2026

IAPMO HEADQUARTERS | ONTARIO, CALIFORNIA | MAY 12

USHGC® TECHNICAL COMMITTEE MEETING MONOGRAPH

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2026 Uniform Solar, Hydronics & Geothermal Code
Technical Committee Meeting
IAPMO World Headquarters, Ontario, CA
May 12, 2026

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Issued: October 2023

IAPMO Group Event Code of Conduct

The IAPMO Group, together with their respective subsidiaries and affiliates (collectively IAPMO) hold events to encourage the open exchange of ideas and to support professional development and personal growth. IAPMO believes that ensuring a wide, diverse range of voices that fully represent the diversity of the people it serves is essential to a thoughtful, robust conversation and better decision-making and policy-setting.

IAPMO is committed to creating and maintaining an engaging and productive conference, meeting, education session, and event environment in which all individuals are treated with respect and dignity. One that is welcoming and free from any form of harassment or other discrimination regardless of gender, gender identity and expression, age, sexual orientation, alienage or citizenship status, physical or mental ability, color, physical appearance, body size, race, ethnicity, national origin, marital status or partnership status, pregnancy or lactation status, religion or creed, status as a veteran or active military service member or any other basis protected by U.S. federal, state, or local laws.

This Conference, Meeting and Event Code of Conduct ("Event Code of Conduct") guides everyone who participates in or attends IAPMO conferences, meetings, education sessions or other sponsored events ("Events"), including members, non-members, employees, speakers, students, sponsors, vendors, contractors, volunteers, and other guests ("Attendees").

IAPMO wants to ensure that all Attendees understand what behavior is expected and what behavior will not be tolerated at an IAPMO Event. The facilities covered by this Event Code of Conduct include any venue, hotel, meeting room, or IAPMO office location where an IAPMO Event takes place, as well as off-site locations where Event-related social gatherings take place.

I. <u>Expected Conduct</u>

Attendees shall:

a. Be mindful of your surroundings and of your fellow participants;
b. Be considerate and respectful to each other;
c. Exercise consideration in your speech and actions;
d. Refrain from harassing, discriminatory or demeaning conduct;
e. Alert IAPMO's Chief Administrative Officer or Legal Department if they observe any conduct that violates this Event Code of Conduct;
f. Comply with all rules, policies, and procedures of the facilities at which any Event is being held; and
g. Comply with all applicable laws and regulations in the state where the Event is being held.

II. <u>Unacceptable Behavior</u>

Harassment, bullying, microaggressions, intimidation, and/or insinuations that are hurtful or interfere with any other attendee's experience or participation are unacceptable behaviors. Examples of unacceptable behavior include but are not limited to the following:

a. Demeaning, discriminatory, or harassing behavior or speech, including but not limited to personal insults, sexist, racist, homophobic, transphobic, ageist or ableist language or any language that insults or demeans the characteristics of a person protected under U.S. federal, state, or local law.

b. Inappropriate physical contact: An Attendee should have another Attendee's consent before touching them.
c. Alternative language: Unwelcome and uninvited attention or contact with another attendee/ participant.
d. Language that implies exclusion or derogation of a person based on the person's immutable characteristic; for example, asking a participant where they are "really from"; assuming a person's spouse or partner is of the opposite gender; deliberately using the wrong pronoun to refer to an individual.
e. Unwelcome sexual attention, including sexualized comments or jokes, inappropriate touching, groping, or sexual advances.
f. Deliberate intimidation, stalking or following.
g. Sustained disruption, including during talks and presentations.
h. Displaying sexually explicit or violent material including in presented materials (e.g. slides, presentations, talks) or in informal settings or on personal devices (e.g. on a phone).
i. Violence, threats of violence, or violent language directed against another person or group.
j. Possession of dangerous or unauthorized materials such as explosives, firearms, weapons or similar items.
k. Bullying, including repeated verbal abuse; verbal, non-verbal or physical conduct of a threatening, intimidating, or humiliating nature; or the sabotage or undermining of a person's performance.
l. Theft or inappropriate removal or possession of property.
m. Use, distribution, sale, or transfer of illegal drugs.
n. Any other illegal activity or forms of harassment not covered above.

IAPMO reserves the right in its sole discretion to determine what constitutes unacceptable behavior and what actions it will take to address incidents that occur.

Consequences of Unacceptable Behavior

Unacceptable behavior will not be tolerated at IAPMO-sponsored events. Anyone asked by an IAPMO staff member or affiliate to stop engaging in unacceptable behavior is expected to comply immediately. If a participant engages in unacceptable behavior or fails to comply with expected behavior at any time during the sponsored event, IAPMO may take any action it deems appropriate, including but not limited to removing the participant from the event without a refund.

What to do About Unacceptable Behavior

If an Attendee witnesses or is subjected to unacceptable behavior or has any other concerns at an IAPMO-sponsored event, notify IAPMO's Chief Administrative Officer (Gaby.Davis@iapmo.org) or the Legal Department as soon as possible. All reported concerns will be treated seriously and investigated promptly. All Attendees are expected to cooperate fully and honestly with any investigation. If there are any questions in advance of the event regarding the Code of Conduct or its implementation, please email Gaby.Davis@iapmo.org.

Agreement

In line with and in consideration for my participation in an IAPMO-sponsored event, I accept and will adhere to the Code of Conduct when participating in such an event. I understand that IAPMO may take any action it deems appropriate, including removing me from the event without a refund, should I fail to adhere to this Code of Conduct.

TENTATIVE ORDER OF DISCUSSION

2026 PROPOSED PUBLIC COMMENTS TO THE UNIFORM SOLAR, HYDRONICS & GEOTHERMAL CODE

The following is the tentative order of discussion on which the proposed public comments will be discussed at the Technical Committee Meeting. Public comments that are grouped together are those that are both indented and separated by lines. Indented proposed code changes are those being discussed out of numerical order.

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Item # 009
Item # 013
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Item # 019
Item # 021
Item # 022
Item # 026
Item # 036
Item # 039
Item # 046
Item # 047
Item # 048
Item # 049
Item # 052

- Item # 053
- Item # 054
- Item # 140

- Item # 055
- Item # 103

Item # 057
Item # 066
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Item # 073
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Item # 079
Item # 081
Item # 084
Item # 093
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TECHNICAL COMMITTEE MEETING ACTIONS

2026 PROPOSED PUBLIC COMMENTS TO THE

UNIFORM SOLAR, HYDRONICS & GEOTHERMAL CODE (USHGC)

The following is a list of items to be discussed during the Technical Committee meeting:

Item #	Public Comment	Committee Action	Notes:
Item # 004	1		
Item # 006	1		
Item # 008	1		
Item # 009	1		
Item # 013	1		
Item # 015	1		
Item # 018	1		
	2		
Item # 019	1		
	2		
Item # 021	1		
Item # 022	1		
Item # 026	1		
Item # 036	1		
Item # 039	1		
Item # 046	1		
	2		
Item # 047	1		
	2		
	3		
Item # 048	1		
Item # 049	1		
Item # 052	1		
Item # 053	1		
	2		
	3		
Item # 054	1		
	2		
Item # 055	1		
Item # 057	1		
Item # 066	1		

Item #	Public Comment	Committee Action	Notes:
Item # 067	1		
	2		
	3		
Item # 073	1		
Item # 074	1		
Item # 076	1		
Item # 077	1		
Item # 079	1		
	2		
Item # 081	1		
Item # 084	1		
Item # 093	1		
Item # 094	1		
Item # 095	1		
	2		
Item # 096	1		
	2		
	3		
	4		
Item # 097	1		
Item # 098	1		
Item # 099	1		
	2		
Item # 100	1		
	2		
Item # 102	1		
	2		
	3		
Item # 103	1		
Item # 105	1		
Item # 107	1		
Item # 108	1		
Item # 111	1		
	2		
Item # 112	1		
Item # 113	1		
	2		
Item # 115	1		
	2		

Item #	Public Comment	Committee Action	Notes:
Item # 116	1		
Item # 117	1		
Item # 118	1		
	2		
Item # 119	1		
Item # 120	1		
Item # 121	1		
	2		
Item # 122	1		
	2		
Item # 123	1		
Item # 125	1		
Item # 126	1		
Item # 127	1		
Item # 129	1		
Item # 133	1		
Item # 135	1		
Item # 136	1		
Item # 137	1		
Item # 138	1		
Item # 139	1		
	2		
Item # 140	1		
Item # 141	1		
	2		
	3		
Item # 142	1		
Item # 143	1		
Item # 144	1		

Technical Committee Actions:

- REJECT
- ACCEPT AS AMENDED
- ACCEPT AS SUBMITTED

Uniform
Solar, Hydronics
& Geothermal Code
Public Comments

Item #:
004

Code Number:
2024 USHGC

Section Number:
203.0

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

203.0 - A -

Antifreeze. An additive used in water-based heat transfer fluids to decrease the freezing temperature of the fluids and protect solar thermal, hydronic, and geothermal energy systems from freezing.

SUBSTANTIATION:
The definition for "antifreeze" is being revised to expand its applicability to solar thermal, hydronic, and geothermal energy systems. Since provisions for antifreeze are provided for each of these systems in the code, this update is necessary.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
004

Code Number:
2024 USHGC

Sections(s):
203.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

203.0 – A –

Antifreeze. An additive used in water-based heat transfer fluids to decrease the freezing temperature of the fluids ~~and protect solar thermal, hydronic, and geothermal energy systems from freezing~~.

Substantiation:

The simplified definition avoids details regarding application and focuses solely on function. Antifreeze is used to lower the freezing point of water-based heat transfer fluids, regardless of the system involved. Expanding on its purpose to provide freeze protection is unnecessary, as this is inherently understood.

Item #:
006

Code Number:
2024 USHGC

Section Number:
205.0

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

205.0 - C -
Chilled Water. Water or fluid that is cooled ~~below the surrounding air temperature~~ via mechanical or other means for the purpose of removing excess heat from conditioned spaces or equipment via hydronic piping distribution.

SUBSTANTIATION:
The definition for “chilled water” is being updated to remove the phrase “below the surrounding air temperature” as it is redundant in this context. Chilled water is inherently understood to be cooler than the air or the system it is intended to cool. The updated description is both clear and concise as it focuses solely on the purpose and method of cooling.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
006

Code Number:
2024 USHGC

Sections(s):
205.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

205.0 – C –

Chilled Water. ~~Water or~~A fluid that is cooled ~~via mechanical or other means~~by refrigeration equipment or other cooling sources for the purpose of removing ~~excess~~ heat from conditioned spaces or ~~equipment via hydronic piping distribution~~processes.

Substantiation:

The definition of "chilled water" is being updated to remove redundant terms, identify applicable equipment, and expand application.

The phrase "water or fluid" is redundant since water is a fluid. The use of water or water-based solutions is sufficiently covered by the term "fluid" alone.

Additionally, the reference to "refrigeration equipment" and "other cooling sources" together provides a complete and inclusive description of the methods used to produce chilled water, accounting for both conventional mechanical systems and alternative technologies such as district cooling connections and geothermal systems.

Furthermore, there are applications where chilled water serves process loads rather than comfort conditioning, such as industrial manufacturing, data center cooling, and laboratory environments.

Item #:
008

Code Number:
2024 USHGC

Section Number:
205.0

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

205.0 - C -

Conditioned Space. An area, room, ~~or~~ space, ~~normally occupied and being heated or cooled for human habitation by any~~ or zone within a building where the temperature, humidity, and/or air quality are controlled by an appliance or equipment.

SUBSTANTIATION:
Conditioning of a space involves more than just heating and cooling; it refers to the deliberate regulation, adjustment, or control of a range of environmental parameters, such as temperature, humidity, and air quality. Although the existing definition emphasizes heating and cooling for simplicity, the terminology should more comprehensively reflect the scope of environmental control. Since the controlled environment is an area, room, or space within a building, this should also be specified within the provided definition. For reference, these updates correlate with definition as shown in the 2024 UMC ROP Preprint.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
008

Code Number:
2024 USHGC

Sections(s):
205.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

205.0 – C –

Conditioned Space. ~~An area, room,~~ A space~~, or zone~~ within a building where the temperature~~,~~ and humidity~~, and/or air quality~~ are controlled~~ by an appliance or equipment~~.

Substantiation:

The definition of "conditioned space" is being simplified by removing redundant terms and narrowing the scope to the basic criteria. Specifically, the phrase "area, room, space, or zone within a building" contains multiple terms describing the same concept, and "space" alone is sufficient.

Additionally, thermal conditioning and ventilation are separate concepts addressed differently in the codes. While thermal conditioning involves controlling temperature and humidity, ventilation addresses indoor air quality.

Furthermore, the phrase "by an appliance or equipment" is unnecessary since the definition should focus on the outcome, that a space is thermally conditioned, rather than the specific means by which conditioning is achieved. Whether conditioning is delivered by a furnace, heat pump, radiant system, or any other mechanism does not change the fundamental nature of the space as conditioned.

Item #:
009

Code Number:
2024 USHGC

Section Number:
205.0

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

205.0 - C -
Cooling. ~~Air cooling to provide a room or space temperature of 68°F (20°C) or above.~~ <u>The action or process of removing heat from air or fluid to maintain a room, space, or product at its intended temperature.</u>

SUBSTANTIATION:
"Cooling" refers to the process of removing heat and encompasses various applications. The existing definition limits cooling to maintaining the temperature of a room or space, which is unnecessarily restrictive. In relation to this code, cooling systems are used to maintain a wide range of temperatures depending on the intended application.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
009

Code Number:
2024 USHGC

Sections(s):
205.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **<u>as modified</u>** by this public comment.

205.0 – C –

Cooling. The ~~action or~~ process of removing heat from air or fluid to maintain a room, space, or product at its intended temperature.

Substantiation:

The definition of "cooling" is being updated to remove redundant terms. Specifically, the phrase "action or process" is redundant since both terms describe the same fundamental concept of removing heat, and "process" alone is sufficient to convey this meaning as it encompasses the steps and actions involved in achieving a reduction in temperature.

Item #: 013

Code Number: 2024 USHGC

Section Number: 209.0, 210.0

SUBMITTER: Cary Smith

Organization Name: USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

209.0 - G -

Geothermal Energy System. A system that exchanges thermal energy ~~between~~with the earth, subsurface water, ~~and/or~~wastewater, bodies of water, or a combination thereof, for the purposes of space heating and cooling, ~~and/or~~ water heating, or both. Such energy may be derived from heat conduction ~~with~~within the earth or ~~solar radiation impacting the ground~~heat transfer at the earth's surface.

> **Geothermal Energy System, Closed-Loop.** ~~A continuous, sealed, underground, or submerged heat exchanger through which a heat transfer fluid passes~~See Hydronic System, Geothermal Closed-Loop.
>
> **Geothermal Energy System, Open-Loop.** ~~A liquid-source system that uses ground water or surface water to extract or reject heat~~See Hydronic System, Geothermal Open-Loop.

210.0 - H -

Hydronic System. Relating to, or being a system of heating or cooling that involves the transfer of heat by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

> **Hydronic System, Geothermal Closed-Loop.** A ~~closed-loop hydronic~~ geothermal system that ~~uses one or more heat exchangers submerged in a body of water or buried in the ground, fluidly coupled to one or more heat exchangers or heat pumps serving one or more conditioned spaces or thermal storage vessels~~circulates a captive fluid in a closed piping network.
>
> **Hydronic System, Geothermal Open-Loop.** A~~n open loop~~ geothermal energy system ~~draws in surface or ground water, passes it through one or more heat exchangers and/or heat pumps, and then discharges the water back into the environment~~that utilizes a non-captive fluid from subsurface water, wastewater, bodies of water, or a combination thereof.

SUBSTANTIATION:
Geothermal energy systems exchange thermal energy with the Earth in a bidirectional manner. The description of the thermal energy source should account for both heat conduction within the Earth and contributions at its surface. The phrase "heat conduction within the Earth" accurately describes geothermal heat transfer through conduction in the Earth's interior. Similarly, "heat transfer at the Earth's surface" appropriately captures thermal energy exchange at ground level through conduction, convection, and radiation.

Both "closed-loop geothermal energy system" and "open-loop geothermal energy system" are defined under "hydronic system" in Chapter 2; however, the terminology used is inconsistent across these locations. Since geothermal systems are a subset of hydronic systems, it is both logical and appropriate to consolidate their definitions under the "hydronic system" category and include appropriate cross-references.

With a clear definition of "geothermal energy system" established, the definitions for "geothermal closed-loop hydronic system" and "geothermal open-loop hydronic system" can be simplified to clearly distinguish the two system types.

An open-loop system circulates a non-captive fluid, whereas a closed-loop system recirculates a captive fluid. This distinction still clarifies that the source fluid for an open-loop system may originate from subsurface water, wastewater, or bodies of water.

Committee Action:
Accept As Amended by the TC

Proposed Text :

209.0 - G -
Geothermal Energy System. A system that exchanges thermal energy with the earth, subsurface water, wastewater, bodies of water, or a combination thereof, for the purposes of space heating and cooling, water heating, or both. Such energy may be derived from heat conduction within the earth or heat transfer at the earth's surface.

Geothermal Energy System, Closed-Loop. See Hydronic System, Geothermal Closed-Loop.

Geothermal Energy System, Open-Loop. See Hydronic System, Geothermal Open-Loop.

210.0 - H -
Hydronic System. Relating to, or being a system of heating or cooling that involves the transfer of heat by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

Hydronic System, Geothermal Closed-Loop. A closed-loop hydronic geothermal system that ~~circulates a captive fluid in a closed piping network~~uses one or more heat exchangers submerged in a body of water or buried in the ground, fluidly coupled to one or more heat exchangers or heat pumps serving one or more conditioned spaces or thermal storage vessels.

Hydronic System, Geothermal Open-Loop. An open loop geothermal energy system that ~~utilizes a non-captive fluid from subsurface water, wastewater, bodies of water, or a combination thereof~~draws in surface or ground water, passes it through one or more heat exchangers and/or heat pumps, and then discharges the water back into the environment.

Committee Statement:
The definitions for "Geothermal Closed-Loop Hydronic System" and "Geothermal Open-Loop Hydronic System" are being amended to retain their existing descriptions. The committee prefers the current definitions as they provide greater clarity and more accurately align with the intent of the code.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
14	1	0	0

EXPLANATION OF NEGATIVE:
ISTEFAN: The reference from one definition to another is confusing and does not add any value. Also, I prefer changing the definitions for "geothermal closed-loop" and "geothermal open-loop" to match the definitions from Item #022, after adjusting the language accordingly to fit geothermal instead of a general hydronic system.

Comment 1

Item #:
013

Code Number:
2024 USHGC

Sections(s):
209.0, 210.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

209.0 – G –
Geothermal Energy System. A system that exchanges thermal energy with the earth, subsurface water, wastewater bodies of water, or a combination thereof, for the purposes of space heating and cooling, water heating, or both. Such energy may be derived from heat conduction within the earth or heat transfer at the earth's surface.

~~**Geothermal Energy System, Closed-Loop.** See Hydronic System, Geothermal Closed-Loop.~~
~~**Geothermal Energy System, Open-Loop.** See Hydronic System, Geothermal Open-Loop.~~

Ground-Source Heat Pump System, Closed-Loop. A closed-loop hydronic geothermal system that uses one or more heat exchangers submerged in a body of water or buried in the ground, fluidly coupled to one or more heat exchangers and/or heat pumps serving one or more conditioned spaces or thermal storage applications.

Ground-Source Heat Pump System, Open-Loop. An open-loop hydronic geothermal energy system that draws in surface water, ground water, or industrial process water and passes it through one or more heat exchangers and/or heat pumps, and then discharges the water back into the environment.

210.0 – H –
Hydronic System. Relating to, or being a system of heating or cooling that involves the transfer of heat by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

~~**Hydronic System, Geothermal Closed-Loop.** A closed-loop hydronic geothermal system that uses one or more heat exchangers submerged in a body of water or buried in the ground, fluidly coupled to one or more heat exchangers or heat pumps serving one or more conditioned spaces or thermal storage vessels.~~

~~**Hydronic System, Geothermal Open-Loop.** An open loop geothermal energy system that draws in surface or ground water, passes it through one or more heat exchangers and/or heat pumps, and then discharges the water back into the environment.~~

Substantiation:
The terms "geothermal open-loop hydronic system" and "geothermal closed-loop hydronic system" are not referenced within existing code requirements. Although open- and closed-loop geothermal systems can be classified as hydronic systems, the design, construction, and installation of geothermal and hydronic systems are governed by separate chapters in the code. The cross-referenced definitions for these terms are therefore confusing and unnecessary.

Geothermal energy systems covered by Chapter 7 are limited to ground-source heat pump systems. Therefore, the existing descriptions for "geothermal open-loop hydronic system" and "geothermal closed-loop hydronic system" are being retained and applied to the terms "open-loop ground-source heat pump system" and "closed-loop ground-source heat pump system." While the broader definition of "geothermal energy system" encompasses any system that exchanges thermal energy with the earth or water sources, ground-source heat pump systems specifically use heat pumps to accomplish this exchange. The revised terminology is both technically accurate and appropriately aligned with code requirements.

Item #:
015

Code Number:
2024 USHGC

Section Number:
210.0

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

210.0 - H -
Heat Exchanger. A device that <u>is designed to </u>transfer~~s~~ heat from one medium to another<u> via conduction through separating walls, convection into and out of the fluid streams, or a combination of both</u>.

SUBSTANTIATION:
This code change proposal is for alignment with the 2024 UMC ROP Preprint. The existing definition of "heat exchanger" is vague and incomplete. As currently written, it could technically describe any object or surface through which heat flows, regardless of whether it was intentionally designed for that purpose.

The revised definition is an improvement because it captures the essential functional principles of heat exchangers:

First, the primary purpose of any heat exchanger is to transfer thermal energy between two distinct media.

Second, the mechanisms of heat transfer typically involve conduction through separating surfaces, convection within fluid streams, or a combination of both.

Third, the definition must be broad enough to encompass the full range of heat exchanger types, regardless of their specific configurations or applications.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
14	1	0	0

EXPLANATION OF NEGATIVE:
CUDAHY: This is still missing "emission." There are three ways to convey heat into a medium or space: conduction, convection, and radiation (emission). Some hydronic panels really are emission panels (radiators).

Heat Exchanger. *A device that is designed to transfer heat from one medium to another via conduction through separating walls, convection into and out of the fluid streams, "radiation, or a combination thereof."*

EXPLANATION OF AFFIRMATIVE:

SMITH: This definition is intended to describe a mechanical device meant to exchange heat between two dissimilar fluids, gases, or a fluid and a gas and is normally used between two fluids in a closed system, not a space conditioning device.

Comment 1

Item #:
015

Code Number:
2024 USHGC

Sections(s):
210.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

210.0 – H –

Heat Exchanger. A device that is designed to transfer heat from one medium to another ~~via conduction through separating walls, convection into and out of the fluid streams, or a combination of both~~without direct contact or mixing of the media.

Substantiation:
The current definition describes how heat exchangers work by referencing conduction through separating walls, convection into and out of fluid streams, or a combination of both. While technically accurate, this level of detail is unnecessary for a code definition.

Additionally, the revised phrase "without direct contact or mixing of the media" improves the definition by capturing the fundamental characteristic of heat exchangers, which is transferring thermal energy between two media while keeping them physically separate.

Item #:
018

Code Number:
2024 USHGC

Section Number:
210.0

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Add new text

Proposed Text :

210.0 - H -
Heat Pump. A refrigeration system that extracts or rejects heat from one source, such as outdoor air, the ground, or water, and transfers it to another source or process. These systems are capable of reversing the direction of the refrigeration cycle to serve either heating or cooling needs.

SUBSTANTIATION:
A definition for "heat pump" is beneficial to the code as it supports various existing provisions. The proposed language is applicable to different types of heat pumps (air-source, ground-source, and water-source), clearly describes how these systems function, and explains the reversible cycle.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

EXPLANATION OF AFFIRMATIVE:
MATSON: I prefer this definition over the one submitted to the UMC (and USHGC in Item #016) and hope that the technical correlating committee adopts this one for both codes.

Comment 1

Item #:
018

Code Number:
2024 USHGC

Sections(s):
210.0

Submitter Name:
Arnie Rodio

Organization Name:
USHGC-USPSHTC TCC, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

210.0 - H -
Heat Pump. ~~A refrigeration system that extracts or rejects heat from one source, such as outdoor air, the ground, or water, and transfers it to another source or process. These systems are capable of reversing the direction of the refrigeration cycle to serve either heating or cooling needs.~~A refrigeration system used to transfer heat into or out of a space or substance.

Substantiation:
The recommendation revises the definition for "heat pump" to correlate with the action taken by the UMC TC to "accept as amended" Item #018 Public Comment 01. The TCC agrees with the definition for "heat pump" in UMC Item #018 Public Comment 01 as it avoids overly descriptive language on heating and cooling modes and provides a broader description that applies across a wide range of heat pump applications.

> *[2025 UMC ROC Preprint]*
> *210.0 (- H -)*
> ***Heat Pump.** A refrigeration system used to transfer heat into or out of a space or substance.*

Comment 2

Item #:
018

Code Number:
2024 USHGC

Sections(s):
210.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

210.0 – H –
Heat Pump. A refrigeration system that ~~extracts or rejects heat from one source, such as outdoor air, the ground, or water, and transfers it to another source or process. These systems are~~transfers thermal energy from one source to another and may be capable of reversing the direction of the refrigeration cycle to serve either heating or cooling needs.

Substantiation:
The definition of “heat pump” is being revised to avoid listing specific heat sources, prevent the inadvertent exclusion of different heat pump types, and provide technically accurate terminology.

Providing a list of specific heat sources is unnecessary, and the phrase “transfers thermal energy from one source to another” sufficiently applies to all potential heat sources and sinks. Additionally, there is a distinction between "heat" and "thermal energy." Thermal energy is the internal energy contained within a substance, while heat is the transfer of that energy between substances. The revised definition correctly identifies thermal energy as what is being transferred by a heat pump.

Furthermore, while many heat pumps can switch between heating and cooling modes by reversing the refrigeration cycle, some are designed for a single purpose. The original statement that heat pumps "are capable of reversing" would inadvertently exclude such systems, and the revised language "may be capable" accurately reflects that reversibility is a common but not universal feature.

Item #:
019

Code Number:
2024 USHGC

Section Number:
210.0, 309.3, 310.7, 312.1, 313.1, 316.1, 412.4.1

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

210.0 - H -
Heat Transfer Fluid. A liquid that is employed in mechanical systems to transport thermal energy between components or stages within a process. The fluid is characterized by properties such as thermal conductivity, appropriate viscosity, chemical and thermal stability, and low freezing point.

~~**Heat Transfer Medium.** The medium used to transfer energy from the solar collectors to the thermal storage or load.~~

309.0 Safety Requirements.

309.3 Hazardous Heat~~-~~ Transfer ~~Mediums~~Fluids. Heat~~-~~ transfer ~~mediums~~fluids that are hazardous shall not be used, except where approved by the Authority Having Jurisdiction.

310.0 Circulators and Pumps.

310.7 Materials. Circulating pumps shall be constructed of materials that are compatible with the heat transfer ~~medium~~fluid.

312.0 Valves.
312.1 General. Valves shall be rated for the operating temperature and pressure of the system. Valves shall be compatible with the type of heat transfer ~~medium~~fluid and piping material.

313.0 Heat Exchangers.
313.1 General. Systems utilizing heat exchangers shall protect the potable water system from being contaminated by the heat transfer ~~medium~~fluid. Systems that incorporate a single-wall heat exchanger to separate potable water from the heat~~-~~ transfer fluid shall meet the following requirements:
(1) Heat transfer ~~medium~~fluid is either potable water or contains fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.
(2) A tag or label shall be securely affixed to the heat source with the word "CAUTION" and the following statements:
(a) The heat transfer ~~medium~~fluid shall be water or other nontoxic fluid recognized as safe by the FDA.
(b) The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.

(3) The word "CAUTION" and the statements listed above shall have an uppercase height of not less than 0.120 of an inch (3.05 mm). The vertical spacing between lines of type shall be not less than 0.046 of an inch (1.168 mm). Lowercase letters shall be not less than compatible with the uppercase letter size specification.
Systems that do not comply with the requirements for a single-wall heat exchanger shall install a double-wall heat exchanger. Double-wall heat exchangers shall separate the potable water from the heat transfer ~~medium~~fluid by providing a space between the two walls that are vented to the atmosphere.

316.0 Disposal of Liquid Waste.
316.1 General. It shall be unlawful for a person to cause, suffer, or permit the disposal of liquid wastes, heat transfer ~~medium~~fluid, or other liquids, in a place or manner, except through and by means of an approved drainage system installed and maintained in accordance with the provisions of this code. Waste that is deleterious to surface or subsurface waters shall not be discharged into the ground or into a waterway.

412.0 Pressure and Flow Controls.

412.4 Automatic Makeup Fluid. (remaining text unchanged)
412.4.1 Potable Makeup Fluid. Where a potable water automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed-loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location.
On systems using only water as a heat transfer ~~medium~~fluid, and where pressurization is achieved using a potable water supply, a pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 402.0 to prevent contamination due to backflow.

SUBSTANTIATION:
The 2024 USHGC contains a definition for "heat transfer medium" which is written with limited applicability to solar thermal systems. Upon review of its uses within the code, reference to "heat transfer fluid" is more appropriate as solar, hydronics, and geothermal systems involve the movement of a fluid substance that absorbs and transports thermal energy. Although "heat transfer medium" is a broader term, it does not emphasize the fluid characteristics that are key in the operation of these systems.

Therefore, the definition for "heat transfer medium" is being deleted, a new definition for "heat transfer fluid" is being proposed that correlates with the 2024 UMC ROP Preprint, and occurrences found in Chapter 3 and Chapter 4 are being updated.

For reference, occurrences in Chapter 5 (Solar Thermal Systems) are being reviewed by the USHGC Solar Thermal Systems Task Group, and occurrences in Chapter 7 (Geothermal Energy Systems and District Geothermal Loops) are being reviewed by the USHGC Geothermal Energy Systems Task Group.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
14	1	0	0

EXPLANATION OF NEGATIVE:
CUDAHY: We go back and forth in the definition using both “fluid” and “liquid.” We should be consistent. All liquids are fluids, but not all fluids are liquids.

Heat Transfer Fluid. *A "liquid" that is employed in mechanical systems to transport thermal energy between components or stages within a process. The "fluid" is characterized by properties such as thermal conductivity, appropriate viscosity, chemical and thermal stability, and low freezing point.*

TCC:
The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3.6 of the Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

The actions taken by the USHGC TC to “accept as submitted” Item #010 do not correlate with the actions taken by the USHGC TC to “accept as submitted” Item #019 regarding the definition for “heat transfer medium.”

Proposed Text TCC

319.0 Protection of System Components.
319.1 Materials. System components in contact with heat~~-~~ transfer ~~mediums~~fluids shall be approved for such use. Components, installed outdoors, shall be resistant to UV radiation.

A 103.0 Water Heat Exchangers.
A 103.1 Protection of Potable Water System. Heat exchangers used for heat transfer, heat recovery, or other solar thermal purposes shall protect the potable water system from being contaminated by the heat~~-~~ transfer ~~medium~~fluid.
A 103.2 Where Permitted. Single-wall heat exchangers shall be permitted where they satisfy the following requirements:
(1) The heat~~-~~ transfer ~~medium~~fluid is either potable water or contains nontoxic fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.
(2) The pressure of the heat~~-~~ transfer ~~medium~~fluid is maintained at less than the average minimum operating pressure of the potable water system.
Exception: Steam complying with Section A 103.2(1).
(3) The equipment is permanently labeled to indicate that only additives recognized as safe by the FDA shall be used in the heat~~-~~ transfer ~~medium~~fluid.

TCC Action:
Accept as Submitted

TCC Statement:
The language in USHGC Item #019, Section 319.1 (Materials), Section A 103.1 (Protection of Potable Water System), and Section A 103.2 (Where Permitted) is being revised for consistency in terminology and to correct and oversight with regards to the updated references from "heat-transfer medium" to "heat transfer fluid."

The action moves forward as approved by the TCC and supersedes the recommendation from the USHGC TC for actions taken on Section 319.1, Section A 103.1, and Section A 103.2 by replacing the term "heat-transfer medium" with "heat transfer fluid."

Comment 1

Item #:
019

Code Number:
2024 USHGC

Sections(s):
501.6

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.14 Storage Tanks. (remaining text unchanged)
~~501.6~~501.14.1 **Thermosiphon Systems.** The storage tank in a thermosiphon system shall be installed above the collector. Heat exchangers for indirect thermosiphon systems, whether integral or external to the storage tank, shall comply with Section 313.0.

(shown for information purposes only)

313.0 Heat Exchangers.
313.1 General. Systems utilizing heat exchangers shall protect the potable water system from being contaminated by the heat transfer fluid. Systems that incorporate a single-wall heat exchanger to separate potable water from the heat transfer fluid shall meet the following requirements:
(1) Heat transfer fluid is either potable water or contains fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.
(2) A tag or label shall be securely affixed to the heat source with the word "CAUTION" and the following statements:
(a) The heat transfer fluid shall be water or other nontoxic fluid recognized as safe by the FDA.
(b) The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.
(3) The word "CAUTION" and the statements listed above shall have an uppercase height of not less than 0.120 of an inch (3.05 mm). The vertical spacing between lines of type shall be not less than 0.046 of an inch (1.168 mm). Lowercase letters shall be not less than compatible with the uppercase letter size specification.

Systems that do not comply with the requirements for a single-wall heat exchanger shall install a double-wall heat exchanger. Double-wall heat exchangers shall separate the potable water from the heat transfer fluid by providing a space between the two walls that are vented to the atmosphere.
313.2 Shutoff Valves. Shutoff valves shall be installed on the supply and return side of a heat exchanger.
Exception: Where a heat exchanger is an integral part of a boiler or is a part of a manufactured boiler and heat exchanger packaged unit, and is capable of being isolated from the hydronic system by supply and return valves.

Substantiation:
Indirect thermosiphon systems transfer heat from the collector loop to potable water through a heat exchanger, either integral to the storage tank or installed externally. Because these systems rely on nonpotable heat transfer fluids for freeze protection, a heat exchanger failure creates a direct risk of chemical contamination of the potable water supply.

Currently, Section 501.14.1 (Thermosiphon Systems) addresses only the physical location of the storage tank relative to the collector. It contains no provisions requiring potable water protection.

To address this gap, the proposed revision references Section 313.0 (Heat Exchangers), which establishes two compliance pathways:

> (1) a single-wall heat exchanger, provided the collector loop fluid is either potable water or is recognized as safe by the Food and Drug Administration (FDA) as food grade; or
>
> (2) a double-wall heat exchanger with the interstitial space vented to atmosphere, so that any fluid leak drains to the exterior rather than entering the potable water supply.

Comment 2

Item #:	Code Number:	Sections(s):
019	2024 USHGC	210.0

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

210.0 – H –
Heat Transfer Fluid. A liquid that ~~is employed in mechanical systems to~~ transport<u>s</u> thermal energy between components ~~or stages within a process~~<u>within a system</u>. The fluid is characterized by properties such as thermal conductivity, ~~appropriate~~ viscosity, chemical and thermal stability, and ~~low~~ freezing point.

Substantiation:
The definition of "heat transfer fluid" is being revised to remove unnecessary complexity. The phrases "employed in mechanical systems" and "stages within a process" do not provide additional clarification and can be removed. Additionally, striking "appropriate" from viscosity and "low" from freezing point eliminates subjective and ambiguous terms.

Item #:
021

Code Number:
2024 USHGC

Section Number:
210.0

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

210.0 - H -

Hydronic System. Relating to, or being a system of heating or cooling that involves the transfer of heat by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

> **Hydronic System, Ambient Temperature Loop (ATL).** A type of district energy system consisting of a closed loop piping system connected to buildings with distributed or central pumping that includes various heat sources and heat sinks to hold the loop fluid temperature near the long term average ambient air/ground temperature for a given geographical location. ~~The sources/sinks can be passive (e.g., a ground loop, a body of water, sewer effluent) or active (e.g. a cooling tower) and further can include opportunistic, or unique locally available waste or by product heat sources (e.g., data center, industrial process).~~ The closed loop piping system typically controls or engages ~~these sources/sinks~~with heat sources and sinks to maintain the loop temperature to meet the ~~seasonal requirements as well as specific building needs~~ varying HVAC or other thermal loads of the connected buildings.

SUBSTANTIATION:
Ambient temperature loops are classified as a type of district energy system, as they operate within an energy infrastructure. Depending on the system configuration, ATL pumping mechanisms may include either distributed or central pumping. The primary function of an ATL within this infrastructure is to meet the varying HVAC and other thermal loads of any connected buildings. Because the ambient temperature is influenced by both the air and the ground, this distinction should be explicitly stated in the description. Language regarding heat sources and sinks is then being removed as such information is sufficiently addressed in the body of the code.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
021

Code Number:
2024 USHGC

Sections(s):
203.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

203.0 – A –

Ambient Temperature. ~~Surrounding temperature~~The temperature of the surrounding environment or air at a specific location, unaffected by artificial heating or cooling.

Substantiation:
Simply defining "ambient temperature" as the "surrounding temperature" provides no useful guidance. A more comprehensive and technically accurate description should reference the environment or air at a specific location, providing a clear reference point for measurement and evaluation.

Additionally, including the phrase "unaffected by artificial heating or cooling" establishes that ambient temperature must reflect natural conditions rather than areas influenced by equipment operation. Without this distinction, there could be confusion about whether to measure temperature near HVAC discharge, mechanical equipment, or other heat-generating sources.

Furthermore, ATL systems maintain a loop temperature near the long-term average ambient air and ground temperature for a given geographic location. A precise definition of ambient temperature is therefore essential to the proper design, sizing, and operation of these systems.

Item #:
022

Code Number:
2024 USHGC

Section Number:
210.0

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

210.0 - H -

Hydronic System. Relating to, or being a system of heating or cooling that involves the transfer of heat by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

> **Hydronic System, Closed-Loop.** A hydronic system that ~~uses~~circulates a captive ~~installed~~ fluid ~~mass that is circulated to transfer thermal energy~~ between heat exchange sources and emitters installed on the system loop.
>
> **Hydronic System, Open-Loop.** A hydronic system that ~~takes in~~circulates a non-captive fluid ~~mass~~ from an external source, transfers thermal energy into or out of the fluid by means of one or more heat exchangers, and then returns the fluid mass all or in part to an external source.

SUBSTANTIATION:
The definitions for "open-loop" and "closed-loop hydronic systems" are being updated to create a clearer contrast between the two. The proposed revisions explicitly distinguish "captive fluid" (closed-loop) from "non-captive fluid" (open-loop), and unnecessary wording has been removed without changing the original intent of the definitions.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
022

Code Number:
2024 USHGC

Sections(s):
210.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

210.0 – H –

Hydronic System. ~~Relating to, or being a system of heating or cooling that involves the transfer of heat~~A heating or cooling system that distributes thermal energy by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

Substantiation:
The current definition opens with the phrase "Relating to, or being a system of heating or cooling," which defines the adjective "hydronic" rather than the noun "hydronic system." The updated definition corrects this by opening with the phrase "heating or cooling system."

While hydronic systems technically constitute the distribution component of a larger mechanical assembly, defining them as heating or cooling systems is consistent with how codes and standards apply requirements to the complete assembly, including the source equipment, distribution piping, circulating pumps, and terminal units.

Finally, the revised definition substitutes "distributes thermal energy" for "involves the transfer of heat." Thermal energy refers to the internal energy stored within a substance, while heat refers specifically to energy in transit between substances due to a temperature difference. In a hydronic system, the circulating fluid carries thermal energy between the source and the terminal units. "Distributes thermal energy" therefore more accurately describes the function of the circulating fluid than "transfer of heat."

Item #:
026

Code Number:
2024 USHGC

Section Number:
220.0

SUBMITTER:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

220.0 - R -
Rock Storage. A bin, basement, or other container filled with rock ~~to act~~which serves as ~~an energy~~a reservoir for ~~a solar system~~thermal energy.

SUBSTANTIATION:
The definition for "rock storage" is being updated to expand applicability to other systems covered by the code. Additionally, the term "energy reservoir" is being replaced with the phrase "reservoir for thermal energy" for technical accuracy. "Energy reservoir" could be interpreted in various ways since energy exists in many forms (electrical, chemical, mechanical, etc.). The phrase "reservoir for thermal energy" is more accurate since rock storage specifically stores heat.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
026

Code Number:
2024 USHGC

Sections(s):
220.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

220.0 – R –

Rock Storage. ~~A bin, basement, or other container filled with rock which serves as a reservoir for thermal energy.~~ A thermal energy storage system which utilizes the thermal mass of rocks, aggregates, or other dense materials.

Substantiation:

The current definition of "rock storage" is being revised to provide a more technically accurate and broad description that aligns with the context of the USHGC. As written, the description is unnecessarily limited to specific container types and also excludes functionally equivalent materials that serve the same thermal storage purpose. To acknowledge the other potential media with suitable thermal mass properties capable of performing this function, the updated definition includes "rocks, aggregates, or other dense materials."

Furthermore, rock storage is categorized as a thermal energy storage system that utilizes thermal mass. Thermal mass describes a material's capacity to absorb, store, and release thermal energy, which correctly identifies the operating principle behind how these systems function.

Item #:
036

Code Number:
2024 USHGC

Section Number:
305.2

SUBMITTER:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

305.0 Installation.

305.2 Dissimilar Metals. Except for necessary valves, where intermembering or mixing of dissimilar metals occur, the point of connection shall be confined to exposed or accessible locations. Where required by ~~T~~the Authority Having Jurisdiction, ~~shall be permitted to require the use of~~ an approved dielectric insulator shall be used on the piping connections of an open loop system.

SUBSTANTIATION:
The revisions to Section 305.2 (Dissimilar Metals) are for enforceability and improvement of code language. The code should not be specifying what the Authority Having Jurisdiction is allowed to require.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
036

Code Number:
2024 USHGC

Sections(s):
305.2, 305.2.1, Table 901.1

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

305.0 Installation.

305.2 Dissimilar Metals. Except for ~~necessary~~ valves, ~~where intermembering or mixing of dissimilar metals occur,~~ the point of connection between dissimilar metals shall be confined to exposed or accessible locations.
Where required by the Authority Having Jurisdiction, ~~an approved dielectric insulator shall be used on~~dielectric fittings complying with Section 305.2.1 shall be installed at the piping connections ~~of an~~in open-loop systems.
305.2.1 Dielectric Fittings. Dielectric fittings installed at connections between dissimilar metals shall comply with ASSE/IAPMO/ANSI/CAN 1079.
Exception: Dielectric fittings complying with IAPMO PS 66 shall be permitted in piping systems conveying potable water.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
IAPMO PS 66-2023	Dielectric Fittings	Fittings	305.2.1

(portions of table not shown remain unchanged)

Note: ASSE/IAPMO/ANSI/CAN 1079 and IAPMO PS 66 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The revisions to Section 305.2 (Dissimilar Metals) remove vague requirements, improve enforceability, and incorporate relevant product standards for dielectric fittings used in open-loop systems. Specifically, the reference to "necessary" valves is subjective, and the existing phrase "intermembering or mixing" can be more directly stated as the "connection between dissimilar metals."

Additionally, the approval requirements for dielectric insulators are undefined, and the industry recognized term for these devices in product standards is "dielectric fitting." Based on the scopes of ASSE 1079 and IAPMO PS 66, a distinction is required for fittings complying with IAPMO PS 66. While ASSE 1079 is appropriate for both potable and nonpotable systems, IAPMO PS 66 is limited to systems conveying potable water. The provided exception makes clear that ASSE 1079 is the primary standard for all applications, and IAPMO PS 66 is an additional permitted option, but only for potable water systems.

Item #:
039

Code Number:
2024 USHGC

Section Number:
310.1

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

310.0 Circulators and Pumps.
310.1 General. Circulators and pumps shall be selected for their intended use based on the heat transfer fluid, intended operating temperature range and pressure. Circulators and pumps shall be installed to allow for service and maintenance. The manufacturer's installation instructions shall be followed for correct orientation and installation. Motor operated pumps rated 600V or less shall ~~be listed and labeled in accordance~~comply with CSA C22.2 No. 108 or with UL 778.

Note: CSA C22.2 No. 108 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
Section 310.1 (General) is being updated to include CSA C22.2 No. 108 as an optional listing for motor operated pumps. This standard is appropriate for reference as it outlines safety and performance criteria for motor-operated liquid pump units intended for use in nonhazardous locations, including indoor, outdoor, exposed, and submerged environments.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
039

Code Number:
2024 USHGC

Sections(s):
310.3

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

310.0 Circulators and Pumps.

310.3 Sizing. The selection and sizing of a circulator or pump shall be based on all of the following:
(1) Loop or system head pressure, feet of head (ft) (m)
(2) ~~Capacity~~Flow rate, gallons per minute (gpm) (L/s)
(3) Maximum and minimum temperature, °F (°C)
(4) Maximum working pressure, pounds-force per square inch (psi) (kPa)
(5) Fluid type

Substantiation:
The term "flow rate" is the standard term used in hydraulic engineering, pump specification data, and HVAC system design to describe the volume of fluid moved through a system per unit of time. This precisely corresponds to the units provided in item (2), gallons per minute (gpm) or liters per second (L/s).

In contrast, the term "capacity" can be ambiguous without context, as it is commonly used to describe unrelated characteristics such as tank storage volume, total system volume, or pump displacement. Replacing "capacity" with "flow rate" removes this ambiguity and ensures consistency with industry terminology, manufacturer specifications, and engineering calculation practices.

Item #:
046

Code Number:
2024 USHGC

Section Number:
401.1

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

401.0 General.
401.1 Applicability. This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, solar thermal systems, ground source heat pump systems, snow and ice melt systems, and district ~~thermal~~ energy ~~loops~~systems. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems. (See Appendix E for recommended configurations of both residential and non-residential closed-loop hydronic heating and cooling systems.)

SUBSTANTIATION:
In alignment with the recommendations of the USHGC Geothermal Energy Systems Task Group, reference to “district thermal energy loop” is being updated to “district energy system” for consistency with current industry terminology and regulations.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
046

Code Number:
2024 USHGC

Sections(s):
Chapter 4

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part I – General.

401.0 General.
401.1 Applicability. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems. Part I of ~~T~~this chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, solar thermal systems, ground source heat pump (GSHP) systems, snow and ice melt systems, and district energy systems. ~~The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.~~Part II shall apply to steam systems. Part III shall apply to hydronic radiant heating and cooling systems, and Part IV shall apply to snow and ice melt systems. (See Appendix E for recommended configurations of both residential and non-residential closed-loop hydronic heating and cooling systems.)

~~418.0~~411.0 **Piping Installation.**

(renumber remaining sections)

Part II – Steam Systems.

414.0 ~~Steam Systems~~General.

Part III – Radiant Heating and Cooling Systems.

415.0 ~~Radiant Heating and Cooling~~General.

(renumber remaining sections)

416.0 Surface Temperature Limitations.
~~415.2~~416.1 ~~Radiant Floor Heating~~**Maximum Floor Temperatures.** Floor finished surface temperatures shall not exceed the following temperatures for space heating applications:
(1) 85°F (29°C) in general occupied applications.
(2) 90°F (32°C) in bathrooms, foyers, distribution areas such as hallways and indoor swimming pools.
(3) 88°F (31°C) in industrial spaces.
(4) 95°F (35°C) in radiant panel perimeter areas, i.e., up to 30 inches (762 mm) from outside walls.
The radiant heating system temperature shall not exceed the maximum temperature rating of the materials used in its construction.
~~415.3.1~~416.2 **Minimum Floor Temperatures.** (remaining text unchanged)

417.0 Radiant Tubing Design.
~~415.4~~417.1 **Tube Placement.** (remaining text unchanged)
~~415.5~~417.2 **Tube Length.** (remaining text unchanged)
~~415.6~~417.3 **Tube Identification.** (remaining text unchanged)

~~415.7~~418.0 **Poured Floor Structural Concrete Slab Systems.**

418.1 Tube Sizing and Spacing. Where tubing is embedded in a structural concrete slab, such tubes shall not be larger in outside dimension than one-third of the overall thickness of the slab and shall be spaced not less than three diameters on center except within 10 feet (3048 mm) of the distribution manifold. The top of the tubing shall be embedded in the slab not less than 2 inches (51 mm) below the surface.

~~415.7.1~~418.2 **Slab Penetration Tube and Joint Protection.** (remaining text unchanged)

~~415.7.2~~418.3 **Insulation.** (remaining text unchanged)

~~415.7.3~~418.4 **Types of Tube Fasteners.** (remaining text unchanged)

~~415.7.4~~418.4.1 **Spacing of Tube Fasteners.** (remaining text unchanged)

~~415.8~~419.0 **Joist Systems and Subfloors.**

419.1 Tube Spacing. Where tubing is installed below a subfloor, the tube spacing shall be in accordance with the system design and joist space limitations. Where tubing is installed above or in the subfloor, the tube spacing shall not exceed 12 inches (305 mm) center-to-center for living areas.

419.2 Insulation. Where tubing is installed in the joist cavity, the cavity shall be insulated with not less than R-12 material below the heated space.

An air space of not less than 1 inch (25.4 mm) and not more than 3 inches (76 mm) shall be maintained between the top of the insulation and the underside of the floor unless a conductive plate is installed in accordance with manufacturer's instructions.

Where tubing is installed in panels above or in the subfloor and not embedded in concrete, the floor assembly shall be insulated with not less than R-5 material below the tubing when installed over habitable space.

~~415.10~~419.3 **Tubing Fasteners.** (remaining text unchanged)

~~415.9~~420.0 **Wall and Ceiling Panels.**

420.1 General. Where radiant tubing is installed in the wall or ceiling assembly, the tubing shall be located on the interior side of the insulation to direct the transfer of thermal energy between the tubing and the conditioned space. An air space of not less than 1 inch (25.4 mm) and not more than 3 inches (76 mm) shall be maintained between the insulation and the interior surface of the panel unless a conductive plate is installed.

Part IV – Snow and Ice Melt Systems.

~~417.0~~421.0 ~~Snow and Ice Melt Systems~~General.

(renumber remaining sections)

422.0 Snow Melt Tubing Design.

~~417.2.1~~422.1 **Tube Placement.** (remaining text unchanged)

~~417.2.2~~422.2 **Tube Length.** (remaining text unchanged)

~~417.2.3~~422.3 **Multizone Systems.** (remaining text unchanged)

~~417.2.4~~423.0 **Poured Structural Concrete Slab Systems.**

423.1 Tube Sizing and Spacing. Where tubes are embedded in a structural concrete slab, such tubes shall not be larger in outside dimension than one-third of the overall thickness of the slab and shall be spaced not less than three diameters on center except within 10 feet (3048 mm) of the distribution manifold. The top of the tubing shall be embedded in the slab not less than 2 inches (51 mm) below the surface of the finished concrete slab.

~~417.2.5~~423.2 **Slab Penetration Tube and Joint Protection.** (remaining text unchanged)

~~417.2.6~~423.3 **Insulation.** (remaining text unchanged)

~~417.3~~423.4 **Types of Tube Fasteners.** (remaining text unchanged)
~~417.4~~423.4.1 **Spacing of Tube Fasteners.** (remaining text unchanged)

Substantiation:
Chapter 4 (Hydronics) is being reorganized into distinct parts addressing general requirements and specific system types. This structure improves usability and technical clarity by grouping related requirements together and providing direct access to relevant provisions. It also establishes a logical framework for future code development and expansion. Radiant systems and snow and ice melt systems in particular benefit from this reorganization, as their requirements are currently contained within lengthy sections that are difficult to navigate.

Comment 2

Item #:	Code Number:	Sections(s):
046	2024 USHGC	408.0 - 408.2

Submitter Name:	Organization Name:	Organization Representation:
Jacob Fear	USHGC Hydronic Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

408.0 Cooling Appliances and Equipment.
408.1 General. Cooling appliances, equipment, safety and operational controls shall be listed for their intended use and installed in accordance with the manufacturer's installation instructions.
408.2 Refrigeration Systems. Where refrigeration systems are used as cooling sources for hydronic systems, the refrigeration systems shall be installed in accordance with the mechanical code.

(renumber remaining sections)

Substantiation:
Section 401.1 (Applicability) explicitly brings chilled water, radiant cooling, and refrigeration systems under the scope of Chapter 4 (Hydronics), yet the chapter currently contains no provisions governing cooling appliances and equipment. The proposed additions to Section 408.0 are intended to close this gap.

> ***[2025 USHGC ROP Preprint]***
> ***401.1 Applicability.*** *This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, solar thermal systems, ground source heat pump systems, snow and ice melt systems, and district energy systems. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.*

New Section 408.1 (General) is modeled after the existing language in Section 407.0 (Heating Appliances and Equipment) and would require that cooling appliances and their associated controls be listed for their intended application and installed in accordance with the manufacturer's instructions. Section 408.2 (Refrigeration Systems) then clarifies that any refrigeration system serving as the cooling source for a hydronic system must comply with the mechanical code.

> ***[2025 USHGC ROP Preprint]***
> ***407.0 Heating Appliances and Equipment.***
> ***407.1 General.*** *Heating appliances, equipment, safety and operational controls shall be listed for their intended use in a hydronic heating system and installed in accordance with the manufacturer's installation instructions.*

Item #:
047

Code Number:
2024 USHGC

Section Number:
401.2

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

401.0 General.

401.2 Insulation. ~~Surfaces within reach of building occupants shall not exceed 140°F (60°C).~~Where a hydronic system conveys fluid exceeding 140°F (60°C) or steam, piping surfaces within reach of building occupants shall be insulated to maintain a surface temperature of not more than 140°F (60°C). Where sleeves are installed, the insulation shall continue full size through them.
Coverings and insulation used for piping shall be of material approved for the operating temperature of the system and the installation environment. Where installed in a plenum, the insulation, jackets, and lap-seal adhesives, including pipe coverings and linings, shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50 where tested in accordance with ASTM E84 or UL 723.

SUBSTANTIATION:
The existing language sets a maximum surface temperature but does not identify which surfaces it applies to nor does it explicitly mandate the use of insulation. Therefore, Section 401.2 (Insulation) is being revised to clarify that "piping" surfaces must be insulated where fluid or steam is being conveyed at temperatures exceeding 140°F. This removes ambiguity and better aligns with the remaining requirements within the section.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

EXPLANATION OF AFFIRMATIVE:
MATSON: This change no longer correlates with the UMC. Hopefully, the technical correlating committee can use this version in the UMC, as it's an improvement to the prior language.

Comment 1

Item #:
047

Code Number:
2024 USHGC

Sections(s):
503.1

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

503.0 Insulation.
503.1 General. ~~The temperature of surfaces within reach of building occupants shall not exceed 140°F (60°C) unless they are protected by insulation.~~Where a solar thermal system conveys fluid exceeding 140°F (60°C), piping surfaces within reach of building occupants shall be insulated to maintain a surface temperature of not more than 140°F (60°C). Where sleeves are installed, the insulation shall continue full size through them.
Coverings and insulation materials used for piping shall be rated for the operating temperature of the system and the installation environment. Where installed in a plenum, the insulation, jackets and lap-seal adhesives, including pipe coverings and linings, shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50 where tested in accordance with ASTM E84 or UL 723.

Substantiation:
Chapter 4 (Hydronics) and Chapter 5 (Solar Thermal Systems) contain the same requirements for pipe insulation. This public comment correlates with the revisions made to Section 401.2 (Insulation) in Item #047. The only difference between Item #047 and this public comment is the reference to steam in Section 401.2, which is not applicable to solar thermal systems.

As stated in the substantiation for Item #047: "The existing language sets a maximum surface temperature but does not identify which surfaces it applies to nor does it explicitly mandate the use of insulation. The section is being revised to clarify that piping surfaces must be insulated where fluid is being conveyed at temperatures exceeding 140°F. This removes ambiguity and better aligns with the remaining requirements within the section."

Comment 2

Item #:
047

Code Number:
2024 USHGC

Sections(s):
401.2, 401.8, 409.2, 409.3

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

418.0 Piping Installation.

~~409.2~~418.2 **Expansion and Contraction.** Pipe and tubing shall be so installed that it will not be subject to undue strains or stresses, and provisions shall be made for expansion, contraction, and structural settlement.
~~409.3~~418.3 **Hangers and Supports.** Pipe and tubing shall be supported in accordance with Section 317.0 and Table 317.3. Equipment that is part of the piping system shall be provided with additional support in accordance with this code and manufacturer's installation instructions. Radiant systems utilizing heat emission or transfer plates shall have a gap of at least ¼ inch (6.4 mm) between adjacent plates or in accordance with the manufacturer's installation instructions.
~~401.8~~418.4 **Flexible Connectors.** Flexible connectors shall be installed in readily accessible locations. Metallic flexible connectors shall comply with ASTM F2934, or other equivalent approved standards.
~~401.2~~418.5 **Insulation.** Where a hydronic system conveys fluid exceeding 140°F (60°C) or steam, piping surfaces within reach of building occupants shall be insulated to maintain a surface temperature of not more than 140°F (60°C). Where sleeves are installed, the insulation shall continue full size through them.
Coverings and insulation used for piping shall be of material approved for the operating temperature of the system and the installation environment. Where installed in a plenum, the insulation, jackets, and lap-seal adhesives, including pipe coverings and linings, shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50 where tested in accordance with ASTM E84 or UL 723.

(renumber remaining sections)

Substantiation:
The provisions for expansion and contraction, hangers and supports, flexible connectors, and insulation previously appeared in multiple, non-contiguous sections of Chapter 4. These updates consolidate them under the existing dedicated piping-installation section to improve clarity, consistency, and ease of use.

Comment 3

Item #:	**Code Number:**	**Sections(s):**
047	2024 USHGC	706.3

Submitter Name:	**Organization Name:**	**Organization Representation:**
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

706.0 Specific System Components Design.

~~**706.3 Insulation.** The temperature of surfaces within reach of building occupants shall not exceed 140°F (60°C) unless they are protected by insulation. Where sleeves are installed, the sleeve insulation shall retain its full size over the length of the material being protected.~~

(renumber remaining sections)

Substantiation:
Indoor piping for GSHP systems is governed by Chapter 4 (Hydronics). Therefore, Section 706.3 (Insulation) addresses materials and components outside the scope of Chapter 7 and unnecessarily duplicates provisions already addressed elsewhere in the code. Removing Section 706.3 improves clarity, reduces redundancy, and aligns GSHP installation requirements with the established organizational structure of the code.

> *[2025 USHGC ROP Preprint]*
> ***401.2 Insulation.*** *Where a hydronic system conveys fluid exceeding 140°F (60°C) or steam, piping surfaces within reach of building occupants shall be insulated to maintain a surface temperature of not more than 140°F (60°C). Where sleeves are installed, the insulation shall continue full size through them.*
> *Coverings and insulation used for piping shall be of material approved for the operating temperature of the system and the installation environment. Where installed in a plenum, the insulation, jackets, and lap-seal adhesives, including pipe coverings and linings, shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50 where tested in accordance with ASTM E84 or UL 723.*

Item #:
048

Code Number:
2024 USHGC

Section Number:
222.0, 401.4, 401.8

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

401.0 General.

401.4 Terminal Units. Terminal units~~, valves, and flow control devices~~ shall be installed in accordance with the manufacturer's installation instructions.

~~**401.8 Heat Emitters.** Heat emitters shall be installed in accordance with the manufacturer's installation instructions.~~

(renumber remaining sections)

222.0 - T -

<u>**Terminal Unit.** A device within a hydronic system that delivers heated or chilled water from the central system to a specific room or zone. Common types include, but are not limited to, radiators, baseboard heaters, fan coil units, radiant floor panels, or ceiling panels.</u>

SUBSTANTIATION:
Heat emitters are considered a type of terminal unit. Therefore, Section 401.8 (Heat Emitters) is redundant to Section 401.4 (Terminal Units) and is being deleted. In support of this change, a definition for "terminal unit" is being proposed which includes a list of common types addressed within Chapter 4 (Hydronics). Section 401.4 is also being revised to remove reference to valves and flow control devices since they are covered by other existing code sections.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
048

Code Number:
2024 USHGC

Sections(s):
401.4, 413.0 – 413.3, 414.1 – 414.4

Submitter Name:	**Organization Name:**	**Organization Representation:**
Jacob Fear	USHGC Hydronic Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

401.0 General.

~~401.4~~401.2 **Terminal Units.** Terminal units shall be installed in accordance with the manufacturer's installation instructions.
~~413.3~~401.3 **Balancing.** System loops shall be installed so that the design flow rates are achieved within the system.

(renumber remaining sections)

~~413.0 Hydronic Space Heating.~~
~~**413.1 General.** Based on the system design, the heat distribution units shall be selected in accordance with the manufacturer's specifications.~~
~~**413.2 Installation.** Heat distribution units shall be installed in accordance with the manufacturer's installation instructions and this code.~~

(renumber remaining sections)

414.0 Steam Systems.
414.1 Steam Traps. For other than one-pipe steam systems, each ~~heat distribution~~terminal unit shall be supplied with a steam trap that is listed for the application.
~~**414.2 Sloping for Two-Pipe System.** Two-pipe steam system piping and heat distributionterminal units shall be sloped down at not less than 1/8 inch per foot (10.4 mm/m) in the direction of the steam flow.~~
~~**414.3**~~**414.2** ~~**Sloping for One-Pipe System**~~**Pipe Slope**. ~~One pipe~~Supply and return lines for steam system piping ~~and heat distributionterminal units~~ shall be sloped ~~down at~~ not less than 1/8 inch per foot (10.4 mm/m) towards the steam boiler, without trapping.
~~414.4~~414.3 **Automatic Air Vents.** Steam automatic air vents shall be installed to eliminate air pressure in ~~heat-distribution~~terminal units on gravity steam piping systems. Air vents shall not be used on a vacuum system.

Substantiation:
"Heat-distribution units" are "terminal units," and for consistency all references throughout the chapter are being updated to use the term "terminal unit."

The requirements in Section 413.1 (General) and Section 413.2 (Installation) are redundant with Section 401.4 (Terminal Unit) and are being deleted. Additionally, Section 413.3 (Balancing) is being relocated under general requirements since balancing provisions are applicable to all hydronic systems.

Section 414.2 (Sloping for Two-Pipe System) currently requires two-pipe steam systems to slope all piping in the direction of steam flow, which effectively forces both supply and return lines to slope downward. This is not feasible when a steam supply line must rise from the boiler to serve upper floors, because the slope requirement conflicts with the physical routing of the system. The updated language resolves this by clarifying the sloping requirement so it can be applied in a practical manner without restricting standard multilevel steam-system design.

Item #:	**Code Number:**	**Section Number:**
049	2024 USHGC	401.6.1, 417.2, Table 401.11

SUBMITTER:	**Organization Name:**	**Organization Representation:**
Jeff Persons	Self	

RECOMMENDATION:
Revise text

Proposed Text :

401.0 General.

401.6 Heat Transfer Fluid Quality. (remaining text unchanged)
401.6.1 Ethylene Glycol. ~~Ethylene glycol shall not be~~ Where used in one- and two-unit residential systems, the concentration of ethylene glycol shall be nontoxic. ~~In existing systems, w~~Where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer or glycol feeder with isolation from a potable water connection shall be installed.

TABLE 401.11
PERCENT GLYCOL MIXTURES

* ~~Ethylene glycol shall not be~~ Where used in one- and two-unit residential systems, the concentration of ethylene glycol shall be nontoxic. ~~In existing systems w~~Where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer or glycol feeder with isolation from a potable water connection shall be installed.

(portions of table not shown remain unchanged)

417.0 Snow and Ice Melt Systems.

417.2 Snow and Ice Melt Controls. An automatic operating control device that controls the supply hydronic fluid temperature to the snow and ice melt area shall be installed in the system. Snow and ice melt systems shall be protected from freezing with a mixture of propylene glycol or ethylene glycol, and water or other approved fluid. Automotive antifreeze shall not be used. ~~Ethylene glycol shall not be~~Where used in one- and two-unit residential systems, the concentration of ethylene glycol shall be nontoxic. Where the hydronic fluid contains a chemical additive, a potable water supply shall be protected in accordance with Section 402.0.

SUBSTANTIATION:
The proposed update is needed to prevent overly restrictive requirements on the use of the ethylene glycol in hydronic systems. There are products currently on the market which are non-toxic and should be allowed to be used in one- and two-unit residential systems.

[Supporting documentation is provided in KAVI for TC review]

Committee Action:
Reject

Committee Statement:
Since ethylene glycol is inherently toxic, the proposed references to "nontoxic" ethylene glycol are ambiguous and unenforceable without a standardized definition or specification for what constitutes a nontoxic solution. Furthermore, specific labeling requirements may also be needed for systems using nontoxic ethylene glycol.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	**NEGATIVE:**	**ABSTAIN:**	**NOT RETURNED:**
14	1	0	0

EXPLANATION OF NEGATIVE:
PERSONS: Sources in the United Kingdom have developed a nontoxic ethylene glycol formulation now available in the United States (e.g., Thermox DTX). United States sources are also coming online with comparable lower viscosity products. We need to change our attitude toward ethylene glycol and allow for nontoxic formulations of ethylene glycol that exhibit lower viscosity and improved heat transfer.

Comment 1

Item #:	**Code Number:**	**Sections(s):**
049	2024 USHGC	215.0, 401.6 - 401.7, 401.9, 401.9.1, 402.4, 404.8, 413.4, 417.2, Table 401.9, Table 901.1

Submitter Name:	**Organization Name:**	**Organization Representation:**
Jacob Fear	USHGC Hydronic Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to **replace** the code change proposal by this public comment.

401.0 General.

401.6 Heat Transfer Fluid ~~Quality~~. Heat transfer fluids used in closed-loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.
~~402.4~~**401.6.1** **Compatibility.** Fluids used in hydronic systems shall be compatible with all components that will contact the fluid.
~~413.4~~**401.6.2** ~~**Heat Transfer Fluid**~~**Flash Point.** The flash point of heat transfer fluid in a hydronic piping system shall be not less than 50°F (28°C) above the maximum system operating temperature. The flash point of the heat transfer fluid shall be determined in accordance with ASTM D56, ASTM D93, or ASTM D3278. The heat transfer fluid shall be compatible with the makeup fluid supplied to the system.

~~401.6.1~~401.6.3 **Ethylene Glycol.** Ethylene glycol shall not be used in one- and two-unit residential systems.
Exception: Where approved by the Authority Having Jurisdiction, detoxified ethylene glycol shall be permitted to be used in one- and two-unit residential systems. Detoxified ethylene glycol shall have a median lethal dose (LD_{50}) of not less than 15 000 mg/kg where tested in accordance with 40 CFR 799.9110.

401.6.3.1 Connections. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.

~~401.7~~401.6.4 **Disposal of Hydronic Fluid.** Hydronic system fluids that contain additives such as antifreeze, corrosion inhibitors, and cleaning solutions shall be recycled or disposed of in an approved manner in accordance with the Authority Having Jurisdiction.

~~404.8~~401.6.5 **Identification of Chemical Additives.** In systems where chemical additives are used, documentation including the following information shall be readily accessible and maintained onsite:

(1) Concentrations
(2) Maintenance requirements
(3) Maintenance log
(4) Safety data sheet (SDS)

~~401.9~~401.7 **Freeze Protection.** Hydronic systems and components shall be ~~designed, installed, and protected from freezing~~designed and installed to prevent freezing under normal operating conditions. Where glycol is used for freeze protection, the percent of glycol by volume shall be determined based on the freezing point of the solution and type of mixture in accordance with Table ~~401.9~~401.7, or the manufacturer's specifications. Automotive antifreeze shall not be used.

~~401.9.1~~401.7.1 **Antifreeze Requirements.** Antifreeze shall be added to a closed hydronic system where one or more of the following conditions exist:

(1) System component(s) are exposed to freezing conditions,
(2) The hydronic system serves as a snow and ice melt system in accordance with Section 417.0, or
(3) Where required by the equipment manufacturer.

Exception: Antifreeze shall not be required where a system is continuously monitored or specifically designed not to require antifreeze, and is not subject to freezing as a result of either of the following:

(1) Loss of electrical power.
(2) Loss of a fuel source.

(renumber remaining sections)

TABLE ~~401.9~~401.7
PERCENT GLYCOL MIXTURES

~~* Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.~~

(portions of table not shown remain unchanged)

417.0 Snow and Ice Melt Systems.

417.2 Snow and Ice Melt Controls. An automatic operating control device that controls the supply hydronic fluid temperature to the snow and ice melt area shall be installed in the system. Snow and ice melt systems shall be protected from freezing ~~with a mixture of propylene glycol or ethylene glycol, and water or other approved fluid~~in accordance with Section 401.7 and Section 401.7.1. ~~Automotive antifreeze shall not be used.~~

215.0 - M -

Median Lethal Dose (LD_{50}). A statistically derived estimate of a single dose of a substance that can be expected to cause death in 50 percent of animals when administered by the oral route. The LD_{50} value is expressed in terms of weight of test substance per unit weight of test animal (mg/kg).

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
40 CFR 799.9110	TSCA Acute Oral Toxicity	Heat Transfer Fluid	401.6.3

(portions of table not shown remain unchanged)

Note: 40 CFR 799.9110 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:

This public comment reorganizes and groups provisions pertaining to heat transfer fluids, provides a new exception for detoxified ethylene glycol, and improves code language for freeze protection requirements.

Section 401.6.3 (Ethylene Glycol) retains the prohibition on ethylene glycol in one- and two-unit residential systems but adds an exception permitting detoxified ethylene glycol where approved by the Authority Having Jurisdiction and meeting specific criteria.

The specified median lethal dose ($LD_{50} \geq 15,000$ mg/kg) aligns with the classification for practically non-toxic substances on the Hodge and Sterner Scale, which is a widely recognized toxicity rating system used in safety assessments. The testing requirements for determining the fluid's median lethal dose are provided in 40 CFR 799.9110, under Section 4 of the Toxic Substances Control Act (TSCA).

For comparison, propylene glycol has an oral LD_{50} of approximately 20,000 mg/kg. Therefore, requiring this level of detoxification for ethylene glycol in residential systems ensures a comparable safety profile to propylene glycol. To support these provisions, a new definition for "median lethal dose (LD_{50})" is being proposed which correlates with the TSCA.

The following links are provided for your review:

- EPA (Final Contaminant Candidate List 3 Chemicals: Screening to a PCCL)

(See page 8 for the Hodge and Sterner Scale.)

- 40 CFR 799.9110 (TSCA acute oral toxicity)

Item #:
052

Code Number:
2024 USHGC

Section Number:
402.2, Table 901.1

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

402.0 Protection of Potable Water Supply.

402.2 Chemical Injection. Additives or chemicals shall be compatible with system components. Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by an air gap in accordance with ASME A112.1.2, an air gap fitting listed and labeled in accordance with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly listed and labeled in accordance with ASSE 1013, AWWA C511, CSA B64.4, or CSA B64.4.1.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
AWWA C511-2017 (R2021)	Reduced-Pressure Principle Backflow Prevention Assembly	Backflow Protection	402.2
CSA B64.4-2021	Reduced Pressure Principle (RP) Backflow Preventers	Backflow Protection	402.2
CSA B64.4.1-2021	Reduced Pressure Principle Backflow Preventers for Fire Protection Systems (RPF)	Backflow Protection	402.2

(portions of table not shown remain unchanged)

Note: AWWA C511, CSA B64.4, and CSA B64.4.1 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
Section 402.2 (Chemical Injection) is being updated to correlate with the standards provided in Table 603.2 (Backflow Prevention Devices, Assemblies, and Methods) of the 2024 UPC for reduced-pressure principle backflow prevention assemblies.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	**NEGATIVE:**	**ABSTAIN:**	**NOT RETURNED:**
15	0	0	0

Comment 1

Item #:	**Code Number:**	**Sections(s):**
052	2024 USHGC	503.0 – 503.3

Submitter Name:	**Organization Name:**	**Organization Representation:**
Edmond Murray	USHGC Solar Thermal Systems Task Group, Vice-Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

503.0 Protection of Potable Water Supply.
503.1 Prohibited Connections. Solar thermal systems using a heat transfer fluid other than potable water shall be constructed in such a manner that system fluid does not enter a portion of the potable water distribution system and is not separately delivered to any potable water fixture or point of use.
503.2 Chemical Injection. Additives or chemicals shall be compatible with system components. Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by an air gap in accordance with ASME A112.1.2, an air gap fitting listed and labeled in accordance with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly listed and labeled in accordance with ASSE 1013, AWWA C511, CSA B64.4, or CSA B64.4.1.
503.3 Protection of Potable Water. Where a solar thermal system uses a heat transfer fluid other than potable water and has a makeup fluid supply connected to a potable water system, the potable water system shall be protected from backflow in accordance with the plumbing code.

(renumber remaining sections)

Note: ASME A112.1.2, ASME A112.1.3, ASSE 1013, AWWA C511, CSA B64.4, and CSA B64.4.1 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The proposed sections are based on the hydronic system requirements in Section 402.0 (Protection of Potable Water Supply), modified to apply specifically to solar thermal systems using heat transfer fluids other than potable water.

Because the code also addresses direct (open-loop) systems that may heat and deliver potable water to fixtures, this distinction is necessary to avoid applying backflow and cross-connection requirements to such systems.

> ***[2025 USHGC ROP Preprint]***
> ***402.0 Protection of Potable Water Supply.***
> ***402.1 Prohibited Connections.*** *Hydronic systems or parts thereof, shall be constructed in such a manner that hydronic system fluid does not enter a portion of the potable water distribution system or from being separately delivered to any potable water fixture or point of use.*
> ***402.2 Chemical Injection.*** *Additives or chemicals shall be compatible with system components. Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by an air gap in accordance with ASME A112.1.2, an air gap fitting listed and labeled in accordance with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly listed and labeled in accordance with ASSE 1013, AWWA C511, CSA B64.4, or CSA B64.4.1.*
> ***402.3 Protection of Potable Water.*** *Where a hydronic system makeup fluid supply is connected to a potable water system, the potable water system shall be protected from backflow from the hydronic system in accordance with the plumbing code.*

Item #: 053	**Code Number:** 2024 USHGC	**Section Number:** 402.5, 407.3, 407.3.1
SUBMITTER: Jacob Fear	**Organization Name:** USHGC Hydronics Systems Task Group, Chair	**Organization Representation:**

RECOMMENDATION:
Revise text

Proposed Text :

402.0 Protection of Potable Water Supply.

402.5 Dual Purpose Water Heaters. Dual purpose water heaters shall be configured to maintain fluid separation between the potable water and the hydronic system fluid. Where an integral heat exchanger is installed in a dual purpose water heater, the installation shall comply with the requirements for a single-wall heat exchanger in Section 313.1. ~~Scald protection shall be provided on the potable water circuit in compliance with ASSE 1070/ASME A112.1070/CSA B125.70, point of generation requirements.~~

407.0 Heating Appliances and Equipment.

407.3 Dual Purpose Water Heaters. Water heaters used for combined space- and water-heating applications shall be in accordance with the standards referenced in Table 403.2, and shall be installed in accordance with the manufacturer's installation instructions. ~~Water used as the heat transfer fluid in t~~The hydronic ~~heating~~ system fluid shall be isolated from the potable water supply and distribution system in accordance with ~~Section 313.0, Section 314.0, and~~ Section 402.0.

407.3.1 Temperature Limitations. Where a ~~combined space- and~~combination potable water-heating ~~application~~and space-heating system requires water for space heating at temperatures ~~exceeding~~greater than 140°F (60°C), a ~~thermostatic~~temperature-actuated mixing valve ~~in accordance~~complying with ASSE 1017 or ASSE 1070/ASME A112.1070/CSA B125.70 shall be ~~installed to temper~~provided to limit the water supplied to the potable water distribution system to a temperature of 140°F (60°C) or less.

Note: ASSE 1070/ASME A112.1070/CSA B125.70 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The provisions for scald protection in Section 402.5 (Dual Purpose Water Heaters) are being relocated to Section 407.3.1 (Temperature Limitations) to maintain all related provisions within the same section. Section 407.3 (Dual Purpose Water Heaters) provides redundant and unnecessary references to Section 313.0 and Section 314.0, which are already included in Section 402.0. Additionally, the requirement for isolation should not be limited to systems using water as the heat transfer fluid.

The revisions to Section 407.3.1 (Temperature Limitations) make clear that the system is used for both potable water heating and space heating applications. Other revisions are for alignment with the included product listings and improvement of code language.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
053	2024 USHGC	402.5

Submitter Name:	Organization Name:	Organization Representation:
Arnie Rodio	USHGC-USPSHTC TCC, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

402.0 Protection of Potable Water Supply.

402.5 Dual Purpose Water Heaters. Dual purpose water heaters shall be configured to maintain fluid separation between the potable water and the hydronic system fluid. Where an integral heat exchanger is installed in a dual purpose water heater, the installation shall comply with the requirements for a single-wall heat exchanger in Section 313.1. Scald protection shall be provided on the potable water circuit in compliance with the plumbing code.

Substantiation:
The recommendation restores the scald protection requirement for potable water circuits and adds reference to the plumbing code. For reference, USHGC Item #053 removed the following requirement, "Scald protection shall be provided on the potable water circuit in compliance with ASSE 1070/ASME A112.1070/CSA B125.70, point of generation requirements."

The TCC disagrees with the previous reference to ASSE 1070/ASME A112.1070/CSA B125.70 as this standard is intended for valves installed at the point of use and does not align with the proposed application.

Comment 2

Item #:	Code Number:	Sections(s):
053	2024 USHGC	407.3.1, Table 901.1

Submitter Name:
Arnie Rodio

Organization Name:
USHGC-USPSHTC TCC, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

407.0 Heating Appliances and Equipment.

407.3 Dual Purpose Water Heaters. (remaining text unchanged)
407.3.1 Temperature Limitations. Where a combination potable water-heating and space-heating system requires water for space heating at temperatures greater than 140°F (60°C), a temperature-actuated mixing valve complying with ASSE 1017~~ or ASSE 1070/ASME A112.1070/CSA B125.70~~ shall be provided to limit the water supplied to the potable water distribution system to a temperature of 140°F (60°C) or less.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~ASSE 1070/ASME A112.1070 /CSA B125.70-2020 (R2025)~~	~~Water Temperature Limiting Devices~~	~~Valves~~	~~403.7.1~~

(portions of table not shown remain unchanged)

Substantiation:
The recommendation is for correlation with the actions taken by the UPC TC to "reject" Item #074 Public Comment 01 regarding listings for temperature-actuated mixing valves. Reference to ASSE 1070/ASME A112.1070/CSA B125.70 is being stricken as this standard is intended for valves installed at the point of use and does not align with the proposed application.

Comment 3

Item #:
053

Code Number:
2024 USHGC

Sections(s):
416.0, 416.1

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

407.0 Heating Appliances and Equipment.

~~416.0~~407.6 **Indirect-Fired Domestic Hot-Water Storage Tanks.** ~~**416.1 General.** Domestic hot-water heat exchangers, whether internal or external to the heating appliance, shall be permitted to be used to heat water in domestic hot water storage tanks. Tanks used to store hot water shall be listed for the intended use and constructed in accordance with nationally recognized standards. A pressure- and temperature relief valve with a set pressure not exceeding 150 percent of the maximum operating pressure of the system, and at a temperature of 210°F (99°C), shall be installed on the storage tank.~~Heating appliances shall be permitted to heat water for domestic hot-water storage tanks through a heat exchanger, whether integral or external to the heating appliance or the storage tank. Storage tanks shall be designed, constructed, and installed in accordance with Chapter 6. Heat exchangers shall comply with Section 313.0.
Where the normal operating temperature of the ~~boiler or dual purpose water heater that provides heat input for domestic hot water~~heating appliance exceeds 140°F (60°C), a ~~thermostatically controlled~~temperature-actuated mixing valve ~~in accordance with Section 407.3.1~~ complying with ASSE 1017 shall be installed to limit the water supplied to the potable hot water system to a temperature of 140°F (60°C) or less. ~~The potability of the water shall be maintained throughout the system.~~

(renumber remaining sections)

(shown for information purposes only)

313.0 Heat Exchangers.
313.1 General. Systems utilizing heat exchangers shall protect the potable water system from being contaminated by the heat transfer fluid. Systems that incorporate a single-wall heat exchanger to separate potable water from the heat transfer fluid shall meet the following requirements:
(1) Heat transfer fluid is either potable water or contains fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.
(2) A tag or label shall be securely affixed to the heat source with the word "CAUTION" and the following statements:
(a) The heat transfer fluid shall be water or other nontoxic fluid recognized as safe by the FDA.
(b) The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.
(3) The word "CAUTION" and the statements listed above shall have an uppercase height of not less than 0.120 of an inch (3.05 mm). The vertical spacing between lines of type shall be not less than 0.046 of an inch (1.168 mm). Lowercase letters shall be not less than compatible with the uppercase letter size specification.
Systems that do not comply with the requirements for a single-wall heat exchanger shall install a double-wall heat exchanger. Double-wall heat exchangers shall separate the potable water from the heat transfer fluid by providing a space between the two walls that are vented to the atmosphere.
313.2 Shutoff Valves. Shutoff valves shall be installed on the supply and return side of a heat exchanger.
Exception: Where a heat exchanger is an integral part of a boiler or is a part of a manufactured boiler and heat exchanger packaged unit, and is capable of being isolated from the hydronic system by supply and return valves.

Note: ASSE 1017 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
An indirect-fired domestic hot-water storage tank relies on a heating appliance as its heat source. Because the tank's operation and associated safety requirements are directly tied to the heating appliance's heat output, these provisions are consolidated under Section 407.0 rather than maintained as a standalone section.

Additionally, the section is being revised to reference Chapter 6 (Thermal Storage) for storage tank requirements instead of requiring compliance with "nationally recognized standards." Since Chapter 6 already addresses safety devices, such provisions are no longer needed in this section. Relevant existing requirements are also being referenced for heat exchangers.

> ***[2025 USHGC ROP Preprint]***
> ***603.4 Separate Storage Tanks.*** *For installations with separate storage tanks, a pressure relief valve and temperature relief valve or combination thereof shall be installed on both the main storage and auxiliary storage tank.*
>
> ***603.7.1 Safety Devices.*** *Pressure-type thermal storage tanks shall be installed with a listed combination temperature and pressure relief valve in accordance with Section 311.1. The temperature setting shall not exceed 210°F (99°C) and the pressure setting shall not exceed 150 percent of the maximum designed operating pressure of the system, or 150 percent of the established normal operating pressure of the piping materials, or the labeled maximum operating pressure of a pressure-type storage tank, whichever is less. The pressure and temperature setting shall not exceed the pressure and temperature rating of the tank or as recommended by the tank manufacturer. […]*

Lastly, the mixing valve requirement is being simplified by removing an unnecessary cross-reference to Section 407.3.1, which requires compliance with both ASSE 1017 and ASSE 1070. While ASSE 1017 covers mixing valves for hot water distribution systems, ASSE 1070 covers thermostatic mixing valves for point-of-use fixtures. Since this section addresses the interface between heating equipment and the domestic hot water storage system rather than point-of-use fixtures, ASSE 1017 is the appropriate standard and ASSE 1070 is not applicable.

Item #:
054

Code Number:
2024 USHGC

Section Number:
403.2, 403.3

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

403.0 Capacity of Heat Source.

403.2 Dual Purpose Water Heaters (Tank Type). Water heaters utilized for combined space-heating and water-heating applications shall comply with the standards referenced in Table 403.2, and shall be installed in accordance with the manufacturer's installation instructions. The total heating capacity of a dual purpose water heater shall be based on the sum of the potable hot water ~~requirements~~demand and the space heating design ~~requirements corrected for hot water first-hour draw recovery~~demand.

403.3 Tankless Water Heater. Tankless water heaters used in space-heating applications shall be rated by the manufacturer for space-heating applications, and the output ~~performance~~capacity shall be determined by the temperature rise and flow rate of water through the unit. The ~~ratings~~output capacity shall be expressed by the water temperature rise at a given flow rate. ~~Manufacturer's flow rates shall not be exceeded.~~The delivery flow rate through the unit shall not exceed the manufacturer's specifications.

SUBSTANTIATION:
The updates to Section 403.2 (Dual Purpose Water Heaters) and Section 403.3 (Tankless Water Heater) are for consistency with industry terminology and improvement of code language.

Section 403.2: The reference to "hot water first-hour draw recovery" creates unnecessary complexity. A more precise and industry standard way of describing the load calculation is "potable hot water demand and the space heating design demand."

Section 403.3: The term "output performance" is being replaced with "output capacity" as this terminology is used in HVAC and plumbing industries. "Output capacity" refers to the heat energy delivered to the water, which is more precise and quantifiable. Additionally, the last sentence of the section is slightly vague in that it doesn't specify whether it refers to the maximum allowable flow rate or actual operational flow rate (delivery flow rate) of the water heater.

Committee Action:
Reject

Committee Statement:
There are concerns regarding potential conflicts between the proposed updates and recent actions by the UMC and UPC Technical Committees related to the sizing of dual purpose and tankless water heaters.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
054

Code Number:
2024 USHGC

Sections(s):
402.5, 403.0 - 403.3, 407.2 - 407.3.1, Table 403.2, Table 901.1

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to **replace** the code change proposal by this public comment.

407.0 Heating Appliances and Equipment.

407.2 Dedicated Water Heaters. Water heaters serving as dedicated heat sources for hydronic systems shall be rated by the manufacturer for space-heating applications and installed in accordance with the manufacturer's installation instructions. Multiple water heaters shall be permitted to be installed in parallel to meet the design load.
~~403.3~~**407.2.1 Instantaneous (Tankless) Water Heater Sizing.** ~~Tankless water heaters used in space-heating applications shall be rated by the manufacturer for space-heating applications, and the output performance shall be determined by the temperature rise and flow rate of water through the unit. The ratings shall be expressed by the water temperature rise at a given flow rate. Manufacturer's flow rates shall not be exceeded.~~The instantaneous water heater capacity shall be based on the hot water demand for fixtures in gallons per minute (gpm) (L/s) and the temperature rise required to meet the design output temperature.
Exception: Instantaneous water heaters used for dual purpose applications shall be sized in accordance with the manufacturer's instructions.

~~403.2~~**407.3 Dual Purpose Water Heaters.** Water heaters utilized for combined space-heating and water-heating applications shall comply with the standards referenced in Table ~~403.2~~407.3, be rated by the manufacturer for combined water- and space-heating applications, and ~~shall be~~ installed in accordance with this code, the plumbing code, and the manufacturer's installation instructions.
Dual purpose water heaters shall be configured to maintain fluid separation between the potable water and the hydronic system fluid. Where an integral heat exchanger is installed in a dual purpose water heater, the installation shall comply with the requirements for a single-wall heat exchanger in Section 313.1.
407.3.1 Sizing. The total heating capacity of a dual purpose water heater shall be based on the sum of the potable hot water requirements and the space heating design requirements corrected for hot water first-hour draw recovery.
Exception: Instantaneous water heaters used for dual purpose applications shall be sized in accordance with the manufacturer's instructions.

~~407.3.1~~407.3.2 **Temperature Limitations.** Where a combination potable water-heating and space-heating system requires water for space heating at temperatures greater than 140°F (60°C), a temperature-actuated mixing valve complying with ASSE 1017 ~~or ASSE 1070/ASME A112.1070/CSA B125.70~~ shall be provided to limit the water supplied to the potable water distribution system to a temperature of 140°F (60°C) or less.

(renumber remaining sections)

TABLE ~~403.2~~407.3
WATER HEATERS

(portions of table not shown remain unchanged)

~~**402.5 Dual Purpose Water Heaters.** Dual purpose water heaters shall be configured to maintain fluid separation between the potable water and the hydronic system fluid. Where an integral heat exchanger is installed in a dual purpose water heater, the installation shall comply with the requirements for a single-wall heat exchanger in Section 313.1.~~

~~**403.0 Capacity of Heat Source.**~~
~~**403.1 Heat Source.** The heat source shall be sized to the design load.~~

~~**407.3 Dual Purpose Water Heaters.** Water heaters used for combined space- and water-heating applications shall be in accordance with the standards referenced in Table 403.2, and shall be installed in accordance with the manufacturer's installation instructions. The hydronic system fluid shall be isolated from the potable water supply and distribution system in accordance with Section 402.0.~~

(renumber remaining sections)

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~ASSE 1070/ASME A112.1070 /CSA B125.70-2020 (2025)~~	~~Water Temperature Limiting Devices~~	~~Valves~~	~~403.7.1~~

(portions of table not shown remain unchanged)

(shown for information purposes only)

313.0 Heat Exchangers.
313.1 General. Systems utilizing heat exchangers shall protect the potable water system from being contaminated by the heat transfer fluid. Systems that incorporate a single-wall heat exchanger to separate potable water from the heat transfer fluid shall meet the following requirements:
(1) Heat transfer fluid is either potable water or contains fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.
(2) A tag or label shall be securely affixed to the heat source with the word "CAUTION" and the following statements:

(a) The heat transfer fluid shall be water or other nontoxic fluid recognized as safe by the FDA.
(b) The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.
(3) The word “CAUTION” and the statements listed above shall have an uppercase height of not less than 0.120 of an inch (3.05 mm). The vertical spacing between lines of type shall be not less than 0.046 of an inch (1.168 mm). Lowercase letters shall be not less than compatible with the uppercase letter size specification.
Systems that do not comply with the requirements for a single-wall heat exchanger shall install a double-wall heat exchanger. Double-wall heat exchangers shall separate the potable water from the heat transfer fluid by providing a space between the two walls that are vented to the atmosphere.

Substantiation:
The requirements for dual purpose water heaters are currently scattered across multiple sections, and the updated text consolidates these requirements under Section 407.0 (Heating Appliances and Equipment). Additionally, the updated sections provide a clear distinction between dedicated water heaters and dual purpose water heaters. The current code conflates these applications, particularly with tankless water heaters, which can serve either function.

Furthermore, the sections containing fluid separation requirements for dual purpose water heaters are redundant and only provide circular references. Therefore, these requirements are being merged, and the redundant sections are being deleted.

The current sizing criteria describes capacity in vague terms such as "temperature rise and flow rate" instead of specifying what those values are based on, and this public comment incorporates the sizing requirements proposed by the UPC Water Heater Task Group, which provide clear guidance based on application:

- For instantaneous water heaters used as dedicated heat sources, sizing is based on the flow rate in gallons per minute (gpm) and the temperature rise needed to meet design output.
- For dual purpose water heaters, sizing must account for both the potable hot water demand and the space heating load, corrected for first-hour draw recovery.
- An exception is provided for instantaneous water heaters in dual purpose applications since sizing these units for simultaneous domestic and space heating loads involves manufacturer-specific variables.

Lastly, Section 407.3.1 is being updated to remove reference to ASSE 1070 which covers thermostatic mixing valves for point-of-use fixtures. While ASSE 1017 covers mixing valves for hot water distribution systems, ASSE 1070 is not applicable.

Comment 2

Item #:
054

Code Number:
2024 USHGC

Sections(s):
403.2, 403.3

Submitter Name:
Arnie Rodio

Organization Name:
USHGC-USPSHTC TCC, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to **replace** the code change proposal by this public comment.

403.0 Capacity of Heat Source.

403.2 Dual Purpose Water Heaters. Water heaters utilized for combined space-heating and water-heating applications shall comply with the standards referenced in Table 403.2, and shall be installed in accordance with this code, the plumbing code, and the manufacturer's installation instructions. The total heating capacity of a dual purpose water heater shall be based on the sum of the potable hot water requirements and the space heating design requirements corrected for hot water first-hour draw recovery.
Exception: Instantaneous water heaters used for dual purpose applications shall be sized in accordance with the manufacturer's instructions.

403.3 Instantaneous (Tankless) Water Heater Sizing. ~~Tankless water heaters used in space-heating applications shall be rated by the manufacturer for space heating applications, and the output performance shall be determined by the temperature rise and flow rate of water through the unit. The ratings shall be expressed by the water temperature rise at a given flow rate. Manufacturer's flow rates shall not be exceeded.~~Instantaneous water heaters shall be installed in accordance with the manufacturer's installation instructions. The instantaneous water heater capacity shall be based on the hot water demand for fixtures in gallons per minute (gpm) (L/s) and the temperature rise required to meet the design output temperature.
Exception: Instantaneous water heaters used for dual purpose applications shall be sized in accordance with the manufacturer's instructions.

Substantiation:
The recommendation is for correlation with the actions taken by the UMC TC to "accept as submitted" Item #210 Public Comment 01 regarding sizing of dual purpose and instantaneous water heaters.

As stated in the substantiation provided for UMC Item #210 Public Comment 01: "The proposed text is for harmonization with the requirements generated by the UPC Water Heater Task Group for tankless water heaters in the UPC. The sizing of instantaneous water heaters is determined by the required temperature rise from the water inlet temperature to the desired outlet temperature. Based on this criterion, the group developed base requirements for sizing and deferred installation requirements to the manufacturer's installation instructions. Following the manufacturer's instructions is particularly important for both sizing and installation of instantaneous dual-purpose water heaters, as specifications vary widely by manufacturer."

> ***[2025 UMC ROC Preprint]***
> ***1203.2 Dual Purpose Water Heaters.*** *Water heaters utilized for combined space-heating and water-heating applications shall comply with the standards referenced in Table 1203.2, and shall be installed in accordance with this code, the plumbing code, and the manufacturer's installation instructions. The total heating capacity of a dual purpose water heater shall be based on the sum of the potable hot water requirements and the space heating design requirements corrected for hot water first-hour draw recovery.*
> ***Exception:*** *Instantaneous water heaters used for dual purpose applications shall be sized in accordance with the manufacturer's instructions.*
> ***1203.3 Instantaneous (Tankless) Water Heater Sizing.*** *Instantaneous water heaters shall be installed in accordance with the manufacturer's installation instructions. The instantaneous water heater capacity shall be based on the hot water demand for fixtures in gallons per minute (gpm) (L/s) and the temperature rise required to meet the design output temperature.*
> ***Exception:*** *Instantaneous water heaters used for dual purpose applications shall be sized in accordance with the manufacturer's instructions.*

Item #:
055

Code Number:
2024 USHGC

Section Number:
Table 403.2

SUBMITTER:
Jacob Fear

Organization Name:
Chair, USHGC Hydronics Systems Task Group

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 403.2
WATER HEATERS

TYPE	STANDARDS
Gas-Fired, 75,000 Btu/h or less, Storage	CSA/ANSI Z21.10.1/CSA 4.1
Gas-Fired, Above 75,000 Btu/h Storage, Circulating and Instantaneous	CSA/ANSI Z21.10.3/CSA 4.3
Electric, Space Heating	UL 834
Solid Fuel-Fired	UL 2523
Heat Pump	UL 1995 or UL 60335-2-40

For SI units: 1000 British thermal units per hour = 0.293 kW

Note: UL 1995 and UL 60335-2-40 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
UL 1995 and UL 60335-2-40 are appropriate product standards for heat pump water heaters (HPWHs) in Table 403.2 (Water Heaters). While UL 60335-2-40 has effectively superseded UL 1995 for new product certifications, many existing HPWHs on the market are still listed under UL 1995. Therefore, both standards should be included to avoid inadvertently excluding these products.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
055

Code Number:
2024 USHGC

Sections(s):
Table 403.2, 407.5, 706.1, Table 901.1

Submitter Name:
Arnie Rodio

Organization Name:
USHGC-USPSHTC TCC, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 403.2
WATER HEATERS

TYPE	STANDARDS
Gas-Fired, 75,000 Btu/h or less, Storage	CSA/ANSI Z21.10.1/CSA 4.1
Gas-Fired, Above 75,000 Btu/h Storage, Circulating and Instantaneous	CSA/ANSI Z21.10.3/CSA 4.3
Electric, Space Heating	UL 834
Solid Fuel-Fired	UL 2523
Heat Pump	~~UL 1995 or~~ UL 60335-2-40

For SI units: 1000 British thermal units per hour = 0.293 kW

407.0 Heating Appliances and Equipment.

407.5 Heat Pumps. Heat pumps shall comply with ~~UL 1995 or~~ UL 60335-2-40. Air-source heat pumps shall also comply with AHRI 210/240. In addition, ground-source heat pumps shall comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

706.0 Specific System Components Design.

706.1 General. Heat pumps shall comply with ~~UL 1995 or~~ UL 60335-2-40. Ground coupled and water source heat pumps shall also comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Direct Exchange (DX) heat pumps shall comply with AHRI 870 and shall be tested in accordance with ASHRAE 194. Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~UL 1995-2015~~	~~Heating and Cooling Equipment (with revisions through August 1, 2022)~~	~~Heat Pumps~~	~~Table 403.2, 407.5, 706.1~~

(portions of table not shown remain unchanged)

Substantiation:
The recommendation is for correlation with the actions taken by the UPC/UMC TCC to "accept as submitted" ROP TCC Item #009 (revising UMC Item #211) with regards to listings for heat pumps. References to UL 1995 are being stricken as this standard has been superseded by UL 60335-2-40.

Item #:
057

Code Number:
2024 USHGC

Section Number:
404.7

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Add new text

Proposed Text :

404.0 Identification of Potable and Nonpotable Water Piping Systems.

404.7 Heat Transfer Fluid. Hydronic piping shall be identified with an orange background with black uppercase lettering, with the words "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."
Each hydronic system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 404.3.
Each outlet on the hydronic piping system shall be posted with black uppercase lettering as follows:
"CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."

(renumber remaining sections)

SUBSTANTIATION:
The proposed language mimics existing requirements in Section 501.16 (Heat Transfer Fluid) as shown below. These same requirements are also applicable in Chapter 4 (Hydronics).

Since the provisions of Section 501.16 specifically apply to "solar thermal piping," direct reference to this section is not suitable. Instead, the language is being duplicated with the charging statement specifying applicability to "hydronic piping."

> *[2024 USHGC]*
> ***501.16 Heat Transfer Fluid.*** *Solar thermal piping shall be identified with an orange background with black uppercase lettering, with the words "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."*
> *Each solar thermal system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 404.3.*
> *Each outlet on the solar thermal piping system shall be posted with black uppercase lettering as follows: "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."*

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
057

Code Number:
2024 USHGC

Sections(s):
404.1 – 404.7, Table 404.3

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

404.0 Identification of Potable and Nonpotable Water Piping Systems.
404.1 General. In buildings where potable ~~water~~ and nonpotable water systems are installed, each system shall be clearly identified in accordance with Section ~~404.2~~404.1.1 through Section ~~404.8~~404.3.1.
404.1.1 Application. Each system shall be identified with a colored pipe or band and coated with paint, wraps, and materials compatible with the piping. The minimum size of the letters and length of the color field shall comply with Table 404.1.1. The background color and required information shall be indicated every 20 feet (6096 mm) but not less than once per room, and shall be visible from the floor level.

TABLE ~~404.3~~**404.1.1**
MINIMUM LENGTH OF COLOR FIELD AND SIZE OF LETTERS

(portions of table not shown remain unchanged)

404.2 Water Supply Systems. Potable water supply systems shall be identified with a green background and white lettering. Nonpotable water supply systems shall be identified with a yellow background and black uppercase lettering including the words "CAUTION: NONPOTABLE WATER, DO NOT DRINK," the type of fluid being conveyed, and the direction of flow.
404.3 Hydronic Systems. Hydronic piping shall be identified with an orange background and black uppercase lettering including the words "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK," the type of fluid being conveyed, and the direction of flow.
404.3.1 Outlets. Each outlet on the hydronic piping system shall be posted with black uppercase lettering as follows: "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."

~~**404.2 Color and Information.** Each system shall be identified with a colored pipe or band and coded with paint, wraps, and materials compatible with the piping.~~
~~**404.3 Potable Water.** Potable water systems shall be identified with a green background with white lettering. The minimum size of letters and length of the color field shall be in accordance with Table 404.3.~~
~~**404.4 Nonpotable Water.** Nonpotable water systems shall have a yellow background with black uppercase lettering, with words "CAUTION: NONPOTABLE WATER, DO NOT DRINK." Each nonpotable system shall be identified to designate the liquid being conveyed, and the direction of normal flow shall be clearly shown. The minimum size of the letters and length of the color field shall comply with Table 404.3.~~

~~**404.5 Location of Piping Identification.** The background color and required information shall be indicated every 20 feet (6096 mm) but not less than once per room, and shall be visible from the floor level.~~

~~**404.6 Flow Directions.** Flow directions shall be indicated on the system.~~

~~**404.7 Heat Transfer Fluid.** Hydronic piping shall be identified with an orange background with black uppercase lettering, with the words "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."~~

~~Each hydronic system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 404.3.~~

~~Each outlet on the hydronic piping system shall be posted with black uppercase lettering as follows: "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."~~

Substantiation:

The identification requirements for potable and nonpotable water piping systems originated from the plumbing code and specifically apply to water supply piping. However, this distinction was not carried over, which created a conflict by providing separate identification requirements for potable water, nonpotable water, and heat transfer fluid systems. Since heat transfer fluids are inherently nonpotable, this resulted in ambiguity regarding which requirements applied to hydronic systems.

To resolve this conflict, the updated text distinguishes between water supply systems and hydronic systems. The general requirements (colored pipe or band identification, compatible materials, letter sizing, color field length, and placement intervals) applicable to all system types are now presented in a single section.

Item #:
066

Code Number:
2024 USHGC

Section Number:
410.16.1

SUBMITTER:
Jacob Fear

Organization Name:
USHGC Hydronics Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

410.0 Joints and Connections.

410.16 Joints Between Different Materials. (remaining text unchanged)
410.16.1 Copper or Copper Alloy Pipe or Tubing to ~~Threaded~~ Pipe Joints of Other Materials. Joints from copper or copper alloy pipe or tubing to ~~threaded~~ pipe of a material other than copper or copper alloy shall be made by the use of copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a grooved, soldered, brazed, flared, or pressed joint, and the connection between the ~~threaded~~other material pipe and the fitting shall be made with a standard pipe size threaded joint or press-connect joint.

SUBSTANTIATION:
This code change proposal introduces grooved joints and press-connect joints as additional joining methods allowed between copper or copper alloy piping/tubing and other materials. The current provisions are overly restrictive and prohibit the use of available and appropriate joining methods.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
14

NEGATIVE:
1

ABSTAIN:
0

NOT RETURNED:
0

EXPLANATION OF NEGATIVE:
CUDAHY: There are times when a transition fitting, not an adapter fitting, is used to transition from copper to other materials, usually to deal with temperature swings that may cause leaks from differences in thermal expansion and contraction. We should include transition fittings here.

Comment 1

Item #:
066

Code Number:
2024 USHGC

Sections(s):
410.16.1, 410.16.2.1

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

410.0 Joints and Connections.

410.16 Joints Between Different Materials. (remaining text unchanged)
410.16.1 Copper or Copper Alloy Pipe or Tubing to Other Metallic Pipe ~~Joints of Other~~ Materials. Joints from copper or copper alloy pipe or tubing to ~~pipe of a material other than copper or copper alloy~~other metallic pipe materials shall be made by the use of copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a grooved, soldered, brazed, flared, or pressed joint and the connection between the other material pipe and the fitting shall be made with a standard pipe size threaded joint or press-connect joint.

410.16.2 Plastic Pipe to Other Materials. (remaining text unchanged)
410.16.2.1 ~~Transition Joint~~Solvent Cement Joints Between ABS and PVC. For non-pressurized systems rated at 25 pounds-force per square inch (psi) (172 kPa) or less, a solvent cement transition joint between ABS and PVC drainpipe and fittings shall be made using listed transition solvent cement in accordance with ASTM D3138. PVC and ABS pipe and fittings shall not be solvent welded to any other unlike material.

Substantiation:
Section 410.16.1 is being revised to clarify that the requirements are specific to metallic pipe connections. The current text uses the phrase "other materials," which could be misinterpreted to include transitions to plastic pipe.

Even though the specified connection methods are not applicable to plastic pipe, and transitions from copper to plastic pipe are already addressed in Section 410.16.2 (Plastic Pipe to Other Materials), the updated title and text further clarify that Section 410.16.1 applies only to metal-to-metal transitions and prevents misapplication.

Section 410.16.2.1 is also being retitled to indicate what type of transition is being addressed, solvent cement joints between ABS and PVC materials.

Item #:
067

Code Number:
2024 USHGC

Section Number:
412.4 - 412.4.2, Figure 412.4.1.1

SUBMITTER:
Lee Stevens

Organization Name:
LH Stevens Constructors LLc

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

412.0 Pressure and Flow Controls.

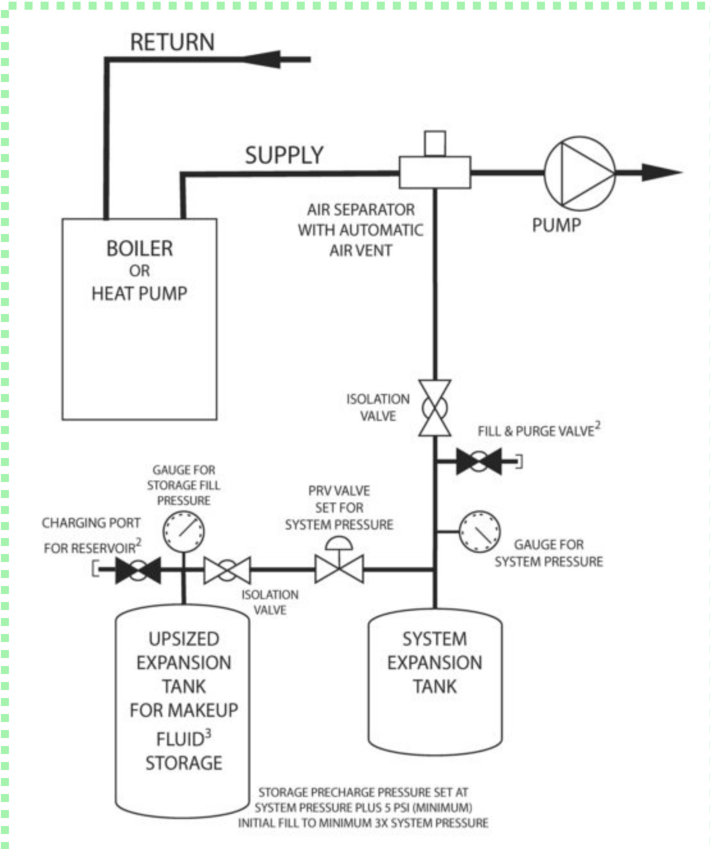
412.4 Automatic Makeup Fluid. ~~Automatic makeup fluid shall be in accordance with Section 412.4.1 for potable water makeup fluid or Section 412.4.2 for nonpotable makeup fluid.~~Where an automatic makeup fluid supply fill device is used to maintain the fluid content of a closed loop hydronic system, or any closed loop in the system, the makeup supply source shall introduce the makeup fluid at the expansion tank or other approved location. A pressure reducing valve or pressure control system shall be installed on the makeup feed line. The pressure of the makeup feed line shall be set in accordance with the design of the system. Makeup fluid supplied to the system shall be in accordance with Section 401.6 and be equivalent to or consistent with the installed hydronic system fluid. Automatic makeup fluid systems shall be in accordance with Section 412.4.1 or Section 412.4.1.1 for potable water makeup fluid or Section 412.4.2 for nonpotable makeup fluid.

~~**412.4.1 Potable Makeup Fluid.** Where a potable water automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location.~~
~~On systems using only water as a heat transfer medium, and where pressurization is achieved using a potable water supply, a pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 402.0 to prevent contamination due to backflow.~~

~~**412.4.2 Nonpotable Makeup Fluid.** Makeup fluid systems that are designed to add pre-mixed antifreeze solutions shall be permitted. Such systems shall include, but not be limited to, glycol feeders and limited-volume reservoir systems. On systems using additives, such as glycol or corrosion inhibitors, the use of a system pressurization unit or glycol feeder shall be required. The fluid capacity of the tank or reservoir shall not exceed the greater of 5 gallons (19 L), or 5 percent of the total system fluid volume.~~

412.4.1 Automatic Makeup Fluid for Systems Using Potable Water. Where the domestic potable water supply meets the requirements of Section 401.6 and is used to fill the system, and the automatic makeup fluid supply source is the domestic potable water supply, connections to the potable water supply shall be in accordance with Section 402.0 to prevent contamination due to backflow. Where an automatic makeup water supply fill device is installed, the hydronic system shall be filled, purged and commissioned. Thereafter, the makeup water fill system shall automatically shut off the makeup supply when the accumulated volume of supplied makeup fluid reaches 5 gallons (19 liters) or 5 percent of the total system volume, whichever is greater. The makeup fluid supply system shall then require a manual reset prior to the introduction of additional makeup fluid into the hydronic system.
Exception: Where the volume of supplied makeup fluid is continuously monitored by permanently installed system controls, the volume limitation shall not be required.

412.4.1.1 Potable Water Reservoir System. Where domestic potable makeup water is supplied by a system pressurization unit or reservoir system that has no permanent connection to the domestic potable water system, the fluid capacity of the potable water makeup reservoir system shall not exceed the greater of 5 gallons (19 L), or 5 percent of the total system fluid volume. Where a temporary connection to a potable water supply system is required, a backflow preventer shall be utilized. Backflow prevention from the system into the reservoir shall not be required. Metering of the introduced makeup fluid volume shall not be required. See Figure 412.4.1.1 for an example of a simplified schematic of a makeup supply reservoir system.



For SI units: 1 pound-force per square inch = 6.8947 kPa

Notes:

[1] This schematic does not include all system components, and configurations may vary based on design.

[2] Where a temporary potable water connection is required, a backflow preventer shall be utilized.

[3] Makeup fluid may be potable water, distilled water, chemically treated water, water-antifreeze mix, or a fluid otherwise compatible with the system fluid.

FIGURE 412.4.1.1

EXAMPLE: MAKEUP SUPPLY RESERVOIR SYSTEM (SIMPLIFIED SCHEMATIC)[1,2,3]

412.4.2 Automatic Makeup Fluid for Systems Using Nonpotable Water. Where the hydronic system is filled with a nonpotable fluid, such as an antifreeze solution, or incorporates a chemical feeder, there shall be no direct or permanent connection to the potable water system. Where a temporary connection to a potable water supply system is required, a backflow preventer shall be utilized. A system pressurization unit or reservoir system shall be required as the source for makeup fluid. The fluid capacity of the pressurization unit or reservoir system shall not exceed 5 gallons (19 liters) or 5 percent of the total system volume, whichever is greater.

Exceptions:

(1) Where the volume of supplied makeup fluid is continuously monitored by permanently installed system controls, the volume limitation shall not be required.

(2) Where a chemical feeder is installed on a system otherwise filled with potable water, an automatic makeup fluid system in accordance with Section 412.4.1 shall be permitted. See Figure E 102.1(1) for an example of a simplified schematic of a potable water supply makeup system feeding a system filled with potable water.

(shown for information purposes only)

401.6 Heat Transfer Fluid Quality. Heat transfer fluids used in closed-loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.

401.6.1 Ethylene Glycol. Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.

402.0 Protection of Potable Water Supply.

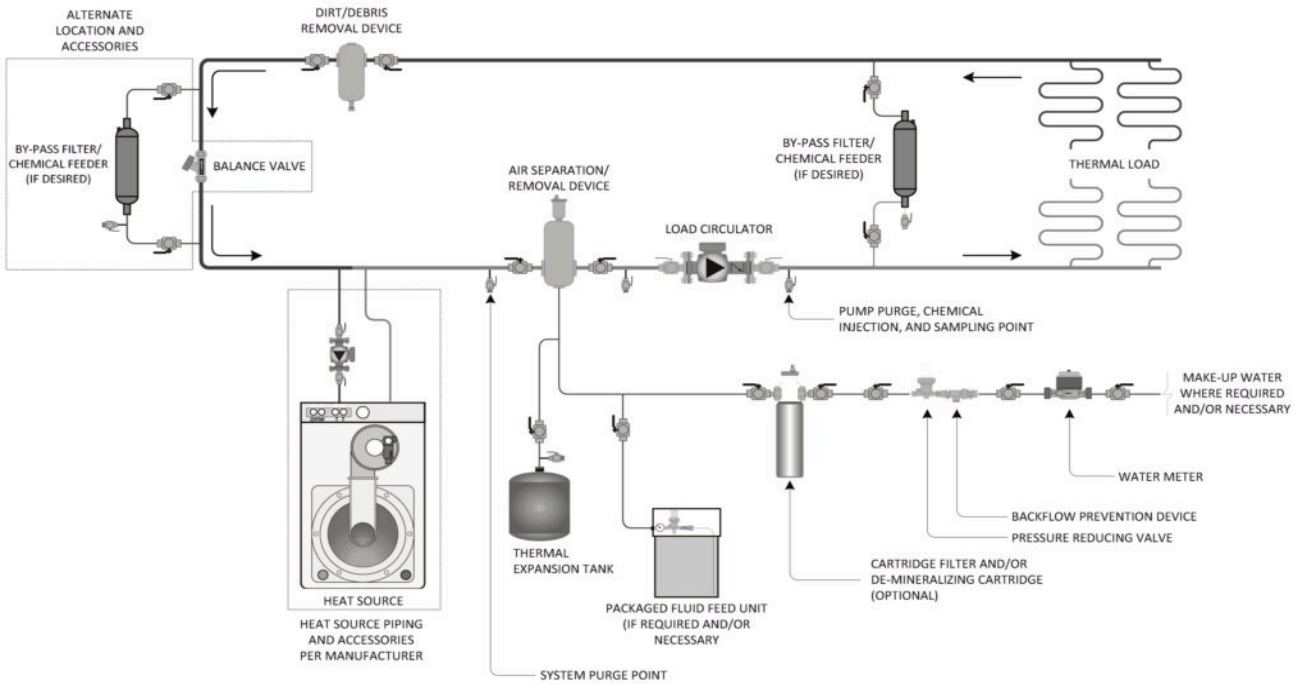
402.1 Prohibited Connections. Hydronic systems or parts thereof, shall be constructed in such a manner that hydronic system fluid does not enter a portion of the potable water distribution system or from being separately delivered to any potable water fixture or point of use.

402.2 Chemical Injection. Additives or chemicals shall be compatible with system components. Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by an air gap in accordance with ASME A112.1.2, an air gap fitting listed and labeled in accordance with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly listed and labeled in accordance with ASSE 1013.

402.3 Protection of Potable Water. Where a hydronic system makeup fluid supply is connected to a potable water system, the potable water system shall be protected from backflow from the hydronic system in accordance with the plumbing code.

402.4 Compatibility. Fluids used in hydronic systems shall be compatible with all components that will contact the fluid.

402.5 Dual Purpose Water Heaters. Dual purpose water heaters shall be configured to maintain fluid separation between the potable water and the hydronic system fluid. Where an integral heat exchanger is installed in a dual purpose water heater, the installation shall comply with the requirements for a single-wall heat exchanger in Section 313.1. Scald protection shall be provided on the potable water circuit in compliance with ASSE 1070/ASME A112.1070/CSA B125.70, point of generation requirements.



* This configuration is not applicable to hydronic systems containing antifreeze on the load side of the system. [e.g. snow and ice melt systems (SIMS)]

FIGURE E 102.1(1)
NEAR BOILER PIPING SCHEMATIC – CHEMICAL ADDITIVES*

SUBSTANTIATION:
The present code language has the unfortunate effect of absolving nonpotable makeup fluid from the requirements for:

- Location at the expansion tank or other approved location
- Pressure reducing valve
- Pressure of the feed line set in accordance with the design of the system

The requirement in existing Section 412.4.2 (Nonpotable Makeup Fluid) regarding chemical feeders is overly restrictive, as chemical feeders are allowed to employ a potable water makeup supply per Section 401.6 (Heat Transfer Fluid Quality) and IAPMO/ANSI H1001.1.

This should be remedied by an overarching Section 412.4 that addresses all types of makeup supplies and systems. For consistency between code sections, Section 412.4 should also reference compliance with Section 401.6, and there should be clear distinctions made between the types of system fluid, makeup fluid, and makeup delivery systems with respect to specific code requirements.

By incorporating IAPMO/ANSI H1001.1 into the code as a requirement, system water quality is now mandated, with implications for the makeup supply. The included limitation of no more than 5% makeup by volume, without manual intervention, has several purposes. This ensures basic system fluid quality, controls dilution in systems with antifreeze or chemical additives, and has the added benefit of limiting consequential water damage in the event of a breached or damaged system. It is important to differentiate between the use of potable water (of acceptable quality standards) and a connection to a potable (pressurized) water supply (also only if of acceptable water quality). The general thrust of this ANSI standard is toward isolation of hydronic systems from a potable water supply, which is encouraged by the use of system pressurization units or reservoirs. This should be further encouraged by placing equivalent makeup volume limitations on potable water supply makeup systems as well, for all the previously stated reasons.

The intent of this proposed language is to trigger the makeup limitation only after successful start-up of the system, so that the true and necessary makeup volume is what is being limited. It is also important to maintain the essential requirements for the location of the makeup connection and for pressure control, whether the makeup supply is from a pressurized domestic potable system, a system feeder with a pump, or another equivalent makeup supply system.

This proposed wording makes clear that systems using chemical and glycol mixes must employ a feed system that introduces makeup fluid of acceptable characteristics and, therefore, will not create a dilution issue in the system fluid over the long term. Again, this is consistent with Section 401.6 and IAPMO/ANSI H1001.1.

Research shows that undamaged hydronic systems will typically require a maximum of about 0.5% makeup fluid by volume annually. It is also shown that municipal water supplies are typically under 2% entrained air by volume. The 5% makeup allowance can easily replace the entrained air volume that is extracted after startup and will typically still provide at least five years of makeup supply requirements. Therefore, this limitation is not an undue burden on the installer or facility owner, nor is it a boiler safety issue, due to the code requirements for low water cutoff or flow monitoring for boiler shutdown. It should be noted that many systems, particularly in Europe, operate very successfully with no automatic makeup supply at all. As the installation of an automatic makeup system is, in fact, discretionary, there should also be discretion allowed regarding a path to code compliance.

A system that is catastrophically damaged, such as by pipes freezing and splitting, can result in very significant and far more consequential damage. This can render a structure uninhabitable, at least over the short term, and can be greatly mitigated by the makeup volume limitation, which can prevent unlimited flooding and destruction of the structure. A prolonged slow leak in an inaccessible location can lead to mold growth, which may pose a serious health risk. If the connection to a potable water supply system is chosen as a path to compliance, the volume limitation for potable supply sources can be easily implemented using currently available off-the-shelf components, such as those used in the irrigation controls industry to meter water delivery volume. Such devices could be installed downstream of the backflow preventer and therefore would not need to be listed for use with potable water. A makeup volume limitation more accurately represents the intent of the current code than “monitoring system,” which is vague and ambiguous (does it monitor flow volume, system pressure, require regular human manual system checks, or something else?) and may therefore be unenforceable, particularly after a final inspection.

Committee Action:

Reject

Committee Statement:

The provided substantiation lacks sufficient technical justification for the proposed changes. The committee requests clear citation of any supporting research or data for review. Additionally, the committee disagrees with the proposed maximum volume for makeup fluid, as the specified value appears arbitrary and is not supported by evidence. Furthermore, the language in Section 412.4.2 (Automatic Makeup Fluid for Systems Using Nonpotable Water) represents best practices rather than enforceable minimum code requirements. The absence of a specified method for backflow prevention in this section further raises concerns regarding clarity and enforceability.

TOTAL ELIGIBLE TO VOTE:

15

AFFIRMATIVE:	**NEGATIVE:**	**ABSTAIN:**	**NOT RETURNED:**
15	0	0	0

Comment 1

Item #:
067

Code Number:
2024 USHGC

Sections(s):
412.4 – 412.4.2

Submitter Name:
Jacob Fear

Organization Name:
USHGC Hydronic Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to **replace** the code change proposal by this public comment.

412.0 Pressure and Flow Controls.

412.4 Automatic Makeup Fluid. Where an automatic makeup fluid supply fill device is used to maintain the fluid content of a closed-loop hydronic system, or any closed-loop in the system, the makeup supply source shall introduce the makeup fluid at the expansion tank or other approved location. Automatic makeup fluid shall ~~be in accordance~~also comply with Section 412.4.1 for potable water makeup fluid or Section 412.4.2 for nonpotable makeup fluid.

412.4.1 Potable Makeup Fluid. ~~Where a potable water automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed-loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location.~~ On systems using only water as a heat transfer fluid, and where pressurization is achieved using a potable water supply, a pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 402.0 to prevent contamination due to backflow.

412.4.2 Nonpotable Makeup Fluid. Makeup fluid systems that are designed to add pre-mixed antifreeze solutions shall be permitted. Such systems shall include, but not be limited to, glycol feeders and limited-volume reservoir systems. On systems using additives, such as glycol or corrosion inhibitors, the use of a system pressurization unit or glycol feeder shall be required. A pressure reducing valve or pressure control system shall be installed on the makeup feed line. The pressure of the makeup feed line shall be set in accordance with the design of the system.

Substantiation:
This revision reorganizes Section 412.4 (Automatic Makeup Fluid) to clarify requirements applicable to all automatic makeup fluid systems regardless of fluid type and to address two gaps in the current code.

First, the requirement that the makeup supply be located at the expansion tank connection or other approved location currently appears only in Section 412.4.1 (Potable Makeup Fluid), despite being equally applicable to nonpotable systems. This requirement is relocated to Section 412.4 so that it applies to all automatic makeup fluid systems.

Second, while Section 412.4.1 requires a pressure-reducing valve on potable makeup feed lines, Section 412.4.2 (Nonpotable Makeup Fluid) contains no equivalent pressure control requirement for nonpotable systems.

Nonpotable makeup systems, including those using glycol feeders or pressurization units, require pressure regulation to prevent overpressurization. Section 412.4.2 is therefore updated to require a pressure-reducing valve or pressure control system on nonpotable makeup feed lines.

Comment 2

Item #:	**Code Number:**	**Sections(s):**
067	2024 USHGC	412.4 - 412.4.2, Figure 412.4.1.1

Submitter Name:	**Organization Name:**	**Organization Representation:**
Lee Stevens	LH Stevens Constructors LLc	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

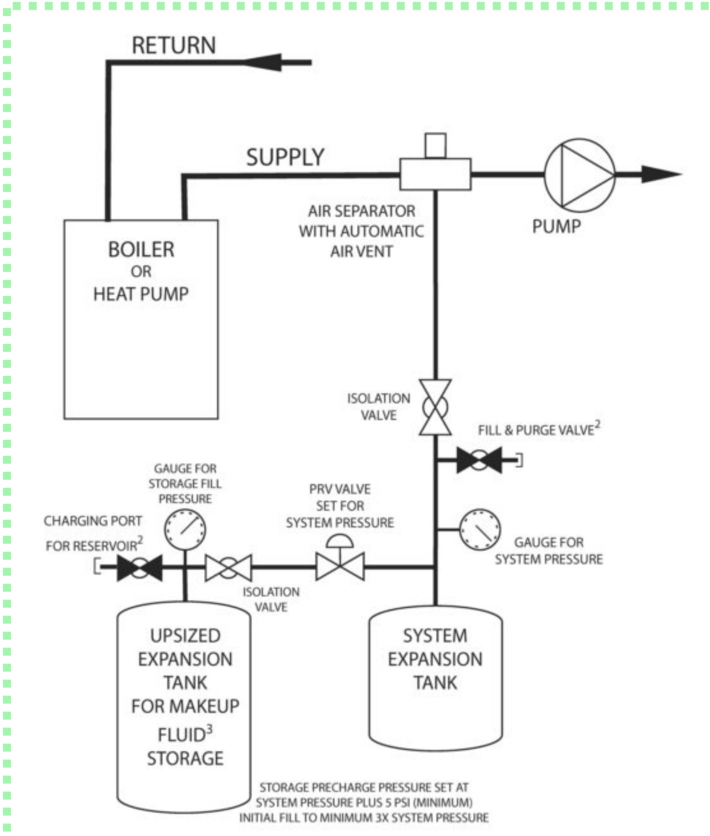
Request to **replace** the code change proposal by this public comment.

412.0 Pressure and Flow Controls.

412.4 Automatic Makeup Fluid. Where an automatic makeup fluid supply fill device is used to maintain the fluid content of a closed loop hydronic system, or any closed loop in the system, the makeup supply source shall introduce the makeup fluid at the expansion tank or other approved location. A pressure reducing valve or pressure control system shall be installed on the makeup feed line. The pressure of the makeup feed line shall be set in accordance with the system design. Makeup fluid supplied to the system shall be in accordance with Section 401.6 and shall be compatible with the installed hydronic system fluid. Automatic makeup fluid systems shall be in accordance with Section 412.4.1 or Section 412.4.1.1 for potable water makeup fluid or Section 412.4.2 for nonpotable makeup fluid.

412.4.1 Potable Makeup Fluid. ~~Where a potable water automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location. On systems using only water as a heat transfer fluid, and where pressurization is achieved using a potable water supply, a pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 402.0 to prevent contamination due to backflow.~~Where the domestic potable water supply meets the requirements of Section 401.6 and is used to fill the system, and the automatic makeup fluid supply source is the domestic potable water supply, connections to the potable water supply shall be protected from backflow in accordance with Section 402.3. After system commissioning, the makeup supply shall be limited to an accumulated volume of fluid of not more than 5 gallons (19 liters) or 5 percent of the total system volume, whichever is greater. The makeup fluid supply system shall be manually reset prior to the introduction of additional makeup fluid into the hydronic system.
Exception: Where the volume of supplied makeup fluid is continuously monitored by permanently installed system controls, the volume limitation shall not be required.

412.4.1.1 Potable Water Reservoir System. Where domestic potable makeup water is supplied by a system pressurization unit or reservoir system that has no permanent connection to the domestic potable water system, the fluid capacity of the potable water makeup reservoir system shall not exceed the greater of 5 gallons (19 L), or 5 percent of the total system fluid volume. Backflow protection from the hydronic system into the reservoir shall not be required. Where a temporary connection to a potable water supply system is required, backflow protection shall be provided in accordance with Section 402.3. Metering of the introduced makeup fluid volume shall not be required. (See Figure 412.4.1.1 for an example of a simplified schematic of a makeup supply reservoir system.)



For SI units: 1 pound-force per square inch = 6.8947 kPa
* This schematic does not include all system components, and configurations may vary based on design.

FIGURE 412.4.1.1
EXAMPLE: MAKEUP SUPPLY RESERVOIR SYSTEM (SIMPLIFIED SCHEMATIC)*

~~**412.4.2 Nonpotable Makeup Fluid.** Makeup fluid systems that are designed to add pre-mixed antifreeze solutions shall be permitted. Such systems shall include, but not be limited to, glycol feeders and limited-volume reservoir systems.On systems using additives, such as glycol or corrosion inhibitors, the use of a system pressurization unit or glycol feeder shall be required.~~

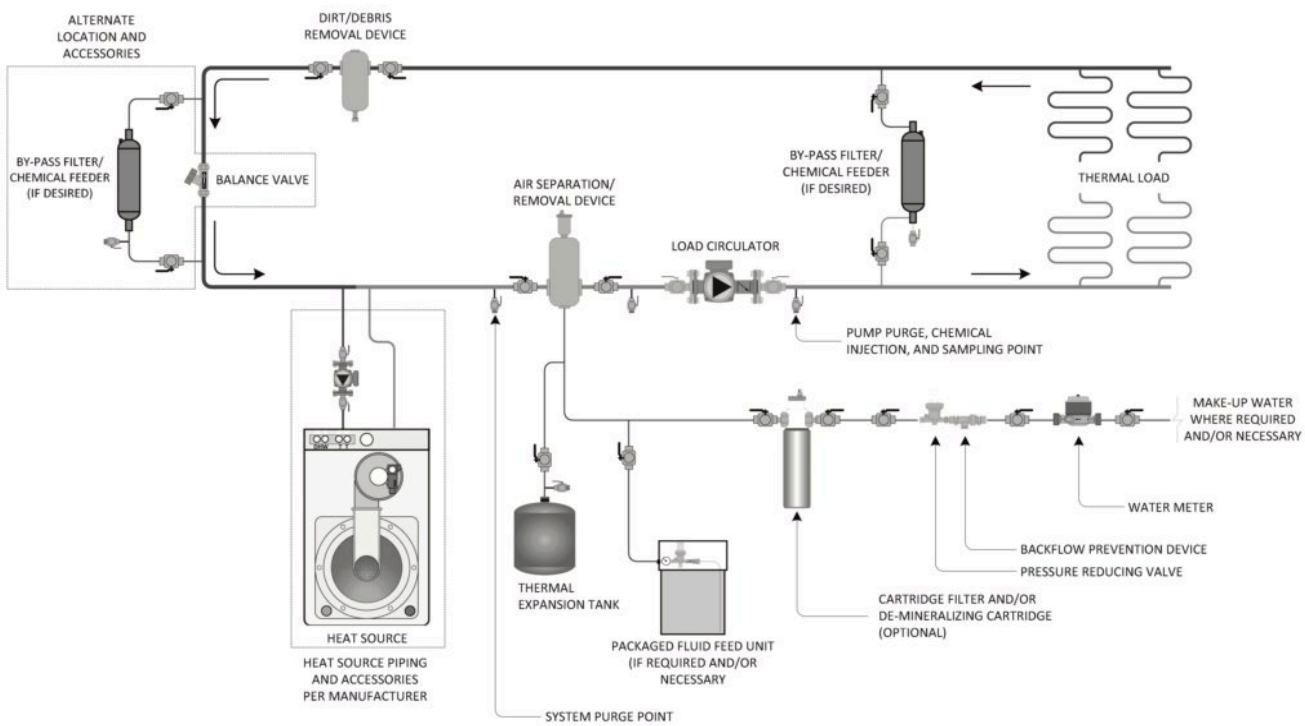
412.4.2 Automatic Makeup Fluid for Systems Using Nonpotable Water. Where the hydronic system is filled with a nonpotable fluid, such as an antifreeze solution, or incorporates a chemical feeder, there shall be no direct or permanent connection to the potable water system. A system pressurization unit or reservoir system shall be required as the source for makeup fluid. The fluid capacity of the pressurization unit or reservoir system shall not exceed 5 gallons (19 liters) or 5 percent of the total system volume, whichever is greater. Where a temporary connection to a potable water supply system is required, backflow protection shall be provided in accordance with Section 402.3.

Exceptions:
(1) Where the volume of supplied makeup fluid is continuously monitored by permanently installed system controls, the volume limitation shall not be required.
(2) Where a chemical feeder is installed on a system otherwise filled with potable water, an automatic makeup fluid system shall be permitted to be installed in accordance with Section 412.4.1. [See Figure E 102.1(1) for an example of a simplified schematic of a potable water supply makeup system feeding a system filled with potable water.]

(shown for information purposes only)

401.6 Heat Transfer Fluid Quality. Heat transfer fluid used in closed loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.

402.3 Protection of Potable Water. Where a hydronic system makeup fluid supply is connected to a potable water system, the potable water system shall be protected from backflow from the hydronic system in accordance with the plumbing code.



* This configuration is not applicable to hydronic systems containing antifreeze on the load side of the system. [e.g., snow and ice melt systems (SIMS)]

FIGURE E 102.1(1)
NEAR BOILER PIPING SCHEMATIC – CHEMICAL ADDITIVES*

Substantiation:
The present code language (Section 412.4 and Section 412.4.2) fails to include nonpotable makeup fluid in the requirements for:

- Location at the expansion tank or other approved location
- Pressure reducing valve
- Pressure of the feed line set in accordance with the design of the system

The language of Section 412.4.2 uses different nomenclature in different paragraphs, despite trying to identify and regulate the same things. “Glycol feeder” is a mis-representation, as a system filled with an antifreeze mix should be introducing the same mix in a makeup supply, not glycol alone. It is more accurate and consistent to refer to “system pressurization unit or reservoir system”. The second paragraph of Section 412.4.2 is overly restrictive regarding systems using chemical feeders, which are allowed to employ a potable water makeup supply, per Section 401.6 and IAPMO/ ANSI H1001.1.

This should be remedied by an over-arching Section 412.4 that addresses these issues for any and all types of makeup supplies and systems. For consistency between code sections, Section 412.4 should also reference compliance with Section 401.6. And, there should be clear distinctions made between types of system fluid, types of makeup fluid, and types of makeup delivery systems, as regarding specific code requirements. A chemical feeder may modify potable water into nonpotable status, but it is not a makeup fluid volume supply, and should not be lumped together with the same regulations as apply to a true makeup supply source. It is important to maintain the essential requirements for the location of the makeup connection (at the expansion tank, or the point of no mechanically induced pressure change), and for pressure control, whether the makeup supply is from a pressurized domestic potable system, a system feeder with a pump, or other equivalent makeup supply system.

By incorporating IAPMO/ ANSI H1001.1 into the code as a requirement, system water quality is now mandated, with implications for the makeup supply. The included limitation in the standard of no more than 5% makeup by volume, without manual intervention, has several purposes. This ensures basic system fluid quality, controls dilution in systems with antifreeze or chemical additives, and has the added benefit of limiting consequential water damage in the event of a breached or damaged system.

The 5% limitation, by volume, is derived from the fact that impeller pumps as used in hydronic systems will fail, if the entrained air content approaches or exceeds 4% by volume (1). This is due to cavitation and creation of an air bubble at the impeller, which grows and quickly results in the pump motor free-wheeling and burning out. Testing has shown that municipal water supplies are typically under 2% entrained air by volume (2), therefore fully usable for initial fill and startup of systems. The 5% makeup allowance can easily replace the entrained air volume that is extracted after startup, and typically will still provide at least an additional year of makeup supply requirements. Therefore, this limitation is not an undue burden on the installer or facility owner, nor is it a boiler safety issue, due to the code requirements for low water cutoff or flow monitoring for boiler shutdown.

It is important to differentiate between the use of potable water (of acceptable quality standards) and a connection to a potable (pressurized) potable water supply (also only if of acceptable water quality). The general thrust of this ANSI standard is towards isolation of hydronic systems from a potable water supply, which is encouraged by the use of system pressurization units or reservoirs. This should be further encouraged by putting equivalent makeup volume limitations on potable water supply makeup systems as well, for all of the previously stated reasons. The intent of this proposed language is to trigger the makeup limitation only after a successful start-up of the system, so that true and necessary makeup volume is what is being limited. The real intent of the proposed wording is to make system pressurization units or reservoir systems (such as an associated oversize expansion tank) the simplest means of code compliance, with all the attendant benefits thereof.

A system catastrophically damaged, such as by pipes freezing and splitting, can result in very significant and far more consequential damage to the structure. This can render a structure uninhabitable, at least over the short term, and can be greatly minimized by the makeup volume limitation, which can prevent unlimited flooding and destruction of the structure. A prolonged slow leak in an inaccessible location can lead to mold growth, which can be a serious health risk. If the connection to a potable water supply system as a path to compliance is taken, the volume limitation for potable supply sources can be easily realized with currently available off the shelf components, such as are used in the irrigation controls industry to meter water delivery volume.

Sources:

(1) Budris, Allan R. "Negative Effects of Air/Gas on Pump Performance, NPSHA/NPSHR." Water Tech Online, June 2009. https://www.watertechonline.com/wastewater/article/16194170/negative-effects-of-air-gas-on-pump-performance-npsha-npshr

(2) Smorol, Douglas R. "Air Entrainment in Public Water Supply." Aquafacts (New York Rural Water Association), Winter 2017/18, p. 9. https://www.nyruralwater.org/sites/default/files/Smorol_Winter%2017.pdf

"Solubility of Air in Water." The Engineering ToolBox. https://www.engineeringtoolbox.com/air-solubility-water-d_639.html

Gasses in Hydronic Systems. Technical Data - Air Elimination. Spirotherm, Inc., 2003. https://www.spirotherm.com/sites/default/files/TechnicalData-AirElimination_3.pdf

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Comment 3

Item #:	Code Number:	Sections(s):
067	2024 USHGC	412.4 - 412.4.2, Figure 412.4.1.1

Submitter Name:	Organization Name:	Organization Representation:
Lee Stevens	LH Stevens Constructors LLc	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to **replace** the code change proposal by this public comment.

412.0 Pressure and Flow Controls.

~~**412.4 Automatic Makeup Fluid.** Automatic makeup fluid shall be in accordance with Section 412.4.1 for potable water makeup fluid or Section 412.4.2 for nonpotable makeup fluid.~~

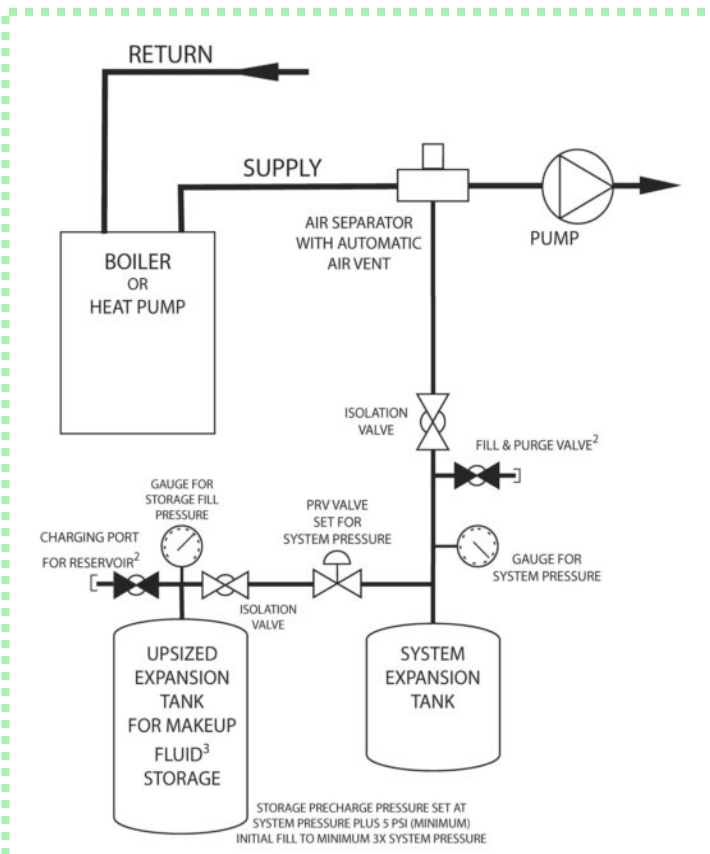
~~**412.4.1 Potable Makeup Fluid.** Where a potable water automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location. On systems using only water as a heat transfer fluid, and where pressurization is achieved using a potable water supply, a pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 402.0 to prevent contamination due to backflow.~~

~~**412.4.2 Nonpotable Makeup Fluid.** Makeup fluid systems that are designed to add pre-mixed antifreeze solutions shall be permitted. Such systems shall include, but not be limited to, glycol feeders and limited-volume reservoir systems. On systems using additives, such as glycol or corrosion inhibitors, the use of a system pressurization unit or glycol feeder shall be required.~~

412.4 Automatic Makeup Fluid. Where an automatic makeup fluid supply fill device is used to maintain the fluid content of a closed loop hydronic system, or any closed loop in the system, the makeup supply source shall introduce the makeup fluid at the expansion tank or other approved location. A pressure reducing valve or pressure control system shall be installed on the makeup feed line. The pressure of the makeup feed line shall be set in accordance with the system design. Makeup fluid supplied to the system shall be in accordance with Section 401.6 and shall be compatible with the installed hydronic system fluid. Automatic makeup fluid systems shall be in accordance with Section 412.4.1 or Section 412.4.1.1 for potable water makeup fluid or Section 412.4.2 for nonpotable makeup fluid.

412.4.1 Potable Makeup Fluid. Where the domestic potable water supply meets the requirements of Section 401.6 and is used to fill the system, and the automatic makeup fluid supply source is the domestic potable water supply, connections to the potable water supply shall be protected from backflow in accordance with Section 402.3.

412.4.1.1 Potable Water Reservoir System. Where domestic potable makeup water is supplied by a system pressurization unit or reservoir system that has no permanent connection to the domestic potable water system, the fluid capacity of the potable water makeup reservoir system shall not exceed the greater of 5 gallons (19 L), or 5 percent of the total system fluid volume. Backflow protection from the hydronic system into the reservoir shall not be required. Where a temporary connection to a potable water supply system is required, backflow protection shall be provided in accordance with Section 402.3. (See Figure 412.4.1.1 for an example of a simplified schematic of a makeup supply reservoir system.)



For SI units: 1 pound-force per square inch = 6.8947 kPa
* This schematic does not include all system components, and configurations may vary based on design.

FIGURE 412.4.1.1
EXAMPLE: MAKEUP SUPPLY RESERVOIR SYSTEM (SIMPLIFIED SCHEMATIC)*

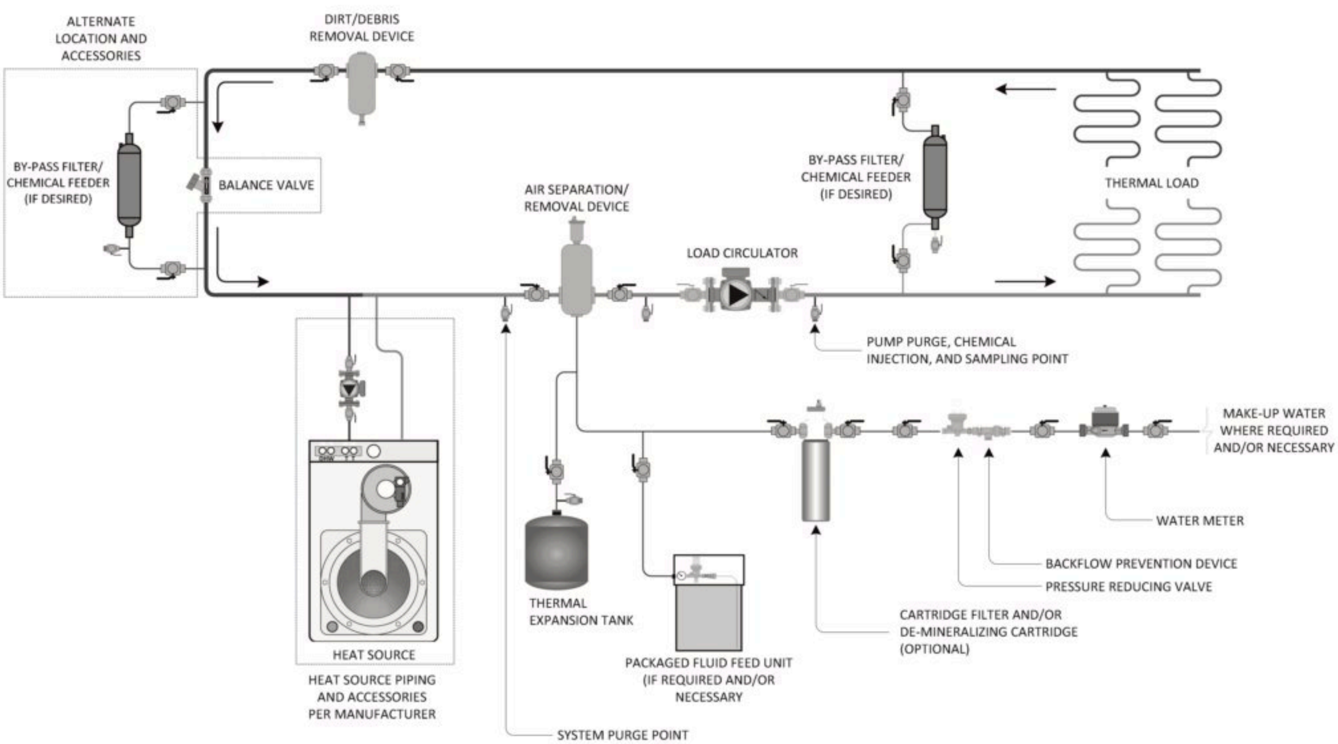
412.4.2 Automatic Makeup Fluid for Systems Using Nonpotable Water. Where the hydronic system is filled with a nonpotable fluid, such as an antifreeze solution, or incorporates a chemical feeder, there shall be no direct or permanent connection to the potable water system. A system pressurization unit or reservoir system shall be required as the source for makeup fluid. The fluid capacity of the pressurization unit or reservoir system shall not exceed 5 gallons (19 liters) or 5 percent of the total system volume, whichever is greater. Where a temporary connection to a potable water supply system is required, backflow protection shall be provided in accordance with Section 402.3.

Exception: Where a chemical feeder is installed on a system otherwise filled with potable water, an automatic makeup fluid system shall be permitted to be installed in accordance with Section 412.4.1. [See Figure E 102.1(1) for an example of a simplified schematic of a potable water supply makeup system feeding a system filled with potable water.]

(shown for information purposes only)

401.6 Heat Transfer Fluid Quality. Heat transfer fluid used in closed loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.

402.3 Protection of Potable Water. Where a hydronic system makeup fluid supply is connected to a potable water system, the potable water system shall be protected from backflow from the hydronic system in accordance with the plumbing code.



* This configuration is not applicable to hydronic systems containing antifreeze on the load side of the system. [e.g., snow and ice melt systems (SIMS)]

FIGURE E 102.1(1)
NEAR BOILER PIPING SCHEMATIC – CHEMICAL ADDITIVES*

Substantiation:
The present code language (Section 412.4 and Section 412.4.2) fails to include nonpotable makeup fluid in the requirements for:

- Location at the expansion tank or other approved location
- Pressure reducing valve
- Pressure of the feed line set in accordance with the design of the system

The language of Section 412.4.2 uses different nomenclature in different paragraphs, despite trying to identify and regulate the same things. “Glycol feeder” is a mis-representation, as a system filled with an antifreeze mix should be introducing the same mix in a makeup supply, not glycol alone. It is more accurate and consistent to refer to “system pressurization unit or reservoir system”. The second paragraph of Section 412.4.2 is overly restrictive regarding systems using chemical feeders, which are allowed to employ a potable water makeup supply, per Section 401.6 and IAPMO/ ANSI H1001.1.

This should be remedied by an over-arching Section 412.4 that addresses these issues for any and all types of makeup supplies and systems. For consistency between code sections, Section 412.4 should also reference compliance with Section 401.6. And, there should be clear distinctions made between types of system fluid, types of makeup fluid, and types of makeup delivery systems, as regarding specific code requirements. A chemical feeder may modify potable water into nonpotable status, but it is not a makeup fluid volume supply, and should not be lumped together with the same regulations as apply to a true makeup supply source. It is important to maintain the essential requirements for the location of the makeup connection (at the expansion tank, or the point of no mechanically induced pressure change), and for pressure control, whether the makeup supply is from a pressurized domestic potable system, a system feeder with a pump, or other equivalent makeup supply system.

By incorporating IAPMO/ ANSI H1001.1 into the code as a requirement, system water quality is now mandated, with implications for the makeup supply. The included limitation in the standard of no more than 5% makeup by volume, without manual intervention, has several purposes. This ensures basic system fluid quality, controls dilution in systems with antifreeze or chemical additives, and has the added benefit of limiting consequential water damage in the event of a breached or damaged system.

The 5% limitation, by volume, is derived from the fact that impeller pumps as used in hydronic systems will fail, if the entrained air content approaches or exceeds 4% by volume (1). This is due to cavitation and creation of an air bubble at the impeller, which grows and quickly results in the pump motor free-wheeling and burning out. Testing has shown that municipal water supplies are typically under 2% entrained air by volume (2), therefore fully usable for initial fill and startup of systems. The 5% makeup allowance can easily replace the entrained air volume that is extracted after startup, and typically will still provide at least an additional year of makeup supply requirements. Therefore, this limitation is not an undue burden on the installer or facility owner, nor is it a boiler safety issue, due to the code requirements for low water cutoff or flow monitoring for boiler shutdown.

Sources:
(1) Budris, Allan R. "Negative Effects of Air/Gas on Pump Performance, NPSHA/NPSHR." Water Tech Online, June 2009. https://www.watertechonline.com/wastewater/article/16194170/negative-effects-of-air-gas-on-pump-performance-npsha-npshr
(2) Smorol, Douglas R. "Air Entrainment in Public Water Supply." Aquafacts (New York Rural Water Association), Winter 2017/18, p. 9. https://www.nyruralwater.org/sites/default/files/Smorol_Winter%2017.pdf

"Solubility of Air in Water." The Engineering ToolBox. https://www.engineeringtoolbox.com/air-solubility-water-d_639.html
Gasses in Hydronic Systems. Technical Data - Air Elimination. Spirotherm, Inc., 2003. https://www.spirotherm.com/sites/default/files/TechnicalData-AirElimination_3.pdf

Item #:
073

Code Number:
2024 USHGC

Section Number:
501.2, 501.9, 501.9.1

SUBMITTER:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

501.0 General.

501.2 ~~Connections~~Access. Connections that are required for filling, draining, and flushing shall be readily accessible. ~~Solar thermal systems using liquid as a heat transfer medium shall have means for purging air.~~

501.9 Air Removal. Solar thermal systems using liquid as a heat transfer medium shall be provided with means for purging air.

~~501.9~~501.9.1 **Automatic Air Vents.** Where installed, automatic air release vents shall be located at high points of the solar thermal system with isolation valves for maintenance and removal in accordance with the system design requirements and manufacturer's installation instructions.

SUBSTANTIATION:
The air removal requirements in Section 501.2 are being relocated to align with existing related provisions. As a result, the title of Section 501.2 is being updated to align with the remaining provision addressing accessibility.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
073

Code Number:
2024 USHGC

Sections(s):
408.1, 412.6, 501.9, 501.9.1, 605.1

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.9 Air-Removal Devices. ~~Solar thermal systems using liquid as a heat transfer medium shall be provided with means for purging air.~~Where a solar thermal system uses heat transfer fluid, provisions shall be made for the removal of air from the system fluid. Where installed, air-removal devices shall be located at high points in the solar thermal piping system where air is likely to accumulate and shall be accessible for repair and replacement.
Exception: Provisions for air removal shall not be required for the following:
(1) Drainback solar thermal systems.
(2) Direct (open-loop) solar thermal systems.
501.9.1 Automatic Air Vents. Where installed, automatic air release vents shall be ~~located at high points of the solar thermal system~~provided with isolation valves for maintenance and removal in accordance with the system design requirements and manufacturer's installation instructions.

412.0 Pressure and Flow Controls.

412.6 Air-Removal Devices. Provisions shall be made for the removal of air from fluid in hydronic systems. Air-removal devices shall be located in the areas of the hydronic piping system where air is likely to accumulate~~. Air-removal devices~~ and shall be ~~installed to facilitate their removal for examination,~~accessible for repair~~, or~~ and replacement.
~~**Exception:** Drainback type solar thermal systems shall not require an air-removal device.~~

408.0 Expansion Tanks.
408.1 General. An expansion tank shall be installed in each hydronic closed-loop system to control system pressure due to thermal expansion and contraction. Expansion tanks shall be of the closed type, incorporating a diaphragm or bladder to ensure the isolation of the system fluid from the pre-charge gas or from the atmosphere. Expansion tanks shall be rated for the pressure of the system. [See Figure 408.1(1) for an example of a simplified schematic of a closed-loop system incorporating a diaphragm type expansion tank.]
Exception~~s~~:
~~(1) Drainback type solar thermal systems shall not require a hydronic expansion tank.~~
~~(2)~~ An engineered fluid expansion storage system shall be permitted to incorporate fluid storage in vessels open to the atmosphere. Storage tanks and components for such systems shall be constructed of non-corrosive materials, or the system fluid shall be treated to inhibit corrosion. [See Figure 408.1(2) for an example of an engineered fluid expansion storage system which incorporates fluid storage in a vessel open to the atmosphere.]

605.0 Expansion Tanks.
605.1 Where Required. An expansion tank shall be installed in a water heating system as a means for controlling increased pressure caused by thermal expansion. Expansion tanks shall be of the closed type and securely fastened to or supported by the structure. Tanks shall be rated for the pressure of the system. Supports shall be capable of carrying twice the weight of the tank filled with water without placing strain on the connecting piping.Water-heating systems incorporating hot water tanks or fluid relief columns shall be installed to prevent freezing under normal operating conditions.
Exceptions:
(1) An expansion tank shall not be required for drainback solar thermal systems.

(2) An engineered fluid expansion storage system shall be permitted to incorporate fluid storage in vessels open to the atmosphere. Storage tanks and components for such systems shall be constructed of non-corrosive materials, or the system fluid shall be treated to inhibit corrosion. [See Figure 408.1(2) for an example of an engineered fluid expansion storage system which incorporates fluid storage in a vessel open to the atmosphere.]

Substantiation:

Section 501.9 (Air Removal): The revised language clarifies that air removal requirements apply to liquid-based solar thermal systems only, distinguishing them from air-based systems where such requirements are not applicable. Location and accessibility requirements for air removal devices are consolidated into a single section for clarity. Exceptions are provided for drainback and direct open-loop systems, as these system types do not require air removal.

Section 412.6 (Air-Removal Device): The revisions remove the exception for drainback solar thermal systems and correlate with the updates to Section 501.9. Placing solar thermal exceptions within the hydronics chapter creates confusion about code organization and applicability.

Section 408.1 (Expansion Tanks – General): The revision removes the exception for drainback solar thermal systems from the hydronics chapter. This exception is being relocated to Section 605.1, which applies to all systems requiring expansion tanks, including solar, hydronic, and geothermal. Consolidating system-specific exceptions in the general expansion tank section improves code organization and provides a single location for installers and inspectors to find applicable exemptions.

Section 605.1 (Expansion Tanks – General): The revised text adds the exception previously from Section 408.1 for drainback solar thermal systems. Drainback systems do not require expansion tanks because the drainback tank contains an air space that accommodates thermal expansion.

Item #:
074

Code Number:
2024 USHGC

Section Number:
501.5 - 501.5.3

SUBMITTER:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

501.0 General.

501.5 Materials. Piping, tubing and fitting materials shall comply with Table 409.1, ~~and shall be identified by the manufacturer for the intended application~~be approved for the intended use, and installed in accordance with the manufacturer's installation instructions. Materials shall be rated for the operating temperature and pressures of the system. ~~Joining methods~~Joints and connections shall be in accordance with Section 410.0. ~~Materials in contact with heat transfer medium shall be approved for such use.~~
501.5.1 Compatibility. System components shall be compatible with system fluids.
501.5.2 Prohibited Installations. Galvanized steel shall not be used for solar thermal piping systems containing antifreeze. Black steel shall not be used in systems with entrapped or entrained air.
501.5.3 Joints Between Different Materials. ~~Unions between dissimilar metals~~Joints between different types of materials shall comply with Section 305.2 and Section 410.16. ~~The material used shall be capable of withstanding the maximum temperature and pressure of the system.~~

~~**501.5.1 Plastic.** Plastic used in the construction of a solar thermal system shall be installed in accordance with the manufacturer's installation instructions.~~

(renumber remaining sections)

SUBSTANTIATION:
This code change proposal includes a breakdown of existing requirements in Section 501.5 (Materials) along with a new categorization based on content. General requirements for all materials in solar thermal systems are then being included, and subsections repeating such requirements are being deleted. This layout allows for a natural progression of requirements: materials → compatibility → prohibited materials → joints between different materials. In Section 501.5.3, the phrase "joints between different types of materials" is more precise and comprehensive than "unions between dissimilar metals." The term "unions" refers to a specific type of fitting, whereas "joints" encompass all types of connections. Additionally, "dissimilar metals" is too narrow, as the requirement also applies to plastic-to-metal joints, as referenced in Section 410.16.

> *[2024 USHGC]*
> ***410.16 Joints Between Different Materials.*** *Joints between different types of materials shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 410.16.1 and Section 410.16.2.*
> ***410.16.1 Copper or Copper Alloy Pipe or Tubing to Threaded Pipe Joints.*** *Joints from copper or copper alloy pipe or tubing to threaded pipe of a material other than copper or copper alloy shall be made by the use of copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.*

410.16.2 Plastic Pipe to Other Materials. *Where connecting plastic pipe to other types of plastic or other types of piping materials, approved adapter or transition fittings designed for the specific transition intended shall be used.*
410.16.2.1 Transition Joint. *For non-pressurized systems rated at 25 pounds-force per square inch (psi) (172 kPa) or less, a solvent cement transition joint between ABS and PVC drainpipe and fittings shall be made using listed transition solvent cement in accordance with ASTM D3138. PVC and ABS pipe and fittings shall not be solvent welded to any other unlike material.*

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
074	2024 USHGC	501.5, 501.5.1, 501.5.3

Submitter Name:	Organization Name:	Organization Representation:
Edmond Murray	USHGC Solar Thermal Systems Task Group, Vice-Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.5 Materials. ~~Piping, tubing and fitting materials shall comply with Table 409.1, be approved for the intended use, and installed in accordance with the manufacturer's installation instructions. Materials shall be rated for the operating temperature and pressures of the system. Joints and connections shall be in accordance with Section 410.0.~~Mechanical equipment, accessories, components, and materials used in the construction and installation of solar thermal systems shall be approved for the intended use and rated for the operating temperature and pressure of the system. Solar collectors shall comply with Section 502.0. Coverings and insulation materials for piping shall comply with Section 503.0.
501.5.1 Pipe, Tubing, and Fittings. Solar thermal piping, tubing, and fittings shall comply with the applicable standards listed in Table 409.1 and shall be installed in accordance with the manufacturer's installation instructions. Pipe fittings and valves shall be approved for the specific type of piping and tubing installed. Joints and connections shall be in accordance with Section 410.0.

~~**501.5.3 Joints Between Different Materials.** Joints between different types of materials shall comply with Section 305.2 and Section 410.16.~~

(renumber remaining sections)

(shown for information purposes only)

TABLE 409.1
MATERIALS FOR HYDRONIC AND SOLAR THERMAL SYSTEM, PIPING, TUBING, AND FITTINGS

MATERIAL	STANDARDS	
	PIPING/TUBING	FITTINGS
Copper and Copper Alloys	ASTM B42, ASTM B43, ASTM B75, ASTM B88, ASTM B135, ASTM B251[2], ASTM B302, ASTM B447	ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.24, ASME B16.26, ASME B16.29, ASME B16.51, ASSE 1061, ASTM F3226, IAPMO/ANSI/CAN Z1117
Ductile Iron	AWWA C115/A21.15, AWWA C151/A21.51	AWWA C110/A21.10[1], AWWA C153/A21.53
Steel	ASTM A53, ASTM A106, ASTM A254	ASME B16.5, ASME B16.9, ASME B16.11, ASTM A420, ASTM F3226, IAPMO IGC 353, IAPMO/ANSI/CAN Z1117
Gray Iron	––	ASTM A126
Malleable Iron	––	ASME B16.3
Chlorinated Polyvinyl Chloride (CPVC)	ASTM D2846, ASTM F441, ASTM F442, CSA B137.6	ASSE 1061, ASTM D2846, ASTM F437, ASTM F438, ASTM F439, ASTM F1970, CSA B137.6
Polyethylene (PE)	ASTM D2737, ASTM D3035, ASTM F714, ASTM F2165, AWWA C901, CSA B137.1, NSF/ANSI 358-1	ASTM D2609, ASTM D2683, ASTM D3261, ASTM F1055, ASTM F2165, CSA B137.1, NSF/ANSI 358-1
Cross-Linked Polyethylene (PEX)	ASTM F876, ASTM F2165, ASTM F3253, CSA B137.5, NSF/ANSI 358-3	ASSE 1061, ASTM F877, ASTM F1055, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2098, ASTM F2159, ASTM F2165, ASTM F2735, ASTM F3253, ASTM F3347, ASTM F3348, CSA B137.5, NSF/ANSI 358-3
Polypropylene (PP)	ASTM F2165, ASTM F2389, CSA B137.11, NSF/ANSI 358-2	ASSE 1061, ASTM F2165, ASTM F2389, CSA B137.11, NSF/ANSI 358-2
Polyvinyl Chloride (PVC)	ASTM D1785, ASTM D2241, CSA B137.3	ASTM D2464, ASTM D2466, ASTM D2467, ASTM F1970, CSA B137.2, CSA B137.3

Polyethylene of Raised Temperature (PE-RT)	ASTM F2165, ASTM F2623, ASTM F2769, CSA B137.18	ASSE 1061, ASTM D3261, ASTM F1055, ASTM F1807, ASTM F2159, ASTM F2165, ASTM F2735, ASTM F2769, ASTM F3347, ASTM F3348, CSA B137.18
Cross-Linked Polyethylene/ Aluminum/ Cross-Linked Polyethylene (PEX-AL-PEX)	ASTM F1281, ASTM F2165, CSA B137.10	ASTM F1281, ASTM F1974, ASTM F2165, ASTM F2434, CSA B137.10
Polyethylene/Aluminum/Polyethylene (PE-AL-PE)	ASTM F1282, ASTM F2165, CSA B137.9	ASTM F1282, ASTM F1974, ASTM F2165, CSA B137.9
Stainless Steel	ASTM A269, ASTM A312, ASTM A554, ASTM A778	ASTM F1476, ASTM F1548, ASTM F3226, IAPMO IGC 353, IAPMO/ANSI/CAN Z1117
Chlorinated Polyvinyl Chloride/ Aluminum/ Chlorinated Polyvinyl Chloride (CPVC/AL/CPVC)	ASTM F2855	ASTM D2846

Notes:

[1] Ductile and gray iron.

[2] Only Type K, L, or M shall be permitted to be installed.

410.0 Joints and Connections.

410.1 General. Joints and connections shall be of an approved type. Joints shall be gas and watertight and designed for the pressure of the hydronic system. Changes in direction shall be made by the use of fittings or with pipe bends. Joints between pipe and fittings shall be installed in accordance with the manufacturer's installation instructions. Joints used underground shall be of an approved type for buried applications.

410.2 Pipe Bends. Pipe bends shall be formed in accordance with Section 410.2.1 through Section 410.2.3.

410.3 Chlorinated Polyvinyl Chloride (CPVC) Pipe. Joints between chlorinated polyvinyl chloride (CPVC) pipe and fittings shall be installed in accordance with one of the following methods:

(1) Mechanical joints shall include, but not be limited to, flanged, grooved, and push fit fittings. Removable and nonremovable push fit fittings with an elastomeric o-ring that employ quick assembly push fit connectors shall be in accordance with ASSE 1061.

(2) Solvent cement joints for CPVC pipe and fittings shall be clean from dirt and moisture. Solvent cements in accordance with ASTM F493, requiring the use of a primer shall be orange in color. The primer shall be colored and be in accordance with ASTM F656. Listed solvent cement in accordance with ASTM F493 that does not require the use of primers, yellow, green, or red in color, shall be permitted for pipe and fittings manufactured in accordance with ASTM D2846, $1/2$ of an inch (15 mm) through 2 inches (50 mm) in diameter or ASTM F442, $1/2$ of an inch (15 mm) through 3 inches (80 mm) in diameter. Apply primer where required inside the fitting and to the depth of the fitting on pipe. Apply liberal coat of cement to the outside surface of pipe to depth of fitting and inside of fitting. Place pipe inside fitting to forcefully bottom the pipe in the socket and hold together until joint is set.

(3) Threaded joints for CPVC pipe shall be made with pipe threads in accordance with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded and the pressure rating shall be reduced by 50 percent. The use of molded fittings shall not result in a 50 percent reduction in the pressure rating of the pipe provided that the molded fittings shall be fabricated so that the wall thickness of the material is maintained at the threads.

Thread sealant compound that is compatible with the pipe and fitting, insoluble in water, and nontoxic shall be applied to male threads. Caution shall be used during assembly to prevent over tightening of the CPVC components once the thread sealant has been applied. Female CPVC threaded fittings shall be used with plastic male threads only.

410.4 CPVC/AL/CPVC Plastic Pipe and Joints. Joints between chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC) pipe and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints shall include, but not be limited to, flanged, grooved and push-fit fittings.
(2) Solvent cement joints for CPVC/AL/CPVC pipe and fittings shall be clean from dirt and moisture. Solvent cements in accordance with ASTM F493, requiring the use of a primer shall be orange in color. The primer shall be colored and be in accordance with ASTM F656. Listed solvent cement in accordance with ASTM F493 that does not require the use of primers, yellow in color, shall be permitted for pipe and fittings manufactured in accordance with ASTM D2846, 1/2 inch (15 mm) through 2 inches (50 mm) in diameter, 1/2 inch (15 mm) through 3 inches (80 mm) in diameter. Apply primer where required inside the fitting and to the depth of the fitting on pipe. Apply liberal coat of cement to the outside surface of pipe to depth of fitting and inside of fitting. Place pipe inside fitting to forcefully bottom the pipe in the socket and hold together until joint is set.
410.5 Copper or Copper Alloy Pipe and Tubing. Joints between copper or copper alloy pipe or tubing and fittings shall be installed in accordance with one of the following methods:
(1) Brazed joints between copper or copper alloy pipe or tubing and fittings shall be made with brazing alloys having a liquid temperature above 1000°F (538°C). The joint surfaces to be brazed shall be cleaned bright by either manual or mechanical means. Tubing shall be cut square and reamed to full inside diameter. Brazing flux shall be applied to the joint surfaces where required by manufacturer's recommendation. Brazing filler metal in accordance with AWS A5.8 shall be applied at the point where the pipe or tubing enters the socket of the fitting.
(2) Flared joints for soft copper or copper alloy tubing shall be made with fittings that are in accordance with the applicable standards referenced in Table 409.1. Pipe or tubing shall be cut square using an appropriate tubing cutter. The tubing shall be reamed to full inside diameter, resized to round, and expanded with a proper flaring tool.
(3) Mechanically formed tee fittings shall have extracted collars that shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the pipe or tube surface to form a collar having a height not less than three times the thickness of the branch tube wall. The branch pipe or tube shall be notched to conform to the inner curve of the run pipe or tube and shall have two dimple depth stops to ensure that penetration of the branch pipe or tube into the collar is of a depth for brazing and that the branch pipe or tube does not obstruct the flow in the main line pipe or tube. Dimple depth stops shall be in line with the run of the pipe or tube. The second dimple shall be $1/4$ of an inch (6.4 mm) above the first and shall serve as a visual point of inspection. Fittings and joints shall be made by brazing. Soldered joints shall not be permitted.
(4) Press-connect joints between copper or copper alloy pipe or tubing and fittings shall be made in accordance with ASTM B1029. Press-connect fittings for copper or copper alloy pipe or tubing shall have an elastomeric o-ring that forms the joint. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fitting. Pipe or tubing shall be cut square, chamfered, and reamed to full inside diameter. The fitting alignment shall be checked against the mark on the pipe or tubing to ensure the pipe or tubing is inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.
(5) Removable and nonremovable push fit fittings for copper or copper alloy tubing or pipe that employ quick assembly push fit connectors shall be in accordance with ASSE 1061. Push fit fittings for copper or copper alloy pipe or tubing shall have an approved elastomeric o-ring that forms the joint. Pipe or tubing shall be cut square, chamfered, and reamed to full inside diameter. The tubing shall be fully inserted into the fitting, and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to ensure the tubing is inserted into the fitting and gripping mechanism has engaged on the pipe.

(6) Soldered joints between copper or copper alloy pipe or tubing and fittings shall be made in accordance with ASTM B828. Pipe or tubing shall be cut square and reamed to the full inside diameter including the removal of burrs on the outside of the pipe or tubing. Surfaces to be joined shall be cleaned bright by manual or mechanical means. Flux shall be applied to pipe or tubing and fittings and shall be in accordance with ASTM B813, and shall become noncorrosive and nontoxic after soldering. Insert pipe or tubing into the base of the fitting and remove excess flux. Pipe or tubing and fitting shall be supported to ensure a uniform capillary space around the joint. Solder in accordance with ASTM B32 shall be applied to the joint surfaces until capillary action draws the molten solder into the cup. Joint surfaces shall not be disturbed until cool and any remaining flux residue shall be cleaned.
(7) Threaded joints for copper or copper alloy pipe shall be made with pipe threads in accordance with ASME B1.20.1. Thread sealant tape or compound shall be applied only on male threads, and such material shall be of approved types, insoluble in water, and nontoxic.

410.6 Cross-Linked Polyethylene (PEX) Pipe. Joints between cross-linked polyethylene (PEX) pipe and fittings shall be installed with fittings for PEX tubing that comply with the applicable standards referenced in Table 409.1. PEX tubing labeled in accordance with ASTM F876 or ASTM F3253 shall be marked with the applicable standard designation for the fittings specified for use with the tubing. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

410.7 Cross-Linked Polyethylene/Aluminum/ Cross-Linked Polyethylene (PEX-AL-PEX) Pipe. Joints between cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints between PEX-AL-PEX pipe and fittings shall include mechanical and compression type fittings and insert fittings with a crimping ring. Insert fittings utilizing a crimping ring shall be in accordance with ASTM F1974 or ASTM F2434. Crimp joints for crimp insert fittings shall be joined to PEX-AL-PEX pipe by the compression of a crimp ring around the outer circumference of the pipe, forcing the pipe material into annular spaces formed by ribs on the fitting.
(2) Compression joints shall include compression insert fittings and shall be joined to PEX-AL-PEX pipe through the compression of a split ring or compression nut around the outer circumference of the pipe, forcing the pipe material into the annular space formed by the ribs on the fitting.

410.8 Ductile Iron Pipe. Joints between ductile iron pipe and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints for ductile iron pipe and fittings shall consist of a bell that is cast integrally with the pipe or fitting and provided with an exterior flange having bolt holes and a socket with annular recesses for the sealing gasket and the plain end of the pipe or fitting. The elastomeric gasket shall comply with AWWA C111/A21.11. Lubricant recommended for the application by the pipe manufacturer shall be applied to the gasket and plain end of the pipe.
(2) Push-on joints for ductile iron pipe and fittings shall consist of a single elastomeric gasket that shall be assembled by positioning the elastomeric gasket in an annular recess in the pipe or fitting socket and forcing the plain end of the pipe or fitting into the socket. The plain end shall compress the elastomeric gasket to form a positive seal and shall be designed so that the elastomeric gasket shall be locked in place against displacement. The elastomeric gasket shall comply with AWWA C111/A21.11. Lubricant recommended for the application by the pipe manufacturer shall be applied to the gasket and plain end of the pipe.

410.9 Polyethylene (PE) Plastic Pipe/Tubing. Joints between polyethylene (PE) plastic pipe or tubing and fittings shall be installed in accordance with one of the following methods:
(1) Butt-fusion joints shall be installed in accordance with ASTM F2620 and shall be made by heating the squared ends of two pipes, pipe and fitting, or two fittings by holding ends against a heated element. The heated element shall be removed where the proper melt is obtained and joined ends shall be placed together with applied force.

(2) Electro-fusion joints shall be heated internally by a conductor at the interface of the joint. Align and restrain fitting to pipe to prevent movement and apply electric current to the fitting. Turn off the current when the proper time has elapsed to heat the joint. The joint shall fuse together and remain undisturbed until cool.
(3) Socket-fusion joints shall be installed in accordance with ASTM F2620 and shall be made by simultaneously heating the outside surface of a pipe end and the inside of a fitting socket. Where the proper melt is obtained, the pipe and fitting shall be joined by inserting one into the other with applied force. The joint shall fuse together and remain undisturbed until cool.
(4) Mechanical joints between PE pipe or tubing and fittings shall include insert and mechanical compression fittings that provide a pressure seal resistance to pullout. Joints for insert fittings shall be made by cutting the pipe square, using a cutter designed for plastic piping, and removal of sharp edges. Two stainless steel clamps shall be placed over the end of the pipe. Fittings shall be checked for proper size based on the diameter of the pipe. The end of pipe shall be placed over the barbed insert fitting, making contact with the fitting shoulder. Clamps shall be positioned equal to 180 degrees (3.14 rad) apart and shall be tightened to provide a leak tight joint. Compression type couplings and fittings shall be permitted for use in joining PE piping and tubing. Stiffeners that extend beyond the clamp or nut shall be prohibited. Bends shall be not less than 30 pipe diameters, or the coil radius where bending with the coil. Bends shall not be permitted closer than 10 pipe diameters of a fitting or valve. Mechanical joints shall be designed for their intended use.

410.10 Polyethylene/Aluminum/Polyethylene (PE-AL-PE). Joints between polyethylene/aluminum/polyethylene (PE-AL-PE) pipe and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints for PE-AL-PE pipe or tubing and fittings shall be either of the metal insert fittings with a split ring and compression nut or metal insert fittings with copper crimp rings. Metal insert fittings shall comply with ASTM F1974. Crimp insert fittings shall be joined to the pipe by placing the copper crimp ring around the outer circumference of the pipe, forcing the pipe material into the space formed by the ribs on the fitting until the pipe contacts the shoulder of the fitting. The crimp ring shall then be positioned on the pipe so the edge of the crimp ring is $1/8$ of an inch (3.2 mm) to $1/4$ of an inch (6.4 mm) from the end of the pipe. The jaws of the crimping tool shall be centered over the crimp ring and tool perpendicular to the barb. The jaws shall be closed around the crimp ring and shall not be crimped more than once.
(2) Compression joints for PE-AL-PE pipe or tubing and fittings shall be joined through the compression of a split ring, by a compression nut around the circumference of the pipe. The compression nut and split ring shall be placed around the pipe. The ribbed end of the fitting shall be inserted onto the pipe until the pipe contacts the shoulder of the fitting. Position and compress the split ring by tightening the compression nut onto the insert fitting.

410.11 Polyethylene of Raised Temperature (PE-RT). Joints between polyethylene of raised temperature (PE-RT) tubing and fittings shall be installed in accordance with the manufacturer’s installation instructions and shall comply with the standards listed in Table 409.1. Metal insert fittings, metal compression fittings, and plastic fittings shall be manufactured to and marked in accordance with the standards for fittings in Table 409.1.

410.12 Polypropylene (PP) Pipe. Joints between polypropylene pipe and fittings shall be installed in accordance with one of the following methods:
(1) Heat-fusion joints for polypropylene (PP) pipe shall be installed with socket-type heat-fused polypropylene fittings, butt-fusion polypropylene fittings or pipe, or electro-fusion polypropylene fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F2389 or CSA B137.11.
(2) Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer’s installation instructions. Polypropylene pipe shall not be threaded. Polypropylene transition fittings for connection to other piping materials shall only be threaded by use of copper alloy or stainless steel inserts molded in the fitting.

410.13 Polyvinyl Chloride (PVC) Pipe. Joints between polyvinyl chloride pipe and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint. The mechanical joint shall include a pipe spigot that has a wall thickness to withstand without deformation or collapse; the compressive force exerted where the fitting is tightened. The push-on joint shall have a minimum wall thickness of the bell at any point between the ring and the pipe barrel. The elastomeric gasket shall comply with ASTM D3139, and be of such size and shape as to provide a compressive force against the spigot and socket after assembly to provide a positive seal.
(2) Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil, and other foreign material, apply primer purple in color in accordance with ASTM F656. Primer shall be applied until the surface of the pipe and fitting is softened. Solvent cements in accordance with ASTM D2564 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. Hold joint in place and undisturbed for 1 minute after assembly.
(3) Threads shall comply with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded; however, the pressure rating shall be reduced by 50 percent. The use of molded fittings shall not result in a 50 percent reduction in the pressure rating of the pipe provided that the molded fittings shall be fabricated so that the wall thickness of the material is maintained at the threads. Thread sealant compound that is compatible with the pipe and fitting, insoluble in water, and nontoxic shall be applied to male threads. Caution shall be used during assembly to prevent over tightening of the PVC components once the thread sealant has been applied. Female PVC threaded fittings shall be used with plastic male threads only.

410.14 Steel Pipe and Tubing. Joints between steel pipe or tubing and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints shall be made with an approved and listed elastomeric gasket.
(2) Threaded joints shall be made with pipe threads that are in accordance with ASME B1.20.1. Thread sealant tape or compound shall be applied only on male threads, and such material shall be of approved types, insoluble in water, and nontoxic.
(3) Welded joints shall be made by electrical arc or oxygen/acetylene method. Joint surfaces shall be cleaned by an approved procedure. Joints shall be welded by an approved filler metal.
(4) Pressed joints shall have an elastomeric o-ring that forms the connection. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fittings. Pipe or tubing shall be cut square, chamfered, and reamed to full inside diameter. The fitting alignment shall be checked against the mark on the pipe or tubing to ensure the pipe or tubing is fully inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.

410.15 Stainless Steel Pipe and Joints. Joining methods for stainless steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 410.15.1 or Section 410.15.2.

410.16 Joints Between Different Materials. Joints between different types of materials shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 410.16.1 and Section 410.16.2.

502.0 Solar Collectors.
502.1 General. Solar collectors shall be designed and installed in accordance with Section 502.2 or Section 502.3.
502.2 Factory-Built Solar Collectors. Factory-built solar collectors shall comply with ICC 901/SRCC 100, UL 1279, or other equivalent standard, and shall be installed in accordance with the terms of their listing and the manufacturer's installation instructions.

502.3 Field Constructed Solar Collectors. Field constructed solar collectors shall be in accordance with Section 502.3.1 through Section 502.3.7.

502.3.1 Combustibles Within Air Collectors. Materials exposed within air collectors shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke developed index not to exceed 50 where tested as a composite product in accordance with ASTM E84 or UL 723.

502.3.1.1 Testing. Materials used within an air collector shall not smoke, smolder, glow, or flame where tested in accordance with ASTM C411 at temperatures exposed to in service. In no case shall the test temperature be less than 250°F (121°C).

502.3.2 Roof-Integrated. Collectors that are integral with or function as part of the building roof structure shall have the same required fire rating classification as the roof.

502.3.3 Above or on the Roof. Collectors that are located above or on roofs and do not function as building components shall not reduce the required fire-resistance and fire-retardance classification of the roof covering materials.

502.3.4 Protection. Collectors shall be designed and constructed as to prevent interior condensation, out-gassing, or other processes that will reduce the transmission properties of the glazing, reduce the efficiency of the insulation, or otherwise adversely affect the performance of the collector.

Frames and braces exposed to the weather shall be constructed of materials for exterior locations, and protected from corrosion or deterioration, in accordance with the Authority Having Jurisdiction.

Wood shall not be used in the construction of collector or system mounting.

502.3.5 Glazing. Glazed collectors shall be in accordance with Section 502.3.5.1 and Section 502.3.5.2.

502.3.5.1 Glass. Glass covers shall be tempered in accordance with ASTM C1048.

502.3.5.2 Plastics. Light-transmitting plastics, including thermoplastic, thermosetting or reinforced thermosetting plastic material, shall comply with the building code.

502.3.6 Installation. Solar collectors shall be ballasted or anchored to roof structures or other surfaces in accordance with Section 317.1. Collectors shall be mounted as to minimize the accumulation of debris. Connecting pipes shall not be used to provide support for a solar collector.

502.3.6.1 Roof Installations. Anchors secured to and through a roofing material shall be made to maintain the water integrity of the roof covering. Roof drainage shall not be impaired by the installation of collectors. Solar collectors that are not an integral part of the roofing system shall be installed to preserve the integrity of the roof surface.

502.3.6.2 Ground Installations. Solar collectors shall terminate above finished grade to avoid being obstructed by vegetation, snow, or ice. The supporting columns shall extend below the frost line.

502.3.6.3 Wall Mounted. Solar collectors that are mounted on a wall shall be secured and fastened in an approved manner in accordance with Section 317.0.

502.3.7 Orientation. Collectors shall be located and oriented in accordance with the manufacturer's installation instructions.

502.4 Disposal and/or Reuse. Solar thermal collectors shall be disposed of or reused in accordance with the Authority Having Jurisdiction.

503.0 Insulation.

503.1 General. The temperature of surfaces within reach of building occupants shall not exceed 140°F (60°C) unless they are protected by insulation. Where sleeves are installed, the insulation shall continue full size through them.

Coverings and insulation materials used for piping shall be rated for the operating temperature of the system and the installation environment. Where installed in a plenum, the insulation, jackets and lap-seal adhesives, including pipe coverings and linings, shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50 where tested in accordance with ASTM E84 or UL 723.

503.2 Where Required. Insulation shall be installed on the following:
(1) Interconnecting solar and hot water piping.
Exception: Low temperature applications including, but not limited to, ground heat exchanger piping and aboveground piping installed for swimming pools, spas, and hot tubs.
(2) The final 5 feet (1524 mm) of the cold water supply line, or the entire length where less than 5 feet (1524 mm).
(3) Piping, storage tanks, and circulating air ductwork.
Exception: Ductwork and piping located in conditioned spaces, where the heat loss does not contribute to the heating or cooling load within such space.
(4) Fittings in accordance with Section 503.3.
Exception: Unions, flanges, and valves.
The insulation shall have an R-value of not less than R-2.6.
503.3 Fittings. Fittings shall be insulated with mitered sections, molded fittings, insulating cement, or flexible insulation.
503.4 Installation. Insulation shall be finished with a jacket or facing with the laps sealed with adhesives or staples so as to secure the insulation on the pipe. Insulation jacket seams shall be on the underside of the piping and shall overlap in accordance with the manufacturer's installation instructions. Joints and seams shall be sealed with a sealant that is approved for both the material and environmental conditions. In lieu of jackets, molded insulation shall be secured with approved fasteners.
503.4.1 Exterior Applications. Insulation for exterior applications shall be finished with an approved jacket, coating, or facing with the surfaces and laps sealed. Jacketing, coating, facing, and tape used for exterior applications shall be designed for such use. Where flexible insulation is used, it shall be wrapped and sealed against water penetration. Insulation used for exterior applications shall be resistant to extreme temperatures, UV exposure, and moisture.
503.5 Ducts. Circulating air ducts shall be insulated in accordance with Table 503.5.

Substantiation:
The revised language in Section 501.5 (Materials) expands the scope beyond piping, tubing, and fittings to include all mechanical equipment, accessories, components, and materials used in solar thermal systems, ensuring that all system components are approved for their intended use and rated for the applicable operating temperature and pressure. Cross-references to Section 502.0 for solar collector requirements and Section 503.0 for coverings and insulation materials are added to direct code users to the appropriate sections for specific component requirements.

New Section 501.5.1 (Pipe, Tubing, and Fittings) consolidates pipe, tubing, and fitting requirements into a dedicated section and addresses compatibility between pipes and fittings, while maintaining the existing reference to Section 410.0 for joints and connections.

Section 501.5.3 (Joints Between Different Materials) is then being deleted to avoid redundant and unnecessary cross-references.

Item #: 076	**Code Number:** 2024 USHGC	**Section Number:** 501.5.4, Table 901.1, Table 901.2
SUBMITTER: Edmond Murray	**Organization Name:** USHGC Solar Thermal Systems Task Group, Vice-Chair	**Organization Representation:**

RECOMMENDATION:
Revise text

Proposed Text :

501.0 General.

501.5 Materials. (remaining text unchanged)

501.5.4 Potable Water. Materials in contact with potable water shall comply with NSF/ANSI/CAN 61 and NSF/ANSI/CAN 372. Piping in solar systems designed to convey potable water shall be flushed and disinfected in accordance with the plumbing code.

Note: NSF/ANSI/CAN 372 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
Both NSF/ANSI/CAN 61 and NSF/ANSI/CAN 372 offer needed protection for potable water sources. As depicted below, these standards address potential contaminants and impurities that negatively impact water quality.

> NSF/ANSI/CAN 61 establishes minimum health effects and requirements for the chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
>
> NSF/ANSI/CAN 372 establishes procedures for determination of lead content based on wetted surface areas of products.

NSF/ANSI/CAN 372 is necessary in this section because it specifically addresses lead-free requirements for materials, while NSF/ANSI/CAN 61 addresses overall material safety.

Committee Action:
Accept As Amended by the TC

Proposed Text :

501.0 General.

501.5 Materials. (remaining text unchanged)

501.5.4 Potable Water. Materials in contact with potable water shall comply with NSF/ANSI/CAN 61~~ and NSF/ANSI/CAN 372~~. Piping in solar systems designed to convey potable water shall be flushed and disinfected in accordance with the plumbing code.

712.0 General.

712.1 Applicability. Part III of this chapter shall apply to open-loop geothermal systems such as, but not limited to, systems coupled to a source of groundwater (well) or surface water. The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems. Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 703.5 and Chapter 4. Components installed in a geothermal open-loop system shall be constructed of corrosion resistant materials. Materials which come into contact with potable water shall comply with NSF/ANSI/CAN 61~~ and NSF/ANSI/CAN 372~~. [See Figure 712.1(1) for an example of a simplified schematic of an open-loop geothermal system utilizing subsurface water. See Figure 712.1(2) for an example of a simplified schematic of an open-loop geothermal system utilizing surface water.]

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~NSF/ANSI/CAN 372-2022~~	~~Drinking Water System Components - Lead Content~~	~~Miscellaneous~~	~~712.1~~

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
NSF/ANSI/CAN 372-2024	Drinking Water System Components - Lead Content	Miscellaneous

(portions of table not shown remain unchanged)

Committee Statement:

The proposed update to Section 501.5.4 (Potable Water) is unnecessary, as NSF/ANSI/CAN 61 already requires compliance with NSF/ANSI/CAN 372. A similar redundant reference appears in Section 712.1 (Applicability). Accordingly, Item #076 is being amended to remove references to NSF/ANSI/CAN 372 from both sections. As a result, NSF/ANSI/CAN 372 is no longer being referenced in the body of the code and is being relocated to Table 901.2 (Standards, Publications, Practices, and Guides), with the latest edition of the standard being incorporated.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	**NEGATIVE:**	**ABSTAIN:**	**NOT RETURNED:**
15	0	0	0

Comment 1

Item #:	**Code Number:**	**Sections(s):**
076	2024 USHGC	501.5.5, 502.0, 502.1

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.5 Materials. (remaining text unchanged)

501.5.5 Potable Water. Materials ~~in~~which come into contact with potable water shall comply with NSF/ANSI/CAN 61. Piping in solar thermal systems designed to convey potable water shall be flushed and disinfected in accordance with ~~the plumbing code~~Section 502.0.

502.0 Disinfection of Potable Water System.
502.1 General. Piping in solar thermal systems designed to convey potable water shall be flushed and disinfected in accordance with the plumbing code and this section. Where required by the Authority Having Jurisdiction, new or repaired potable water systems shall be disinfected prior to use. The method to be followed shall be that prescribed by the Health Authority or, in case no method is prescribed by it, the following:
(1) The piping system shall be flushed with clean, potable water until potable water appears at the points of the outlet.
(2) The system or parts thereof shall be filled with a water-chlorine solution containing not less than 50 parts per million of chlorine, and the system or parts thereof shall be valved-off and allowed to stand for 24 hours; or, the system or parts thereof shall be filled with a water-chlorine solution containing not less than 200 parts per million of chlorine and allowed to stand for 3 hours.
(3) Following the allowed standing time, the system shall be flushed with clean, potable water until the chlorine residual in the water coming from the system does not exceed the chlorine residual in the flushing water.
(4) The procedure shall be repeated where it is shown by a bacteriological examination made by an approved agency that contamination persists in the system.

(renumber remaining sections)

Substantiation:
This public comment incorporates the requirements from the plumbing code for disinfection of potable water systems. The requirements are not extensive and can be inserted into this code to provide more comprehensive guidance for the installation of solar thermal systems that convey potable water. Including disinfection requirements ensures that systems connected to the potable water supply are properly disinfected before being placed into service.

Item #:	Code Number:	Section Number:
077	2024 USHGC	216.0, 501.5.5

SUBMITTER:	Organization Name:	Organization Representation:
Edmond Murray	USHGC Solar Thermal Systems Task Group, Vice-Chair	

RECOMMENDATION:
Revise text

Proposed Text :

501.0 General.

501.5 Materials. (remaining text unchanged)

501.5.5 Racks. Dissimilar metals used for racking shall be isolated to prevent galvanic corrosion. Paint shall not be used as a method of isolation.
Exception: Noncorrosive metals.

216.0 - N -
Noncorrosive Metals. Metals or metal alloys which are resistant to corrosion and degradation when exposed to environmental elements.

SUBSTANTIATION:
The new exception to Section 501.5.5 (Racks) acknowledges that some metals or alloys do not require isolation because they are inherently resistant to galvanic corrosion. This prevents unnecessary isolation requirements for materials that do not pose a corrosion risk.

A definition is also included to avoid ambiguity as to what qualifies as a noncorrosive metal. The definition eliminates misinterpretations and inconsistencies in enforcement.

Committee Action:
Reject

Committee Statement:
The proposed language regarding noncorrosive metals is ambiguous and unenforceable. While the intent is to address dissimilar metals, the proposed definition for “noncorrosive metals” describes how materials react with their environment, not their compatibility with other metals.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
077

Code Number:
2024 USHGC

Sections(s):
501.5.7, Table 901.1

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to **replace** the code change proposal by this public comment.

501.0 General.

501.5 Materials.

501.5.7 Fasteners. Mountings and fasteners shall be made of corrosion-resistant materials. ~~Carbon steel mountings and fasteners shall be classified as noncorrosive in accordance with ASME SA194.~~ Stainless steel fasteners shall comply with ASTM F593 or ASTM F594, as applicable. Carbon steel fasteners shall comply with ASTM A153.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~ASME SA194-2021~~	~~Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both~~	~~Mounting~~	~~501.5.7~~
ASTM A153/A153M-2016a	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware	Fasteners	501.5.7
ASTM F593-2024	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs	Fasteners	501.5.7
ASTM F594-2022	Standard Specification for Stainless Steel Nuts	Fasteners	501.5.7

(portions of table not shown remain unchanged)

Note: ASTM A153/A153M, ASTM F593, and ASTM F594 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
In response to the Technical Committee's action on Item #077, the Solar Thermal Systems Task Group reviewed other material requirements relating to corrosion: both galvanic corrosion (metal compatibility) and general corrosion resistance (exposure to the environment).

From this review, the Task Group identified inconsistencies in Section 501.5.7 (Fasteners) regarding the classification of noncorrosive materials using ASME SA194. This requirement is both technically inaccurate and overly restrictive. ASME SA194 covers nuts for high-pressure and high-temperature service in industrial applications such as pressure vessels, boilers, and process piping. These service conditions do not apply to solar thermal systems. Additionally, the standard does not address corrosion resistance classification.

The revised text references standards appropriate for the application. ASTM F593 and ASTM F594 cover stainless steel bolts and nuts, providing corrosion resistance suitable for exterior solar thermal installations. ASTM A153 covers zinc coating (hot-dip galvanizing) on iron and steel hardware, protecting carbon steel fasteners through a sacrificial zinc layer.

Item #:
079

Code Number:
2024 USHGC

Section Number:
501.12, 501.12.3 - 501.12.5

SUBMITTER:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

501.0 General.

501.12 Freeze Protection. Unless designed for such conditions, solar thermal systems and components ~~that contain liquid as the heat transfer medium~~ shall be protected from freezing ~~where the ambient temperature is less than 46°F (8°C) by means of fail-safe~~ in accordance with Section 501.12.1 through Section 501.12.6.

501.12.3 Integral Collector Storage. Integral collector storage systems shall be permitted to be installed in applications where the ambient temperature is not less than 23°F (-5°C) and the duration of a below-freezing episode has not exceeded 18 hours. Exposed piping in a solar thermal system shall be protected with insulation having ~~a thermal resistance~~an R-value of not less than R-5.

501.12.4 Indirect Thermosiphon. Indirect thermosiphon systems shall be permitted to be installed in applications where the ambient temperature is not less than 23°F (-5°C). Exposed piping in a solar thermal system shall be protected with insulation having ~~a thermal resistance~~an R-value of not less than R-5.

501.12.5 Direct (Open-Loop) Systems. Direct solar thermal systems shall be permitted to be installed in locations where the ambient temperature is not less than 46°F (8°C). Exposed piping in a solar thermal system shall be protected with insulation having an R-value of not less than R-5.

(renumber remaining sections)

SUBSTANTIATION:
The specified minimum temperature in Section 501.12 (Freeze Protection) applies only to direct (open-loop) systems and should not be included within the general requirement for freeze protection of all solar thermal systems. Therefore, Section 501.12.5 [Direct (Open-Loop) Systems] is being added to clarify that this minimum temperature applies specifically to such systems. For consistency, the proposed language in Section 501.12.5 aligns with the terminology used in other subsections that establish freeze protection requirements for specific system types.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
079	2024 USHGC	501.4, 501.11 – 501.11.7

Submitter Name:	Organization Name:	Organization Representation:
Edmond Murray	USHGC Solar Thermal Systems Task Group, Vice-Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.4 Draining. ~~Solar thermal system piping shall be installed to permit draining of the system.~~Piping, fittings, and collectors shall be designed and installed to drain by gravity when the circulating pump is not operating. Collector header pipes and absorber plate riser tubes internal to the collector shall be sloped in accordance with the manufacturer's instructions. A drain valve shall be installed at the lowest point of the system.

~~501.11~~**501.7** **Freeze Protection.** ~~Unless designed for such conditions, solar thermal systems and components shall be protected from freezing in accordance with Section 501.11.1 through Section 501.11.7.~~Solar thermal systems and components subject to freezing conditions shall be provided with freeze protection in accordance with Section 501.7.1 through Section 501.7.5. The method of freeze protection shall be identified with a permanent-type label attached to the system in a location visible at the point of service. Where antifreeze is used, the label shall indicate the type and concentration of the antifreeze.
Exceptions:
(1) Systems using air as the heat transfer medium.
(2) Systems and components specifically designed and listed for exposure to freezing conditions without damage.

~~501.11.1~~**501.7.1** **Antifreeze.** Where ~~propylene~~ glycol is used for freeze protection, the percent of ~~propylene~~ glycol by volume shall be determined based on the freezing point of the solution and type of mixture in accordance with Table 401.9, or the manufacturer's specifications.

~~501.11.2~~**501.7.2** **Drainback.** Drainback systems shall drain by gravity and shall be permitted to be installed in applications where the ambient temperature is not less than -60°F (-51°C).

~~501.11.3~~**501.7.3** **Integral Collector Storage.** Integral collector storage systems shall be permitted to be installed in applications where the ambient temperature is not less than 23°F (-5°C) and the duration of a below-freezing episode has not exceeded 18 hours. ~~Exposed piping in a solar thermal system~~Piping located outdoors or in unconditioned spaces shall be protected with insulation having an R-value of not less than R-5.

~~501.11.4~~**501.7.4** **Indirect Thermosiphon.** Indirect thermosiphon systems shall be permitted to be installed in applications where the ambient temperature is not less than 23°F (-5°C). ~~Exposed piping in a solar thermal system~~Piping located outdoors or in unconditioned spaces shall be protected with insulation having an R-value of not less than R-5.

~~501.11.5~~501.7.5 **Direct (Open-Loop) Systems.** Direct solar thermal systems shall be permitted to be installed in locations where the ambient temperature is not less than 46°F (8°C). ~~Exposed piping in a solar thermal system~~Piping located outdoors or in unconditioned spaces shall be protected with insulation having an R-value of not less than R-5.

~~**501.11.6 Labeling.** A label indicating the method of freeze protection for the system shall be attached to the system in a visible location.~~

~~**501.11.7 Piping.** Fittings, pipe slopes, and collectors shall be designed and installed to allow for manual gravity draining of solar thermal system components and piping. Collector header pipes or absorber plate riser tubes internal to the collector shall be sloped in accordance with the manufacturer's instructions. Where a means to drain the system is provided a drain valve shall be installed.~~

(renumber remaining sections)

Substantiation:
Section 501.4 (Draining) is being updated to include the draining requirements for piping from Section 501.11.7 (Piping). This is a general requirement for solar thermal systems and does not belong under the options for freeze protection. As a result, Section 501.11.7 is being deleted.

The revised text in Section 501.7 (Freeze Protection) improves clarity by replacing "unless designed for such conditions" with specific exceptions for systems using air as the heat transfer medium and systems listed for exposure to freezing conditions. This eliminates ambiguity about which systems require freeze protection. The labeling requirement from Section 501.11.6 is incorporated into the main section and expanded to require identification of antifreeze type and concentration. As a result, Section 501.11.6 is being deleted.

In a separate public comment (Item #081), requirements for ethylene glycol are being proposed. To prevent conflicting requirements, Section 501.7.1 (Antifreeze) is being revised to allow for the use of either propylene glycol or ethylene glycol as freeze protection.

In the remaining subsections addressing specific system types, the phrase "exposed piping" is being updated to "piping located outdoors or in unconditioned spaces." The term "exposed" is ambiguous and subject to interpretation. These revisions clearly identify which piping requires insulation and improve enforceability.

Comment 2

Item #:	**Code Number:**	**Sections(s):**
079	2024 USHGC	501.7, 501.10, 501.10.1
Submitter Name:	**Organization Name:**	**Organization Representation:**
Edmond Murray	USHGC Solar Thermal Systems Task Group, Vice-Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.7 Water Heating Systems. Solar water heating systems shall ~~be in accordance~~comply with IAPMO S1001.1 or ICC 900/SRCC 300 and be installed in accordance with the manufacturer's installation instructions. ~~Where solar collectors are capable of being isolated from the remainder of the system, a suitable pressure relief valve shall be installed in the isolatable section.~~

501.10 ~~Protection~~Safety Devices. Solar thermal systems shall be protected from excessive pressures, temperature, and vacuum in accordance with Section 311.0. ~~Where required, freeze protection shall be provided in accordance with Section 501.11.~~

501.10.1 Isolated Collectors. Solar collectors capable of being isolated from the system shall have a pressure relief valve installed within the isolatable section. The collector shall not be capable of being isolated from the relief device.

Substantiation:

To avoid unnecessary redirections to different sections and to consolidate related requirements, Section 501.10 is being revised to focus solely on safety devices. This includes removing the reference to freeze protection requirements, which are being comprehensively addressed in Item #079, and relocating requirements for pressure relief valves from Section 501.7 (Water Heating Systems). Section 501.7 is also being revised to require installation in accordance with the manufacturer's installation instructions.

Section 501.10.1 (Isolated Collectors) contains the relocated requirements from Section 501.7 and further revises the language to clarify that a pressure relief valve must be installed within the isolatable section and that the collector cannot be isolated from the relief device. The current text only requires a "suitable" pressure relief valve without specifying its location relative to isolation valves.

Item #:
081

Code Number:
2024 USHGC

Section Number:
501.14, 501.16, Table 901.1, Table 901.2

SUBMITTER:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

501.0 General.

501.14 ~~**Flash Points**~~**Heat Transfer Fluid.** The flash point of ~~a~~the heat~~-~~transfer ~~medium~~fluid shall not be less than 50°F (28°C) ~~or more~~ above the ~~design~~ maximum system operating temperature. The flash point of the heat transfer fluid shall be determined in accordance with ASTM D56, ASTM D93, or ASTM D3278. The heat transfer fluid shall be compatible with the makeup fluid supplied to the system.

~~**501.16**~~**501.14.1** ~~**Heat Transfer Fluid**~~**Marking.** Solar thermal piping shall be identified with an orange background with black uppercase lettering, with the words "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."
Each solar thermal system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 404.3.
Each outlet on the solar thermal piping system shall be posted with black uppercase lettering as follows: "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASTM D56-2022	Standard Test Method for Flash Point by Tag Closed Cup Tester	Heat Transfer Fluid	501.14
ASTM D93-2020	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester	Heat Transfer Fluid	501.14
ASTM D3278-2021	Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus	Heat Transfer Fluid	501.14

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
~~ASTM D56-2022~~	~~Standard Test Method for Flash Point by Tag Closed Cup Tester~~	~~Testing~~
~~ASTM D93-2020~~	~~Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester~~	~~Testing~~
~~ASTM D3278-2021~~	~~Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus~~	~~Testing~~

(portions of table not shown remain unchanged)

Note: ASTM D56, ASTM D93, and ASTM D3278 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:

The flash point is the lowest temperature at which a **liquid** gives off enough vapor to ignite in air when exposed to an ignition source, making the requirements of Section 501.14 specific to the heat transfer fluid used within the system.

ASTM D56, ASTM D93, and ASTM D3278 provide the test methods used internationally to determine the flash point of liquids. Each standard describes a specific method or apparatus for testing:

> **ASTM D56:** Standard Test Method for Flash Point by Tag Closed Cup Tester, typically used for liquids with a flash point below 93.3°C (200°F).
>
> **ASTM D93:** Standard Test Method for Flash Point by Pensky-Martens Closed Cup Tester, applicable to a wide range of substances, including those with high viscosity or suspended solids.
>
> **ASTM D3278:** Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus, often used for testing liquids in small quantities.

Committee Action:

Accept As Submitted

TOTAL ELIGIBLE TO VOTE:

15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
081	2024 USHGC	501.6.1 - 501.6.5, 501.13, 501.13.1

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

~~501.13~~**501.6** **Heat Transfer Fluid.** The heat transfer fluid shall be compatible with the makeup fluid supplied to the system.
501.6.1 Flash Point. The flash point of the heat transfer fluid shall not be less than 50°F (28°C) above the maximum system operating temperature. The flash point of the heat transfer fluid shall be determined in accordance with ASTM D56, ASTM D93, or ASTM D3278. ~~The heat transfer fluid shall be compatible with the makeup fluid supplied to the system.~~
501.6.2 Water Quality. The quality of potable water shall be in accordance with the Authority Having Jurisdiction.
501.6.3 Ethylene Glycol. Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.
501.6.4 Chemical Compatibility. Antifreeze and other additives used in the system shall be chemically compatible with the pipe, tubing, fittings, and mechanical systems.
501.6.5 Disposal of System Fluids. Solar thermal system fluids that contain additives such as antifreeze, corrosion inhibitors, and cleaning solutions shall be recycled or disposed of in an approved manner in accordance with the Authority Having Jurisdiction.
~~501.13.1~~**501.6.6** **Marking.** ~~Solar thermal piping~~In solar thermal systems using heat transfer fluid other than potable water, the system piping shall be identified with an orange background with black uppercase lettering, with the words "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK." Each solar thermal system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 404.3.
Each outlet on the solar thermal piping system shall be posted with black uppercase lettering as follows: "CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK."

(renumber remaining sections)

Substantiation:
The requirements for heat transfer fluids are being expanded to address potable water, ethylene glycol, chemical compatibility, and proper disposal. Additionally, the marking requirements for piping are being revised to specifically address systems that use heat transfer fluids other than potable water.

Section 501.6 (Heat Transfer Fluid): This section now focuses on general compatibility requirements.

Section 501.6.2 (Water Quality): This is a new requirement addressing potable water quality for solar thermal systems. This is particularly relevant for direct (open-loop) systems that circulate potable water through the collectors. The requirement defers to the Authority Having Jurisdiction since potable water quality standards vary by location.

Section 501.6.3 (Ethylene Glycol): Correlates with Section 401.6.1 (Ethylene Glycol)
These requirements are needed in Chapter 5 to restrict the use of ethylene glycol and protect the potable water supply from contamination.

> ***[2025 USHGC ROP Preprint]***
> ***401.6.1 Ethylene Glycol.*** *Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.*

Section 501.6.4 (Chemical Compatibility): Correlates with Section 701.10 (Chemical Compatibility)
These requirements are needed in Chapter 5 to ensure that antifreeze and other additives are compatible with system components. Incompatible chemicals can degrade piping, fittings, and seals, leading to leaks and system failures.

> ***[2025 USHGC ROP Preprint]***
> ***701.10 Chemical Compatibility.*** *Antifreeze and other materials used in the system shall be chemically compatible with the pipe, tubing, fittings, and mechanical systems.*

Section 501.6.5 (Disposal of System Fluids): Correlates with Section 401.6 (Disposal of System Fluids)
These requirements are needed in Chapter 5 to ensure proper disposal of heat transfer fluids containing antifreeze, corrosion inhibitors, or cleaning solutions. These fluids can be harmful to the environment if improperly disposed of.

> ***[2025 USHGC ROP Preprint]***
> ***401.7 Disposal of Hydronic Fluid.*** *Hydronic system fluids that contain additives such as antifreeze, corrosion inhibitors, and cleaning solutions shall be recycled or disposed of in an approved manner in accordance with the Authority Having Jurisdiction.*

Section 501.6.6 (Marking): The current text applies the same marking requirements to all solar thermal systems regardless of whether they convey potable water. This revision eliminates an overly broad requirement and ensures markings are applied appropriately based on the type of fluid in the system.

Item #: 084	**Code Number:** 2024 USHGC	**Section Number:** 502.2, 502.3.2, 502.5.3
SUBMITTER: Edmond Murray	**Organization Name:** USHGC Solar Thermal Systems Task Group, Vice-Chair	**Organization Representation:**

RECOMMENDATION:
Revise text

Proposed Text :

502.0 Solar Collectors.

~~**502.2 Fire Safety Requirements.** Collectors that function as building components shall be in accordance with the building code and the fire code.~~

502.3.2 Roof-Integrated. Collectors that are integral with or function as part of the building roof structure shall have the same required fire rating classification as the roof.
~~502.5.3~~**502.3.3** **Above or on the Roof.** Collectors that are located above or on roofs~~,~~ and do not function~~ing~~ as building components~~,~~ shall not reduce the required fire-resistance and fire-retardance classification of the roof covering materials.
~~**Exceptions:**~~
~~(1) One- and two-family dwellings.~~

~~(2) Collectors located on buildings not exceeding three stories in height, a 9000 square feet (ft^2) (836.13 m^2) total floor area; or both providing:~~
~~(a) The collectors are noncombustible.~~
~~(b) Collectors with plastic covers have noncombustible sides and bottoms, and the total area covered and the collector shall not exceed the following:~~
~~(i) Plastic CC1 – 33 ⅓ percent of the roof area.~~
~~(ii) Plastic CC2 – 25 percent of the roof area.~~
~~(c) Collectors with plastic film covers having a thickness of not more than 0.010 of an inch (0.25 mm) shall have noncombustible sides and bottoms, and the total area covered by the collector shall not exceed 33 ⅓ percent of the roof area.~~

SUBSTANTIATION:
The proposed updates clearly separate requirements for two key scenarios: roof-integrated collectors (functioning as roofing material) and above-roof collectors (installed on, but not part of the roof). Roof-integrated systems must match the fire rating, and above-roof systems must not reduce fire resistance.

The Task Group then reviewed the existing exceptions and determined that they specifically applied to light-transmitting plastic covers on solar collectors which are extensively covered within the building code. However, the building code does not use these as exceptions to allow for reducing fire ratings of roof materials. They are listed as restrictions or conditions on the installation of light-transmitting plastic covers on solar collectors. Detailed material specifications are then provided for fire protection. To ensure such provisions are applied appropriately, a separate code change has been submitted which mandates that light-transmitting plastic covers are to comply with the building code.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
084

Code Number:
2024 USHGC

Sections(s):
218.0

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

218.0 – P –

~~**Plastic CC1.** Plastic materials that have a burning extent of 1 inch (25.4 mm) or less where tested in nominal 0.060 of an inch (1.52 mm) thickness by ASTM D635 or in the thickness intended for use.~~

~~**Plastic CC2.** Plastic materials that have a burning rate of 150 inches per hour (in/h) (63.5 mm/min) or less where tested in nominal 0.060 inch (1.52 mm) thickness by ASTM D635 or in the thickness intended for use.~~

Substantiation:
The definitions for "Plastic CC1" and "Plastic CC2" are being deleted. These terms are no longer used in the code following the revisions made in Item #084.

Item #:
093

Code Number:
2024 USHGC

Section Number:
701.1.2, 707.2

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

701.0 General.
701.1 Applicability. (remaining text unchanged)

701.1.2 Equipment, Accessories, Components, and Materials. The mechanical equipment, accessories, components, and materials used shall be of the type and rating approved for the specific use. Piping, tubing, and fittings shall comply with Section 703.0.

707.0 Installation Practices.

~~**707.2 Equipment, Accessories, Components, and Materials.** The mechanical equipment, accessories, components, and materials used shall be of the type and rating identified for the specific use.~~

(renumber remaining sections)

SUBSTANTIATION:
Section 701.1.2 (Equipment, Accessories, Components, and Materials) and Section 707.2 (Equipment, Accessories, Components, and Materials) are duplicates. Therefore, the additional occurrence is being deleted.

For additional clarity, reference is being made to Section 703.0 (Design of Systems) which includes material requirements for piping, tubing, and fittings. As a note, Section 703.0 is being revised via a separate code change proposal and is therefore not shown here.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
093

Code Number:
2024 USHGC

Sections(s):
701.1.2, 701.4, 701.11.2, 702.0, 702.1

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

701.0 General.
701.1 Applicability. (remaining text unchanged)

~~**701.1.2 Equipment, Accessories, Components, and Materials.** The mechanical equipment, accessories, components, and materials used shall be of the type and rating approved for the specific use. Piping, tubing, and fittings shall comply with Section 703.0.~~

(renumber remaining sections)

702.0 Materials.
702.1 General. Mechanical equipment, accessories, components, and materials used in the construction and installation of GSHP systems shall be approved for the intended use and rated for the operating temperature and pressure of the system.
~~701.11.2~~**702.1.1 Compatibility.** System components shall be compatible with system fluids including, but not limited to, antifreeze. For systems utilizing chemical additives, system components and fluids shall be tested and approved for compatibility.
~~701.4~~**702.1.2 Used Materials.** The installation of used pipe, fittings, valves, and other materials shall not be permitted.

(renumber remaining sections)

Substantiation:
The USHGC Geothermal Energy Systems Task Group submitted public comments to Item #093, Item #096, Item #099, and Item #100, which reorganize and improve requirements for materials.

Item #093: New Section 702.0 (Materials) is being proposed as the sole location for material requirements.

- The base language from Section 701.1.2 (Equipment, Accessories, Components, and Materials) was used to develop Section 702.1 (General), which limits applicability to GSHP systems and expands on rating requirements.
- Existing provisions for used materials and compatibility of system components are being relocated here for appropriate grouping.

Since the Task Group's public comments to Item #093, Item #096, Item #099, and Item #100 are all related, a brief summary of their actions is shown below. For additional information, please refer to the substantiation provided for each public comment.

Item #096: Removes duplicative requirements for indoor piping materials.
Item #099: Updates and combines the existing tables for piping, tubing, and fitting standards.
Item #100: Updates and clarifies the additional piping and tubing material requirements.

Item #:
094

Code Number:
2024 USHGC

Section Number:
701.3

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

701.0 General.

701.3 Site Survey. A site survey shall be conducted prior to designing the geothermal system. The requirements for construction documents shall be defined by the Authority Having Jurisdiction. Where no guidance is provided, the construction documents shall include a plat plan indicating the following:
(1) The dimension, pipe sizing, and location of the ground heat exchanger or submerged heat exchanger.
(2) The distance from the structure to the ground heat exchanger or submerged heat exchanger.
(3) The configuration, field geometry, and depth of the ground heat exchanger or submerged heat exchanger.
(4) The distance to any utility and sanitary features that exist near the ground heat exchanger or submerged heat exchanger.

SUBSTANTIATION:
Including pipe sizing in the construction documents is needed to confirm compatibility with flow rates and fluid type. Pipe size influences the total volume of fluid in the system and contributes to the system's thermal storage capacity.

Field geometry refers to the layout pattern and spatial configuration of the ground or submerged heat exchanger. The layout affects how heat moves through the ground and how much thermal interference occurs between adjacent loops. This in turn affects the amount of land required, depth of excavation or drilling, and overall site impact.

Committee Action:
Accept As Amended by the TC

Proposed Text :

701.0 General.

701.3 Site Survey. A site survey shall be conducted prior to designing the geothermal system. The requirements for construction documents shall be defined by the Authority Having Jurisdiction. Where no guidance is provided, the construction documents shall include a plat plan indicating the following:
(1) The dimension~~, pipe sizing,~~ and location of the ground heat exchanger or submerged heat exchanger.
(2) The distance from the structure to the ground heat exchanger or submerged heat exchanger.
(3) The configuration, field geometry, and depth of the ground heat exchanger or submerged heat exchanger.
(4) The distance to any utility and sanitary features that exist near the ground heat exchanger or submerged heat exchanger.

Committee Statement:
Item (1) of Section 701.3 (Site Survey) is being amended to remove the reference to "pipe sizing" as site surveys are intended to identify spatial and locational aspects, not hydraulic or thermal design details. The remaining updates are applicable, improve the section, and align with this intent.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
094	2024 USHGC	701.3, 707.3 - 707.4.2, 712.2

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

701.0 General.

701.3 Site Survey. A site survey shall be conducted prior to designing the ~~geothermal~~GSHP system. The requirements for construction documents shall be defined by the Authority Having Jurisdiction. Where no guidance is provided, the construction documents shall include a plat plan indicating the following:
(1) The dimension and location of the ground heat exchanger or submerged heat exchanger.
(2) The distance from the structure to the ground heat exchanger or submerged heat exchanger.
(3) The configuration, field geometry, and depth of the ground heat exchanger or submerged heat exchanger.
(4) The distance to any utility and sanitary features that exist near the ground heat exchanger or submerged heat exchanger.
(5) Physical limitations of the land area, including its extent, structures, existing wells, proximity of other existing ground heat exchangers, pavements, trees, grading, ponds, waterways, easements, overhead and underground services, septic systems, identified septic repair areas, utility of rights of way, protected preserves or archeology sites, and other elements that affect the GSHP system installation.
(6) A subsurface investigation in accordance with Section 701.4.

~~707.4~~**701.4 Subsurface Investigation.** A subsurface investigation shall be performed in accordance with Section ~~707.4.1~~701.4.1 as determined by the registered design professional or certified designer conducting the site survey.

~~707.4.1~~<u>**701.4.1**</u> **Subsurface Conditions.** The water well logs and other geological records shall be used to anticipate the subsurface conditions of the aquifer and its potential supply of fresh water, multiple aquifers, saltwater intrusions, contaminated soils and groundwater, hazardous gases, and any interference with neighboring water wells and ground heat exchangers. Geological issues such as permafrost conditions and building stability shall be considered when reviewing available records.
<u>**701.4.2 Test Wells.** Test wells drilled to investigate subsurface conditions shall provide details on the groundwater location, chemical and physical characteristics, rock strata, and temperature profiles. The number of test wells shall be determined in accordance with the Authority Having Jurisdiction. Test wells for open-loop GSHP systems shall also comply with Section 712.2.</u>

(renumber remaining sections)

707.0 Installation Practices.

~~**707.3 Site Survey Requirements.** The site survey shall identify the physical limitations of the land area, including its extent, structures, existing wells of all types, proximity of other existing ground heat exchangers, pavements, trees, grading, ponds, waterways, easements, overhead and underground services, septic systems, any identified septic repair areas, utility of rights of way, protected preserves or archeology sites, and any other elements that could affect an open-loop configuration.~~
~~Permission shall be obtained from any adjoining property owner(s), as evidenced by the registration and approval of a formal easement that meets requirements of the Authority Having Jurisdiction. It shall be received prior to the installation of any open loop system that will extend into, cross, or interfere with the equipment or rights-of-way of utilities, jurisdictions, and other property owners. The site survey shall include a subsurface investigation that meets the requirements for an open loop ground heat exchanger.~~

(renumber remaining sections)

Part III – Open-Loop Systems.

712.0 General.

712.2 Test Wells. ~~Test wells drilled to investigate subsurface conditions shall provide details of the groundwater location, chemical and physical characteristics, rock strata, and temperature profiles. The number of test wells shall be determined in accordance with the Authority Having Jurisdiction.~~<u>Test wells shall comply with Section 701.4.2 and this section.</u> Each test well shall be tested for flow rate for a period of not less than 24 hours. Water samples shall be collected in accordance with the NGWA-01 from each well to establish existing water quality levels are approved for groundwater system use. Water samples shall be analyzed for standard drinking water, fecal and coliform content, bacterial iron, nitrate, dissolved minerals, pH, hardness, and other compounds in accordance with NGWA-01 or in accordance with the Authority Having Jurisdiction. Wells shall be tested for water production and recovery. Monitoring wells shall be protected, and marked to allow for monitoring of ground temperature, groundwater levels, and groundwater quality.

Substantiation:
Since GSHP systems cannot be properly designed without first understanding surface constraints and subsurface conditions, requirements for site surveys, subsurface investigations, and test wells are logically placed before construction and installation provisions to reflect the actual sequence of project development. Accordingly, Section 701.3 (Site Survey) is being updated to incorporate related provisions currently located in Section 707.3 (Site Survey Requirements). The remaining provisions in Section 707.3 pertain to easements, adjoining property owner consent, and utility right-of-way coordination.

These are general legal and permitting obligations that apply to any construction activity crossing property boundaries or interfering with utility infrastructure, and the Authority Having Jurisdiction already enforces them through permit review, zoning compliance, and civil property law. Section 707.3 is therefore being deleted in its entirety.

Similarly, test well requirements are being updated to reflect their applicability to all GSHP systems. Although test wells are drilled to investigate subsurface conditions regardless of system type, the current code only addresses them in Section 712.2 (Test Wells) within the open-loop provisions. That section contains a general list of details (groundwater location, chemical and physical characteristics, rock strata, and temperature profiles) that are universally applicable. New Section 701.4.2 (Test Wells) relocates this list to the general requirements and cross-references Section 712.2 for additional testing specific to open-loop systems.

Item #:
095

Code Number:
2024 USHGC

Section Number:
209.0, Chapter 7

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

701.0 General.

701.5 Contact with Building Material. A ground ~~source heat pump ground-loop piping~~heat exchanger system shall not be in direct contact with building materials that cause the piping or fitting material to degrade or corrode, or that interferes with the operation of the system.

701.9 Velocities. Ground ~~source heat pump ground-loop~~heat exchanger systems shall be designed so that the flow velocities do not exceed the maximum flow velocity recommended by the pipe and fittings manufacturer. Flow velocities shall be controlled to reduce the possibility of water hammer.

703.0 Design of Systems.

703.1 Ground~~-~~ Heat Exchanger Design. The ground~~-~~ heat exchanger design shall be provided by a licensed professional or a designer with the appropriate certifications or credentials as defined by the Authority Having Jurisdiction.

707.0 Installation Practices.

707.1 Prior to Construction. Documents for permits shall be submitted prior to the construction of a ~~building system,~~ground heat exchanger or water well. Permits shall be issued by the Authority Having Jurisdiction.

707.5 Subsurface Investigation. (remaining text unchanged)

707.5.1 Subsurface Conditions. The water well logs and other geological records shall be used to anticipate the subsurface conditions of the aquifer and its potential supply of fresh water, multiple aquifers, saltwater intrusions, contaminated soils and groundwater, hazardous gases, and any interference with neighboring water wells and ground ~~source~~ heat exchangers.
Geological issues such as permafrost conditions and building stability shall be considered when reviewing available records.

707.16 Pressurizing During Installation. Ground ~~source heat pump ground-loop~~heat exchanger piping to be embedded in concrete shall be pressure tested prior to pouring concrete. During pouring, the pipe shall be maintained at the proposed operating pressure.

707.18 Trenches, Excavation, and Backfill. Excavation for horizontal piping shall comply with Section 707.8 through Section 707.11, Section 707.18.1 through Section 707.18.8, and in accordance with requirements of the Authority Having Jurisdiction. Prior to any excavation, trenching, or drilling, all buried utilities including drainage and irrigation systems shall be located and flagged by the appropriate utility and ground ~~source heat pump system~~heat exchanger contractor representative.

708.0 System Start-Up.

708.4 Documentation. The ground ~~source heat pump system~~heat exchanger as-built installation drawings and instructions shall be provided to the building owner or designated agent.

708.6 Records. The ground ~~source heat pump system~~heat exchanger construction documents shall be provided to the owner.

710.0 General.

710.1 Applicability. Part II of this chapter shall apply to closed-loop geothermal systems such as, but not limited to, systems coupled to a ground ~~loop~~ heat exchanger, or a heat exchanger submerged in a surface body of water. [See Figure 710.1(1) for an example of a simplified schematic of a closed-loop geothermal system coupled to a ground ~~loop~~ heat exchanger. See Figure 710.1(2) for an example of a simplified schematic of a closed-loop geothermal system coupled to a heat exchanger submerged in a surface body of water.]

FIGURE 710.1(1)[1, 2]
EXAMPLE OF A CLOSED-LOOP SYSTEM COUPLED TO A GROUND ~~LOOP~~ HEAT EXCHANGER
(SIMPLIFIED SCHEMATIC)

(portions of figure not shown remain unchanged)

711.0 Ground~~-~~ Heat Exchanger Testing.

711.3 Field Pressure Testing – Final. The ground heat exchanger and building piping shall be cleaned, flushed, and, where required, shall be filled with the heat transfer fluid medium. The ground ~~loop system~~heat exchanger shall be tested at the design flow rate(s) and differential pressure(s) recorded. Where the actual pressure change at design flow is more than +/- 10 percent of the design flow pressure drop, the cause shall be identified, and corrective action taken.

209.0 - G -

~~**Geothermal Ground-Loop.** A conduit for a fluid, such as water or a water based antifreeze solution, used to create a circuit that serves as a heat sink, source, or storage device.~~

Ground~~-~~ Heat Exchanger. An underground closed-loop ~~heat exchanger through which~~piping network which exchanges thermal energy with the earth by circulating a heat~~-~~ transfer ~~medium passes~~fluid to and from a heat pump or other rated mechanical equipment. ~~It includes the buried pipe and connecting main(s) up to and terminating with the building.~~

SUBSTANTIATION:

A ground heat exchanger is the portion of the ground-source heat pump system that exchanges thermal energy with the ground and specifically pertains to the underground piping network, and a ground heat exchanger system is a subsystem of the ground-source heat pump system and includes the underground piping network and any associated equipment used to circulate fluid through the loop. Therefore, current provisions which to “ground source heat pump ground-loop” and “ground source heat pump ground-loop systems” have been updated accordingly. Additionally, provisions that incorrectly refer to “ground source heat pump systems,” but in context apply to the “ground heat exchanger system,” have been updated for technical accuracy.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
095

Code Number:
2024 USHGC

Sections(s):
205.0, 701.2, 703.1

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

701.0 General.

701.2 Qualifications. Ground-source heat pump systems shall be designed by a registered design professional or certified designer. District energy systems shall be designed by a registered design professional.

(renumber remaining sections)

703.0 Design of Systems.
~~**703.1 Ground Heat Exchanger Design.** The ground heat exchanger design shall be provided by a licensed professional or a designer with the appropriate certifications or credentials as defined by the Authority Having Jurisdiction.~~

(renumber remaining sections)

205.0 - C -
Certified Designer. An individual who has successfully completed the formal training, testing, project design experience, and continuing education credits to be granted the IGSHPA/AEE title of Certified GeoExchange Designer, the CSA/IGSHPA title of GSHP Commercial System Designer (GCSD), or other equivalent approved certification program.

Substantiation:
Section 701.2 (Qualifications) establishes designer qualification requirements within the general provisions at the beginning of the chapter to clarify that they apply universally to all GSHP system types, rather than appearing to govern only ground heat exchanger design as the previous location implied.

The updated language distinguishes between two system categories: standard GSHP systems, which may be designed by either a registered design professional or certified designer; and district energy systems, which require a registered design professional.

Section 703.1 is being deleted as it references "a licensed professional or a designer with the appropriate certifications or credentials as defined by the Authority Having Jurisdiction," which is already clearly established via the existing definitions for “certified designer” and “registered design professional.”

> *[2025 USHGC ROP Preprint]*
> *220.0 (-R-)*
> ***Registered Design Professional.*** *An individual who is registered or licensed by the laws of the state to perform such design work in the jurisdiction.*

Additionally, the definition for certified designer is being expanded to recognize the CSA/IGSHPA title of GSHP Commercial System Designer (GCSD) as an accepted credential.

Comment 2

Item #:
095

Code Number:
2024 USHGC

Sections(s):
701.5 – 701.8

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

701.0 General.

~~**701.5 Contact with Building Material.** A ground heat exchanger system shall not be in direct contact with building materials that cause the piping or fitting material to degrade or corrode, or that interferes with the operation of the system.~~

~~**701.6 Strains and Stresses.** Piping shall be installed so as to prevent detrimental strains and stresses in the pipe. Provisions shall be made to protect piping from damage resulting from expansion, contraction, and structural settlement. Piping shall be installed so as to avoid structural stresses or strains within building components.~~

~~**701.7 Flood Hazard.** Piping located in a flood hazard area shall be capable of resisting hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation.~~

~~**701.8 Pipe Support.** Pipe shall be supported in accordance with Section 317.1.~~

(renumber remaining sections)

Substantiation:
This public comment deletes select requirements already addressed in Chapter 3 (General Regulations), which contains additional provisions on protection of piping, materials, and structures beyond those removed here.

> *[2025 USHGC ROP Preprint]*
> ***302.3 Flood Hazard Areas.*** *Systems shall be located above the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher.*
> ***Exception:*** *Systems shall be permitted to be located below the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher, provided that the systems are designed and installed to prevent water from entering or accumulating within their components and the systems are constructed to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to such elevation.*
> ***302.3.1 Coastal High Hazard Areas.*** *Systems in buildings located in coastal high hazard areas shall be in accordance with the requirements of Section 302.3, and systems, pipes, tubing, and appurtenances shall not be mounted on or penetrate through walls that are intended to breakaway under flood loads in accordance with the building code.*
> ***302.3.2 Flood Resistant Materials.*** *System components installed in flood hazard areas and below the design flood elevation shall be made of flood damage-resistant materials.*
>
> ***318.0 Protection of Piping, Materials, and Structures.***
> ***318.1 General.*** *Piping or tubing passing under or through walls shall be protected from breakage. Piping passing through or under cinders or other corrosive materials shall be protected from external corrosion in an approved manner. Approved provisions shall be made for expansion of hot liquid piping. Voids around piping or tubing passing through concrete floors on the ground shall be sealed.*
> ***318.2 Installation.*** *Piping or tubing shall be installed so that piping, tubing, or connections will not be subject to undue strains or stresses, and provisions shall be made for expansion, contraction, and structural settlement. No piping or tubing, unless designed and listed for such use, shall be directly embedded in concrete or masonry. No structural member shall be seriously weakened or impaired by cutting, notching, or otherwise, as defined in the building code.*
>
> ***319.0 Protection of System Components.***
> ***319.2 Corrosion.*** *Systems and components subject to corrosion shall be protected in an approved manner. Metal parts exposed to atmospheric conditions shall be of corrosion-resistant material.*

Item #:
096

Code Number:
2024 USHGC

Section Number:
208.0, 701.11, 701.11.1, 703.5, 706.2, 706.3, 715.2, Table 901.1, Table 901.2

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

701.0 General.

701.11 Heat Transfer Fluid. ~~The heat transfer fluid shall be compatible with the makeup fluid supplied to the system.~~

~~**706.3 Heat Transfer Medium.**~~ The heat~~-~~ transfer ~~medium~~fluid shall be compatible with components with which it comes into contact. The makeup fluid supplied to the system shall be compatible with the heat transfer fluid. Where antifreeze or corrosion inhibitors are used, such solutions shall be approved by the Authority Having Jurisdiction. The flash point of the heat~~-~~ transfer fluid ~~flash point~~ shall be not less than 50°F (28°C) above the maximum system operating temperature. The flash point of the heat transfer fluid shall be determined in accordance with ASTM D56, ASTM D93, or ASTM D3278. For DX systems, the heat transfer ~~medium~~fluid shall be a refrigerant listed in ASHRAE 34 or the mechanical code. ~~For~~Where the source and load fluids are comingled, such as in six-pipe heat pump systems ~~and other specialty heat pumps that comingle source and load fluids~~, the manufacturer's installation instructions shall apply.

701.11.1 Water Quality. The makeup water quality within the closed-loop ground ~~source~~ heat ~~pump~~exchanger system shall be in accordance with IAPMO/ANSI H1001.1, ANSI/CSA/IGSHPA C448, or Table 701.11.1. The quality of potable water shall be in accordance with the equipment manufacturer's installation instructions or the Authority Having Jurisdiction.

703.0 Design of Systems.

703.5 Indoor Piping. Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Chapter 4. Such materials shall be rated for the operating temperature and pressures of the system and shall be compatible with the ~~type of transfer medium~~heat transfer fluid.

706.0 Specific System Components Design.

706.2 Heat Exchangers. Heat exchangers used for heat transfer or heat recovery shall protect the potable water system from being contaminated by the heat transfer ~~medium~~fluid. Single-wall heat exchangers shall comply with Section 313.1. Double-wall heat exchangers shall separate the potable water from the heat transfer ~~medium~~fluid by providing a space between the two walls that are vented to the atmosphere.

715.0 Direct Exchange (DX) Systems.

715.2 Applicability. Part IV of this chapter shall apply to geothermal energy systems such as, but not limited to, building systems coupled with a DX closed-loop using refrigerant as a heat transfer ~~medium~~fluid. ~~The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems.~~ Indoor piping, fittings, and accessories that are part of the ground ~~source system~~heat exchanger shall be in accordance with Section 703.5 and Chapter 4.

208.0 - F -

Flash Point. The minimum temperature corrected to a pressure of 14.7 psia (101 kPa) at which a test flame causes the vapors of a portion of the sample to ignite under the conditions specified by the test procedures and apparatus. ~~The flash point of a liquid shall be determined in accordance with ASTM D56, ASTM D93, or ASTM D3278.~~

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASTM D56-2022	Standard Test Method for Flash Point by Tag Closed Cup Tester	Heat Transfer Fluid	701.11
ASTM D93-2020	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester	Heat Transfer Fluid	701.11
ASTM D3278-2021	Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus	Heat Transfer Fluid	701.11

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
~~ASTM D56-2022~~	~~Standard Test Method for Flash Point by Tag Closed Cup Tester~~	~~Testing~~
~~ASTM D93-2020~~	~~Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester~~	~~Testing~~
~~ASTM D3278-2021~~	~~Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus~~	~~Testing~~

(portions of table not shown remain unchanged)

Note: ASTM D56, ASTM D93, and ASTM D3278 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:

Geothermal systems rely on a circulating fluid in closed or open loops to transfer thermal energy between the earth and heat pumps. The term “heat transfer medium” is broader and less specific, whereas “heat transfer fluid” accurately dictates the use of liquids. This clearly conveys the correct system design, where a circulating liquid is the primary means of transferring heat in geothermal applications.

The existing requirements for heat transfer fluids are being consolidated to present all applicable provisions in a single location. This includes the referenced ASTM standards, which were previously listed in the definition for “flash point.” Because definitions cannot contain enforceable requirements, the definition is being revised, and the ASTM standards are being relocated to Section 701.11 (Heat Transfer Fluid).

Additionally, the makeup fluid needs to be compatible with the system's heat transfer fluid because incompatibility can compromise the performance, safety, and longevity of the system. Furthermore, the language addressing six-pipe heat pump systems is being reworded to cover any system in which the source and load fluids are comingled. The existing language references “specialty” heat pumps which may be ambiguous.

Committee Action:

Accept As Submitted

TOTAL ELIGIBLE TO VOTE:

15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
096	2024 USHGC	313.1, 701.6, 701.10, 701.11, 702.0, 702.1, 706.2

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:

Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

701.0 General.

~~701.11~~701.5 **Heat Transfer Fluid.** The heat transfer fluid shall be compatible with components with which it comes into contact. The makeup fluid supplied to the system shall be compatible with the heat transfer fluid. Where antifreeze or corrosion inhibitors are used, such solutions shall be approved by the Authority Having Jurisdiction.

The flash point of the heat transfer fluid shall be not less than 50°F (28°C) above the maximum system operating temperature. The flash point of the heat transfer fluid shall be determined in accordance with ASTM D56, ASTM D93, or ASTM D3278. For DX systems, the heat transfer fluid shall be a refrigerant listed in ASHRAE 34 or the mechanical code. Where the source and load fluids are comingled, such as in six-pipe heat pump systems, the manufacturer's installation instructions shall apply.
~~701.10~~701.5.1 **Chemical Compatibility.** Antifreeze and other materials used in the system shall be chemically compatible with the pipe, tubing, fittings, and mechanical systems.

701.6 Protection of Potable Water Supply. Where a GSHP system is connected to a potable water system, the potable water system shall be protected from backflow from the GSHP system in accordance with the plumbing code.
~~706.2~~**701.6.1** **Heat Exchangers.** ~~Heat exchangers used for heat transfer or heat recovery shall protect the potable water system from being contaminated by the heat transfer fluid. Single-wall heat exchangers shall comply with Section 313.1. Double-wall heat exchangers shall separate the potable water from the heat transfer fluid by providing a space between the two walls that are vented to the atmosphere.~~Heat exchangers shall comply with Section 313.0.

(renumber remaining sections)

~~702.0 Groundwater Systems.~~
~~702.1 General. The potable water supply connected to a groundwater system shall be protected with an approved backflow prevention device. The connection of a discharge line to the sanitary or storm sewer system, or private sewage disposal system, shall be in accordance with the plumbing code or in accordance with the Authority Having Jurisdiction.~~

(renumber remaining sections)

313.0 Heat Exchangers.
313.1 General. Systems utilizing heat exchangers shall protect the potable water system from being contaminated by the heat transfer fluid. Systems that incorporate a single-wall heat exchanger to separate potable water from the heat transfer fluid shall meet the following requirements:
(1) – (3) (remaining text unchanged)
Systems that do not comply with the requirements for a single-wall heat exchanger shall install a double-wall heat exchanger. Double-wall heat exchangers shall separate the potable water from the heat transfer fluid by providing a space between the two walls that ~~are~~is vented to the atmosphere.

Substantiation:
These updates reorganize fluid compatibility and potable water protection requirements into logical groupings within the general provisions. Chemical compatibility is inherently a subset of heat transfer fluid considerations, and such requirements should be presented together.

New Section 701.6 (Protection of Potable Water Supply) consolidates requirements previously split between Section 702.1 (Groundwater Systems) and Section 706.2 (Heat Exchangers), establishes a universal backflow protection requirement applicable whenever a GSHP system connects to a potable water system, and references the plumbing code for specific device requirements.

Comment 2

Item #:	Code Number:	Sections(s):
096	2024 USHGC	701.1.3, 702.0, 702.2, 703.5

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

701.0 General.
701.1 Applicability. (remaining text unchanged)

~~**701.1.3 Indoor Piping.** Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 703.5 and Chapter 4.~~

(renumber remaining sections)

702.0 Materials.

702.2 Indoor Piping, Fittings, and Appurtenances. Indoor piping, fittings, and appurtenances that are part of the GSHP system shall be in accordance with Chapter 4.

703.0 Design of Systems.

~~**703.5 Indoor Piping.** Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Chapter 4. Such materials shall be rated for the operating temperature and pressures of the system and shall be compatible with the heat transfer fluid.~~

(renumber remaining sections)

Substantiation:
The USHGC Geothermal Energy Systems Task Group submitted public comments to Item #093, Item #096, Item #099, and Item #100, which reorganize and improve requirements for materials.

Item #096: Indoor piping requirements are repeated in five separate locations (Section 701.1.3, Section 703.5, Section 712.1, Section 715.2, and Section 715.5).

- Section 701.1.3 and Section 703.5 are addressed via this public comment, while all other occurrences are addressed separately by public comments relating to those sections. [See Item #096 (other public comment), Item #098, and Item #115.]

- To avoid this duplication, a single general requirement in Section 702.2 (Indoor Piping, Fittings, and Appurtenances) is being proposed that applies to all GSHP systems covered by the chapter.

Since the Task Group's public comments to Item #093, Item #096, Item #099, and Item #100 are all related, a brief summary of their actions is shown below. For additional information, please refer to the substantiation provided for each public comment.

Item #093: Proposes new Section 702.0 (Materials) as the sole location for material requirements.
Item #099: Updates and combines the existing tables for piping, tubing, and fitting standards.
Item #100: Updates and clarifies the additional piping and tubing material requirements.

Comment 3

Item #:
096

Code Number:
2024 USHGC

Sections(s):
701.11.1, 710.1, Table 701.11.1, Figure 710.1(1), Figure 710.1(2)

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

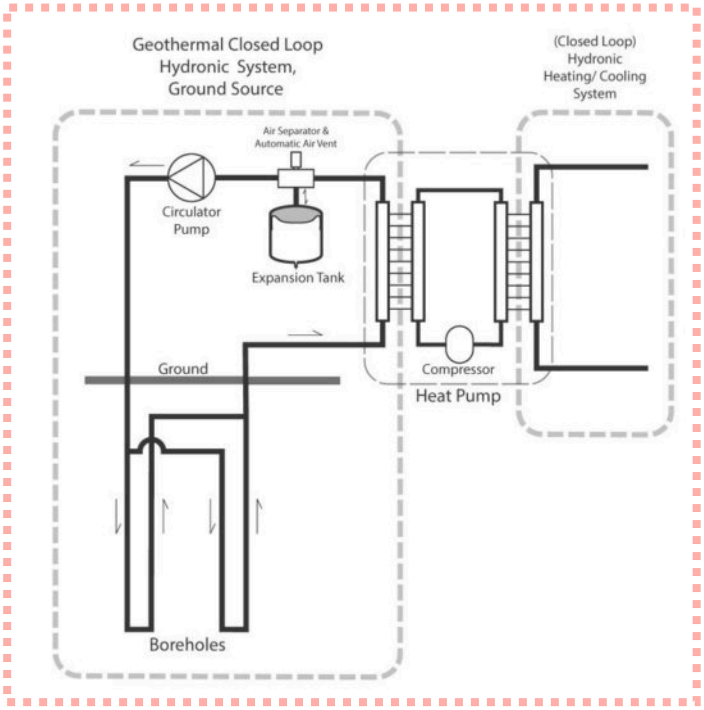
Part II – Closed-Loop Systems.

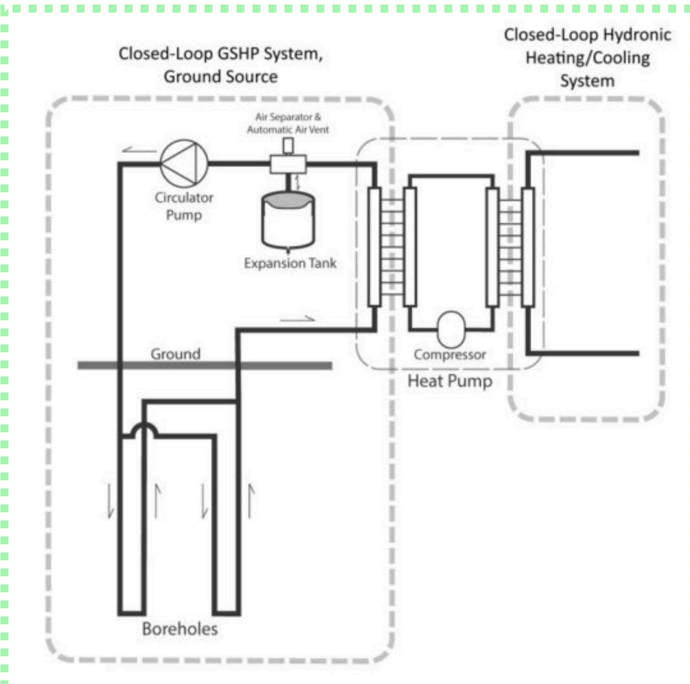
710.0 General.
710.1 Applicability. Part II of this chapter shall apply to closed-loop ~~geothermal~~GSHP systems ~~such as, but not limited to, systems~~ coupled to a ground heat exchanger, or a heat exchanger submerged in a surface body of water, using water-based heat transfer fluid. [See Figure 710.1(1) for an example of a simplified schematic of a closed-loop ~~geothermal~~GSHP system coupled to a ground heat exchanger. See Figure 710.1(2) for an example of a simplified schematic of a closed-loop ~~geothermal~~GSHP system coupled to a heat exchanger submerged in a surface body of water.]
~~701.11.1~~710.2 **Water Quality.** The makeup water quality within the closed-loop ~~ground heat exchanger~~GSHP system shall be in accordance with IAPMO/ANSI H1001.1, ANSI/CSA/IGSHPA C448, or Table ~~701.11.1~~710.2. The quality of potable water shall be in accordance with the equipment manufacturer's installation instructions or the Authority Having Jurisdiction.

(renumber remaining sections)

TABLE ~~701.11.1~~710.2
WATER QUALITY

(portions of table not shown remain unchanged)



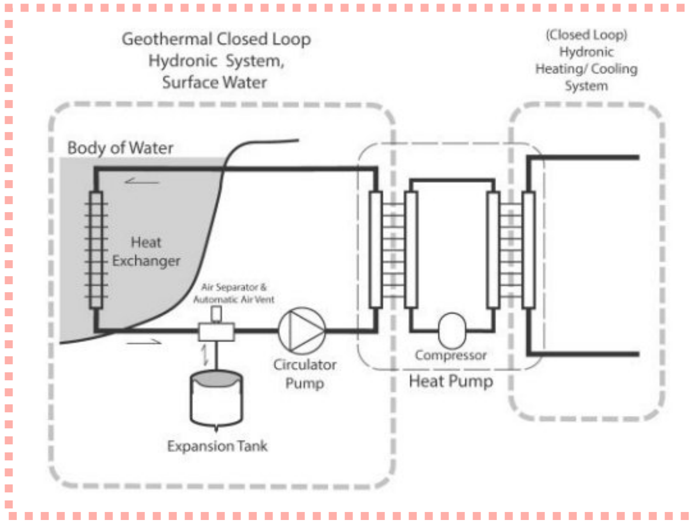


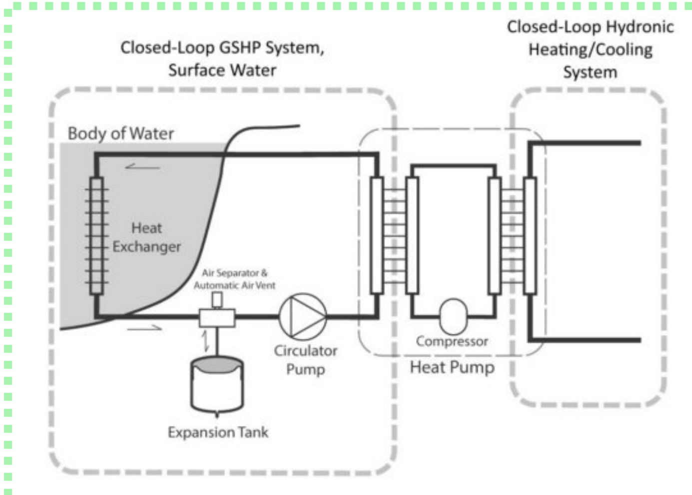
Notes:

[1] This schematic does not include all system components, and configurations may vary based on design.

[2] The heat pump refrigerant loop and the outgoing building hydronic loop are not considered part of the ~~closed-loop geothermal~~GSHP system loop.

FIGURE 710.1(1)[1, 2]
EXAMPLE OF A CLOSED-LOOP GSHP SYSTEM
COUPLED TO A GROUND HEAT EXCHANGER
(SIMPLIFIED SCHEMATIC)





Notes:

[1] This schematic does not include all system components, and configurations may vary based on design.

[2] The heat pump refrigerant loop and the outgoing building hydronic loop are not considered part of the ~~closed-loop geothermal~~GSHP system loop.

FIGURE 710.1(2)[1, 2]
EXAMPLE OF A CLOSED-LOOP GSHP SYSTEM
COUPLED TO A HEAT EXCHANGER
SUBMERGED IN A SURFACE BODY OF WATER
(SIMPLIFIED SCHEMATIC)

Substantiation:
Chapter 7 regulates three distinct categories of ground-source heat pump (GSHP) systems, each with unique installation requirements and safety considerations. While GSHP systems are a type of geothermal system, the term "geothermal system" has multiple meanings within the broader energy industry and can refer to vastly different technologies with distinct engineering requirements, safety considerations, and regulatory frameworks. For clarity and consistency with the type of geothermal technologies these requirements address, references to "geothermal system" are being updated to "GSHP system" throughout the chapter.

Since the provisions in Part II (Closed-Loop Systems) are specific to closed-loop GSHP systems which are either coupled to a ground heat exchanger or coupled to a heat exchanger submerged in a surface body of water, the phrase "such as, but not limited to" is being removed to avoid the implication that such provisions may be applied to other types of GSHP systems.

To clearly differentiate the applicability between Part II (Closed-Loop Systems) and Part IV (Direct Exchange Systems), the phrase "using water-based heat transfer fluid" is being included in Section 710.1. This clarification is necessary because DX systems also circulate fluid through a sealed ground heat exchanger circuit, and without this qualifier, the applicability of Part II could be ambiguous.

Additionally, references to "closed-loop ground heat exchanger system" are being updated to "closed-loop GSHP system" since the ground heat exchanger is a component of the closed-loop GSHP system rather than a separate system. Furthermore, the requirements in Section 701.11.1 (Water Quality) are applicable to closed-loop GSHP systems and are being relocated to Part II (Closed-Loop Systems).

Comment 4

Item #:	Code Number:	Sections(s):
096	2024 USHGC	206.0, 715.1 – 715.3

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part IV – Direct Exchange (DX) Systems.

715.0 Direct Exchange (DX) Systems.
~~715.2~~715.1 **Applicability.** Part IV of this chapter shall apply to ~~geothermal energy systems such as, but not limited to, building systems coupled with a DX closed-loop~~direct exchange (DX) systems coupled to a ground heat exchanger using refrigerant as ~~a~~the heat transfer fluid.
~~Indoor piping, fittings, and accessories that are part of the ground heat exchanger shall be in accordance with Section 703.5 and Chapter 4.~~

~~715.1~~**715.2** ~~General~~**Installation.** The installation and use of ~~direct exchange (DX) wells~~DX ground heat exchangers shall be in accordance with the Authority Having Jurisdiction.
715.3 Records. ~~The DX well records~~Where required by the Authority Having Jurisdiction, records for DX ground heat exchangers shall include ~~well logs,~~ pressure tests, ~~and~~ aquifer information, and well logs, as applicable.

(renumber remaining sections)

206.0 – D –
Direct Exchange (DX) System. A ground-source heat pump system that circulates a refrigerant through a ~~closed-loop system~~ground heat exchanger.

Substantiation:
Section 715.1 (Applicability) is being revised to clarify that Part IV applies only to DX systems coupled to a ground heat exchanger using refrigerant as the heat transfer fluid. The previous text referenced a "DX closed-loop," which incorrectly described coupling to a system type rather than to a physical component. The phrase "such as, but not limited to" is also being removed to eliminate any implication that these provisions may apply to other types of GSHP systems. The definition of "direct exchange (DX) system" is being updated accordingly.

Additionally, references to "DX wells" are being updated to "DX ground heat exchangers" since DX systems can be installed in various configurations depending on site conditions, and the term "well" implies a limitation to vertical boreholes.

Lastly, the section addressing records and documentation for DX systems is being updated to reflect the range of DX system installations. The original language requires well logs, pressure tests, and aquifer information for all DX systems; however, not all installations involve boreholes or wells, penetrate or are proximate to aquifers, or present the same documentation requirements. The updated language establishes documentation requirements that are appropriately scaled to the nature of the installation.

Item #:
097

Code Number:
2024 USHGC

Section Number:
211.0, 701.11.2, 703.3

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

701.0 General.

701.11 Heat Transfer Fluid. (remaining text unchanged)

701.11.2 Compatibility. System components shall be compatible with system fluids including, but not limited to, antifreeze. For systems utilizing chemical additives, system components and fluids shall be tested and ~~identified~~approved for compatibility.

703.0 Design of Systems.

703.3 Fittings. For water-based systems, fittings for ~~ground source heat pump systems~~ground heat exchanger piping shall be ~~identified~~approved for installation with the piping materials to be installed, and shall comply with the standards listed in Table 703.3. Fittings for use in DX systems shall comply with Section 715.3.

211.0 - I -

~~**Identified (as referenced to equipment and materials).** Recognized as being suitable for the specific application, environment, function, installation, purpose, use, and so forth, where described in a particular code requirement.~~

SUBSTANTIATION:
The term "identified" does not indicate whether the compatibility was verified to any standard, by an authority, or through formal evaluation, which leaves room for subjective interpretation. For consistency with existing code language, the term "approved" is preferred.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
097

Code Number:
2024 USHGC

Sections(s):
501.5.1

Submitter Name:
Edmond Murray

Organization Name:
USHGC Solar Thermal Systems Task Group, Vice-Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.5 Materials. (remaining text unchanged)
501.5.1 Compatibility. System components shall be compatible with system fluids including, but not limited to, antifreeze. For systems utilizing chemical additives, system components and fluids shall be tested and approved for compatibility.

Substantiation:
The current text is vague as it requires system components to be compatible with system fluids but provides no guidance on what fluids must be considered or how compatibility is to be verified. The revised text specifically identifies antifreeze as a system fluid that must be considered for compatibility, and requires that components and fluids be tested and approved for compatibility. Furthermore, the proposed language correlates with Section 701.11.2 (Compatibility).

> ***[2025 USHGC ROP Preprint]***
> ***701.11.2 Compatibility.*** *System components shall be compatible with system fluids including, but not limited to, antifreeze. For systems utilizing chemical additives, system components and fluids shall be tested and approved for compatibility.*

Item #:	**Code Number:**	**Section Number:**
098	2024 USHGC	703.2, 715.3

SUBMITTER:	**Organization Name:**	**Organization Representation:**
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

RECOMMENDATION:
Revise text

Proposed Text :

Part I – General.

703.0 Design of Systems.

703.2 Piping and Tubing Material Standards. For water-based systems, ~~ground source heat pump ground loop pipe~~ground heat exchanger piping and tubing shall comply with the standards listed in Table 703.2. Piping and tubing used for DX systems shall be ~~of copper~~ in accordance with Section 715.3.

Part IV – Direct Exchange (DX) Systems.

715.0 Direct Exchange (DX) Systems.

715.3 DX Systems. Piping and tubing used for DX systems shall be of copper. Copper pipe and tubing installed for DX systems shall be manufactured in accordance with ASTM B280 and copper fittings in accordance with ASME B16.22. Joints shall be purged with an inert gas and brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8. Underground piping and tubing shall have a cathodic protection system installed.
Exception: Where required for the installation environment and the heat transfer fluid used in the system, the use of other approved materials having a greater corrosion resistance than copper shall be permitted.

SUBSTANTIATION:
The specified piping and tubing material for DX systems in Section 703.2 (Piping and Tubing Material Standards) is best suited within Section 715.3 (DX Systems) which provides detailed requirements for copper piping and tubing.

Furthermore, an exception to Section 715.3 is being proposed to address material compatibility and corrosion resistance in non-standard or harsh installation environments. While copper is suitable in most cases, there are specific conditions (such as acidic soils, high sulfate or chloride content) where copper is not ideal due to accelerated corrosion.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	**NEGATIVE:**	**ABSTAIN:**	**NOT RETURNED:**
15	0	0	0

Comment 1

Item #:
098

Code Number:
2024 USHGC

Sections(s):
715.3 – 715.5, 715.8

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part IV – Direct Exchange (DX) Systems.

715.0 Direct Exchange (DX) Systems.

715.3 ~~DX Systems~~Materials. Piping and tubing used for DX systems shall be of copper. Copper pipe and tubing installed for DX systems shall be manufactured in accordance with ASTM B280 and copper fittings in accordance with ASME B16.22. Joints shall be purged with an inert gas and brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8. Underground piping and tubing shall have a cathodic protection system installed.
Exception: Where required for the installation environment and the heat transfer fluid used in the system, the use of other approved materials having a greater corrosion resistance than copper shall be permitted.
715.4 DX System Testing. For ~~direct exchange (~~DX~~)~~ systems, each refrigerant u-bend shall be tested and proved tight with an inert gas at not less than 315 psi (2172 kPa) and maintained for 15 minutes without pressure drop. The pressure reading after tremie grouting of the boreholes shall be maintained in the ground heat exchanger for not less than 2 hours, in accordance with ANSI/CSA/IGSHPA C448.
~~**715.5 Indoor Piping.** For DX systems, joints shall be purged with an inert gas and brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8.~~

(renumber remaining sections)

715.8 DX Piping. ~~DX~~Direct exchange system piping shall be installed in accordance with approved plans and specifications, including provisions for cathodic protection.

Substantiation:
The title of Section 715.3 is being updated to “Materials” to align with the context of the provisions presented. The original title is broad and redundant since all of Section 715.0 addresses DX systems.

Section 715.5 (Indoor Piping) is being deleted since indoor piping, fittings, and appurtenances that are part of the GSHP system are governed by Chapter 4. Additionally, the identical requirement for purging joints with inert gas and brazing with 15 percent silver content alloy already appears in Section 715.3.

Item #:
099

Code Number:
2024 USHGC

Section Number:
Table 703.2, Table 703.3

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 703.2
~~PLASTIC GROUND SOURCE LOOP PIPING~~
MATERIALS FOR GROUND HEAT EXCHANGER PIPING

MATERIAL	STANDARDS
Cross-Linked Polyethylene (PEX)	ASTM F876, CSA B137.5, ~~ANSI/CSA/IGSHPA C448,~~ NSF/ANSI 358-3
High Density Polyethylene (HDPE)	ASTM D2737, ASTM D3035, ASTM F714, AWWA C901, CSA B137.1, ~~ANSI/CSA/IGSHPA C448,~~ NSF/ANSI 358-1
Polypropylene (PP)	ASTM F2389, CSA B137.11, NSF/ANSI 358-2
Polyethylene of Raised Temperature (PE-RT)	~~ASTM F2623,~~ ASTM F2769, CSA B137.18, ~~ANSI/CSA/IGSHPA C448,~~ NSF/ANSI 358-4

TABLE 703.3
~~GROUND SOURCE LOOP PIPE FITTINGS~~
MATERIALS FOR GROUND HEAT EXCHANGER FITTINGS

MATERIAL	STANDARDS
Cross-Linked Polyethylene (PEX)	ASTM F877, ASTM F1055, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2159, ASTM F2434, ASTM F3347, ASTM F3348, CSA B137.5, ~~ANSI/CSA/IGSHPA C448,~~ NSF/ANSI 358-3
High Density Polyethylene (HDPE)	ASTM D2683, ASTM D3261, ASTM F1055, CSA B137.1, ~~ANSI/CSA/IGSHPA C448,~~ NSF/ANSI 358-1
Polypropylene (PP)	ASTM F2389, CSA B137.11, NSF/ANSI 358-2
Polyethylene of Raised Temperature (PE-RT)	ASTM D3261, ASTM F1055, ASTM F1807, ASTM F2080, ASTM F2159, ASTM F2769, ASTM F3347, ASTM F3348, CSA B137.18, ~~ANSI/CSA/IGSHPA C448,~~ NSF/ANSI 358-4

SUBSTANTIATION:
ASTM F2623 is valid for PE-RT but only for lower pressure applications. As noted within the standard, “The tubing systems produced under this specification are intended for use in the transport of non-potable water such as hydronic and irrigation systems.”

This standard is currently referenced in Table 409.1 for hydronics systems but needs to be removed from Table 703.2. Additionally, ANSI/CSA/IGSHPA C448 is not a piping or fitting standard and does not belong in Table 703.2 or Table 703.3.

The titles of these tables are being updated to refer to ground heat exchangers which are a component of ground source heat pump systems. The term "ground heat exchanger" more appropriately aligns with the context of these requirements since it represents the underground piping network which exchanges thermal energy with the earth. Instances within the code where provisions pertain to this component of the ground source heat pump system have been updated to reference “ground heat exchanger” for technical accuracy.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
099	2024 USHGC	702.0, 702.3, 703.0, 703.2 – 703.4, Table 409.1, Table 702.3(1), Table 703.2 – Table 703.4, Table 901.1

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

<u>702.0 Materials.</u>

<u>**702.3 Underground and Submerged Piping, Tubing, and Fittings.** Underground and submerged piping, tubing, and fittings for ground heat exchangers shall comply with the applicable material standards listed in Table 702.3(1). Such piping and tubing shall also comply with Table 702.3(2) and Section 702.3.1 through Section 702.3.3, as applicable.</u>
<u>**Exception:** Piping, tubing, and fittings for DX systems shall comply with Section 715.3.</u>

TABLE 702.3(1)
MATERIALS FOR GROUND HEAT EXCHANGER PIPING, TUBING, AND FITTINGS
(UNDERGROUND AND SUBMERGED)

MATERIAL	PIPING/TUBING	FITTINGS
Cross-Linked Polyethylene (PEX)	ASTM F876, ASTM F2788, CSA B137.5	ASTM F877, ASTM F1055, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2159, ASTM F2829, ASTM F3347, ASTM F3348, CSA B137.5
Polyethylene (PE)	ASTM D2737, ASTM D3035, ASTM F714, CSA B137.1	ASTM D2683, ASTM D3261, ASTM F1055, CSA B137.1
Polyethylene of Raised Temperature (PE-RT)	ASTM F2769, CSA B137.18	ASTM F1055, ASTM F1807, ASTM F2080, ASTM F2159, ASTM F2769, ASTM F3347, ASTM F3348, CSA B137.18

TABLE ~~703.4~~702.3(2)
GROUND HEAT EXCHANGER PIPING AND TUBING: MINIMUM DESIGNATION CODES AND WALL THICKNESSES

(portions of table not shown remain unchanged)

~~TABLE 703.2~~
~~MATERIALS FOR GROUND HEAT EXCHANGER PIPING~~

(delete table in its entirety)

~~TABLE 703.3~~
~~MATERIALS FOR GROUND HEAT EXCHANGER FITTINGS~~

(delete table in its entirety)

~~**703.0 Design of Systems.**~~

~~**703.2 Piping and Tubing Material Standards.** For water-based systems, ground heat exchanger piping and tubing shall comply with the standards listed in Table 703.2. Piping and tubing used for DX systems shall be in accordance with Section 715.3.~~
~~**703.3 Fittings.** For water-based systems, fittings for ground heat exchanger piping shall be approved for installation with the piping materials to be installed, and shall comply with the standards listed in Table 703.3. Fittings for use in DX systems shall comply with Section 715.3.~~
~~**703.4 Underground Piping and Submerged Materials.** Underground and submerged piping for a ground heat exchanger shall comply with Table 703.4, and shall be polyethylene (PE) pipe or tubing in accordance with Section 703.4.1 and Section 703.4.1.1, polyethylene of raised temperature (PE-RT) pipe or tubing in accordance with Section 703.4.2 and Section 703.4.2.1, or cross-linked polyethylene (PEX) pipe or tubing in accordance with Section 703.4.3 and Section 703.4.3.1.~~

(renumber remaining sections)

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~ASTM F2434-2019~~	~~Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing~~	~~Fittings~~	~~Table 409.1, 410.7(1), Table 703.3~~
ASTM F2788/F2788M-2025	Standard Specification for Metric and Inch-sized Crosslinked Polyethylene (PEX) Pipe	Piping	Table 702.3(1)
ASTM F2829/F2829M-2021	Standard Specification for Metric- and Inch-Sized Fittings for Crosslinked Polyethylene (PEX) Pipe	Fittings	Table 702.3(1)

(portions of table not shown remain unchanged)

(shown for information purposes only)

715.3 DX Systems. Piping and tubing used for DX systems shall be of copper. Copper pipe and tubing installed for DX systems shall be manufactured in accordance with ASTM B280 and copper fittings in accordance with ASME B16.22. Joints shall be purged with an inert gas and brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8. Underground piping and tubing shall have a cathodic protection system installed.
Exception: Where required for the installation environment and the heat transfer fluid used in the system, the use of other approved materials having a greater corrosion resistance than copper shall be permitted.

Note: The ASTM and CSA standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The USHGC Geothermal Energy Systems Task Group submitted public comments to Item #093, Item #096, Item #099, and Item #100, which reorganize and improve requirements for materials.

Item #099: The existing list of standards for piping, tubing and fitting are being combined into Table 702.3(1) [Materials for Ground Heat Exchanger Piping, Tubing, and Fittings (Underground and Submerged)].

Additional updates are as follows:

As polypropylene (PP) is an indoor piping material and not applicable to ground exchangers, this material and corresponding product standards are not included in Table 702.3(1). The list of remaining materials (PEX, PE, and PE-RT) also aligns with those addressed in Table 702.3(2) (Ground Heat Exchanger Piping and Tubing: Minimum Designations and Wall Thicknesses).

Removed Standards: ASTM D3261, ASTM F2434, AWWA C901, NSF 358 Series

> **ASTM D3261** is being removed from the list of fitting standards for PE-RT as this specification covers PE butt fusion fittings for use with PE pipe and tubing. For reference, this standard is already included under PE fittings.

ASTM F2434 has been withdrawn without replacement.

AWWA C901 is intended for municipal water distribution applications. This standard provides requirements for PE pipe and tubing for potable water, wastewater, and reclaimed water systems.

The **NSF/ANSI 358 Series** requires compliance with the applicable ASTM and CSA product standards and provides additional criteria specifically addressing the unique operating conditions of ground heat exchangers. Therefore, these NSF standards do not belong in Table 702.3(1) as an optional requirement but are to be applied in conjunction with Table 702.3(1). For reference, this is already accomplished via the existing material requirements within Chapter 7.

Added Standards: ASTM F2788 and ASTM F2829

ASTM F2788 covers crosslinked polyethylene (PEX) pipe that is outside diameter controlled in inch pipe sizes NPS 3 to NPS 54, made in nominal pipe dimension ratios, and pressure rated for water at three temperatures. ASTM F2788 addresses larger diameter PEX pipe (3 inches and above) using iron pipe size (IPS) outside diameter dimensions, whereas ASTM F876 covers smaller diameter PEX tubing using copper tube size (CTS) dimensions. Therefore, including ASTM F2788 alongside ASTM F876 ensures the code covers the full range of PEX products.

ASTM F2829 is the companion fitting standard for ASTM F2788 pipe. It establishes performance requirements specifically for fittings used with larger diameter IPS-sized PEX pipe, including hydrostatic strength, tensile load resistance, and requirements for electrofusion fittings.

Since the Task Group's public comments to Item #093, Item #096, Item #099, and Item #100 are all related, a brief summary of their actions is shown below. For additional information, please refer to the substantiation provided for each public comment.

Item #093: Proposes new Section 702.0 (Materials) as the sole location for material requirements.
Item #096: Removes duplicative requirements for indoor piping materials.
Item #100: Updates and clarifies the additional piping and tubing material requirements.

Comment 2

Item #:
099

Code Number:
2024 USHGC

Sections(s):
410.7, Table 409.1, Table 901.1

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

TABLE 409.1
MATERIALS FOR HYDRONIC AND SOLAR THERMAL SYSTEM, PIPING, TUBING, AND FITTINGS

MATERIAL	STANDARDS	
	PIPING/TUBING	FITTINGS
Polyethylene (PE)	ASTM D2737, ASTM D3035, ASTM F714, ASTM F2165, ~~AWWA C901,~~ CSA B137.1~~; NSF/ANSI 358-1~~	ASTM D2609, ASTM D2683, ASTM D3261, ASTM F1055, ASTM F2165, CSA B137.1~~; NSF/ANSI 358-1~~
Cross-Linked Polyethylene (PEX)	ASTM F876, ASTM F2165, ASTM F2788, ASTM F3253, CSA B137.5~~, NSF/ANSI 358-3~~	ASSE 1061, ASTM F877, ASTM F1055, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2098, ASTM F2159, ASTM F2165, ASTM F2735, ASTM F2829, ASTM F3253, ASTM F3347, ASTM F3348, CSA B137.5~~; NSF/ANSI 358-3~~
Polypropylene (PP)	ASTM F2165, ASTM F2389, CSA B137.11~~, NSF/ANSI 358-2~~	ASSE 1061, ASTM F2165, ASTM F2389, CSA B137.11~~, NSF/ANSI 358-2~~
Polyethylene of Raised Temperature (PE-RT)	ASTM F2165, ASTM F2623, ASTM F2769, CSA B137.18	ASSE 1061, ~~ASTM D3261,~~ ASTM F1055, ASTM F1807, ASTM F2159, ASTM F2165, ASTM F2735, ~~ASTM F2769,~~ ASTM F3347, ASTM F3348, CSA B137.18
Cross-Linked Polyethylene/ Aluminum/ Cross-Linked Polyethylene (PEX-AL-PEX)	ASTM F1281, ASTM F2165, CSA B137.10	ASTM F1281, ASTM F1974, ASTM F2165, ~~ASTM F2434,~~ CSA B137.10

(portions of table not shown remain unchanged)

410.0 Joints and Connections.

410.7 Cross-Linked Polyethylene/Aluminum/ Cross-Linked Polyethylene (PEX-AL-PEX) Pipe. Joints between cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe and fittings shall be installed in accordance with one of the following methods:

(1) Mechanical joints between PEX-AL-PEX pipe and fittings shall include mechanical and compression type fittings and insert fittings with a crimping ring. Insert fittings utilizing a crimping ring shall be in accordance with ASTM F1974~~ or ASTM F2434~~. Crimp joints for crimp insert fittings shall be joined to PEX-AL-PEX pipe by the compression of a crimp ring around the outer circumference of the pipe, forcing the pipe material into annular spaces formed by ribs on the fitting.

(2) (remaining text unchanged)

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~ASTM F2434-2019~~	~~Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing~~	~~Fittings~~	~~Table 409.1, 410.7(1), Table 703.3~~
ASTM F2788/F2788M-2025	Standard Specification for Metric and Inch-sized Crosslinked Polyethylene (PEX) Pipe	Piping	Table 409.1
ASTM F2829/F2829M-2021	Standard Specification for Metric- and Inch-Sized Fittings for Crosslinked Polyethylene (PEX) Pipe	Fittings	Table 409.1

(portions of table not shown remain unchanged)

Note: ASTM F2788 and ASTM F2829 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
In alignment with the USHGC Geothermal Energy Systems Task Group's public comment revising material standards for ground-source heat pump systems, the following updates are also being proposed to Chapter 4 (Hydronics):

Removed Standards: ASTM D3261, ASTM F2434, AWWA C901, NSF 358 Series

ASTM D3261 is being removed from the list of fitting standards for PE-RT as this specification covers PE butt fusion fittings for use with PE pipe and tubing. For reference, this standard is already included under PE fittings.

ASTM F2434 has been withdrawn without replacement. All other occurrences throughout the code are also being stricken.

AWWA C901 is intended for municipal water distribution applications. This standard provides requirements for PE pipe and tubing for potable water, wastewater, and reclaimed water systems.

The **NSF/ANSI 358 Series** standards are specific to ground loop heat exchanger piping for water-based ground-source heat pump systems and are therefore not applicable to general hydronic piping. These standards are appropriately referenced in Chapter 7 (Ground-Source Heat Pump Systems).

Added Standards: ASTM F2788 and ASTM F2829

ASTM F2788 covers crosslinked polyethylene (PEX) pipe that is outside diameter controlled in inch pipe sizes NPS 3 to NPS 54, made in nominal pipe dimension ratios, and pressure rated for water at three temperatures. ASTM F2788 addresses larger diameter PEX pipe (3 inches and above) using iron pipe size (IPS) outside diameter dimensions, whereas ASTM F876 covers smaller diameter PEX tubing using copper tube size (CTS) dimensions. Therefore, including ASTM F2788 alongside ASTM F876 ensures the code covers the full range of PEX products.

ASTM F2829 is the companion fitting standard for ASTM F2788 pipe. It establishes performance requirements specifically for fittings used with larger diameter IPS-sized PEX pipe, including hydrostatic strength, tensile load resistance, and requirements for electrofusion fittings.

As both of these standards are applicable to PEX in hydronic applications, they are being added to Table 409.1.

Item #:
100

Code Number:
2024 USHGC

Section Number:
703.4 - 703.4.3.1, Table 703.4, Table 703.4.1, 710.3, Table 901.1

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

Part I – General.

703.0 Design of Systems.

703.4 Underground Piping and Submerged Materials. Underground and submerged piping for a ground~~-~~ heat exchanger shall comply with Table 703.4, and shall be polyethylene (PE) pipe or tubing in accordance with Section 703.4.1 and Section 703.4.1.1, polyethylene of raised temperature (PE-RT) pipe or tubing in accordance with Section 703.4.2 and Section 703.4.2.1, or cross-linked polyethylene (PEX) pipe or tubing in accordance with Section 703.4.3 and Section 703.4.3.1.

~~TABLE 703.4.1~~
~~PE PIPE AND TUBING MINIMUM WALL THICKNESS~~

~~PE PIPE MATERIAL~~	~~MINIMUM WALL THICKNESS~~
~~PE 3608~~	~~SDR 11~~
~~PE 4710~~	~~SDR 13.5~~

TABLE 703.4
GROUND HEAT EXCHANGER PIPING AND TUBING:
DESIGNATION CODES AND MINIMUM WALL THICKNESSES

MATERIAL	DESIGNATION CODE	MINIMUM WALL THICKNESS
Polyethylene (PE)	PE 3608	SDR 11
	PE 4710	SDR 13.5
Cross-Linked Polyethylene (PEX)	PEX 1206	SDR 9
Polyethylene of Raised Temperature (PE-RT)	PE 3608	SDR 9
	PE 4710	SDR 9

703.4.1 Polyethylene (PE). Polyethylene pipe or tubing shall comply with the following:

(1) ~~b~~Be manufactured in accordance with the applicable material standards listed in Table 703.2.

(2) ~~Pipe or tubing shall h~~Have a minimum pressure rating of not less than 160 pounds-force per square inch (psi) (1103 kPa) at 73°F (23°C).

Exception: Horizontal and lateral piping or tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(3) ~~Polyethylene pipe or tubing shall b~~Be manufactured from a PE compound that has a pipe material designation code ~~of PE 3608 or PE 4710 as defined in the applicable standards referenced in Table 703.2, with a cell classification~~ in accordance with Table 703.4, when evaluated in accordance with ASTM D3350. ~~appropriate for the material designation code, and~~

Exception: Compliance with Table 703.4 shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(4) Have a color and ultraviolet stabilizer code of C or E. Code E compounds shall be stabilized against deterioration from unprotected exposure to ultraviolet rays for not less than 3 years in accordance with the test criteria specified in AWWA C901. ~~Polyethylene pipe or tubing shall have a minimum wall thickness in accordance with Table 703.4.1.~~

~~**Exception:** HDPE lateral piping with a minimum pressure rating of 100 psi (689 kPa) at 73°F (23°C) shall not be required to have a minimum wall thickness in accordance with Table 703.4.1.~~

(5) The requirements of NSF/ANSI 358-1.

703.4.1.1 Joining Methods for Polyethylene Pipe or Tubing. Joints between ~~high density~~ polyethylene (~~HD~~PE) plastic pipe or tubing and fittings shall be installed in accordance with the manufacturer's installation instructions, the ~~appropriate~~applicable standards listed in ~~accordance with~~ Table 703.3, and one of the following heat fusion methods:

(1) Butt-fusion joints shall be made in accordance with ASTM F2620.

(2) Socket-fusion joints shall be made in accordance with ASTM F2620.

(3) Electrofusion joints shall be made in accordance with ~~ASTM F1055~~ASTM F1290.

703.4.2 Polyethylene of Raised Temperature (PE-RT). Polyethylene of raised temperature tubing shall comply with the following:

(1) ~~b~~Be manufactured in accordance with the applicable material standards listed in Table 703.2.

(2) ~~Tubing shall have a minimum wall thickness equal to SDR 9 and shall h~~Have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).

Exception: Horizontal and lateral piping or tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(3) ~~Polyethylene of raised temperature tubing shall b~~Be manufactured from a PE compound that has a pipe material designation code ~~of PE 2708, PE 3608, or PE 4710 as defined in the applicable standards referenced in Table 703.2 with a cell classification~~ in accordance with Table 703.4, when evaluated in accordance with ASTM D3350 ~~appropriate for the material designation code~~.

Exception: Compliance with Table 703.4 shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(4) The requirements of NSF/ANSI 358-4.

703.4.2.1 Joining Methods for Polyethylene of Raised Temperature (PE-RT) Tubing. Joints between polyethylene of raised temperature (PE-RT) tubing and fittings shall be installed in accordance with the manufacturer's installation instructions, ~~and~~ the ~~appropriate~~applicable standards listed in ~~accordance with~~ Table 703.3~~.~~, and one of the following heat fusion methods:

(1) Butt-fusion joints shall be made in accordance with ASTM F2620.

(2) Socket-fusion joints shall be made in accordance with ASTM F2620.

(3) Electrofusion joints shall be made in accordance with ASTM F1290.

703.4.3 Cross-Linked Polyethylene (PEX). Cross-linked polyethylene ~~pipe~~tubing shall comply with the following:
(1) ~~b~~Be manufactured in accordance with the applicable material standards listed in Table 703.2.
(2) ~~PEX shall have a minimum tubing material designation code of PEX 1206 and shall h~~Have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).
Exception: Horizontal and lateral tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(3) Be manufactured from a PE compound that has a tubing material designation code in accordance with Table 703.4, when evaluated in accordance with ASTM F876.
Exception: Compliance with Table 703.4 shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(4) The requirements of NSF/ANSI 358-3.
703.4.3.1 Joining Methods for Cross-Linked Polyethylene ~~Pipe or~~ Tubing. Joints between cross-linked polyethylene (PEX) ~~pipe or~~ tubing and fittings shall be installed in accordance with the manufacturer's installation instructions and the ~~appropriate~~applicable standards listed in ~~accordance with~~ Table 703.3.

Part II – Closed-Loop Systems.

710.0 General.

710.3 Borehole Piping and Tubing. Borehole piping or tubing for vertical and horizontally drilled closed-loop systems, shall have a minimum wall thickness in accordance with Table ~~703.4.1~~703.4 and shall have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASTM F1290-2019	Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings	Joints	703.4.1.1, 703.4.2.1

(portions of table not shown remain unchanged)

Note: ASTM F876, ASTM F1290, ASTM F2620, NSF/ANSI 358-1, NSF/ANSI 358-3, and NSF/ANSI 358-4 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
This proposal clarifies requirements for ground heat exchanger piping in several key ways. A new Table 703.4 (Ground Heat Exchanger Piping and Tubing: Designation Codes and Minimum Wall Thicknesses) consolidates pipe material designation codes and minimum wall thickness requirements into a tabular format for improved clarity and ease of use, replacing scattered in-text references.

The proposal also permits the use of SDR 13.5 pipes manufactured from PE 4710 compounds in vertical boreholes. PE 4710 pipes offer significantly greater resistance to slow crack growth and higher tensile strength compared to PE 3608 pipes. As a result, the thicker wall of SDR 11 pipe is not necessary to ensure mechanical toughness when PE 4710 material is used. SDR 13.5 pipes made from PE 4710 have higher thermal conductivity and flexibility, offering better heat transfer performance while still meeting minimum pressure requirements.

In contrast, PE 3608 pipes have lower tensile strength and are more susceptible to surface damage such as scratches and gouges, which can lead to slow crack growth. Therefore, when using PE 3608 material, the thicker SDR 11 wall is still required in borehole applications.

Additionally, this proposal allows PE-RT pipe and tubing to be joined using heat fusion techniques. PE-RT is made from PE compounds that are equally fusible as those listed in Section 703.4.1 [Polyethylene (PE)]. Similar revisions have been adopted by the ANSI/CSA/IGSHPA C448 Piping Task Force for inclusion in the next edition of that bi-national standard.

Committee Action:
Accept As Amended by the TC

Proposed Text :

Part I – General.

703.0 Design of Systems.

703.4 Underground Piping and Submerged Materials. Underground and submerged piping for a ground heat exchanger shall comply with Table 703.4, and shall be polyethylene (PE) pipe or tubing in accordance with Section 703.4.1 and Section 703.4.1.1, polyethylene of raised temperature (PE-RT) pipe or tubing in accordance with Section 703.4.2 and Section 703.4.2.1, or cross-linked polyethylene (PEX) pipe or tubing in accordance with Section 703.4.3 and Section 703.4.3.1.

TABLE 703.4
GROUND HEAT EXCHANGER PIPING AND TUBING:
MINIMUM DESIGNATION CODES AND ~~MINIMUM~~ WALL THICKNESSES

MATERIAL	MINIMUM DESIGNATION CODE	MINIMUM WALL THICKNESS
Polyethylene (PE)	PE 3608	SDR 11
	PE 4710	SDR 13.5
Cross-Linked Polyethylene (PEX)	PEX 1206	SDR 9
Polyethylene of Raised Temperature (PE-RT)	PE 3608	SDR 9
	PE 4710	SDR 9

703.4.1 Polyethylene (PE). Polyethylene pipe or tubing shall comply with the following:
(1) Be manufactured in accordance with the applicable material standards listed in Table 703.2.
(2) Have a minimum pressure rating of not less than 160 pounds-force per square inch (psi) (1103 kPa) at 73°F (23°C).
Exception: Horizontal and lateral piping or tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(3) Be manufactured from a PE compound that has a pipe material designation code in accordance with Table 703.4, when evaluated in accordance with ASTM D3350.
Exception: Compliance with Table 703.4 shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(4) Have a color and ultraviolet stabilizer code of C or E. Code E compounds shall be stabilized against deterioration from unprotected exposure to ultraviolet rays for not less than 3 years in accordance with the test

criteria specified in AWWA C901.
(5) The requirements of NSF/ANSI 358-1.
703.4.1.1 Joining Methods for Polyethylene Pipe or Tubing. Joints between polyethylene (PE) plastic pipe or tubing and fittings shall be installed in accordance with the manufacturer's installation instructions, the applicable standards listed in Table 703.3, and one of the following heat fusion methods:
(1) Butt-fusion joints shall be made in accordance with ASTM F2620.
(2) Socket-fusion joints shall be made in accordance with ASTM F2620.
(3) Electrofusion joints shall be made in accordance with ASTM F1290.

703.4.2 Polyethylene of Raised Temperature (PE-RT). Polyethylene of raised temperature tubing shall comply with the following:
(1) Be manufactured in accordance with the applicable material standards listed in Table 703.2.
(2) Have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).
Exception: Horizontal and lateral piping or tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(3) Be manufactured from a PE compound that has a pipe material designation code in accordance with Table 703.4, when evaluated in accordance with ASTM D3350.
Exception: Compliance with Table 703.4 shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(4) The requirements of NSF/ANSI 358-4.
703.4.2.1 Joining Methods for Polyethylene of Raised Temperature (PE-RT) Tubing. Joints between polyethylene of raised temperature (PE-RT) tubing and fittings shall be installed in accordance with the manufacturer's installation instructions, the applicable standards listed in Table 703.3, and one of the following heat fusion methods:
(1) Butt-fusion joints shall be made in accordance with ASTM F2620.
(2) Socket-fusion joints shall be made in accordance with ASTM F2620.
(3) Electrofusion joints shall be made in accordance with ASTM F1290.

703.4.3 Cross-Linked Polyethylene (PEX). Cross-linked polyethylene tubing shall comply with the following:
(1) Be manufactured in accordance with the applicable material standards listed in Table 703.2.
(2) Have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).
Exception: Horizontal and lateral tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(3) Be manufactured from a PE compound that has a tubing material designation code in accordance with Table 703.4, when evaluated in accordance with ASTM F876.
Exception: Compliance with Table 703.4 shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).
(4) The requirements of NSF/ANSI 358-3.
703.4.3.1 Joining Methods for Cross-Linked Polyethylene Tubing. Joints between cross-linked polyethylene (PEX) tubing and fittings shall be installed in accordance with the manufacturer's installation instructions and the applicable standards listed in Table 703.3.

Part II – Closed-Loop Systems.

710.0 General.

710.3 Borehole Piping and Tubing. Borehole piping or tubing for vertical and horizontally drilled closed-loop systems, shall have a minimum wall thickness in accordance with Table 703.4 and shall have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASTM F1290-2019	Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings	Joints	703.4.1.1, 703.4.2.1

(portions of table not shown remain unchanged)

Committee Statement:
The designation codes listed in Table 703.4 are intended to serve as minimum requirements, not to limit installations only to those specific designations. Therefore, the title of Table 703.4 is being updated to "Ground Heat Exchanger Piping and Tubing: Minimum Designation Codes and Wall Thicknesses," and the column header is being updated to "Minimum Designation Codes."

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

EXPLANATION OF AFFIRMATIVE:
MATSON: The amendments made to this proposal by the committee improve Table 703.4 and should be affirmed. Section 703.4.3 likely needs some further work via public comment to clarify ambiguities/conflicts between the numbered requirements. (This is not a reason to vote negative here. I am just documenting this for a future public comment.)

Comment 1

Item #:
100

Code Number:
2024 USHGC

Sections(s):
703.0, 703.1, 703.4.1 – 703.4.3.1

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>as modified</u> by this public comment.

~~703.4.1~~702.3.1 **Polyethylene (PE).** Polyethylene pipe or tubing shall comply with NSF/ANSI/CAN 61, NSF/ANSI 358-1, and the following:

~~(1) Be manufactured in accordance with the applicable material standards listed in Table 703.2.~~

(~~2~~1) Have a minimum pressure rating of not less than 160 pounds-force per square inch (psi) (1103 kPa) at 73°F (23°C).

Exception: Horizontal and lateral piping or tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(~~3~~2) Be manufactured from a PE compound that has a pipe material designation code in accordance with Table ~~703.4~~702.3(2), when evaluated in accordance with ASTM D3350.

Exception: Compliance with Table ~~703.4~~702.3(2) shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(~~4~~3) Have a color and ultraviolet stabilizer code of C or E. Code E compounds shall be stabilized against deterioration from unprotected exposure to ultraviolet rays for not less than 3 years in accordance with the test criteria specified in AWWA C901.

~~(5) The requirements of NSF/ANSI 358-1.~~

~~703.4.2~~702.3.2 **Polyethylene of Raised Temperature (PE-RT).** Polyethylene of raised temperature tubing shall comply with NSF/ANSI/CAN 61, NSF/ANSI 358-4, and the following:

~~(1) Be manufactured in accordance with the applicable material standards listed in Table 703.2.~~

(~~2~~1) Have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).

Exception: Horizontal and lateral piping or tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(~~3~~2) Be manufactured from a PE compound that has a pipe material designation code in accordance with Table ~~703.4~~702.3(2), when evaluated in accordance with ASTM D3350.

Exception: Compliance with Table ~~703.4~~702.3(2) shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

~~(4) The requirements of NSF/ANSI 358-4.~~

~~703.4.3~~702.3.3 **Cross-Linked Polyethylene (PEX).** Cross-linked polyethylene tubing shall comply with NSF/ANSI/CAN 61, NSF/ANSI 358-3, and the following:

~~(1) Be manufactured in accordance with the applicable material standards listed in Table 703.2.~~

(~~2~~1) Have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).

Exception: Horizontal and lateral tubing shall be permitted to have a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

(~~3~~2) Be manufactured from a PE compound that has a tubing material designation code in accordance with Table ~~703.4~~702.3(2), when evaluated in accordance with ASTM F876.

Exception: Compliance with Table ~~703.4~~702.3(2) shall not be required for horizontal and lateral piping or tubing having a minimum pressure rating of not less than 100 psi (689 kPa) at 73°F (23°C).

~~(4) The requirements of NSF/ANSI 358-3.~~

(renumber remaining sections)

703.0 Joints and Connections.

703.1 General. Joints and connections shall be of an approved type. Joints shall be gas and watertight and designed for the pressure of the system. Changes in direction shall be made by the use of fittings or with pipe bends. Joints between pipe or tubing and fittings shall comply with Section 703.2 through Section 703.4, as applicable.

~~703.4.1.1~~703.2 ~~Joining Methods for~~ **Polyethylene (PE) Pipe or Tubing.** Joints between polyethylene (PE) plastic pipe or tubing and fittings shall be installed in accordance with the manufacturer's installation instructions, the applicable standards listed in Table ~~703.3~~702.3(1), and one of the following heat fusion methods:
(1) Butt-fusion joints shall be made in accordance with ASTM F2620.
(2) Socket-fusion joints shall be made in accordance with ASTM F2620.
(3) Electrofusion joints shall be made in accordance with ASTM F1290.
~~703.4.2.1~~703.3 ~~Joining Methods for~~ **Polyethylene of Raised Temperature (PE-RT) Tubing.** Joints between polyethylene of raised temperature (PE-RT) tubing and fittings shall be installed in accordance with the manufacturer's installation instructions, the applicable standards listed in Table ~~703.3~~702.3(1), and one of the following heat fusion methods:
(1) Butt-fusion joints shall be made in accordance with ASTM F2620.
(2) Socket-fusion joints shall be made in accordance with ASTM F2620.
(3) Electrofusion joints shall be made in accordance with ASTM F1290.
~~703.4.3.1~~703.4 ~~Joining Methods for~~ **Cross-Linked Polyethylene (PEX) Tubing.** Joints between cross-linked polyethylene (PEX) tubing and fittings shall be installed in accordance with the manufacturer's installation instructions and the applicable standards listed in Table ~~703.3~~702.3(1).

(renumber remaining sections)

Note: NSF/ANSI/CAN 61, NSF/ANSI 358-1, NSF/ANSI 358-3, and NSF/ANSI 358-4 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The revisions separate material requirements from joining methods into two distinct sections, with Section 702.0 addressing materials and Section 703.0 addressing joints and connections. This reorganization groups all material specifications together and all joining requirements together.

The material requirements are being updated to include NSF/ANSI/CAN 61 to provide additional protection against potential contamination of drinking water supplies. These systems operate within geological formations that store and transmit drinking water, and contaminants can migrate from the pipe material into the surrounding ground or submerged environment, potentially reaching aquifers and water reservoirs.

New Section 703.1 (General) provides performance criteria applicable to all joint and connections. Requiring joints to be gas and watertight ensures the system maintains its charge and operates efficiently throughout its service life, and the pressure rating requirement addresses the fact that these systems experience varying pressures during operation. For reference, this language is consistent with existing requirements for joints and connections in Chapter 4.

> *[2025 USHGC ROP Preprint]*
> ***410.0 Joints and Connections.***
> ***410.1 General.*** *Joints and connections shall be of an approved type. Joints shall be gas and watertight and designed for the pressure of the hydronic system. Changes in direction shall be made by the use of fittings or with pipe bends. Joints between pipe and fittings shall be installed in accordance with the manufacturer's installation instructions. Joints used underground shall be of an approved type for buried applications.*

Comment 2

Item #:
100

Code Number:
2024 USHGC

Sections(s):
710.2 – 710.4

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part II – Closed-Loop Systems.

710.0 General.

~~**710.2 Piping and Tubing.** Piping and tubing for closed-loop systems shall be in accordance Section 703.2 and Table 703.2.~~
~~**710.3 Borehole Piping and Tubing.** Borehole piping or tubing for vertical and horizontally drilled closed-loop systems, shall have a minimum wall thickness in accordance with Table 703.4 and shall have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).~~
~~**710.4 Underground Fittings.** Underground fittings for closed-loop systems shall be in accordance with Section 703.3 and Table 703.3.~~

(renumber remaining sections)

Substantiation:
Since material requirements are sufficiently addressed under Part I (General) applying to all systems covered by Chapter 7, Section 710.2 through Section 710.4 are being deleted. This update is beneficial as it removes unnecessary cross-references and duplicative requirements.

Item #:
102

Code Number:
2024 USHGC

Section Number:
312.12, 705.1 – 705.9

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

705.0 Valves.
~~705.6~~**705.1** ~~**Equipment and Appliances**~~**Shutoff Valves**. Shutoff valves shall be installed as a means of isolating mechanical equipment and appliances for maintenance or replacement. Such equipment shall include, but not be limited to, pumps, air separators, and metering devices.
Exception: Shutoff valves shall not be required for individual geothermal ground-loops.
~~705.1~~**705.1.1** ~~**Where Required**~~**Locations**. Shutoff valves shall be installed ~~in ground source loop piping systems~~ in the following locations~~ indicated in Section 705.2 through Section 705.9.~~:
~~**705.2 Heat Exchangers.** Shutoff valves shall be installed on~~
(1) On the supply and return side of a heat exchanger.
Exception: Where the heat exchanger is integral with a boiler or is a component of a manufacturer's boiler and heat exchanger packaged unit, and is capable of being isolated from the hydronic system by the supply and return valves.
~~**705.3 Central Systems.** Shutoff valves shall be installed on~~
(2) On the building supply and return of a district energy system or central utility ~~system~~plant.
~~**705.4 Pressure Vessels.** Shutoff valves shall be installed on~~
(3) On the connection to a pressure vessel.
~~**705.5 Pressure-Reducing Valves.** Shutoff valves shall be installed on~~
(4) On both sides of a pressure-reducing valve.
~~**705.7 Expansion Tanks.** Shutoff valves shall be installed at~~
(5) At connections to nondiaphragm-type expansion tanks.
(6) At all stub-out connections, where applicable.

~~705.8~~**705.2** ~~**Reduced**~~ **Pressure Relief Valves**. A pressure relief valve shall be installed on the low-pressure side of a ~~hydronic~~ piping system that has been reduced in pressure. The relief valve shall be set at the maximum pressure of the system design.

~~705.9~~**705.3** **Bypass Valves.** Means shall be provided to allow for bypass of the geothermal system for independent flushing and purging of the geothermal system and building piping system.

312.0 Valves.

312.12 District Energy Systems and Central Utility ~~Systems~~Plants. Isolation valves shall be accessible and shall be installed on each building supply and return of a district energy system or central utility ~~system~~plant.

SUBSTANTIATION:
The requirements for shutoff valves under Section 705.0 (Valves) are being reorganized into a list for clarity. The reference to "district energy and central utility system" in both sections is then being updated to "district energy system and central utility plant" to clarify that the energy supply is provided from a centralized facility serving multiple buildings or an entire district, rather than a singular system within one building.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
102	2024 USHGC	704.1, 705.1 – 705.3, 710.5

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part I – General.

704.0 Distribution Systems.
704.1 General. The distribution system shall be designed in accordance with the following:
(1) – (2) (remaining text unchanged)
(3) An isolation (shutoff) valve shall be installed on both the supply and return piping of each terminal unit.
(4) – (10) (remaining text unchanged)

705.0 Valves.
705.1 General. Valves shall be installed in GSHP systems in accordance with Section 312.0 and Section 705.2 through Section 705.4. Valves shall be rated for the operating temperature and pressure of the system, shall be compatible with the type of heat transfer fluid and piping material, and shall be installed in accessible locations.

~~705.1~~705.2 **Shutoff Valves.** Shutoff valves shall be installed as a means of isolating mechanical equipment and appliances for maintenance or replacement. Such equipment shall include, but not be limited to, pumps, air separators, and metering devices.

Exception: Shutoff valves shall not be required for individual ~~geothermal ground~~ ground heat exchanger loops.

~~705.1.1~~705.2.1 **Locations.** Shutoff valves shall be installed in the following locations:

(1) On the supply and return side of a heat exchanger.

Exception: Where the heat exchanger is integral with a boiler or is a component of a manufacturer's boiler and heat exchanger packaged unit, and is capable of being isolated from the hydronic system by the supply and return valves.

(2) On the building supply and return of a district energy system or central utility plant.

(3) On the connection to a pressure vessel.

(4) On both sides of a pressure-reducing valve.

(5) At connections to nondiaphragm-type expansion tanks.

(6) On both the supply and return piping of each terminal unit, where applicable.

(~~6~~7) At all stub-out connections, where applicable.

~~705.2~~705.3 **Pressure Relief Valves.** ~~A pressure relief valve shall be installed on the low-pressure side of a piping system that has been reduced in pressure. The relief valve shall be set at the maximum pressure of the system design.~~ Pressure relief valves shall be installed in accordance with Section 311.0.

~~705.3~~705.4 **Bypass Valves.** Means shall be provided to allow for bypass of the ~~geothermal~~GSHP system for independent flushing and purging of the ~~geothermal~~GSHP system and building piping system.

Part II – Closed-Loop Systems.

710.0 General.

~~**710.5 Bypass Valves.** Means shall be provided to allow for bypass of the closed-loop geothermal system for independent flushing and purging of the geothermal system and building piping system~~.

(renumber remaining sections)

(shown for information purposes only)

311.0 Safety Devices.

311.1 General. Solar thermal system components containing pressurized fluids shall be protected against pressures exceeding the design limitations with a pressure relief valve. Hydronic or geothermal system components containing pressurized fluids shall be protected against pressures exceeding design limitations with a pressure relief valve. Each section of the system in which excessive pressures are capable of developing shall have a relief valve located so that a section is not capable of being isolated from a relief device. Pressure relief valves shall be installed in accordance with the terms of their listing and the manufacturer's installation instructions.

311.2 Pressurized Vessels. Pressurized vessels shall be provided with overpressure protection by means of a listed pressure relief valve installed in accordance with the manufacturer's installation instructions.

311.3 Discharge Piping. The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and be provided with the following:

(1) Not less than the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.

(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1.

(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.
(4) Discharge in such a manner that does not cause personal injury or structural damage.
(5) No part of such discharge pipe shall be trapped or subject to freezing.
(6) The terminal end of the pipe shall not be threaded.
(7) Discharge from a relief valve into a water heater pan shall be prohibited.
(8) The discharge termination point shall be readily observable.

Substantiation:
Section 704.1(3) is being updated to clarify that shutoff valves are required on both the supply and return piping of each terminal unit. Without this distinction, the current text is vague and does not appropriately identify the endpoints of the distribution system.

Section 705.1 (General) provides general requirements for valves installed in GSHP systems, including reference to the existing related requirements in Section 312.0 (Valves) and provisions for ratings, compatibility, and accessibility.

Section 705.2.1 (Locations) includes a new item (6) for correlation with the updates to Section 704.1(3), which require shutoff valves on the supply and return piping of each terminal unit.

Section 705.3 (Pressure Relief Valves) is being updated to reference the existing requirements in Section 311.0 (Safety Devices). The current text only addresses pressure reduction in piping, while Section 311.0 covers all system components containing pressurized fluids and specifies that no section of the system shall be isolated from a relief device.

Section 710.5 (Bypass Valves) is being deleted because the same requirement is already addressed by Section 705.4 (Bypass Valves) under Part I (General), which applies to all systems covered by Chapter 7. This deletion eliminates unnecessary duplication.

Section 705.4 (Bypass Valves) is being updated to reference "GSHP system" for consistency with the type of geothermal system covered by Chapter 7.

For reference, a separate public comment by the USHGC Geothermal Energy Systems Task Group has been submitted to Section 312.0 (Valves) for correlation with these updates to Section 705.0.

Comment 2

Item #:
102

Code Number:
2024 USHGC

Sections(s):
312.1, 312.3 – 312.7, 312.11, 312.12, 312.15, 313.2

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

312.0 Valves.

312.1 General. Valves shall be rated for the operating temperature and pressure of the system, ~~. Valves~~ shall be compatible with the type of heat transfer fluid and piping material, and shall be installed in accessible locations.

~~312.6~~312.3 ~~Equipment, Components, and Appliances~~**Isolation (Shutoff) Valves**. Serviceable equipment, components, and appliances within the system shall have isolation valves installed upstream and downstream of such devices to allow for maintenance and replacement.

Exception: Isolation valves shall not be required for individual ground heat exchanger loops.

312.3.1 Location. Isolation valves shall be installed in the following locations:

(1) On the supply and return side of a heat exchanger.

Exception: Where the heat exchanger is integral with a boiler, or is a component of a manufacturer's boiler and heat exchanger packaged unit, and is capable of being isolated from the hydronic system by the supply and return valves.

(2) On the building supply and return of a district energy system or central utility plant.

(3) On the connection to a pressure vessel.

(4) On both sides of a pressure-reducing valve.

(5) At connections to nondiaphragm-type expansion tanks.

(6) On both the supply and return piping of each terminal unit, where applicable.

(7) Upstream of air removal devices or automatic air vents.

(8) At all stub-out connections, where applicable.

312.4 Pressure Relief Valves. Pressure relief valves shall be installed in accordance with Section 311.0.

(renumber remaining sections)

~~**312.3 Heat Exchanger.** Isolation valves shall be installed on the supply and return side of the heat exchanger.~~

~~**312.4 Pressure Vessels.** Isolation valves shall be installed on connections to pressure vessels.~~

~~**312.5 Pressure Reducing Valves.** Isolation valves shall be installed on both sides of a pressure reducing valve.~~

~~**312.7 Expansion Tanks.** Isolation valves shall be installed at connections to non-diaphragm-type expansion tanks.~~

~~**312.11 Air Removal Device or Air Vents.** Isolation valves shall be installed where air removal devices or automatic air vents are utilized to permit cleaning, inspection, or repair without shutting the system down.~~

~~**312.12 District Energy Systems and Central Utility Plants.** Isolation valves shall be accessible and shall be installed on each building supply and return of a district energy system or central utility plant.~~

~~**312.15 Accessible.** Required fullway or shutoff valves shall be accessible.~~

(renumber remaining sections)

313.0 Heat Exchangers.

313.2 Shutoff Valves. Shutoff valves shall be installed ~~on the supply and return side of a heat exchanger~~ in accordance with Section 312.3.1(1).

~~**Exception:** Where a heat exchanger is an integral part of a boiler or is a part of a manufactured boiler and heat exchanger packaged unit, and is capable of being isolated from the hydronic system by supply and return valves.~~

(shown for information purposes only)

311.0 Safety Devices.
311.1 General. Solar thermal system components containing pressurized fluids shall be protected against pressures exceeding the design limitations with a pressure relief valve. Hydronic or geothermal system components containing pressurized fluids shall be protected against pressures exceeding design limitations with a pressure relief valve. Each section of the system in which excessive pressures are capable of developing shall have a relief valve located so that a section is not capable of being isolated from a relief device. Pressure relief valves shall be installed in accordance with the terms of their listing and the manufacturer's installation instructions.
311.2 Pressurized Vessels. Pressurized vessels shall be provided with overpressure protection by means of a listed pressure relief valve installed in accordance with the manufacturer's installation instructions.
311.3 Discharge Piping. The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and be provided with the following:
(1) Not less than the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.
(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1.
(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.
(4) Discharge in such a manner that does not cause personal injury or structural damage.
(5) No part of such discharge pipe shall be trapped or subject to freezing.
(6) The terminal end of the pipe shall not be threaded.
(7) Discharge from a relief valve into a water heater pan shall be prohibited.
(8) The discharge termination point shall be readily observable.

Substantiation:
In alignment with the updates submitted to Section 705.0 (Valves) by the USHGC Geothermal Energy Systems Task Group, Section 312.0 (Valves) is being updated for correlation as both sections address shutoff (isolation) valves.

The Task Group determined that the terms "isolation valve" and "shutoff valve" carry the same meaning in the code and throughout the industry and referencing both terms does not pose any conflict or risk incorrect code interpretation.

Section 313.2 (Shutoff Valves) is being updated to reference Section 312.3.1(1), as this same requirement is already presented there. This removes duplicative provisions and prevents potential conflicts in the future if either section is updated.

Comment 3

Item #:
102

Code Number:
2024 USHGC

Sections(s):
311.1, 312.2, 705.2

Submitter Name:
Jazmin Curiel

Organization Name:
Self

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

311.0 Safety Devices.

311.1 General. Solar thermal, hydronic, and geothermal system components containing pressurized fluids shall be protected against pressures exceeding ~~the~~ design limitations with a pressure relief valve. ~~Hydronic or geothermal system components containing pressurized fluids shall be protected against pressures exceeding design limitations with a pressure relief valve.~~ Each section of the system in which excessive pressures are capable of developing shall have a relief valve located so that a section is not capable of being isolated from a relief device. Pressure relief valves shall be installed in accordance with the terms of their listing and the manufacturer's installation instructions.

~~705.2~~**311.3** ~~Pressure Relief Valves~~**Pressure-Reducing Points.** A pressure relief valve shall be installed on the low-pressure side of a piping system that has been reduced in pressure. The relief valve shall be set at the maximum pressure of the system design.

(renumber remaining sections)

312.0 Valves.

312.2 Where Required. Valves shall be installed in solar thermal, hydronic, and geothermal piping systems in accordance with the manufacturer's installation instructions, Section 311.0, and Section 312.3 through Section 312.15.

Substantiation:
Section 311.1 (General) consolidates two duplicative sentences that state the same pressure-relief requirement for different system types. This is a simple cleanup with no technical change.

Section 705.2 (Pressure Relief Valves) is being relocated to Chapter 3 (General Regulations). Since any closed-loop pressurized piping system that incorporates a pressure-reducing valve requires a relief valve on the downstream low-pressure side to protect against overpressure, this requirement is not specific to geothermal systems.

Item #:	Code Number:	Section Number:
103	2024 USHGC	706.1, Table 706.1

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

706.0 Specific System Components Design.
706.1 General. ~~Heat pumps shall be in compliance with Table 706.1, as applicable.~~ Heat pumps shall ~~also~~ comply with UL 1995 or UL 60335-2-40. Ground coupled and water source heat pumps shall ~~be listed in accordance~~ also comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Direct Exchange (DX) heat pumps shall ~~be listed~~ comply with AHRI 870 and shall be tested in accordance with ASHRAE 194. ~~All heat pump equipment used in DX systems shall comply with AHRI 870.~~ Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

~~TABLE 706.1~~
~~HEAT PUMPS~~

~~TYPE OF HEAT PUMP~~	~~STANDARDS~~
~~Water-to-Air~~	~~AHRI/ASHRAE/ISO 13256-1~~
~~Water-to-Water~~	~~AHRI/ASHRAE/ISO 13256-2~~

Note: AHRI 870 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
Since the standards listed in Table 706.1 (Heat Pumps) are already referenced in Section 706.1 (General), this table can be removed to avoid redundant requirements. The revisions to Section 706.1 are for both consistency in code language and technical accuracy.

While AHRI 870 covers performance ratings, ASHRAE 194 prescribes the method of testing for residential, commercial, and industrial direct-expansion (DX) ground-source heat pumps (GSHPs). ASHRAE 194 is compatible with AHRI 870 and further provides the test procedures for determining heating capacity, cooling capacity, coefficients of performance (COPs), and energy efficiency ratios (EERs) for these systems.

As indicated in AHRI 870, "The purpose of this standard is to establish for Direct Geoexchange Heat Pumps: definitions; classification; test and rating requirements; minimum data requirements for Published Ratings; operating requirements; marking and nameplate data; and conformance conditions." Additionally, Section 6.1 (Standard Ratings) of AHRI 870 states, "Standard Ratings shall be established at the Standard Rating Conditions specified in Section 6.1.3 using test procedures described in ANSI/ASHRAE Standard 194."

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
103	2024 USHGC	706.1, 707.14

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

701.1 General.

~~706.1~~**701.8** ~~General~~**Heat Pumps**. Heat pumps shall comply with UL 1995 or UL 60335-2-40. Ground coupled and water source heat pumps shall also comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Direct Exchange (DX) heat pumps shall comply with AHRI 870 and shall be tested in accordance with ASHRAE 194. ~~Heat pumps shall be fitted with a means to indicate that the compressor is locked out.~~

(renumber remaining sections)

707.0 Installation Practices.

~~**707.14 Heat Pump and Distribution System Installation.** The heat pump and distribution system shall be installed in accordance with the system's design, with this code, and the manufacturer's installation instructions.~~

(renumber remaining sections)

Substantiation:
Requirements for heat pumps are being relocated and updated to remove unnecessary provisions which are inherently covered by the product listings. Specifically, the UL standards address safety requirements for heat pumps, including control and protection systems. This includes compressor lockout indication and other safety interlocks. Similarly, the AHRI and ASHRAE standards also include requirements related to control functionality.

Section 707.14 (Heat Pump and Distribution System Installation) is being deleted as each of the requirements already exists independently, and the text isn’t enforceable in a meaningful way. Additionally, approved construction documents already require installation per the submitted design.

Item #:
105

Code Number:
2024 USHGC

Section Number:
707.6

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

707.0 Installation Practices.

707.6 Ground Heat~~-~~ Exchanger Installation Practices. A ground~~-~~ heat exchanger system shall be installed in accordance with the following:
(1) Where the design of the ground heat exchanger system permits freezing of the heat transfer fluid, freeze protection shall be provided in accordance with the following:
(~~3~~a) Where conditions permit, ~~H~~horizontal piping shall be installed not less than 12 inches (305 mm) below the frost line.
(~~1~~b) Outside piping or tubing located within 5 feet (1524 mm) of any wall or structure, and above the frost line, shall be continuously insulated with ~~insulation that has a minimum~~not less than R-5 ~~value~~material, or in accordance with the Authority Having Jurisdiction. Such pipe or tubing installed under the slab or basement floors shall be insulated within 5 feet (1524 mm) from the structure to the exterior point of exit from the slab.
~~(2) Freeze protection shall be provided where the design of the ground heat exchanger system would permit the heat transfer medium to freeze.~~
(~~4~~2) Submerged heat exchangers shall be protected from damage and shall be securely fastened to the bottom of the lake or pond, or other approved submerged structure.
(~~5~~3) Wells and boreholes shall be sealed in accordance with the Authority Having Jurisdiction. Where grout or cement is required, it shall be applied in a continuous operation from the bottom of the borehole by pumping through a tremie pipe.

SUBSTANTIATION:
The installation requirements in Section 707.6 (Ground Heat Exchanger Installation Practices) are being updated and reorganized based on topic, with all provisions pertaining to freeze protection now covered under Item (1).

The frost line is the maximum depth in the ground where soil water can freeze during the winter in a given climate zone. This depth varies depending on geographic location, soil composition, and local weather patterns. When piping is installed above the frost line, it is exposed to ambient air temperatures and freezing conditions, particularly during winter. Therefore, piping or tubing located “above the frost line” requires freeze protection.

Additionally, while a standard minimum R-value for insulation is beneficial, it may not be suitable for all geographic locations. For this reason, reference to the Authority Having Jurisdiction has been included.

Committee Action:
Accept As Amended by the TC

Proposed Text :

707.0 Installation Practices.

707.6 Ground Heat Exchanger Installation Practices. A ground heat exchanger system shall be installed in accordance with the following:
(1) Where ~~the design of the ground heat exchanger system permits freezing of~~ the heat transfer fluid is subject to freezing under normal operating conditions, freeze protection shall be provided in accordance with the following:
(a) Where conditions permit, horizontal piping shall be installed not less than 12 inches (305 mm) below the frost line.
(b) Outside piping or tubing located within 5 feet (1524 mm) of any wall or structure, and above the frost line, shall be continuously insulated with not less than R-5 material, or in accordance with the Authority Having Jurisdiction. Such pipe or tubing installed under the slab or basement floors shall be insulated within 5 feet (1524 mm) from the structure to the exterior point of exit from the slab.
(2) Submerged heat exchangers shall be protected from damage and shall be securely fastened to the bottom of the lake or pond, or other approved submerged structure.
(3) Wells and boreholes shall be sealed in accordance with the Authority Having Jurisdiction. Where grout or cement is required, it shall be applied in a continuous operation from the bottom of the borehole by pumping through a tremie pipe.

Committee Statement:
Item (1) of Section 707.6 (Ground Heat Exchanger Installation Practices) is being amended to improve code language and enforceability. Specifically, the phrase "permits freezing of the heat transfer fluid" is vague and implies an allowance. This amendment clarifies that freeze protection is required whenever the heat transfer fluid is subject to freezing under normal operating conditions, rather than relying on inferred design intent.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
105	2024 USHGC	704.1, 707.5 – 707.9, 707.17, 707.17.1

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

~~707.5~~704.0 **Ground Heat Exchanger Installation Practices.**
704.1 General. A ground heat exchanger system shall be installed in accordance with the following:
(1) – (3) (remaining text unchanged)
~~707.6~~704.2 **Setbacks.** Minimum setbacks from ground heat exchangers to existing infrastructure shall be determined by the registered design professional, and considerations shall be made for the following:
(1) Buried utilities such as electrical, gas, or water.
(2) Pressurized sewer lateral(s) into a building.
(3) Unpressurized sewer lateral(s) into a building.
(4) Water well(s).
(5) Septic tank(s) and subsurface sewage leaching fields.
(6) Natural water springs or bodies of water.
~~707.7~~704.3 **Trenching, Excavation, and Backfill.** Prior to excavation, trenching, or drilling, buried utilities, drainage, water, and irrigation systems shall be located. Prior to excavation, trenching, or drilling, the contractor, and owner shall agree in writing to site restoration requirements and submit to the Authority Having Jurisdiction for approval. Prior to any excavation, trenching, or drilling, all protected preserves, archeology sites, and buried utilities, including drainage and irrigation systems, shall be located and flagged by the appropriate utility and ground heat exchanger contractor representative.
Trenching, excavations, and backfill shall be in accordance with Section 320.0. Trenches for underground piping or tubing shall be excavated in accordance with the setback requirements in Section 704.2.

(renumber remaining sections)

~~**707.8 Trenches, Tunneling, and Driving.** Trenches shall comply with Section 320.1. Tunneling and driving shall comply with Section 320.2.~~
~~**707.9 Excavations and Open Trenches.** Excavations required to be made for the installation of piping or tubing shall be in accordance with Section 320.3. Piping or tubing shall be supported to maintain its alignment and prevent sagging. Piping in the ground shall be laid on a firm bed for its entire length; where other support is otherwise provided, it shall be approved in accordance with Section 302.0. Piping or tubing shall be backfilled after an inspection in accordance with Section 320.4.~~

~~**707.17 Trenches, Excavation, and Backfill.** Excavation for horizontal piping shall comply with Section 707.7 through Section 707.10, Section 707.17.1 through Section 707.17.8, and in accordance with requirements of the Authority Having Jurisdiction. Prior to any excavation, trenching, or drilling, all buried utilities including drainage and irrigation systems shall be located and flagged by the appropriate utility and ground heat exchanger contractor representative.~~
~~**707.17.1 Trenches.** Trenches for underground piping or tubing shall be excavated in accordance with the setback requirements in Section 712.4~~.

(renumber remaining sections)

(shown for information purposes only)

320.0 Trenching, Excavation, and Backfill.
320.1 Trenches. Trenches deeper than the footing of a building or structure, and paralleling the same, shall be located not less than 45 degrees (0.79 rad) from the bottom exterior edge of the footing, or as approved in accordance with Section 302.0.

320.2 Tunneling and Driving. Tunneling and driving shall be permitted to be done in yards, courts, or driveways of a building site. Where sufficient depth is available to permit, tunnels shall be permitted to be used between open-cut trenches. Tunnels shall have a clear height of 2 feet (610 mm) above the pipe and shall be limited in length to one-half the depth of the trench, with a maximum length of 8 feet (2438 mm). Where pipes are driven, the drive pipe shall be not less than one size larger than the pipe to be laid.
320.3 Open Trenches. Excavations required to be made for the installation of a system or a part thereof, within the walls of a building, shall be open trench work and shall be kept open until it has been inspected, tested, and accepted.
320.4 Excavations. Excavations shall be completely backfilled as soon after inspection as practicable. Precaution shall be taken to ensure compactness of backfill around piping without damage to such piping. Trenches shall be backfilled in thin layers to 12 inches (305 mm) above the top of the piping with clean earth, which shall not contain stones, boulders, cinder fill, frozen earth, construction debris, or other materials that will damage or break the piping or cause corrosive action. Mechanical devices such as bulldozers, graders, etc., shall be permitted to then be used to complete backfill to grade. Fill shall be properly compacted. Precautions shall be taken to ensure permanent stability for pipe laid in filled or made ground.

Substantiation:
This public comment removes repeated references to general requirements in Chapter 3 (General Regulations) pertaining to trenching, excavations, and backfill. For clear and concise direction, a single reference to Section 320.0 (Trenching, Excavation, and Backfill) is presented.

Additionally, the provisions addressing installation practices for ground heat exchangers are currently grouped into an extensive list of subsections under Section 707.0. To provide a clearer delineation between topics, these provisions are being moved to their own dedicated section with subsections for general requirements, setbacks, and trenching.

Item #:
107

Code Number:
2024 USHGC

Section Number:
707.11

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

707.0 Installation Practices.

707.11 Protection of Piping, Materials, and Structures. Piping and tubing passing under or through walls shall be protected from breakage in accordance with Section 318.1. Piping and tubing shall be installed in accordance with Section 318.2 to provide for expansion, contraction, and structural settlement. An electrically continuous corrosion-resistant tracer wire ~~(~~of not less than AWG 14~~) or~~, detectable metallic tracer tape, radio frequency markers, or other approved detectable markers shall be buried with the plastic pipe to facilitate locating. Where tracer wire is installed, ~~O~~one end shall be brought aboveground at a building wall or riser.

SUBSTANTIATION:
Section 707.11 (Protection of Piping, Materials, and Structures) is being revised to specify the type of tape to be used for this application and to include other available options. Radio frequency markers serve as an alternative for locating buried plastic pipes. These markers emit a specific frequency when activated by a compatible RF locator and give precise pipe locations in underground environments. Since they do not rely on electrical continuity, they are considered highly reliable.

Committee Action:
Accept As Amended by the TC

Proposed Text :

707.0 Installation Practices.

707.11 Protection of Piping, Materials, and Structures. Piping and tubing passing under or through walls shall be protected from breakage in accordance with Section 318.1. Piping and tubing shall be installed in accordance with Section 318.2 to provide for expansion, contraction, and structural settlement. ~~An e~~Electrically continuous corrosion-resistant tracer wire of not less than AWG 14, metallic detectable~~ metallic tracer~~ tape, ~~radio frequency markers~~electronic locating devices, or other approved detectable markers shall be buried with the plastic pipe to facilitate locating. Where tracer wire is installed, one end shall be brought aboveground at a building wall or riser.

Committee Statement:
Item #110 was heard prior to Item #107. Item #107 is being amended to correlate with the language accepted in Item #110. This includes the updated references to “electronic locating devices” and “metallic detectable tape.”

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
107

Code Number:
2024 USHGC

Sections(s):
704.1, 707.5, 707.10 – 707.13, 707.15, 707.16.3

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

~~707.5~~704.0 **Ground Heat Exchanger Installation Practices.**
704.1 General. A ground heat exchanger system shall be installed in accordance with the following:
(1) – (3) (remaining text unchanged)

~~707.10~~704.5 **Protection of Piping, Materials, and Structures.** ~~Piping and tubing passing under or through walls shall be protected from breakage in accordance with Section 318.1. Piping and tubing shall be installed in accordance with Section 318.2 to provide for expansion, contraction, and structural settlement. Electrically continuous corrosion-resistant tracer wire of not less than AWG 14, metallic detectable tape, electronic locating devices, or other approved detectable markers shall be buried with the plastic pipe to facilitate locating. Where tracer wire is installed, one end shall be brought aboveground at a building wall or riser.~~Piping, tubing, materials, and structures shall be protected in accordance with Section 318.0.

~~707.15~~704.6 ~~**Pressurizing During Installation**~~**Embedded Piping**. Ground heat exchanger piping to be embedded in concrete shall be pressure tested prior to pouring concrete. During pouring, the pipe shall be maintained at the proposed operating pressure.

(renumber remaining sections)

~~**707.11 Sleeves.** In exterior walls, annular space between sleeves and pipes shall be sealed and made watertight and shall not be subject to a load from building construction in accordance with Section 318.7 through Section 318.7.2.~~
~~**707.12 Steel Nail Plates.** Steel nail plates shall be installed for plastic and copper piping penetrating framing members to within 1 inch (25.4 mm) of the exposed framing in accordance with Section 318.6.~~
~~**707.13 Piping Protection.** Prior to system use and during construction, piping shall be fitted with end caps and protected from freezing, UV radiation, corrosion, and degradation.~~

~~**707.16.3 Protection of Piping.** Pipes passing through walls shall be sleeved and sealed in accordance with Section 318.0.~~

(renumber remaining sections)

(shown for information purposes only)

318.0 Protection of Piping, Materials, and Structures.
318.1 General. Piping or tubing passing under or through walls shall be protected from breakage. Piping passing through or under cinders or other corrosive materials shall be protected from external corrosion in an approved manner. Approved provisions shall be made for expansion of hot liquid piping. Voids around piping or tubing passing through concrete floors on the ground shall be sealed.
318.2 Installation. Piping or tubing shall be installed so that piping, tubing, or connections will not be subject to undue strains or stresses, and provisions shall be made for expansion, contraction, and structural settlement. No piping or tubing, unless designed and listed for such use, shall be directly embedded in concrete or masonry. No structural member shall be seriously weakened or impaired by cutting, notching, or otherwise, as defined in the building code.
318.3 Fire-Resistant Construction. Piping penetrations of fire-resistance-rated walls, partitions, floors, floor/ceiling assemblies, roof/ceiling assemblies, or shaft enclosures shall be protected in accordance with the requirements of the building code and the fire code.
318.4 Waterproofing of Openings. Joints at the roof around pipes, ducts, or other appurtenances shall be made watertight by the use of lead, copper, galvanized iron, or other approved flashings or flashing material. Exterior wall openings shall be made watertight.
318.5 Protection of Plastic Pipe or Tubing. Plastic pipe or tubing passing through drilled or notched metal studs or metal joists, or hollow-shell masonry walls shall be protected from abrasion.
318.6 Steel Nail Plates. Plastic and copper or copper alloy piping penetrating framing members to within 1 inch (25.4 mm) of the exposed framing shall be protected by steel nail plates not less than No. 18 gauge (0.0478 inches) (1.2141 mm) in thickness. The steel nail plate shall extend along the framing member not less than 1½ inches (38 mm) beyond the outside diameter of the pipe or tubing.
318.7 Sleeves. Sleeves shall be provided to protect piping through concrete and masonry walls, and concrete floors.
Exception: Sleeves shall not be required where openings are drilled or bored.
318.7.1 Building Loads. Piping through concrete or masonry walls shall not be subject to a load from building construction.
318.7.2 Exterior Walls. In exterior walls, annular space between sleeves and pipes shall be sealed and made watertight, as approved by the Authority Having Jurisdiction. A penetration through fire-resistive construction shall be in accordance with Section 318.3.
318.8 Firewalls. A pipe sleeve through a firewall shall have space around the pipe completely sealed with an approved fire-resistive material in accordance with the building code and the fire code.
318.9 Structural Members. A structural member weakened or impaired by cutting, notching, or otherwise shall be reinforced, repaired, or replaced so as to be left in a safe structural condition in accordance with the requirements of the building code.
318.10 Rodentproofing. Solar thermal, hydronic, and geothermal systems shall be constructed in such a manner as to restrict rodents or vermin from entering a building by following the duct work from the outside into the building.
318.11 Metal Collars. In or on buildings where openings have been made in walls, floors, or ceilings for the passage of pipes, such openings shall be closed and protected by the installation of approved metal collars securely fastened to the adjoining structure.

Substantiation:
This public comment removes duplicative requirements and references to general requirements in Chapter 3 (General Regulations) pertaining to the protection of piping, materials, and structures. The current text contains multiple provisions that either restate or overlap with those addressed in Section 318.0 (Protection of Piping, Materials, and Structures), and these updates are needed to avoid potential conflicts if sections are updated via future code changes and correlation is missed. For clear and concise direction, a single reference to Section 318.0 is presented.

Furthermore, tracer wires are already sufficiently addressed by Section 707.17.8 (Tracer and Warning Markings) and maintaining differing provisions in Section 704.5 (Protection of Piping, Materials, and Structures) creates a conflict.

> *[2025 USHGC ROP Preprint]*
> ***707.17.8 Tracer and Warning Markings.*** *Means shall be provided for underground detection or utility location of the buried pipe system. This shall include, but is not limited to, metallic detectable tape and electronic locating devices. Where metallic detectable tape is used, the tape shall have a thickness of not less than 0.005 inches (0.127 mm) and a width of not less than 3 inches (76 mm). Warning markings shall be permanent, conspicuous, and resistant to the environmental conditions and shall be located not less than 1 foot (305 mm) and not more than 2 feet (610 mm) above the horizontal piping.*

Item #:
108

Code Number:
2024 USHGC

Section Number:
707.18.3, Table 901.1

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

707.0 Installation Practices.

707.18 Trenches, Excavation, and Backfill. (remaining text unchanged)

707.18.3 Pipe Installation. Piping in horizontal trenches shall be ~~embedded with not less than 6 inches (152 mm) of inert granular material above and below, or in accordance with the Authority Having Jurisdiction and project specifications~~installed in accordance with ASTM D2774. Horizontal piping trenching shall be backfilled with approved material and shall be compacted.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASTM D2774-2021a	Standard Practice for Underground Installation of Thermoplastic Pressure Piping	Piping	707.18.3

(portions of table not shown remain unchanged)

Note: ASTM D2774 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
ASTM D2774 is the specification governing underground installation of thermoplastic pressure piping and is appropriate for reference in Section 707.18.3 (Pipe Installation).

This standard provides detailed procedures covering proper trench preparation, selection and placement of bedding and backfill materials, and stress considerations on buried piping. The existing language provides less guidance and relies on the AHJ for other project specifications.

Committee Action:
Accept As Amended by the TC

Proposed Text :

707.0 Installation Practices.

707.18 Trenches, Excavation, and Backfill. (remaining text unchanged)

707.18.3 Pipe Installation. Piping in horizontal trenches shall be installed in accordance with ~~ASTM D2774~~ANSI/CSA/IGSHPA C448. Horizontal piping trenching shall be backfilled with approved material and shall be compacted.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
~~ASTM D2774-2021a~~	~~Standard Practice for Underground Installation of Thermoplastic Pressure Piping~~	~~Piping~~	~~707.18.3~~

(portions of table not shown remain unchanged)

Committee Statement:
Section 707.18.3 (Pipe Installation) is being amended to reference ANSI/CSA/IGSHPA C448 in place of ASTM D2774. ANSI/CSA/IGSHPA C448 is the more appropriate standard since it specifically addresses the burial and installation of geothermal piping. In contrast, ASTM D2774 primarily applies to larger diameter piping and is less relevant to typical geothermal applications.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
108

Code Number:
2024 USHGC

Sections(s):
704.1, 707.5, 707.16 – 707.16.2, 707.17.2 – 707.17.8

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

~~707.5~~704.0 **Ground Heat Exchanger Installation Practices.**
704.1 General. A ground heat exchanger system shall be installed in accordance with the following:
(1) – (3) (remaining text unchanged)

~~707.17.3~~704.4 ~~**Pipe Installation**~~**Horizontal Trenched Piping**. Piping in horizontal trenches shall be installed in accordance with ANSI/CSA/IGSHPA C448 and Section 704.4.1 through Section 704.4.6, as applicable. ~~Horizontal piping trenching shall be backfilled with approved material and shall be compacted.~~
~~707.17.2~~704.4.1 **Buried Systems.** Buried open-loop system piping, shall be installed not less than 3.3 feet (1006 mm) below the finished grade.
~~707.17.4~~704.4.2 **Separation.** The horizontal piping shall be separated from fluid-based on-site service systems to prevent excessive short-circuiting heat transfer between such systems.
~~707.17.5~~704.4.3 **Insulation.** Insulation shall be provided on the piping where there is close proximity of all site services to prevent thermal interference between fluid-based on-site service systems.
~~707.17.6~~704.4.4 **Pipe Bends.** ~~Sharp bending of pipe shall be prevented or approved elbow fitting shall be used with a bend radius in accordance with the manufacturer's installation instructions.~~Pipe bends shall be formed in accordance with Section 410.2.
~~707.17.7~~704.4.5 **Closed Cell Insulation.** Where the design operating temperature is less than 32°F (0°C), ~~B~~buried horizontal ~~open-loop system~~ pipes passing parallel within 5 feet (1524 mm) of a wall, structure, or water pipe shall be installed with closed cell insulation. The minimum R-value of the insulation shall be in accordance with the registered design professional and the Authority Having Jurisdiction.
~~707.17.8~~704.4.6 **Tracer and Warning Markings.** Means shall be provided for underground detection or utility location of the buried pipe system. This shall include, but is not limited to, metallic detectable tape and electronic locating devices. Where metallic detectable tape is used, the tape shall have a thickness of not less than 0.005 inches (0.127 mm) and a width of not less than 3 inches (76 mm). Warning markings shall be permanent, conspicuous, and resistant to the environmental conditions and shall be located not less than 1 foot (305 mm) and not more than 2 feet (610 mm) above the horizontal piping.

(renumber remaining sections)

~~**707.16 Horizontal Geothermal Piping - Materials and Methods.** Horizontal geothermal piping shall be in accordance with Section 707.16.1 through Section 707.17.8.~~
~~**707.16.1 Piping Materials.** Piping materials and joining methods for horizontal piping from the ground heat exchanger shall be in accordance with Section 703.2 through Section 703.5, and Section 715.3.~~
~~**707.16.2 Dissimilar Materials.** Transition fittings between dissimilar materials shall be inside or accessible.~~

(renumber remaining sections)

(shown for information purposes only)

410.2 Pipe Bends. Pipe bends shall be formed in accordance with Section 410.2.1 through Section 410.2.3.
410.2.1 Cross-Linked Polyethylene (PEX) Tubing. Cross-linked polyethylene (PEX) tubing bends shall have a bend radius of not less than eight times the outside diameter (OD) of the tubing or shall be in accordance with the manufacturer's installation instructions.

410.2.2 Polyethylene (PE) Plastic Pipe/Tubing. Polyethylene pipe and tubing bends shall have a bend radius in accordance with Table 410.2.2. When a fitting or flange connection is present in the pipe bend, the minimum bend radius shall be one hundred times the pipe outside diameter (OD) for a distance of five times the pipe diameter on either side of the fitting location.

TABLE 410.2.2
MINIMUM BEND RADIUS FOR PE PIPE INSTALLED IN OPEN CUT TRENCH

<table>
<tr><th>DIMENSION RATIO (DR)</th><th>MINIMUM COLD BEND RADIUS</th></tr>
<tr><td>7</td><td rowspan="3">20 x Pipe OD</td></tr>
<tr><td>7.3</td></tr>
<tr><td>9</td></tr>
<tr><td>11</td><td rowspan="2">25 x Pipe OD</td></tr>
<tr><td>13.5</td></tr>
<tr><td>17</td><td rowspan="2">27 x Pipe OD</td></tr>
<tr><td>21</td></tr>
<tr><td>26</td><td>34 x Pipe OD</td></tr>
<tr><td>32.5</td><td>42 x Pipe OD</td></tr>
<tr><td>41</td><td>52 x Pipe OD</td></tr>
<tr><td>Fitting or flange present in bend</td><td>100 x Pipe OD</td></tr>
</table>

410.2.3 Polyethylene of Raised Temperature (PE-RT) Tubing. Polyethylene of raised temperature (PE-RT) tubing bends shall have a bend radius of not less than eight times the outside diameter (OD) of the tubing or shall be in accordance with the manufacturer's installation instructions.

Substantiation:

The proposed update groups the remaining provisions addressing the installation of ground heat exchanger piping in horizontal trenches, with explicit cross references to ANSI/CSA/IGSHPA C448 and Sections 704.4.1 through 704.4.6 to provides users with clear direction on the full scope of applicable requirements. Since backfill requirements were previously addressed through the cross reference to Section 320.0, such requirements do not need to also be repeated here.

The current text in Section 707.17.6 (Pipe Bends) requires that sharp bending be prevented or that approved elbow fittings be used with a bend radius in accordance with manufacturer instructions, which is vague and difficult to enforce. Therefore, the language is being updated to instead reference existing related requirements found in Section 410.2 (Pipe Bends).

The current text in Section 707.17.7 (Closed Cell Insulation) requires closed cell insulation for buried horizontal open-loop system pipes, but does not specify when this protection is actually necessary. To prevent overly stringent requirements, the section is being updated to require such insulation only where the design operating temperature is less than 32°F. This reflects the freezing point of water and addresses the thermal risk being mitigated by the insulation. Additionally, this insulation requirement is being expanded to all ground heat exchanger configurations since open-loop systems are not the only type that may operate below freezing temperatures.

Item #: 111

Code Number: 2024 USHGC

Section Number: 708.0 – 708.3

SUBMITTER: Cary Smith

Organization Name: USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

708.0 ~~System Start-Up~~**Commissioning.**
708.1 General. The following requirements shall be verified prior to ~~system start-up~~commissioning of a ground heat exchanger:
(1) ~~To prevent debris in the building piping system from entering the geothermal loop field piping or residual debris from the geothermal loop field entering the building piping, t~~The connection between the building piping and the ~~geothermal loop field~~ground heat exchanger shall be isolated so as to allow a bypass for the independent cleaning, flushing, and purging of both the ~~loop field~~ground heat exchanger as well as the building piping and equipment prior to the introduction of building fluid into the ~~geothermal loop field~~ground heat exchanger.
(2) The ground heat exchanger and building piping shall be cleaned, flushed, and purged.
(~~2~~3) The ground heat exchanger and building piping, where required, shall be filled with the heat transfer fluid ~~medium~~. The ground ~~loop system~~heat exchanger shall be tested at the design flow rate(s), and the differential pressure(s) shall be recorded in the commissioning documents. Where the actual pressure change at design flow is more than ± 10 percent of the design flow pressure drop, ~~the cause shall be identified and corrective action taken~~the identified cause and corrective actions taken shall be recorded in the commissioning documents.
(~~3~~4) A method for the removal of air and ~~a method~~ for adding the heat transfer fluid ~~(where necessary)~~ shall be provided.
(~~4~~5) The heat pumps shall be operational and adjustments shall be made in accordance with the manufacturer's installation instructions and the registered design professional.
(~~5~~6) ~~All necessary~~Where required by the registered design professional, additional flow tests of the ground heat exchanger shall be completed prior to commissioning of the heat pump(s) ~~start-up~~.
(~~6~~7) Ground heat exchanger and building piping, valves, and operating controls, shall be set, adjusted, and operating as ~~required~~designed.
(~~7~~8) The system shall be labeled at the ~~loop~~ground heat exchanger charging valves with a permanent-type label, indicating the type of heat transfer fluid used. Where antifreeze is used, the labels shall indicate the ~~antifreeze~~ type and concentration of the antifreeze.
(~~8~~9) Supply lines, ~~and~~ return lines, ~~as well as associated~~and isolation valves from individual boreholes or water wells, shall be identified and tagged with a permanent-type label.
(~~9~~10) Supply and return lines on submerged ~~systems~~heat exchangers shall be identified ~~in an approved manner,~~and tagged at the point of entry to a surface water resource, with a permanent-type label.

708.2 Operation and Maintenance Manual. An operation and maintenance manual for the geothermal system shall be provided to the owner or designated agent. The manual shall include information on required testing and maintenance of the system. Training shall be provided on the system's operation, maintenance requirements, and on the content of the operation and maintenance manual. The operation and maintenance manual shall contain a layout of the ground-heat exchanger and building loop.

708.3 Labeling and Marking. Ground ~~source heat pump ground loop system~~heat exchanger piping shall be marked with tape, metal tags, or other methods where it enters a building or mechanical room. The marking shall ~~indicate~~state the following words: "~~GROUND SOURCE HEAT PUMP LOOP SYSTEM.~~GROUND HEAT EXCHANGER" or other unique system identifier. The marking shall indicate the type and concentration of the antifreeze used in the system ~~by name and concentration~~and the direction of flow.

SUBSTANTIATION:
"System start-up" is being replaced with "commissioning" to align with industry-standard terminology. Commissioning is more appropriate as it refers to the complete verification of system functionality. The revised text provides more detailed procedural steps, including explicit documentation of differential pressure changes and corrective actions, and requirements for permanent-type tags to identify supply and return lines. The other updates are for overall improvement of code language.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
111	2024 USHGC	705.0 – 705.2, 708.0 – 708.3, 708.7, 708.8, 715.7, Table 901.1

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

708.0 System Commissioning/Start-Up.
708.1 General. ~~The following requirements shall be verified prior to commissioning of a ground heat exchanger:~~Commissioning and start-up of GSHP systems shall be in accordance with ANSI/CSA/IGSHPA C448 and Section 708.2. Commissioning and start-up of ATL systems shall be in accordance with IAPMO/ANSI/CAN Z1381.

708.2 Verification. Prior to commissioning or start-up of a GSHP system, the following shall be verified:
(1) The connection between the building piping and the ground heat exchanger shall be isolated so as to allow a bypass for the independent cleaning, flushing, and purging of both the ground heat exchanger as well as the building piping and equipment prior to the introduction of building fluid into the ground heat exchanger.
(2) The ground heat exchanger and building piping shall be cleaned, flushed, and purged. Particulate contaminants shall be removed from the indoor piping system prior to connecting to the ground heat exchanger.
(3) The ground heat exchanger and building piping, where required, shall be filled with the heat transfer fluid. The ground heat exchanger shall be tested at the design flow rate(s), and the differential pressure(s) shall be recorded in the commissioning documents. Where the actual pressure change at design flow is more than ± 10 percent of the design flow pressure drop, the identified cause and corrective actions taken shall be recorded in the commissioning documents.
(4) A method for the removal of air and for adding the heat transfer fluid shall be provided.
(5) The heat pumps shall be operational and adjustments shall be made in accordance with the manufacturer's installation instructions and the registered design professional.
~~(6) Where required by the registered design professional, additional flow tests of the ground heat exchanger shall be completed prior to commissioning of the heat pump(s).~~
(~~7~~6) Ground heat exchanger and building piping, valves, and operating controls, shall be set, adjusted, and operating as designed.
~~(8) The system shall be labeled at the ground heat exchanger charging valves with a permanent-type label, indicating the type of heat transfer fluid used. Where antifreeze is used, the labels shall indicate the type and concentration of the antifreeze.~~
~~(9) Supply lines, return lines, and isolation valves from individual boreholes or water wells, shall be identified and tagged with a permanent type label.~~
~~(10) Supply and return lines on submerged heat exchangers shall be identified and tagged at the point of entry to a surface water resource, with a permanent type label.~~

~~**708.3 Labeling and Marking.** Ground heat exchanger piping shall be marked with tape, metal tags, or other methods where it enters a building or mechanical room. The marking shall state the following words: "GROUND HEAT EXCHANGER" or other unique system identifier. The marking shall indicate the type and concentration of the antifreeze used in the system and the direction of flow.~~

~~**708.7 System Start-Up.** System start-up shall be in accordance with ANSI/CSA/IGSHPA C448 and Section 708.0.~~
~~**708.8 Contaminants.** Particulate contaminants shall be removed from the indoor piping system prior to initial start-up.~~

(renumber remaining sections)

705.0 Labeling and Identification.
705.1 General. Water-based GSHP systems shall be identified with permanent markings in accordance with the following:
(1) Ground heat exchanger and submerged heat exchanger piping at building or mechanical room entry points shall be marked with tape, metal tags, or other approved methods indicating a unique system identifier, direction of flow, and heat transfer fluid type. Where antifreeze is used, the type and concentration shall be indicated.
(2) Charging valves shall be labeled indicating the type of heat transfer fluid and, where antifreeze is used, the type and concentration.
(3) For borehole and water well systems, supply lines, return lines, and isolation valves shall be identified and tagged.
(4) For submerged heat exchangers, supply and return lines shall be identified and tagged at the point of entry to a surface water resource.

705.2 Direct Exchange (DX) Systems. Direct exchange (DX) systems shall be identified with permanent markings in accordance with the following:
(1) Refrigerant piping at building or mechanical room entry points shall be marked with tape, metal tags, or other approved methods indicating a unique system identifier, direction of flow, and refrigerant type.
(2) The compressor unit shall be labeled with the refrigerant type and quantity.

(renumber remaining sections)

Part IV – Direct Exchange (DX) Systems.

715.0 Direct Exchange (DX) Systems.

715.7 System Commissioning/Start-Up. Commissioning and start-up of DX systems ~~start-up~~ shall be in accordance with Section 708.0 and ~~the following:~~this section.
~~(1)~~ DX systems shall be pressurized using nitrogen for not less than 1 hour. There shall be no allowable variance to the test pressure after being corrected for ambient temperature changes during the test. The test pressure shall not exceed 150 psig (1034 kPa) when pressure testing the compressor unit and indoor system components.
~~(2) DX systems shall have permanent type labels installed and affixed on the compressor unit with the refrigerant type and quantity.~~
~~(3) For DX systems, refrigerant liquid and vapor lines from the loop system shall be identified and tagged.~~

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
IAPMO/ANSI/CAN Z1381-2025	Ambient Temperature Loop Systems	District Energy Systems	708.1

(portions of table not shown remain unchanged)

Note: ANSI/CSA/IGSHPA C448 and IAPMO/ANSI/CAN Z1381 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
This public comment reorganizes and updates requirements for system commissioning and start-up as well as system labeling and identification. The updated structure consolidates all labeling and identification requirements into a dedicated Section 705.0 and streamlines commissioning and start-up provisions under Section 708.0.

To provide comprehensive coverage of all systems addressed in Chapter 7, Section 708.1 (General) is being updated to reference ANSI/CSA/IGSHPA C448 for commissioning and start-up of GSHP systems and IAPMO/ANSI/CAN Z1381 for ATL systems. Consequently, Section 708.7 (System Start-Up) is no longer needed and is being deleted.

Under verification requirements, item (2) is being updated to include requirements for removal of particulate contaminants in Section 708.8 (Contaminants); existing item (6) is being deleted as additional flow tests are already addressed in item (3); and the information in item (8) through item (10) is being relocated to new Section 705.0 as it pertains specifically to labeling and identification.

New Section 705.0 (Labeling and Identification) compiles and improves the current labeling requirements that are distributed across Section 708.1, Section 708.3, and Section 715.7 and distinguishes between provisions for water-based GSHP systems and DX systems. The updated text clarifies that labels must indicate a unique system identifier, direction of flow, and heat transfer fluid type, with antifreeze type and concentration required only where antifreeze is used.

Comment 2

Item #:
111

Code Number:
2024 USHGC

Sections(s):
708.0, 708.2, 708.4 – 708.6

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **<u>as modified</u>** by this public comment.

708.0 <u>System </u>Commissioning<u>/Start-Up</u>.

~~708.4~~**<u>708.3</u> Documentation.** The ~~ground heat exchanger as-built installation drawings and instructions~~<u>following documentation</u> shall be provided to the building owner or designated agent~~.~~<u>:</u>
<u>(1) Operation and maintenance manual containing system layout, required testing procedures, and maintenance requirements for the ground heat exchanger and distribution system.</u>
<u>(2) As-built drawings of the ground heat exchanger and distribution system installation.</u>

(renumber remaining sections)

~~**708.2 Operation and Maintenance Manual.** An operation and maintenance manual for the geothermal system shall be provided to the owner or designated agent. The manual shall include information on required testing and maintenance of the system. Training shall be provided on the system's operation, maintenance requirements, and on the content of the operation and maintenance manual. The operation and maintenance manual shall contain a layout of the ground heat exchanger and building loop.~~

~~**708.5 Maintenance.** The periodic maintenance required, in accordance with the design requirements, shall be provided and be made available to the owner or designated agent.~~

~~**708.6 Records.** The ground heat exchanger construction documents shall be provided to the owner.~~

(renumber remaining sections)

Substantiation:
The requirements within these sections all pertain to documentation that needs to be provided to the building owner or designated agent. Therefore, the provisions are being consolidated into a single Section 708.3 (Documentation) that clearly identifies the required deliverables: an operation and maintenance manual containing system layout, required testing procedures, and maintenance requirements, along with as-built drawings of the ground heat exchanger and distribution system installation. The training requirements from Section 708.2 (Operation and Maintenance Manual) were intentionally excluded as such requirements are unenforceable.

Item #: 112

Code Number: 2024 USHGC

Section Number: 710.6

SUBMITTER: Cary Smith

Organization Name: USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

Part II – Closed-Loop Systems.

710.0 General.

710.6 Verification. ~~For closed-loop systems, t~~T̲he system shall be flushed of debris and purged of air after completion of the entire ground-heat exchanger. Flow rates and pressure drops shall be compared to calculated values to ~~assure~~ensure that no blockage or kinking of the pipe exists. A report shall be submitted to the owner to confirm that the loop flow is in accordance with the construction documents.

SUBSTANTIATION:
The provisions in Section 710.6 (Verification) are located under Part II (Closed-Loop Systems). Therefore, the phrase "for closed-loop systems" is redundant and unnecessary. The other remaining revisions are for improvement of code language.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #: 112

Code Number: 2024 USHGC

Sections(s): 710.6

Submitter Name: Cary Smith

Organization Name: USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part II – Closed-Loop Systems.

710.0 General.

~~**710.6 Verification.** The system shall be flushed of debris and purged of air after completion of the entire ground-heat exchanger. Flow rates and pressure drops shall be compared to calculated values to ensure that no blockage or kinking of the pipe exists. A report shall be submitted to the owner to confirm that the loop flow is in accordance with the construction documents.~~

(renumber remaining sections)

Substantiation:
Section 710.6 (Verification) is being deleted as these requirements are already addressed by the requirements for system start-up and commissioning under Part I (General) which applies to all systems covered by the chapter. To avoid duplication and potential conflicts, this section should be removed.

Item #:	Code Number:	Section Number:
113	2024 USHGC	223.0, 710.7, 710.7.2

SUBMITTER:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

RECOMMENDATION:
Revise text

Proposed Text :

Part II – Closed-Loop Systems.

710.0 General.

710.7 Vertical and Directional Bores. Vertical and directional bores shall be drilled to a depth to provide complete insertion of the u-bend ~~pipe~~assembly to its specified depth. The borehole diameter shall be sized for the installation and placement of the heat exchange u-bend assembly and the tremie used to place the grouting material. ANSI/CSA/IGSHPA C448 shall be used for vertical and directional loop ~~depth~~length and borehole diameter sizing guidance. The u-bend ~~joint and pipe~~assembly shall be visually inspected for integrity in accordance with the manufacturer's installation instructions. The u-bend ~~joint and pipe~~assembly shall be pressurized to not less than 100 psi (689 kPa), not to exceed the pressure rating of the pipe at the test temperature, for 1 hour to check for leaks before insertion into the borehole.

710.7.2 U-Bend~~s~~ Assemblies and Headers. Headers, u-bend~~s~~ assemblies and ground ~~loop~~heat exchanger pipes shall be pressure-tested in accordance with ANSI/CSA/IGSHPA C448, or as required by the Authority Having Jurisdiction. Before testing, heat fusion joints shall be cooled to ambient temperature. Mechanical joints shall be completely assembled. Flushing and purging to remove air and debris shall be completed before testing. The assembly shall be filled with water (or water/antifreeze solution) and purged at a minimum flow rate of 2 feet per second (0.6 m/s) to remove air, but not more than the maximum flow velocity recommended by the pipe and fittings manufacturer to remove debris.

223.0 - U -

U–Bend Assembly. A 180 degree (3.14 rad) directional change in a ground loop pipe, typically used at the bottom of a vertical borehole, that is fabricated or formed using a one-piece molded fitting attached to HDPE pipes via butt fusion, approved fittings for PE-RT or PEX pipe and tubing, or jointless hot-forming techniques.

SUBSTANTIATION:
The geothermal industry regularly employs directional drilling techniques for both closed-loop and open-loop systems. While vertical bores are common for deep, straight-down installations, directional bores are frequently used when angled drilling is necessary.

Limiting specifications to vertical bores would exclude appropriate and proven directional drilling methods. This update is necessary because not all sites are suitable for vertical bores due to factors such as variable soil conditions, underground obstructions, or spatial limitations.

The term "U-bend assembly" is proposed to replace "U-bend" or "U-bend joint and pipe" to clarify that the assembly refers to the complete connection of piping to a U-bend fitting, or to piping formed into a U-bend configuration.

The "U-bend" itself is the molded fitting that is fusion-welded to HDPE pipes, and the U-bend assemblies function as the piping loops that are installed in the boreholes. Therefore, the proposed definition is specific to this application. Furthermore, this definition aligns with what is published by the Plastics Pipe Institute (PPI).

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
113

Code Number:
2024 USHGC

Sections(s):
710.7 – 710.7.2.4, 711.0 – 711.3

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part II – Closed-Loop Systems.

~~710.7~~711.0 **Vertical and Directional Bores.**
711.1 General. Vertical and directional bores shall be drilled to a depth to provide complete insertion of the u-bend assembly to its specified depth. The borehole diameter shall be sized for the installation and placement of the heat exchange u-bend assembly and the tremie used to place the grouting material. ANSI/CSA/IGSHPA C448 shall be used for vertical and directional loop length and borehole diameter sizing guidance.
711.2 U-Bend Assembly Verification. The u-bend assembly shall be visually inspected for integrity in accordance with the manufacturer's installation instructions. The u-bend assembly shall be pressurized to not less than 100 psi (689 kPa), not to exceed the pressure rating of the pipe at the test temperature, for 1 hour to check for leaks before insertion into the borehole.
~~710.7.1~~711.3 **Backfill.** Bentonite grout and thermally-enhanced bentonite grout, where used to seal and backfill each borehole, shall comply with NSF/ANSI/CAN 60. Boreholes shall be backfilled in accordance with the Authority Having Jurisdiction.

~~710.7.2~~711.4 ~~U-Bend Assemblies and Headers~~**Ground Heat Exchanger Pressure Testing.** Headers, u-bend assemblies and ground heat exchanger pipes shall be pressure-tested in accordance with ANSI/CSA/IGSHPA C448, or as required by the Authority Having Jurisdiction. Before testing, heat fusion joints shall be cooled to ambient temperature. Mechanical joints shall be completely assembled. Flushing and purging to remove air and debris shall be completed before testing. The assembly shall be filled with water (or water/antifreeze solution) and purged at a minimum flow rate of 2 feet per second (0.6 m/s) to remove air, but not more than the maximum flow velocity recommended by the pipe and fittings manufacturer to remove debris.
~~710.7.2.3~~**711.4.1** ~~Calculation of~~ **Static Pressure** ~~(Water)~~**Calculation**. For freshwater, the static pressure applied shall be equivalent to 0.43 psig (2.96 kPa) per foot (305 mm) of elevation.
~~710.7.2.4 Calculation of Static Pressure (Other Fluids).~~ For fluids of different density, the static pressure shall be calculated using the density of the system fluid.
~~710.7.2.1~~**711.4.2 Test Pressure.** The maximum test pressure shall be 1.5 times the system design pressure, as determined by Section ~~710.7.2.3~~711.4.1, ~~or Section 710.7.2.4,~~ not to exceed 100 psi (689 kPa). Components or devices with lower pressure-ratings than the pipe shall be protected from excessive pressure during testing by removing or isolating from the test section.
Exception: Where lower pressure-rated components or devices cannot be removed or isolated from the test section, the maximum test pressure shall not exceed the pressure rating of the component or device.
~~710.7.2.2~~**711.4.3 Testing Procedure.** The test section and the test liquid shall be at the same temperature. The test section shall be filled with liquid and purged of air. The test section shall be brought to the specified test pressure. Test pressure shall be maintained for 4 hours, with additional fluid added as needed. The test pressure shall be reduced by 10 psi (69 kPa) and monitored for 1 hour with no addition of pressure or additional fluid. A passing test is indicated where after a period of 1 hour no visual leakage is observed, and pressure remains equal to or greater than 95 percent of the original pressure.

(renumber remaining sections)

~~**711.0 Ground Heat Exchanger Testing.**~~
~~**711.1 Testing.** Pressure testing of the ground heat exchanger shall be performed in accordance with the testing method in Section 710.7 or ANSI/CSA/IGSHPA C448. Where required by the Authority Having Jurisdiction, testing of individual ground loops shall be performed.~~
~~**711.2 Field Pressure Testing – Final.** The ground heat exchanger and building piping shall be cleaned, flushed, and, where required, shall be filled with the heat transfer fluid medium. The ground heat exchanger shall be tested at the design flow rate(s) and differential pressure(s) recorded. Where the actual pressure change at design flow is more than +/- 10 percent of the design flow pressure drop, the cause shall be identified, and corrective action taken.~~
~~**711.3 Field Flow Testing – Final.** Final field flow testing shall be performed as required by the Authority Having Jurisdiction.~~

(renumber remaining sections)

Substantiation:
This public comment provides a dedicated section for vertical and directional bores, splits lengthy provisions based on topic, updates section titles to more accurately reflect content, and removes duplicative testing provisions. The remaining revisions are as follows:

Section 711.4.1 (Static Pressure Calculation): Updated to clarify that the static pressure of 0.43 psig per foot of elevation pertains specifically to "freshwater." Saltwater and antifreeze solutions have different densities that would result in different static pressure values.

Section 711.1 (Testing): Deleted as these provisions are already covered under Section 711.4 (Ground Heat Exchanger Pressure Testing).

Section 711.2 (Field Pressure Testing – Final) & Section 711.3 (Field Flow Testing – Final): Deleted as these provisions are covered under commissioning and start-up.

Comment 2

Item #:
113

Code Number:
2024 USHGC

Sections(s):
204.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

204.0 – B –
Borehole. A penetration into the earth at any angle, typically drilled, bored, cored, driven, hydraulically advanced, or otherwise constructed for ~~geothermal system~~ground heat exchanger installations, and not intended for water extraction or disposal.

Substantiation:
The definition is being updated to clarify that boreholes are "not intended for water extraction or disposal" and are specifically constructed for "ground heat exchanger" installations, which are by definition closed-loop. These details distinguish boreholes from other types of ground penetrations that may be associated with geothermal applications, including wells used for open-loop systems, water supply, or injection purposes.

Item #: 115	**Code Number:** 2024 USHGC	**Section Number:** 712.1, 712.4
SUBMITTER: Cary Smith	**Organization Name:** USHGC Geothermal Energy Systems Task Group, Chair	**Organization Representation:**

RECOMMENDATION:
Revise text

Proposed Text :

Part III – Open-Loop Systems.

712.0 General.
712.1 Applicability. Part III of this chapter shall apply to open-loop geothermal systems such as, but not limited to, systems coupled to a source of groundwater (well) or surface water. ~~The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems.~~Water wells shall be installed and tested in accordance with Section 713.0.
Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 703.5 and Chapter 4. Such materials shall be rated for the operating temperature and pressures of the system and shall be compatible with the type of heat transfer fluid.
Components installed in an open-loop geothermal ~~open-loop~~ system shall be constructed of corrosion resistant materials. Materials which come into contact with potable water shall comply with NSF/ANSI/CAN 61 and NSF/ANSI/CAN 372. [See Figure 712.1(1) for an example of a simplified schematic of an open-loop geothermal system utilizing subsurface water. See Figure 712.1(2) for an example of a simplified schematic of an open-loop geothermal system utilizing surface water.]

712.4 Setbacks. Open-loop ~~G~~geothermal ~~open-loop~~ systems shall maintain separation between supply and discharge locations in accordance with the registered design professional and the Authority Having Jurisdiction.

(shown for information purposes only)

713.0 Open Ground Water Systems.
713.1 General. The installation and use of water wells shall be in accordance with the Authority Having Jurisdiction. The water well records shall include well logs, pumping tests, and aquifer information.
713.2 Open-Loop Water Well Drilling Logs. The water well drilling logs shall include the following:
(1) The subsurface stratigraphy.
(2) The aquifer type and conditions such as, but not limited to, confined, unconfined, flowing and depth.
(3) The drilling method used and the penetration speed.
(4) The presence of substances known to have a potential risk to health and safety shall be documented in the drill logs and the property owner shall be advised of the potential risk to health and safety.
713.3 Design Considerations. A groundwater heat pump system shall be designed by a registered design professional or certified designer. Due design consideration shall be given to the following:
(1) Where multiple heat pumps or fan coils are connected to a common water loop, a diversified building design load shall be used to design a ground water heat pump.
(2) The water supply well(s) and injection wells, or water discharge system, shall be capable of being operated at sustainable pumping rates that exceed the maximum daily requirements without causing an adverse impact to existing or future offsite uses of groundwater or surface water bodies.

(3) The water temperature and the quality and chemical composition of the water resource are in accordance with the system manufacturer's recommendations.
(4) The groundwater and surface water resources shall be protected by returning water to the source aquifer or an aquifer with the same water quality, or a surface water body.
(5) The return capacity of the injection, or surface water body discharge system, shall be suitable under winter conditions.
(6) The temperature of the return water shall have no adverse thermal impacts on offsite existing or future uses of groundwater, or on surface water bodies, in accordance with the requirements of the Authority Having Jurisdiction.
(7) Pressure gauges shall be provided to aid in start-up and monitoring of the system during operation.
(8) The ability to switch over operation of supply and return wells for 100 percent standby, redevelopment, cleaning of wells, and the thermal balancing of the ground and aquifer shall be provided.
(9) There shall be no adverse effects on the quality and quantity of offsite existing or future users of groundwater, in accordance with the requirements of the Authority Having Jurisdiction.
713.4 Water Wells and Injection Wells. Water wells and injection wells for groundwater heat pump systems shall be installed and tested by a registered professional who is qualified to drill wells that comply with the requirements of the Authority Having Jurisdiction.
Water supply wells and injection wells shall be developed in accordance with NGWA-01.
713.5 Testing and Sampling. Pumping tests and water sampling shall be done as required by the registered design professional or certified designer.
713.6 Disinfection. Water wells shall be disinfected upon completion in accordance with requirements of the Authority Having Jurisdiction and NGWA-01.

SUBSTANTIATION:
Section 712.1 (Applicability) is being revised to reference the existing requirements for water wells in Section 713.0 (Open Ground Water Systems) and to include a critical specification that materials must be compatible with the heat transfer fluid and rated for the operating temperature and pressures of the system.

Committee Action:
Accept As Amended by the TC

Proposed Text :

Part III – Open-Loop Systems.

712.0 General.
712.1 Applicability. Part III of this chapter shall apply to open-loop geothermal systems such as, but not limited to, systems coupled to a source of groundwater (well) or surface water. Water wells shall be installed and tested in accordance with Section 713.0.
Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 703.5 and Chapter 4. Such materials shall be rated for the operating temperature and pressures of the system and shall be compatible with the type of heat transfer fluid.
Components installed in an open-loop geothermal system shall be constructed of corrosion resistant materials. Materials which come into contact with potable water shall comply with NSF/ANSI/CAN 61~~ and NSF/ANSI/CAN 372~~. [See Figure 712.1(1) for an example of a simplified schematic of an open-loop geothermal system utilizing subsurface water. See Figure 712.1(2) for an example of a simplified schematic of an open-loop geothermal system utilizing surface water.]

712.4 Setbacks. Open-loop geothermal systems shall maintain separation between supply and discharge locations in accordance with the registered design professional and the Authority Having Jurisdiction.

Committee Statement:
Item #115 is being amended to align with the actions taken on Item #076.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
115	2024 USHGC	209.0

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

209.0 – G –

Groundwater. ~~Water that exists beneath the earth's surface.~~Water naturally present in aquifers and saturated zones beneath the earth's surface.

~~**Groundwater Source.** A geothermal energy system that uses the groundwater as a heat source or sink.~~

Substantiation:
The definition is being updated to improve technical accuracy by specifying that groundwater is "water naturally present in aquifers and saturated zones beneath the earth's surface."

The current definition simply states, "water that exists beneath the earth's surface," which is broad and could be misinterpreted to include water in underground pipes, tanks, or other man-made systems. The addition of "aquifers and saturated zones" identifies the specific subsurface conditions where groundwater is found.

The definition of "groundwater source" is being deleted as it essentially describes what an open-loop GSHP system does, and maintaining both "groundwater source" and "open-loop GSHP system" as defined terms creates potential confusion.

Comment 2

Item #:
115

Code Number:
2024 USHGC

Sections(s):
712.1, 712.2, 712.4, Figure 712.1(1), Figure 712.1(2)

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

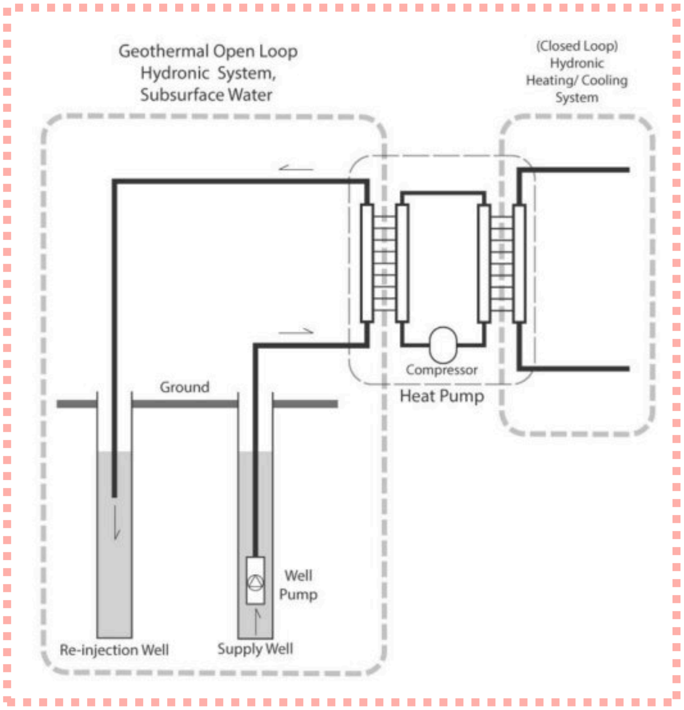
Part III – Open-Loop Systems.

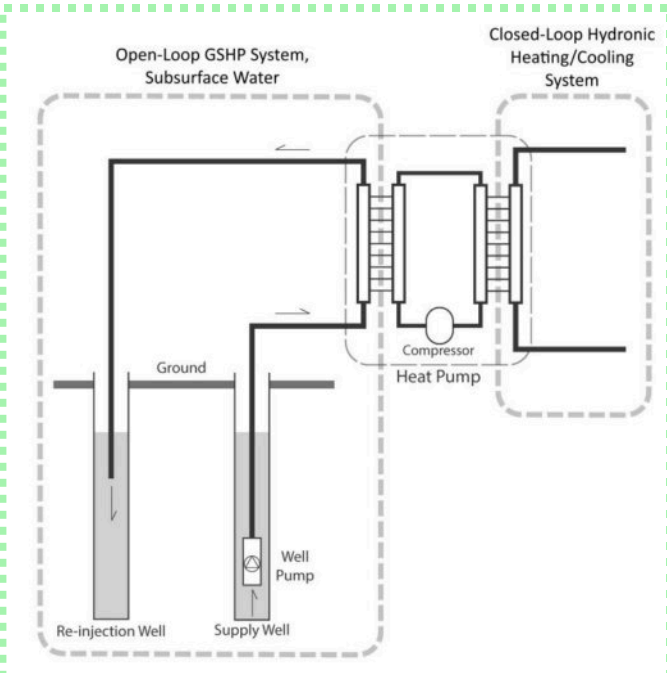
712.0 General.
712.1 Applicability. Part III of this chapter shall apply to open-loop ~~geothermal~~GSHP systems ~~such as, but not limited to, systems~~ coupled to a source of groundwater (well) or surface water. Water wells shall be installed and tested in accordance with Section 713.0. [See Figure 712.1(1) for an example of a simplified schematic of an open-loop GSHP system utilizing subsurface water. See Figure 712.1(2) for an example of a simplified schematic of an open-loop GSHP system utilizing surface water.]
~~Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 703.5 and Chapter 4. Such materials shall be rated for the operating temperature and pressures of the system and shall be compatible with the type of heat transfer fluid.~~

712.2 Materials. Components installed in an open-loop ~~geothermal~~GSHP system shall be constructed of corrosion resistant materials. Materials which come into contact with potable water shall comply with NSF/ANSI/CAN 61. ~~[See Figure 712.1(1) for an example of a simplified schematic of an open-loop geothermal system utilizing subsurface water. See Figure 712.1(2) for an example of a simplified schematic of an open-loop geothermal system utilizing surface water.]~~

(renumber remaining sections)

712.4 Setbacks. Open-loop ~~geothermal~~GSHP systems shall maintain separation between supply and discharge locations in accordance with the registered design professional and the Authority Having Jurisdiction.



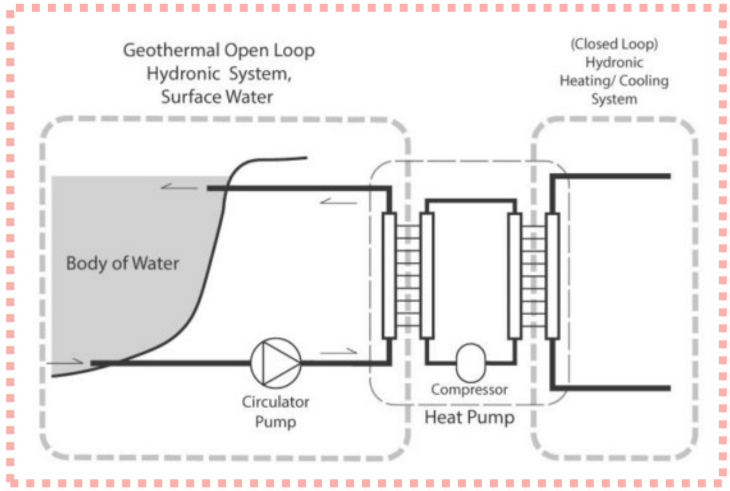


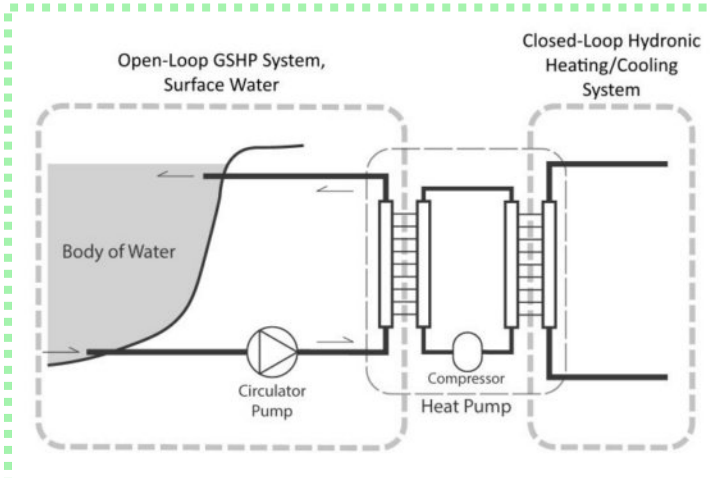
Notes:

[1] This schematic does not include all system components, and configurations may vary based on design.

[2] The heat pump refrigerant loop and the outgoing building hydronic loop are not considered part of the ~~open-loop geothermal~~GSHP system loop.

FIGURE 712.1(1)[1, 2]
EXAMPLE OF AN OPEN-LOOP GSHP SYSTEM
UTILIZING SUBSURFACE WATER
(SIMPLIFIED SCHEMATIC)





Notes:

[1] This schematic does not include all system components, and configurations may vary based on design.

[2] The heat pump refrigerant loop and the outgoing building hydronic loop are not considered part of the ~~open-loop geothermal~~GSHP system loop.

FIGURE 712.1(2)[1, 2]
EXAMPLE OF AN OPEN-LOOP GSHP SYSTEM
UTILIZING SURFACE WATER
(SIMPLIFIED SCHEMATIC)

Substantiation:
This public comment updates the current text as follows:

- Removes indoor piping requirements which are governed by Chapter 4 (Hydronics);
- Updates references to “GSHP system” to specifically align with the type of geothermal system being addressed; and
- Provides a separate section dedicated for material requirements.

Item #: 116	**Code Number:** 2024 USHGC	**Section Number:** 713.1, 713.3
SUBMITTER: Cary Smith	**Organization Name:** USHGC Geothermal Energy Systems Task Group, Chair	**Organization Representation:**

RECOMMENDATION:
Revise text

Proposed Text :

Part III – Open-Loop Systems.

713.0 Open Ground Water Systems.
713.1 General. The installation and use of water wells shall be in accordance with the Authority Having Jurisdiction. Water that is extracted from a well shall be returned to its source or designated location in accordance with the Authority Having Jurisdiction. The water well records shall include well logs, pumping tests, and aquifer information.

713.3 Design ~~Considerations~~Requirements. ~~A groundwater heat pump system shall be designed by a registered design professional or certified designer. Due design consideration shall be given to~~Open-loop systems shall be designed by a registered design professional or certified designer in accordance with the following:
(1) ~~Where multiple heat pumps or fan coils are connected to a common water loop, a diversified building design load shall be used to design a ground water heat pump~~Considerations shall be made for diversified building design loads where multiple heat pumps or fan coils are connected to a common water loop.
(2) The water supply well(s) and injection wells, or water discharge system, shall be capable of being operated at sustainable pumping rates that meet or exceed the maximum daily requirements without causing an adverse impact to existing or future offsite uses of groundwater or surface water bodies.
(3) The water temperature and the quality and chemical composition of the water resource ~~are~~shall be in accordance with the ~~system manufacturer's recommendations~~equipment manufacturer's installation requirements.
~~(4) The groundwater and surface water resources shall be protected by returning water to the source aquifer or an aquifer with the same water quality, or a surface water body.~~
(~~5~~4) ~~The return capacity of the injection, or surface water body discharge system, shall be suitable under winter conditions.~~The injection well(s) shall have adequate return capacity.
(~~9~~5) There shall be no adverse effects on the quality and quantity of ~~offsite~~ existing or future ~~users of~~proximal groundwater~~,~~ uses in accordance with the ~~requirements of the~~ Authority Having Jurisdiction.
(6) The temperature of the return water shall have no adverse thermal impacts on ~~offsite~~ existing or future ~~uses of~~proximal groundwater~~,~~ uses or ~~on~~ surface ~~water~~ bodies~~,~~ of water in accordance with the ~~requirements of the~~ Authority Having Jurisdiction.
~~(7) Pressure gauges shall be provided to aid in start-up and monitoring of the system during operation.~~
~~(8) The ability to switch over operation of supply and return wells for 100 percent standby, redevelopment, cleaning of wells, and the thermal balancing of the ground and aquifer shall be provided.~~

SUBSTANTIATION:
Section 713.1 (General) is being revised to address the re-injection of water into the same aquifer or groundwater reservoir. This provision is necessary for preventing the depletion of groundwater resources and for maintaining aquifer balance.

This requirement is being relocated from Item (4) of Section 713.3, and additional language is being proposed which specifies compliance with the Authority Having Jurisdiction, who will dictate where and how the water can be returned based on various factors such as water quality and thermal discharge limits.

The updates to **Section 713.3 (Design Requirements)** are for clarity, organization, and enforceability. The updates to each item are explained below:

Item (1): The existing language is overly restrictive as it requires a diversified building design load for all installations where multiple heat pumps or fan coils are connected to a common water loop. Instead, the registered design professional should make considerations for such installations and use a diversified building design load where appropriate.

Item (3): The manufacturer's installation requirements are included in the certified documentation that accompanies listed or labeled equipment. These requirements specify acceptable water chemistry limits, which must be followed to prevent issues such as corrosion, scaling, and premature equipment failure.

Item (4) [Previously Item (5)]: The existing language combines two distinct topics: protection of water resources and adequacy of return capacity under winter conditions. To mitigate this issue, the updated provision instead focuses on the hydraulic capacity of the injection wells to receive the return flow from the heat pump system.

Item (5) [Previously Item (9)]: The term "offsite" is vague and lacks a defined technical meaning. Industry standards more commonly use the term "proximal," which refers to locations within a measurable distance or impact area.

Item (6): See the justification for updates to Item (5).

Item (7): These are installation and operational requirements, not design requirements for ground heat exchangers.

Item (8): While this requirement is useful in larger systems, switchover capability should not be required for all applications. For example, this may not be feasible for small residential or light commercial systems.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
116	2024 USHGC	712.3, 713.0 – 713.4, 713.6

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part III – Open-Loop Systems.

713.0 Open-Loop GSHP ~~Ground Water~~ Systems.
713.1 General. The installation and use of open-loop GSHP systems, including water wells, shall be in accordance with the Authority Having Jurisdiction. Water that is extracted from a well shall be returned to its source or designated location in accordance with the Authority Having Jurisdiction. ~~The water well records shall include well logs, pumping tests, and aquifer information.~~

~~713.4~~713.2 ~~Water Wells and Injection Wells~~Qualifications. ~~Water wells and injection wells for groundwater heat pump~~Open-loop GSHP systems shall be installed and tested by a registered professional who is qualified to drill wells that comply with the requirements of the Authority Having Jurisdiction. Water supply wells and injection wells shall be developed in accordance with NGWA-01.

713.3 Design Requirements. Open-loop GSHP systems shall be designed by a registered design professional or certified designer in accordance with the following:
(1) – (6) (remaining text unchanged)

~~712.3~~713.4 Installation ~~of Water Wells~~. Water supply, recharge wells, and pumping equipment shall be hydraulically tested, sealed, and grouted in accordance with approved well construction practices and submitted to the Authority Having Jurisdiction for approval. ~~Wells shall be tested for water production and recovery, water quality before final system design. Wells shall be disinfected upon completion in accordance with NGWA-01 or in accordance with the Authority Having Jurisdiction. A copy of the water quality test results and the log of well construction in accordance with NGWA-01 shall be provided to the owner.~~

~~713.2~~713.5 ~~Open-Loop Water Well~~ Drilling Logs. The ~~water~~ well drilling logs shall include the following:
(1) The subsurface stratigraphy.
(2) The aquifer type and conditions such as, but not limited to, confined, unconfined, flowing and depth.
(3) The drilling method used and the penetration speed.
(4) The presence of substances known to have a potential risk to health and safety shall be documented in the drill logs and the property owner shall be advised of the potential risk to health and safety.
The well records shall include well logs, pumping tests, and aquifer information. A copy of the water quality test results and the log of well construction in accordance with NGWA-01 shall be provided to the owner.

713.6 Disinfection. Water wells shall be disinfected upon completion in accordance with ~~requirements of the Authority Having Jurisdiction and~~ NGWA-01 and the Authority Having Jurisdiction.

Note: NGWA-01 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
This public comment updates the current text as follows:

- Reorganizes provisions following a logical sequence that reflects the progression of an open-loop system project;
- Updates references to “open-loop GSHP system” to specifically align with ground-source heat pump applications that extract and return groundwater for heat exchange purposes;
- Consolidates drilling log and record-keeping requirements; and
- Provides a single disinfection requirement referencing both NGWA-01 and the Authority Having Jurisdiction.

Item #:
117

Code Number:
2024 USHGC

Section Number:
714.3, 714.4

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

Part III – Open-Loop Systems.

714.0 Testing and Verification.

714.3 Variable -Rate Pumping Test. The operating conditions of the water supply wells and injection wells shall be evaluated and verified with a variable -rate pumping test. The variable-rate pumping test shall be performed at rates and durations as specified by the registered design professional or certified designer. Test rates and durations shall be documented in writing.

714.4 Constant -Rate Pumping Test. The sustainable well yield, aquifer coefficients, and zones of influences on the groundwater flow requirements shall be confirmed with a constant -rate- pumping test. The constant -rate- pumping test shall be ~~done~~performed on the water supply and injection wells at rates and durations as specified by the registered design professional or certified designer. Test rates and durations shall be documented in writing.

SUBSTANTIATION:
Section 714.3 (Variable-Rate Pumping Test) is currently incomplete and requires additional language to address testing rates and durations, which are to be specified by the registered design professional or certified designer.

Similar provisions exist in Section 1714.4 (Constant-Rate Pumping Test) and are applicable to variable-rate tests as well. Language has also been added to both sections to ensure proper documentation of testing rates and durations.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
117

Code Number:
2024 USHGC

Sections(s):
713.5, 714.0 – 714.2, 714.6, 714.7

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part III – Open-Loop Systems.

714.0 Open-Loop GSHP System Testing~~ and Verification~~.
~~713.5~~**714.1** ~~Testing and Sampling~~**General**. Wells shall be tested for water production, recovery, and water quality before final system design. Pumping tests and water sampling shall be ~~done~~performed as required by the registered design professional or certified designer.
~~714.1~~**714.2** **Pumping Test.** Water supply wells and injection wells shall undergo a stop and start pumping test to demonstrate the sand-free yield.

~~714.2~~**714.6** **Retesting.** Where sediment is present, the problem shall be corrected, and the test shall be repeated until acceptable results are obtained.
~~714.6~~ **714.7** **Injection Well~~s~~ Testing.** Injection testing shall be performed on water wells that are designated to be used as injection wells at rates specified by the registered design professional or certified designer. The results of the drilling and pumping tests shall be provided to the owner or the owner's representative and provided in accordance with requirements of the Authority Having Jurisdiction.
~~714.7~~**714.8** **Re-Injected Water Quality.** The water quality of re-injected water into the earth shall comply with the requirements of the Authority Having Jurisdiction.

Substantiation:
This public comment updates the current text as follows:

- Updates section titles to more accurately describe the content of each provision;
- Consolidates testing and sampling requirements previously located in separate sections;
- Reorganizes testing provisions for open-loop GSHP systems to reflect actual order of testing procedures; and
- Establishes critical pre-design verification steps pertaining to water production, recovery, and water quality.

Item #:
118

Code Number:
2024 USHGC

Section Number:
206.0, 701.1, 716.0, 716.1

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

CHAPTER 7
GEOTHERMAL ENERGY SYSTEMS AND DISTRICT ~~GEOTHERMAL LOOPS~~ENERGY SYSTEMS

Part I – General.

701.0 General.

701.1 Applicability. The regulations of this chapter shall govern the construction, location, and installation of geothermal energy systems and district energy systems. Geothermal energy systems covered by this chapter shall be limited to ground source heat pump systems.

Part I of this chapter shall apply to geothermal energy systems such as, but not limited to, building systems coupled with a ground~~-~~ heat exchanger, submerged heat exchanger using water-based heat transfer fluid~~ as a heat transfer medium~~, or groundwater (well).~~ The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems.~~

Part I ~~through~~Part II, Part III, and Part V of this chapter shall apply to geothermal energy systems and district energy systems including, but not limited to, ambient temperature loop (ATL) systems that circulate ground-ambient-temperature water, conditioned water, or heat transfer fluid, to be used in end-use buildings as a ~~thermal~~heat source or heat sink via water source heat pump or reversing chiller. ~~The systems shall operate to permit independent and bi-directional heating and cooling for comfort and water heating such as, but not limited to, building systems with ground coupled district loops, including ambient temperature loops (ATL), a ground heat exchanger, submerged heat exchanger using water based fluid as a heat transfer medium, or groundwater (well), or such local energy resources to the advantage of the district. Central district auxiliary components shall add or reject heat to benefit district ability to reduce both power consumption and demand combined with energy sharing.~~

The regulations of this chapter shall ~~govern the construction, location, and installation of ground temperature thermal distribution districts~~apply to district energy systems ranging from 100 percent geothermal energy systems to multiple hybrid district systems, ~~including systems which utilize multiple hybrid district systems and components~~or a combination thereof.

Part V – ~~Ambient Temperature Loops (ATL) Geothermal~~District Energy Systems.

716.0 General.

716.1 Applicability. Part V of this chapter shall apply to district energy systems, including but not limited to, ambient temperature loop (ATL) systems. District energy systems shall also comply with the refrigerant requirements of the mechanical code, and Part I, Part II, and Part III of this chapter, as applicable.

District energy systems shall operate to permit independent and bi-directional heating and cooling for comfort conditioning and water heating. Such systems shall include, but are not limited to, building systems coupled to ground ambient temperature loops (ATL), a ground heat exchanger, submerged heat exchanger using a water-based heat transfer fluid, groundwater (well), or such local heat sources and sinks to the advantage of the district.

Central district auxiliary components shall add or reject heat to benefit district's ability to reduce both power consumption and demand combined with energy sharing.

206.0 - D -

District Energy System. A system characterized by one or more heat sources or sinks distributing ambient water and/or conditioned water, which then flows through a network of pipes to provide hot or chilled water, space heating, and/or air conditioning for multiple buildings. These systems include Ambient Temperature Loop (ATL) systems with distributed mechanical equipment, combination systems, and may include site-generated power or energy storage. Also known as district heating and cooling systems, district geothermal energy systems, community heat pump systems (CHP), thermal energy networks (TEN), distributed thermal energy networks (TEN), and utility thermal energy networks (UTEN).

~~**District Thermal Energy Loop.** A closed loop piping system with central pumping that includes various heat sources and heat sinks. The sources/sinks can be passive (e.g., a ground loop, a body of water, sewer effluent) or active (e.g. boiler, cooling tower, heat pumps, or chillers) and further can include opportunistic, or unique locally available waste or by product heat sources (e.g., data center, industrial process). The loop may run exterior to conditioned spaces in order to serve multiple structures and the heat exchange devices installed within.~~

SUBSTANTIATION:

The USHGC Geothermal Energy Systems Task Group has generated code change proposals to expand requirements for district energy systems in Chapter 7, which are currently limited to ambient temperature loops. For reference, this proposal is part of a series of Task Group submissions relating to this topic.

In Section 701.1 (Applicability), the terms "heat transfer medium" and "thermal resources" have been updated to "heat transfer fluid" and "heat sources and sinks."

> These systems rely on a circulating fluid to transfer thermal energy. The term "heat transfer medium" is broader and less specific, whereas "heat transfer fluid" accurately dictates the use of liquids. This clearly conveys the correct system design, where a circulating liquid is the primary means of transferring heat in geothermal applications.
>
> "Heat sources and sinks" are specific and well-defined terms that represent the direction and role of energy transfer within the system. Heat sources include systems or components that supply thermal energy (e.g., boilers, solar collectors, waste heat recovery systems), and heat sinks include systems or components that absorb or consume thermal energy (e.g., buildings, cooling systems, thermal storage). "Thermal resources" does not inherently imply this flow or the interactive relationship between supply and demand.

Since DX systems (covered under Part IV of Chapter 7) are not installed in district energy systems, Part IV has been excluded from the applicable provisions for district systems. Additionally, the language explicitly pertaining to district energy systems in Section 701.1 has been relocated to new Section 716.1 (Applicability).

Committee Action:

Accept As Submitted

TOTAL ELIGIBLE TO VOTE:

15

AFFIRMATIVE:	**NEGATIVE:**	**ABSTAIN:**	**NOT RETURNED:**
15	0	0	0

Comment 1

Item #:
118

Code Number:
2024 USHGC

Sections(s):
209.0, 701.1

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

Part I – General.

701.0 General.
701.1 Applicability. The regulations of this chapter shall govern the construction, location, and installation of geothermal energy systems and district energy systems. Geothermal energy systems covered by this chapter shall be limited to ground source heat pump (GSHP) systems.
~~Part I of this chapter shall apply to geothermal energy systems such as, but not limited to, building systems coupled with a ground heat exchanger, submerged heat exchanger using water-based heat transfer fluid or groundwater (well).~~
~~Part I, Part II, Part III, and Part V of this chapter shall apply to geothermal energy systems and district energy systems including, but not limited to, ambient temperature loop (ATL) systems that circulate ground-ambient-temperature water, conditioned water, or heat transfer fluid, to be used in end-use buildings as a heat source or heat sink via water source heat pump or reversing chiller. The regulations of this chapter shall apply to district energy systems ranging from 100 percent geothermal energy systems to multiple hybrid district systems, or a combination thereof.~~
Part I of this chapter contains general requirements for GSHP systems, including closed-loop source side systems using water-based heat transfer fluid in ground heat exchangers or submerged heat exchangers, open-loop source side systems using groundwater or surface water, and direct exchange (DX) systems.
Part V of this chapter shall apply to district energy systems, whether entirely GSHP systems or hybrid systems that integrate GSHP with other energy sources. District energy systems shall also comply with Part I through Part III of this chapter, as applicable.

209.0 - G -
Ground-Source Heat Pump (GSHP). A heat pump that exchanges thermal energy with the earth, subsurface water, wastewater, bodies of water, or a combination thereof.

Substantiation:
The updates to Section 701.1 (Applicability) provide clarity regarding the system types covered under Part I by explicitly identifying closed-loop source side systems, open-loop source side systems, and direct exchange (DX) systems. The current text uses less precise language without clearly categorizing these configurations.

Previously, DX systems were not mentioned in Section 701.1 despite Part IV being dedicated to these systems. Including them clarifies that DX systems are subject to the general requirements in Part I in addition to the specific requirements in Part IV.

The language pertaining to district energy systems and ambient temperature loops has been updated to remove unnecessary details already provided within existing definitions. Additionally, the current text references "100 percent geothermal energy systems to multiple hybrid district systems, or a combination thereof," which is redundant and unclear. This has been replaced with a more general statement encompassing all hybrid configurations that combine GSHP systems with other energy sources.

Comment 2

Item #:
118

Code Number:
2024 USHGC

Sections(s):
206.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

206.0 – D –
District Energy System. A centralized or distributed hydronic system characterized by one or more heat sources or sinks distributing ambient water and/or conditioned water, which then flows through a network of pipes to provide hot or chilled water, space heating, and/or air conditioning for multiple buildings. These systems include Ambient Temperature Loop (ATL) systems with distributed mechanical equipment, combination systems, and may include site-generated power or energy storage. Also known as district heating and cooling systems, district geothermal energy systems, community heat pump systems ~~(CHP)~~, thermal energy networks ~~(TEN)~~, distributed thermal energy networks ~~(TEN)~~, and utility thermal energy networks ~~(UTEN)~~.

Substantiation:
The definition of "district energy system" is being updated to provide additional information regarding how these systems are classified and how they relate to the scope and requirements of this code. Specifically, the inclusion of both "centralized" and "distributed" accounts for the different district energy system configurations, and the term "hydronic" accurately classifies these systems as water-based heating and cooling distribution systems. Although the current definition mentions both centralized and distributed configurations by referencing "Ambient Temperature Loop (ATL) systems with distributed mechanical equipment" and "combination systems," this is implied rather than explicitly stated. Furthermore, the abbreviations can be removed since the associated terms are not used elsewhere in the code and "CHP" is already used to represent "combined heat and power."

Item #: 119	**Code Number:** 2024 USHGC	**Section Number:** 716.2
SUBMITTER: Cary Smith	**Organization Name:** USHGC Geothermal Energy Systems Task Group, Chair	**Organization Representation:**

RECOMMENDATION:
Add new text

Proposed Text :

716.2 Prior to Construction. Prior to the construction and installation of a district energy system, documentation shall be submitted to the Authority Having Jurisdiction, and permits shall be obtained. Site surveys shall be in accordance with Section 701.3 and Section 707.4. Construction documents, engineering calculations, diagrams, and specifications shall be prepared by a registered design professional.

(shown for information purposes only)

701.3 Site Survey. A site survey shall be conducted prior to designing the geothermal system. The requirements for construction documents shall be defined by the Authority Having Jurisdiction. Where no guidance is provided, the construction documents shall include a plat plan indicating the following:
(1) The dimension and location of the ground or submerged heat exchanger.
(2) The distance from the structure to the ground or submerged heat exchanger.
(3) The configuration and depth of the ground or submerged heat exchanger.
(4) The distance to any utility and sanitary features that exist near the ground or submerged heat exchanger.

707.4 Site Survey Requirements. The site survey shall identify the physical limitations of the land area, including its extent, structures, existing wells of all types, proximity of other existing ground source heat pump systems, pavements, trees, grading, ponds, waterways, easements, overhead and underground services, septic systems, any identified septic repair areas, utility of rights of way, and any other elements that could affect an open-loop configuration.
Permission shall be obtained from any adjoining property owner(s), as evidenced by the registration and approval of a formal easement that meets requirements of the Authority Having Jurisdiction. It shall be received prior to the installation of any open-loop system that will extend into, cross, or interfere with the equipment or rights-of-way of utilities, jurisdictions, and other property owners. The site survey shall include a subsurface investigation that meets the requirements for an open-loop heat exchanger.

SUBSTANTIATION:
The USHGC Geothermal Energy Systems Task Group has generated code change proposals to expand requirements for district energy systems in Chapter 7, which are currently limited to ambient temperature loops. For reference, this proposal is part of a series of Task Group submissions relating to this topic.

New Section 716.2 (Prior to Construction) covers construction documents for district energy systems. Due to the complexity and scale of these systems, the provisions specify that such documents must be prepared by a registered design professional. Reference is also made to existing suitable requirements pertaining to site surveys in Section 701.3 (Site Survey) and Section 707.4 (Site Survey Requirements).

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
119

Code Number:
2024 USHGC

Sections(s):
701.1.1, 701.2, 707.1, 707.2, 716.2

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

Part I – General.

701.0 General.
701.1 Applicability. (remaining text unchanged)
~~**701.1.1 Prior to Construction.** Documents for permits shall be submitted prior to the construction of a building system, ground heat exchanger, submerged heat exchanger, or water well. Permits shall be issued by the Authority Having Jurisdiction.~~

~~**701.2 Construction Documents.** The construction documents for the building system portion of the geothermal energy system shall be submitted to the Authority Having Jurisdiction.~~

(renumber remaining sections)

707.0 Installation Practices.
~~**707.1 Prior to Construction.** Documents for permits shall be submitted prior to the construction of a ground heat exchanger, or water well. Permits shall be issued by the Authority Having Jurisdiction.~~
~~**707.2 Construction Documents.** The construction documents for the building system portion of the geothermal energy system shall be submitted to the Authority Having Jurisdiction.~~

(renumber remaining sections)

Part V – District Energy Systems.

716.0 General.

~~**716.2 Prior to Construction.** Prior to the construction and installation of a district energy system, documentation shall be submitted to the Authority Having Jurisdiction, and permits shall be obtained. Site surveys shall be in accordance with Section 701.3 and Section 707.3. Construction documents, engineering calculations, diagrams, and specifications shall be prepared by a registered design professional.~~

(renumber remaining sections)

Substantiation:
These sections are being deleted because they all address documentation to be submitted to the Authority Having Jurisdiction for obtaining permits. These requirements are already clearly defined in Section 104.0 (Permits), making the provisions in Chapter 7 redundant.

> ***[2025 USHGC ROP Preprint]***
> ***104.0 Permits.***
> ***104.1 Permits Required.*** *It shall be unlawful for a person, firm, or corporation to make an installation, alteration, repair, replacement, or remodel a system regulated by this code except as permitted in Section 104.2, or to cause the same to be done without first obtaining a separate permit for each separate building or structure.*
>
> ***104.3 Application for Permit. […]***
> ***104.3.1 Construction Documents.*** *Construction documents, engineering calculations, diagrams, and other data shall be submitted in two or more sets, or in a digital format where permitted by the Authority Having Jurisdiction, with each application for a permit. The construction documents, computations, and specifications shall be prepared by, and the system designed by, a registered design professional. Construction documents shall be drawn to scale with clarity to identify that the intended work to be performed is in accordance with the code.*
> ***Exception:*** *The Authority Having Jurisdiction shall be permitted to waive the submission of construction documents, calculations, or other data where the Authority Having Jurisdiction finds that the nature of the work applied for is such that reviewing of construction documents is not necessary to obtain compliance with the code.*

Item #:	Code Number:	Section Number:
120	2024 USHGC	206.0, 209.0, 221.0, 222.0, 717.0 – 717.2.3

SUBMITTER:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

RECOMMENDATION:
Revise text

Proposed Text :

717.0 ~~ATL Distributed Energy Systems~~ Design Requirements.
717.1 Basis-of-Design. The Basis-of-Design (BOD) for a district energy system shall include, but not be limited to, the following information:
(1) System assets including, but not limited to, the following:
(a) Building type and quantity.
(b) Heat sources and sinks in accordance with Section 717.2.
(c) Heat capacity of the ground heat exchanger for thermal storage, as applicable.
(d) Other available or planned system assets, as applicable.
(2) Distribution system piping arrangement.
(3) Annual load profiles for all heating and cooling loads to be served by the system, including driver loads, profiles, and diversity.

~~**717.2 District Load Profiles.** The district load profile of an ambient temperature loop (ATL) distributed energy system shall be identified and shall be included in the basis-of-design (BOD).~~
~~**717.2.1 System Asset Identification.** System assets shall be listed and included in the system design. The system assets shall include, but not be limited to, the following:~~
~~(1) Building type and quantity.~~
~~(2) Natural or constructed sources and sinks such as ground water, boreholes, etc.~~
~~(3) Other renewable assets.~~
~~(4) Waste heat recovery.~~
~~(5) Potable and non-potable water or fluid sources.~~
~~(6) Conventional assets such as boilers and cooling towers.~~
~~(7) Other geothermal micro-districts or thermal highways.~~
~~**717.2.2 Driver Building.** The driver building profile shall be identified in an ATL distributed energy system and shall be reported in the design documents.~~
~~**717.2.3 Diversity Factor.** The diversity factor and/or anticipated wasted energy recovery component of the geothermal micro-district shall be identified by the designer, and this information shall be included in the drawings and specifications.~~

206.0 - D -
Diversity. Variations in the aggregate heating and cooling demand profiles of system components over a specific duration.

Driver ~~Building~~Load(s). ~~One or more building(s) or facility(s) that determine the upper and lower temperature limits of a hot fluid or cold fluid delivery system.~~The dominant factor in a district energy system that determines the thermal energy system's design constraints and is used as the baseline conditions for other system components.

209.0 - G -

~~**Geothermal Micro-District.** A collection of buildings and facilities on an independently pumped ambient temperature loop (ATL) that supplies or receives energy. An independent segment served by a thermal highway. Also known as GeoMicroDistrict.~~

221.0 - S -

System Asset. The collection of physical components and infrastructure that comprise a district energy system, including equipment, structures, and supporting elements needed to distribute thermal energy from a central source to multiple buildings or facilities.

222.0 - T -

~~**Thermal Highway.** A collection of one or more geothermal micro-districts that acts as an energy transport system and supplies or accepts energy from multiple geothermal micro-districts, individual buildings, or other sources. Also known as convective circulation circuit.~~

SUBSTANTIATION:

The USHGC Geothermal Energy Systems Task Group has generated code change proposals to expand requirements for district energy systems in Chapter 7, which are currently limited to ambient temperature loops. For reference, this proposal is part of a series of Task Group submissions relating to this topic.

The requirements in Section 717.2 (District Load Profiles) through Section 717.2.3 (Diversity Factor) all pertain to information that is included in the Basis-of-Design. This proposal consolidates these requirements and accounts for other information such as the heat capacity of the ground heat exchanger for thermal storage, other available or planned system assets, the distribution system piping arrangement, and annual load profiles.

System Assets:

(a) The building type and quantity establishes the energy demand by understanding the buildings served (e.g., residential, commercial, industrial). This helps in sizing and designing the system to meet the actual demand without over- or under-provisioning.

(b) Proper identification and analysis of heat sources and sinks is then needed to optimize energy use. Please note that Section 717.2 is being revised in a separate proposal.

(c) The heat capacity of the ground heat exchanger is needed to determine the extent to which the system can store excess heat and release it when needed.

(d) Identification of other available or planned system assets is needed for leveraging existing infrastructure or future expansions to maximize system utility.

Distribution System Piping Arrangement: Properly documenting the piping arrangement ensures efficient distribution of thermal energy across the network and minimizes thermal losses.

Annual Load Profiles: Load profiles and diversity factors provide a detailed understanding of the seasonal and daily variations in energy demand so the system can be designed to handle peak and part load conditions efficiently.

To align with the updated requirements in this proposal, Chapter 2 (Definitions) is being updated as follows:

1. New definitions are being added for “diversity” and “system asset” to provide accurate descriptions of these industry terms.

2. The definitions for “geothermal micro-district” and “thermal highway” are being removed, as these terms are no longer referenced in the code.

3. The definition for “driver load” is being updated to clarify that the thermal loads are the actual energy demands (heating or cooling) that dictate the system's operational parameters.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
120	2024 USHGC	206.0

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

206.0 – D –

Diversity. A characteristic of a district energy system that accounts for ~~V~~variations in the aggregate heating and cooling demand profiles of system components over a specific duration and includes recovery of waste heat.

Substantiation:
The definition of "diversity" is being updated to align with how this term is used in the code by clarifying its application to district energy systems. Additionally, the inclusion of waste heat recovery reflects a key operational characteristic of district energy systems, where waste heat rejected by buildings in cooling mode can be recovered and redistributed to buildings in heating mode.

Item #:
121

Code Number:
2024 USHGC

Section Number:
204.0, 205.0, 210.0, 218.0, 222.0, 717.1, 717.2, Table 901.1, Table 901.2

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

~~**717.1 Thermal Resources.** The ambient temperature loop (ATL) shall be permitted to connect to a thermal resource(s). Such resources may be an alternative energy source and sink, such as but not limited to, solar photovoltaic (PV), solar thermal, combined heat power (CHP), and phase change thermal storage. These systems shall be installed and comply with the respective system requirements. ATL distributed energy systems coupled with solar thermal systems shall comply with this code or equivalent. ATL systems coupled with a solar photovoltaic (PV) or a photovoltaic thermal system (PVT) shall comply with this code or NFPA 70, or equivalent. These systems shall optimize the use of the equipment and energy based on the system design intent.~~

717.2 Heat Sources and Sinks. Heat sources and sinks connected to a district energy system shall optimize the use of the equipment and energy based on the system design intent.The district energy system shall be permitted to be connected to one or more of the following heat sources and sinks:
(1) Solar thermal systems in accordance with Chapter 5.
(2) Ground heat exchangers in accordance with Part I through Part III of this chapter, as applicable.
(3) Geothermal heat sources.
(4) Hydronics systems in accordance with Chapter 4.
(5) Cooling towers.
(6) Boilers in accordance with ASME BPVC Section I, ASME BPVC Section IV, or NFPA 85.
(7) Combined heat and power (CHP) systems.
(8) Sewage and wastewater heat recovery systems.
(9) Pump-and-treat groundwater remediation processes.
(10) Thermal energy storage in accordance with Section 717.4.
(11) Independently pumped ATLs.
(12) Advanced thermal energy system configurations.
(13) Borehole advection heat exchangers in accordance with Section 717.2.1.
(14) Other heat sources and sinks, where approved by the Authority Having Jurisdiction.

717.2.1 Borehole Advection Heat Exchangers. Where a closed-loop borehole heat exchanger or closed-loop borehole advection heat exchanger is utilized as a thermal resource in a district energy system, the closed-loop portion of the system shall be in accordance with Part II of this chapter, and the open-loop portion of the system shall be in accordance with Part III of this chapter, as applicable.

204.0 - B -

Borehole Advection Heat Exchanger. A manufactured heat exchanger which is inserted into a borehole and operates as a closed-loop on the building side and an open-loop on the ground side. Such heat exchangers rely on groundwater movement and may use or rely on mechanically enhanced heat transfer capability of water to provide a consistent thermal source or sink.

205.0 - C -

Combined Heat and Power (CHP). A generation process that is designed to produce electricity and recover the heat that is normally wasted in electric power generation for use in satisfying a heating need.

210.0 - H -

Heat Sources and Sinks. Equipment, subsystems, or components integrated into the district energy system that transfer thermal energy to and from the circulating heat transfer fluid within the loop, or store thermal energy for future use. Also known as thermal resources. There are two categories:

(1) Ground-source, air-source, and fuel-fired resources (e.g. ground heat exchangers, cooling towers for heat rejection and absorption, boilers, etc.)

(2) Systems that leverage existing local infrastructure including, but not limited to, water resources (e.g., oceans, rivers, raw sewage pipes, treated sewage outfall, potable water pipes, buildings, etc.), and process byproduct heat resources (e.g., data center cooling process reject heat, industrial process reject heat, etc.).

218.0 - P -

Pump-and-Treat Groundwater Remediation. A process used in remediation of contaminated ground water where water is pumped from one well, a treatment process is applied to the ground water to remediate the contamination, and then the ground water is returned to another well.

222.0 - T -

~~**Thermal Resources.** A source for heating and a sink for cooling. There are two types of sources:~~

~~(1) Conventional type: such systems are known as geothermal energy systems, including air-source resources and ground-source resources.~~

~~(2) Opportunistic type: such systems use water-source resources (e.g., oceans, rivers, raw sewage pipes, treated sewage outfall, potable water pipes, etc.), process byproduct heat resources (e.g., data center cooling process reject heat, industrial process reject heat, etc.), and other resources.~~

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASME BPVC Section I-2023	Rules for Construction of Power Boilers	Boilers	717.2(6)
ASME BPVC Section IV-2023	Rules for Construction of Heating Boilers	Boilers	717.2(6)
NFPA 85-2023	Boiler and Combustion Systems Hazards Code	Boilers	717.2(6)

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
~~ASME BPVC Section IV-2021~~	~~Rules for Construction of Heating Boilers~~	~~Miscellaneous~~

(portions of table not shown remain unchanged)

Note: ASME BPVC Section I, ASME BPVC Section IV, and NFPA 85 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The USHGC Geothermal Energy Systems Task Group has generated code change proposals to expand requirements for district energy systems in Chapter 7, which are currently limited to ambient temperature loops. For reference, this proposal is part of a series of Task Group submissions relating to this topic.

"Heat sources" and "heat sinks" are specific and well-defined terms that represent the direction and role of energy transfer within these systems. Heat sources include systems or components that supply thermal energy (e.g., boilers, solar collectors, waste heat recovery systems), and heat sinks include systems or components that absorb or consume thermal energy (e.g., buildings, cooling systems, thermal storage). "Thermal resources" does not inherently imply this flow or the interactive relationship between supply and demand.

Section 717.2 (Heat Sources and Sinks) includes various equipment and systems that supply, reject, or absorb heat when connected to a district energy system. Where appropriate and applicable, references have been made for compliance with existing industry standards and code requirements. To prevent overly restrictive requirements and avoid unintended limitations, line item (14) permits the use of other heat sources and sinks where approved by the Authority Having Jurisdiction.

Section 717.2.1 (Borehole Advection Heat Exchangers) then introduces new requirements for a group of heat exchangers which are closed-loop on the building side and open-loop on the ground side. Therefore, compliance with Part II (Closed-Loop Systems) and Part III (Open-Loop Systems) of this chapter is required.

> A new definition for "borehole advection heat exchanger" is being added to support these new requirements. As indicated within the provided definition, such heat exchangers rely on groundwater movement and may use or rely on mechanically enhanced heat transfer capability of water to provide a consistent thermal source or sink, thereby improving efficiency and performance of geothermal systems.

A definition for "pump-and-treat groundwater remediation" is also be added as such processes are increasingly recognized in the industry as valuable components within district energy systems. These processes involve extracting groundwater from a well, treating it to remove contaminants, and then discharging it back into another well or water body. The extracted groundwater typically exhibits a temperature profile that can be harnessed as a heat source or heat sink.

A read-only version of the referenced NFPA standard is provided for your review via the following link: NFPA 85

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
121

Code Number:
2024 USHGC

Sections(s):
225.0, 717.2, 717.2.1

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

717.0 Design Requirements.

717.2 Heat Sources and Sinks. Heat sources and sinks connected to a district energy system shall optimize the use of the equipment and energy based on the system design intent. The district energy system shall be permitted to be connected to one or more of the following heat sources and sinks:
(1) – (12) (remaining text unchanged)
(13) ~~Borehole~~Well advection heat exchangers in accordance with Section 717.2.1.
(14) (remaining text unchanged)
717.2.1 ~~Borehole~~Well Advection Heat Exchangers. Where a closed-loop borehole heat exchanger or closed-loop ~~borehole~~well advection heat exchanger is utilized as a thermal resource in a district energy system, the closed-loop portion of the system shall be in accordance with Part II of this chapter, and the open-loop portion of the system shall be in accordance with Part III of this chapter, as applicable.

225.0 - W -
~~Borehole~~Well Advection Heat Exchanger. ~~A manufactured heat exchanger which is inserted into a borehole and operates as a closed-loop on the building side and an open-loop on the ground side. Such heat exchangers rely on groundwater movement and may use or rely on mechanically enhanced heat transfer capability of water to provide a consistent thermal source or sink.~~A ground heat exchanger that uses groundwater flow (advection) within an aquifer to transfer heat. The system operates as an open-loop within the aquifer and as a closed-loop on the building side.

Substantiation:
As previously mentioned via a separate public comment by the USHGC Geothermal Energy Systems Task Group revising the definition of "borehole," the term applies specifically to penetrations constructed for closed-loop ground heat exchanger installations that are not intended for water extraction or disposal.

Since advection heat exchangers interact directly with groundwater within an aquifer, the term "well" is more appropriate. This change provides consistency across related definitions and prevents confusion about whether advection heat exchangers fall under borehole or well requirements within the code. Accordingly, all references to "borehole advection heat exchanger" have been updated to "well advection heat exchanger."

Furthermore, the updated definition clearly identifies advection as the heat transfer mechanism by stating the system "uses groundwater flow (advection) within an aquifer to transfer heat," and removes text that is ambiguous and does not clearly identify a specific characteristic.

Comment 2

Item #:	**Code Number:**	**Sections(s):**
121	2024 USHGC	205.0

Submitter Name:	**Organization Name:**	**Organization Representation:**
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

205.0 – C –
Combined Heat and Power (CHP). ~~A generation process that is designed to produce electricity and recover the heat that is normally wasted in electric power generation for use in satisfying a heating need.~~ A system that simultaneously produces electricity and captures thermal energy from a single fuel source for heating, cooling, or process applications. Also known as cogeneration.

Substantiation:
The definition of "combined heat and power" is being updated for technical accuracy and to align with industry terminology. Specifically, CHP is more appropriately described as a system since it is an integrated assembly of components rather than simply a process.

The phrase "simultaneously produces electricity and captures thermal energy from a single fuel source" more precisely describes CHP operation and its defining efficiency characteristic.

The phrase "heating, cooling, or process applications" reflects the full range of CHP applications, where captured thermal energy can drive absorption chillers for cooling or serve industrial process loads in addition to space heating.

Item #:
122

Code Number:
2024 USHGC

Section Number:
205.0, 717.1.1

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

~~717.1.1~~717.2.2 **System Performance.** ~~The System Coefficient of Performance (SCOP) shall account for the net COP of each individual component(s) in the district. The SCOP shall be provided by the designer and included in the system design documents.~~ The Coefficient of Performance of the district energy system (*COP_{DES}*) shall account for the net Coefficient of Performance of individual component(s) in the district. The *COP_{DES}* shall be determined by the registered design professional and shall be included in the Basis-of-Design.

205.0 - C -

Coefficient of Performance, District Energy System (*COP_{DES}*). A ratio of the total system energy transferred (from heat sources and sinks) to the total system energy input (work or purchased energy for operation of equipment in the system).

SUBSTANTIATION:
The abbreviation “SCOP” typically represents the Seasonal Coefficient of Performance. To prevent confusion and align with current industry terminology, Section 717.2.2 (System Performance) is being revised to clearly reference the Coefficient of Performance of the district energy system. In support of this change, a new definition is also being proposed.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
122

Code Number:
2024 USHGC

Sections(s):
205.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

205.0 – C –
Coefficient of Performance, District Energy System (*COP_{DES}*). ~~A ratio of the total system energy transferred (from heat sources and sinks) to the total system energy input (work or purchased energy for operation of equipment in the system).~~ The ratio of useful thermal energy delivered to or removed from connected heat sources and sinks to the total energy input required to operate the district energy system, including central plant equipment, distribution pumps, and controls.

Substantiation:
The definition of "Coefficient of Performance, District Energy System" is being revised to clarify what is measured and what is included in the calculation. The current language refers to "total system energy transferred," which is vague and does not clearly indicate whether this represents useful output or total energy movement within the system.

Instead, the phrase "useful thermal energy delivered to or removed from connected heat sources and sinks" more precisely describes the numerator of the COP calculation. The term "useful" establishes that only thermal energy serving a productive purpose counts toward system performance, and the phrase "delivered to or removed from" accounts for both heating and cooling modes.

The updated definition also specifies the key components that constitute total energy input by listing "central plant equipment, distribution pumps, and controls," providing clearer guidance on what must be accounted for when determining system COP.

Comment 2

Item #:
122

Code Number:
2024 USHGC

Sections(s):
221.0

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

221.0 – S –

~~**System Coefficient of Performance (SCOP).** A ratio of the total system energy moved to the total system purchased energy.~~

Substantiation:
Resulting from the accepted revisions to Section 717.2.2 (System Performance) in Item #122, the term "system coefficient of performance" is no longer used in the code and the provided definition should be deleted.

> ***[2025 USHGC ROP Preprint]***
> *717.2.2 **System Performance.** The Coefficient of Performance of the district energy system (COP_{DES}) shall account for the net Coefficient of Performance of individual component(s) in the district. The COP_{DES} shall be determined by the registered design professional and shall be included in the Basis-of-Design.*

Item #:
123

Code Number:
2024 USHGC

Section Number:
717.1.2, 717.2.4

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

~~717.1.2~~**717.2.3** ~~Emergency Response~~**Auxiliary Heating and Cooling Equipment**. An auxiliary heating or cooling methodology shall be provided with the ~~ATL~~district energy system controls and shall be ~~adequate to provide temporary service in the absence of an ATL energy transfer~~capable of providing supplemental thermal energy transfer from the district energy system to meet demand loads. ~~Emergency source/sink measures such as, but not limited to, control subroutines that move energy between spaces in the building, the use of locally connected ground-source assets, combined heat and power (CHP), conventional equipment, and other renewable systems shall be permitted to be used.~~The following measures shall be permitted to be used as a means of auxiliary heating or cooling:
(1) Control of subroutines that move energy between spaces in the building.
(2) Use of locally connected ground-source assets.
(3) Combined heat and power (CHP).
(4) Conventional equipment, including but not limited to, combustion equipment, electric resistance equipment, and cooling towers.
(5) Renewable systems in accordance with Section 717.2, as applicable.
(6) Thermal storage in accordance with Section 717.4.
717.2.4 Emergency and Temporary Heating and Cooling. In the event of catastrophic disruption to the district energy system, external chillers and boilers shall be permitted to be utilized as a means of emergency backup for temporary heating and cooling. Stub outs shall be provided in accordance with Section 718.4.

SUBSTANTIATION:
The USHGC Geothermal Energy Systems Task Group has generated code change proposals to expand requirements for district energy systems in Chapter 7, which are currently limited to ambient temperature loops. For reference, this proposal is part of a series of Task Group submissions relating to this topic.

Section 717.2.3 (Auxiliary Heating and Cooling Equipment) is being revised to include a list of auxiliary heating and cooling methods which may be utilized to meet demand. These auxiliary methods differ from the emergency responses addressed in Section 717.2.4 (Emergency and Temporary Heating and Cooling) which are intended to substitute and meet the thermal energy demand in the event of catastrophic disruption to the district energy system. Such provisions address temporary connections to external chillers and boilers and require stub outs for such connections.

Please note that Section 717.2 and Section 717.4 are being revised, and Section 718.4 is being added through separate code change proposals; therefore, they are not shown for reference here.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	**NEGATIVE:**	**ABSTAIN:**	**NOT RETURNED:**
15	0	0	0

Comment 1

Item #:	**Code Number:**	**Sections(s):**
123	2024 USHGC	501.8, 501.8.1

Submitter Name:	**Organization Name:**	**Organization Representation:**
Edmond Murray	USHGC Solar Thermal Systems Task Group, Vice-Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

501.0 General.

501.8 Auxiliary Heating. ~~An auxiliary heating system shall be installed in conjunction with the solar thermal system and shall be adequate to provide service in the absence of solar thermal energy input. Auxiliary heating that utilizes electricity as the energy source shall be in accordance with Section 315.0. Auxiliary heating that utilizes solid fuel or fuel gas as the energy source shall be in accordance with the mechanical code.~~ Where an auxiliary heating system is installed in conjunction with a solar thermal system, the auxiliary heating system shall be sized to meet the full design heating load without solar contribution. Electric auxiliary heating systems shall comply with Section 315.0. Solid-fuel-fired and gas-fired auxiliary heating systems shall comply with the mechanical code. Water heaters utilized for auxiliary heating shall comply with the standards referenced in Table 403.2, and shall be installed in accordance with the manufacturer's installation instructions.
501.8.1 Use of Chemical Additives and Corrosive Fluids. Where auxiliary heating systems contain chemical additives, corrosive fluids, or both, not intended or designed for use in the primary system, a heat exchanger shall be used in accordance with Section 313.0. Chemical additives shall be compatible with the auxiliary heating system components and approved by the heat exchanger manufacturer for the intended application.

(shown for information purposes only)

313.0 Heat Exchangers.
313.1 General. Systems utilizing heat exchangers shall protect the potable water system from being contaminated by the heat transfer fluid. Systems that incorporate a single-wall heat exchanger to separate potable water from the heat transfer fluid shall meet the following requirements:
(1) Heat transfer fluid is either potable water or contains fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.

(2) A tag or label shall be securely affixed to the heat source with the word “CAUTION” and the following statements:
(a) The heat transfer fluid shall be water or other nontoxic fluid recognized as safe by the FDA.
(b) The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.
(3) The word “CAUTION” and the statements listed above shall have an uppercase height of not less than 0.120 of an inch (3.05 mm). The vertical spacing between lines of type shall be not less than 0.046 of an inch (1.168 mm). Lowercase letters shall be not less than compatible with the uppercase letter size specification.
Systems that do not comply with the requirements for a single-wall heat exchanger shall install a double-wall heat exchanger. Double-wall heat exchangers shall separate the potable water from the heat transfer fluid by providing a space between the two walls that are vented to the atmosphere.
313.2 Shutoff Valves. Shutoff valves shall be installed on the supply and return side of a heat exchanger.
Exception: Where a heat exchanger is an integral part of a boiler or is a part of a manufactured boiler and heat exchanger packaged unit, and is capable of being isolated from the hydronic system by supply and return valves.

315.0 Electrical.
315.1 Wiring. Electrical connections, wiring and devices shall be installed in accordance with NFPA 70. Electrical equipment, appliances, and devices installed in areas that contain flammable vapors or dusts shall be of a type approved for such environment.
315.2 Controls. Required electrical, mechanical, safety, and operating controls shall be listed and labeled by a listing agency. Electrical controls shall be of such design and construction as to be suitable for installation in the environment in which they are located.

TABLE 403.2
WATER HEATERS

TYPE	STANDARDS
Gas-Fired, 75,000 Btu/h or less, Storage	CSA/ANSI Z21.10.1/CSA 4.1
Gas-Fired, Above 75,000 Btu/h Storage, Circulating and Instantaneous	CSA/ANSI Z21.10.3/CSA 4.3
Electric, Space Heating	UL 834
Solid Fuel-Fired	UL 2523
Heat Pump	UL 1995 or UL 60335-2-40

For SI units: 1000 British thermal units per hour = 0.293 kW

Substantiation:
Section 501.8 (Auxiliary Heating) is being revised to improve code language and avoid overly restrictive requirements relating to supplemental heating for solar thermal systems. Solar thermal systems vary in application and design and may not require means for auxiliary heating. This includes, but is not limited to, properly sized systems in warm climates with consistent solar availability, and pool heating systems operating seasonally when solar energy is abundant.

The phrase "sized to meet the design heating load without solar contribution" is clearer and more enforceable than "adequate to provide service in the absence of solar thermal energy input." The updated terminology to “electric,” “solid-fuel-fired,” and “gas-fired” is for consistency with verbiage in the mechanical code and is more concise than the phrases “utilizes electricity as the energy source” and “utilizes solid fuel or fuel gas as the energy source.” Reference is then being made to Table 403.2 (Water Heaters) for appropriate product listings for water heaters based on energy/fuel source.

New Section 501.8.1 (Use of Chemical Additives and Corrosive Fluids) is based on the requirements found in Chapter 4 (Hydronics) and is needed to ensure system separation where auxiliary systems use fluids incompatible with the primary solar thermal system.

[2025 USHGC ROP Preprint]
417.1 Use of Chemical Additives and Corrosive Fluids. *Where auxiliary systems contain chemical additives, corrosive fluids, or both, not intended or designed for use in the primary system, a heat exchanger shall be used in accordance with Section 313.0. The chemical additives in the auxiliary systems shall be compatible with auxiliary system components and accepted for use by the heat exchanger manufacturer.*

Item #:
125

Code Number:
2024 USHGC

Section Number:
716.0 – 716.3.2, Figure 716.1, Table 901.1

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

~~716.0~~**717.3 Ambient Temperature Loop (ATL)** ~~**Distributed Energy**~~ **Systems.** Extended range water-source heat pumps installed within an ATL system shall be listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, or other applicable equivalent standards. Ambient temperature loop systems installed in district energy systems shall comply with IAPMO Z1381 and Section 717.3.1 through Section 717.3.3. (See Figure 717.3 for an example schematic of an ATL in a district energy system.)

FIGURE ~~716.1~~717.3
~~GEOTHERMAL SYSTEM SCHEMATIC: EXAMPLE OF AN AMBIENT TEMPERATURE LOOP (ATL)~~
DISTRICT ENERGY SYSTEM: EXAMPLE ATL SCHEMATIC*

~~Note:~~* Equipment arrangements and configurations may vary.

(portions of figure not shown remain unchanged)

~~**716.1 General.** An ambient temperature loop (ATL) distributed energy system shall be installed in accordance with Section 716.2 through Section 716.6.3, and Section 717.0. ATL systems shall comply with Part I through Part IV of this chapter, as applicable. (See Figure 716.1 for a schematic of a geothermal system utilizing an ambient temperature loop.)~~

~~**716.2 Permitting.** Permits required for the installation and application of an ATL distributed energy system shall be obtained as required by the Authority Having Jurisdiction.~~

717.3.1 Heat Transfer Fluid. The ATL system shall use treated water as the heat transfer fluid.
~~**716.3**~~**717.3.2** ~~**Ambient Loop**~~**ATL Operating Temperature Range.** The operating loop temperature range of an ambient temperature loop (ATL) system shall be ~~not less than the freezing point of the circulating fluid and not more than the maximum temperature, as required by the manufacturer's installation instructions for the attached heat pump equipment in accordance with Section 716.3.1 and Section 716.3.2~~determined by the registered design professional and shall be in accordance with the equipment manufacturer's specifications. ~~The ATL system shall use treated water as the heat transfer medium.~~Equipment shall be identified in the design documentation and shall be approved for the design operating temperature range of the ATL system.

~~**716.3.1 ATL Operating Temperature.** For equipment listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, the controlled temperature range of the ambient closed loop shall be not less than 7°F (4°C) above the freezing point of the transport fluid and 10°F (6°C) below the (collective) heat pump lowest maximum inlet supply temperature as recommended by the manufacturer's instructions.~~

~~**Exception:** Equipment that is not listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, the controlled temperature range of the ambient closed loop shall be in accordance with Section 716.3.2 for minimum and maximum temperatures.~~

~~**716.3.2 ATL Operating Temperature Range for Mixed Equipment Certifications.** The source inlet temperature range of any attached equipment shall govern the design operating temperature range. Such equipment shall be identified in the design documentation. In any case, the most restrictive minimum and maximum inlet supply temperatures, as recommended by the manufacturer's instructions, shall determine the system operating temperature range.~~

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
IAPMO Z1381-XXXX (Working Draft)	Ambient Temperature Loops for District Energy Systems	Ambient Temperature Loops	717.3

(portions of table not shown remain unchanged)

Note: IAPMO Z1381.XX is a working draft and is not completed at the time of this monograph.

Note: AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
This proposal incorporates reference to IAPMO Z1381 into Section 717.3 [Ambient Temperature Loop (ATL) Systems]. For clarity, the only difference between the Task Group's proposals on these same sections is the reference to this additional standard.

IAPMO Z1381 applies to the design, construction, and installation of ambient temperature loops (ATLs) installed in district energy systems that circulate air/ground-ambient-temperature water, conditioned water, or heat transfer fluid, to be used as a heat source or sink.

Committee Action:
Reject

Committee Statement:
IAPMO Z1381 is a draft standard and was not published at the time of the monograph.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
125

Code Number:
2024 USHGC

Sections(s):
717.3, Table 901.1

Submitter Name:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to **replace** the code change proposal by this public comment.

Part V – District Energy Systems.

717.0 Design Requirements.

717.3 Ambient Temperature Loop (ATL) Energy Systems. Extended range water-source heat pumps installed within an ATL system shall be listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, or other applicable equivalent standards. Ambient temperature loop systems installed in district energy systems shall comply with IAPMO/ANSI/CAN Z1381 and Section 717.3.1 through Section 717.3.3. (See Figure 717.3 for an example schematic of an ATL in a district energy system.)

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
IAPMO/ANSI/CAN Z1381-2025	Ambient Temperature Loop Systems	District Energy Systems	717.3

(portions of table not shown remain unchanged)

Note: IAPMO/ANSI/CAN Z1381 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
IAPMO/ANSI/CAN Z1381 applies to the design, construction, and installation of ambient temperature loop (ATL) systems that circulate tempered water or water-based heat transfer fluid to integrate with heat sources and sinks and meet the heating and cooling demands of the buildings served by the system. This standard covers key aspects of ATL system implementation including piping materials and installation, water quality and treatment, system controls, safety devices, commissioning procedures, and documentation requirements.

It addresses the unique characteristics of ATL systems, such as bidirectional thermal exchange between buildings, operation at relatively low temperature differentials, and the integration of distributed heat pumps at individual buildings. The inclusion of this standard in the code ensures that ATL systems are designed and installed according to recognized industry practices and provides code officials with a compliance pathway for these systems.

Item #:
126

Code Number:
2024 USHGC

Section Number:
210.0, 716.1.1, 716.1.2

SUBMITTER:
Cary Smith

Organization Name:
USHGC Geothermal Energy Systems Task Group, Chair

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

~~**716.1.1 Fourth Generation (4G) System Configuration.** A fourth generation system configuration shall be a district geothermal energy system distributing hot water, cold water, or both to the conditioned space or building for a specific use. Where a geothermal energy source is used, such systems shall comply with Part I through Part IV of this chapter and Chapter 4.~~

~~716.1.2~~717.3.3 ~~Fifth Generation (5G)~~Grid Interactive ATL System Configurations. ~~An advanced ambient temperature loop (ATL) System or fifth generation (5G)~~Grid interactive ATL system configurations shall ~~also~~ be capable of interacting with the electric utility ~~system~~grid as well as other utility systems and systems components. System components shall include, but not be limited to, the following:
(1) ~~Thermally diverse buildings with independent hydronic systems.~~Heat sources and sinks in accordance with Section 717.2.
(2) Circulation loop.
(3) Global control system.
~~(4) Segment isolation capability.~~
~~**Note:** System components may include, but are not limited to, the following:~~
(~~1~~4) Electric grid-interactive enabled buildings
~~(2) Hybrid components~~
~~(3) Other renewable systems~~

210.0 - H -
Hydronic System. Relating to, or being a system of heating or cooling that involves the transfer of heat by circulating a fluid in a liquid state (such as water) or a gaseous state (such as steam).

> ~~**Hydronic System, Fifth Generation (5G) System Configurations.** An advanced ambient temperature (ATL) system that distributes near ambient temperature water among and between end use buildings that are equipped with water-source heat pumps or other water source HVAC equipment. Such systems stand in contrast to fourth generation (4G) systems that distribute hot water or chilled water to buildings to serve facility loads.~~
>
> ~~**Hydronic System, Fourth Generation (4G) System Configurations.** A district geothermal energy system that distributes dedicated hot water and chilled water for direct use in the conditioned space.~~
>
> **Hydronic System, Grid Interactive ATL System Configuration.** An ambient temperature (ATL) system that is capable of interacting with the electric utility grid or other supply systems and components for the purposes of load shifting and system optimization.

SUBSTANTIATION:
The USHGC Geothermal Energy Systems Task Group has generated code change proposals to expand requirements for district energy systems in Chapter 7, which are currently limited to ambient temperature loops. For reference, this proposal is part of a series of Task Group submissions relating to this topic.

Upon review of the existing sections addressing fourth and fifth generation system configurations, it was determined that the language offers descriptions of these systems rather than provisions. Instead, all newer generation systems are better suited under the umbrella term, “grid interactive ATL system configurations,” which are now addressed in Section 717.3.3.

This section was modified to specify that such configurations require interactive capabilities with electric utility systems or other supply systems. Additionally, the list of system components was updated to remove “segment isolation capability” as this is not an actual component, and a general reference to heat sources and sinks was added. This allowed for the removal of any other items which fall under the definition of heat source or sink. Please note that Section 717.2 is being revised through a separate code change proposal and is therefore not shown for reference here.

Aligning with these modifications, a definition for “grid interactive ATL system configuration” is being proposed to replace those existing for “fourth-“ and “fifth generation system configuration.”

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
126	2024 USHGC	203.0, 717.3, 717.3.3

Submitter Name:	Organization Name:	Organization Representation:
Cary Smith	USHGC Geothermal Energy Systems Task Group, Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

717.0 Design Requirements.

717.3 Ambient Temperature Loop (ATL) ~~Energy~~ Systems. (remaining text unchanged)

717.3.3 Grid Interactive ATL Systems ~~Configurations~~. Grid interactive ATL systems ~~configurations~~ shall be capable of interacting with the electric utility grid as well as other utility systems and systems components.
System components shall include, but not be limited to, the following:
(1) Heat sources and sinks in accordance with Section 717.2.
(2) Circulation loop.
(3) Global control system.
(4) Electric grid-interactive enabled buildings

203.0 - A -

~~Hydronic System,~~ **Ambient Temperature Loop (ATL) System.** A type of district energy system consisting of a closed loop piping system connected to buildings with distributed or central pumping that includes various heat sources and heat sinks to hold the loop fluid temperature near the long term average ambient air/ground temperature for a given geographical location. The closed loop piping system typically controls or engages with heat sources and sinks to maintain the loop temperature to meet the varying HVAC or other thermal loads of the connected buildings.

> ~~Hydronic System,~~ **Ambient Temperature Loop System, Grid Interactive** ~~ATL System Configuration~~. An ambient temperature (ATL) system that is capable of interacting with the electric utility grid or other supply systems and components for the purposes of load shifting and system optimization.

Substantiation:
While ambient temperature loop systems satisfy the technical characteristics of a hydronic system, specifically a closed-loop piping system circulating fluid to connected buildings, classifying them as such within the defined term itself is misleading with respect to code scope. Chapter 4 (Hydronics) does not govern ATL systems, nor do the terms "ATL hydronic system" or "grid-interactive ATL system configuration hydronic system" appear within any code requirements.

Additionally, the term "configuration" denotes a specific arrangement or setup within a broader system type. However, the definition describes a system capability, specifically the ability to interact with the electric utility grid for load shifting and optimization, and not a particular arrangement of components.

Item #: 127	**Code Number:** 2024 USHGC	**Section Number:** 222.0, 601.1, 607.0, 607.1, 717.4
SUBMITTER: Cary Smith	**Organization Name:** USHGC Geothermal Energy Systems Task Group, Chair	**Organization Representation:**

RECOMMENDATION:
Revise text

Proposed Text :

717.4 Thermal Storage. Where practical for installation, district energy systems shall be provided with means for daily and seasonal thermal storage and load shifting in accordance with Chapter 6.

601.0 General.
601.1 Applicability. This chapter shall govern the construction, design, location, and installation~~s a~~ of thermal storage. ~~Thermal storage includes storage tanks with or without heat exchangers and expansion tanks.~~

607.0 Other Methods.
607.1 General. Where installed, thermal storage for geothermal energy systems and district energy systems shall be in accordance with one or more of the following methods:
(1) Thermal storage methods in accordance with this chapter.
(2) Utilization of boreholes including, but not limited to, Borehole Thermal Energy Storage (BTES). Borehole(s) shall be constructed in accordance with Section 710.7 and shall maintain minimum setbacks in accordance with Section 707.7.
(3) Aquifer thermal energy storage (ATES).
(4) Pit thermal energy storage (PTES).
(5) Phase change materials (PCM). The active temperature range of the selected phase change material shall be in accordance with the manufacturer's specifications.
(6) Utilization of available stored fluids, where approved by the Authority Having Jurisdiction.
(7) Other methods of thermal energy storage, where approved by the Authority Having Jurisdiction.

222.0 - T -
Thermal Storage. ~~A tank or vessel used in a solar thermal, hydronic, or geothermal system, in which thermal energy is stored.~~The use of sensible or latent heat storage media to absorb and release heat energy from any source for the purposes of balancing and reducing energy consumption.

> **Aquifer Thermal Energy Storage (ATES).** A method of transient thermal storage in which groundwater is injected into and extracted from aquifers using wells.
>
> **Borehole Thermal Energy Storage (BTES).** A method of transient thermal storage in which ground materials are utilized as the storage medium by means of boreholes.
>
> **Pit Thermal Energy Storage (PTES).** A method of transient thermal storage in which shallow ground materials are utilized as the storage medium.

SUBSTANTIATION:
The USHGC Geothermal Energy Systems Task Group has generated code change proposals to expand requirements for district energy systems in Chapter 7, which are currently limited to ambient temperature loops. For reference, this proposal is part of a series of Task Group submissions relating to this topic.

This proposal outlines methods for thermal energy storage in geothermal and district energy systems. Based on applicability, it was determined that these provisions are best incorporated into Chapter 6 (Thermal Storage), which currently specifies requirements for storage tanks and dry storage systems.

The proposed list includes the methods already addressed in Chapter 6, as well as additional technologies such as boreholes, aquifers, pits, phase change materials, and available stored fluids. To ensure flexibility and avoid excluding emerging or alternative approaches, item (7) allows for the use of other methods when approved by the Authority Having Jurisdiction. Specific provisions have been added to address setback requirements for boreholes and the active temperature ranges for phase change materials.

For reference, the minimum setback requirements in Section 707.7 and the construction requirements for boreholes in Section 710.7 are being updated through separate proposals and are therefore not shown here.

In support of these changes, new terminology is being provided for “aquifer thermal energy storage,” “borehole thermal energy storage,” and “pit thermal energy storage.” Additionally, the existing definition of “thermal storage” is being expanded to encompass all methods included in this proposal.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
127	2024 USHGC	501.1

Submitter Name:	Organization Name:	Organization Representation:
Edmond Murray	USHGC Solar Thermal Systems Task Group, Vice-Chair	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

501.0 General.

501.1 Applicability. ~~The provisions of this chapter address the construction and installation of solar thermal systems, including components. The solar thermal system shall include the solar collector, thermal storage, system piping and appurtenances.~~<u>The regulations of this chapter shall govern the construction and installation of solar thermal systems and components, including solar collectors, system piping, and appurtenances. Thermal storage shall comply with Chapter 6.</u>

Substantiation:

The applicability of Chapter 5 (Solar Thermal Systems) is being revised to consolidate system components into a single list and add a reference to Chapter 6 for thermal storage requirements. The current text identifies thermal storage as a system component covered under Chapter 5; however, no associated provisions exist within the chapter. A reference to Chapter 6 is therefore added to direct code users to the appropriate location for such requirements.

Item #:
129

Code Number:
2024 USHGC

Section Number:
801.1, 801.2, Figure 801.2

SUBMITTER:
Andrew Todd

Organization Name:
Self

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

801.0 General.
~~801.2~~801.1 **Applicability.** ~~This chapter applies to solar PV systems, other than those covered by Part IX of this chapter, including the array circuit(s), inverter(s), and controller(s) for such systems (See Figure 801.2). The systems covered by this chapter include those interactive with other electric power production sources or stand-alone, or both. These PV systems may have ac or dc output for utilization. (NFPA 70:690.1)~~The regulations of this chapter shall govern the design, construction, location and installation of solar photovoltaic (PV) systems. Part I through Part VIII of this chapter provides general requirements for residential, commercial, and small-scale PV systems connected to electrical power systems, stand-alone systems, interactive systems, or a combination thereof. (See Figure 801.1 for an illustration of PV system circuits and components in a typical installation.)Part IX of this chapter shall apply to large-scale PV stations which generate and supply power to a system operated by a regulated utility.
~~801.1~~801.2 **Electrical Wiring and Equipment.** Electrical wiring and equipment shall comply with the requirements of NFPA 70, National Electrical Code (NEC), or local ordinances. This chapter does not provide all electrical information necessary for the installation of a photovoltaic (PV) system. ~~Resort shall be had to t~~The applicable edition of NFPA 70 shall be as adopted by the Authority Having Jurisdiction.

FIGURE ~~801.2~~801.1
ILLUSTRATION OF PV SYSTEM DC CIRCUITS AND PV SYSTEM
COMPONENTS IN A TYPICAL PV INSTALLATION
[NFPA 70:FIGURE 690.1]

(portion of figure not shown remains unchanged)

SUBSTANTIATION:
Following the standard layout of existing chapters, the applicability should be displayed first. Additionally, this section should clearly dictate the contents of the chapter. In this case, Chapter 8 (Solar Photovoltaic Systems) is split into nine parts, with the first eight pertaining to general requirements for residential, commercial, and small-scale PV systems. Part IX is then specific to large-scale PV stations which generate and supply power to a system operated by a regulated utility.

Furthermore, the existing language is confusing as it states that the "chapter applies to solar PV systems, other than those covered by Part IX of this chapter." This was an oversight resulting from incorporating extracted language from NFPA 70. The last sentence of Section 801.2 (Electrical Wiring and Equipment) is then being updated to improve code language.

A read-only version of the NFPA standard is provided for your review via the following link: NFPA 70

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:	Code Number:	Sections(s):
129	2024 USHGC	203.0, 204.0, 218.0, Chapter 8

Submitter Name:	Organization Name:	Organization Representation:
IAPMO Staff	NFPA 70 - Extract Updates	

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

Part I – General.

802.0 General Requirements.

~~**802.2 Equipment.** Electronic power converters, motor generators, PV modules, ac modules and ac module systems, dc combiners, PV rapid shutdown equipment (PVRSE), PV hazard control equipment (PVHCE), PV hazard control systems (PVHCS), dc circuit controllers, and charge controllers intended for use in PV systems shall be listed or be evaluated for the application and have a field label applied. [NFPA 70:690.4(B)]~~
~~802.2.1~~802.2 **Listing Requirements.** (remaining text unchanged)
802.3 Qualified Personnel. The installation of equipment, associated wiring, and interconnections shall be performed only by qualified persons. [NFPA 70:~~690.4(C)~~690.4(B)] For purposes of this chapter, a qualified person is defined as one who has skills and knowledge related to the construction, ~~and~~ operation, and installation of ~~the~~ electrical equipment ~~and installations~~ and has received safety training to recognize and avoid the hazards involved. [NFPA 70:100]

802.6 Electronic Power Converters Mounted in Not Readily Accessible Locations. Electronic power converters and their associated devices shall be permitted to be mounted ~~on roofs or other~~in areas that are not readily accessible. Disconnecting means shall be installed in accordance with Section 811.1. [NFPA 70:~~690.4(F)~~690.4(E)]

803.0 Alternating-Current (ac) Modules and Systems.
803.1 Photovoltaic Source Circuits. ~~The r~~Requirements ~~of this chapter~~ pertaining to PV source circuits shall not apply to ac modules or ac module systems. The PV source circuit~~,~~ conductors~~,~~ and inverters shall be considered as internal components of ~~an~~ ac modules or ac module systems. [NFPA 70:690.6(A)]

Part II – Circuit Requirements.

804.0 Circuit Requirements.

804.1 Maximum Voltage. The maximum dc voltage shall be used to determine the voltage and voltage to ground of circuits in the application of this chapter and NFPA 70. Maximum voltage shall be used for conductors, cables, equipment, working space, and other applications where voltage limits and ratings are used. The maximum voltage of PV system dc circuits shall be the highest voltage between any two conductors of a circuit or any conductor and ground and shall comply with the following:

(1) ~~PV system dc circuits shall n~~Not exceed 1000 volts within or originating from arrays located on or attached to buildings and PV system dc circuits inside buildings.

(2) ~~PV system dc circuits shall n~~Not exceed 600 volts on or in one- and two-family dwellings.

~~(3) PV system dc c~~Circuits exceeding 1000 volts shall comply with Section 812.7. [NFPA 70:690.7]

804.1.1 Photovoltaic Source Circuits. The maximum dc voltage for ~~a~~ PV source circuits shall be ~~calculated in accordance~~the sum of the series-connected PV module rated open-circuit voltages corrected for ambient temperature using with one of the following methods:

(1) ~~The sum of the PV module –rated open-circuit voltage of the series-connected modules in the PV string circuit c~~Corrected for the lowest expected ambient temperature using the open-circuit voltage temperature coefficients in accordance with the instructions included in the listing or labeling of the module.

(2) For crystalline and multicrystalline silicon modules, ~~the sum of the PV module–rated open-circuit voltage of the series-connected modules in the PV string circuit~~ corrected for the lowest expected ambient temperature using the correction factors provided in Table 804.1.1.

(3) ~~For PV systems with an inverter generating capacity of 100 kW or greater, a d~~Documented and stamped PV system design, using an industry standard method maximum voltage calculation provided by a licensed professional electrical engineer. [NFPA 70:690.7(A)]

804.1.2 DC-to-DC Converter Circuits. In PV dc-to-dc converter circuits, ~~the~~ maximum voltage shall be calculated in accordance with Section 804.1.2.1 or Section 804.1.2.2. [NFPA 70:690.7(B)]

804.1.2.1 Single DC-to-DC Converter. For circuits connected to the output of ~~a~~ single dc-to-dc converters, ~~the~~ maximum voltage shall be determined in accordance with the instructions included in the listing or labeling of the dc-to-dc converters. If the instructions do not provide a method to determine the maximum voltage, the maximum voltage shall be the maximum rated voltage output of the dc-to-dc converters. [NFPA 70:690.7(B)(1)]

804.1.2.2 Two or More Series -Connected DC-to-DC Converters. For circuits connected to the output of two or more series -connected dc-to-dc converters, ~~the~~ maximum voltage shall be determined in accordance with the instructions included in the listing or labeling of the dc-to-dc converters. If the instructions do not provide a method to determine the maximum voltage, the maximum voltage shall be the sum of the maximum rated voltage output of the dc-to-dc converters in series. [NFPA 70:690.7(B)(2)]

804.2 Bipolar PV Source Circuits. For monopole subarrays in bipolar systems, ~~the~~ maximum voltage shall be the highest voltage between the monopole circuit conductors where one conductor of the monopole circuit is connected to the functionally grounded reference. To prevent overvoltage in the event of a ground fault or arc fault, ~~the~~ monopole circuits shall be isolated from ground. [NFPA 70:690.7(C)]

805.0 Circuit Sizing and Current.

805.1 Calculation of Maximum Circuit Current. (remaining text unchanged)

805.1.1 Photovoltaic System Circuits. The maximum current for the specific circuit shall be calculated in accordance with Section 805.1.1.1 through Section 805.1.1.3. [NFPA 70:690.8(A)(1)]

805.1.1.1 Photovoltaic Source Circuit Currents. ~~The m~~Maximum current shall be ~~as~~ calculated ~~in either~~using one of the following methods:

(1) The ~~maximum current shall be the~~ sum of the highest short-circuit current ratings of the PV modules connected in parallel multiplied by 125 percent.

(2) The sum of the short-circuit current ratings of the PV modules connected in parallel calculated in accordance with the instructions included in the listing or labeling of the module.

(~~2~~3) ~~For PV systems with an inverter generating capacity of 100 kW or greater, a d~~Documented and stamped PV system design, using an industry standard method maximum current calculation provided by a licensed professional electrical engineer, ~~shall be permitted.~~as follows:

(a) The calculated maximum current value shall be based on the highest 3-hour current average resulting from the simulated local irradiance on the PV array accounting for elevation and orientation.

(b) The current value used by this method shall not be less than 70 percent of the value calculated using Section 805.1.1.1(1). [NFPA 70:690.8(A)(1)(a)]

805.1.1.2 PV DC-to-DC Converter Circuit Current. ~~The m~~Maximum current shall be the sum of parallel connected dc-to-dc converter continuous output current ratings. [NFPA 70:690.8(A)(1)(b)]

805.1.1.3 Inverter Output Circuit Current. ~~The m~~Maximum current shall be the inverter continuous output current rating. [NFPA 70:690.8(A)(1)(c)]

805.1.2 Circuits ~~Connected~~Terminating to the Input of Electronic Power Converters. Where a circuit is ~~protected with an overcurrent device not exceeding the conductor ampacity~~terminated to the input of an electronic power converter (EPC), the maximum current shall be permitted to be the rated input current of the ~~electronic power converter input to which it is connected.~~EPC in accordance with any of the following conditions:

(1) The circuit terminated to the input of the EPC is protected at its source of supply with an OCPD not exceeding the conductor ampacity.

(2) The circuit complies with Section 805.1.1 for the maximum current as calculated in Section 805.1.1.1.

(3) The circuit complies with Section 806.1.3. [NFPA 70:690.8(A)(2)]

~~**805.1.3 Stand-Alone Inverter Input Circuit Current.** The maximum current shall be the stand-alone continuous inverter input current rating when the inverter is producing rated power at the lowest input voltage. [NFPA 70:710.12]~~

805.2 Conductor Ampacity. (remaining text unchanged)

805.2.1 Without Adjustment and Correction Factors. The minimum conductor size with an ampacity not less than the maximum currents calculated in Section 805.1 multiplied by 125 percent.

Exceptions:

(1) Circuits containing an assembly, together with its ~~overcurrent device(s)~~OCPD, if any, that is listed for continuous operation at 100 percent of its rating shall be permitted to be used at 100 percent of its rating.

(2) Where a portion of a circuit is connected at both its supply and load ends to separately installed pressure connections as covered in Section 110.14(C)(2) of NFPA 70, it shall be permitted to have an ampacity not less than the calculated maximum current of Section 805.1. No portion of the circuit installed under this exception shall extend into an enclosure containing either the circuit supply or the circuit load terminations, as covered in Section 110.14(C)(1) of NFPA 70. [NFPA 70:690.8(B)(1)]

805.3 Systems with Multiple Direct-Current Voltages. For a PV power source that has multiple ~~output~~PV dc circuit voltages and employs a common-return conductor, the ampacity of the common-return conductor shall not be less than the sum of the ampere ratings of the ~~overcurrent devices~~OCPDs of the individual ~~output~~ circuits. [NFPA 70:690.8(C)]

805.4 Multiple PV String Circuits. Where an ~~overcurrent device~~OCPD is used to protect more than one set of parallel-connected PV string circuits, the ampacity of each conductor protected by the device shall not be less than the sum of the following:

(1) The rating of the ~~overcurrent device~~OCPD.

(2) The sum of the maximum currents as calculated in Section 805.1.1.1 for the other parallel-connected PV string circuits protected by the ~~overcurrent device~~OCPD. [NFPA 70:690.8(D)]

805.5 Standard Ampere Ratings. (remaining text unchanged)

805.5.2 Adjustable-Trip Circuit Breakers. The rating of adjustable-trip circuit breakers having external means for adjusting the current setting (long-time pickup setting)~~, not meeting the requirements of Section 805.5.3,~~ shall be the maximum setting possible unless otherwise permitted in Section 805.5.3 or Section 805.5.4. [NFPA 70:240.6(B)]

805.5.3 Local Restricted Access Adjustable-Trip Circuit Breakers. A circuit breaker(s) that cannot be adjusted remotely to modify the current setting (long-time pickup setting) and has restricted access to the adjusting means shall be permitted to have an ampere rating(s) that is equal to the adjusted current setting (long-time pickup setting). Restricted access shall be achieved by one of the following methods:

(1) – (4) (remaining text unchanged) [NFPA 70:240.6(C)]

805.5.4 Remotely Accessible Adjustable-Trip Circuit Breakers. ~~A c~~Circuit breaker~~(s)~~ that can be adjusted remotely to modify the ~~adjusting means~~current setting (long-time pickup setting) shall be permitted to have an ampere rating(s) that is equal to the adjusted current setting (long-time pickup setting)~~.~~ only when local restricted access to the circuit breaker is achieved by Section 805.5.3(1), Section 805.5.3(2), Section 805.5.3(3), or Section 805.5.3(4) and ~~R~~remote access ~~shall be~~is achieved by one of the following methods:

(1) Connected directly through a local non-networked interface.

(2) Connected through a networked interface complying with one of the following methods:

(a) The circuit breaker and associated software for adjusting the settings are identified as being evaluated for cybersecurity.

(b) A cybersecurity risk assessment of the network is completed~~.~~ and ~~D~~documentation of the assessment and certification ~~shall be made~~is available to those authorized to inspect, operate, and maintain the system. [NFPA 70:240.6(D)]

806.0 Overcurrent Protection.

806.1 Circuits and Equipment. ~~PV~~Photovoltaic system dc circuit and inverter output conductors and equipment shall be ~~protected against overcurrent. Circuits sized in accordance with Section 805.1.2 are required to be protected against overcurrent with overcurrent protective devices. Each circuit shall be protected from~~provided with overcurrent protection in accordance with Section 806.1.1, Section 806.1.2 or Section 806.1.3. [NFPA 70:690.9(A)]

806.1.1 Circuits Where Overcurrent Protection Is Not Required. Overcurrent protective devices shall not be required where both of the following conditions are met:

(1) The conductors have sufficient ampacity for the maximum circuit current.

(2) The currents from all sources do not exceed the maximum ~~overcurrent protective device~~OCPD rating specified for the PV module or electronic power converter. [NFPA 70:690.9(A)(1)]

806.1.2 Circuits Where Overcurrent Protection Is Required on One End. A circuit conductor connected at one end to a current-limited supply, where the conductor is rated for the maximum circuit current from that supply, and also connected to sources having an available maximum circuit current greater than the ampacity of the conductor~~,~~ shall be ~~protected from~~provided with overcurrent protection at the point of connection to the higher current source. [NFPA 70:690.9(A)(2)]

806.1.3 Other Circuits. Circuits that do not comply with Section 806.1.1 or Section 806.1.2 shall be protected with one of the following methods:

(1) – (3) (remaining text unchanged)

(4) Conductors not installed on or in buildings are permitted to be protected from overcurrent on one end of the circuit where the circuit complies with all of the following conditions:

(a) The conductors are installed in metal raceways or metal-clad cables, ~~or installed~~ in enclosed metal cable trays, ~~or~~ underground, or where directly entering pad-mounted enclosures.

(b) (remaining text unchanged)

(c) The ~~overcurrent device~~OCPD for the conductors is an integral part of a disconnecting means or ~~shall be~~is located within 10 feet (3048 mm) of conductor length of the disconnecting means.

(d) (remaining text unchanged) [NFPA 70:690.9(A)(3)]

806.2 Device Ratings. ~~Overcurrent devices used in PV source circuits shall be listed for use in PV systems.~~ Electronic devices that are listed to prevent backfeed current in PV system dc circuits shall be permitted to prevent overcurrent of conductors on the PV array side of the devices. Overcurrent protective devices, where required, shall be rated in accordance with one of the following and permitted to be rounded up to the next higher standard size in accordance with Section 806.2.1:

(1) Overcurrent protective devices shall be rated at not less than 125 percent of the maximum currents calculated in Section 805.1.

(2) An assembly, together with its ~~overcurrent device(s)~~OCPD, that is listed for continuous operation at 100 percent of its rating shall be permitted to be used at 100 percent of its rating. [NFPA 70:690.9(B)]

806.2.1 Overcurrent Protective Devices Rated 800 Amperes or Less. The next higher standard ~~overcurrent device~~OCPD rating (above the ampacity of the conductors being protected) shall be permitted to be used, provided all of the following conditions are met:

(1) The conductors being protected are not part of a branch circuit supplying more than one receptacle for cord-and ~~-~~plug-connected portable loads.

(2) (remaining text unchanged)

(3) The next higher standard rating selected does not exceed 800 amperes. If the ~~overcurrent protective device~~OCPD is an adjustable trip device installed in accordance with Section 806.2.1(1) through Section 806.2.1(3), it shall be permitted to be set to a value that does not exceed the next higher standard value above the ampacity of the conductors being protected as shown in Table 805.5.1 where restricted access in accordance with Section 805.5.3 is provided. [NFPA 70:240.4(B)]

806.2.2 Overcurrent Protective Devices Rated over 800 Amperes. Where the ~~overcurrent device~~OCPD is rated over 800 amperes, the ampacity of the conductors it protects shall be equal to or greater than the rating of the ~~overcurrent device~~OCPD defined in Section 805.5. [NFPA 70:240.4(C)]

806.3 Photovoltaic System DC Circuits. A single ~~overcurrent protective device~~OCPD, where required, shall be permitted to protect the PV modules, dc-to-dc converters, and conductors of each circuit. Where single ~~overcurrent protection devices~~OCPDs are used to protect circuits, all ~~overcurrent devices~~OCPDs shall be placed in the same polarity for all circuits within a PV system. The ~~overcurrent devices~~OCPD shall be accessible but shall not be required to be readily accessible. [NFPA 70:690.9(C)]

~~**806.4 Power Transformers.** Overcurrent protection for power transformers shall be installed in accordance with Section 806.4.1.~~

~~**Exception:** A power transformer with a current rating on the side connected toward the interactive inverter output, not less than the rated continuous output current of the inverter, shall be permitted without overcurrent protection from the inverter. [NFPA 70:690.9(D)]~~

806.4 Marking. Overcurrent protection devices used in PV system dc circuits shall be marked "Photovoltaic" or "PV." [NFPA 70:690.9(D)]

~~**806.4.1**~~**806.5** ~~**Installation**~~**Transformers.** The following shall apply to the installation of transformers:

(1) For the purpose of overcurrent protection, the primary side of transformers with sources on each side shall be the side connected to the largest source of available fault current.

(2) Transformer secondary conductors shall be protected in accordance with Section 240.21(C) of NFPA 70. [NFPA 70:705.30(F)]

807.0 Stand-Alone Systems.

~~**807.1 General.** The wiring system connected to a stand-alone system shall be installed in accordance with Section 807.2.~~

~~**807.2 Wiring System.** Premises wiring systems shall be adequate to meet the requirements of this chapter and NFPA 70 for similar installations supplied by a feeder or service. The wiring on the supply side of the building or structure disconnecting means shall comply with the requirements of this chapter and NFPA 70, except as modified by Section 807.2.1 through Section 807.2.5, and Section 807.2.7. [NFPA 70:710.15]~~

~~**807.2.1 Supply Output.** Power supply to premises wiring systems fed by stand-alone or isolated microgrid power sources shall be permitted to have less capacity than the calculated load. The capacity of the sum of all sources of the stand-alone supply shall be equal to or greater than the load posed by the largest single utilization equipment connected to the system. Calculated general lighting loads shall not be considered as a single load. [NFPA 70:710.15(A)]~~

~~**807.2.2 Sizing and Protection.** The circuit conductors between a stand-alone source and a building or structure disconnecting means shall be sized based on the sum of the output ratings of the stand-alone source(s). For three-phase interconnections, the phase loads shall be controlled or balanced to be compatible with specifications of the sum of the power supply capacities. [NFPA 70:710.15(B)]~~

~~**807.2.3 Single 120-Volt Supply.** Stand-alone and isolated microgrid systems shall be permitted to supply 120 volts to single-phase, three-wire, 120/240-volt service equipment or distribution panels where there are no 240-volt outlets and where there are no multiwire branch circuits. In all installations, the sum of the ratings of the power sources shall be less than the rating of the neutral bus in the service equipment. This equipment shall be marked with the following words or equivalent:~~

~~WARNING:~~
~~SINGLE 120-VOLT SUPPLY. DO NOT CONNECT~~
~~MULTIWIRE BRANCH CIRCUITS!~~

~~The warning sign(s) or label(s) shall comply with Section 821.2. [NFPA 70:710.15(C)]~~

~~**807.2.4 Three-Phase Supply.** Stand-alone and microgrid systems shall be permitted to supply three-phase, three-wire or four-wire systems. [NFPA 70:710.15(D)]~~

~~**807.2.5 Energy Storage or Backup Power System Requirements.** Energy storage or backup power supplies shall not be required. [NFPA 70:710.15(E)]~~

807.2 Capacity and Rating. A stand-alone system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The system user shall be permitted to select the loads connected to the system. [NFPA 70:710.15(A)]

807.3 Power Production Source Circuits. Circuits shall comply with Section 807.3.1 through Section 807.3.3.

807.3.1 Circuit Sizing and Current. The maximum current for power sources shall be calculated in accordance with the following:

(1) The sum of the continuous output current ratings of power production sources at the circuit nominal system voltage unless different requirements elsewhere in this code apply to the power sources.

(2) The power control system (PCS) control settings for the power production sources controlled by the PCS.

(3) Where sources controlled by a PCS are combined with other sources on the same power source output circuit, the sum of Section 807.3.1(1) and Section 807.3.1(2).

Calculations shall be permitted to be rounded to the nearest whole ampere, with decimal fractions smaller than 0.5 dropped. [NFPA 70:705.28(A)]

807.3.2 Conductor Ampacity. Power source output conductors shall have an ampacity not less than the larger of the following and comply with Section 110.14(C) of NFPA 70:

(1) The maximum currents in Section 807.3.1 multiplied by 125 percent without adjustment or correction factors.

> **Exceptions:**
> (1) Where the assembly, including the OCPDs protecting the circuit, is listed for operation at 100 percent of its rating, the ampacity of the conductors shall be permitted to be not less than the calculated maximum current of Section 807.3.1.

(2) Where a portion of a circuit is connected at both its supply and load ends to separately installed pressure connections as covered in Section 110.14(C)(2) of NFPA 70, it shall be permitted to have an ampacity not less than the calculated maximum current of Section 807.3.1. No portion of the circuit installed under this exception shall extend into an enclosure containing either the circuit supply or the circuit load terminations, as covered in Section 110.14(C)(1) of NFPA 70.
(3) Grounded conductors that are not connected to an OCPD shall be permitted to be sized at 100 percent of the calculated maximum current of Section 807.3.1.

(2) The maximum currents in Section 807.3.1 after the application of adjustment and correction factors in accordance with Section 310.14 of NFPA 70.
(3) Where connected to feeders, if smaller than the feeder conductors, the ampacity as calculated in Section 240.21(B) of NFPA 70 based on the OCPD protecting the feeder. [NFPA 70:705.28(B)]
807.3.3 Neutral Conductors. Neutral conductors shall be permitted to be sized in accordance with either of the following:
(1) Where not elsewhere required or permitted in this code, the ampacity of a neutral conductor to which a single-phase line-to-neutral power source is connected shall not be smaller than the ampacity in Section 807.3.2.
(2) A power production equipment neutral conductor used solely for instrumentation, voltage detection, or phase detection shall be permitted to be sized in accordance with Section 250.102 of NFPA 70. [NFPA 70:705.28(C)]
807.4 Circuit and Equipment. Power source output conductors and equipment shall be provided with OCPDs. Circuits connected to more than one electrical source shall have OCPDs located to provide overcurrent protection from all sources. [NFPA 70:705.30(A)]

~~807.2.6~~**807.5 Suitable for Backfeed.** Suitability for backfeeding shall be determined as follows:
(1) Fused disconnects, unless otherwise marked, shall be considered suitable for backfeed where fuses are not energized when the disconnect is in the open position.
(2) Circuit breakers not marked "line" and "load" shall be considered suitable for backfeed.
(3) Circuit breakers marked "line" and "load" shall ~~be considered suitable for backfeed or reverse current if specifically rated~~not be used to satisfy the requirements in Section 807.4. [NFPA 70:705.30(D)]
~~807.2.6.1~~**807.5.1 Backfed Devices.** Plug-in-type ~~overcurrent protection devices~~OCPDs or plug-in type main lug assemblies that are backfed and used to terminate field-installed ungrounded supply conductors shall be secured in place by an additional fastener that requires other than a pull to release the device from the mounting means on the panelboard. [NFPA 70:408.36(D)]

~~**807.2.7 Voltage and Frequency Control.** The stand-alone power sources shall be controlled during operation so that voltage and frequency are supplied within limits compatible with the connected loads. [NFPA 70:710.15(F)]~~

809.0 Rapid Shutdown of PV Systems on Buildings.
809.1 Reduce Shock Hazard. (remaining text unchanged)

809.1.2 Controlled Limits. (remaining text unchanged)

809.1.2.2 Inside the Array Boundary. ~~The PV system shall comply with one of the following:~~
~~(1) The PV~~Photovoltaic systems shall provide shock hazard control for firefighters in accordance with either of the following:
(1) ~~t~~Through the use of a PVHCS installed in accordance with the following:
(a) The instructions included with the listing or field labeling. ~~Where a~~
(b) Use of the rapid shutdown initiation device required in Section 809.1.3 where the PVHCS requires initiation to transition to a controlled state~~, the rapid shutdown initiation device required in Section 809.1.3 shall perform this initiation~~.

(2) ~~The PV system shall provide shock hazard control for firefighters b~~By limiting the highest voltage inside equipment, ~~or~~ between any two conductors of a circuit, or between any conductor and ground inside array boundary to not more than 80 volts within 30 seconds of rapid shutdown initiation. [NFPA 70:690.12(B)(2)]

809.1.3 Initiation Devices. Where circuits identified in Section 809.1.1 are required to meet the requirements in Section 809.1.2, ~~an~~ initiation device~~(s)~~ meeting the requirements in Section 809.1.3.1 through Section 809.1.3.3 shall be provided ~~and shall~~to initiate the rapid shutdown function.
~~The device's "off" position shall indicate that the rapid shutdown function has been initiated for all PV systems connected to that device. For one- and two-family dwellings an initiation device(s), where required, shall be located at a readily accessible outdoor location.~~
~~For a single PV system, the rapid shutdown initiation shall occur by the operation of any single initiation device. Devices shall consist of at least one or more of the following:~~
~~(1) Service disconnecting means.~~
~~(2) PV system disconnecting means.~~
~~(3) Readily accessible switch that plainly indicates whether it is in the "off" or "on" position.~~
~~Where multiple PV systems are installed with rapid shutdown functions on a single service, the initiation device(s) shall consist of not more than six switches or six sets of circuit breakers, or a combination of not more than six switches and sets of circuit breakers, mounted in a single enclosure, or in a group of separate enclosures. These initiation device(s) shall initiate the rapid shutdown of all PV systems with rapid shutdown functions on that service.~~ [NFPA 70:690.12(C)]

809.1.3.1 Type and Location. Initiation devices shall be readily accessible and consist of one or more of the following as specified in the rapid shutdown equipment instructions:
(1) Service disconnecting means
(2) PV system disconnecting means
(3) Listed switches
For one- and two-family dwellings, initiation devices, where required, shall be located at an outdoor location. [NFPA 70:690.12(C)(1)]
809.1.3.2 Operation. The "off" position of devices shall perform the rapid shutdown function for all PV systems connected to such devices. Additional manual or automatic initiation methods not meeting the requirements in Section809.1.3.1 shall be permitted. For a single PV system, the rapid shutdown initiation shall occur by the operation of any single initiation device. [NFPA 70:690.12(C)(2)]
809.1.3.3 More Than One System. Where multiple PV systems are installed with rapid shutdown functions on a single service, initiation devices shall consist of not more than six devices meeting the requirements in Section 809.1.3.1 grouped together whose combined operation initiates the rapid shutdown of all PV systems with rapid shutdown functions on that service. [NFPA 70:690.12(C)(3)]

Part III – Disconnecting Means.

810.0 Disconnecting Means.
810.1 Photovoltaic System Disconnecting Means. ~~Means shall be provided to disconnect the PV system from all wiring systems including power systems, energy storage systems, and utilization equipment and its associated premises wiring. [NFPA 70:690.13]~~Photovoltaic system disconnecting means shall be in accordance with Section 810.1.1 through Section 810.1.5.
810.1.1 Location. ~~The PV system d~~Disconnecting means shall be ~~installed at a~~ readily accessible~~ location~~. ~~Where a disconnecting means for circuits operating above 30 volts is readily accessible to unqualified persons, an enclosure door or hinged cover that exposes energized parts when open shall have its door or cover locked or require a tool to be opened.~~Disconnecting means shall be externally operable without exposed live parts. [NFPA 70:~~690.13(A)~~705.20(A), 705.20(D)]

810.1.2 Maximum Number of Disconnects. ~~Each PV system~~The disconnecting means for each PV system installed in accordance with Section 802.4 shall consist of not more than six switches or six sets of circuit breakers, or a combination of not more than six switches and sets of circuit breakers, mounted in a single enclosure~~,~~ or in a group of separate enclosures. A single PV system disconnecting means shall be permitted for the combined ac output of one or more inverters or ac modules. [NFPA 70:~~690.13(C)~~690.13(D)]
810.1.3 Ratings. ~~The PV system d~~Disconnecting means shall have ratings sufficient for the maximum circuit current available fault current, and available voltage ~~that is available~~ at the terminals of the ~~PV system~~ disconnecting means. [NFPA 70:~~690.13(D)~~705.20(B)]
810.1.4 Type of Disconnect. The PV system disconnecting means shall simultaneously disconnect the PV system conductors that are not solidly grounded from all conductors of other wiring systems. The PV system disconnecting means or ~~its~~their remote operating devices or the enclosures providing access to the disconnecting means shall be ~~capable of being locked~~lockable open in accordance with Section 810.1.4.1. [NFPA 70:690.13(A), 690.13(B)]
~~The PV system d~~Disconnecting means shall simultaneously disconnect all ungrounded conductors of the circuit and be one of the following:
(1) A manually operable switch or circuit breaker.
~~(2) A connector meeting the requirements of Section 814.1.4(1) or Section 814.1.4(3).~~
(~~3~~2) A load-break-rated pull-out switch~~ with the required interrupting rating~~.
(~~4~~3) A power-operated or remote-controlled switch or circuit breaker that is manually operable locally and opens automatically when control power is interrupted.
(~~5~~4) A device listed or approved for the intended application. [NFPA 70:~~690.13(E)~~705.20(C)]
810.1.5 Direct-Current Power Source Connections. Termination of dc power source output conductors to disconnecting means shall comply with one of the following:
(1) Terminate to either side of disconnecting means not marked "line" and "load."
(2) Terminate only to the line side of disconnecting means marked "line" and "load." [NFPA 70:705.20(G)]

811.0 Disconnecting Means for Isolating Photovoltaic Equipment.
811.1 General. (remaining text unchanged)

811.1.3 Equipment Disconnecting Means. Equipment disconnecting means shall comply with the following:
(1) – (2) (remaining text unchanged)
(3) Be externally operable without exposing the operator to contact with energized parts and ~~shall~~ indicate whether in the open (off) or closed (on) position.~~ Where not within sight or not within 10 feet (3048 mm) of the equipment, the disconnecting means or its remote operating device or the enclosure providing access to the disconnecting means shall be capable of being locked in accordance with Section 810.1.4.1.~~
(4) Be one of the following types~~ in Section 810.1.4(1) through Section 810.1.4(5).~~:
(a) Manually operable switch or circuit breaker.
(b) Load-break-rated pull-out switch.
(c) Device listed or approved for the intended application.
Equipment disconnecting means, other than those complying with Section 814.1, shall be marked in accordance with the warning in Section 823.1 if the line and load terminals can be energized in the open position. [NFPA 70:690.15(C)]
811.1.4 Location and Control. Isolating devices or equipment disconnecting means shall comply with one or more of the following:
(1) Be ~~L~~located within the equipment.
(2) Be ~~L~~located in sight from and readily accessible from the equipment for those to whom access is required.
(3) Be ~~L~~lockable open in accordance with Section ~~810.1.4.1~~810.1.2.1.

(4) Be located in an enclosure with a door or cover capable of being locked closed that restricts access to the operation of the disconnecting means.
(~~4~~5) Be ~~P~~provided with remote controls to activate the disconnecting means ~~where the remote controls~~that comply with one of the following:
(a) The disconnecting means and their controls are located within the same equipment.
(b) The disconnecting means ~~is~~are lockable open in accordance with Section ~~810.1.4.1~~810.1.2.1, and the location of the controls are marked on the disconnecting means. [NFPA 70:690.15(D)]

Part IV – Wiring Methods.

812.0 Wiring Methods Permitted.
812.1 Wiring Systems. (remaining text unchanged)
812.1.1 Serviceability. ~~Where wiring devices with integral enclosures are used, sufficient length of cable shall be provided to facilitate replacement.~~Wiring shall be considered accessible where in accordance with Section 815.1. [NFPA 70:690.31(A)(1)]

812.1.4 Special Equipment. In addition to wiring methods included elsewhere in this chapter, other wiring systems ~~specifically~~ listed for use in PV systems shall be permitted. [NFPA 70:690.31(A)(4)]

812.2 Identification and Grouping. (remaining text unchanged)
812.2.1 Conductors of Different Systems. ~~Where not otherwise allowed in an equipment's listing, PV~~Photovoltaic system dc circuits shall not occupy the same equipment wiring enclosures, cables, or raceways as other non-PV systems or inverter output circuits unless ~~separated from other circuits by a barrier or partition.~~ installed in accordance with one or more of the following:
(1) A barrier or partition separates the PV system dc circuits from the other circuits.
(2) The installation of other circuit conductors is permitted by the equipment listing.
(3) ~~**Exception:** Where a~~All conductors or cables have an insulation rating equal to at least the maximum circuit voltage applied to any conductor installed within the same wiring method~~, the following shall be permitted:~~and the PV system dc circuits are identified and grouped as required by Section 812.2.2(2) and Section 812.2.2(3).
(4) The other circuit conductors are part of a multiconductor jacketed cable with a jacket insulation rating equal to at least the maximum circuit voltage applied to any conductor installed within the same wiring method, and are used for remote control, signaling, or a Class 1 power-limited circuit associated with the PV system or energy management system.
~~(1) Multiconductor jacketed cables for remote control, signaling, or power-limited circuits shall be permitted within the same wiring enclosure, cable, or raceway as PV system dc circuits where all circuits serve the PV system.~~
~~(2) Inverter output circuits shall be permitted to occupy the same junction box, pull box, or wireway with PV system dc circuits that are identified and grouped as required by Section 812.2.2 and Section 812.2.3.~~
~~(3) PV system dc circuits utilizing multiconductor jacketed cable or metal-clad cable assemblies or listed wiring harnesses identified for the application shall be permitted to occupy the same wiring method as inverter output circuits and other non-PV systems.~~ [NFPA 70:690.31(B)(1)]

812.2.2 Identification. ~~PV~~Photovoltaic system dc circuit conductors shall be identified at all termination, connection, and splice points by color coding, marking tape, tagging, or other approved means in accordance with the following:
(1) ~~Conductors that rely on other than color coding for polarity identification shall be identified by an approved permanent marking means such as labeling, sleeving, or shrink tubing that is suitable for the conductor size.~~Identification of dc positive conductors shall occur by one of the following means:
(a) Imprinted plus signs (+) or the word POSITIVE or POS durably marked on conductor insulation.

(b) An approved permanent marking means, such as, sleeving or shrink-tubing, that is suitable for the conductor size at all termination, connection, and splice points, with imprinted plus signs (+) or the word POSITIVE or POS. [NFPA 70:705.25(B)(1)]

(2) ~~The permanent marking means for nonsolidly grounded positive conductors shall include imprinted plus signs (+) or the word POSITIVE or POS durably marked on insulation of a color other than green, white, or gray. The permanent marking means for nonsolidly grounded negative conductors shall include imprinted negative signs (-) or the word NEGATIVE or NEG durably marked on insulation of a color other than green, white, gray, or red. Only solidly grounded PV system dc circuit conductors shall be marked in accordance with Section 200.6 of NFPA 70.~~ Identification of dc negative conductors shall occur by one of the following means:

(a) Imprinted minus signs (−) or the word NEGATIVE or NEG durably marked on conductor insulation.

(b) An approved permanent marking means (e.g., sleeving or shrink-tubing) that is suitable for the conductor size at all termination, connection, and splice points, with imprinted minus signs (−) or the word NEGATIVE or NEG. [NFPA 70:705.25(B)(2)]

(3) Where color is used, identification shall occur by one of the following means:

(a) For nonsolidly grounded dc positive conductors, marked with an insulation color other than green, white, or gray.

(b) For nonsolidly grounded dc negative conductors, marked with an insulation color other than green, white, gray, or red.

(c) For solidly grounded dc conductors, marked in accordance with Section 200.7 of NFPA 70. [NFPA 70:705.25(B)(3)]

Exception: Where the identification of the conductors is evident by spacing or arrangement, further identification shall not be required. [NFPA 70:690.31(B)(2)]

812.3 Cables. Type PV wire ~~or cable and~~ shall be permitted in all locations where Type RHW-2 is permitted. Type distributed generation (DG) cable shall be ~~listed~~permitted in all locations where Type TC is permitted. [NFPA 70:690.31(C)]

812.3.1 Single~~-~~ Conductors~~ Cable~~. Single~~-~~ conductors ~~cables~~ shall comply with the following:

(1) Single~~-~~ conductors ~~cable~~ in exposed outdoor locations in PV system dc circuits within ~~the~~ PV arrays shall be permitted to be one of the following:

(a) Type PV wire~~ or cable~~.

(b) Single~~-~~ conductors ~~cable~~ marked sunlight resistant and Type USE-2 and Type RHW-2.

(2) Exposed ~~cables sized 8 AWG or smaller~~conductors shall be supported and secured ~~at intervals not to exceed 2 feet (610 mm)~~ by one of the following methods:

(a) ~~c~~Cable ties~~, straps, hangers, or similar fittings~~ that are listed and identified for securement and support in outdoor locations.~~ PV wire or cable shall be permitted in all locations where RHW-2 is permitted.~~

(b) Straps, hangers, or similar fittings, or other approved means designed and installed so as not to damage the conductors.

(3) Conductors sized larger than 8 AWG shall be supported and secured at intervals not to exceed 54 inches (1372 mm).

(4) Conductors sized 8 AWG and smaller shall be supported and secured at intervals not to exceed 24 inches (610 mm).

Exception: ~~PV~~Photovoltaic systems ~~meeting the requirements of~~complying with Section 829.2 shall be permitted to have support and securement intervals as defined in the engineered design. [NFPA 70:690.31(C)(1)]

~~(3) Exposed cables sized larger than 8 AWG shall be supported and secured at intervals not to exceed 54 inches (1372 mm) by cable ties, straps, hangers, or similar fittings listed and identified for securement and support in outdoor locations. [NFPA 70:690.31(C)(1)]~~

812.3.2 Cable Tray. ~~Single-conductor~~Type PV wire ~~or cable~~ of all sizes or ~~distributed generation (~~Type DG~~)~~ cable of all sizes, with or without ~~a~~ cable tray ratings, shall be permitted in cable trays ~~installed~~ in outdoor locations~~, provided that~~ where the wires or cables are supported at intervals not to exceed 12 inches (305 mm) and secured at intervals not to exceed ~~4½ feet~~54 inches (1372 mm). ~~Where installed in uncovered cable trays, ampacity of single-conductor PV wire smaller than 1/0 AWG, t~~The adjustment factors for 1/0 AWG single -conductor cable in

Section 392.80(A)(2) of NFPA 70 shall be permitted to be used for the ampacity of single-conductor PV wire smaller than 1/0 AWG installed in uncovered cable trays. Where ~~single-conductor~~Type PV wire smaller than 1/0 AWG ~~is installed~~are in ladder or ventilated trough cable trays, the following shall apply:

(1) All ~~single~~ conductors shall be installed in a single layer.

(2) Conductors that are bound together to comprise each circuit pair shall be permitted to be installed in other than a single layer.

(3) The sum of diameters of all ~~single~~ conductors ~~cables~~ shall not exceed the cable tray width. [NFPA 70:690.31(C)(2)]

812.3.3 Multiconductor Jacketed Cables. Where part of a listed PV assembly, multiconductor jacketed cables shall be installed in accordance with the included instructions. Where not part of a listed assembly, or where not otherwise covered in this chapter or NFPA 70, multiconductor jacketed cables, including Type DG cable, shall be permitted in PV systems where installed in accordance with the product listing and ~~shall be permitted in PV systems. These cables shall be installed in accordance with~~one of the following:

(1) In raceways, where on or in buildings other than rooftops.

(2) Where not in raceways, in accordance with the following:

(a) Marked sunlight resistant, where installed in exposed outdoor locations.

(b) Protected or guarded, where subject to physical damage.

(c) Closely following the surface of support structures.

(d) Secured at intervals not exceeding 6 feet (1829 mm).

(e) Secured within 2 feet (610 mm) of mating connectors or entering enclosures.

(f) Marked direct burial, where buried in the earth. [NFPA 70:690.31(C)(3)]

812.3.4 ~~Flexible Cords and Cables~~Circuits Connected to Moving Parts of PV Arrays. ~~Flexible cords and flexible cables, where connected to moving parts of tracking PV arrays, shall comply with Article 400 of NFPA 70 and shall be of a type~~Conductors exposed to cyclical movement in PV arrays with movable components shall comply with the following:

(1) Conductors shall be flexible cords or flexible cables complying with Section 400.4 of NFPA 70 and the following:

(a) Be identified as a hard service cord or portable power cable.~~; they shall be~~

(b) Be suitable for extra-hard usage~~,~~.

(c) Be listed for outdoor use~~,~~.

(d) Be water ~~resistant,~~ and sunlight resistant. ~~Allowable ampacities shall be in accordance~~

(e) Be compliant with Section 400.5 of NFPA 70 for allowable ampacities.

(2) Conductors shall be ~~S~~stranded copper Type PV wire ~~shall be permitted to be connected to moving parts of tracking PV arrays in accordance~~and Type DG cable with the minimum number of strands specified in Table 812.3.4. [NFPA 70:690.31(C)(4)]

TABLE 812.3.4
MINIMUM ~~PV WIRE~~CONDUCTOR STRANDS
[NFPA 70: TABLE 690.31(C)(4)(b)]

~~PV WIRE~~ AWG	MINIMUM STRANDS
18	17
16 – 10	19
8 – 4	49
2	130
1 AWG – 1000 ~~MCM~~kcmil	259

812.3.6 ~~Small~~Single-Conductor Cables. Single-conductor cables listed for outdoor use that are sunlight resistant and moisture resistant in sizes 16 AWG and 18 AWG shall be permitted for module interconnections where such cables meet the ampacity requirements of Section 400.5 of NFPA 70. Cable ampacity adjustment and correction factors shall be determined in accordance with Section 310.14 of NFPA 70~~ shall be used to determine the cable ampacity adjustment and correction factors~~. [NFPA 70:690.31(C)(6)]

812.4 Direct-Current Circuits on or in a Building. (remaining text unchanged)
812.4.1 Metal ~~Raceways~~Wiring Methods and Enclosures. Where inside buildings, PV system dc circuits that exceed 30 volts or 8 amperes shall be contained in metal raceways, in Type MC metal-clad cable that complies with Section 812.4.2(10)(b) or Section 812.4.2(10)(c), or in metal enclosures.
Exception: PVHCS installed in accordance with Section 809.1.2.2(1) shall be permitted to be provided with or listed for use with nonmetallic enclosure~~(s)~~, nonmetallic raceway~~(s)~~, and cables other than Type MC metal-clad cable~~(s)~~, at the point of penetration of the surface, and in the interior spaces, of the building. [NFPA 70:690.31(D)(1)]

812.4.2 Types of Equipment Grounding Conductors. Each equipment grounding conductor run with or enclosing ~~the~~ circuit conductors shall be one or more, or a combination, of the following as part of an effective ground-fault current path:
(1) A copper, aluminum, or copper-clad aluminum conductor~~. This conductor shall be~~ that is solid or stranded; insulated, covered, or bare; and in the form of a wire or a busbar of any shape.
(2) – (4) (remaining text unchanged)
(5) Listed flexible metal conduit meeting all of the following conditions:
(a) The conduit is terminated in listed fittings.
(b) The circuit conductors contained in the conduit are protected by ~~overcurrent devices~~OCPDs rated at 20 amperes or less.
(c) – (d) (remaining text unchanged)
(e) If flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor or a bonding jumper in accordance with Section 812.4.2.1 ~~shall be~~is installed.
(f) If flexible metal conduit is constructed of stainless steel, a wire-type equipment grounding conductor or bonding jumper in accordance with Section 812.4.2.1 ~~shall be~~is installed.
(6) Listed liquidtight flexible metal conduit meeting all of the following conditions:
(a) The conduit is terminated in listed fittings.
(b) For trade sizes 3/8 through ½ (12 through 16 metric designator), the circuit conductors contained in the conduit are protected by ~~overcurrent devices~~OCPDs rated at 20 amperes or less.
(c) For trade sizes ¾ through 1¼ (21 through 35 metric designator), the circuit conductors contained in the conduit are protected by ~~overcurrent devices~~OCPDs rated not more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in trade sizes 3/8 through ½ (12 through 16 metric designator) in the effective ground-fault current path.
(d) (remaining text unchanged)
(e) If flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor or a bonding jumper in accordance with Section 812.4.2.1 ~~shall be~~is installed.
(f) If liquidtight flexible metal conduit contains a stainless steel core, a wire-type equipment grounding conductor or a bonding jumper in accordance with Section 812.4.2.1 ~~shall be~~is installed.
(7) Flexible metallic tubing, if the tubing is terminated in listed fittings and ~~meeting~~meets the following conditions:
(a) The circuit conductors contained in the tubing are protected by ~~overcurrent devices~~OCPDs rated at 20 amperes or less.
(b) (remaining text unchanged)
(c) The tubing contains circuit conductors not exceeding 1000 volts, nominal.

(8) Armor of Type AC, cable as provided in Section 320.108 of NFPA 70, containing circuit conductors not exceeding 600 volts, nominal.
(9) ~~The c~~Copper sheath of mineral-insulated, metal-sheathed cable Type MI containing circuit conductors not exceeding 600 volts, nominal.
(10) Type MC cable that provides an effective ground-fault current path in accordance with one or more of the following:
(a) It contains an insulated or uninsulated equipment grounding conductor ~~in compliance~~complying with Section 812.4.2(1).
(b) The combined metallic sheath and uninsulated equipment grounding/bonding conductor of interlocked metal-tape-type MC cable ~~that~~ is listed and identified as an equipment grounding conductor.
(c) The metallic sheath or the combined metallic sheath and equipment grounding conductors of the smooth or corrugated tube-type MC cable ~~that~~ is listed and identified as an equipment grounding conductor.
(11) – (13) (remaining text unchanged)
(14) Surface metal raceways listed for grounding and containing circuit conductors not exceeding 600 volts, nominal. [NFPA 70:250.118(A)]

812.5 Bipolar PV Systems. Where the sum, without consideration of polarity, of the voltages of the two monopole circuits exceeds the rating of the conductors and connected equipment, monopole circuits in a bipolar PV system shall be physically separated~~,~~ and the electrical output circuits from each monopole circuit shall be installed in separate raceways until connected to the inverter. The disconnecting means and ~~overcurrent protective devices~~OCPDs for each monopole circuit output shall be in separate enclosures. All conductors from each separate monopole circuit shall be routed in the same raceway. Solidly grounded bipolar PV systems shall be clearly marked with a permanent, legible warning notice indicating that ~~the~~ disconnection of the grounded conductor(s) may result in overvoltage on the equipment.
Exception: Listed switchgear rated for the maximum voltage between circuits and containing a physical barrier separating the disconnecting means for each monopole circuit shall be permitted to be used instead of disconnecting means in separate enclosures. [NFPA 70:690.31(E)]

814.0 Connectors.
814.1 General. (remaining text unchanged)

814.1.3 Type. ~~The m~~Mating connectors shall be ~~of~~ the latching or locking type. Mating connectors that are readily accessible and that are used in circuits operating at over 30 volts dc or 15 volts ac shall require a tool for opening. Where mating connectors are not ~~of the~~ an identical type and brand, they shall be listed and identified for intermatability, as ~~described in the manufacturer's instructions~~documented by both manufacturers. [NFPA 70:690.33(C)]

815.0 Access to Boxes.
815.1 Junction, Pull, and Outlet Boxes. Junction boxes, pull boxes, and ~~outlet boxes~~ devices located behind modules or panels shall be ~~so~~ installed such that the wiring contained in them can be rendered accessible directly or by displacement of a module(s) or panel(s) secured by removable fasteners and connected by a flexible wiring system. [NFPA 70:690.34]

Part V – Grounding and Bonding.

816.0 Grounding and Bonding.
816.1 PV System DC Circuit Grounding Configurations. One or more of the following system configurations shall be employed for PV system dc circuits:

~~(1) Two-wire circuits with one functionally grounded conductor.~~

~~(2) Bipolar circuits according to Section 804.2 with a functional ground reference (center tap).~~

~~(3) Not isolated from the grounded inverter output circuit.~~

(1) Functionally grounded through listed equipment.

(~~4~~2) Ungrounded circuits.

(~~5~~3) Solidly grounded circuits as permitted in Section 816.2.

~~(6) Circuits protected by equipment listed and identified for the use.~~ [NFPA 70:690.41(A)]

816.1.1 Electrical System Grounding. Electrical systems that are grounded shall be connected to earth ~~in a manner~~ such that ~~will limit~~ the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines is limited and that ~~will stabilize~~ the voltage to earth is stabilized during normal operation. [NFPA 70:250.4(A)(1)]

816.1.2 Grounding of Electrical Equipment. Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth ~~so as to limit~~such that the voltage to ground on these materials is limited. [NFPA 70:250.4(A)(2)]

816.1.3 Bonding of Electrical Equipment. Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source ~~in a manner~~such that ~~establishes~~ an effective ground-fault current path is established. [NFPA 70:250.4(A)(3)]

816.1.4 Bonding of Electrically Conductive Materials and Other Equipment. Normally non-current-carrying electrically conductive materials that are likely to become energized shall be connected together and to the electrical supply source ~~in a manner~~such that ~~establishes~~ an effective ground-fault current path is established. [NFPA 70:250.4(A)(4)]

816.1.5 Effective Ground-Fault Current Paths. Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed ~~in a manner~~such that ~~creates~~ a low-impedance circuit ~~facilitating~~is created that will facilitate the operation of the ~~overcurrent device~~OCPD or ground detector for impedance grounded systems. ~~It~~The effective ground-fault current path shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault occurs to the electrical supply source. The earth shall not be considered ~~as~~ an effective ground-fault current path. [NFPA 70:250.4(A)(5)]

816.2 DC Ground-Fault Detector-Interrupter (GFDI) Protection. (remaining text unchanged)

816.2.1 Ground-Fault Detection. The GFDI devices or systems shall detect ground fault~~(s)~~ in the PV system dc circuits, including any functionally grounded conductors, and be listed for providing GFDI protection. ~~For dc-to-dc converters not listed as providing GFDI protection, where required, listed GFDI protection equipment identified for the combination of the dc-to-dc converter and the GFDI device shall be installed to protect the circuit.~~Where the GFDI function is not integral to an electronic power converter, PVRSE, or PVHCE installed in the PV dc circuit, GFDI protection shall be provided for the entire circuit and be identified for the combination of the electronic power converter, PVRSE, PVHCE, and the GFDI device. [NFPA 70:690.41(B)(1)]

816.2.2 Faulted Circuits. ~~The f~~Faulted circuits shall be controlled by one of the following methods:

(1) ~~The c~~Current-carrying conductors of ~~the~~ faulted circuits shall be automatically disconnected.

(2) ~~The d~~Device providing GFDI protection fed by ~~the~~ faulted circuits shall automatically cease to supply power to output circuits and interrupt the faulted PV system dc circuits from the ground reference in ~~a~~ functionally grounded systems. [NFPA 70:690.41(B)(2)]

818.0 Equipment Grounding and Bonding.

818.1 General. Exposed non-current-carrying metal parts of PV module frames, electrical equipment, and conductor enclosures of PV systems shall be connected to ~~an~~ equipment grounding conductors in accordance with Section 818.1.3.1 or Section 250.136 of NFPA 70, regardless of voltage. Equipment grounding conductors and devices shall comply with Section 818.1.1 through Section 818.1.4. [NFPA 70:690.43]

818.1.1 Photovoltaic Module Mounting Systems and Devices. Devices and systems used for mounting PV modules that are also used for bonding module frames shall be listed, labeled, and identified for bonding the specific PV modules with which they are used. [NFPA 70:690.43(A)]

818.1.2 Equipment Secured to Grounded ~~Metal~~Metallic Support~~s~~ Structures. Devices listed, labeled, and identified for bonding and grounding the metal parts of PV ~~systems~~arrays shall be permitted to bond the equipment to grounded metal support~~s~~ structures. Metallic support structures shall have identified bonding jumpers connected between separate metallic sections or ~~shall~~ be identified for equipment bonding and ~~shall~~ be connected to ~~the~~ equipment grounding conductors. [NFPA 70:690.43(B)]

818.1.3 Location. (remaining text unchanged)

818.1.3.1 Equipment Fastened in Place or Connected by Permanent Wiring Methods (Fixed). Unless connected to the grounded circuit conductor as permitted by Section 250.32, Section 250.140, and Section 250.142 of NFPA 70, non-current-carrying metal parts of equipment, raceways, and other enclosures, if grounded, shall be connected to an equipment grounding conductor by one of the following methods:

(1) By connecting to any of the equipment grounding conductors permitted by Section 812.4.2(2) through Section 812.4.2(14).

~~**Exception:** As provided in Section 250.130(C) of NFPA 70, the equipment grounding conductor shall be permitted to be run separately from the circuit conductors.~~

(2) By connecting to an equipment grounding conductor of the wire type that is contained within the same raceway, contained within the same cable, or otherwise run with the circuit conductors.

Exceptions:

(1) As provided in Section 250.130(C) of NFPA 70, the equipment grounding conductor shall be permitted to be run separately from the circuit conductors.

(2) For dc circuits, the equipment grounding conductor shall be permitted to be run separately from the circuit conductors. [NFPA 70:250.134]

819.0 Size of Equipment Grounding Conductors.

819.1 General. Equipment grounding conductors for PV system circuits shall be sized in accordance with Section 250.122 of NFPA 70. Where no ~~overcurrent protective device~~OCPD is used in the circuit, an assumed ~~overcurrent device~~OCPD rated in accordance with Section 806.2 shall be used when applying Table 819.1. Increases in equipment grounding conductor size to address voltage drop considerations shall not be required. [NFPA 70:690.45]

819.2 Equipment Grounding Conductor Installation. (remaining text unchanged)

819.2.1 Raceways, Cable Trays, Cable Armor, Cablebus, or Cable Sheaths. ~~If it consists of a raceway, cable tray, cable armor, cablebus framework, or cable sheath or if it is a wire within a raceway or cable, it shall be installed in accordance with the applicable provisions of NFPA 70 using fittings for joints and terminations approved for use with the type of raceway or cable used. All connections, joints, and fittings shall be made tight using suitable tools.~~Equipment grounding conductors consisting of raceways, cable trays, cable armor, cablebus framework, or cable sheaths or wires within raceways or cables shall be installed with all connections, joints, and fittings made tight. [NFPA 70:250.120(A)]

820.0 Grounding Electrode System.

820.1 Electrode System. (remaining text unchanged)

820.1.3 Concrete-Encased Electrodes. ~~A c~~Concrete-encased electrodes shall consist of at least 20 feet (6096 mm) of either of the following:

(1) One or more bare or zinc galvanized or other electrically conductive coated rebar of not less than $1/2$ of an inch (12.7 mm) in diameter, installed in one continuous 20 foot (6096 mm) length, or if in multiple pieces, ~~the rebar shall be~~ connected together by steel tie wires, exothermic welding, welding, or other effective means to create a 20 foot (6096 mm) or greater length~~;~~.
(2) Bare copper conductor not smaller than 4 AWG.
Metal components shall be encased by at least 2 inches (51 mm) of concrete and ~~shall~~ be located horizontally within that portion of a concrete foundation or footing that is in direct contact with the earth or within vertical foundations or structural components or members that are in direct contact with the earth. If multiple concrete-encased electrodes are present at a building or structure, ~~it shall be permissible to bond~~bonding only one into the grounding electrode system shall be permitted. [NFPA 70:250.52(A)(3)]

820.1.9 Not Permitted for Use as Grounding Electrodes. The following systems and materials shall not be used as grounding electrodes:
(1) Metal underground gas piping systems.
(2) Aluminum.
(3) The structures and structural rebar ~~steel~~ described in Section 680.26(B)(1) and Section 680.26(B)(2) of NFPA 70. [NFPA 70:250.52(B)]
820.2 Buildings or Structures Supporting ~~a~~ PV ~~Array~~Systems. ~~A b~~Buildings or structure~~(s)~~ supporting ~~a~~ PV systems shall ~~utilize~~ use a grounding electrode system installed in accordance with ~~Section 820.3~~Part III of Article 250 of NFPA 70.
PV array equipment grounding conductors shall be connected to a grounding electrode system in accordance with Part VII of Article 250 of NFPA 70,~~. This connection shall be~~ in addition to any other equipment grounding conductor requirements in Section 818.1.3. The minimum size of grounding electrode conductors shall be sized in accordance with Section 250.66 of NFPA 70. The PV array equipment grounding conductors shall be sized in accordance with Section 819.1.
For specific PV system grounding configurations permitted in Section 816.1, one of the following conditions shall apply:
(1) For PV systems that are not solidly grounded, ~~the~~ equipment grounding conductors for the output of ~~the~~ PV systems, where connected to associated distribution equipment connected to a grounding electrode system, shall be permitted to be the only connection to ground for the system.
(2) For solidly grounded PV systems, as permitted in Section ~~816.1(5)~~816.1(3), the grounded conductors shall be connected to a grounding electrode system by means of ~~a~~ grounding electrode conductors sized in accordance with Section 820.2.1. [NFPA 70:690.47(A)]

~~**820.3 Grounding Electrodes and Grounding Electrode Conductors.** Additional grounding electrodes shall be permitted to be installed in accordance with Section 250.54 of NFPA 70, and Section 820.1.1 through Section 820.1.9 of this chapter. Grounding electrodes shall be permitted to be connected directly to the PV module frame(s) or support structure. A grounding electrode conductor shall be sized according to Section 250.66 of NFPA 70. A support structure for a ground-mounted PV array shall be permitted to be considered a grounding electrode if it meets the requirements of Section 820.1.1 through Section 820.1.9. PV arrays mounted to buildings shall be permitted to use the metal structural frame of the building if the requirements of Section 250.68(C)(2) of NFPA 70 are met. [NFPA 70:690.47(B)]~~

Part VI – Marking.

821.0 Marking.
821.1 Identification of Power Sources. Permanent plaques, labels, or directories shall be installed at each service equipment location, or at an approved readily visible location in accordance with the following:
(1) Denote the location of each power source disconnecting means for the building or structure.

Exception: Installations with multiple co-located power production sources shall be permitted to be identified as ~~a~~ group~~(s)~~. ~~The p~~Plaques, labels, or ~~directory~~directories shall not be required to identify each power source individually.
(2) Indicate the emergency telephone numbers of any off-site entities servicing the power source systems.
(3) Be marked with the wording "CAUTION: MULTIPLE SOURCES OF POWER." ~~The marking shall comply with Section 821.2.~~ [NFPA 70:705.10]

822.0 Marking Direct-Current Photovoltaic Circuits.
822.1 Labeling. It shall be permitted to round up to a value greater than the calculated PV dc circuit maximum voltage to allow standardized labeling. ~~A p~~Permanent readily visible labels indicating the highest maximum dc voltage in ~~a~~ PV systems~~, calculated in accordance with Section 804.1,~~ shall be provided by ~~the~~ installers at one of the following locations:
(1) DC PV system disconnecting means.
(2) PV system electronic power conversion equipment.
(3) Distribution equipment associated with ~~the~~ PV systems. [NFPA 70:690.7(D)]

823.0 Disconnecting Means.
823.1 Markings. Each PV system disconnecting means shall ~~plainly indicate whether in the open (off) or closed (on) position and~~ be permanently marked "PV SYSTEM DISCONNECT" or equivalent. [NFPA 70:690.13(C)] Disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position. ~~Additional markings shall be permitted based upon the specific system configuration. For PV system disconnecting means w~~Where the line and load terminals ~~may be~~ of disconnecting means are capable of being energized in the open position, ~~the device~~disconnecting means shall be marked with the following words or equivalent:

WARNING:
ELECTRIC SHOCK HAZARD TERMINALS
ON THE LINE AND LOAD SIDES MAY BE
ENERGIZED IN THE OPEN POSITION

~~The warning sign(s) or label(s) shall comply with Section 821.2.~~ [NFPA 70:~~690.13(B)~~705.20(E), 705.20(F)]

825.0 Facilities with Stand-Alone Systems.
825.1 Identification of Power Sources. A permanent plaque, label, or directory shall be installed at ~~a~~each building ~~supplied by a stand-alone system at the~~ power source disconnecting means location, or at an approved readily visible location, and~~. The plaque, label, or directory shall~~ denote the location of each power source disconnecting means for the building ~~or be grouped with other plaques or directories for other on-site sources~~. Where multiple sources supply the building, markings shall comply with Section 821.1. [NFPA 70:710.10]
825.2 Buildings with Rapid Shutdown. Buildings with PV systems shall have a permanent label located at each service equipment location to which the PV systems are connected or at an approved readily visible location and shall indicate the location of rapid shutdown initiation devices. The label shall include a simple diagram of a building with a roof and shall include the following words:

SOLAR PV SYSTEM ~~IS~~ EQUIPPED WITH RAPID SHUTDOWN.
TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN
PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY.

The ~~title~~letters for the text "SOLAR PV SYSTEM ~~IS~~ EQUIPPED WITH RAPID SHUTDOWN" shall ~~have these letters~~be capitalized and ~~having~~have a minimum height of 3/8 inch (9.5 mm). All text shall be legible and contrast the background. [NFPA 70:690.12(D)] [See Figure 825.2]

Part VIII – Energy Storage Systems.

828.0 Self-Regulating Charge Control.
828.1 General. (remaining text unchanged)

828.1.3 Diversion Charge Controller, Circuits with Diversion Charge Controller and Diversion Load. Circuits containing a diversion charge controller and a diversion load shall comply with the following:
(1) (remaining text unchanged)
(2) The conductor ampacity and the rating of the ~~overcurrent device~~OCPD for this circuit shall be at least 150 percent of the maximum current rating of the diversion charge controller. [NFPA 70:706.33(B)(2)]

Part IX – Large-Scale Photovoltaic (PV) Electric Power Production Facility.

829.0 Large-Scale Photovoltaic (PV) Electric Power Production Facility.

~~**829.3 Equipment.** All electrical equipment shall be approved for installation by one of the following:~~
~~(1) Listing and labeling.~~
~~(2) Be evaluated for the application and have a field label applied.~~
~~(3) Where products complying with Section 829.3(1) or Section 829.3(2) are not available, by engineering review validating that the electrical equipment is evaluated and tested to relevant standards or industry practice. [NFPA 70:691.5]~~

(renumber remaining sections)

829.9 ~~Fence~~ Bonding and Grounding. Details of the grounding electrode system shall be included in the documentation required by Section 829.4. Fence bonding and grounding requirements and details shall be included in the documentation required in Section 829.4. [NFPA 70:691.11]

203.0 – A –
Array. A mechanically and electrically integrated grouping of solar PV modules with ~~support structure~~mounting system, including any attached system components such as inverter~~(s)~~ or dc-to-dc converter~~(s)~~ and attached associated wiring. [NFPA 70:100]

204.0 – B –
Branch Circuit. The circuit conductors between the final overcurrent protective device (OCPD) protecting the circuit and the outlet(s). [NFPA 70:100]

218.0 – P –
Photovoltaic Module. A complete~~, environmentally protected~~ unit consisting of solar cells and other components designed to produce dc power. [NFPA 70:100]

Note: NFPA 70 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The above section is being revised to correlate with NFPA 70-2026 (latest version) in accordance with Section 16.0 of the IAPMO Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes (Extract Guidelines).

A read-only version of the standard is provided for your review at the following link: NFPA 70

Item #: 133

Code Number: 2024 USHGC

Section Number: Appendix G, Table 901.2

SUBMITTER: Jim Majerowicz

Organization Name: Plumbers Local 130, UA

Organization Representation:

RECOMMENDATION:
Add new text

Proposed Text :

APPENDIX G
PROFESSIONAL QUALIFICATIONS

G 101.0 General.

G 101.1 Scope. The provisions of this appendix address minimum qualifications for installers, inspectors, or employers for systems covered within the scope of this code.

G 102.0 Qualifications.

G 102.1 General. Where permits are required, the Authority Having Jurisdiction shall have the authority to require contractors, installers, or service technicians to demonstrate competency. Where determined by the Authority Having Jurisdiction, the contractor or technician shall be licensed or certified to perform such work. Professional qualifications shall be required for an individual to demonstrate the required level of competency.

G 102.2 Inspectors and Plans Examiners. Professional qualification for mechanical system inspectors and mechanical plans examiners shall be in accordance with ASSE/IAPMO/ANSI Series 16000.

G 102.2.1 Qualification for Mechanical Inspector. Professional qualification for mechanical inspectors shall be in accordance with ASSE/IAPMO/ANSI 16020.

G 102.2.2 Qualification for Mechanical Plan Examiner. Professional qualification for mechanical plan examiners shall be in accordance with ASSE/IAPMO/ANSI 16050.

G 102.3 Residential Mechanical Service Technician. Professional qualification for residential mechanical service technicians shall be in accordance with ASSE/IAPMO/ANSI Series 13000.

G 102.3.1 Qualification for Residential Mechanical Service Technician. Professional qualification for residential mechanical service technicians shall be with accordance ASSE/IAPMO/ANSI 13020.

G 102.4 Hydronic Systems. Personnel qualification for installers and designers of hydronic heating and cooling systems, as well as installers of solar water heaters shall be in accordance with ASSE/IAPMO/ANSI Series 19000.

G 102.4.1 Qualification for Solar Water Heating System Installer. Professional qualification for solar water heating system installers shall be in accordance with ASSE/IAPMO/ANSI 19110.

G 102.4.2 Qualification for Hydronic Heating and Cooling System Installer. Professional qualification for hydronic heating and cooling system installers shall be in accordance with ASSE/IAPMO/ANSI 19210.

G 102.4.3 Qualification for Hydronic Heating and Cooling System Designer. Professional qualification for hydronic heating and cooling system designers shall be in accordance with ASSE/IAPMO/ANSI 19220.

G 102.5 Water Management and Infection Control Risk Assessment for Building Systems. Professional qualification for construction and maintenance personnel and employers to identify and manage potentially hazardous exposure to bloodborne, waterborne and airborne pathogens. Also includes qualifications for members of a water safety team involved in the development of a risk assessment analysis, and water management and sampling plan, for protection from Legionella and other waterborne pathogens and persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella. Qualifications are in accordance with ASSE/IAPMO/ANSI/CAN Series 12000.

G 102.5.1 Qualification for Environment of Care, Infection Control and Construction Risk Assessment. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment procedures to protect facility operations, occupants, workers or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE/IAPMO/ANSI/CAN 12010.

G 102.5.2 Qualification for Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard for Construction and Maintenance Employers. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment requirements and procedures to protect facility operations, occupants, workers, or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE/IAPMO/ANSI/CAN 12020. It also provides general knowledge of employer responsibilities to the worker and to the facility.

G 102.5.3 Qualification for Water Quality Program, Pipefitters and HVAC Technicians. Professional qualification for water quality program for pipe fitters and HVAC technicians shall be in accordance with ASSE/IAPMO/ANSI/CAN 12062.

G 102.5.4 Legionella Water Safety and Management Personnel. Professional qualification of persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella shall be in accordance with ASSE/IAPMO/ANSI/CAN 12080.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASSE/IAPMO/ANSI/CAN Series 12000-2024	Professional Qualifications Standard for Water Management and Infection Control Risk Assessment for Building Systems	Professional Qualifications
ASSE/IAPMO/ANSI/CAN 12010-2024	Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard	Professional Qualifications
ASSE/IAPMO/ANSI/CAN 12020-2024	Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard for Construction and Maintenance Employers	Professional Qualifications
ASSE/IAPMO/ANSI/CAN 12062-2024	Water Quality Program Professional Qualifications Standard for Pipefitters and HVAC Technicians	Professional Qualifications
ASSE/IAPMO/ANSI/CAN 12080-2024	Professional Qualification Standard for Legionella Water Safety and Management Specialist	Professional Qualifications
ASSE/IAPMO/ANSI Series 13000-2015(R2020)	Service Plumber and Residential Mechanical Service Technician Professional Qualifications Standard	Professional Qualifications
ASSE/IAPMO/ANSI 13020-2015(R2020)	Professional Qualifications Standard for the Residential Mechanical Service Technician	Professional Qualifications
ASSE/IAPMO/ANSI Series 16000-2019(R2025)	Professional Qualifications Standard for Inspectors and Plans Examiners	Professional Qualifications
ASSE/IAPMO/ANSI 16020-2019(R2025)	Professional Qualifications Standard for the Mechanical Inspector	Professional Qualifications
ASSE/IAPMO/ANSI 16050-2019(R2025)	Professional Qualifications Standard for the Mechanical Plan Examiner	Professional Qualifications
ASSE/IAPMO/ANSI Series 19000-2015(R2020)	Hydronic Systems Professional Qualifications Standard	Professional Qualifications

ASSE/IAPMO/ANSI 19110-2015(R2020)	Professional Qualifications Standard for the Solar Water Heating System Installer	Professional Qualifications
ASSE/IAPMO/ANSI 19210-2015(R2020)	Professional Qualifications Standard for the Hydronic Heating and Cooling System Installer	Professional Qualifications
ASSE/IAPMO/ANSI 19220-2015(R2020)	Professional Qualifications Standard for the Hydronic Heating and Cooling System Designer	Professional Qualifications

(portions of table not shown remain unchanged)

SUBSTANTIATION:
A new appendix is being proposed which provides minimum qualifications for installers, inspectors, or employers for systems covered within the scope of this code. These professional qualifications serve as a baseline for determining competency.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
8	7	0	0

Failed Ballot Disclaimer:
Note: Item # 133 failed to achieve the necessary two-thirds affirmative vote of returned ballots. In accordance with Section 6.8.2 of the Regulations Governing Consensus Development of the USHGC and USPSHTC, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF NEGATIVE:
CUDAHY: I agree with Jeff Matson's comment.

ISTEFAN: I agree with the concept; however, the list needs to be revised to include additional options or a method to accept equivalent qualifications.

KREITENBERG: It is unreasonable to have a Code Enforcement Officer policing these technicians.

KURTZ: I agree with the comments made by George Istefan and Jeff Matson. I agree that other equivalent professional qualification options should be included.

MACK: I agree with Jeff Matson's comment.

MATSON: While I recognize that the professional qualifications listed are optional at the AHJs discretion (and in an appendix), I feel that this list of requirements is overly restrictive and should only be adopted with the additional phrase "or equivalent." I will happily work with a task group to draft a public comment with such text. I support including qualifications in this code, but at this point, I prefer we submit a stronger and slightly more permissive set before acceptance.

PERSONS: The list of qualifications is exhaustive. I agree with Jeff Matson's comments. If the solar contractor is licensed for the work and is directing his installers, that should cover all bases. This would also be the case for any electrical/plumbing subcontractors if needed.

EXPLANATION OF AFFIRMATIVE:
TABAKH: I agree with the added language in 2025 USHGC TC Meeting Monograph.

Comment 1

Item #:
133

Code Number:
2024 USHGC

Sections(s):
Appendix G, Table 901.2

Submitter Name:
Jim Majerowicz

Organization Name:
Plumbers Local 130, UA

Organization Representation:

Recommendation:
Accept the Code Change Proposal as Submitted

Proposed Text:

Request to accept the code change proposal **as submitted** by this public comment.

Substantiation:
The USHGC governs solar thermal, hydronic, and geothermal systems that use complex and advanced components. However, the base code does not set minimum competency requirements for the professionals who install, design, inspect, or maintain these systems.

To address this issue, Appendix G references nationally recognized ASSE/IAPMO/ANSI qualifications that establish clear and measurable competency standards aligned with the technical needs of these systems. These ASSE/IAPMO/ANSI qualifications ensure that system work is performed by individuals with verified knowledge and skills, which helps reduce installation errors, safety risks, and performance problems.

By including Appendix G in the code, jurisdictions gain a consistent method for determining who is qualified to perform this work, and they may adopt and require these professional qualifications if they choose. The appendix also includes specialized qualifications for waterborne pathogen control and infection-risk management, which are essential for addressing issues such as Legionella.

Read-only versions of the ASSE/IAPMO/ANSI standards are provided for your review via the following links: ASSE/IAPMO/ANSI/CAN Series 12000, ASSE/IAPMO/ANSI Series 13000, ASSE/IAPMO/ANSI Series 16000, ASSE/IAPMO/ANSI Series 19000

Item #:
135

Code Number:
2024 USHGC

Section Number:
Table 901.1, Table 901.2

SUBMITTER:
Emily Toto

Organization Name:
ASHRAE

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASHRAE 34-~~2022~~2024	Designation and Safety Classification of Refrigerants	Refrigerant Classifications	706.3

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ANSI/ASHRAE/IES 90.1-~~2019~~2022	Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings	Energy

(portions of table not shown remain unchanged)

Note: ASHRAE 34 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASHRAE standards that are referenced in Table 901.1 and Table 901.2.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
135

Code Number:
2024 USHGC

Sections(s):
Table 901.2

Submitter Name:
Emily Toto

Organization Name:
ASHRAE

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASHRAE Handbook-~~2021~~2025	Fundamentals	Electrical

(portions of table not shown remain unchanged)

Substantiation:
The above revision reflects the latest update to the ASHRAE standard that is referenced in Table 901.2.

Item #:
136

Code Number:
2024 USHGC

Section Number:
Table 901.1, Table 901.2

SUBMITTER:
Steven Rossi

Organization Name:
ASME

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASME A112.4.1-2009 ~~(R2019)~~(R2024)	Water Heater Relief Valve Drain Tubes	Discharge Piping	311.3(2)
ASME B16.9-~~2018~~2024	Factory-Made Wrought Buttwelding Fittings	Fittings	Table 409.1
ASME B16.15-~~2018~~2024	Cast Copper Alloy Threaded Fittings: Classes 125 and 250	Fittings	Table 409.1
ASME B16.29-~~2017~~2022	Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings – DWV	Fittings	Table 409.1
ASME BPVC Section VIII.1-~~2021~~2023	Rules for Construction of Pressure Vessels Division 1	Miscellaneous	408.3, 601.2.1, 603.6, 605.2

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASME A13.1-~~2020~~2023	Scheme for the Identification of Piping Systems	Piping
ASME BPVC Section IV-~~2021~~2023	Rules for Construction of Heating Boilers	Miscellaneous
ASME BPVC Section IX-~~2021~~2023	Welding, Brazing, and Fusing Qualifications	Certification

(portions of table not shown remain unchanged)

Note: The ASME standards meet the requirements for mandatory referenced standards in accordance with Section15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermaland Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASME standards that are referenced in Table 901.1 and Table 901.2.

Committee Action:
Accept As Amended by the TC

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASME A112.4.1-2009 (R2024)	Water Heater Relief Valve Drain Tubes	Discharge Piping	311.3(2)
ASME B16.9-2024	Factory-Made Wrought Buttwelding Fittings	Fittings	Table 409.1
ASME B16.15-2024	Cast Copper Alloy Threaded Fittings: Classes 125 and 250	Fittings	Table 409.1
ASME B16.29-2022	Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings – DWV	Fittings	Table 409.1
ASME BPVC Section IV-2023	Rules for Construction of Heating Boilers	Boilers	717.2(6)
ASME BPVC Section VIII.1-2023	Rules for Construction of Pressure Vessels Division 1	Miscellaneous	408.3, 601.2.1, 603.6, 605.2

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASME A13.1-2023	Scheme for the Identification of Piping Systems	Piping
~~ASME BPVC Section IV-2023~~	~~Rules for Construction of Heating Boilers~~	~~Miscellaneous~~
ASME BPVC Section IX-2023	Welding, Brazing, and Fusing Qualifications	Certification

(portions of table not shown remain unchanged)

Committee Statement:
Item #136 is being amended to align with actions taken on Item #121.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
136

Code Number:
2024 USHGC

Sections(s):
Table 901.1, Table 901.2

Submitter Name:
Steven Rossi

Organization Name:
ASME

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASME B16.5-~~2020~~2025	Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/ Inch	Fittings	Table 409.1
ASME B16.26-~~2018~~2024	Cast Copper Alloy Fittings for Flared Copper Tubes	Fittings	Table 409.1
ASME B16.51-~~2021~~2025	Copper and Copper Alloy Press-Connect Pressure Fittings	Fittings	Table 409.1
ASME BPVC Section I-~~2023~~2025	Rules for Construction of Power Boilers	Boilers	717.2(6)
ASME BPVC Section IV-~~2023~~2025	Rules for Construction of Heating Boilers	Boilers	717.2(6)
ASME BPVC Section VIII.1-~~2023~~2025	Rules for Construction of Pressure Vessels Division 1	Miscellaneous	408.3, 601.2.1, 603.6, 605.2
ASME BPVC Section X-~~2021~~2025	Fiber-Reinforced Plastic Pressure Vessels	Pressure Vessel Construction, Pressure Vessels	603.6

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASME B16.34-~~2020~~2025	Valves - Flanged, Threaded, and Welding End	Valves
ASME B16.47-~~2020~~2025	Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/ Inch	Fittings
ASME BPVC Section IX-~~2023~~2025	Welding, Brazing, and Fusing Qualifications	Certification

(portions of table not shown remain unchanged)

Note: The ASME standards were not provided at the time of this monograph.

Substantiation:
The above revisions reflect the latest updates to the ASME standards that are referenced in Table 901.1 and Table 901.2.

Item #:
137

Code Number:
2024 USHGC

Section Number:
Table 901.1

SUBMITTER:
Terry Burger

Organization Name:
ASSE

Organization Representation:
ASSE

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASSE 1017-~~2009~~2023	Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems	Valves	311.5, 407.3.1
ASSE 1070/ASME A112.1070/CSA B125.70-2020 (R2025)	Water Temperature Limiting Devices	Valves	402.5
ASSE/IAPMO/ANSI/CAN 1079-~~2012 (R2021)~~2024	Performance Requirements for Dielectric Pipe Unions	Fittings	410.16.1

(portions of table not shown remain unchanged)

Note: The ASSE standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASSE standards that are referenced in Table 901.1.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:	Code Number:	Sections(s):
137	2024 USHGC	Table 901.1

Submitter Name:	Organization Name:	Organization Representation:
Terry Burger	ASSE	ASSE

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASSE/ANSI 1017-2023	Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems	Valves	311.5, 407.3.1
ASSE/ANSI 1061-~~2020~~2025	Performance Requirements for Push-Fit Fittings	Fittings	Table 409.1, 410.3(1), 410.5(5)

(portions of table not shown remain unchanged)

Note: ASSE/ANSI 1017 and ASSE/ANSI 1061 meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The above revisions reflect the latest updates to the ASSE standards that are referenced in Table 901.1.

Item #:
138

Code Number:
2024 USHGC

Section Number:
Table 901.1, Table 901.2

SUBMITTER:
Frank McConnell

Organization Name:
ASTM

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASTM A53/A53M-~~2022~~2024	Standard Specification for Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless	Piping	Table 409.1
ASTM A126-2004 ~~(R2019)~~(R2023)	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings	Piping	Table 409.1
ASTM A269/A269M-~~2022~~2024	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service	Piping	Table 409.1
ASTM A312/A312M-~~2022a~~2024b	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes	Piping	Table 409.1
ASTM A420/A420M-~~2022~~2024a	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service	Fittings	Table 409.1
ASTM A778/A778M-~~2022~~2024a	Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products	Piping	Table 409.1
ASTM B280-~~2020~~2023	Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service	Piping	715.3
ASTM B813-~~2016~~2024	Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube	Joints	410.5(6)
ASTM B828-~~2016~~2023	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings	Joints	410.5(6)
ASTM D2241-~~2020~~2024	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)	Piping	Table 409.1
ASTM D2464-~~2015~~2023	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 409.1

ASTM D2466-~~2021~~2024	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40	Fittings	Table 409.1
ASTM D2467-~~2020~~2024	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 409.1
ASTM D2564-2020 (R2024)	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems	Joints	410.13(2)
ASTM D2609-~~2021~~2024	Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe	Fittings	Table 409.1
ASTM D2846/D2846M-~~2019a~~2024	Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems	Piping	Table 409.1, 410.3(2), 410.4(2)
ASTM D3261-~~2016~~2024	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing	Fittings	Table 409.1, Table 703.3
ASTM D3350-~~2021~~2024	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials	Piping	Table 409.1, 703.4.1, 703.4.2
ASTM E84-~~2023~~2024	Standard Test Method for Surface Burning Characteristics of Building Materials	Miscellaneous	401.2, 502.4, 503.1, 606.5
ASTM F437-~~2021~~2024	Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 409.1
ASTM F438-~~2017~~2023	Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40	Fittings	Table 409.1
ASTM F439-~~2019~~2024	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 409.1
ASTM F441/F441M-~~2020~~2023	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80	Piping	Table 409.1
ASTM F442/F442M-~~2020~~2023	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)	Piping, Plastic	Table 409.1, 410.3(2)
ASTM F714-~~2022~~2024	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter	Piping	Table 409.1, Table 703.2
ASTM F876-~~2023~~2024b	Standard Specification for Crosslinked Polyethylene (PEX) Tubing	Piping	Table 409.1, 410.6, Table 703.2
ASTM F877-~~2023~~2024	Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems	Piping	Table 409.1, Table 703.3
ASTM F1281-~~2023~~2024	Standard Specification for Crosslinked Polyethylene/ Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe	Piping	Table 409.1

ASTM F1282-~~2017~~2023a	Standard Specification for Polyethylene/ Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe	Piping	Table 409.1
ASTM F1476-2007 ~~(R2019)~~(R2024)	Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications	Fittings	Table 409.1
ASTM F1548-2001 ~~(R2018)~~(R2023)	Standard Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications	Fittings	Table 409.1
ASTM F1960-~~2023~~2024	Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 409.1, Table 703.3
ASTM F1970-~~2023~~2024	Standard Specification for Special Engineered Fittings, Appurtenances or Valves for Use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems	Piping	Table 409.1
ASTM F1974-~~2009 (R2020)~~2023	Standard Specification for Metal Insert Fittings for Polyethylene/Aluminum/Polyethylene and Crosslinked Polyethylene/Aluminum/ Crosslinked Polyethylene Composite Pressure Pipe	Fittings	Table 409.1, 410.7(1), 410.10(1)
ASTM F2098-~~2018~~2024	Standard Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) to Metal Insert and Plastic Insert Fittings	Fittings	Table 409.1
ASTM F2165-~~2019~~2024	Standard Specification for Flexible Pre-Insulated Plastic Piping	Fittings, Piping and Tubing	Table 409.1
ASTM F2389-~~2023~~2024a	Standard Specification for Pressure-Rated Polypropylene (PP) Piping Systems	Piping	Table 409.1, 410.12(1), Table 703.2, Table 703.3
ASTM F2620-~~2020a~~$^{\text{e2}}$2024	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings	Joints	410.9(1), 410.9(3), 703.4.1.1(1), 703.4.1.1(2)
ASTM F2623-~~2022~~2024$^{\text{e1}}$	Standard Specification for Polyethylene of Raised Temperature (PE-RT) Systems for Non-Potable Water Applications	Piping	Table 409.1, Table 703.2
ASTM F2735-~~2021~~2023	Standard Specification for Plastic Insert Fittings for SDR9 Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 409.1

ASTM F2769-~~2023~~2024	Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems	Piping, Fitting	Table 409.1, Table 703.2, Table 703.3
ASTM F2855-2019 (R2024)	Standard Specification for Chlorinated Poly (Vinyl Chloride) /Aluminum/Chlorinated Poly (Vinyl Chloride) (CPVC- AL-CPVC) Composite Pressure Tubing	Piping, Plastic	Table 409.1
ASTM F3226/F3226M-2019 (R2024)	Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems	Fittings	Table 409.1
ASTM F3253-~~2019~~2024	Standard Specification for Crosslinked Polyethylene (PEX) Tubing with Oxygen Barrier for Hot- and Cold-Water Hydronic Distribution Systems	Piping, Fittings	Table 409.1, 410.6
ASTM F3348-2023a	Standard Specification for Plastic Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 409.1, Table 703.3

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASTM D2855-2020 (R2024)	Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets	Joints
ASTM E136-~~2022~~2024c	Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C	Furnace
ASTM F891-~~2016~~2024	Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core	Piping, Plastic

(portions of table not shown remain unchanged)

Note: The ASTM standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASTM standards that are referenced in Table 901.1 and Table 901.2.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
138

Code Number:
2024 USHGC

Sections(s):
410.7, Table 409.1, Table 703.3, Table 901.1, Table 901.2

Submitter Name:
Frank McConnell

Organization Name:
ASTM

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASTM A269/A269M-~~2024~~2025	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service	Piping	Table 409.1
ASTM A312/A312M-~~2024b~~2025	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes	Piping	Table 409.1
ASTM A420/A420M-~~2024a~~2025a	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service	Fittings	Table 409.1
ASTM B42-~~2020~~2025	Standard Specification for Seamless Copper Pipe, Standard Sizes	Piping	Table 409.1
ASTM B43-~~2020~~2026	Standard Specification for Seamless Red Brass Pipe, Standard Sizes	Piping	Table 409.1

ASTM B135/B135M-~~2017~~2026	Standard Specification for Seamless Brass Tube	Piping	Table 409.1
ASTM B251/B251M-~~2017~~2025	Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	Piping	Table 409.1
ASTM D93-~~2020~~2025	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester	Heat Transfer Fluid	413.4, 501.13, 701.11
ASTM D2241-~~2024~~2025a	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)	Piping	Table 409.1
ASTM D2737-~~2022~~2025	Standard Specification for Polyethylene (PE) Plastic Tubing	Piping	Table 409.1, Table 703.2
ASTM D3139-2019 (R2025)	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals	Joints	410.13(1)
ASTM E84-~~2024~~2025	Standard Test Method for Surface Burning Characteristics of Building Materials	Miscellaneous	401.2, 502.3.1, 503.1, 606.5
ASTM F656-~~2021~~2025	Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings	Joints	410.3(2), 410.4(2), 410.13(2)
ASTM F714-~~2024~~2025	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter	Piping	Table 409.1, Table 703.2
ASTM F876-~~2024b~~2025	Standard Specification for Crosslinked Polyethylene (PEX) Tubing	Piping	Table 409.1, 410.6, Table 703.2
ASTM F877-~~2024~~2025	Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems	Piping	Table 409.1, Table 703.3
ASTM F1281-~~2024~~2025^{e1}	Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe	Piping	Table 409.1
ASTM F1807-~~2023~~2026	Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps, for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 409.1, Table 703.3
ASTM F2098-~~2024~~2025	Standard Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) to Metal Insert and Plastic Insert Fittings	Fittings	Table 409.1

~~ASTM F2434-2019~~	~~Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/ Aluminum/ Cross-linked Polyethylene (PEX-AL-PEX) Tubing~~ (WITHDRAWN)	~~Fittings~~	~~Table 409.1, 410.7(1), Table 703.3~~
ASTM F2623-~~2024$^{\epsilon 1}$~~2025	Standard Specification for Polyethylene of Raised Temperature (PE-RT) Systems for Non-Potable Water Applications	Piping	Table 409.1, Table 703.2
ASTM F3253-~~2024~~2025	Standard Specification for Crosslinked Polyethylene (PEX) Tubing with Oxygen Barrier for Hot- and Cold-Water Hydronic Distribution Systems	Piping, Fittings	Table 409.1, 410.6

(portions of table not shown remain unchanged)

Note: The ASTM standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASTM A733-~~2016 (R2022)~~2025	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples	Piping, Ferrous
ASTM E136-~~2024e~~2026	Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C	Furnace
ASTM F480-~~2014 (R2022)~~2025	Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80	Piping, Plastic

(portions of table not shown remain unchanged)

TABLE 409.1
MATERIALS FOR HYDRONIC AND SOLAR THERMAL SYSTEM, PIPING, TUBING, AND FITTINGS

MATERIAL	STANDARDS	
	PIPING/TUBING	FITTINGS
Cross-Linked Polyethylene/Aluminum/ Cross-Linked Polyethylene (PEX-AL-PEX)	ASTM F1281, ASTM F2165, CSA B137.10	ASTM F1281, ASTM F1974, ASTM F2165, ~~ASTM F2434,~~ CSA B137.10

(portions of table not shown remain unchanged)

410.0 Joints and Connections.

410.7 Cross-Linked Polyethylene/Aluminum/ Cross-Linked Polyethylene (PEX-AL-PEX) Pipe. Joints between cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints between PEX-AL-PEX pipe and fittings shall include mechanical and compression type fittings and insert fittings with a crimping ring. Insert fittings utilizing a crimping ring shall be in accordance with ASTM F1974~~ or ASTM F2434~~. Crimp joints for crimp insert fittings shall be joined to PEX-AL-PEX pipe by the compression of a crimp ring around the outer circumference of the pipe, forcing the pipe material into annular spaces formed by ribs on the fitting.
(2) (remaining text unchanged)

TABLE 703.3
MATERIALS FOR GROUND HEAT EXCHANGER FITTINGS

MATERIAL	STANDARDS
Cross-Linked Polyethylene (PEX)	ASTM F877, ASTM F1055, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2159, ~~ASTM F2434,~~ ASTM F3347, ASTM F3348, CSA B137.5, NSF/ANSI 358-3

(portions of table not shown remain unchanged)

Substantiation:
The above revisions reflect the latest updates to ASTM standards referenced in Tables 901.1 and 901.2, including the removal of ASTM F2434, which has been withdrawn by ASTM without replacement. Existing references throughout the code have been stricken accordingly.

Item #:
139

Code Number:
2024 USHGC

Section Number:
Table 901.1, Table 901.2

SUBMITTER:
Paul Olson

Organization Name:
AWWA

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
AWWA C111/A21.11-~~2017~~2023	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings	Joints	410.8
AWWA C151/A21.51-~~2017~~2023	Ductile-Iron Pipe, Centrifugally Cast	Piping	Table 409.1

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
AWWA C507-~~2018~~2023	Ball Valves, ~~6~~4 In. through 60 In. (~~150~~100 mm Through 1,500 mm)	Valves

(portions of table not shown remain unchanged)

Note: The AWWA standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the AWWA standards that are referenced in Table 901.1 and Table 901.2.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
139

Code Number:
2024 USHGC

Sections(s):
Table 901.1

Submitter Name:
Paul Olson

Organization Name:
AWWA

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal <u>**as modified**</u> by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
AWWA C901-~~2020~~<u>2025</u>	Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. (19 mm) Through 3 In. (76 mm), for Water Service	Piping	Table 409.1, Table 703.2, 703.4.1

(portions of table not shown remain unchanged)

Note: AWWA C901 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The above revision reflects the latest update to the AWWA standard that is referenced in Table 901.1.

Comment 2

Item #:
139

Code Number:
2024 USHGC

Sections(s):
Table 901.2

Submitter Name:
Julia Bloxham

Organization Name:
BSI

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
BS EN 12975~~-1~~-~~2006 (R2010)~~2022	~~Thermal Solar Systems and Components –~~ Solar Collectors – ~~Part 1:~~ General Requirements	Collector
BS EN ISO 9806-~~2017~~2025	Solar Energy – Solar Thermal Collectors – Test Methods	Collector

(portions of table not shown remain unchanged)

Substantiation:
The above revisions reflect the latest updates to the BS standards that are referenced in Table 901.2.

Item #: 140

Code Number: 2024 USHGC

Section Number: Table 901.1

SUBMITTER: Nikki Kidd

Organization Name: CSA

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
CSA B137.1-~~2020~~2023	Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services	Piping	Table 409.1, Table 703.2, Table 703.3
CSA B137.2-~~2020~~2023	Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications	Fittings	Table 409.1
CSA B137.3-~~2020~~2023	Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications	Piping, Fittings	Table 409.1
CSA B137.5-~~2020~~2023	Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications	Piping	Table 409.1, Table 703.2, Table 703.3
CSA B137.6-~~2020~~2023	Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing, and Fittings for Hot- and Cold-Water Distribution Systems	Piping, Fittings	Table 409.1
CSA B137.9-~~2020~~2023	Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure-Pipe Systems	Piping	Table 409.1
CSA B137.10-~~2020~~2023	Crosslinked Polyethylene/ Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Composite Pressure-Pipe Systems	Piping	Table 409.1
CSA B137.11-~~2020~~2023	Polypropylene (PP-R & PP-RCT) Pipe and Fittings for Pressure Applications	Piping	Table 409.1, 410.12(1), Table 703.2, Table 703.3
CSA B137.18-~~2020~~2023	Polyethylene of Raised Temperature Resistance (PE-RT) Tubing Systems for Pressure Applications	Piping, Fittings	Table 409.1, Table 703.2, Table 703.3
CSA C22.2 No. 108-2014 ~~(R2019)~~(R2024)	Liquid Pumps	Pumps	308.1.1
CSA/ANSI Z21.10.1-2019 (R2024)/CSA 4.1-2019 (R2024)	Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less	Fuel Gas, Appliances	Table 403.2

CSA/ANSI Z21.10.3-2019 (R2024)/CSA 4.3-2019 (R2024)	Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous	Fuel Gas, Appliances	Table 403.2

(portions of table not shown remain unchanged)

Note: The CSA standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the CSA standards that are referenced in Table 901.1.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE: 15
NEGATIVE: 0
ABSTAIN: 0
NOT RETURNED: 0

Comment 1

Item #:
140

Code Number:
2024 USHGC

Sections(s):
Table 901.1, Table 901.2

Submitter Name:
Nikki Kidd

Organization Name:
CSA

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
ASSE 1070/ASME A112.1070/CSA B125.70-2020 (R2025)	Performance Requirements for Water Temperature Limiting Devices	Valves	403.7.1
CSA/ANSI~~/CSA~~/IGSHPA C448 Series-~~2016~~ ~~(R2021)~~2025	Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings	Ground-Source Heat Pumps	701.11.1, Table 703.2, Table 703.3, 708.7, 709.1, 710.7, 710.7.2, 715.4

(portions of table not shown remain unchanged)

Note: The CSA standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ANSI Z21.22-2015 (~~R2020~~R2025) /CSA 4.4-2015 (~~R2020~~R2025)	Relief Valves for Hot Water Supply Systems	Valves

(portions of table not shown remain unchanged)

Substantiation:
The above revisions reflect the latest updates to the CSA standards that are referenced in Table 901.1 and Table 901.2.

Item #:
141

Code Number:
2024 USHGC

Section Number:
Table 901.2

SUBMITTER:
Terry Burger

Organization Name:
IAPMO

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
IAPMO/ANSI WE•Stand-~~2020~~2023	Water Efficiency and Sanitation Standard for the Built Environment	Water Conservation

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The above revision reflects the latest update to the IAPMO standard that is referenced in Table 901.2.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
141

Code Number:
2024 USHGC

Sections(s):
Table 901.1

Submitter Name:
Terry Burger

Organization Name:
ASSE

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
IAPMO S1001.1-2013 (~~R2019~~R2024)	Design and Installation of Solar Water Heating Systems	Solar Thermal Systems	501.7

(portions of table not shown remain unchanged)

Note: IAPMO S1001.1 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The above revision reflects the latest update to the IAPMO standard that is referenced in Table 901.1.

Comment 2

Item #:
141

Code Number:
2024 USHGC

Sections(s):
Table 901.1

Submitter Name:
Lorna Soderberg

Organization Name:
MSS

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
MSS SP-58-~~2018~~2025	Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation ~~(including Amendment 1, dated October 17, 2019)~~	Hangers and Supports	317.3

(portions of table not shown remain unchanged)

Note: MSS SP-58 meets the requirements for a mandatory referenced standard in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The above revision reflects the latest update to the MSS standard that is referenced in Table 901.1.

Comment 3

Item #:
141

Code Number:
2024 USHGC

Sections(s):
Table 901.2

Submitter Name:
Daniel Abbate

Organization Name:
NEMA

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ANSI/NEMA EN 10250-~~2020~~2024	Enclosures for Electrical Equipment (1000 Volts Maximum)	Electrical

(portions of table not shown remain unchanged)

Substantiation:
The above revision reflects the latest update to the NEMA standard that is referenced in Table 901.2.

NEMA has published an update to ANSI/NEMA 250-2020. The new version is designated as ANSI/NEMA 10250, Enclosures for Electrical Equipment (1000 Volts Maximum), and reflects current technology, safety considerations, and harmonization with international standards.

Item #:
142

Code Number:
2024 USHGC

Section Number:
Table 901.2

SUBMITTER:
Alexander Ing

Organization Name:
NFPA

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
NFPA 13D-~~2022~~2025	Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes	Fire Safety
NFPA 54/Z223.1-~~2021~~2024	National Fuel Gas Code	Fuel Gas
NFPA 70E-~~2021~~2024	Electrical Safety in the Workplace	Electrical Safety
NFPA 274-~~2018~~2023	Standard Test Method to Evaluate Fire Performance Characteristics of Pipe Insulation	Pipe Insulation

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the NFPA standards that are referenced in Table 901.2.

Read-only versions of the NFPA standards are provided for your review via the following links: NFPA 13D, NFPA 54/Z223.1, NFPA 70E, NFPA 274

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:
15

NEGATIVE:
0

ABSTAIN:
0

NOT RETURNED:
0

Comment 1

Item #:
142

Code Number:
2024 USHGC

Sections(s):
Table 901.1

Submitter Name:
Alexander Ing

Organization Name:
NFPA

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
NFPA 70-~~2023~~2026	National Electrical Code	Miscellaneous	304.4.5, 315.1, 801.2, 804.1, 806.1.3(4)(d), 806.4.1(2), 807.2, 809.1.1, 812.2.2(2), 812.3.2, 812.3.3, 812.3.4, 812.3.5, 812.3.6, 812.4.2(8), 812.4.2(11), 812.4.2(12), 812.6, 818.1, 818.1.3.1, 818.1.4, 819.1, 819.2.1, 819.2.3, Table 819.1, 820.1.9(3), 820.2, 820.2.2, 820.3, 826.1, 827.1, 829.2(2), 829.4, B 104.1
NFPA 855-~~2023~~2026	Standard for the Installation of Stationary Energy Storage Systems	Electrical	827.1

(portions of table not shown remain unchanged)

Note: The NFPA standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

Substantiation:
The above revisions reflect the latest updates to the NFPA standards that are referenced in Table 901.1.

Read-only versions of the NFPA standards are provided for your review via the following links: NFPA 70, NFPA 855

Item #: 143

Code Number: 2024 USHGC

Section Number: Table 901.1, Table 901.2

SUBMITTER: Jeremy Brown

Organization Name: NSF

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
NSF/ANSI/CAN 60-~~2021~~2024	Drinking Water Treatment Chemicals - Health Effects	Backfill	710.7.1
NSF/ANSI/CAN 61-~~2022~~2024	Drinking Water System Components - Health Effects	Miscellaneous	501.5.4, 712.1
NSF/ANSI 358-1-~~2021~~2022	Polyethylene Pipe and Fittings for Water-Based Ground-Source "Geothermal" Heat Pump Systems	Piping, Fittings	Table 409.1, Table 703.2, Table 703.3
NSF/ANSI 358-2-~~2017~~2022	Polypropylene Pipe and Fittings for Water-Based Ground-Source "Geothermal" Heat Pump Systems	Piping, Fittings	Table 409.1, Table 703.2, Table 703.3
NSF/ANSI/CAN 372-~~2022~~2024	Drinking Water System Components - Lead Content	Miscellaneous	712.1

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
NSF/ANSI 14-~~2022~~2023	Plastics Piping System Components and Related Materials	Piping, Plastic

(portions of table not shown remain unchanged)

Note: The NSF standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the NSF standards that are referenced in Table 901.1 and Table 901.2.

Committee Action:
Accept As Amended by the TC

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
NSF/ANSI/CAN 60-2024	Drinking Water Treatment Chemicals - Health Effects	Backfill	710.7.1
NSF/ANSI/CAN 61-2024	Drinking Water System Components - Health Effects	Miscellaneous	501.5.4, 712.1
NSF/ANSI 358-1-2022	Polyethylene Pipe and Fittings for Water-Based Ground-Source "Geothermal" Heat Pump Systems	Piping, Fittings	Table 409.1, Table 703.2, Table 703.3
NSF/ANSI 358-2-2022	Polypropylene Pipe and Fittings for Water-Based Ground-Source "Geothermal" Heat Pump Systems	Piping, Fittings	Table 409.1, Table 703.2, Table 703.3
~~NSF/ANSI/CAN 372-2024~~	~~Drinking Water System Components - Lead Content~~	~~Miscellaneous~~	~~712.1~~

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
NSF/ANSI 14-2023	Plastics Piping System Components and Related Materials	Piping, Plastic
NSF/ANSI/CAN 372-2024	Drinking Water System Components - Lead Content	Miscellaneous

(portions of table not shown remain unchanged)

Committee Statement:
Item #143 is being amended to align with the actions taken on Item #076.

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
143

Code Number:
2024 USHGC

Sections(s):
Table 901.2

Submitter Name:
Jeremy Brown

Organization Name:
NSF

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal **as modified** by this public comment.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
NSF/ANSI 14-~~2023~~2024	Plastics Piping System Components and Related Materials	Piping, Plastic

(portions of table not shown remain unchanged)

Substantiation:
The above revision reflects the latest update to the NSF standard that is referenced in Table 901.2.

Item #:
144

Code Number:
2024 USHGC

Section Number:
Table 901.1, Table 901.2

SUBMITTER:
Nikita Patel

Organization Name:
UL

Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text :

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
UL 98B-~~2015~~2024	Outline of Investigation for Enclosed and Dead-front Switches for use in Photovoltaic Systems	Electrical	Table 802.2.1
UL 248-2019	Low-Voltage Fuses – Part 19: Photovoltaic Fuses (with revisions through ~~February 28, 2020~~ November 25, 2024)	Electrical	Table 802.2.1
UL 723-2018	Test for Surface Burning Characteristics of Building Materials (with revisions through April 27, 2023)	Miscellaneous	401.2, 502.4, 503.1, 606.5
UL 778-2016	Motor-Operated Water Pumps (with revisions through ~~June 29, 2021~~July 23, 2024)	Pumps	308.1.1, 310.1
UL 834-2004	Heating, Water Supply, and Power Boilers – Electric (with revisions through ~~July 17, 2019~~ July 8, 2024)	Appliances	Table 403.2
UL 1699B-2018	Photovoltaic (PV) DC Arc-Fault Circuit Protection (with revisions through ~~May 18, 2021~~July 9, 2024)	Electrical	Table 802.2.1
UL 1703-2002	Flat-Plate Photovoltaic Modules and Panels (with revisions through ~~November 25, 2019~~ May 15, 2024)	Electrical	Table 802.2.1
UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources (with revisions through ~~October 18, 2022~~October 23, 2024)	Electrical	Table 802.2.1
UL 1995-~~2022~~2015	Heating and Cooling Equipment (with revisions through August 1, 2022)	Heat Pumps	407.5, 706.1
UL 2703-2015	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels (with revisions through ~~March 24, 2021~~ July 11, 2024)	Electrical	Table 802.2.1

UL 2989-~~2022~~2024	Outline of Investigation for Tracer Wire	Tracer Wire	707.18.8
UL 3730-2014	Photovoltaic Junction Boxes (with revisions through ~~June 11, 2021~~July 10, 2024)	Electrical	Table 802.2.1
UL 6703-2014	Connectors for Use in Photovoltaic Systems (with revisions through ~~June 10, 2021~~June 25, 2024)	Electrical	Table 802.2.1
UL 61730-2-2022	Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for Testing (with revisions through November 10, 2023)	Electrical	Table 802.2.1
UL 62109-1-2014	Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General Requirements (with revisions through ~~April 30, 2019~~November 28, 2023)	Electrical	Table 802.2.1

(portions of table not shown remain unchanged)

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
UL 174-2004	Household Electric Storage Tank Water Heaters (with revisions through ~~December 16, 2021~~November 1, 2024)	Appliances
UL 1453-2016	Electric Booster and Commercial Storage Tank Water Heaters (with revisions through ~~May 18, 2018~~February 4, 2025)	Appliances
UL 60730-1-~~2016~~2024	Automatic Electrical Controls – Part 1: General Requirements ~~(with revisions through October 18, 2021)~~	Electrical

(portions of table not shown remain unchanged)

Note: The UL standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

SUBSTANTIATION:
The above revisions reflect the latest updates to the UL standards that are referenced in Table 901.1 and Table 901.2.

Committee Action:
Accept As Submitted

TOTAL ELIGIBLE TO VOTE:
15

AFFIRMATIVE:	NEGATIVE:	ABSTAIN:	NOT RETURNED:
15	0	0	0

Comment 1

Item #:
144

Code Number:
2024 USHGC

Sections(s):
Table 901.1, Table 901.2

Submitter Name:
Nikita Patel

Organization Name:
UL

Organization Representation:

Recommendation:
Accept the Proposal as Modified

Proposed Text:

Request to accept the code change proposal as modified by this public comment.

TABLE 901.1
REFERENCED STANDARDS

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTIONS
UL 67-2018	Panelboards (with revisions through ~~August 1, 2024~~August 15, 2025)	Electrical	Table 802.2.1
UL 248-19-~~2019~~2015	Low-Voltage Fuses – Part 19: Photovoltaic Fuses (with revisions through November 25, 2024)	Electrical	Table 802.2.1
UL 489B-2016	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems (with revisions through ~~May 19, 2021~~August 26, 2025)	Electrical	Table 802.2.1
UL 723-2018	Test for Surface Burning Characteristics of Building Materials (with revisions through ~~April 27, 2023~~June 23, 2025)	Miscellaneous	401.2, 502.3.1, 503.1, 606.5
UL 1741-2021	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources (with revisions through ~~October 23, 2024~~April 22, 2025)	Electrical	Table 802.2.1
UL 2703-2015	Mounting Systems, Mounting Devices, Clamping/ Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels (with revisions through ~~July 11, 2024~~June 11, 2025)	Electrical	Table 802.2.1
UL 2846-2014	Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics (with revisions through ~~January 14, 2021~~July 14, 2025)	Piping	606.5
UL 3703-2015	Solar Trackers (with revisions through ~~April 7, 2020~~July 31, 2025)	Electrical	Table 802.2.1
UL 3730-2014	Photovoltaic Junction Boxes (with revisions through ~~July 10, 2024~~April 2, 2025)	Electrical	Table 802.2.1

UL 3741-2020	Photovoltaic Hazard Control (with revisions through October 20, 2025)	Electrical	Table 802.2.1
UL 9540-2023	Energy Storage Systems and Equipment (with revisions through March 7, 2025)	Electrical	Table 802.2.1
UL 60335-2-40-2022	Household and Similar Electrical Appliances- Safety-Part 2- 40: Particular Requirements for Electrical Heat Pumps, Air- Conditioners and Dehumidifiers (with revisions through October 31, 2025)	Heat Pumps	407.5, 706.1
UL 61730-2-2022	Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for Testing (with revisions through ~~November 10, 2023~~June 2, 2025)	Electrical	Table 802.2.1

(portions of table not shown remain unchanged)

Note: The UL standards meet the requirements for mandatory referenced standards in accordance with Section 15.0 of IAPMO's Regulations Governing Consensus Development of the Uniform Solar, Hydronics & Geothermal and Swimming Pool, Spa & Hot Tub Codes.

TABLE 901.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
UL 174-2004	Household Electric Storage Tank Water Heaters (with revisions through ~~November 1, 2024~~April 28, 2025)	Appliances

(portions of table not shown remain unchanged)

Substantiation:
The above revisions reflect the latest updates to the UL standards that are referenced in Table 901.1 and Table 901.2.

Task Group Reports

USHGC Geothermal Energy Systems Task Group Report

Task Group Members:	Representation:
Cary Smith (Chair)	Sound Geothermal Corporation
Jacob Fear	Simple Hydronics LLC
Greg Kurtz	IGSHPA
Lance MacNevin	PPI
James Majerowicz	Plumbers Local 130, UA
Jeff Persons	Self

During the Uniform Solar, Hydronics and Geothermal Code Technical Committee (USHGC TC) Teleconference Meeting on June 18, 2025, the USHGC TC requested that a Geothermal Energy Systems Task Group be formed.

The scope of the Geothermal Energy Systems Task Group, as approved by the USHGC Technical Committee, was to review proposals related to geothermal energy systems and district energy systems, as published in the 2025 USHGC Report on Proposals, and develop public comments for USHGC Technical Committee consideration towards the development of the 2027 edition of the USHGC.

Based on the 2025 USHGC ROP, the Task Group reviewed geothermal energy system requirements, along with related definitions, general regulations, and potential updates for correlation with the other chapters of the USHGC. From their review, the Task Group generated recommendations pertaining to materials, joints and connections, ground heat exchanger installation practices, valves, system commissioning and start-up, and labeling and identification. Four meetings were conducted to complete this review and discussion.

The Task Group dedicated considerable attention to the code's defined terms, proposing revisions aimed at improving technical accuracy, eliminating redundancy, and ensuring alignment with code requirements. Most notably, the existing definitions for geothermal system types were revised to draw a clear distinction between the broader concept of a geothermal energy system and the specific ground-source heat pump (GSHP) systems regulated by Chapter 7. This shift in terminology was then implemented throughout the chapter, with references to "geothermal system" updated to "GSHP system."

Following these terminology updates, the Task Group conducted a thorough review of the chapter's organizational structure. Provisions that were duplicated across multiple sections or misplaced relative to their scope were consolidated or relocated, with general requirements moved to Part I and system-specific requirements placed within their corresponding parts. The goal of this reorganization was to reduce redundancy, prevent potential conflicts, improve usability, and establish a logical framework for the chapter.

Material specifications and joining methods also received significant attention. The existing tables for ground heat exchanger piping, tubing, and fitting standards were consolidated and updated to incorporate new product standards for larger diameter PEX products while removing standards that had been withdrawn or were otherwise inapplicable. Corresponding updates were also proposed to the hydronic system material tables in Chapter 4 to maintain consistency across the code. Furthermore, provisions for joints and connections were relocated into a dedicated section, and general performance criteria were incorporated.

The remaining recommendations generated by the Task Group address heat transfer fluids, potable water protection, site surveys, subsurface investigations, system commissioning and start-up, labeling and identification, and documentation requirements.

Upon completion of their final meeting, the Task Group generated and submitted 50 public comments to the USHGC for consideration during the Technical Committee Meeting scheduled for May 12, 2026.

USHGC Hydronic Systems Task Group Report

Task Group Members:	Representation:
Jacob Fear (Chair)	Simple Hydronics LLC
Jeff Matson (Vice-Chair)	Viega LLC
George Istefan	Watts Water Technologies
Lance MacNevin	PPI
James Majerowicz	Plumbers Local 130, UA
Jeff Persons	Self
Donald Cary Smith	Sound Geothermal Corporation
Loren Subia	Self

During the Uniform Solar, Hydronics and Geothermal Code Technical Committee (USHGC TC) Teleconference Meeting on June 18, 2025, the USHGC TC requested that a Hydronic Systems Task Group be formed.

The scope of the Hydronic Systems Task Group, as approved by the USHGC Technical Committee, was to review proposals related to hydronic systems, as published in the 2025 USHGC Report on Proposals (ROP), and develop public comments for USHGC Technical Committee consideration towards the development of the 2027 edition of the USHGC.

Based on the 2025 USHGC ROP, the Task Group generated recommendations pertaining to chapter organization, heating appliances and equipment, terminal units, heat transfer fluids, and identification of piping systems. Three meetings were conducted to complete this review and discussion.

The Task Group's initial efforts focused on reorganizing the requirements in Chapter 4 (Hydronics) into distinct parts to separate general requirements from those applicable to specific system types: Part I (General), Part II (Steam Systems), Part III (Radiant Heating and Cooling Systems), and Part IV (Snow and Ice Melt Systems). This reorganization aims to improve usability and establish a logical framework for future code development and expansion of requirements for each system type.

Following this reorganization, the Task Group conducted a comprehensive review of all provisions relating to heating appliances and equipment and developed recommendations to make the following improvements: provide installation and sizing requirements for dedicated water heaters; consolidate appliance-specific requirements currently scattered across the chapter; incorporate the water heater sizing requirements developed by the UPC Water Heater Task Group; and update provisions for indirect-fired domestic hot-water storage tanks. Additionally, new provisions for cooling appliances and equipment were introduced to address a gap in the current code.

Another topic heavily researched and discussed was the use of detoxified ethylene glycol and providing enforceable toxicity thresholds for heat transfer fluids used in residential systems. The Task Group researched available and appropriate methods for determining toxicity classifications and, based on their findings, proposed a new exception to permit the use of detoxified ethylene glycol in one- and two-family residential systems, provided the fluid meets a specified minimum median lethal dose (LD_{50}) threshold consistent with practically non-toxic classifications on the Hodge and Sterner Scale.

The Task Group further generated recommendations addressing circulator and pump sizing terminology, labeling and identification requirements for hydronic piping systems, permitted joining methods for dissimilar metal connections, clarification of section titles for joints between different materials, and automatic makeup fluid provisions for both potable and nonpotable systems.

Upon completion of their final meeting, the Task Group generated and submitted 11 public comments to the USHGC for consideration during the Technical Committee Meeting scheduled for May 12, 2026.

USHGC Solar Thermal Systems Task Group Report

Task Group Members:	Representation:
Adam Chrisman (Chair)	SunEarth
Edmond Murray (Vice-Chair)	Aztec Solar Inc.
James Majerowicz	Plumbers Local 130, UA
James Richards	Sunbank Solar
Cary Smith	Sound Geothermal Corporation
Henry Vandermark	Solar Wave Energy, Inc.

During the Uniform Solar, Hydronics and Geothermal Code Technical Committee (USHGC TC) Teleconference Meeting on June 18, 2025, the USHGC TC requested that a Solar Thermal Systems Task Group be formed.

The scope of the Solar Thermal Systems Task Group, as approved by the USHGC Technical Committee, was to review proposals related to solar thermal systems, as published in the 2025 USHGC Report on Proposals (ROP), and develop public comments for USHGC Technical Committee consideration towards the development of the 2027 edition of the USHGC.

Based on the 2025 USHGC ROP, the Task Group generated recommendations pertaining to materials, heat transfer fluids, protection of the potable water supply, system design and installation, and thermal storage. Two meetings were conducted to complete this review and discussion.

Primary attention was aimed at improving requirements for protection of the potable water supply. New provisions modeled after hydronic system requirements were proposed to address prohibited connections, chemical injection, and backflow prevention in solar thermal systems using heat transfer fluids other than potable water. In addition, provisions for indirect thermosiphon systems were updated to close an existing gap in potable water protection.

The Task Group then reviewed provisions for heat transfer fluids and identified important topics insufficiently addressed. As a result, such provisions were expanded to address water quality, restrictions on the use of ethylene glycol, chemical compatibility of antifreeze and additives with system components, and proper disposal of system fluids. Furthermore, the marking requirements for solar thermal system piping were revised to ensure proper application based on system type by distinguishing between systems conveying potable water versus heat transfer fluids.

Another major area of focus was placed on reviewing and updating the material requirements to provide clarity, consistency throughout the code, and alignment with recognized product standards. This included refinements to the dissimilar metals provisions which clarify dielectric fitting usage and applicable product listings, revisions to avoid technically inaccurate and overly restrictive fastener requirements, expansion of material requirements to cover all mechanical equipment and components used in solar thermal systems, and incorporation of requirements from the plumbing code for disinfection of potable water systems.

As part of their comprehensive review, the Task Group proposed further updates to correlate with hydronic system insulation requirements, address the use of chemical additives and corrosive fluids in auxiliary systems, clarify air removal and expansion tank requirements, avoid ambiguity regarding which systems require freeze protection, and remove obsolete definitions.

Upon completion of their final meeting, the Task Group generated and submitted 15 public comments to the USHGC for consideration during the Technical Committee Meeting scheduled for May 12, 2026.