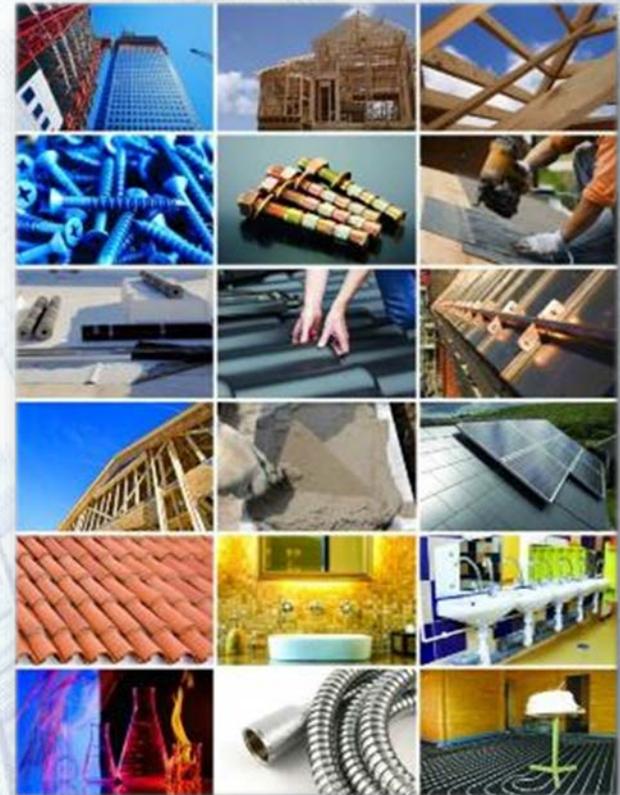


Evolution of solar thermal requirements in building codes

ICC-SRCC Webinar
January 30, 2019



Disclaimer



This presentation is to be used in conjunction with the referenced codes and not as a substitute for the full code. **The presentation is advisory only;** the code official alone possesses the authority and responsibility for interpreting the code.

Referenced code sections should be considered in context and along with other relevant code provisions.

See the References at the end of the presentation for information on copyrights, trademarks and promulgators of the codes and standards mentioned.

Presenter



Shawn Martin is a mechanical engineer currently serving as ICC-SRCC's VP of Technical Services. He was previously the ICC PMG Director, and moved to SRCC in 2015.

He has experience in code and standard development, product certification and testing, sustainable construction, compliance assessment, product design and development and technology commercialization.



What is ICC-ES?



- ICC-ES evaluates products using codes and standards for the built environment.
 - **ICC-SRCC is a program of ICC-ES**
- Accredited by ANSI to the requirements of ISO/IEC 17065
- Accredited by the Standards Council of Canada (SCC)
- Accredited by EMA in Mexico
- A subsidiary of the International Code Council
- An organization with a dedicated staff of:
 - Licensed Professional Engineers
 - Licensed Architects
 - Evaluation Specialists

Webinar Topics



This webinar will provide an overview of the codes that impact the solar heating and cooling industry across the U.S.

1. Introduction to U.S. Codes
2. Solar Standards in the Codes
3. Supporting Code Provisions
4. Differences between Codes & Standards
5. Compliance Assessment
6. Q&A



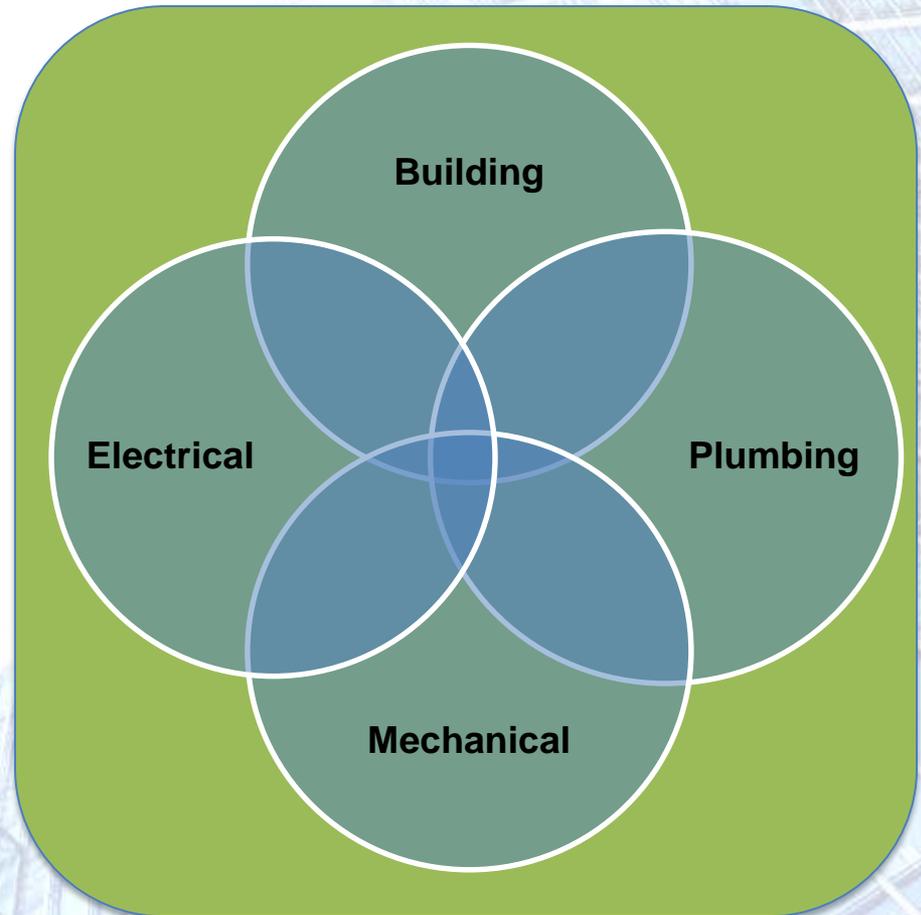
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1. INTRODUCTION TO U.S. CODES

What are Building Codes?

Collection of laws, regulations, ordinances (or other statutory requirements) adopted by a government legislative authority involved with the physical structure and healthful conditions of buildings and building sites.



Core Family of Building Codes

Why Building Codes?

Provide minimum requirements to protect:

- Health
- Safety
- General Welfare

of occupants and the public in new & existing buildings & structures.



Flavors of “THE BUILDING CODE”



- Building Codes
- Residential Codes
- Fire Code
- Electrical Code
- Plumbing Code
- Mechanical Code
- Fuel Gas Code
- Energy & Green Codes
- Swimming Pool Codes



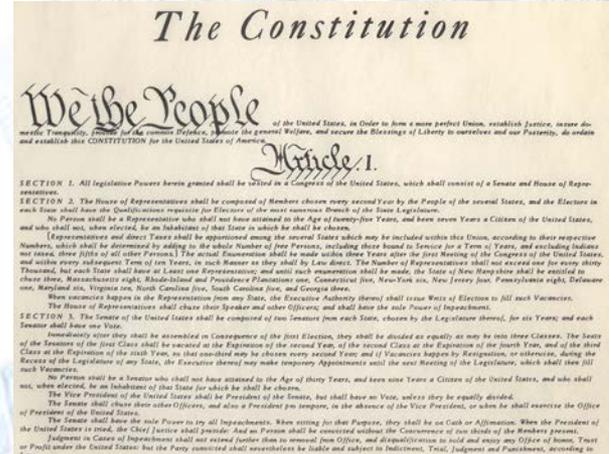
Layering of the Codes



Who is Responsible for Building Codes in the U.S.?



Simply put –
the states.



In the United States, the power to regulate the safety of buildings is not delegated to the Federal government in the Constitution, therefore that power is reserved by the states, through the 10th Amendment to the Constitution.

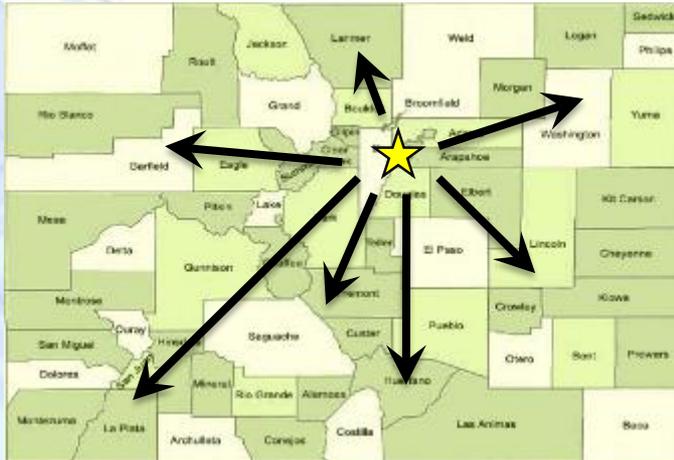
What is a model code?

- Codes developed by an organization for use by jurisdictions.
- Updated through open [consensus](#) processes.
 - Draw on expertise from around the country and world.
 - Open any participant
 - Most updated on three year schedules.
- Not in force until adopted.

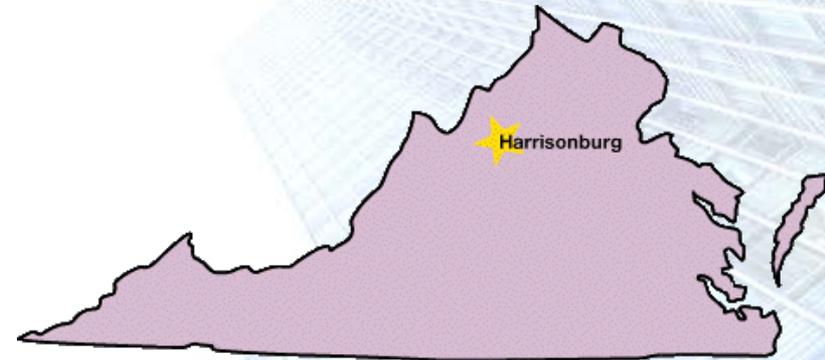


Adopting a Model Code Locally

COLORADO



VIRGINIA



Individual states either adopt a state plumbing code or delegate the responsibility downward.

- No two states are alike
- Can be pre-empted and delegated
- 40,000+ political subdivisions enforce codes

Example: Florida's Codes



Local Jurisdictions...	
• required to adopt state code?	Yes
• required to enforce state code?	Yes
• permitted to amend state code?	Very Limited
• have major cities exempted from the state code?	No

Model Codes in U.S.



CODE DEVELOPER**	CODE TYPE								
	Building	Plumbing	Fuel Gas	Mechanical	Fire	Swimming Pool	Electrical	Energy Efficiency	Solar
ICC	<u>IBC</u> <u>IRC</u>	<u>IPC</u>	<u>IFGC</u>	<u>IMC</u>	<u>IFC</u>	<u>ISPSC</u>	-	<u>IECC</u>	<u>ISEP*</u>
NFPA	-	-	-	-	NFPA 1	-	NFPA 70 (NEC)	-	-
IAPMO	-	UPC		UMC	-	USPHTC	-	-	USEHC
ASHRAE	-	-	-	-	-	-	-	90.1	-

* ICC does not produce a dedicated solar code, but solar is covered throughout the I-codes. The ISEP is a compendium of these provisions.

** See References at the end of this presentation for more information on acronyms, promulgators, trademarks and copyrights.

What is Used Where? (the easy ones)



In use or adopted in...

- IBC: 50 states, the District of Columbia, the U.S. Virgin Islands, Guam and the Northern Marianas Islands.
- IRC: 49 states, the District of Columbia and the U.S. Virgin Islands.
- NEC: 50 states.

Tip: See the Government Relations Page on the ICCSafe.org website for the [latest code adoption](#) information.

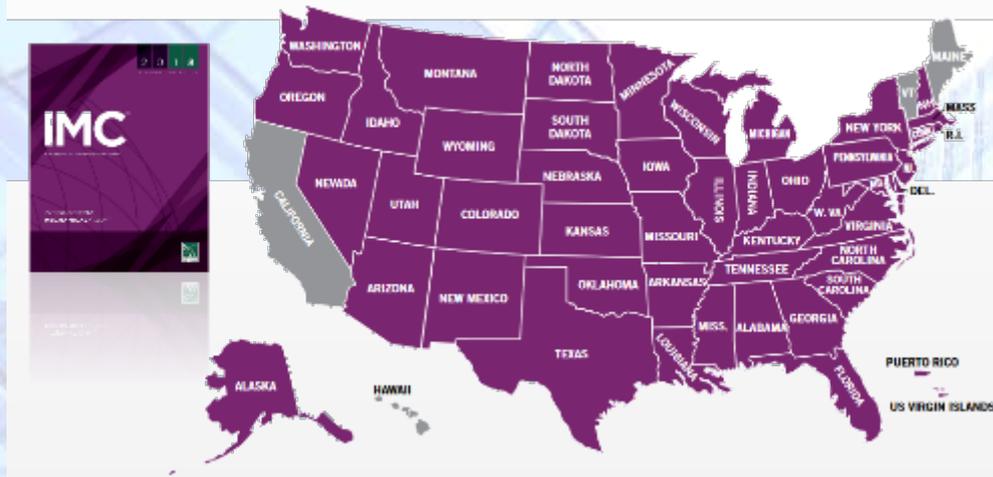
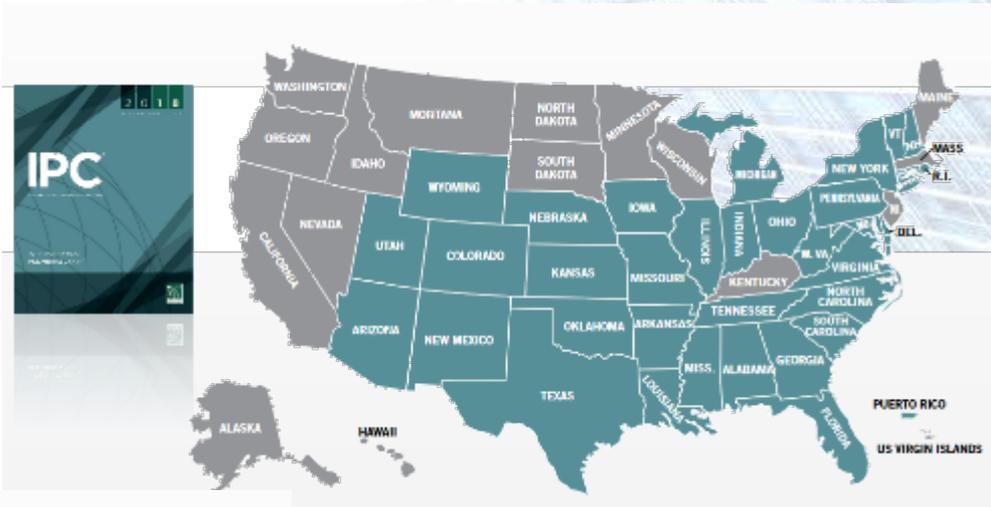
www.iccsafe.org/about-icc/government-relations/



What is Used Where? (the more complicated ones)



The IPC is in use or adopted in 35 states, the District of Columbia, Guam, and Puerto Rico.



The IMC is in use or adopted in 46 states, the District of Columbia, Guam, Puerto Rico and the U.S. Virgin Islands.

USEC/USEHC Adoptions



The USEC or USEHC is in use or adopted in 7 states*, most notably the City of Los Angeles.

** Note that adoption information is not published by the code promulgator. The information above represents the best available information at the time collected from various public sources.*

Code Language & Structure

Organizational hierarchy:

CHAPTER 6: WATER SUPPLY AND DISTRIBUTION

SECTION 605: MATERIALS, JOINTS & CONNECTIONS

605.6: Flexible water connectors.



605.6 Flexible water connectors. Flexible water connectors exposed to continuous pressure shall conform to ASME A112.18.6. Access shall be provided to all flexible water connectors.

Unambiguous language

Referenced standard:

ASME A112.18.6—2003

Flexible Water Connectors

Defined term:

ACCESS (TO). That which enables a fixture, 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 “Ready access”).



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ICC
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2. SOLAR STANDARDS IN CODES

Solar Heating & Cooling Standards



Recent Evolution of SRCC Standards & Codes



SRCC OG-100 split

2015 IRC references SRCC 100 & 300

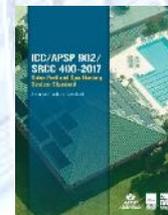
2018 IBC, IMC, IPC, ISPSC references SRCC 100 & 300



ANSI approves new Standard 100 & 300



ANSI approves new Standard 400



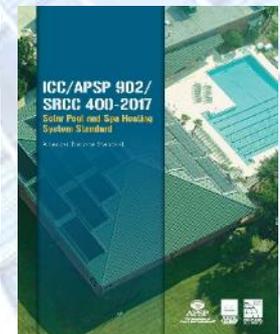
2021 ISPSC references SRCC 400

SRCC Standard References in Codes



STANDARD	IBC	IRC	IPC	IMC	ISPSC	USEHC
<u>ICC 901/SRCC 100</u>	●	●	●	●	●	●
<u>ICC 900/SRCC 300</u>	●	●	●	●		●
<u>ICC 902/APSP 902/SRCC 400</u>					○	

○ Note: SRCC 400 will be referenced in the 2021 ISPSC (not yet available)



SHC in the 2018 I-Codes: Commercial Systems

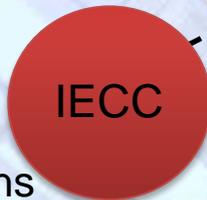
- Pool energy use
- Pool heaters



- Potable Water
- Piping & Fittings
- Backflow
- Contamination
- Relief valves



- Detailed design & installation provisions



- HVAC efficiency
- Efficiency compliance options
- Pool/spa efficiency
- Solar-Ready Homes Appendix

- Special Construction
- Roof coverings
- Structural
- Fire & Plastics



- Heat transfer fluids
- Roof access

2018 IBC & IRC: Key Requirements



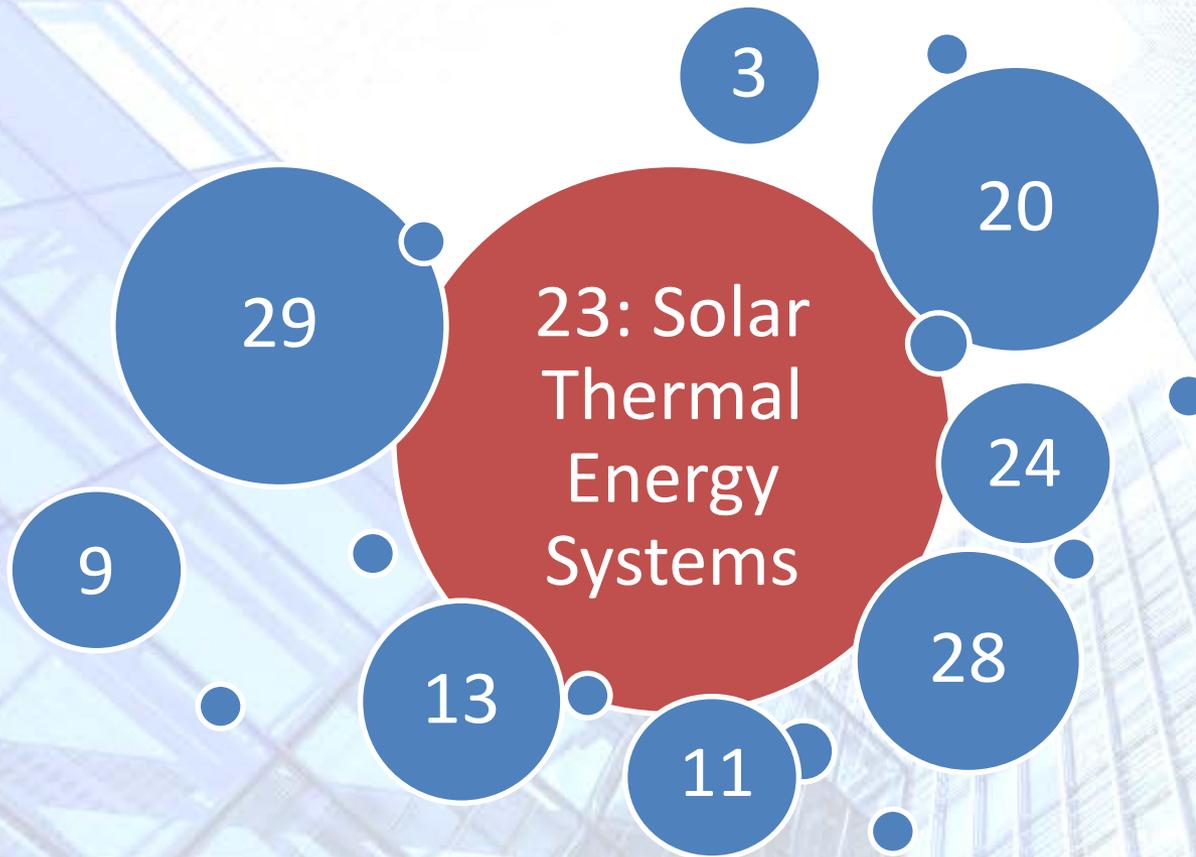
IBC 3111.2 Solar thermal systems. Solar thermal systems shall be designed and installed in accordance with Section 2606.12, the *International Plumbing Code*, the *International Mechanical Code* and the *International Fire Code*.

3111.2.1 Equipment. Solar thermal systems and components shall be *listed* and *labeled* in accordance with ICC 900/SRCC 300 and ICC 901/SRCC 100.

IRC SECTION M2005 WATER HEATERS

M2005.1 General. Water heaters shall be installed in accordance with 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 M1305.1.2. Solar thermal water heating systems shall comply with Chapter 23 and SRCC 300.

SHC in the 2018 I-Codes: Residential



IRC Chapters

3: Building Planning

9: Roof Assemblies

11: [RE] Energy Efficiency

13: General Mechanical System Requirements

20: Boilers & Water Heaters

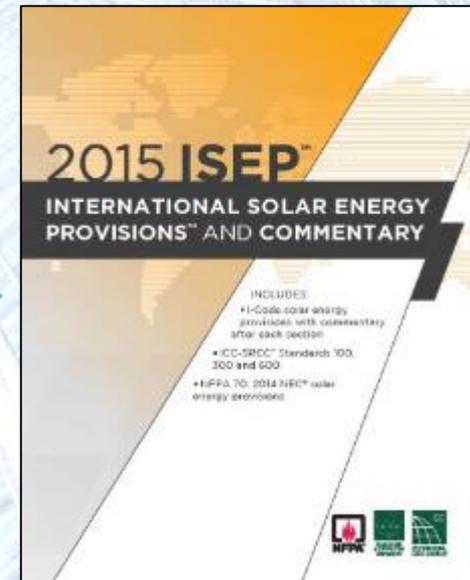
24: Fuel Gas

28: Water Heaters

29: Water Supply & Distribution

Part VIII - Electrical

Solar Code Resources: ISEP





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3. SUPPORTING CODE PROVISIONS

Codes primarily rely on the SRCC reference standards to set requirements for solar thermal collectors and systems.

SRCC standards have been carefully coordinated with the I-Codes.

- BUT-

- There are additional requirements and exceptions in many codes.
- Solar systems must meet all applicable requirements in force in a given jurisdiction.

**IMPORTANT
NOTICE**

Consistency – Codes & Standards



Various codes and the SRCC standards largely agree for topics such as:

- Temperature control & protection
- Cross-connection control
- Freeze protection
- Component listings
- Pipe insulation
- Protection of equipment & structure
- Fluid safety

**SO WHY ARE
THERE
DIFFERENCES?**

Supporting Code Provisions



301.3 Water heating equipment and storage tanks. Water heating equipment and *storage tanks* shall comply with Sections 301.3.1 through 301.3.3 and shall comply with the plumbing code and mechanical code adopted by the authority having jurisdiction, or, in the absence of such code, the *International Plumbing Code*® and *International Mechanical Code*®.

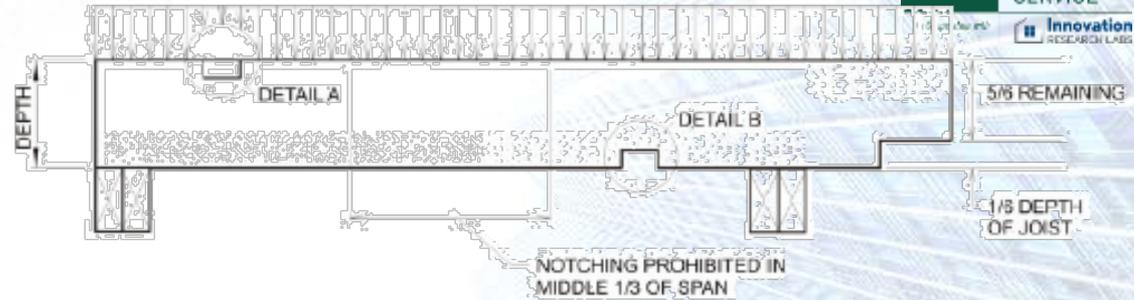


Standard 300 can't do it all....

- Protection of structure (notching/boring)
- Water contamination (materials, cross connection, backflow)
- Gas/Water piping (materials, support, insulation, firestopping, penetrations, protection, fittings)
- Auxiliary water heater installation (venting, support, leak prevention,)
- Installation (access, fall prevention)
- Fire classification
- Wind resistance

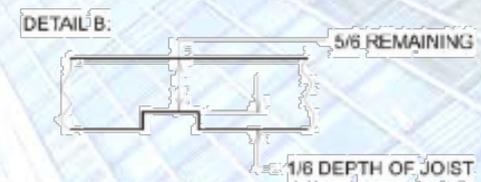
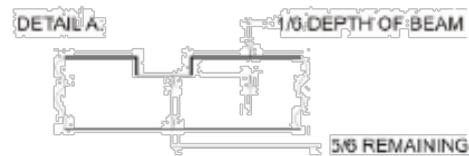
Example: Wood Framing Notching and Boring - Joists

Figure 1: Limitations for Cutting, Notching and Bored Holes

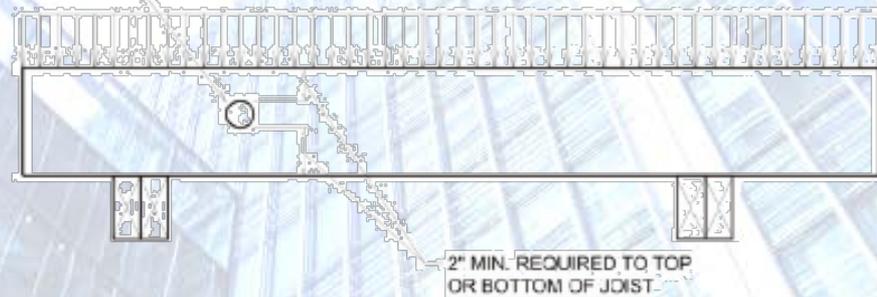


IMC 302.3

- Holes $\geq 2"$ of the top or bottom of the wood joist.
- Other requirements for vertical studs, steel framing, trusses.



MAXIMUM DIAMETER OF HOLES IS 1/3 DEPTH OF JOIST

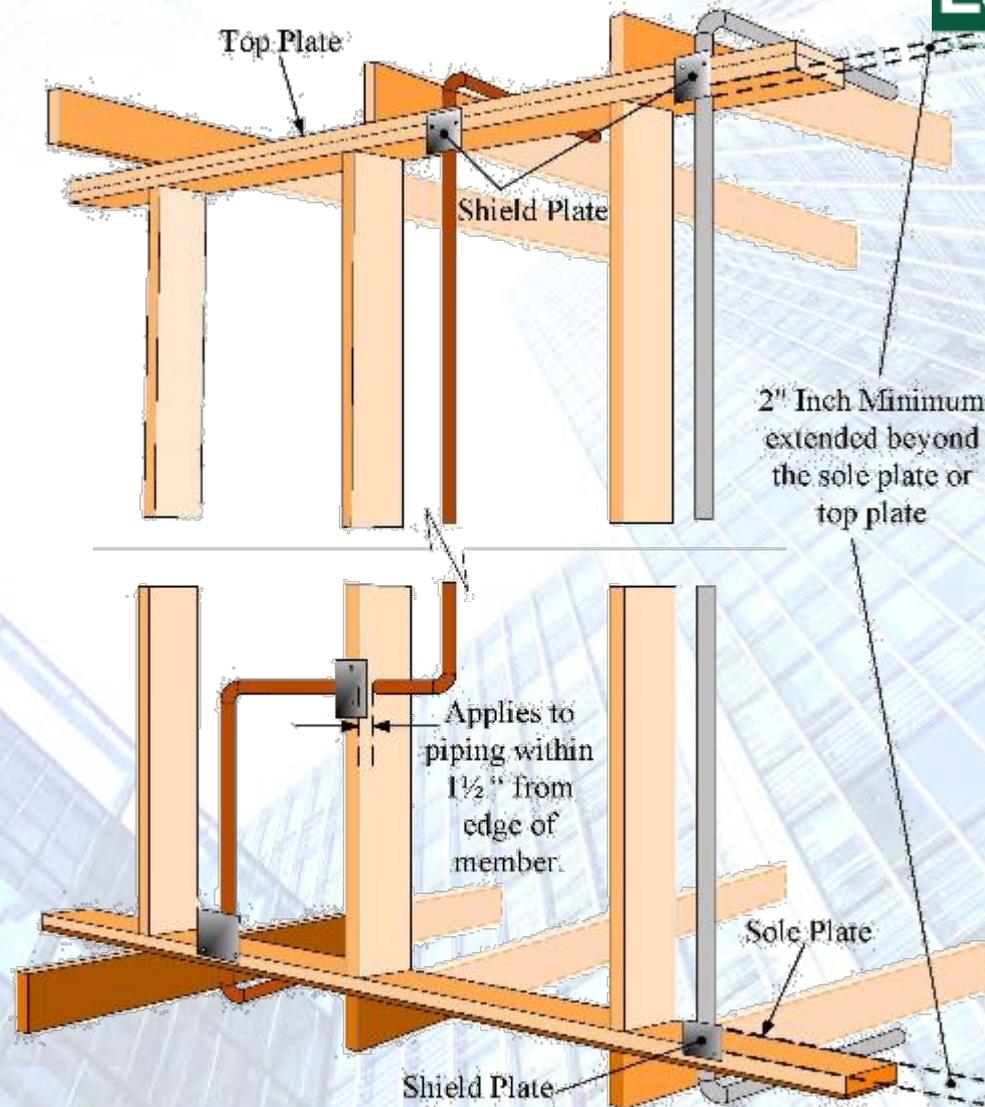


For SI: 1 inch = 25.4 mm

Example: Protection & Shielding of Piping

IMC 305.5

- Shield plates
- Extension past framing members



Example: Roofing Penetrations

IMC 1402.6

IRC M2301.2.9

IBC 1503

- Weatherproofing
- Rodents/insects
- Structural integrity
- Maintain fire rating



IMC 1402.6 Penetrations. Roof and wall penetrations shall be flashed and sealed to prevent entry of water, rodents & insects.

Example: Temperature and Pressure Relief Discharge Piping

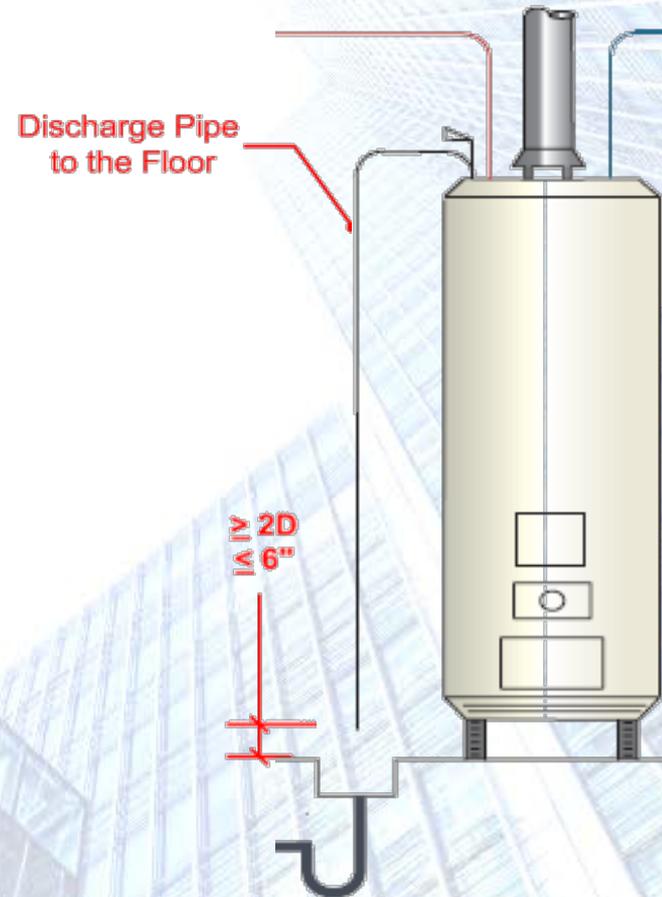
IPC 504.6

Relief valve discharge pipe termination must have a suitable air gap

- Previously only limited the maximum height to 6"
- Now also limits the minimum height to $> 2XD$ off the floor or waste receptor flood level rim

IMC 1006.6

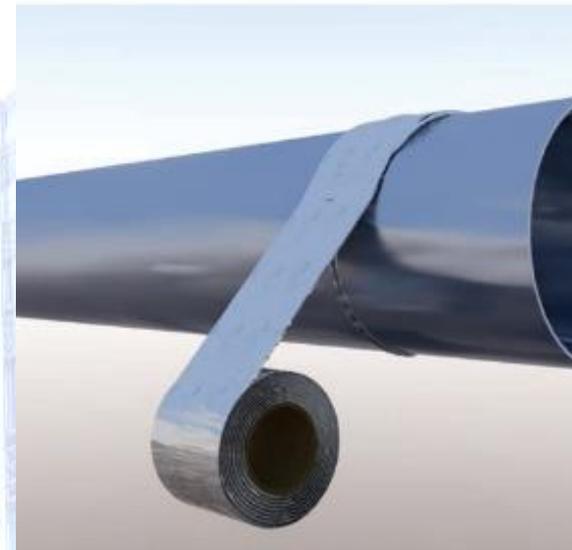
- Discharge may not be "a hazard or potential cause of damage"



Example: Duct Joints, Seams & Connections

IMC 603.9

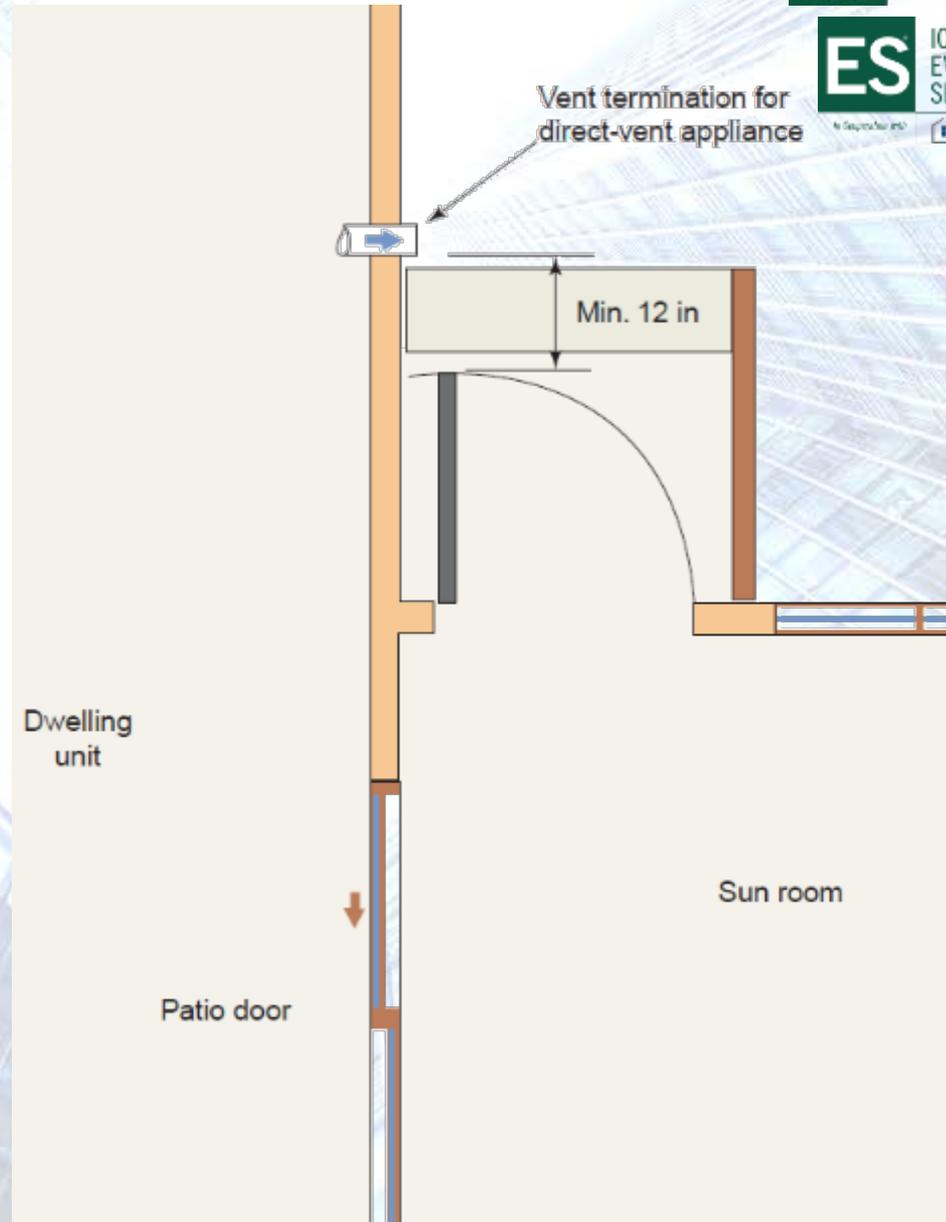
- Duct sealant tapes used on sheet-metal ducts must be listed to UL 181B as is required for sealing tapes and mastics for flexible ducts.
- Snap-lock and button-lock seams are no longer exempt from the sealing requirements.



Example: Door Clearance to Vent Terminals

IMC 502.7.1

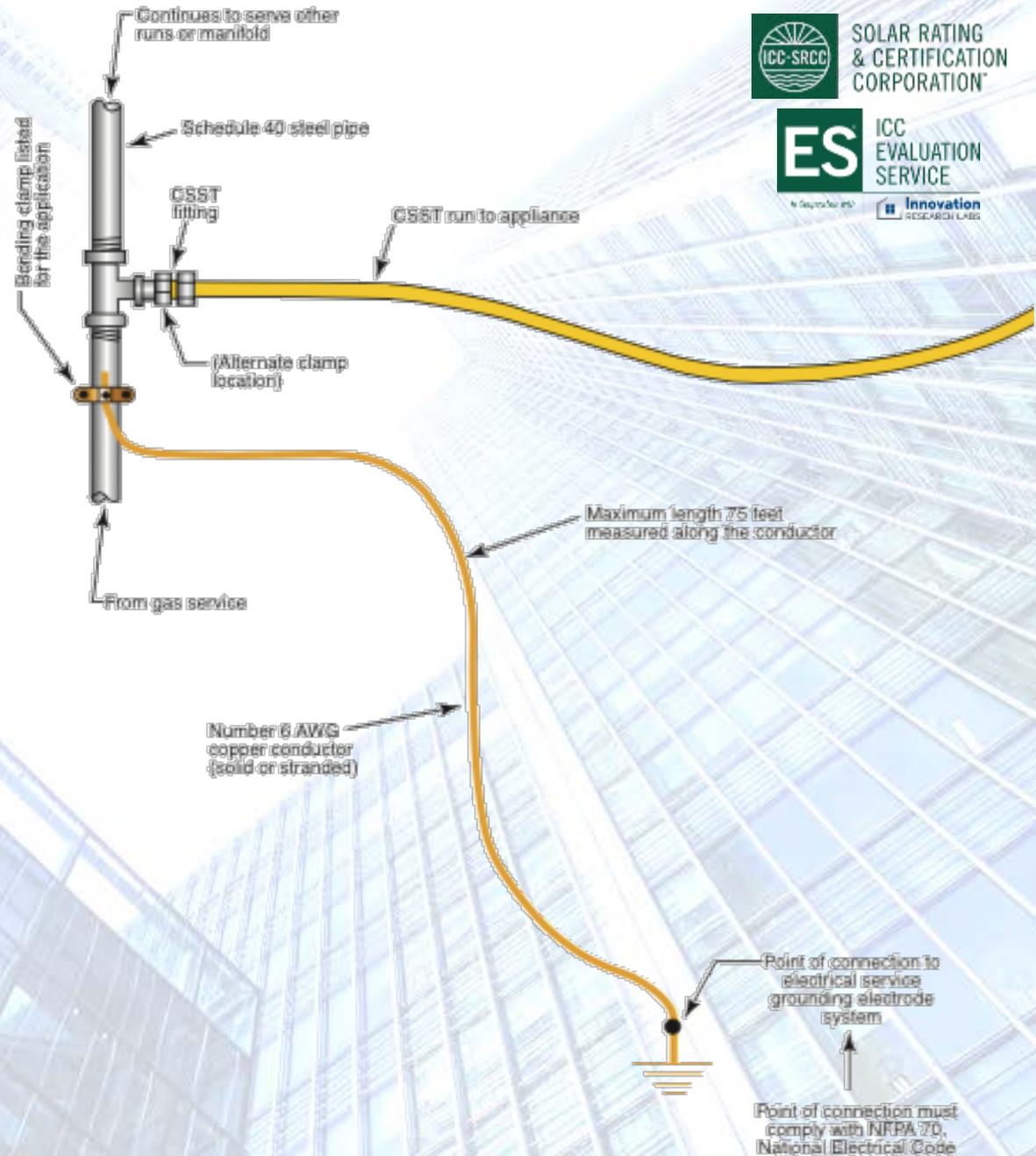
- Prohibits the installation of appliance equipment vent terminals within 12" of door swings
- Could damage device and cause a fire hazard, or combustion gas hazard.



Example: Electrical Bonding of Corrugated Stainless Steel Gas Tubing

IFGC 310.1.1

- Addresses safety of bonding and grounding for CSST
- Increased length means increased electrical impedance.
- Independent grounding electrodes are prohibited.
- Supplemental grounding electrodes must be grounded to electrical service per NFPA 70
- Points of connection to the pipe and electrical service must be in accordance with NFPA 70



Water Contamination: Leaching

- Materials in contact with water can release chemicals and compounds into that water leading to contamination.
- Codes rely on established standards that set out tests for products in contact with water.
- Application for water heaters is tricky.
 - Difference between “potable water” and “drinking water”
 - Approved materials instead of testing



NSF 61 in Plumbing Codes

- NSF 61 standard is cited in the IPC for components supplying drinking water to prevent contamination.
- Plumbing codes require NSF 61 compliance for (2018 IPC sections shown):



Faucets & fixture fittings (424.1)	Ball, gate, globe valves (605.7)
Water service pipe (605.3)	DWTU tubing (611.3)
Distribution pipe (605.4)	Fountains & coolers (410.1)
Pipe fittings (605.5)	

Note: Water heaters are not specifically required to be listed and labelled to NSF 61 in current model plumbing codes.

Lead in Plumbing Codes

IPC Section 605.2

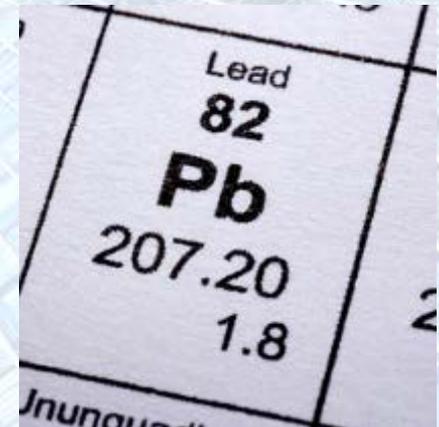
- Previous section on 8% lead remains.

IPC 605.2 Lead content of water supply pipe and fittings. Pipe and pipe fittings, including valves and faucets, utilized in the water supply system shall have a maximum of 8-percent lead content.

- Section added in 2015 to address Federal Reduction of Lead in Drinking Water Act:

IPC 605.2.1 Lead content of drinking water pipe and fittings. Pipe, pipe fittings, joints, valves, faucets, and fixture fittings utilized to supply water for drinking or cooking purposes shall comply with NSF 372 and shall have a weighted average lead content of 0.25 percent lead or less.

- Some states have additional requirements.



Fire Resistance



IBC Section 1505

addresses fire classifications for roof assemblies and structures.

But, NO specific provisions for solar thermal in Chapter 15.

IBC Chapter 26

However, there is some language in the chapter on plastics that does provide some guidance for roof-mounted solar thermal collectors

2606.12 Solar collectors.

Light-transmitting plastic covers on solar collectors having noncombustible sides and bottoms shall be permitted on buildings not over three stories above grade plane or 9,000 square feet (836.1 m²) in total floor area, provided that the light-transmitting plastic cover does not exceed 33.33 percent of the roof area for CC1 materials or 25 percent of the roof area for CC2 materials.

Fire Resistance: CC1 & CC2



Light Transmitting Plastics

IBC 2606.4 Specs

Self-ignition: $\geq 650^{\circ}\text{F}$ (343°C) per ASTM D1929, and

Smoke development: ≤ 450

Per ASTM E84 or UL 723, or

Max ave. smoke density: ≤ 75 per ASTM D2843, and

Compliance with CC1 or CC2

Class CC1: Plastic materials that have a burning extent of 1 inch (25 mm) or less where tested at a nominal thickness of 0.060 inch (1.5 mm), or in the thickness intended for use, in accordance with ASTM D635.

Class CC2: Plastic materials that have a burning rate of 2 1/2 inches per minute (1.06 mm/s) or less where tested at a nominal thickness of 0.060 inch (1.5 mm), or in the thickness intended for use, in accordance with ASTM D635.

So what happens?



Without specific, comprehensive guidance, code officials can interpret the code various ways:

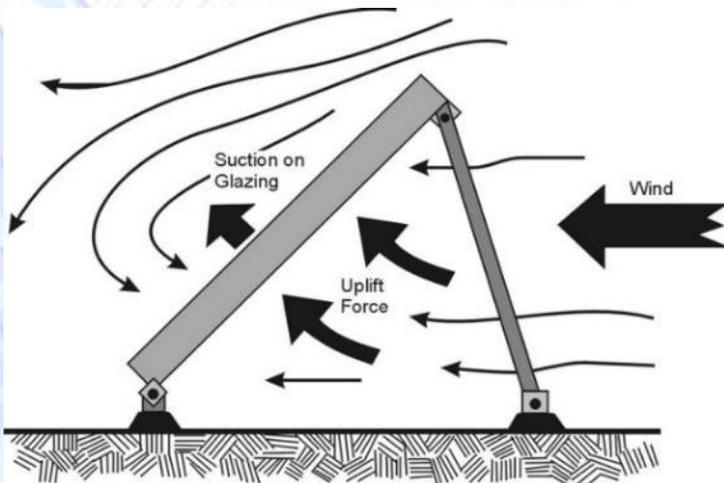
- Require collectors to meet PV fire classifications/methods,
- Require all collectors to meet Chapter 26,
- Skip since they are not addressed in code or are materials are non-combustible,
- Others?

Rooftop Structural

IBC Chapter 16

Addresses structural requirements

- But, NO specific provisions for solar thermal in Chapter 16.
- No specific racking standards for solar thermal
- Structures must meet load requirements in ASCE 7
 - Includes dead loads and live load combinations wind, seismic, and snow.
 - ASCE 7-2016 revises wind requirements for PV & solar thermal



Compliance often demonstrated through stamped designs and structural analyses, testing and/or ICC-ES Evaluation Reports (ES-Rs)



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4. DIFFERENCES BETWEEN CODES & STANDARDS

Codes primarily rely on the SRCC reference standards to set requirements for solar thermal collectors and systems.

SRCC standards have been carefully coordinated with the I-Codes.

- BUT-

- There are additional requirements and exceptions in most codes.
- Solar thermal systems must meet all applicable requirements in force in a given jurisdiction.

City of LA Differences



The City of Los Angeles amends the CA Plumbing Code in several ways including requiring compliance with several unique standards (in addition to requiring SRCC Standard 100 and 300 compliance through the USEC).



IAPMO PS 92-2010 <i>Material & Property Standard for Heat Exchangers and Indirect Water Heaters.</i>	Heat exchangers
IAPMO PS 96-2002 <i>Passive Direct Solar Water Heaters</i>	Passive Direct (thermosiphon) systems

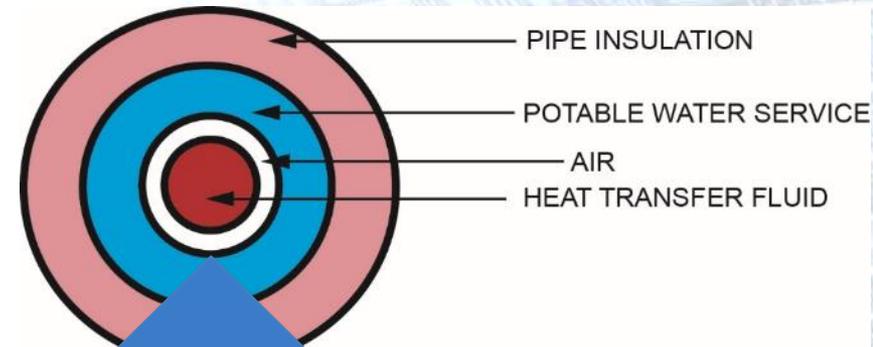
[View Roster of Approved Mechanical Testing Agencies \(pdf\)](#)

Heat Exchanger Cross-Connection Control



IPC 608.16.3 SRCC 300

- Double-wall heat exchangers required for toxic heat transfer fluids.
- SRCC 300 adds discharge to daylight requirement



SRCC 300: "...discharge of exchanger fluid and/or potable water to the atmosphere at a location visible to the operator or owner."

IRC & IMC: Heat Transfer Fluids

2018 IMC SRCC 300

- Double-wall Hx for *non-food grade fluids*
- Single-wall Hx permitted for *food-grade fluids*.
- Flammable, combustible, hazardous fluids must comply with the IFC

FOOD GRADE FLUID.

Potable water or a fluid additive listed in accordance with the CFR Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Parts 174–186.

2018 IRC

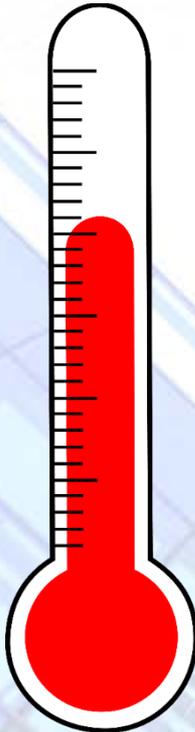
- No *essentially toxic transfer fluids*, ethylene glycol, flammable fluids
- Flash point $\geq 50^{\circ}\text{F}$ (28°C) above the design maximum nonoperating or no-flow temperature.

ESSENTIALLY TOXIC TRANSFER FLUIDS.

Soil, water or gray water and fluids having a Gosselin rating of 2 or more including ethylene glycol, hydrocarbon oils, ammonia refrigerants and hydrazine.



IRC: Maximum Temperature



2018 IRC 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 M2301.2.3



5. COMPLIANCE ASSESSMENT

Compliance Assessment

- Demonstrating compliance with the applicable codes to plan checkers/inspectors/code officials.
- Two levels
 - Certifications: Compliance with standards referenced by codes (required per listing & labeling)
 - Code Listings: Compliance with standards referenced by codes and additional code requirements (optional)



Listing & Labeling



LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the *building 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.

ICC 901/SRCC 100
ICC 900/SRCC 300
ICC 902/SRCC 400

LABELED. Equipment, materials or products to which has been affixed a *label*, seal, symbol or other identifying *mark* of a nationally recognized testing laboratory, *approved* 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.



Third-Party Certification



Third-Party certification to the reference standards for collectors and systems is required by plumbing codes.

IPC 303.4 Third-party certification. All plumbing products and materials shall be *listed* by a *third-party certification agency* as complying with the referenced standards. Products and materials shall be identified in accordance with Section 303.1.

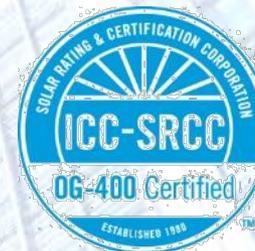
THIRD-PARTY CERTIFICATION AGENCY.

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.

Product Labeling & Certificates



- Label product as required by the certifier.
- Certificate awarded providing evidence of certification, scope, and conditions of listing.
- Online directory available from most certifiers, and code officials consult the directory to ensure certifications are active.



Listings



- Listings are a tool to help demonstrate compliance with selected code(s) or standards.
 - Mfg selects specific codes & standards and products to be included.
 - Listing agency confirms compliance with relevant requirements
- NOT required by jurisdictions – but can be a very effective way to streamline approval in the field.

Certification Bodies (CBs)

- Select a certification body that is accepted by the jurisdiction.
 - Most recognize third-party agencies, accredited to ISO/IEC 17065
 - Some jurisdictions require that certification/listing providers be pre-approved (e.g. City of LA)
- Listings do NOT need to be provided by the organization who wrote the code.

Surveillance



- Both the codes and ISO/IEC 17065 require surveillance of production facilities for certified/listed products.
 - Ensures that the mfg can and does produce products that match the original submitted for certification.
- Certification bodies differ in the details but most require:
 - Periodic review and renewal
 - Qualifying inspection of production facilities and periodic surveillance inspections.

ICC-SRCC Services



- [OG-100](#), [300](#), [400](#) certification programs demonstrate compliance to SRCC standards
- [Listings](#) for all model codes and several additional standards.
 - IPC, IMC, IRC, IBC, UPC, UMC, USEC, NSF 50, PS 92, PS 96, Low-Lead and more...
- Accredited to ISO/IEC 17065
 - Scope: solar heating & cooling products
 - [Approved by City of LA](#)
 - [GSCN member](#)

Additional Resources

- [ICC Public Access](#)
 - [International Solar Energy Provisions \(ISEP\)](#)
 - [SRCC Standards Online](#)
- [ICC Government Relations](#)
 - [State Adoption Chart](#)
 - [International Adoptions](#)
 - [Code Adoption Maps](#)
- [ICC-SRCC Code Listings](#)
 - [Directory](#)
 - [Program](#) Info and FAQ



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Please enter your questions in the chat box.
If we run out of time, we will follow up individually.
You can also contact the presenter after the webinar at
smartin@solar-rating.org

6. QUESTIONS



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Thank you!

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