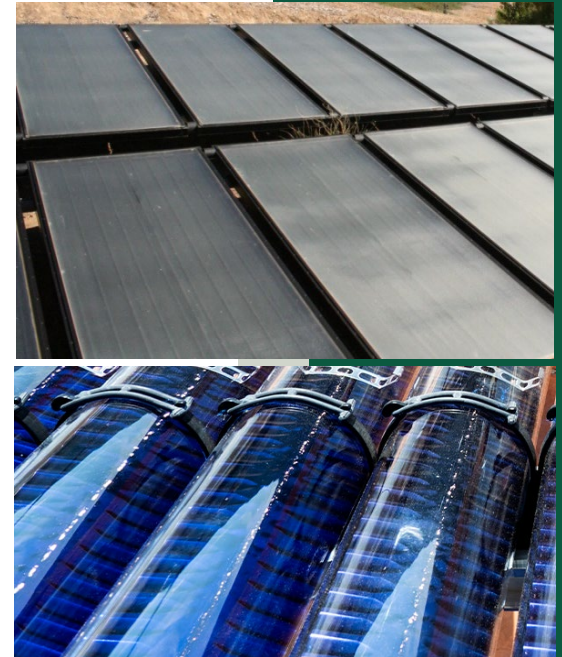




SOLAR RATING
& CERTIFICATION
CORPORATION™

2020 Solar Heating Standards Overview Webinar

June 16, 2021



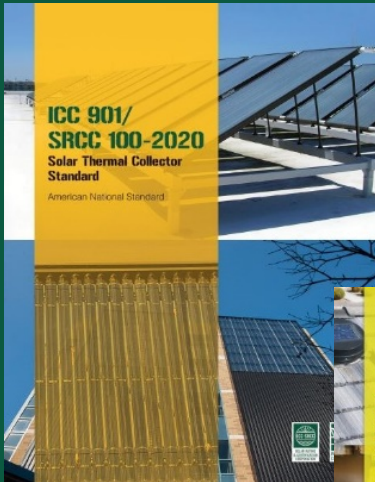
Agenda

1. Background
2. Rollout
3. Significant Changes for Collectors
4. Significant Changes for Systems
5. Reaffirmation of ICC 901/SRCC 400

Note: In this presentation, the section numbers of the relevant standards are given using the section symbol within parentheses (e.g. §9.2). Text excerpts from a standard are given in *red Times New Roman italicized text*.



BACKGROUND



Latest ICC-SRCC Standards

- ICC 901/SRCC 100 – 2020 *Solar Thermal Collector Standard*
- ICC 900/SRCC 300 – 2020 *Solar Thermal System Standard*
- ICC 902/SRCC 400 – 2020 *Solar Pool & Spa Heating System Standard*

View for FREE at:

<https://solar-rating.org/resources/standards/>

ICC-SRCC Certification & Listing Programs



OG-100

Solar Collectors

- Compliance with ICC 901/SRCC 100
- Standardized performance ratings
- Testing required in all cases.



OG-300

SHC Systems

- Compliance with ICC 900/SRCC 300
- Annual performance ratings throughout NA
- Testing may or may not be required



OG-400

Solar Pool Heaters

- Compliance with ICC 902/SRCC 400
- No performance ratings
- Testing may or may not be required

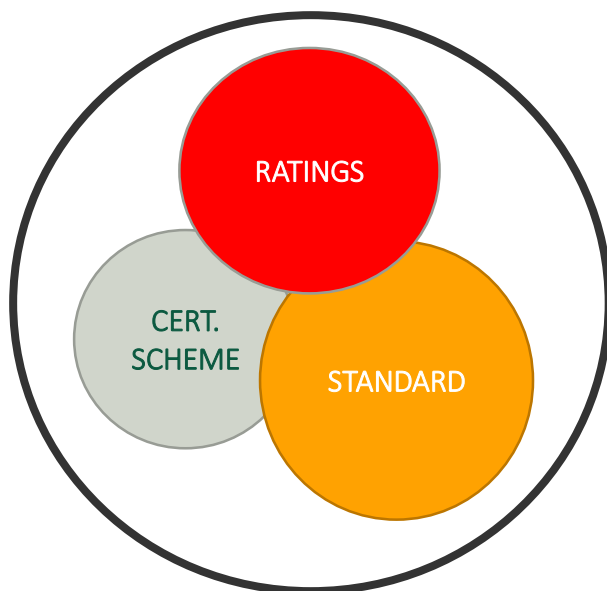


Code Listings

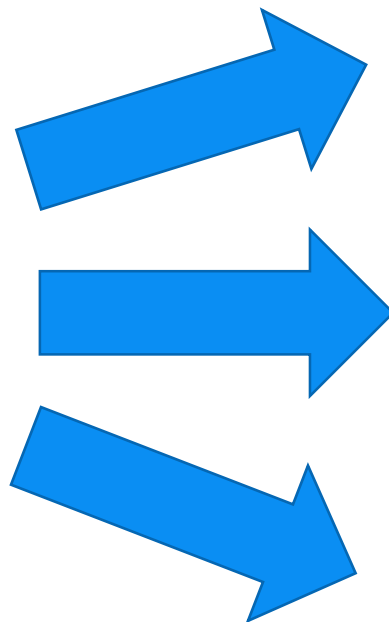
Any SHC System or Component

- Compliance with codes & standards
- No ratings
- Testing may or may not be required

OG-300 Guidelines & Minimum Standards for Rating Solar Water Heating Systems



PRIOR TO 2015



**ICC 900/SRCC
300 Solar
Thermal
Systems
Standard**



**ICC-SRCC ROP
Rules for SHC
Listing Reports**



**OG-300 Guidelines
for Rating Solar
Water Heating
Systems**

2015 AND AFTER

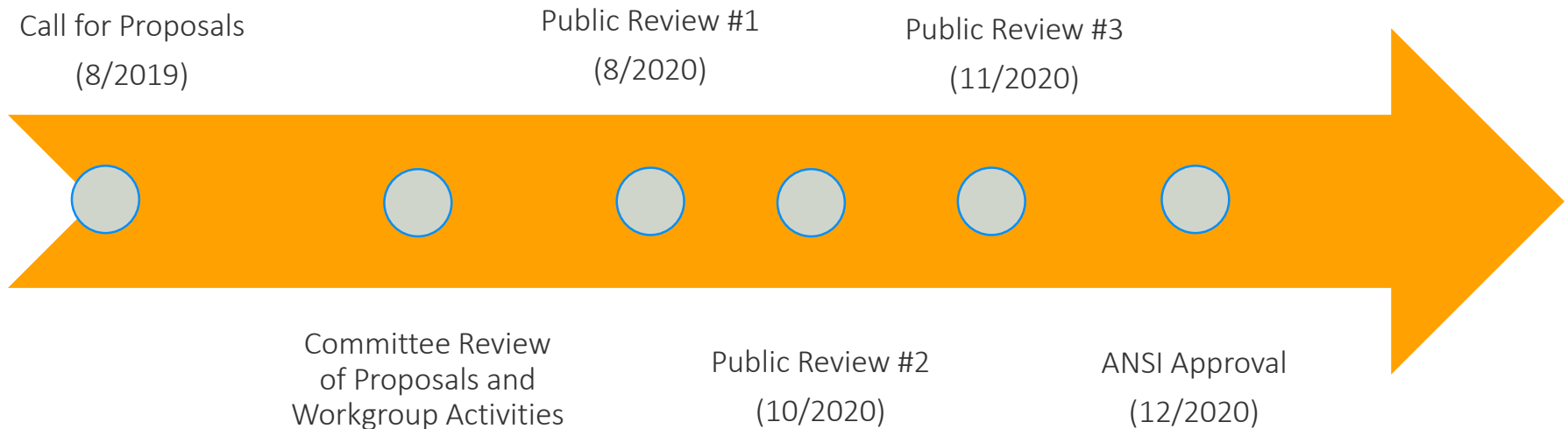
Why change?

- When OG documents combined certification and technical requirements it was difficult to reference in building codes/regulations.
 - Necessary for ANSI approval of standard
 - Compliance with ISO/IEC 17065
 - Reference standard without specifying CB
- Standard committee desired to keep ratings separate from qualification requirements
 - Building codes address health/safety/durability requirements, not performance.

ICC/SRCC Standard References in Model Codes

	ICC					IAPMO	CROSQ
STANDARD	IBC	IRC	IPC	IMC	ISPSC	USEHC	CREEBC
ICC 901/SRCC 100 Solar Thermal Collectors	●	●	●	●	●	●	●
ICC 900/SRCC 300 Solar Thermal Systems	●	●	●	●		●	●
ICC 902/SRCC 400 Solar Pool Heaters					●		

ICC/SRCC Standard Update Process



2019/2020 Standard Update Details

- ICC served as SDO, SRCC as Secretariat
 - Developed per ICC's ANSI-approved consensus process.
 - Review required every 5 years.
- Changes set by 12 member technical committee (IS-STSC)
 - Balanced committee of manufacturers, test labs, regulators, general members
- 1 Call for Proposals and 3 Public Comment Periods
- 2015 Editions of Standards Served as Initial Draft

<https://www.iccsafe.org/products-and-services/standards-development/icc-srcc-solar-thermal-standards/>



2020 ICC/SRCC Standard Rollout

Standards Rollout in SRCC Certifications

NEW CERTIFICATIONS

- Required for new applications received after 7/1/2021.
- Case by case exemptions for testing conducted or started prior to 1/1/2021.

EXISTING CERTIFICATIONS

- Optional updates from the 2015 to 2020 edition for calendar year.
- Nominal fee for upgrade processing.
- May require gap testing in some limited cases.





SIGNIFICANT CHANGES FOR SOLAR THERMAL COLLECTORS

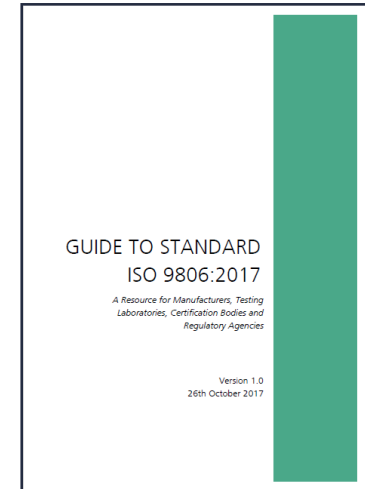
General

Key Updates to ICC 901/SRCC 100

- Migration from 2013 to 2017 edition of ISO 9806
- Improved alignment with Solar Keymark/EN standards
- Improved alignment with ICC Building Codes and NEC
- Clarified design requirements
- Better coverage for concentrating & PVT collectors
- New requirement for collector manuals
- Revised label content

ISO 9806-2017 Enhancements

- (NEW) Single thermal performance equation for all collector types based on $\Delta T = T_m - T_a$.
- (NEW) WISC Category (Wind & Infrared Sensitive Collectors)
- (NEW) Standard Rating Conditions (SRC)
- Adapted test procedures for collectors with specific attributes (PVTs, active mechanisms, WISC)



[Guide to Standard ISO 9806:2017, A Resource for Manufacturers, Testing Laboratories, Certification Bodies and Regulatory Agencies](#)

$$\dot{Q} = A_G(\eta_{0,b}K_b(\theta_L, \theta_T)G_b + \eta_{0,b}K_dG_d - a_1(T_m - T_a) - a_2(T_m - T_a)^2 - a_3u'(T_m - T_a) + a_4(E_L - \sigma T_a^4) - a_5\left(\frac{dT_m}{dt}\right) - a_6u'G - a_7u'(E_L - \sigma T_a^4) - a_8(T_m - T_a)^4$$

ISO 9806 Testing References & Deviations

TEST	SECTION	DEVIATIONS
Standard Stagnation	9806-2017 §9	
Exposure	9806-2017 §10	Min. Class B, 30 days, PVT exceptions
External Thermal Shock	9806-2017 §11	Min. Class B, PVT exceptions
Internal Thermal Shock	9806-2017 §12	Min. Class B, continuous flow exception
Internal Pressure	9806-2017 §6	
Time Constant	9806-2017 §25	
Thermal Performance	9806-2017 §19	Internal storage per App. B
IAM	9806-2017 §26	Bi-axial for asymmetry, concentrating
Mechanical Load	9806-2017 §15	Unglazed and PVT exceptions
Impact Resistance		Unglazed, tempered glass, PVT exceptions

Steel or Ice Balls
Now Permitted

Optional Tests

Test	Test Method	Notes
Freeze Resistance	9806-2017 §9	Only when freeze tolerance claimed
Thermal Capacity	9806-2017 §26	Can be determined through testing or calculations.
Pressure Drop	9806-2017 §27	Changed to align with SKN
Rain Penetration	9806-2017 §13	Still required by SKN

Previously
Required

(NEW) Test Report Format

Test reports must comply with ISO 9806-2017, Appendix A (§ 404.1)

- New performance coefficients
- Power output at Standard Rating Conditions (SRC)
 - Table and Graphical format

Table A.6 — Collector performance coefficients

	Standard deviation	Unit	Decimal places
$\eta_{0,hem}$		—	3
$\eta_{0,b}$		—	3
K_d		—	2
a_1		W/m ² K	2
a_2		W/m ² K ²	3
a_3		Ws/(m ³ ·K)	3
a_4		—	2
a_5		Ws/(m ² ·K)	0
a_6		s/m	3
a_7		s/m	2
a_8		W/m ² K ⁴	3
C/A		Ws/(m ² ·K)	0

Nominal flowrate during the measurement $\dot{m} = \text{___ kg/h}$
 $\eta_{0,hem}$ is calculated using $\eta_{0,hem} = \eta_{0,beam} (0.85 + 0.15 K_d)$

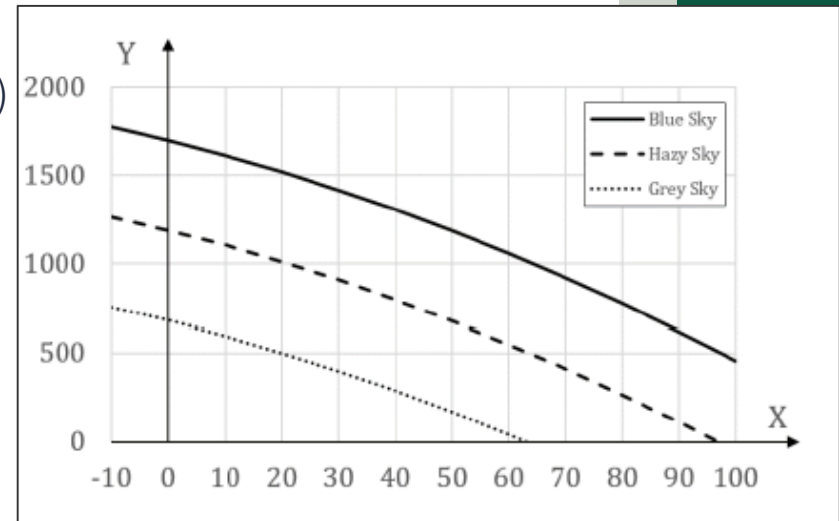




Table A.7 — Collector power output

$\theta_m - \theta_a$	Standard reporting conditions		
	Blue sky	Hazy sky	Grey sky
-10			
0			
10			
...			
Max. tested temperature difference + 30 K			

Nominal flowrate during the measurement $\dot{m} = \text{___ kg/h}$

Peak Power per unit $\dot{Q}_{peak} = \text{___ W}$ (indicate as integer)

Updated Labeling Requirements (§503)

	This product certified by the Solar Rating & Certification Corporation™ www.solar-rating.org				
	OG-100 Certification Number:	10001234		Collector Type:	Glazed Flat Plate
	Certification Standard:	ICC 901/SRCC 100 - 2020		Dimensions:	2440 x 1220 x 100 mm (96 x 48 x 4 in)
	Model:	Solar Collector ABC		Gross Area:	3.0 m² (32.3 ft²)
	Certification Holder:	Solar Thermal Collectors Inc.		Max Operating Pressure:	1000 kPa (145 psi)
	Manufactured in:	Country		Max Operating Temperature:	200°C (393°F)
	Serial Number:	123456		Empty Weight:	20 kg (44 lb)
		Fluid Volume:	10 L (3 gal)		
		Fluid(s):	Water or Water-Glycol Mixture		

- Changes made to resolve differences in requirements in building codes and the standard.
- Requires units to be SI and Imperial.
- QR code is optional.
- See [Rules for Mark and Certificate Use](#) for details on use and format.

Product Manual Requirements (§503)

Collectors are now required to be provided with a manual describing the procedure for installation, operation and maintenance.

- Hardcopy or digital version permitted
- Minimum contents
 - General information (§503.1)
 - Installation information (§503.2)
 - Operating instructions (§503.3)



PV-Thermal Hybrid Collectors

SIGNIFICANT CHANGES FOR
SOLAR THERMAL COLLECTORS

Standard 100-2020: PVTs

The provisions for PVT testing and qualification underwent a complete review and update. A working group of manufacturers and other stakeholders met many times to develop and refine the requirements for PVTs.

But – Building codes in North America still address PV and solar thermal products separately, so compliance remains a challenge.

NEW DEFINITION

PHOTOVOLTAIC THERMAL HYBRID

SOLAR COLLECTOR (PVT):

A photovoltaic thermal hybrid solar collector is a solar collector using photovoltaic panels or cells as a thermal absorber and therefore converts solar radiation into electrical and thermal energy.

PVT Test Method Exceptions



Exposure testing (§402.3.1):

- Half-exposure, Class B, ≥ 15 days
- Exempted where assembly undergoes Damp Heat & Thermal Cycling and stagnation temp < 185 °F



External thermal shock testing (§402.4.4):

- Omit when fully covered



Impact testing exception (§402.15):

- Omit when fully covered



Thermal performance testing (§402.10.3):

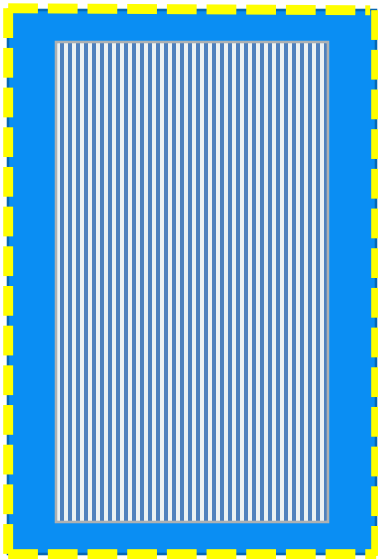
- Electrical power generation at MPP
(All other tests OC)



(NEW) Fire testing of the PVT assembly per UL 1703 or 61730 (§402.17)

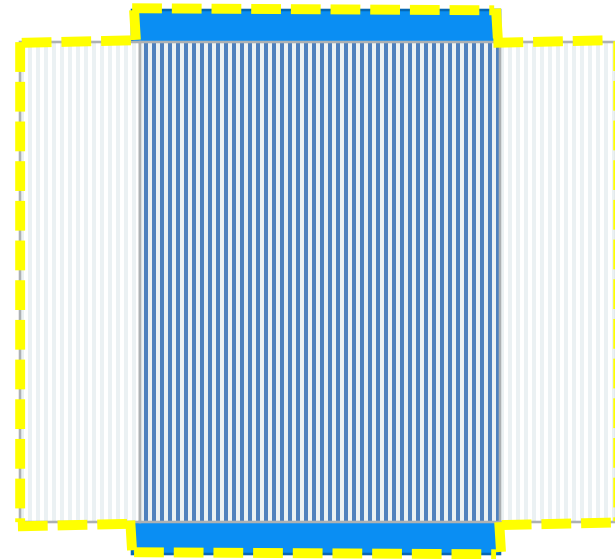
- Fire tests based on UL 790

(NEW) PVT Gross Area (§401.6) and Testing Exceptions (§402.15, §402.4.4)



✗ Impact Test

✗ External Thermal Shock Test



✓ Impact Test

✓ External Thermal Shock Test

(NEW) PV Module Substitution Criteria

PV modules in PVTs may be substituted without retesting where at least one of two conditions is met (§303.4):

1: Area of new module within $\pm 10\%$ and P_{\max} within $\pm 20\%$ of tested module (@STC)

2: Ratio $\frac{P_{\max}}{A_G}$ of new module within $\pm 10\%$ of tested module

Fire classification of substituted PV module must be same or greater than tested module.



Concentrating Collectors

SIGNIFICANT CHANGES FOR
SOLAR THERMAL COLLECTORS

Concentrating Collector Enhancements

- In-situ testing specifically permitted (§401.3.4)
- Clarification of impact testing of reflectors and receivers (§402.15)
- Clarification of stagnation temperature determination for collectors with active controls (§402.2.2)
- New provisions for active mechanisms:
 - Trackers must be listed to UL 3703 (ICC 900/SRCC 300)
 - Test lab to document and confirm operation (defocusing, stowing, tracking, etc). (§401.3.1)
- New definition: “concentration ratio”

CONCENTRATION RATIO. *The ratio of the projected area of the concentrator to the projected area of the absorber of a concentrating solar thermal collector in any given configuration.*



Solar Air Heating Collectors

SIGNIFICANT CHANGES FOR
SOLAR THERMAL COLLECTORS

Solar Air Heating Collector Tests

Table of testing requirements for solar air heating collectors separated from liquids in 401.1(b)

TABLE 401.1(b)
SOLAR AIR HEATING COLLECTOR TEST REQUIREMENTS

TEST	SECTION	CLOSED LOOP			TRANSPIRED		
		1	2 Q	2 P	1	2 Q	2 P
Stagnation Temperature	402.2	X	X		X	X	
Exposure	402.3	X	X		X	X	
External Thermal Shock	402.4.4	X	X		X	X	
Internal Thermal Shock	402.4.5	X	X		X	X	
Internal Pressure Test	402.5	X	X				
Leakage	402.6	X	X				
Rupture and Collapse	402.7	X	X		X	X	
Thermal Capacity/Time Constant	402.9	X		X	X		X
Thermal Performance	402.10	X		X	X		X
Incident Angle Modifier	402.11	X		X	X		X
Pressure Drop (optional)	402.12						
Rain Penetration (optional)	402.13						
Mechanical Load	402.14	X	X		X	X	
Impact Resistance	402.15	X	X		X	X	
Solar Absorptivity and Emissivity	402.16	X		X	X		X

Previously
Required for
Some Types

NEW

NEW Requirements for SAH Collectors

- (NEW) Absorptivity & emissivity testing of transpired absorbers per ASTM C1549 (§402.16)
 - 6" x 6" (152x152 mm) sample of tested to be collected and sent to SRCC with report (§402.16.1)
- (NEW) Materials exposed to airflow must have flame spread index ≤ 25 and smoke-developed index ≤ 50 per ASTM E84 or UL 723 (§302.4)
- Solar Air Heating Collector Datasheet required with each test report ([available on SRCC website](#))



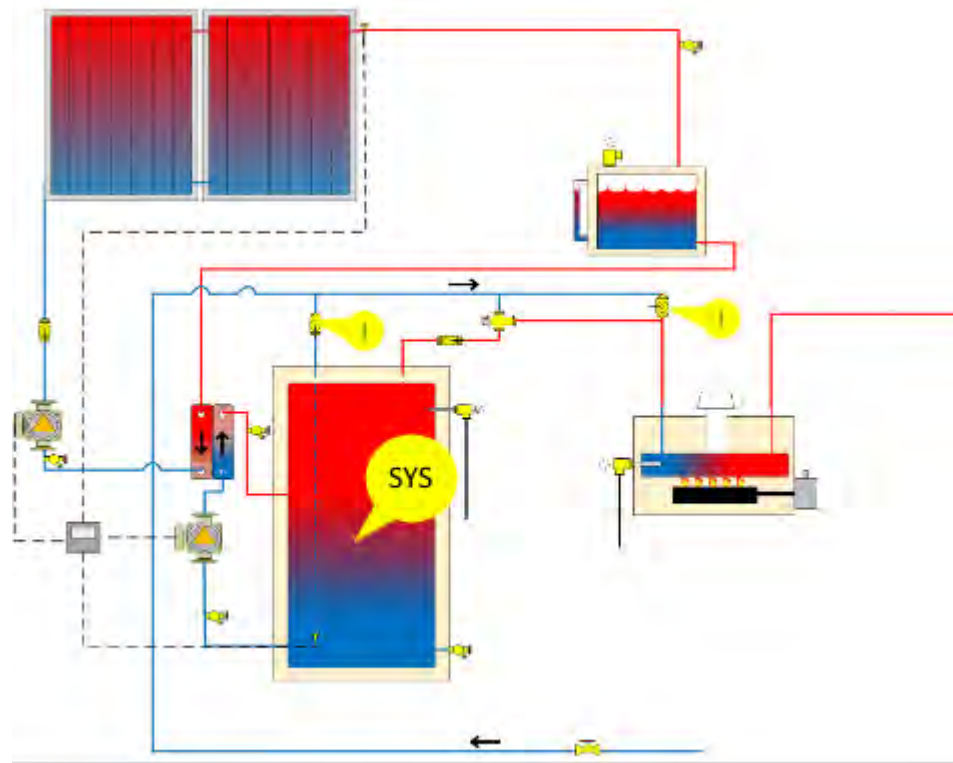
SIGNIFICANT CHANGES FOR SOLAR WATER HEATING SYSTEMS

General



Key Updates to ICC 900/SRCC 300

- Improved alignment with ICC Building Codes and NEC
- Consolidated system label
- Revised requirement for system manuals
- Eliminated requirements for full-sized backup water heater
- Updated hot water storage tank listing requirements
- Support added for PV water heaters
- New appendix with test method for Uniform Energy Factor of solar water heaters

System Labeling Changes





New OG-300 System Label

 <p>This product certified by Solar Rating & Certification Corporation™ ICC-SRCC™</p> <p>OG-300 Solar Thermal System</p> <p>www.solar-rating.org</p> <p>OG-300 Certification Number: 10002114 Certification Standard: ICC 900/SRCC 300-2020</p>	<p>This solar water heater manufactured by Sample Solar Corporation P.O. Box 12345 Anytown, CA 97402 www.samplesolarcorp.com</p> <p>System Model: Super Sample 2B Collector Certification: ICC-SRCC OG-100 100012345 Collector Quantity:</p>	<p>Heat Transfer Fluid: Storage Tank Volume: Expansion Tank Volume: Relief Valve: Maximum Water Supply Pressure: Maximum Solar Loop Pressure: Flow Rate: Backup Energy Rating: Installation Date:</p> <p>1 V kVA 3 V kVA minimum pressure</p> 
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- System label can be affixed to solar tank, auxiliary water heater, or inverter (§402.2)
 - Installation date to be filled in field
- Master electrical wiring diagram required (§402.5) – may be combined with label
- Mechanical diagram required (§402.6) – may be combined with label
- Other configuration templates available
 - QR code is optional

Combined OG-300 Label Options Available



This product certified by
**Solar Rating & Certification
Corporation™ (ICC-SRCC™)**
OG-300 Solar Thermal System
www.solar-rating.org

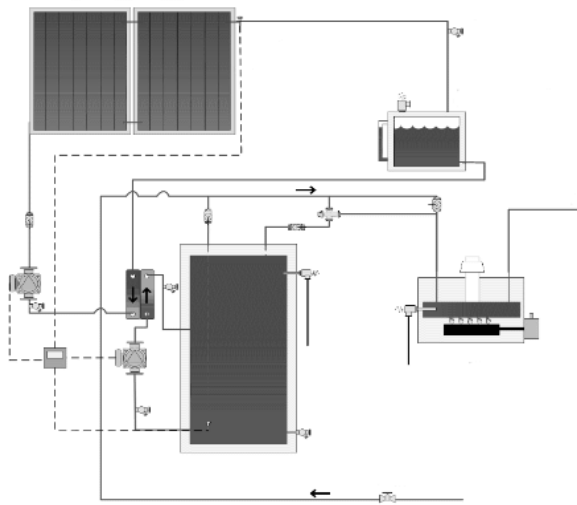
OG-300 Certification Number: 10002114
Certification Standard: ICC-900/SRCC 300-2020

This solar water heater manufactured by
Sample Solar Corporation
P.O. Box 12345
Anytown, CA 97402
www.samplesolarcorp.com

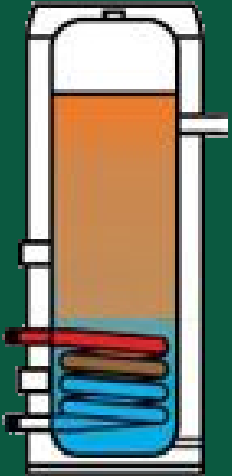
System Model: Super Sample 2B
Collector Certification: ICC-SRCC OG-100 100012345
Collector Quantity:

Heat Transfer Fluid:
Storage Tank Volume:
Expansion Tank Volume:
Relief Valve:
Maximum Water Supply Pressure:
Maximum Solar Loop Pressure:

Flow Rate:
Backup Energy Rating: 1 | V | kVA
3 | V | kVA
minimum pressure
Installation Date:



Hot Water Storage Tank Listings



301.4.2 Storage tank listing. *Storage tanks* shall be listed and labeled by a recognized *third-party listing agency*. *Storage tanks* that are not separable from the collector shall comply with ICC 901/SRCC 100.

- Tank listing required but standard is not specified.
 - Applies to pressurized and unpressurized tanks
- Differentiates between “auxiliary heating equipment” and “storage tanks”
 - Water heaters capable of standalone operation listed to UL 174 or 1453 for electric and ANSI Z21.10.1 or Z21.10.3 for gas.
- SRCC to determine appropriate tests and listings for solar tanks on case-by-case basis, but will require hydrostatic testing for all pressurized tanks.
 - No US or Canadian standard specifically for unfired hot water storage tanks.
 - New standard project to clarify requirements for wide range of solar tank types.

Code Alignment

- Rubber hoses must be EPDM type, listed to ASTM D3568-03 (§301.9.3)
- Solar trackers must be listed to UL 3703 (§303.2.3)
- Unpressurized tank venting with screens and relief valves (§301.4.2)
- Requirements to prevent ignition of combustible materials (§303.1.3)
- Requires all wiring and electrical components over 24V to comply with electrical codes (§303.2)
 - Pump listing
 - Differential controller listings

Backup Water Heater Requirements

301.1.4 Auxiliary heating equipment. ~~A backup system shall be provided such that the combined solar and backup system will provide the same degree of reliability and performance as a conventional nonsolar system. The backup system shall be sized to meet the design load without any solar contribution.~~ *Auxiliary heating equipment shall be compatible with the solar thermal system heat output, temperatures, flow rates and heat transfer fluid types. Auxiliary heating equipment shall be listed and labeled by a recognized third party listing agency.*

Implementing New Options for Backups in OG-300

- Solar-only (no-backup) systems can now be OG-300 certified
 - Codes in most locations in North America will require a backup water heater.
 - SRCC to include disclaimer on solar-only systems.
- Backup (auxiliary) water heaters are no longer required to meet the entire load.
- ENERGY STAR Certification not available for solar-only systems.
- New metric developed for solar-only: Fraction of Load Satisfied
- Solar-only option now being provided for OG-300 Puerto Rico Supplement on request

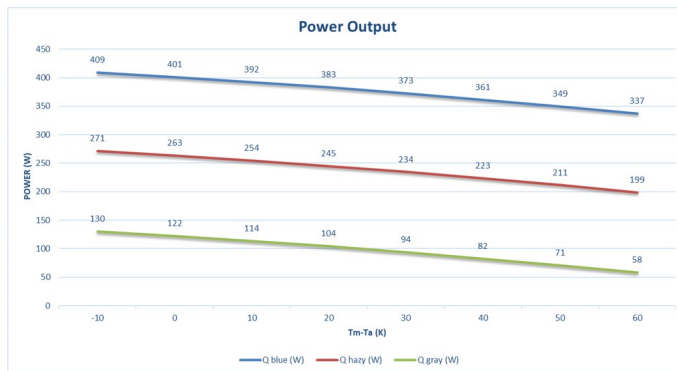
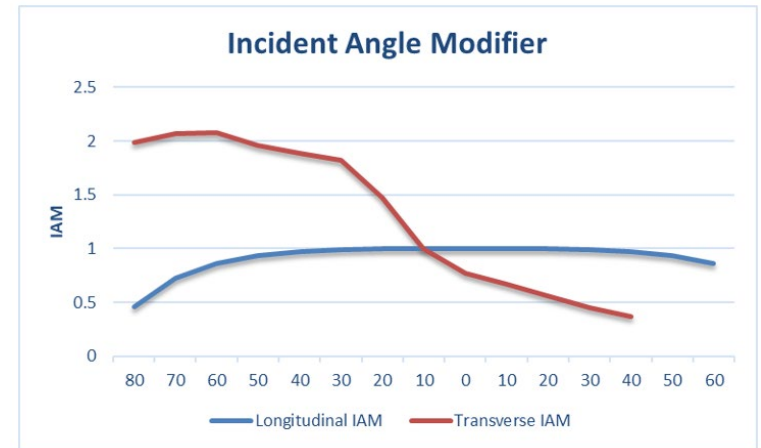


CAUTION – SOLAR WATER HEATING SYSTEMS WITHOUT A BACKUP HEATER MAY BE UNABLE TO MEET HOT WATER LOADS UNDER CERTAIN WEATHER AND USAGE CONDITIONS. THEY SHOULD NOT BE INSTALLED WHERE PROHIBITED BY LOCAL CODES.

MEASURED THERMAL PERFORMANCE RESULTS						
ISO Efficiency Equation: [Note: Based on gross area and P = T _m - T _a in accordance with ISO 9806-2017]						
Second Order Thermal Efficiency Equation ¹			Linearized Thermal Efficiency Equation ¹			
SI UNITS	$\eta_{0,hem} = 0.438 - 1.296(P/G) - 0.006(P^2/G)$		Y Intercept:	0.438	Slope:	-2.278
IP UNITS	$\eta_{0,hem} = 0.438 - 0.2284(P/G) - 0.00059(P^2/G)$		Y Intercept:	0.438	Slope:	-0.4022
¹ Second order thermal efficiency equation provided in accordance with ISO 9806-2013. The non-linear, second order efficiency equation should be considered to be a more accurate representation of the measured collector performance test results. The linearized efficiency equation is provided for use with incentive programs, regulations and software that require the "slope" and "intercept" terms to describe collector performance.						

COLLECTOR PERFORMANCE COEFFICIENTS												
	$\eta_{0,hem}$	$\eta_{0,b}$	K_{col}	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	C/A
Value	0.390	0.376	1.252	1.296	.006	0	0	1610	0	0	0	1610
Unit	-	-	-	W/(m²·K)	W/(m²·K)	W/(m²·K)	-	W/(m²·K)	m/s	m/s	W/(m²·K)	W/(m²·K)
Nominal flowrate during the Measurement m: 113 kg/h												

Incident Angle Modifier (IAM)																
θ	-80°	-70°	-60°	-50°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	50°	60°	70°
$K_{a0}(\theta, 0)$	0.46	0.72	0.86	0.93	0.97	0.99	1.0	1.00	1.00	1.00	1.00	0.99	0.97	0.93	0.86	0.0
$K_{a0}(\theta, \theta_t)$	1.00	1.99	2.07	2.08	1.96	1.89	1.82	1.47	1.00	0.77	0.67	0.56	0.45	0.37	0.0	0.0



New OG-100 Certificate Features

Based on ISO 9806-2017

Appendix A: Solar Uniform Energy Factor (SUEF)

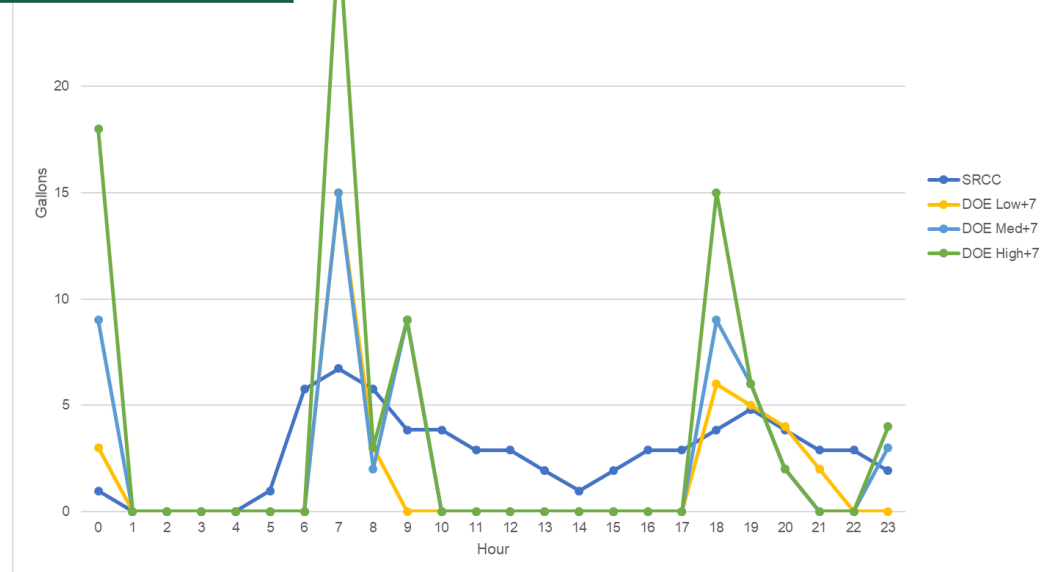
- New metric developed to replace the outdated Solar Energy Factor (SEF)
- DOE updated water heater efficiency tests in 2014 to move from Energy Factor (EF) to Uniform Energy Factor (UEF)
 - Metric to compare performance of gas, electric HP water heaters (not solar)
 - Calculated using data from First Hour and 24-hour Tests
 - Uses four different hot water draw patterns
- Stakeholder group worked with EPA to develop add-on specification to expand scope to include SWH
 - Adds basic system setup, irradiance and temperature profiles to 24-hour test
 - Selects draw pattern based on collector area
- SUEF results can be determined through testing with a solar simulator or modeling in TRNSYS software
- SUEF results can now be compared with UEF results for other water heaters

<https://solar-rating.org/icc-resources/suef/>

DOE 24-Hour Test Draw Patterns

DOE DRAW PATTERN	DAILY HOT WATER TOTAL
Very Small	10 gal (38 L)
Low	38 gal (144 L)
Medium	55 gal (208 L)
High	84 gal (318 L)

24-Hour Hot Water Draw Profile Comparison



ENERGY STAR® Adoption of SUEF

EPA released ENERGY STAR *Residential Water Heater Specification v4.0* adopting the SUEF metric

- As of July 26, all new ENERGY STAR certifications must comply with Version 4.0.
- Existing ENERGY STAR certifications must transition to Version 4.0 by January 5, 2022.
- SUEF modeling of current ENERGY STAR certs underway.

VERSION 3.2

Certification: OG-300

Performance:

SEF > 1.8 for electric backup

SEF > 1.2 for gas backup

VERSION 4.0

Certification: OG-300

Performance:

SUEF > 3.0 for electric backup

SUEF > 1.8 for gas backup

Warranty:

> 10 years for collector

> 6 years on sealed system

> 2 years on controls

> 1 year on piping & parts

<https://solar-rating.org/programs/icc-srcc-energy-star-residential-water-heater-certification-program/>



Reaffirmation of ICC 902/PHTA 902/SRCC 400

Reaffirmation of ICC 902/PHTA 902/SRCC 400

ICC 902/APSP 902/SRCC 400 *Solar Pool & Spa Heating System Standard*

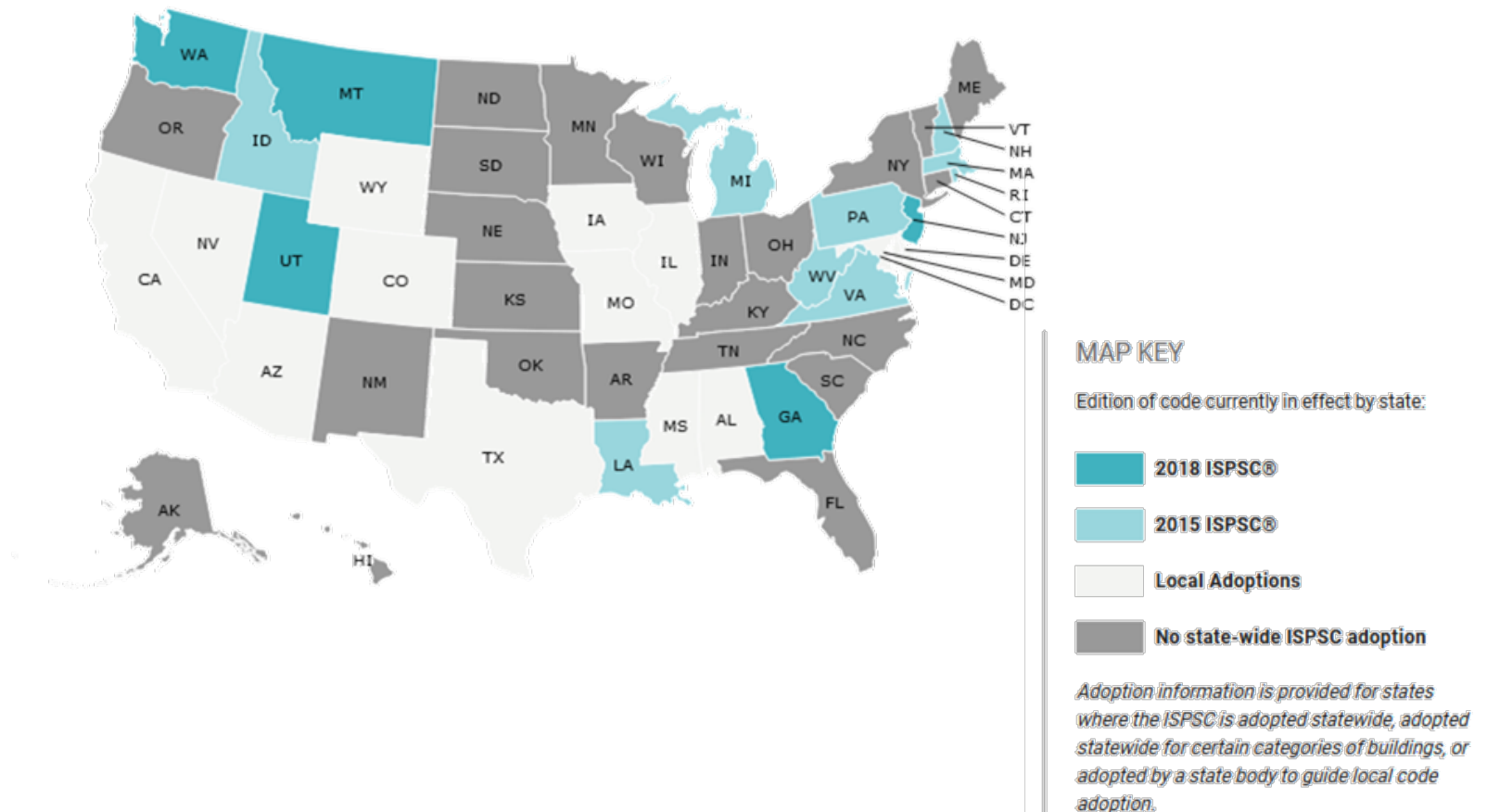
- First edition completed and approved in 2017
- Subsequently adopted into the *International Swimming Pool and Spa Code (ISPSC)*
- Implemented at the basis of the ICC-SRCC OG-400 certification program.
- Association of Pool & Spa Professionals (APSP) became the Pool & Hot Tub Alliance (PHTA)

Standard reaffirmed as ICC 902/PHTA 902/SRCC 400 – 2020 with no changes, except to reference the latest version of ICC 901/SRCC 100.



INTERNATIONAL SWIMMING POOL AND SPA CODE® (ISPSC®)

ADOPTION MAP



<https://codeadoptions.iccsafe.org/code-adoption-map/ISPSC>

Conclusion

- ICC-SRCC is implementing the 2020 editions of the ICC/SRCC standards for all new applications starting 7/1/2021
 - Existing certifications may be upgraded but will not be required in 2021.
- ISO 9806-2017 test methods, performance metrics and data reporting adopted
 - Closer testing alignment with Solar Keymark (impact, pressure drop testing)
- Many enhancements, especially for PVTs, concentrating and SAH collectors.
- New options for system designers with new backup water heater requirements.
- SUEF specification has replaced SEF for use in ENERGY STAR certification

New Services ICC-SRCC Services Referenced Include:

- Listing to Mexican NORMEX standards
- Listing to CSA F378 and F379 standards
- Solar-only OG-300 certifications
- OG-300 Puerto Rico Supplements for use in R3 program
- Certification to ENERGY STAR v4.0 Specification using SUEF
- Certification updates from 2015 to 2020 standards for existing certifications.

HOW TO CONTACT US

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