CHAPTER 3 [CS]

GENERAL REQUIREMENTS

SECTION CS301 (IMC 301) GENERAL

CS301.1 (IMC 301.1) Scope. [This chapter] shall govern the approval and installation of all *equipment* and appliances that comprise parts of the building mechanical systems regulated by [this code] in accordance with Section CS101.1 (IMC 101.2).

CS301.2 (IMC 301.2) Energy utilization. Heating, ventilating and air-conditioning systems of all structures shall be designed and installed for efficient utilization of energy in accordance with the *International Energy Conservation Code*.

CS301.3 (IMC 301.3) Identification. Each length of pipe and tubing and each pipe fitting utilized in a mechanical system shall bear the identification of the manufacturer.

CS301.4 (IMC 301.4) Plastic pipe, fittings and components. Plastic pipe, fittings and components shall be *third-party certified* as conforming to NSF 14.

CS301.5 (IMC 301.5) Third-party testing and certification. Piping, tubing and fittings shall comply with the applicable referenced standards, specifications and performance criteria of [this code] and shall be identified in accordance with Section CS301.3 (IMC 301.3). Piping, tubing and fittings shall either be tested by an approved third-party testing agency or certified by an approved *third-party certification agency*.

CS301.6 (IMC 301.6) Fuel gas appliances and equipment. The approval and installation of fuel gas distribution piping and equipment, fuel gas-fired appliances and fuel gas-fired *appliance* venting systems shall be in accordance with the *International Fuel Gas Code*.

CS301.7 (IMC 301.7) Listed and labeled. Appliances regulated by [this code] shall be *listed* and *labeled* for the application in which they are installed and used, unless otherwise *approved* in accordance with Section CS103 (IMC 105).

CS301.8 (IMC 301.8) Labeling. Labeling shall be in accordance with the procedures set forth in Sections CS301.8.1 (IMC 301.8.1) through CS301.8.2.3 (IMC 301.8.2.3).

Additional labeling requirements of electrical systems can be found in NFPA 70.

CS301.8.1 (IMC 301.8.1) Testing. An *approved* agency shall test a representative sample of the mechanical *equipment* and appliances being *labeled* to the relevant standard or standards. The *approved* agency shall maintain a record of all of the tests performed. The record shall provide sufficient detail to verify compliance with the test standard.

CS301.8.2 (IMC 301.8.2) Inspection and identification. The *approved* agency shall periodically perform an inspection, which shall be in-plant if necessary, of the mechanical *equipment* and appliances to be *labeled*. The inspection shall verify that the *labeled* mechanical *equipment* and appliances are representative of the mechanical *equipment* and appliances tested.

CS301.8.2.1 (IMC 301.8.2.1) Independent. The agency to be *approved* shall be objective and competent. To confirm its objectivity, the agency shall disclose all possible conflicts of interest.

CS301.8.2.2 (IMC 301.8.2.2) Equipment. An *approved* agency shall have adequate equipment to perform all required tests. The *equipment* shall be periodically calibrated.

CS301.8.2.3 (IMC 301.8.2.3) Personnel. An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests.

CS301.9 (IMC 301.9) Label information. A permanent factory-applied nameplate(s) shall be affixed to appliances on which shall appear in legible lettering, the manufacturer's name or trademark, the model number, serial number and the seal or mark of the *approved* agency. A label shall also include the following:

1. Electrical *equipment* and appliances: Electrical rating in volts, amperes and motor phase; identification of individual electrical components in volts, amperes or watts, motor phase; Btu/h (W) output; and required clearances.
2. Absorption units: Hourly rating in Btu/h (W); minimum hourly rating for units having step or automatic modulating controls; type of fuel; type of refrigerant; cooling capacity in Btu/h (W); and required clearances.
3. Fuel-burning units: Hourly rating in Btu/h (W); type of fuel *approved* for use with the *appliance*; and required clearances.
4. Electric comfort heating appliances: electric rating in volts, amperes and phase; Btu/h (W) output rating; individual marking for each electrical component in amperes or watts, volts and phase; and required clearances from combustibles.

CS301.10 (IMC 301.10) Electrical. Electrical wiring, controls and connections to equipment and appliances regulated by [this code] shall be in accordance with NFPA 70.

CS301.11 (IMC 301.11) Plumbing connections. Potable water supply and building drainage system connections to *equipment* and appliances regulated by [this code] shall be in accordance with the *International Plumbing Code*.

CS301.12 (IMC 301.12) Fuel types. Fuel-fired appliances shall be designed for use with the type of fuel to which they will be connected and the altitude at which they are installed. Appliances that comprise parts of the building mechanical system shall not be converted for the usage of a different fuel, except where *approved* and converted in accordance with the manufacturer's instructions. The fuel input rate shall not be

increased or decreased beyond the limit rating for the altitude at which the *appliance* is installed.

CS301.13 (IMC 301.13) Vibration isolation. Where vibration isolation of *equipment* and appliances is employed, an *approved* means of supplemental restraint shall be used to accomplish the support and restraint.

CS301.14 (IMC 301.14) Repair. Defective material or parts shall be replaced or repaired in such a manner so as to preserve the original approval or listing.

CS301.15 (IMC 301.15) Wind resistance. Mechanical *equipment*, appliances and supports that are exposed to wind shall be designed and installed to resist the wind pressures determined in accordance with the *International Building Code*.

CS301.16 (IMC 301.16) Flood hazard. For structures located in flood hazard areas, mechanical systems, equipment and appliances shall be located at or above the elevation required by Section 1612 of the *International Building Code* for utilities and attendant equipment.

Exception: Mechanical systems, equipment and appliances are permitted to be located below the elevation required by Section 1612 of the of the *International Building Code* for utilities and attendant equipment provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding up to such elevation.

CS301.16.1 (IMC 301.16.1) Coastal high-hazard areas and coastal A zones. In coastal high-hazard areas and coastal A zones, mechanical systems and equipment shall not be mounted on or penetrate walls intended to break away under flood loads.

CS301.17 (IMC 301.17) Rodentproofing. Buildings or structures and the walls enclosing habitable or occupiable rooms and spaces in which persons live, sleep or work, or in which feed, food or foodstuffs are stored, prepared, processed, served or sold, shall be constructed to protect against the entrance of rodents in accordance with the *International Building Code*.

CS301.18 (IMC 301.18) Seismic resistance. Where earthquake loads are applicable in accordance with the *International Building Code*, mechanical system supports shall be designed and installed for the seismic forces in accordance with the *International Building Code*.

SECTION CS302 (IMC 302) PROTECTION OF STRUCTURE

CS302.1 (IMC 302.1) Structural safety. The building or structure shall not be weakened by the installation of mechanical systems. Where floors, walls, ceilings or any other portion of the building or structure are required to be altered or replaced in the process of installing or repairing any system, the building or structure shall be left in a safe structural condition in accordance with the *International Building Code*.

CS302.2 (IMC 302.2) Penetrations of floor/ceiling assemblies and fire-resistance-rated assemblies. Penetrations of floor/ceiling assemblies and assemblies required to have a fire-resistance rating shall be protected in accordance with Chapter 7 of the *International Building Code*.

CS302.3 (IMC 302.3) Cutting, notching and boring in wood framing. The cutting, notching and boring of wood framing members shall comply with Sections CS302.3.1 (IMC 302.3.1) through CS302.3.4 (IMC 302.3.4).

CS302.3.1 (IMC 302.3.1) Joist notching. Notches on the ends of joists shall not exceed one-fourth the joist depth. Holes bored in joists shall not be within 2 inches (51 mm) of the top or bottom of the joist, and the diameter of any such hole shall not exceed one-third the depth of the joist. Notches in the top or bottom of joists shall not exceed one-sixth the depth and shall not be located in the middle third of the span.

CS302.3.2 (IMC 302.3.2) Stud cutting and notching. In exterior walls and bearing partitions, a wood stud shall not be cut or notched in excess of 25 percent of its depth. In nonbearing partitions that do not support loads other than the weight of the partition, a stud shall not be cut or notched in excess of 40 percent of its depth.

CS302.3.3 (IMC 302.3.3) Bored holes. The diameter of bored holes in wood studs shall not exceed 40 percent of the stud depth. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in nonbearing partitions. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in any wall where each stud is doubled, provided that not more than two such successive doubled studs are so bored. The edge of the bored hole shall be not closer than $^5/_8$ inch (15.9 mm) to the edge of the stud. Bored holes shall be not located at the same section of stud as a cut or notch.

CS302.3.4 (IMC 302.3.4) Engineered wood products. Cuts, notches and holes bored in trusses, structural composite lumber, structural glue-laminated members and I-joists are prohibited except where permitted by the manufacturer's recommendations or where the effects of such alterations are specifically considered in the design of the member by a registered design professional.

CS302.4 (IMC 302.4) Alterations to trusses. Truss members and components shall not be cut, drilled, notched, spliced or otherwise altered in any way without written concurrence and approval of a *registered design professional*. Alterations resulting in the addition of loads to any member, such as HVAC *equipment* and water heaters, shall not be permitted without verification that the truss is capable of supporting such additional loading.

CS302.5 (IMC 302.5) Cutting, notching and boring in steel framing. The cutting, notching and boring of steel framing members shall comply with Sections CS302.5.1 (IMC 302.5.1) through CS302.5.3 (IMC 302.5.3).

CS302.5.1 (IMC 302.5.1) Cutting, notching and boring holes in structural steel framing. The cutting, notching and boring of holes in structural steel framing members shall be as prescribed by the *registered design professional*.

CS302.5.2 (IMC 302.5.2) Cutting, notching and boring holes in cold-formed steel framing. Flanges and lips of load-bearing cold-formed steel framing members shall not be cut or notched. Holes in webs of load-bearing cold-formed steel framing members shall be permitted along the centerline of the web of the framing member and shall not exceed the dimensional limitations, penetration spacing or minimum hole edge distance as prescribed by the *registered design professional*. Cutting, notching and boring holes of steel floor/roof decking shall be as prescribed by the *registered design professional*.

CS302.5.3 (IMC 302.5.3) Cutting, notching and boring holes in nonstructural cold-formed steel wall framing. Flanges and lips of nonstructural cold-formed steel wall studs shall not be cut or notched. Holes in webs of nonstructural cold-formed steel wall studs shall be permitted along the centerline of the web of the framing member, shall not exceed $1^1/_2$ inches (38 mm) in width or 4 inches (102 mm) in length, and shall not be spaced less than 24 inches (610 mm) center to center from another hole or less than 10 inches (254 mm) from the bearing end.

SECTION CS303 (IMC 303)
EQUIPMENT AND APPLIANCE LOCATION

CS303.1 (IMC 303.1) General. *Equipment* and appliances shall be located as required by this section, specific requirements elsewhere in [this code] and the conditions of the *equipment* and *appliance* listing.

This collection of provisions imports code sections which address both Solar Thermal and Photovoltaic Solar Systems, and the structural, mechanical, plumbing, fire safety and energy conservation measures for each. Some are specific to Solar Systems and others to their auxiliary, or backup systems. The installation of Photovoltaic Solar Systems is also addressed in NFPA 70.

CS303.2 (IMC 303.2) Hazardous locations. Appliances shall not be located in a *hazardous location* unless *listed* and *approved* for the specific installation.

CS303.3 (IMC 303.4) Protection from damage. Appliances shall not be installed in a location where subject to mechanical damage unless protected by *approved* barriers.

CS303.4 (IMC 303.6) Outdoor locations. Appliances installed in other than indoor locations shall be *listed* and *labeled* for outdoor installation.

CS303.5 (IMC 303.7) Pit locations. Appliances installed in pits or excavations shall not come in direct contact with the surrounding soil. The sides of the pit or excavation shall be held back not less than 12 inches (305 mm) from the *appliance*. Where the depth exceeds 12 inches (305 mm) below adjoining grade, the walls of the pit or excavation shall be lined with concrete or masonry. Such concrete or masonry shall extend not less than 4 inches (102 mm) above adjoining grade and shall have sufficient lateral load-bearing capacity to resist collapse. The *appliance* shall be protected from flooding in an *approved* manner.

CS303.6 (IMC 303.8) Elevator shafts. Mechanical systems shall not be located in an elevator shaft.

SECTION CS304 (IMC 304)
INSTALLATION

CS304.1 (IMC 304.1) General. *Equipment* and appliances shall be installed as required by the terms of their approval, in accordance with the conditions of the listing, the manufacturer's installation instructions and [this code]. Manufacturer's installation instructions shall be available on the job site at the time of inspection.

CS304.2 (IMC 304.2) Conflicts. Where conflicts between [this code] and the conditions of listing or the manufacturer's installation instructions occur, the provisions of [this code] shall apply.

Exception: Where a code provision is less restrictive than the conditions of the listing of the *equipment* or *appliance* or the manufacturer's installation instructions, the conditions of the listing and the manufacturer's installation instructions shall apply.

CS304.3 (IMC 304.3) Elevation of ignition source. Equipment and appliances having an *ignition source* and located in hazardous locations and public garages, private garages, repair garages, automotive motor fuel-dispensing facilities and parking garages shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor surface on which the *equipment* or *appliance* rests. For the purpose of this section, rooms or spaces that are not part of the living space of a *dwelling unit* and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

Exception: Elevation of the ignition source is not required for appliances that are listed as flammable vapor ignition resistant.

CS304.3.1 (IMC 304.3.1) Parking garages. Connection of a parking garage with any room in which there is a fuel-fired *appliance* shall be by means of a vestibule providing a two-doorway separation, except that a single door is permitted where the sources of ignition in the *appliance* are elevated in accordance with Section CS304.3 (IMC 304.3).

Exception: This section shall not apply to *appliance* installations complying with Section CS304.5 (IMC 304.6).

CS304.4 (IMC 304.4) Prohibited equipment and appliance location. Equipment and appliances having an *ignition source* shall not be installed in Group H occupancies or control areas where open use, handling or dispensing of combustible, flammable or explosive materials occurs.

CS304.5 (IMC 304.6) Public garages. Appliances located in public garages, motor fueling-dispensing facilities, repair garages or other areas frequented by motor vehicles, shall be installed not less than 8 feet (2438 mm) above the floor. Where motor vehicles are capable of passing under an *appliance*, the *appliance* shall be installed at the clearances required by the *appliance* manufacturer and not less than 1 foot (305 mm) higher than the tallest vehicle garage door opening.

Exception: The requirements of this section shall not apply where the appliances are protected from motor vehi-

cle impact and installed in accordance with Section CS304.3 (IMC 304.3) and NFPA 30A.

CS304.6 (IMC 304.7) Private garages. Appliances located in private garages and carports shall be installed with a minimum clearance of 6 feet (1829 mm) above the floor.

Exception: The requirements of this section shall not apply where the appliances are protected from motor vehicle impact and installed in accordance with Section CS304.3 (IMC 304.3).

CS304.7 (IMC 304.8) Construction and protection. Boiler rooms and furnace rooms shall be protected as required by the *International Building Code*.

CS304.8 (IMC 304.9) Clearances to combustible construction. Heat-producing *equipment* and *appliances* shall be installed to maintain the required *clearances* to combustible construction as specified in the listing and manufacturer's instructions. Such clearances shall be reduced only in accordance with Section (IMC 308). *Clearances* to combustibles shall include such considerations as door swing, drawer pull, overhead projections or shelving and window swing, shutters, coverings and drapes. Devices such as doorstops or limits, closers, drapery ties or guards shall not be used to provide the required *clearances*.

CS304.9 (IMC 304.10) Clearances from grade. Equipment and *appliances* installed at grade level shall be supported on a level concrete slab or other *approved* material extending not less than 3 inches (76 mm) above adjoining grade or shall be suspended not less than 6 inches (152 mm) above adjoining grade. Such support shall be in accordance with the manufacturer's installation instructions.

CS304.10 (IMC 304.11) Guards. Guards shall be provided where various components that require service and roof hatch openings are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof, or grade below. The guard shall extend not less than 30 inches (762 mm) beyond each end of components that require service. The top of the guard shall be located not less than 42 inches (1067 mm) above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21-inch-diameter (533 mm) sphere and shall comply with the loading requirements for guards specified in the *International Building Code*.

Exception: Guards are not required where permanent fall arrest/restraint anchorage connector devices that comply with ANSI/ASSE Z 359.1 are affixed for use during the entire lifetime of the roof covering. The devices shall be re-evaluated for possible replacement when the entire roof covering is replaced. The devices shall be placed not more than 10 feet (3048 mm) on center along hip and ridge lines and placed not less than 10 feet (3048 mm) from roof edges and the open sides of walking surfaces.

CS304.11 (IMC 304.12) Area served. Appliances serving different areas of a building other than where they are installed shall be permanently marked in an *approved* manner that uniquely identifies the *appliance* and the area it serves.

SECTION CS305 (IMC 305)
PIPING SUPPORT

CS305.1 (IMC 305.1) General. Mechanical system piping shall be supported in accordance with this section.

CS305.2 (IMC 305.2) Materials. Pipe hangers and supports shall have sufficient strength to withstand all anticipated static and specified dynamic loading conditions associated with the intended use. Pipe hangers and supports that are in direct contact with piping shall be of *approved* materials that are compatible with the piping and that will not promote galvanic action.

CS305.3 (IMC 305.3) Structural attachment. Hangers and anchors shall be attached to the building construction in an *approved* manner.

CS305.4 (IMC 305.4) Interval of support. Piping shall be supported at distances not exceeding the spacing specified in Table CS305.4 (IMC Table 305.4), or in accordance with ANSI/MSS SP-58.

CS305.5 (IMC 305.5) Protection against physical damage. In concealed locations where piping, other than cast-iron or steel, is installed through holes or notches in studs, joists, rafters or similar members less than $1^1/_2$ inches (38 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) shall cover the area of the pipe where the member is notched or bored, and shall extend not less than 2 inches (51 mm) above sole plates and below top plates.

SECTION CS306 (IMC 306)
ACCESS AND SERVICE SPACE

CS306.1 (IMC 306.1) Access. Appliances, controls devices, heat exchangers and HVAC system components that utilize energy shall be accessible for inspection, service, repair and replacement without disabling the function of a fire-resistance-rated assembly or removing permanent construction, other appliances, venting systems or any other piping or ducts not connected to the *appliance* being inspected, serviced, repaired or replaced. A level working space not less than 30 inches deep and 30 inches wide (762 mm by 762 mm) shall be provided in front of the control side to service an *appliance*.

CS306.2 (IMC 306.2) Appliances in rooms. Rooms containing appliances shall be provided with a door and an unobstructed passageway measuring not less than 36 inches (914 mm) wide and 80 inches (2032 mm) high.

Exception: Within a *dwelling unit*, appliances installed in a compartment, alcove, basement or similar space shall be accessed by an opening or door and an unobstructed passageway measuring not less than 24 inches (610 mm) wide and large enough to allow removal of the largest *appliance* in the space, provided that a level service space of not less than 30 inches (762 mm) deep and the height of the *appliance*, but not less than 30 inches (762 mm), is present at the front or service side of the *appliance* with the door open.

CHAPTER 3 [RS]

SOLAR THERMAL AND AUXILIARY SYSTEMS

The source code for section numbers in parenthesis is the 2015 International Residential Code®, except where the International Fire Code® has been denoted.

PART 1—SOLAR THERMAL SYSTEMS

SECTION RS301 (M2301) THERMAL SOLAR ENERGY SYSTEMS

RS301.1 (M2301.1) General. This section provides for the design, construction, installation, *alteration* and repair of *equipment* and systems using thermal solar energy to provide space heating or cooling, hot water heating and swimming pool heating.

RS301.2 (M2301.2) Design and installation. The design and installation of thermal solar energy systems shall comply with Sections RS301.2.1 (M2301.2.1) through RS301.2.13 (M2301.2.13).

RS301.2.1 (M2301.2.1) Access. Solar energy collectors, controls, dampers, fans, blowers and pumps shall be accessible for inspection, maintenance, repair and replacement.

RS301.2.1.1 (IFC 605.11.1.1) Roof access points. Roof access points shall be located in areas that do not require the placement of ground ladders over openings such as windows or doors, and located at strong points of building construction in locations where the access point does not conflict with overhead obstructions such as tree limbs, wires or signs.

RS301.2.2 (M2301.2.2) Collectors and panels. Solar collectors and panels shall comply with Sections RS301.2.2.1 (M2301.2.2.1) and RS301.2.2.2 (M2301.2.2.2).

RS301.2.2.1 (IFC 317.3) Rooftop structure and equipment clearance. For all vegetated roofing systems abutting combustible vertical surfaces, a Class A-rated roof system complying with ASTM E108 or UL 790 shall be achieved for a minimum 6-foot-wide (1829 mm) continuous border placed around rooftop structures and all rooftop equipment including, but not limited to, mechanical and machine rooms, penthouses, skylights, roof vents, solar panels, antenna supports and building service equipment.

RS301.2.2.2 (M2301.2.2.1) Roof-mounted collectors. The roof shall be constructed to support the loads imposed by roof-mounted solar collectors. Roof-mounted solar collectors that serve as a roof covering shall conform to the requirements for roof coverings in (IRC) Chapter 9 of [this code]. Where mounted on or above the roof coverings, the collectors and supporting structure shall be constructed of noncombustible materials or fire-retardant-treated wood equivalent to that required for the roof construction.

RS301.2.2.3 (M2301.2.2.2) Collector sensors. Collector sensor installation, sensor location and the protection of exposed sensor wires from ultraviolet light shall be in accordance with SRCC 300.

RS301.2.3 (M2301.2.3) Pressure and temperature relief valves and system components. System components containing fluids shall be protected with temperature and pressure relief valves or pressure relief valves. Relief devices shall be installed in sections of the system so that a section cannot be valved off or isolated from a relief device. Direct systems and the potable water portion of indirect systems shall be equipped with a relief valve in accordance with Section (P2804). For indirect systems, pressure relief valves in solar loops shall comply with SRCC 300. System components shall have a working pressure rating of not less than the setting of the pressure relief device.

RS301.2.4 (M2301.2.4) Vacuum relief. System components that might be subjected to pressure drops below atmospheric pressure during operation or shutdown shall be protected by a vacuum-relief valve.

RS301.2.5 (M2301.2.5) Piping insulation. Piping shall be insulated in accordance with the requirements of (IRC) Chapter 11. Exterior insulation shall be protected from ultraviolet degradation. The entire solar loop shall be insulated. Where split-style insulation is used, the seam shall be sealed. Fittings shall be fully insulated.

Exceptions:

1. Those portions of the piping that are used to help prevent the system from overheating shall not be required to be insulated.
2. Those portions of piping that are exposed to solar radiation, made of the same material as the solar collector absorber plate and are covered in the same manner as the solar collector absorber, or that are used to collect additional solar energy, shall not be required to be insulated.
3. Piping in thermal solar systems using unglazed solar collectors to heat a swimming pool shall not be required to be insulated.

RS301.2.6 (M2301.2.6) Protection from freezing. System components shall be protected from damage resulting from freezing of heat-transfer liquids at the winter design temperature provided in Table (IRC R301.2(1)). Freeze protection shall be provided by heating, insulation, thermal mass and heat transfer fluids with freeze points lower than the winter design temperature, heat tape or other *approved* methods, or combinations thereof.

Exception: Where the winter design temperature is greater than 32°F (0°C).

RS301.2.7 (M2301.2.7) Storage tank sensors. Storage tank sensors shall comply with SRCC 300.

RS301.2.8 (M2301.2.8) Expansion tanks. Expansion tanks in solar energy systems shall be installed in accordance with Section M2003 in solar collector loops that contain pressurized heat transfer fluid. Where expansion tanks are used, the system shall be designed in accordance with SRCC 300 to provide an expansion tank that is sized to withstand the maximum operating pressure of the system.

Exception: Expansion tanks shall not be required in *drain-back systems*.

RS301.2.9 (M2301.2.9) Roof and wall penetrations. Roof and wall penetrations shall be flashed and sealed in accordance with (IRC) Chapter 9 of [this code] to prevent entry of water, rodents and insects.

RS301.2.10 (M2301.2.10) Description and warning labels. Solar thermal systems shall comply with description label and warning label requirements of Section RS301.2.11.2 (M2301.2.11.2) and SRCC 300.

RS301.2.11 (M2301.2.11) Solar loop. Solar loops shall be in accordance with Sections RS301.2.11.1 (M2301.2.11.1) and RS301.2.11.2 (M2301.2.11.2).

RS301.2.11.1 (M2301.2.11.1) Solar loop isolation. Valves shall be installed to allow the solar collectors to be isolated from the remainder of the system.

RS301.2.11.2 (M2301.2.11.2) Drain and fill valve labels and caps. Drain and fill valves shall be labeled with a description and warning that identifies the fluid in the solar loop and a warning that the fluid might be discharged at high temperature and pressure. Drain caps shall be installed at drain and fill valves.

RS301.2.12 (M2301.2.12) Maximum temperature limitation. Systems shall be equipped with means to limit the maximum water temperature of the system fluid entering or exchanging heat with any pressurized vessel inside the *dwelling* to 180°F (82°C). This protection is in addition to the required temperature- and pressure-relief valves required by Section RS301.2.3 (M2301.2.3).

RS301.2.13 (M2301.2.13) Thermal storage unit seismic bracing. In Seismic Design Categories D_0, D_1 and D_2 and in townhouses in Seismic Design Category C, thermal storage units shall be anchored in accordance with Section (M1307.2).

RS301.3 (M2301.3) Labeling. *Labeling* shall comply with Sections RS301.3.1 (M2301.3.1) and RS301.3.2 (M2301.3.2).

RS301.3.1 (M2301.3.1) Collectors and panels. Solar thermal collectors and panels shall be listed and labeled in accordance with SRCC 100 or SRCC 600. Collectors and panels shall be *listed* and *labeled* to show the manufacturer's name, model number, serial number, collector weight, collector maximum allowable temperatures and pressures, and the type of heat transfer fluids that are compatible with the collector or panel. The *label* shall clarify that these specifications apply only to the collector or panel.

RS301.3.2 (M2301.3.2) Thermal storage units. Pressurized thermal storage units shall be *listed* and *labeled* to show the manufacturer's name, model number, serial number, storage unit maximum and minimum allowable operating temperatures and pressures, and the type of heat transfer fluids that are compatible with the storage unit. The *label* shall clarify that these specifications apply only to the thermal storage unit.

RS301.4 (M2301.4) Heat transfer gasses or liquids and heat exchangers. *Essentially toxic transfer fluids*, ethylene glycol, flammable gases and flammable liquids shall not be used as heat transfer fluids. Heat transfer gasses and liquids shall be rated to withstand the system's maximum design temperature under operating conditions without degradation. Heat exchangers used in solar thermal systems shall comply with Section RS303.1.2 (P2902.5.2) and SRCC 300.

Heat transfer fluids shall be in accordance with SRCC 300. The flash point of the heat transfer fluids utilized in solar thermal systems shall be not less than 50°F (28°C) above the design maximum nonoperating or no-flow temperature attained by the fluid in the collector.

RS301.5 (M2301.5) Backflow protection. Connections from the potable water supply to solar systems shall comply with Section RS303.1.3 (P2902.5.5).

RS301.6 (M2301.6) Filtering. Air provided to occupied spaces that passes through thermal mass storage systems by mechanical means shall be filtered for particulates at the outlet of the thermal mass storage system.

RS301.7 (M2301.7) Solar thermal systems for heating potable water. Where a solar thermal system heats potable water to supply a potable hot water distribution system, the solar thermal system shall be in accordance with Sections RS301.7.1 (M2301.7.1), RS301.7.2 (M2301.7.2) and RS303.1.3 (P2902.5.5).

RS301.7.1 (M2301.7.1) Indirect systems. Heat exchangers that are components of indirect solar thermal heating systems shall comply with Section RS303.1.2 (P2902.5.2).

RS301.7.2 (M2301.7.2) Direct systems. Where potable water is directly heated by a solar thermal system, the pipe, fittings, valves and other components that are in contact with the potable water in the solar heating system shall comply with the requirements of (IRC) Chapter 29.

The requirements for Chapter 29 of the International Residential Code can be found in Section RS303 of the International Solar Energy Provisions.

SECTION RS302 (P2802)
SOLAR WATER HEATING SYSTEMS

RS302.1 (P2802.1) Water temperature control. Where heated water is discharged from a solar thermal system to a *hot water* distribution system, a thermostatic mixing valve complying with ASSE 1017 shall be installed to temper the water to a temperature of not greater than 140°F (60°C). Solar thermal systems supplying *hot water* for both space

heating and domestic uses shall comply with Section RS302.3 (P2803.2). A temperature-indicating device shall be installed to indicate the temperature of the water discharged from the outlet of the mixing valve. The thermostatic mixing valve required by this section shall not be a substitute for water temperature limiting devices required by (IRC) Chapter 27 for specific fixtures.

RS302.2 (P2802.2) Isolation valves. Isolation valves in accordance with RS303.2 (P2903.9.2) shall be provided on the cold water feed to the water heater. Isolation valves and associated piping shall be provided to bypass solar storage tanks where the system contains multiple storage tanks.

RS302.3 (P2803.2) Temperature control. Where a combination water heater-space heating system requires water for space heating at temperatures exceeding 140°F (60°C), a master thermostatic mixing valve complying with ASSE 1017 shall be installed to temper the water to a temperature of not greater than 140°F (60°C) for domestic uses.

SECTION RS303 (P2902)
PROTECTION OF POTABLE WATER SUPPLY

RS303.1 (P2902.5) Protection of potable water connections. Connections to the potable water shall conform to Sections RS303.1.1 (P2902.5.1) through RS303.1.3 (P2902.5.5).

RS303.1.1 (P2902.5.1) Connections to boilers. Where chemicals will not be introduced into a boiler, the potable water supply to the boiler shall be protected from the boiler by a backflow preventer with an intermediate atmospheric vent complying with ASSE 1012 or CSA B64.3. Where chemicals will be introduced into a boiler, the potable water supply to the boiler shall be protected from the boiler by an *air gap* or a reduced pressure principle backflow prevention assembly complying with ASSE 1013, CSA B64.4 or AWWA C511.

RS303.1.2 (P2902.5.2) Heat exchangers. Heat exchangers using an essentially toxic transfer fluid shall be separated from the potable water by double-wall construction. An *air gap* open to the atmosphere shall be provided between the two walls. Single-wall construction heat exchangers shall be used only where an *essentially nontoxic transfer fluid* is utilized.

RS303.1.3 (P2902.5.5) Solar thermal systems. Where a solar thermal system heats potable water to supply a potable *hot water* distribution or any other type of heating system, the solar thermal system shall be in accordance with Section RS303.1.3.1 (P2902.5.5.1), RS303.1.3.2 (P2902.5.5.2) or RS303.1.3.3 (P2902.5.5.3) as applicable.

RS303.1.3.1 (P2902.5.5.1) Indirect systems. Water supplies of any type shall not be connected to the solar heating loop of an indirect solar thermal *hot water* heating system. This requirement shall not prohibit the presence of inlets or outlets on the solar heating loop for the purposes of servicing the fluid in the solar heating loop.

RS303.1.3.2 (P2902.5.5.2) Direct systems for potable water distribution systems. Where a solar thermal system directly heats potable water for a potable water distribution system, the pipe, fittings, valves and other components that are in contact with the potable water in the system shall comply with the requirements of (IRC) Chapter 29.

RS303.1.3.3 (P2902.5.5.3) Direct systems for other than potable water distribution systems. Where a solar thermal system directly heats water for a system other than a potable water distribution system, a potable water supply connected to such system shall be protected by a backflow preventer with an intermediate atmospheric vent complying with ASSE 1012. Where a solar thermal system directly heats chemically treated water for a system other than a potable water distribution system, a potable water supply connected to such system shall be protected by a reduced pressure principle backflow prevention assembly complying with ASSE 1013.

RS303.2 (P2903.9.2) Water heater valve. A *readily accessible* full-open valve shall be installed in the cold-water supply pipe to each water heater at or near the water heater.

RS303.3 (P2912.2) Collection surface. Rainwater shall be collected only from above-ground impervious roofing surfaces constructed from *approved* materials. Collection of water from vehicular parking or pedestrian walkway surfaces shall be prohibited except where the water is used exclusively for landscape irrigation. Overflow and bleed-off pipes from roof-mounted *appliances* including, but not limited to, evaporative coolers, water heaters and solar water heaters shall not discharge onto rainwater collection surfaces.

This section refers to nonpotable rainwater collection and distribution systems.

PART 2—AUXILIARY AND BACKUP THERMAL SYSTEMS

SECTION RS304 (M2001)
BOILERS

RS304.1 (M2001.1) Installation. In addition to the requirements of [this code], the installation of boilers shall conform to the manufacturer's instructions. The manufacturer's rating data, the nameplate and operating instructions of a permanent type shall be attached to the boiler. Boilers shall have their controls set, adjusted and tested by the installer. A complete control diagram together with complete boiler operating instructions shall be furnished by the installer. Solid and liquid fuel-burning boilers shall be provided with *combustion air* as required by (IRC) Chapter 17.

RS304.1.1 (M2001.1.1) Standards. Packaged oil-fired boilers shall be listed and labeled in accordance with UL 726. Packaged electric boilers shall be listed and labeled in accordance with UL 834. Solid fuel-fired boilers shall be listed and labeled in accordance with UL 2523. Boilers shall be designed, constructed and certified in accordance with the ASME *Boiler and Pressure Vessel Code*, Section I or IV. Controls and safety devices for boilers with fuel input ratings of 12,500,000 Btu/hr (3 663 388 watts) or

less shall meet the requirements of ASME CSD-1. Gas-fired boilers shall conform to the requirements listed in (IRC) Chapter 24.

RS304.2 (M2001.2) Clearance. Boilers shall be installed in accordance with their *listing* and *label.*

RS304.3 (M2001.3) Valves. Every boiler or modular boiler shall have a shutoff valve in the supply and return piping. For multiple boiler or multiple modular boiler installations, each boiler or modular boiler shall have individual shutoff valves in the supply and return piping.

Exception: Shutoff valves are not required in a system having a single low-pressure steam boiler.

RS304.4 (M2001.4) Flood-resistant installation. In flood hazard areas established in Table (IRC R301.2(1)), boilers, water heaters and their control systems shall be located or installed in accordance with Section (R322.1.6).

SECTION RS305 (M2002)
OPERATING AND SAFETY CONTROLS

RS305.1 (M2002.1) Safety controls. Electrical and mechanical operating and safety controls for boilers shall be *listed* and *labeled.*

RS305.2 (M2002.2) Hot water boiler gauges. Every hot water boiler shall have a pressure gauge and a temperature gauge, or combination pressure and temperature gauge. The gauges shall indicate the temperature and pressure within the normal range of the system's operation.

RS305.3 (M2002.3) Steam boiler gauges. Every steam boiler shall have a water-gauge glass and a pressure gauge. The pressure gauge shall indicate the pressure within the normal range of the system's operation. The gauge glass shall be installed so that the midpoint is at the normal water level.

RS305.4 (M2002.4) Pressure-relief valve. Boilers shall be equipped with pressure-relief valves with minimum rated capacities for the *equipment* served. Pressure-relief valves shall be set at the maximum rating of the boiler. Discharge shall be piped to drains by gravity to within 18 inches (457 mm) of the floor or to an open receptor.

RS305.5 (M2002.5) Boiler low-water cutoff. Steam and hot water boilers shall be protected with a low-water cutoff control.

Exception: A low-water cutoff is not required for coil-type and water-tube type boilers that require forced circulation of water through the boiler and that are protected with a flow sensing control.

RS305.6 (M2002.6) Operation. Low-water cutoff controls and flow sensing controls required by Section RS305.5 (M2002.5) shall automatically stop the combustion operation of the appliance when the water level drops below the lowest safe water level as established by the manufacturer or when the water circulation flow is less than that required for safe operation of the appliance, respectively.

SECTION RS306 (M2003)
EXPANSION TANKS

RS306.1 (M2003.1) General. Hot water boilers shall be provided with expansion tanks. Nonpressurized expansion tanks shall be securely fastened to the structure or boiler and supported to carry twice the weight of the tank filled with water. Provisions shall be made for draining nonpressurized tanks without emptying the system.

RS306.1.1 (M2003.1.1) Pressurized expansion tanks. Pressurized expansion tanks shall be consistent with the volume and capacity of the system. Tanks shall be capable of withstanding a hydrostatic test pressure of two and one-half times the allowable working pressure of the system.

RS306.2 (M2003.2) Minimum capacity. The minimum capacity of expansion tanks shall be determined from Table RS306.2 (Table M2003.2).

TABLE RS306.2 (TABLE M2003.2)
EXPANSION TANK MINIMUM CAPACITY[a]
FOR FORCED HOT-WATER SYSTEMS

SYSTEM VOLUME[b] (gallons)	PRESSURIZED DIAPHRAGM TYPE	NONPRESSURIZED TYPE
10	1.0	1.5
20	1.5	3.0
30	2.5	4.5
40	3.0	6.0
50	4.0	7.5
60	5.0	9.0
70	6.0	10.5
80	6.5	12.0
90	7.5	13.5
100	8.0	15.0

For SI: 1 gallon = 3.785 L, 1 pound per square inch gauge = 6.895 kPa, °C = [(°F)-32]/1.8.

a. Based on average water temperature of 195°F (91°C), fill pressure of 12 psig and a maximum operating pressure of 30 psig.

b. System volume includes volume of water in boiler, convectors and piping, not including the expansion tank.

SECTION RS307 (M2004)
WATER HEATERS USED FOR SPACE HEATING

RS307.1 (M2004.1) General. Water heaters used to supply both potable hot water and hot water for space heating shall be installed in accordance with [this chapter], (IRC) Chapter 24, (IRC) Chapter 28 and the manufacturer's instructions.

SECTION RS308 (M2005)
WATER HEATERS

RS308.1 (M2005.1) General. Water heaters shall be installed in accordance with (IRC) Chapter 28, the manufacturer's instructions and the requirements of [this code]. Water heaters installed in an attic shall comply with the requirements of Section (M1305.1.3). Gas-fired water heaters shall comply with the requirements in (IRC) Chapter 24. Domestic electric water heaters shall comply with UL 174. Oiled-fired water heaters shall comply with UL 732. Thermal solar water

CHAPTER 5 [RS]

ALTERNATE COMPLIANCE PROVISIONS

This chapter contains alternate compliance provisions associated with solar energy systems excerpted directly from the International Energy Conservation Code® and the International Swimming Pool and Spa Code™.

SECTION RS501 (IECC CHAPTER 4 [RE]) RESIDENTIAL ENERGY EFFICIENCY—GENERAL

RS501.1 (IECC R401.1) Scope. This chapter applies to residential buildings.

RS501.2 (IECC R401.2) Compliance. Projects shall comply with one of the following:

1. Sections RS501.1 (IECC R401.1) through RS502.1.2 (IECC R403.10.4).
2. Section (IECC R405) and the provisions of Sections RS501.1 (IECC R401.1) through RS502.3 (IECC R403.10.4) labeled "Mandatory."
3. An energy rating index (ERI) approach in Section (IECC R406).

RS501.2.1 (IECC R401.2.1) Tropical zone. *Residential buildings* in the tropical zone at elevations below 2,400 feet (731.5 m) above sea level shall be deemed to comply with this chapter where the following conditions are met:

1. Not more than one-half of the *occupied* space is air conditioned.
2. The *occupied* space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.

SECTION RS502 (IECC R403) SYSTEMS

RS502.1 (IECC R403.10) Pools and permanent spa energy consumption (Mandatory).

RS502.1.1 (IECC R403.10.3) Time switches. Time switches or other control methods that can automatically turn off and on according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- and waste-heat-recovery pool heating systems.

RS502.1.2 (IECC R403.10.4) Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means.

Exception: Where more than 70 percent of the energy for heating, computed over an operation season, is from site-recovered energy, such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

SECTION RS503 (ISPSC 303) ENERGY

RS503.1 (ISPSC 303.1.2) Time switches. Time switches or other control methods that can automatically turn off and on heaters and pump motors according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- or waste-heat recovery pool heating systems.

RS503.2 (ISPSC 303.1.3) Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means in accordance with Section (ISPSC 104.11).

Exception: Where more than 70 percent of the energy for heating, computed over an operating season, is from site-recovered energy such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

SECTION 504 (ISPSC 316) HEATERS

RS504.1 (ISPSC 316.2) Listed and labeled. Heaters shall be listed and labeled in accordance with the applicable standard listed in Table RS504.1 (ISPSC Table 316.2).