, and a list of model numbers of major components.
2. Provide the system operating setpoints and settings for normal operation, including fill weights, pressure ratings and temperature ratings for servicing and routine maintenance of the system.
3. Describe procedures for system start-up, shut-down, routine maintenance and special conditional operations such as *draindown*.
4. Include instructions for isolating different sections of the system in emergency situations and include instructions for leaving the system unused for extended periods of time.
5. Indicate the *freeze tolerance limit* and freezing control measures in accordance with 603.3
6. Identify non-water *heat transfer fluids* used in the solar thermal system.
7. Provide instructions on control system operation, including indicators, adjustments, alarms, and trouble-shooting procedures in accordance with 603.5.

603.2 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 anticipated frequency.

603.2.1 Backflush. The manual shall address the procedure for isolating the solar system when performing a backflush on the pool or spa 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 manual*.

603.2.1 Fluid quality. Procedures shall be described for maintaining non-water *heat transfer fluids* chemical composition at levels that prevent deposits on the heat transfer surfaces that are beyond design specifications, corrosion of the heat transfer surfaces and loss of freeze resistance. The manual shall provide recommended inspection and test intervals for non-water *heat transfer fluids*.

603.3 Service and replacement parts. The *operation manual* shall include information to allow the user to contact the manufacturer for service or replacement parts, or locate a qualified local dealer.

603.4 Freeze protection instructions. The *operation manual* shall include measures to be taken to prevent freeze damage to *solar thermal collectors* and/or components. If the system relies on *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, along with instructions for system refilling and restart.

603.4.1 Freeze tolerance limits. The statement: "Freeze tolerance limits are based upon an assumed set of environmental conditions," shall be included. 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."

603.5 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.

CHAPTER 7 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 102.2.

AHRI 1160-2009, Performance Rating of Heat Pump Pool Heaters

ANSI Z21.22-1999 (R2014), Relief Valves for Hot Water Supply Systems

ANSI Z21.56/CSA 4.7a-2013, Gas Fired Pool Heaters

APSP/ICC 7-2013 American National Standard for Suction Entrapment Avoidance in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Catch Basins

APSP/ICC 16-2011 American National Standard for Suction Fittings for Use in Swimming Pools, Wading Pools, Spas and Hot Tubs

ASSE 1017-2010 Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems

Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Parts 174–186.

CSA 22.1-2009, Canadian Electrical Code (CEC), Part I

CSA 22.2 No. 108-2001 (R2010), Liquid Pump

CSA C22.2 No. 218.1 M89 (R2011), Spas, Hot Tubs and Associated Equipment

CSA C22.2 No. 236-2011, Cooling Equipment

CSA E60730-1-2002 (R2007) Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements

ICC 901/SRCC 100-2015 Solar Thermal Collector Standard

ICC 900/SRCC 300-2015 Solar Thermal System Standard

IEC 61215-1-2016, Terrestrial photovoltaic (PV) modules – Design qualifications and type approval – Part 1: Test Requirements

IEC 61646-2008, Thin-film terrestrial photovoltaic (PV) modules – Design qualification and type approval

IMC-2015, International Mechanical Code (IMC)

IPC-2015, International Plumbing Code (IPC)

ISPSC-2015, International Pool and Spa Code (ISPSC)

IRC-2015, International Residential Code (IRC)

IBC-2015 International Building Code (IBC)

IFC-2015 International Fire Code (IFC)

IFGC-2015 International Fuel Gas Code (IFGC)

ISO 9488-1999 Solar Energy – Vocabulary

NFPA 70-2017 National Electrical Code (NEC)

Typical Meteorological Year 3 Weather Files, NREL

[\(http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/\)](http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/)

UL 508A-2013 Standard for Industrial Control Panels

UL 873-2007, Standard for Temperature-Indicating and Regulating Equipment

UL 1004-1-2012 Standard for Rotating Electrical Machines General Requirements – with revisions through June 23, 2011

UL 1030-2015 Standard for Sheathed Heating Elements

UL 1081-2008, Standard for Swimming Pool Pumps, Filters and Chlorinators-with revisions through May, 2013

UL 1261-2016 Standard for Electric Water Heaters for Pools and Tubs

UL 1563-2009, Standard for Electric Hot Tubs, Spas and Associated Equipment-with revisions through July 2012

UL 1703-2002, Standard for Flat-Plate Photovoltaic Modules and Panels—with revisions through November 2014

UL 1741-2010, Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources

UL 1995-2011, Heating and Cooling Equipment

UL 60730-1-2002 Standard for Safety Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements