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AGENDA

2024 Uniform Plumbing Code Technical Committee Meeting
The Westin San Diego Bayview, San Diego, CA
May 6 - 8, 2024

I. Call to Order
II. Chairman Comments
III. Announcements
IV. Self-Introductions
V. Review and Approval of Agenda
VI. Approval of Minutes from Previous Meeting (Via Teleconference on April 18, 2023)
VII. Report of AdultChanging Station Task Group (Chair)
VIII. Review Code Change Proposals
IX. Other business
X. Next scheduled meeting (May 5 - May 6, 2025)
XI. Adjournment
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. Expected Conduct

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. Unacceptable Behavior

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 demean 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. Alternative language: Unwelcome and uninvited attention or contact with another attendee/participant.

c. 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.

d. Unwelcome sexual attention, including sexualized comments or jokes, inappropriate touching, groping, or sexual advances.

e. Deliberate intimidation, stalking or following.

f. Sustained disruption, including during talks and presentations.

g. 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).

h. Violence, threats of violence, or violent language directed against another person or group.

i. Possession of dangerous or unauthorized materials such as explosives, firearms, weapons or similar items.

j. 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.

k. Theft or inappropriate removal or possession of property.

l. Use, distribution, sale, or transfer of illegal drugs.

m. 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.
The following is the tentative order of discussion on which the proposed changes will be discussed at the Technical Committee Meeting. Proposed code changes 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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Uniform Plumbing Code Change Proposals
103.3 Applications and Permits. (remaining text unchanged)

103.3.2 Well Contractors Exempt from Licensing and Bond Conditions. No license, registration, or bond under sections (insert applicable agency and statute or code which allows or has jurisdiction) is required of a well contractor or a limited well/boring contractor who is licensed and bonded under the delegated agency having the Authority Having Jurisdiction for wells and water supply systems and is engaged in the work or business of installing one or more of the following:

1. Water service pipe from a well to a pressure tank;
2. A buried, or at grade or elevated water supply storage tank system located between the well and the final pressure tank and master shutoff valve leading to distribution;
3. A frost free water hydrant with an antisiphon device on a well water service pipe located entirely outside of a building requiring potable water;
4. A control valve located outside the building, on a well water service pipe; or
5. A main control valve located within 2 feet (610 mm) of the pressure tank on the distribution supply line.

SUBSTANTIATION:
The purpose for adding this language to the UPC is to address that current provisions do not recognize wells as a water supply. This results in overlapping jurisdiction of regulatory agencies that regulate the area and materials between the well and distribution shutoff valve.
105.0 Inspections and Testing.

105.5 Remote Inspections. Where approved by the Authority Having Jurisdiction, remote inspections of plumbing systems shall be permitted in accordance with NFPA 915 and Section 105.5.1 through Section 105.5.3.

105.5.1 General. The entity or person(s) performing remote inspections shall comply with the requirements set forth by the Authority Having Jurisdiction. The accuracy of the information, quality, verification, usability, and authenticity of the data shall be verified by a qualified person(s). The written test plan shall be submitted to the Authority Having Jurisdiction for approval. The following information shall be provided to the Authority Having Jurisdiction when remote inspections are requested:

(1) Suitability of performing the inspection remotely.
(2) Limitations.
(3) Supporting documentation including, but not limited to, plans, specifications, drawings, details, and records.
(4) Information on the technology or device being used for inspection and data collection.
(5) Submission format.
(6) Scheduling requirements.
(7) Modifications.
(8) Record retention.
(9) Format being used for the transmission of content.

105.5.2 Verification. The following information shall be verified and documented at the time of the remote inspection:

(1) Date and time of remote inspection.
(2) Type of plumbing system being inspected.
(3) Inspection areas.
(4) Building occupancy category where the plumbing system is installed.
(5) Technology or device used for inspection and data collection.
(6) Location of the plumbing system being inspected.

105.5.3 Data Collection or Transmission Devices. Non-aerial and aerial vehicles shall be permitted to be used for remote inspections. Data and content protection shall be provided in accordance with NFPA 915.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
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<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>NFPA 915-2024</td>
<td>Standard for Remote Inspections and Tests</td>
<td>Inspections and Testing</td>
<td>105.5, 105.5.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)
Note: NFPA 915 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Remote inspections for permits offer several benefits to both regulatory authorities and permit applicants. Virtual inspections can typically be arranged and executed more swiftly than conventional on-site evaluations, thanks to digital documentation and communication technologies that simplify the application and inspection processes. In particular, digital photographs, videos, and schematics are capable of offering precise depictions of site conditions. Furthermore, remote inspections contribute to health and safety by minimizing the need for physical contact and travel, especially during situations such as the COVID-19 pandemic.

NFPA 915 is suitable for reference as it provides minimum requirements for transmission and data collection associated with remote inspections and tests, automated inspection and testing, and distance monitoring performed in accordance with other governing laws, codes, and standards. This standard lists the appropriate formatting requirements for various data collection methods including written submissions, live and recorded audio or video, and photography.
**Proposed Text:**

203.0  -A-

Alternate Water Source. Nonpotable source of water that includes but not limited to gray water, on-site treated non-potable water, rainwater, stormwater, and reclaimed (recycled) water.

206.0  -D-

Debris Excluder. A device installed on the rainwater or stormwater catchment conveyance system to prevent the accumulation of leaves, needles, or other debris in the system.

208.0  -F-

First Flush. The first portion of roof or stormwater runoff, usually defined as a depth in inches or as a volume, is considered to contain the highest pollutant concentration resulting from a storm event.

220.0  -R-

Roof Washer. An antiquated device or method for removal of sediment and debris from a collection surface by diverting initial rainfall from entry into the cistern(s). Also commonly known as a first flush device.

**Rainwater Pre-tank Filter Unit.** A manufactured device that has one inlet and two outlets. One outlet discharges only water that has been filtered to a micron level and the other discharge allows for debris and excess water to be directed away from the rainwater storage tank.

**SUBSTANTIATION:**

The definition for "Rainwater Pre-Tank Filter Unit" restates the filtration goes down to the micron level which is needed to keep a tank clean and standardizes one of the two outlets (one for excess water, trash, and debris and one for the filtered water). The other definitions are related to proposals being made to Chapter 15 and Appendix K and gives a description of these systems and their intent as used in the UPC.
RECOMMENDATION:
Add new text

Proposed Text:
203.0 – A –

**Alternative Engineered Design.** A plumbing system that provides equivalent or a greater level of quality, strength, effectiveness, fire resistance, durability, and safety that is not already addressed in the code.

SUBSTANTIATION:
This is a very common term in the plumbing code. It is worth defining the term as it is also common for local jurisdictions to determine whether an "alternative engineered design" is being utilized appropriately.
Antisiphon. The action of preventing the emptying of a trap, fixture, or appliance. This action is typically prevented by a device or mechanism that prevents the action of siphoning.

SUBSTANTIATION:
This term is used to describe the prevention of siphoning by the use of flushing devices, fill valves, and backflow prevention devices. The term is used for protecting water storage tanks and trap seals. Adding this definition will give clarity to the user with the intent of protection as used in the plumbing code.
Circulating Hot Water System. A water distribution system where one or more pumps on the hot-water piping circulates heated water from the water-heating source to fixtures and back to the water heating source.

SUBSTANTIATION:
This term is used within the code and clarifies the intent of "circulating hot water systems" as used. There are many styles of designing such a system, but this definition gives a general description of its use.
205.0 – C –
Cistern. See Rainwater Storage Tank.

220.0 – R –
Rainwater Storage Tank. The central component of the rainwater catchment system used to store collected rainwater for future beneficial use. (Also, known as a cistern or rain barrel.)

SUBSTANTIATION:
This change updates the definition for "rainwater storage tank" by removing the term "central" component and replacing it with "reservoir" component. While the rainwater storage tank is a vital component of such systems, it is not necessarily the "central" component. Additionally, the term "cistern" is being added with a pointer to the rainwater storage tank since cistern is a common term used in the code and in industry.
SUBMITTER: Armando Barragan
Organization Name: Self
Organization Representation:

RECOMMENDATION:
Add new text

Proposed Text:
205.0  – C –

Cleanout. A cap or plug at the end of a pipe which can be removed to provide access for inspection and cleaning.

SUBSTANTIATION:
A cleanout in a plumbing system serves as an access point that allows for inspection, cleaning, and removal of blockages in drainage pipes. It consists of a plug or cap that can be removed to provide such access. Since they serve as an essential feature for maintaining health and efficiency of the building drainage system, a definition of "cleanout" is beneficial to the code.
**RECOMMENDATION:**
Revise text

**Proposed Text:**

*205.0  – C –*

**Combustible Material.** A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn; a material that does not meet the definition of noncombustible or limited combustible. [NFPA 54:3.3.64.1, 3.3.65.1]

*207.0  – E –*

**Effective Ground-Fault Current Path.** An intentionally constructed, low impedance electrically conductive path designed and intended to carry current during ground-fault conditions from the point of a ground fault on a wiring system to the electrical supply source and that facilitates the operation of the overcurrent protective device or ground-fault detectors. [NFPA 70:100]

*209.0  – G –*

**Gas Convenience Outlet.** A permanently installed, hand-operated device providing a means for connecting and disconnecting an appliance or an appliance connector to the gas supply piping. [NFPA 54:3.3.48]

**SUBSTANTIATION:**

In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 2 is being revised to the latest edition of NFPA 54-2024.
RECOMMENDATION:
Revise text

Proposed Text:
205.0  – C –
Condensate. The liquid phase produced by condensation of a particular gas (including flue gas) or vapor resulting from a decrease in temperature.

SUBSTANTIATION:
It is poor language to reference condensation within the definition for “condensate.” Condensation is the process by which a substance transforms from a gaseous or vapor state into a liquid state as a result of cooling. Therefore, the reference is duplicative and should be replaced with a simple description, as proposed. Also, mentioning “flue gas” is suitable for reference since many provisions in the code address condensate from combustion processes occurring in appliances (i.e., furnaces, boilers, etc.).

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RECOMMENDATION:
Revise text

Proposed Text:
206.0 - D -
Drainage Fixture Unit (DFU). See Fixture Unit.

225.0 - W -
Water Supply Fixture Unit (WSFU). See Fixture Unit.

(by shown for informational purposes only)

208.0 - F -
Fixture Unit. A quantity in terms of which the load-producing effects on the plumbing system of different kinds of plumbing fixtures are expressed on some arbitrarily chosen scale.

SUBSTANTIATION:
This change adds the terms for "DFU" and "WSFU" which are based off similar foundation of "fixture units." We see these acronyms in many places of the code and these definitions will guide the user to their use and point to "fixture units."
Proposed Text:
207.0 – E –
Expansion Tank. A vessel used to protect closed potable water systems from excessive pressure.

SUBSTANTIATION:
Expansion tanks are not solely used in only potable water systems. They are used in other non-potable HVAC space heating and cooling systems. The revised definition allows for this and is consistent to the definition recently added in the mechanical code. This revision would therefore create consistency in terminology between the codes.
Joint, Brazed. A gastight joint obtained by joining of metal parts with alloys that melt where a filler metal, a brazing alloy with a melting point lower than that of the base metals, is melted and flowed into the joint. The brazing process is conducted at temperatures exceeding 840°F (449°C), but less than the melting temperature of the parts to be joined, point of the base metal.

Joint, Compression. A multipiece mechanical joint with cup-shaped threaded nuts that, when tightened, compress tapered sleeves so that they form a tight joint on the periphery of the tubing they connect.

Joint, Flanged. A mechanical joint obtained by bolting together a pair of flanged ends with a gasket between them.

Joint, Heat-Fusion. A welded joint used in some thermoplastic systems to connect the pipe to fittings or pipe lengths directly to one another (butt-fusion). This method of joining pipe to fittings includes socket-fusion, electro-fusion, and saddle-fusion. This method of welding involves the application of heat and pressure to the components, allowing them to fuse together forming a bond between the pipe and fitting.

Joint, Soldered. A gastight joint obtained by the joining of metal parts with metallic mixtures or alloys that melt at a temperature up to and including where a filler metal, a metallic mixture or alloy with a melting point lower than that of the base metals, is melted and flowed into the joint. The soldering process is conducted at temperatures not exceeding 840°F (449°C), but less than the melting point of the base metal.

SUBSTANTIATION:
The definitions of "soldered joint" and "brazed joint" require detailed information about filler metals and base metals for accurate descriptions. From a metallurgical standpoint, brazing and soldering are joining processes in which a filler metal, with a lower melting point than the base metals, is heated above its liquidus temperature but below the solidus temperature of the base metals. The primary difference between soldering and brazing is the temperature ranges employed in each process.

The definition of "flanged joint" now mentions the use of gaskets, as the creation of a flanged joint involves placing a gasket between two flange surfaces to be joined. Tightening the bolts compresses the gasket between the flanges, creating a secure seal.

Similarly, heat-fusion joints are identified as a subtype of welded joints. Thus, this distinction has been incorporated into the given definition. With a separate definition for "welded joint" existing within the code, this minor update correctly aligns joints with their respective categories and subtypes.
Proposed Text:

212.0  – J –

Joint, Heat-Fusion. A joint used in some thermoplastic systems to connect the pipe to fittings or pipe lengths directly to one another. (butt-fusion). This method of joining pipe to fittings includes socket-fusion, electro-fusion, and saddle-fusion. This method of welding involves the application of heat and pressure to the components, allowing them to fuse together forming a bond between the pipe and fitting.

SUBSTANTIATION:
The first sentence in this definition describes a heat-fusion joint. The second sentence describes the different types of fusion methods. There is no reason to only indicate "butt-fusion" in the first sentence as it is only one method of heat-fusion.
RECOMMENDATION:
Add new text

Proposed Text:
214.0  – L –
Lavatory. A fixture in the shape of a basin or fixed bowl with running water and drainage piping used for washing. Such fixtures are typically located in a bathroom or toilet facility.

221.0  – S –
Sink. A fixture in the shape of a basin or vessel connected to a drain and typically a water supply for washing and drainage. Such fixtures are typically located in a kitchen, bar, work area, or as a floor receptor.

SUBSTANTIATION:
The terms “lavatory” and “sink” are used many times in the code and in different ways. However, the terms are not necessarily interchangeable. These definitions will assist the end users to correctly use and identify the correct fixtures for the appropriate applications when using the terms.
RECOMMENDATION:
Revise text

Proposed Text:
215.0 – M –
Manifold (Medial Gas). A device for connecting the outlets of one or more gas cylinders to the central piping system for that specific gas. [NFPA 99:3.3.103]
Manifold (Water Supply). A pipe or chamber branching out to multiple openings.

SUBSTANTIATION:
The UPC has a definition for "manifold" however, it is intended for medical gas. The change adds the term medical gas to distinguish its uniqueness and adds a manifold definition for water supply systems.
RECOMMENDATION:
Add new text

Proposed Text:
216.0 – N –
Nonpotable Water. Water that is not safe for human consumption.

SUBSTANTIATION:
This term is used throughout the code in many applications, but it is not defined. The intent of the term is that the water is not safe for human consumption. This definition will provide clarity when such term is used.
RECOMMENDATION:
Add new text

Proposed Text:
217.0 – O –
Occupancy. The condition in which a building or portions thereof are intended to be occupied or resided in.

SUBSTANTIATION:
This term is used in many portions of the code. The following definition will describe what an occupancy means and will assist users researching occupancy types, occupant loads, or the various ways in which this term is used in the code.
RECOMMENDATION:
Add new text

Proposed Text:
218.0   – P –
Flow Pressure. The supply pressure near the point of use of a fixture or water outlet when the valve or fixture is fully open and flowing.

SUBSTANTIATION:
The term "flow pressure" is used various portions of the code, including medical gas, and water supply. This definition will assist the end user to determine the appropriate meaning of "flow pressure" and to avoid confusing the term with "static pressure."
RECOMMENDATION:
Revise text

Proposed Text:
220.0 – R –

Rainwater Catchment System. A system that utilizes the principal of collecting, storing, and using rainwater from a rooftop or other manmade, aboveground collection surface. Natural precipitation that has landed on an impervious roof system and has not been contaminated by use or contact. Also, known as a rainwater harvesting system. Such systems typically fall under two types: active systems or passive systems.

Rainwater Catchment (Active System). Harvesting that uses storage tanks to collect and store rainwater for immediate beneficial uses (e.g., indoor flushing, irrigation, cooling, laundry washing, fire protection, etc.). To be distinguished from Passive Rainwater Catchment/Harvesting.

Rainwater Catchment (Passive System). Harvesting that uses earthworks, land shaping, or other earth-related techniques and structures to direct, concentrate, and infiltrate rainwater into the soil for beneficial uses (e.g., plant uptake and groundwater recharge). To be distinguished from Active Rainwater Catchment/Harvesting.

SUBSTANTIATION:
The definition for "Rainwater Catchment System" is being updated and the distinction between an "active system" and "passive system" is being added. The definitions will correlate with ARCSA/ASPE/ANSI 63 and 78.
RECOMMENDATION:
Revise text

Proposed Text:
220.0  – R –
Rainwater Storage Tank. The central component of the rainwater catchment system. Also, known as a cistern or rain barrel.

221.0  – S –
Storage Tank. The central component of the rainwater, stormwater, or dry weather runoff catchment system. Also known as a cistern.

L 201.0 Definitions.
Storage Tank. The central component of the rainwater, stormwater, or dry weather runoff catchment system. Also known as a cistern or rain barrel.

SUBSTANTIATION:
The phrase “or rain barrel” is being stricken from the definitions for “Storage Tank” and “Rainwater Storage Tank” as rain barrels are no longer used. Additionally, the definition for “Storage Tank” is being relocated (and updated) from Appendix L (Sustainable Practices) to Chapter 2 (Definitions).
221.0 – S –

Stormwater Catchment System. A system that utilizes the principle of collecting, storing, and using stormwater from an at grade collection surface for beneficial use. Such a system may include rainwater from an aboveground collection surface. These systems typically fall under two types: active systems or passive systems. Also, known as a stormwater harvesting system.

Stormwater Catchment (Active System). Harvesting that uses storage tanks to collect and store stormwater for immediate beneficial uses (e.g., indoor flushing, irrigation, cooling, laundry washing, fire protection, etc.).

Stormwater Catchment (Passive System). Harvesting that uses earthworks, land shaping, or other earth-related techniques and structures to direct, concentrate, and infiltrate stormwater into the soil for beneficial uses (e.g., plant uptake and groundwater recharge).

SUBSTANTIATION:
The definition for "Stormwater Catchment System" is being relocated and updated from Appendix L (Sustainable Practices) to Chapter 2 (Definitions). The definitions will correlate with ARCSA/ASPE/ANSI 63 and 78.
RECOMMENDATION:
Add new text

Proposed Text:
222.0 – T –

Toilet Room. A room or space containing either one water closet; one water closet and lavatory; or one water closet, one lavatory, and one urinal.

SUBSTANTIATION:
Based on IAPMO's "Manual of Recommended Practice for Toilet Room Design: All Gender/Health Safety, Privacy and Security" a definition for "toilet room" is needed.
RECOMMENDATION:
Add new text

Proposed Text:
224.0  – V –
Valve, Fill. A water supply valve that is used to supply water to a tank. Such a valve can be opened or closed by means of a float, or similar device.

SUBSTANTIATION:
A fill valve has many uses including a valve for filling water closet tanks, or any type of vessel that requires an automatically closing valve once a predetermined water level is reached.
RECOMMENDATION:
Add new text

Proposed Text:
224.0 – V –
Valve, Fullway (Full-port), A control or shutoff component in the plumbing piping system where the flow-path through the component’s closure does not restrict the component’s through-flow area.

SUBSTANTIATION:
This definition defines "fullway valves" as valves that have a fully open port with no restrictions or reductions of the internal diameter of the openings.

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RECOMMENDATION: Add new text

Proposed Text:
225.0 – W –

**Water Outlet.** As used in connection with the water distributing system, is the discharge opening for the water to a fixture or to any water-operated device or equipment requiring water to operate.

SUBSTANTIATION: This definition is needed to clarify what is meant by water outlet as used throughout the code. Water outlet is used about 20 times in the code and this definition will assist users of the code on the intent of the phrase.
308.0 Prohibited Locations.

308.1 General. Piping, fixtures, appliances, or equipment shall not be so located as to interfere with the normal use thereof or with the normal operation and use of windows, doors, or other required facilities. Plumbing systems shall not be located in an elevator equipment room or elevator shafts. Exception: Floor drains, sumps, or sump pumps located at the bottom of the elevator shafts shall be permitted to be indirectly connected to the plumbing system with an approved oil separator.

SUBSTANTIATION:
The code currently prohibits medical gas and natural gas applications for elevator shafts, however, it is silent on waste systems that are part of elevator shafts. Plumbing systems are prohibited in elevator shafts and elevator equipment rooms as these locations are restricted to access if a repair is required. Although, an elevator shaft may not have plumbing piping, there may be oil leaks from the elevator and rain that may make its way in via openings. This update will fill that void to guide the end user for these installations and require that an oil separator or interceptor is installed.
RECOMMENDATION:
Revise text

Proposed Text:
310.0 Prohibited Fittings and Practices.

310.4 Use of Vent and Waste Pipes. Except as hereinafter provided in Section 908.0 through Section 911.0, no vent pipe shall be used as a soil or waste pipe, nor shall a soil or waste pipe be used as a vent. Also, single-stack drainage and venting systems with unvented branch lines are prohibited.

SUBSTANTIATION:
Single stack drainage systems are often engineered systems, like Sovent systems utilizing aerators and de-aerators, Studor-type systems utilizing AAVs with positive pressure reduction devices, and oversized single stack drainage systems (Philadelphia), and have been in use for decades in many buildings around the country. In Las Vegas, for example, most of the high-rise hotels and casinos utilize single stack drainage systems; this is also true in many other cities.

[Supporting documentation provided in KAVI for TC review]
Proposed Text:
310.0 Prohibited Fittings and Practices.

310.9 Female Plastic Connections. Female plastic tapered (NPT) threaded connections shall not be allowed to be used when threaded onto a male metallic connection.

Exception: Female plastic parallel (straight) threaded and other transition fittings designed for plastic to metal the connections shall be permitted, such as metal reinforced transition fittings, shall be permitted.

SUBSTANTIATION:
There are specific transition fittings designed for plastic to metal connections, such as fittings that seal on a gasket and transitional fittings with reinforcement metal inserts, that should be listed as exceptions to the requirements of Section 310.9 (Female Plastic Connections).
RECOMMENDATION:
Add new text

Proposed Text:
312.0 Protection of Piping, Tubing, Materials, and Structures.

312.6 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 by elastomeric or plastic sleeves or grommets.

(renumber remaining sections)

SUBSTANTIATION:
This protection is part of an installation standard, IAPMO IS 31 (Installation Standard for PEX Tubing Systems for Hot- and Cold-Water Distribution) located in Appendix I (Installation Standards). This guidance should be common practice for all plastic pipes penetrating any drilled or notched metal or masonry walls as plastic piping can shift and vibrate when the water is opened and closed. Plastic pipes can be damaged when repeatedly rubbing against metal or masonry.
312.11 Structural Members. Cutting, notching, and boring of structural members shall be in accordance with the building code. 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.

SUBSTANTIATION:
Cutting, notching, drilling into or otherwise altering the original form of structural members is of great concern and should be handled with caution. Although the section indicates that the structural member should be replaced if weakened or impaired, there is no guidance that would have prevented the weakening of the member in the first place. Since the building code contains specific guidance for cutting, notching and boring practices, the proposed requirement is necessary.
TABLE 313.3
HANGERS AND SUPPORTS

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>TYPES OF JOINTS</th>
<th>HORIZONTAL</th>
<th>VERTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEX</td>
<td>Cold Expansion, Insert, Press, Push Fit, and Compression</td>
<td>1 inch and smaller, 32 inches; 1 1/4 inches and larger, 4 feet</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
<tr>
<td>PE-RT</td>
<td>Cold Expansion, Insert, Press, Push Fit, and Compression</td>
<td>1 inch and smaller, 32 inches; 1 1/4 inches and larger, 4 feet</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The lists of "types of joints" for PEX and PE-RT tubing which are in Table 313.3 do not match the types of joints which are approved for these piping materials in Table 604.1. This proposal would clarify that Table 313.3 applies to each of the type of joints which are included in Chapter 6, Table 604.1 (Building Supply Fittings and Water Distribution Fittings).
TABLE 313.3
HANGERS AND SUPPORTS

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>TYPES OF JOINTS</th>
<th>HORIZONTAL</th>
<th>VERTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE-RT in support channel</td>
<td>Cold Expansion</td>
<td>¾ inch and smaller, 6 feet; 1 inch, 8 feet; 1¼ inches and larger, 10 feet</td>
<td>All sizes, 9 feet</td>
</tr>
<tr>
<td></td>
<td>Insert and Compression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEX in support channel</td>
<td>Cold Expansion</td>
<td>¾ inch and smaller, 6 feet; 1 inch, 8 feet; 1¼ inches and larger, 10 feet</td>
<td>All sizes, 9 feet</td>
</tr>
<tr>
<td></td>
<td>Insert and Compression</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
Pipe support channel is a rigid restraint product that prevents PEX and PE-RT tubing from sagging. When installed with continuous pipe support channel, The Plastics Pipe Institute recommends to increase the spacing between hangers and supports for PEX and PE-RT tubing to the lengths shown in this proposal. The lengths in this proposal match those within CSA B214-2021 (Installation Code for Hydronic Heating Systems), Clause 9.4.2.
### TABLE 313.3
HANGERS AND SUPPORTS

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>TYPES OF JOINTS</th>
<th>HORIZONTAL</th>
<th>VERTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>Wiped or Burned</td>
<td>Continuous Support</td>
<td>Not to exceed 4 feet</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
Remove rarely used lead pipe from code. This product does not serve the health and safety purposes of the code.
SUBMITTER:
Lance MacNevin

Organization Name:
Plastics Pipe Institute (PPI)

RECOMMENDATION:
Revise text

Proposed Text:
313.0 Hangers, Supports, and Anchors.

313.3 Suspended Piping. Suspended piping shall be supported at intervals not to exceed those shown in Table 313.3 or in accordance with MSS SP-58.

SUBSTANTIATION:
This proposal will harmonize requirements for the intervals of pipe supports by allowing interval spacing for pipes to also be in accordance with MSS SP-58 Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.

According to the ANSI press release on this standard, “MSS SP-58 2018 is an extensive standard with information on a multitude of topics involving pipe hangers and supports. Not only does it serve as “an industry accepted basis” for those involved in the different aspects of pipe hangers and supports, but it also establishes the minimum guidelines for materials, allowable stresses, product design, testing, and load ratings for pipe hanger and support assemblies for standard and unique pipe hangers and supports.”
314.4 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, pea gravel, 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 be then 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.

Underground thermoplastic pipe and fittings for sewers and other gravity flow applications shall be installed in accordance with this code and Section 314.4.1.

SUBSTANTIATION:
Contractors have suggested using pea gravel as a cost-saving measure for backfilling instead of clean earth aiming to reduce costs and minimize compaction efforts. However, it's crucial to note that pea gravel, being a type of stone, does not align with the requirement in Section 314.4 (Excavation) and poses a risk of damaging the pipes. Addressing this matter has been a recurring challenge across multiple projects we have worked on over the past decade. Clarifying that clean earth does not contain pea gravel specifically would mitigate this issue.
314.0 Trenching, Excavation, and Backfill.

314.4 Excavations. (remaining text unchanged)

314.4.1 Installation of Thermoplastic Pipe and Fittings. Installation of thermoplastic pipe and fittings in trenches shall be in accordance with this section, or in accordance with ASTM D2321 for sewer pipe, or ASTM D2774 for pressure pipe. Trench width for thermoplastic sewer pipe shall be not less than 1.25 times the outside diameter of the piping plus 12 inches (305 mm) or the outside diameter of the piping plus not less than 16 inches (406 mm). Thermoplastic piping shall be bedded in not less than 4 inches (102 mm) of granular fill supporting the piping. The backfill for thermoplastic piping shall be compacted along the sides of the piping in 6 inch (152 mm) layers and continue to not less than 12 inches (305 mm) above the piping. Compaction shall be not less than an 85 percent standard proctor density.

**TABLE 1701.1**
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D2321-2020</td>
<td>Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications</td>
<td>Piping, Plastic</td>
<td>314.4.1</td>
</tr>
<tr>
<td>ASTM D2774-2021a</td>
<td>Standard Practice for Underground Installation of Thermoplastic Pressure Piping</td>
<td>Piping, Plastic</td>
<td>314.4.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**TABLE 1701.2**
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D2774-2021a</td>
<td>Standard Practice for Underground Installation of Thermoplastic Pressure Piping</td>
<td>Piping, Plastic</td>
</tr>
</tbody>
</table>

Note: ASTM D2321 and ASTM D2774 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The ASTM standards are 8 and 10 pages long and offer far more extensive guidance for conditions than the current code and should obviously be options for installing pressure and non-pressure thermoplastic piping in trenches.
Item #: 038

Code Number: 2024 UPC

Section Number: 314.4.2

SUBMITTER: Larry Soskin

Organization Name: ACE Duraflo

Organization Representation: Self

RECOMMENDATION: Add new text

Proposed Text:

314.0 Trenching, Excavation, and Backfill.

314.4 Excavations. (remaining text unchanged)

314.4.2 Special Inspection Required. Special inspection required of plastic drainage and sewer piping trenching, bedding, backfill, and compaction shall be conducted by persons who are licensed or certified to perform such work. Inspections shall be in accordance with Section 314.4.1.

(Shown for information purposes only)

314.4.1 Installation of Thermoplastic Pipe and Fittings. Trench width for thermoplastic sewer pipe shall be not less than 1.25 times the outside diameter of the piping plus 12 inches (305 mm) or the outside diameter of the piping plus not less than 16 inches (406 mm). Thermoplastic piping shall be bedded in not less than 4 inches (102 mm) of granular fill supporting the piping. The backfill for thermoplastic piping shall be compacted along the sides of the piping in 6 inch (152 mm) layers and continue to not less than 12 inches (305 mm) above the piping. Compaction shall be not less than an 85 percent standard proctor density.

SUBSTANTIATION:
The requirement for a special inspection being required is due to the notion that the backfilling and compaction requirements being outside of the normal schedule of inspections for most AHJ’s. These are crucial steps to ensure that the plastic piping installation is adequate to maintain its integrity and function as intended. If the enforcement component is not there, the critical installation steps may not be completed properly, leading to sewage exfiltration into the ground, contamination, possible structural issues and costly repairs. There have been failures and issues due to improper installation occurring in a similar fashion as the code currently states, rather than the proper minimum installation guidance as it is being revised to. This code change provides a minimum level of proper installation and the enforcement component to guide all users of this code to ensure safety of occupants and our environment.

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402.10 Maximum Flow Rate and Water Consumption. The maximum flow rates or water consumption for plumbing fixtures and fixture fittings shall be in accordance with Table 402.10.

402.10.1 Group Wash Fixtures. Group wash fixtures used as public lavatories shall have a maximum water consumption flow rate in accordance with Table 604.4 based on each 16 inches of rim space.

(renumber remaining sections)

Table 402.10
MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS

<table>
<thead>
<tr>
<th>PLUMBING FIXTURE OR FIXTURE FITTING</th>
<th>MAXIMUM FLOW RATE OR WATER CONSUMPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Spray</td>
<td>2.5 gpm at 80 psi</td>
</tr>
<tr>
<td>Clinical Sink</td>
<td>4.5 gallons per flushing cycle</td>
</tr>
<tr>
<td>Lavatory, private</td>
<td>2.2 gpm at 60 psi</td>
</tr>
<tr>
<td>Lavatory, public, metering faucet</td>
<td>0.25 gallon per metering cycle</td>
</tr>
<tr>
<td>Lavatory, public, non-metering faucet</td>
<td>0.5 gpm at 60 psi</td>
</tr>
<tr>
<td>Showerhead</td>
<td>2.5 gpm at 80 psi</td>
</tr>
<tr>
<td>Kitchen sink faucet</td>
<td>2.2 gpm at 60 psi</td>
</tr>
<tr>
<td>Urinal</td>
<td>1.0 gallon per flushing cycle</td>
</tr>
<tr>
<td>Water closet</td>
<td>1.6 gallons per flushing cycle</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 3.785 L/min, 1 pound-force per square inch = 6.8947 kPa, 1 gallon = 3.785 L

407.0 Lavatories.
407.2 Water Consumption. The maximum water flow rate of faucets shall comply with Section 407.2.1 and Section 407.2.2.
407.2.1 Maximum Flow Rate. The maximum flow rate for public lavatory faucets shall not exceed 0.5 gpm at 60 psi (1.9 L/m at 414 kPa) and 2.2 gpm at 60 psi (8.3 L/m at 414 kPa) for private lavatory faucets.

(renumber remaining sections)

408.0 Showers.
408.3 Water Consumption. Showerheads shall have a maximum flow rate of not more than 2.5 gpm at 80 psi (9.5 L/m at 552 kPa). Body sprays shall have a flow rate of not more than 2.5 gpm at 80 psi (9.5 L/m at 552 kPa).

(renumber remaining sections)

411.0 Water Closets.
411.2 Water Consumption. Water closets shall have a maximum consumption not to exceed 1.6 gallons (6.0 Lpf) of water per flush.
411.2.1 Dual Flush Water Closets. Dual flush water closets shall comply with ASME A112.19.14. The effective flush volume for dual flush water closets shall be defined as the composite, average flush volume of two reduced flushes and one full flush.
411.2.2 Flushometer Valve Activated Water Closets. Flushometer valve activated water closets shall have a maximum flush volume of 1.6 gallons (6.0 Lpf) of water per flush.

(renumber remaining sections)

412.0 Urinals.
412.1 Application. Urinals shall comply with ASME A112.19.2/CSA B45.1, ASME A112.19.19, or CSA B45.5/IAPMO Z124. Urinals shall have an average water consumption not to exceed 1 gallon (3.8 Lpf) of water per flush.

420.0 Sinks.
420.2 Water Consumption. Sink faucets shall have a maximum flow rate of not more than 2.2 gpm at 60 psi (8.3 L/m at 414 kPa).
Exceptions:
(1) Clinical sinks
(2) Laundry sinks
(3) Service sinks

(renumber remaining sections)

SUBSTANTIATION:
This proposal consolidates the water conservation requirements into a single table. This will make the code more user friendly allowing an AHJ to immediately identify the water conservation requirements.

With a single table, the code section for each type of fixture can be deleted.

There are three significant changes proposed with the addition of this table. Sinks are identified as “kitchen sinks,” since that is the intent of the water conservation requirements. Thus, there is no need to list exceptions for laundry sinks or service sinks.

The other two changes are the addition of water conservation requirements for clinical sinks and the indication of how to identify the water flow rates for group wash fixtures. Water conserving clinical sinks use 4.5 gallons per flushing cycle. This flush cycle limitation is listed in the proposed new table.
For group wash fixtures, the water consumption is based on the number of individuals that can use the fixture at the same time. The water flow rate is based on a rim space of 16 inches. The flow rate remains the public lavatory flow rate when the fixture is used as a public lavatory.
RECOMMENDATION:
Revise text

Proposed Text:
402.0 Installation.

402.5 Setting. Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet or bidet shall be set closer than 15 inches (381 mm) from its center to a side wall or obstruction or closer than 30 inches (762 mm) center to center to a similar fixture. The clear space in front of a water closet, lavatory, or bidet shall be not less than 24 inches (610 mm). No urinal shall be set closer than 12 inches (305 mm) from its center to a side wall or partition or closer than 24 inches (610 mm) center to center.

Exception: The installation of paper dispensers, sanitary napkin receptors, or accessibility grab bars shall not be considered obstructions.

SUBSTANTIATION:
The accessibility code allows sanitary napkin receptors to be within the the accessible clear space of water closet compartment and designers often put these next to the water closet. The wall hung styles of receptors range from 3.5-4 inches and the accessible code allows the water closet to be set 16-18 inches off the side wall which then makes the water closet clearance from a obstruction less than 15 inches. If we are to follow the 15 inches to center and 24 inches to the front prescriptive rules in Section 402.5 (Settings) the sanitary receptor would be out of reach range. This change wouldn't affect the clearances as most wall hung paper dispensers in these type of installations protrude the same if not more creating a less then 15 inches to center clearance to the water closet.
SUBMITTER: Armando Barragan

Organization Name: Self

RECOMMENDATION:
Revise text

Proposed Text:

405.0 Prohibited Fixtures.

405.2 Prohibited Urinals. Trough urinals and urinals with an invisible seal shall be prohibited.

Exception: Waterless urinals.

(shown for information purposes only)

405.1 Prohibited Water Closets. Water closets having an invisible seal or an unventilated space or having walls which are not thoroughly washed at each discharge shall be prohibited. A water closet that might permit siphonage of the contents of the bowl back into the tank shall be prohibited.

SUBSTANTIATION:
There is confusion on what an “invisible seal” is. As written, a waterless urinal may not comply with the section as you cannot see the water seal without first removing the drain cover.
Proposed Text:
406.0 Special Fixtures and Specialties.

406.3 Special Use Fixtures. Special use fixtures shall be made of one of the following:
(1) Soapstone
(2) Chemical stoneware
(3) Copper-based alloy
(4) Nickel-based alloy
(5) Corrosion-resistant steel
(6) Stainless Steel
(67) Other materials suited for the intended use of the fixture

406.5 Sheet Copper. Sheet copper for general applications shall comply with ASTM B152. The copper sheet weight shall not be less than 12 ounces per square foot (oz/ft²) (3.7 kg/m²)

Note: ASTM B152 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Readily available, off-the-shelf fixtures are designed and manufactured to meet nationally recognized standards. There are times when a fixture is field fabricated, and the local jurisdiction and maker of such fixture must have guidance to meet the intent of minimum standards for health, safety, and functionality of the intended use of the fixture. This proposed change adds “stainless steel” as a common material used to fabricate fixtures. Additionally, additional verbiage is being added specific to “sheet copper” as a viable option. This sheet copper verbiage further guides the user (fabricator, AHJ) on the specific guidelines for sheet copper. This verbiage will match other recognized practices used in the industry.
SUBMITTER:
Bruce Meiners

Organization Name:
Wisconsin DPH

Organization Representation:
Self

RECOMMENDATION:
Revise text

Proposed Text:

407.0 Lavatories.

407.2 Water Consumption. The maximum water flow rate of faucets shall comply with Section 407.2.1 and through Section 407.2.3.

407.2.3 Health Care Facilities. Lavatories with self-closing faucets located in health care facilities, shall have the faucet metering-delay-time set long enough to evacuate the hot-water supply branch from the hot water main to the fixture.

SUBSTANTIATION:
Reduces water age, biofilm growth reducing the potential for *Legionella*. Already enforced in the Wisconsin Plumbing Code.
SUBMITTER:
Bruce Meiners

Organization Name:
Wisconsin DPH

RECOMMENDATION:
Add new text

Proposed Text:
407.0 Lavatories.

407.7 Health Care Facilities. Faucets accessible to patients shall not be equipped with an aerator.

SUBSTANTIATION:
Infection preventionist in health care do not like aerators because they aerosolize the water and any pathogens in the water exposing the patients to pathogens.
408.4 In-line Individual Pressure Balancing Valves for Individual Fixture Fittings. Where in-line individual pressure balancing valves for individual fixture fittings are installed, such valves shall comply with ASSE 1066. Such valves shall be accessible. The valves shall not be permitted to be used alone as a replacement for a pressure balance, thermostatic, or combination pressure balance/thermostatic mixing valve required in accordance with Section 408.4.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1066-2023</td>
<td>Individual Pressure Balancing In-Line Valves for</td>
<td>Valves</td>
<td>408.4.4</td>
</tr>
<tr>
<td></td>
<td>Individual Fixture Fittings</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1066-1997</td>
<td>Individual Pressure Balancing In-Line Valves for</td>
<td>Valves</td>
</tr>
<tr>
<td></td>
<td>Individual Fixture Fittings</td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASSE 1066 meets the requirements for mandatory a referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
These valves are viable solutions for protecting the end user from thermal shock when used with two-handle fixture fittings.
408.6 Finished Curb or Threshold. Where a shower receptor has a finished dam, curb, or threshold, it shall be not less than 1 inch (25.4 mm) lower than the sides and back of such receptor. In no case, shall a dam, curb, or threshold be less than 2 inches (51 mm) or exceeding 9 inches (229 mm) in depth where measured from the top of the dam or threshold to the top of the drain. Each such receptor shall be provided with a nailing flange either integral or field installed in accordance with the manufacturer’s installation instructions. The flange shall be watertight and extend vertically not less than 1 inch (25.4 mm) above the top of the sides of the receptor. The finished floor of the receptor shall slope uniformly from the sides towards the drain not less than $\frac{1}{8}$ inch per foot (10.4 mm/m), nor more than $\frac{1}{2}$ inch per foot (41.6 mm/m).

Thresholds shall be of sufficient width to accommodate a minimum 22 inch (559 mm) door. Shower doors shall open so as to maintain not less than a 22 inch (559 mm) unobstructed opening for egress. Where there is a shower without a threshold, the floor space within the same room shall be considered a wet location and shall comply with the requirements of the building, residential, and electrical codes.

Exceptions:
(1) Showers in accordance with Section 403.2.
(2) A cast-iron shower receptor flange shall be not less than 0.3 of an inch (7.62 mm) in height.
(3) For flanges not used as a means of securing, the sealing flange shall be not less than 0.3 of an inch (7.62 mm) in height.

SUBSTANTIATION:
The proposed text is being updated as it seems to have an oversight to leave out "curb" as being required to be not less than 2 inches or exceeding 9 inches in depth. This change will clarify that the curb is also required to meet the requirements.
408.6 Finished Curb or Threshold. Where a shower receptor has a finished dam, curb, or threshold, it shall be not less than 1 inch (25.4 mm) lower than the sides and back of such receptor. In no case, shall a dam or threshold be less than 2 inches (51 mm) or exceeding 9 inches (229 mm) in depth where measured from the top of the dam or threshold to the top of the drain. Each such receptor shall be provided with a nailing flange either integral or field installed in accordance with the manufacturer's installation instructions. The flange shall be watertight and extend vertically not less than 1 inch (25.4 mm) above the top of the sides of the receptor. The finished floor of the receptor shall slope uniformly from the sides towards the drain not less than 1/8 inch per foot (10.4 mm/m), nor more than 1/2 inch per foot (41.6 mm/m). Thresholds shall be of sufficient width to accommodate a minimum 22 inch (559 mm) door. Shower doors shall open so as to ensure a clear horizontal opening for egress. Where there is a shower without a threshold, the floor space within the same room shall be considered a wet location and shall comply with the requirements of the building, residential, and electrical codes. Exceptions:

1. Showers in accordance with Section 403.2.
2. A cast-iron shower receptor flange shall be not less than 0.3 of an inch (7.62 mm) in height.
3. For flanges not used as a means of securing, the sealing flange shall be not less than 0.3 of an inch (7.62 mm) in height.

SUBSTANTIATION:
This section is not clear as what is considered a clear 22 inch width egress access. The confusion comes from the current language being referenced to the door opening. The intent is to have a clear horizontal clearing to enter all the way into the shower compartment. The required clearance should not be connected to only the door as it applies to the full access. If there is a bench inside the compartment that blocks the door or extends into the 22 inch with opening, it is no longer clear. This change will provide the clarity to the section. The 22 inches (559 mm) is based on the approximate shoulder width of an average adult and provides safe access for servicing and emergency egress.
408.12 Recirculating Shower Systems.
408.12.1 Application. Recirculating shower systems shall comply with IAPMO IGC 330.
408.12.2 Water Consumption.
408.12.2.1 Recirculating Mode. During recirculating mode the showerhead or handheld shower shall comply with the manufacturers specified flow rate which shall be permitted to exceed the maximum flow rate in accordance with ASME A112.18.1/CSA B125.1.
408.12.2.2 Conventional Mode. The supply of water while in conventional mode shall comply with the flow rate in accordance with ASME A112.18.1/CSA B125.1.
408.12.3 Temperature Limiting. The water temperature discharging from a recirculating shower system (either in recirculating or conventional mode) shall not exceed 120°F (49°C).
408.12.4 Backflow Protection. The hot and cold water supplies to the recirculating shower system shall be protected against backflow by one of the following means:
(1) A reduced-pressure principle backflow preventor assembly (RP) that complies with ASSE 1013 or CSA B64 Series.
(2) An air gap that complies with ASME A112.1.2 or CSA B64 Series.
(3) An atmospheric vacuum breaker (AV) that complies with ASSE 1001 or CSA B64 Series, installing shut-off valves, pumps, or any devices that may apply backpressure on the atmospheric vacuum breaker (AVB) is prohibited.

L 402.0 Water-Conserving Plumbing Fixtures and Fittings.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
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<tr>
<td>IAPMO IGC 330-2023</td>
<td>Recirculating Shower Systems</td>
<td>Fixtures</td>
<td>408.12.1</td>
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<tr>
<td>CSA B64 Series-2021</td>
<td>Backflow preventers and vacuum breakers</td>
<td>Backflow Protection</td>
<td>408.12.4</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.18.1/CSA B125.1, ASSE 1001, IAPMO IGC 330, and the CSA B64 Series meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>IAPMO IGC 330-2018</td>
<td>Recirculating Shower Systems</td>
<td>Fixtures</td>
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</tbody>
</table>
Water scarcity poses an increasing global and national challenge. Within the United States, it is estimated that more than 50% of the Continental U.S. has experienced drought conditions since 2000. This is expected to only become worse. In addressing the water scarcity crisis in the United States, there is a pressing need for regulatory bodies and standards organizations to adapt their requirements to facilitate the entry of new water-saving technologies into the market. This adaptation is crucial for fostering innovation and ensuring that emerging solutions can be swiftly and effectively implemented in homes across the country.

Regulations and building codes which lag behind technological advancements, create barriers for the adoption of cutting-edge water conservation products. For instance, the use of Flow Loop's recirculation shower – a solution currently on the Danish market saving up to 85% water of the traditional shower - faces regulatory hurdles in many jurisdictions. The establishment of updated standards is also critical. These standards should reflect the latest research and technological capabilities, setting benchmarks for water efficiency that encourage continuous improvement in product design. Adopting IGC 330 recycling shower systems into the plumbing code would allow faster market entry for similar technologies and products that safely reuse water and significantly begin reducing household water consumption.

Flow Loop's product on the Danish market has received global attention for its innovative solution which allows people to have a great shower experience while drastically cutting back on water use. It has undergone the relevant EU requirements, and has been meticulously tested for water quality and to ensure safety to the bather. It saves up to 22 gallons of water and 2.1 kWh of energy per shower and cuts the consumption use by 85% and 75% respectively. The broader impact of the recirculation shower technology in environmental terms is major. With 100,000 of recirculation shower systems installed by 2028, it will annually save 2.2 billion gallons of water. This will help to reduce both water stress and scarcity while reducing the environmental impact of showering as a whole. This highlights the unique, disruptive impact of recirculation shower technology on salient societal issues. Many small and larger manufactures are increasingly joining the challenge to provide safe water saving recirculation showers. Companies from the Netherlands, Sweden, Germany, the UK and Canada are developing or developed a recirculation shower solution, with Orbital system (Sweden) already being on the Nordic EU markets for 10 years. With the increase of manufactures being able to provide innovative and novel solutions, there is a need to accelerate the approval of new technologies, ensuring that they meet safety and efficiency standards while also being commercially feasible.

Alongside technological and behavioral changes in homes, a comprehensive approach to water scarcity in the United States must include the evolution of regulatory frameworks and standards. By doing so, we can create an environment that encourages the adoption of innovative water-saving solutions, thereby making a substantial impact on water conservation efforts nationwide.

Michael Fox:

To tackle water scarcity and to influence the amount of water consumed in the home, IKEA believes in solutions that enable re-use of water where appropriate. Since the shower is the largest consumer (40%) of water in the home, it seems sensible to innovate here and create solutions that allow for reduced water consumption. Water Recirculating Showers allow for significant reduction in shower water use (up to 90%), but critically do not affect user experience.

It is clear that this is an area of interest with many manufacturers, both large players and smaller start-ups, either with solutions on the market already or under development. It is also well-known that there has been significant IP filed in the last 10 years for these types of solutions.

With these new solutions coming to the market, it is crucial that requirements and standards are put in place to control their safety, function and claimed performance. We believe that adding IGC 330 into the plumbing code is the first critical step to this, with updating IGC 330 to be more inclusive to all types of solutions under development, either as a second step or preferably in parallel.
**408.12 Recirculating Shower Systems.**

**408.12.1 Application.** Recirculating shower systems shall comply with IAPMO IGC 330.

**408.12.2 Water Consumption Recirculating Mode.** During recirculating mode the showerhead or handheld shower shall comply with the manufacturers specified flow rate and shall be permitted to exceed the maximum flow rate in accordance with ASME A112.18.1/CSA B125.1.

**408.12.3 Temperature Limiting.** The water temperature discharging from a recirculating shower system (either in recirculating or conventional mode) shall not exceed 120°F (49°C).

**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<td>IAPMO IGC 330-2023</td>
<td>Recirculating Shower Systems</td>
<td>Fixtures</td>
<td>408.12.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.18.1/CSA B125.1 and IAPMO IGC 330 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**TABLE 1701.2**

<table>
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<tr>
<td>IAPMO-IGC-330-2018</td>
<td>Recirculating Shower Systems</td>
<td>Fixtures</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**

Water shortage is a commonly known and rapidly expanding problem in many regions of the world today. Solutions that minimize household water consumption are strongly needed. Showers represent one of the heaviest water consumers. Orbital Systems Inc. (https://www.orbital-systems.com/), an American technology company founded in 2012 after a joint NASA/academia project, has been developing technologies for smarter water use in home environments, for more than 10 years.

We believe that it is important to have regulations and standards that support the development of new products and industry solutions, as well as making sure that they fulfill standards and safety requirements. IGC 330 is an Industry Standard for Recirculating Shower Systems and we strongly believe that adding IGC 330 into the plumbing code will drive the development of recirculating showers in a positive way.
**Proposed Text:**

411.0 Water Closets.

411.2 Water Consumption. Water closets shall have a maximum consumption not to exceed 1.28 gallons (4.85 L) or 1.6 gallons (6.0 Lpf) of water per flush.

411.2.1 Dual Flush Water Closets. Dual flush water closets shall comply with ASME A112.19.14. The effective flush volume for dual flush water closets shall be defined as the composite, average flush volume of two reduced flushes and one full flush.

411.2.2 Flushometer Valve Activated Water Closets. Flushometer valve activated water closets shall have a maximum flush volume of 1.6 gallons (6.0 Lpf) of water per flush.

**Substantiation:**

This proposal will set a uniform maximum flush volume of 1.28 gallons per flush (gpf) for all single-flush water closets. The maximum flush volume of 1.6 gpf in the current UPC is based on the federal standard signed into law 32 years ago. Although it was originally a preemptive federal standard, in December, 2010, the US Department of Energy determined that states were no longer preempted from adopting more stringent efficiency standards for water closets, among other products. Federal Register, Vol. 75, No. 245, December 22, 2010, p. 80289. This document may be accessed at this link [http://www.regulations.gov/#documentDetail;D=EERE-2010-BT-WAV-0045-0001](http://www.regulations.gov/#documentDetail;D=EERE-2010-BT-WAV-0045-0001) and then placing EERE-2010-BT-WAV-0045-0001 in the search bar. Today, 11 states and the District of Columbia have adopted the 1.28 gpf requirement.

Since its establishment in 2006, the US EPA's WaterSense voluntary labeling program has provided a framework for the recognition of products that are substantially more efficient than minimum federal requirements while maintaining full functionality and customer satisfaction. WaterSense criteria for tank-type water closets were established in 2007, followed by WaterSense criteria for flushometer valve closets in 2015. Manufacturers have responded by bringing large numbers of models to market that meet or exceed WaterSense specifications. Today, water closets operating at 1.28 gpf or less are widely available and perform as well as those with higher flush volumes. To be eligible for WaterSense labeling, water closets must not only meet the flush volume requirement but also the performance requirements that are required for all toilets, including:

- Mixed testing media flushability: Ability to flush testing media of different sizes and density (i.e., floating versus sinking media).
- Bowl surface cleaning: Ability to clean the surface of the bowl.
- Drainline waste transport: Ability to transport waste media through a drainline.
- Waste extraction: Ability to clear soybean paste test media and toilet paper from the bowl.

Based on the most recent reports from WaterSense partners, 3,299 models of tank-type toilets from over than 170 brands and 837 models of flushometer valve fixtures, valves, and fixture-valve combinations from over 40 brands are currently rated at 1.28 gpf and meet all other WaterSense criteria, showing the widespread availability and commercial viability of 1.28 gpf water closets.
According to EPA, if all old, inefficient tank-type toilets in the United States were replaced with WaterSense labeled models, water savings would reach 986 million gallons of water per day. Savings from flushometer valve toilets would add to this amount. By amending the UPC, we have the opportunity to build greater efficiency into new and remodeled buildings right from the start, offering an additional measure of protection for our supplies of treated drinking water.

It should be noted that the US EPA has pending a proposed revision to the WaterSense specification for toilets to apply the maximum flush volume of 1.28 gpf to the full flush mode of dual-flush water closets, which in some models uses 1.6 gpf. EPA states that this is based on information that consumers’ use of the low-volume flush is not frequent enough to offset the water use of full flushes at 1.6 gpf. If WaterSense completes this step by mid-2024, as currently expected by that agency, the proponent may offer a modification to this proposal via public comment to remove Section 411.2.1 to ensure consistency with WaterSense going forward.
411.2 Water Consumption.

411.2.1 Dual Flush Water Closets. Dual flush water closets shall comply with ASME A112.19.14, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, or CSA B45.5/IAPMO Z124. The effective flush volume for dual flush water closets shall be defined as the composite, average flush volume of two reduced flushes and one full flush.

Note: ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, or CSA B45.5/IAPMO Z124 meet the requirements for a mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This change is a clarification to note that the ASME A112.19.14 standard was discontinued and the requirements for dual flush water closets are now included in the applicable fixture standard.
411.5 Water Supply. Water closets supplied by an alternate non-potable water source for use in flushing shall also be supplied with an equally-sized potable water line that is dry until in use.

1501.0 General.
1501.1 Applicability. (remaining text unchanged)

1501.1.2 Water Closets. Water closets supplied by an alternate water source for use in flushing shall also be supplied with an equal-sized potable water line that is dry until in use.

1505.0 Reclaimed (Recycled) Water Systems.
1505.1 General. (remaining text unchanged)

1505.1.1 Water Closets. Water closets supplied by an alternate water source for use in flushing shall also be supplied with an equally-sized potable water line that is dry until in use.

1506.0 On-Site Treated Nonpotable Water Systems.
1506.1 General. (remaining text unchanged)

1506.1.1 Water Closets. Water closets supplied by an on-site treated nonpotable water source for use in flushing shall also be supplied with an equal-sized potable water line that is dry until in use.

1506.10 Design and Installation.

1506.10.2 Minimum Water Quality. On-site treated nonpotable water supplied to toilets or urinals or for other uses in which it is sprayed or exposed shall be disinfected. Acceptable disinfection methods shall include chlorination, ultraviolet sterilization, ozone, or other methods as approved by the Authority Having Jurisdiction. The minimum water quality for on-site treated nonpotable water systems shall meet the applicable water quality requirements for the intended applications as determined by the public health Authority Having Jurisdiction. Water closets supplied by an on-site treated nonpotable water source for use in flushing shall also be supplied with an equally-sized potable water line that is dry until in use.

1601.0 General.

1601.1 Applicability. The provisions of this chapter shall apply to the installation, construction, alteration, and repair of nonpotable rainwater catchment systems.

1601.1.1 Allowable Use of Alternate Water. Where approved or required by the Authority Having Jurisdiction, rainwater shall be permitted to be used instead of potable water for the applications identified in this chapter.
**1601.1.2 Water Closets.** Water closets supplied by a nonpotable rainwater source for use in flushing shall also be supplied with an equal-sized potable water line that is dry until in use.

**SUBSTANTIATION:**
The objective of this proposal is to safeguard an individual's freedom to choose between a conventional flush toilet and a smart toilet or personal hygiene device (bidet seat) for their home, ensuring that the code upholds this right.

The current code incorporates provisions for providing non-potable water indoors specifically for toilet flushing and other applications. In instances where a building is plumbed with a non-potable water supply line to the toilet, residents opting for a smart toilet or personal hygiene device, whether out of necessity or choice, must connect to the available non-potable water supply or re-pipe with a potable water supply line for proper installation of the smart toilet – often incurring prohibitive expenses. The code restricts the use of non-potable water for activities like bathing, washing with faucets, showerheads, tub spouts, etc. This same consideration should be extended to personal hygiene devices and smart toilets, crucial for many Americans due to medical conditions, or preferred for reasons of cleanliness, health, and environmental awareness.

Making an allowance in the existing code for the inclusion of these products, which adhere to all major plumbing codes and boast a longstanding presence in the market, is important for ensuring public health and safety. The U.S. smart toilet market, valued at $1.8 billion, is anticipated to surpass $3 billion within the next five years. Individuals across the United States incorporate these products into their bathrooms, with some relying on them for maintaining dignity, privacy, and self-reliance, especially those with special needs or limited mobility.

Ensuring ease of cleaning is immediately beneficial and crucial for seniors, significantly impacting their hygiene. Moreover, individuals facing colorectal issues like hemorrhoids, irritable bowel syndrome (IBS), and inflammatory bowel disease (IBD), along with pregnant women experiencing severe constipation or postpartum recovery, derive additional hygiene-related advantages from these products. They also contribute to maintaining hand hygiene, a critical factor in preventing the spread of diseases.

Beyond hygiene, many smart toilets feature health monitoring capabilities that analyze stool or urine to detect health issues such as sugar levels in diabetics. These innovations have proven especially beneficial for stroke rehabilitation. For certain individuals who cannot use toilet paper due to medical reasons, personal hygiene devices are indispensable. Additionally, these devices have demonstrated a reduction in instances of rashes, hemorrhoids, and urinary tract infections.

In essence, these products are vital for numerous individuals across the United States in preserving their health. However, the existing code could impede the installation of such products in residential bathrooms where the building is plumbed with a non-potable water supply line to the toilet.

This proposal aims to guarantee residents the freedom to choose personal hygiene devices or smart toilets for their homes. It specifies the availability of a potable water supply if builders opt to install non-potable water lines for toilet flushing. To prevent stagnant water conditions, the proposal necessitates keeping the potable water line dry until it is in use. Achieving this could involve installing a water line from the lavatory and incorporating a labeled shutoff valve at the lavatory.

Furthermore, the code already approves using personal hygiene devices that conform to ASME A112.4.2/CSA B45.16. This industry standard requires that a personal hygiene device includes backflow protection through an atmospheric vacuum breaker, air space type vacuum breaker, or air gap fitting.
Non-potable water treated to the level for use in toilet flushing that is compliant with the code, applicable laws, rules, ordinances, and NSF/ANSI 350 or IGC 324 is not equivalent to the level of safety that is dictated by federal law for potable water. Many individuals that use smart toilets and personal hygiene devices do so out of necessity due to disabilities and/or underlying health issues (e.g., arthritis, urinary tract infections, hemorrhoids, anal fissures). The quality level of water that is used with smart toilets and personal hygiene devices must be free of any pathogens, etc., that could cause infection or disease, and therefore, must be treated at a minimum in accordance with regulations for potable water.

Though it is always wise to consult a building official before tackling a new project, the codes do not require a permit to be pulled for every installation in a residential occupancy. For example, the UPC allows for the removal and reinstallation of a toilet without a permit if the installation does not involve or require the replacement or rearrangement of valves, pipes, or fixtures (UPC Section 104.2). A personal hygiene device or smart toilet would meet this exemption as they are installed using the existing plumbing components and piping configuration.


412.0 Urinals.

412.1 Application. Urinals shall comply with ASME A112.19.2/CSA B45.1, ASME A112.19.19, or CSA B45.5/IAPMO Z124. Urinals shall have an average water consumption not to exceed 0.5 gallon (1.9 L) of water per flush.

SUBSTANTIATION:
Urinals can account for a significant amount of indoor water usage in commercial and institutional buildings. A typical urinal getting 18 flushes a day over 260 weekdays will draw and discharge nearly 5,000 gallons of water per year if operating at the UPC's maximum flush volume of 1 gallon per flush. In 2009 the US EPA WaterSense Program published a voluntary specification for flushing urinals, with a maximum flush volume of 0.5 gallons per flush while conforming with all other applicable industry standards. Manufacturers responded with scores of urinal models having a maximum flush rate of 0.5 gallons or less without sacrificing product performance.

Based on WaterSense product listings from January 2024, there are 19 brands and 399 models of flushing urinals and 17 brands and 407 models of urinal flush valves sold separately that meet the 0.5 gpf criterion, demonstrating the commercial viability and availability of water-efficient urinals. To date, 12 states (including New York and California) and the District of Columbia have adopted requirements limiting new urinals to a maximum flush volume of 0.5 gallons or less.

All flushing urinals produce calcite build-up in the urinal trapway and drain pipes caused by the bonding of the mineral ions in the flush water with the sediment in urine. As such, build-up occurs in all flushing urinals from 1.0 gpf down to 0.1 gpf and is not any greater for 0.5 gpf urinals.

While urinals and urinal valves can vary greatly in price, there is no indication that products that flush at 0.5 gpf are generally or usually more expensive than similar products that flush at 1 gpf. The WaterSense program found the following in 2017:

"Our product research has found that high-efficiency urinal fixtures and flushing devices are no more expensive than their standard (1.0 gpf) counterparts. The average price of a new high-efficiency or standard urinal fixture is about $350 and the average cost for a high-efficiency or standard pressurized flushing device (flushometer valve) is approximately $200. Because there is very little to no cost difference between high-efficiency flushing urinals and standard flushing urinals, installing high-efficiency models in new construction or as part of the natural replacement process is cost-effective with immediate payback in water cost savings." See https://19january2017snapshot.epa.gov/www3/watersense/pubs/faqifu.html#two.

Water savings to the building owner or tenant will vary by usage. But for a urinal receiving typical usage of 18 flushes per day over 260 weekdays per year (assumptions used by WaterSense in their own analysis), the savings in water and wastewater charges from flushing at 0.5 gpf rather than 1.0 gpf amount to about $22 per year per urinal, based on a national average $9.09/kgal for the quantity charge for water and wastewater service to commercial
customers as of July 2022, as reported by the Water and Wastewater Rate Survey produced by the American Water Works Association, Raftelis Financial Consultants, Inc, and posted here: https://ellio.raftelis.com/Account/AWWA. The installation of urinals that conform to this proposal will save building owners on water and wastewater charges and help protect public water supplies by reducing unnecessary water use over the life of the building.
**Proposed Text:**

414.0 Dishwashing Machines.

**414.2 Backflow Protection.** The water supply connection to a commercial dishwashing machine shall be protected by an air gap or a backflow prevention device in accordance with Section 603.3.2, Section 603.3.3, Section 603.3.5, Section 603.3.6, or Section 603.3.13 in compliance with ASSE 1004.

(shown for information purposes only)

**603.3.3 Hose Connection Backflow Preventer.** A hose connection backflow preventer consists of two independent check valves with an independent atmospheric vent between and a means of field testing and draining.

**SUBSTANTIATION:**

ASSE 1004 allows for 6 methods of backflow prevention, but currently only 4 are referenced within Section 414.2. The proposed text includes the 2 missing methods allowed by ASSE 1004, Section 603.3.3 (Hose Connection Backflow Preventers) and Section 603.3.13 (Hose Connection Vacuum Breakers).

A separate proposal is being submitted to add Section 603.3.13 (Hose Connection Vacuum Breakers), ASSE 1011 to the code. Hose Connection Vacuum Breakers are currently included in Table 603.2 but not defined.
SUBMITTER:
Joe Wolff

Organization Name:
Zurn Elkay Water Solutions

RECOMMENDATION:
Revise text

Proposed Text:
415.0 Drinking Fountains.

415.2 Drinking Fountain Alternatives. Where food is consumed indoors, water stations shall be permitted to be substituted for drinking fountains. Bottle filling stations shall be permitted to be substituted for drinking fountains up to 50 percent of the requirements for drinking fountains, provided that at least two drinking fountains are installed. Drinking fountains shall not be required for an occupant load of 30 or less.

SUBSTANTIATION:
Ensuring safe access to drinking water is crucial for the public health and well-being of building occupants. Traditional drinking fountains have served this purpose; however, limitations of these traditional fixtures were uncovered when many drinking fountains were roped off and abandoned due to fears of disease transmission during the COVID pandemic. The use of water bottles and bottle filling stations largely took the place of traditional drinking fountains during this time and has persisted, as a portion of the population no longer trusts drinking fountains as a "safe" water source. Recognizing this shift in water consumption habits, the proposed change aims to expand the existing allowance in Section 415.2 of the UPC for the substitution of drinking fountains with bottle filling stations. This proposed change will allow additional flexibility in interior design while maintaining water access points and a minimum of two drinking fountains for persons without receptacles or who require fountains due to accessibility reasons.
RECOMMENDATION:
Revise text

Proposed Text:
415.0 Drinking Fountains.

415.2 Drinking Fountain Alternatives. Where food is consumed indoors, or outdoors, with a seating area for customers, water stations shall be permitted to be substituted for drinking fountains. Bottle filling stations shall be permitted to be substituted for drinking fountains up to 50 percent of the requirements for drinking fountains. Drinking fountains shall not be required for an occupant load of 30 or less.

SUBSTANTIATION:
The phrase “where consumed indoors” is overly specific and does not cover the intent of providing access to customers visiting such establishments. The additional language will cover food serving establishments who have seating outdoors to also comply with these provisions without the confusion of whether this section applies when only outdoor seating is provided. This was common during Covid and continues to exist in many places.

Additionally, the first two sentences allow both water stations and bottle filling stations to be a substitute for drinking fountains. The current language is confusing as only the sentence with bottle filling stations specifying the percent permitted. If water stations are an acceptable replacement, there should also be a percentage of how many can be replaced. As written, water stations are also permitted to be a substitute for drinking fountains and the modification will clarify that it is intended to be allowed for up to 50 percent.
RECOMMENDATION:
Revise text

Proposed Text:
418.0 Floor Drains.

418.1 Application. Floor drains shall comply with ASME A112.3.1; or ASME A112.6.3/CSA B79.3, or CSA B79.

Trench drains shall comply with ASME A112.6.8/CSA B79.8

TABLE 1701.1
REFERENCED STANDARDS

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<th>REFERENCED SECTION</th>
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<td>Trench Drains</td>
<td>Fixtures</td>
<td>418.1</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.6.8/CSA B79.8-2022 standards meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The ASME A112.6.3 standard was harmonized with the CSA B79 standard. Floor drains requirements are covered under ASME A112.6.3/CSA B79.3 and trench drain requirements are covered under ASME A112.6.8/CSA B79.8
418.0 Floor Drains.

418.3 Location of Floor Drains. Floor drains shall be installed in the following areas:
(1) Toilet rooms containing two or more water closets or a combination of one water closet and one urinal, except in a dwelling unit.
(2) Commercial kitchens and in accordance with Section 704.3.
(3) Laundry rooms in commercial buildings and common laundry facilities in multi-family dwelling buildings.
(4) Boiler rooms. Rooms containing a water heater or a hot water heating boiler.

SUBSTANTIATION:
A floor drain should be in a room equipped with a water heater or hot water heating boiler. This allows for easier access to service for annual draining and emergencies when temperature and pressure relief drainage discharge.
RECOMMENDATION:
Revise text

Proposed Text:
418.0 Floor Drains.

418.3 Location of Floor Drains. Floor drains shall be installed in the following areas:
(1) Toilet rooms containing two or more water closets or a combination of one water closet and one urinal, except in a dwelling unit.
(2) Commercial kitchens and in accordance with Section 704.3.
(3) Laundry rooms in commercial buildings and common laundry facilities in multi-family dwelling buildings.
(4) Boiler rooms.
(5) Toilet rooms containing adult changing stations.

422.6.3 Floor Drain. Where an adult changing station is installed in a toilet room, a floor drain shall be provided in accordance with Section 418.0.

SUBSTANTIATION:
The Adult Changing Station Task Group was of the opinion that a floor drain should be required in a toilet room where an adult changing station is installed. This proposed change will add this requirement as item (5) in Section 418.3 (Location of Floor Drains). A change to the adult changing station location section will add a reference back to this section regarding the need to install a floor drain.

It was noted during meetings of the Task Group that it is common practice in the plumbing engineering profession to provide floor drains in commercial toilet rooms. Thus, it is not a hardship to mandate floor drains where an adult changing station is installed. The floor drain is needed to facilitate the cleaning and wash down of an adult changing station for the health and safety of all users.
SUBMITTER: Justin Cassamassino
Organization Name: ASME
Organization Representation: A112 Main Committee

RECOMMENDATION:
Revise text

Proposed Text:
421.1 Application. Floor sinks shall comply with ASME A112.6.7/CSA B79.7.

### TABLE 1701.1
REFERENCED STANDARDS

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<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.6.7/CSA B79.7-2010 (R2019) 2022</td>
<td>Sanitary Floor Sinks</td>
<td>Fixtures</td>
<td>421.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.6.7/CSA B79.7 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The ASME A112.6.7 standard was harmonized with the CSA B79 standard.
RECOMMENDATION:
Revise text

Proposed Text:
422.0 Minimum Number of Required Fixtures.
422.1 Fixture Count. (remaining text unchanged)
422.1.1 Fixture Calculations. The minimum number of fixtures shall be calculated at 50 percent male and 50 percent female based on the total occupant load. Where information submitted indicates a difference in the distribution of the sexes such information shall be used to determine the number of fixtures for each sex. Once the occupancy load and occupancy are determined, Table 422.1 shall be applied to determine the minimum number of plumbing fixtures required. Where applying the fixture ratios in Table 422.1 results in fractional numbers, such numbers shall be rounded to the next whole number. For multiple occupancies, fractional numbers shall be first summed and then rounded to the next whole number. For toilet facilities designed for use by all genders, the minimum number of fixtures shall be the aggregate calculated at 50 percent female and 50 percent male in accordance with Table 422.1. Where all-gender fixtures are provided in addition to separate men’s and women’s facilities, the aggregate number of fixtures from the all-gender, men’s, and women’s facilities shall be not less than included in determining the minimum number of fixtures provided required in an occupancy.

SUBSTANTIATION:
This change clarifies that the minimum number of fixtures are as required by Table 422.1. When an all-gender, men, and women facility are part of the same occupancy type, then the minimum number of fixtures should not be less than the minimum required in Table 422.1 for the given occupancy load and occupancy type.
Proposed Text:

422.0 Minimum Number of Required Fixtures.

422.1 Fixture Count. Plumbing fixtures shall be provided for the type of building occupancy and in the minimum number shown in Table 422.1. The total occupant load and occupancy classification shall be determined in accordance with the building code. Occupancy classification not shown in Table 422.1 shall be considered separately by the Authority Having Jurisdiction. Plumbing fixtures shall be located in separate gender toilet rooms or in all gender toilet rooms. Single occupant toilet rooms shall be all gender toilet rooms.

422.1.1 Fixture Calculations. The minimum number of fixtures shall be calculated at 50 percent male and 50 percent female based on the total occupant load. Where information submitted indicates a difference in the distribution of the sexes such information shall be used to determine the number of fixtures for each sex. Once the occupancy load and occupancy are determined, Table 422.1 shall be applied to determine the minimum number of plumbing fixtures required. Where applying the fixture ratios in Table 422.1 results in fractional numbers, such numbers shall be rounded to the next whole number. For multiple occupancies, fractional numbers shall be first summed and then rounded to the next whole number. For toilet facilities designed for use by all genders, the minimum number of fixtures shall be the aggregate calculated at 50 percent female and 50 percent male in accordance with Table 422.1. Where all-gender fixtures are provided in addition to separate men’s and women’s facilities, those fixtures shall be included in determining the number of fixtures provided in an occupancy. Where multiuser all gender facilities are provided in lieu of or in addition to separate men’s and women’s facilities, the total number of fixtures collectively shall be used to determine the number of fixtures provided in an occupancy. The substitution of a water closet for each urinal shall be permitted provided the total number of fixtures installed complies with Table 422.1 to get the total required.

422.2.1 Single Use Toilet Facilities. Single use toilet facilities, bathing facilities, and family or assisted use toilet facilities shall be identified with signage indicating use by either sex or any gender.

422.2.2 Family or Assisted-Use Toilet Facilities. Where a separate toilet facility is required for each sex, and each toilet facility is required to have only one water closet, two family or assisted-use toilet facilities shall be permitted in place of the required separate toilet facilities. Assisted-use toilet facilities shall have not less than one water closet and one lavatory. Family or assisted-use toilet facilities shall be identified as all gender toilet facilities.

422.3 Fixture Requirements for Special Occupancies. Additional fixtures shall be permitted to be required where unusual environmental conditions or referenced activities are encountered. In food preparation areas, fixture requirements shall be permitted to be dictated by health codes.

422.4 Toilet Facilities Serving Employees and Customers. Each building or structure shall be provided with toilet facilities for employees and customers. Requirements for customers and employees shall be permitted to be met with a single set of restrooms accessible to both groups. Required toilet facilities for employees and customers located in shopping malls or centers shall be permitted to be met by providing a centrally located toilet facility accessible to several stores. The maximum travel distance from entry to any store to the toilet facility shall not exceed 300 feet (91 440 mm). Required toilet facilities for employees and customers in other than shopping malls or centers shall have a maximum travel distance not to exceed 500 feet (152 m).

422.4.1 Access to Toilet Facilities. In multi-story buildings, accessibility to the required toilet facilities shall not exceed one vertical story. Access to the required toilet facilities for customers shall not pass through areas designated as for employee use only such as kitchens, food preparation areas, storage rooms, closets, or similar spaces. Toilet facilities accessible only to private offices shall not be counted to determine compliance with this section.

422.7 All Gender Toilet Facilities. Not less than one all gender toilet facility shall be provided and shall contribute to the total number of required fixtures in accordance with Table 422.1.
422.8 Lavatory Locations. Lavatories shall be located either in the toilet room or grouped in an adjacent common area within the toilet facility.

423.0 Safety and Security
423.1 Partitions. Partitions shall comply with Section 423.1.1 through Section 423.3.

422.6.423.1.1 Water Closet Compartment. Public water closets shall occupy a separate compartment with walls or partitions and a door enclosing the fixtures to ensure privacy. Partitions for water closets located in separate gender toilet or bathrooms shall comply with the Type B security requirements of IAPMO Z124.10. Partitions for water closets located in all gender toilet or bathrooms shall comply with the Type A security requirements of IAPMO Z124.10. Water Closet Partitions Walls are Required When There is More than One Water Closet in a Toilet Facility. In all gender toilet rooms, partitions shall comply with IAPMO/ANSI/CAN Z124.10, Type A partition requirements. The maximum height of partition walls off the floor shall be 1 inch (25.4 mm).

Exceptions:
(1) Water closet compartments shall not be required in a single-occupant toilet room having a lockable door.
(2) Toilet rooms in day care facilities having more than one water closets shall be permitted to have one water closet without an enclosing compartment.

423.1.2 Urinal Partitions. Where provided, urinals shall be located in an area visually separate from the rest of the toilet facilities. Each urinal shall be separated with walls or partitions to provide privacy. The horizontal dimension between walls or partitions at each urinal shall comply with Section 402.5. Partitions for urinals shall comply with the Type C security requirements of IAPMO/ANSI/CAN Z124.10. Walls or partitions shall extend from not less than 12 inches (305 mm) above the finished floor to not less than 60 inches (1524 mm) above the finished floor. Walls shall extend outward from the wall surface not less than 18 inches (457 mm). Urinals located in all gender toilet rooms shall be visually separated from the remainder of the room or each urinal shall be installed in a privacy compartment complying with Type A security requirements of IAPMO/ANSI/CAN Z124.10.

Exception: Urinal partitions shall not be required in a single occupant or family/assisted-use toilet room with a lockable door.

423.2 Full Height Compartments. Where full height compartment walls and doors are used instead of partitions, each compartment shall comply with the mechanical code for ventilation, electrical code for lighting, and the fire code for sprinklers and alarms.

423.3 Locks. Doors shall be lockable from the inside of the compartment or partition enclosure. The door locking device shall be readily distinguishable as locked from the outside of the partition enclosure, with emergency access from maintenance personnel. In all gender toilet rooms, the lock shall have a visual indication that the compartment is occupied when locked.

424.0 Signage
424.1 Signage for Toilet Facilities. Signage identifying the intended users shall be provided at the entrance of all toilet facilities. See Figure 424.1 for sample signage.
424.2 Signage for Single Use, and Family or Assisted Use Toilet Facilities. Single use, family or assisted use toilet facilities shall have a sign on the entry indicating use by all genders. See Figure 424.1 for sample signage.
TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ANSI/CAN Z124.10-2022</td>
<td>Standard for Water Closets and Urinal Partitions</td>
<td>Miscellaneous</td>
<td>423.1.1</td>
</tr>
</tbody>
</table>

Note: IAPMO/ANSI/CAN Z124.10 meets the requirements for mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This code proposal addresses toilet room design, specifically when it comes to all-gender accessibility and privacy concerns and comes from the Manual of Recommended practice for Toilet Room Design. This code proposal addresses the concerns of restroom accessibility for all genders while also providing consideration for safety and privacy within the restroom environment. This code proposal is another step in equal consideration for all human beings and provides holistic solutions in addressing simultaneous and sometimes opposing concerns. It also move the design community closer to the accepted practices around the globe, while helping to reduce duplication of restroom facilities and the cost associated with such duplication.

[Supporting documentation provided in KAVI for TC review]
Proposed Text:

422.0 Minimum Number of Required Fixtures.

422.1 Fixture Count. (remaining text unchanged)

422.1.1 Fixture Calculations. The minimum number of fixtures shall be calculated at 50 percent male and 50 percent female based on the total occupant load. Where information submitted indicates a difference in the distribution of the sexes such information shall be used to determine the number of fixtures for each sex. Once the occupancy load and occupancy are determined, Table 422.1 shall be applied to determine the minimum number of plumbing fixtures required. Where applying the fixture ratios in Table 422.1 results in fractional numbers, such numbers shall be rounded to the next whole number. For multiple occupancies, fractional numbers shall be first summed and then rounded to the next whole number. For toilet facilities designed for use by all genders, the minimum number of fixtures shall be the aggregate calculated at 50 percent female and 50 percent male in accordance with Table 422.1. Where all-gender fixtures are provided in addition to separate men's and women's facilities, those fixtures shall be included in determining the number of fixtures provided in an occupancy. The substitution of a water closet for each urinal shall be permitted provided the total number of required fixtures complies with Table 422.1.

422.2 Separate Facilities. Separate toilet facilities shall be provided for each sex.

Exceptions:
(1) - (4) (remaining text unchanged)
(5) The substitution of a water closet for each urinal shall be permitted provided the total number of required fixtures complies with Table 422.1.

TABLE 422.1
MINIMUM PLUMBING FACILITIES

Each building shall be provided with sanitary facilities, including provisions for persons with disabilities as prescribed by the Department Having Jurisdiction. Table 422.1 applies to new buildings, additions to a building, and changes of occupancy or type in an existing building resulting in increased occupant load.

<table>
<thead>
<tr>
<th>TYPE OF OCCUPANCY</th>
<th>WATER CLOSETS (FIXTURES PER PERSON)</th>
<th>URINALS (FIXTURES PER PERSON)</th>
<th>LAVATORIES (FIXTURES PER PERSON)</th>
<th>BATHTUBS OR SHOWERS (FIXTURES PER PERSON)</th>
<th>DRINKING FOUNTAINS/FACILITIES (FIXTURES PER PERSON)</th>
<th>OTHER</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4,8</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Notes:
1-7 (remaining text unchanged)
8 For all gender facilities, the substitution of a water closet for each urinal shall be permitted provided the total number of fixtures installed complies with Table 422.1.
SUBSTANTIATION:
This proposed change will align with the amendment in CA regarding the one-to-one substitution of a urinal with a water closet. Additionally, the amendments clarify that a separate privacy compartment or separate private area for areas is only needed when/if urinals are installed installed, as newly proposed Exception 5 allows them to be substituted with an equal number of water closets. The text provides the user with the option to replace the urinal(s) with a water closet. The minimum number of fixtures is not changed. For example, if you have 3 water closets and 2 urinal; you would be permitted to replace the urinal(s) with a water closet and the final count would be a 5 water closets (or five total fixtures). In all cases it will allow 5 persons access to a facility. This exception is already permitted in California.
Proposed Text:

422.0 Minimum Number of Required Fixtures.

422.2 **Separate Location of Facilities.** Toilet facilities shall be located in all gender rooms or in separate rooms provided for each sex.

**Exceptions:**

(1) Residential installations.

(2) In occupancies with a total occupant load of 10 or less, including customers and employees, one toilet facility, designed for use by no more than one person at a time, shall be permitted for use by both sexes.

(3) In business and mercantile occupancies with a total occupant load of 50 or less including customers and employees, one toilet facility, designed for use by no more than one person at a time, shall be permitted for use by both sexes.

(4) Separate facilities shall not be required where rooms have fixtures designed for use by both sexes and the water closets are installed in privacy compartments. Urinals shall be located in a privacy compartment.

**SUBSTANTIATION:**

This change is editorial. When exception 4 was added the code switched to allowing either all gender facilities or separate facilities for each sex. The result is an option for the designer or building owner. Rather than listing the option as an exception, the option should be stated as the requirement for the location of facilities. Also, with the addition of exception 4, exceptions 1 through 3 became superfluous. Exception 4 allows all gender toilet rooms in any building.
222.0 – T –
Toilet Facility. A room or space containing not less than one lavatory and one water closet.

Toilet Room. See Toilet Facility

422.6 Adult Changing Station. Where adult changing stations are provided, they shall be located in accordance with one of the following:
(1) The adult changing station shall be installed in a single-user toilet room.
(2) The adult changing station shall be installed in a family or assisted-use toilet room.
(3) The adult changing station shall be installed in a toilet room with multiple water closet compartments. The adult changing station shall be installed within a separate compartment with walls or partitions and a door. Where separate facilities are provided for each sex, the adult changing station shall be installed in both toilet rooms.
(4) The adult changing station shall be installed in a separate room with ventilation in accordance with the mechanical code.

422.6.1 Lavatory Location. Where an adult changing station is installed, a lavatory shall also be provided.

SUBSTANTIATION:
The Adult Changing Station Task Group met on 4 occasions to develop code requirements to regulate the location of adult changing stations where they are required by the Building Code or law. There are four options for locating an adult changing station. These requirements are specified in proposed Section 422.6. The first two options are obvious in that the adult changing station can be located in a single-user toilet room or in a family or assisted use toilet room. Both rooms provide the necessary privacy and sanitation for locating an adult changing station.

The third option would be in a toilet room with multiple water closets. However, when located in such a room, privacy must be provided for the adult changing station. The privacy identified can be with walls or partitions and a door.

The fourth location is in a separate room having the necessary ventilation in accordance with the Mechanical Code. This location is typically found in schools whereby the room is located in or near the nurse's station. However, other buildings can also set aside a separate room.

Proposed Section 422.6.1 would require a lavatory for proper sanitation and cleaning. The Task Group acknowledges that when an adult changing station is located in a separate room in an existing building, a lavatory may not be in the close proximity of the changing station. It is recognized that alcohol-based hand sanitizer dispenser may substituted for the lavatory under the alternative approval allowance in the Plumbing Code.

It should be noted that the Plumbing Code does not mandate the installation of adult changing stations. The Building Code and certain state laws currently mandate that adult changing stations be provided in certain buildings. The Plumbing Code will facilitate the location of these adult changing stations where required.
<table>
<thead>
<tr>
<th>Item #:</th>
<th>Code Number:</th>
<th>Section Number:</th>
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<tbody>
<tr>
<td>066</td>
<td>2024 UPC</td>
<td>422.6.2</td>
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</tbody>
</table>

**SUBMITTER:**
Julius Ballanco

**Organization Name:**
JB Engineering and Code Consulting, P.C.

**Organization Representation:**
UPC Adult Changing Station Task Group Chair

**RECOMMENDATION:**
Add new text

**Proposed Text:**
422.0 Minimum Number of Required Fixtures.

422.6.2 Hose Bibb. Where an adult changing station is installed in a toilet room, a hose bibb shall be provided.

**SUBSTANTIATION:**
This proposed change is a follow up to the original proposed change prepared by the Adult Changing Station Task Group. Two additional sections have been added to the original change. The first section added, Section 422.6.2 (Hose Bibb) would mandate that a hose bibb be located in the toilet room having an adult changing station. The second section, Section 422.6.3 (Floor Drain) would require a floor drain in accordance with Section 418.0 (Floor Drains). There is a separate proposed change to modify Section 418.3 (Location of Floor Drains) to be consistent with this proposed change.

The purpose of requiring a hose bibb and a floor drain is to facilitate cleaning of the adult changing station. A hose can be attached to the hose bibb to wash down the changing station into the floor drain.

Since requiring a hose bibb and floor drain was considered somewhat controversial, the Task Group is providing two code changes to give the Technical Committee and IAPMO membership to decide what level of sanitation should be provided. If this change is accepted, the change to Section 418.3 must also be accepted. If this change is rejected, the change to Section 418.3 must also be rejected.
**Proposed Text:**

422.0 Assistive Tables.

422.1 Application. Assistive tables shall comply with IAPMO Z1390. Assistive tables with fittings and fixtures shall comply with Section 402.0, Section 404.0, Section 407.0, Section 410.0, Section 411.0, Section 413.0, or Section 417.0 as applicable.

(renumber remaining sections)

203.0 – A –

Assistive Table. A product produced, generally available, or used by or for persons that are physically or mentally challenged intended to facilitate and support personal hygiene.

Adult Changing Station. See Assistive Table

### TABLE 1701.1

**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO Z1390-202X (Working Draft)</td>
<td>Assistive Tables</td>
<td>Miscellaneous</td>
<td>422.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** IAPMO Z1390 is a working draft and is not completed at the time of this monograph.

**SUBSTANTIATION:**

Assistive tables, also known as adult changing tables, are required in many jurisdictions and included in the IBC Section 1110.4.

IAPMO Z1390 was developed for these products, which is added to ensure the plumbing products meet performance and safety requirements.

Definitions are added for new terms.
RECOMMENDATION:
Revise text

Proposed Text:
422.0 Minimum Number of Required Fixtures.

422.4 Toilet Facilities Serving Employees and Customers. Each building or structure shall be provided with toilet facilities for employees and customers. Requirements for customers and employees shall be permitted to be met with a single set of restrooms accessible to both groups, **Such toilet facilities shall be permitted to be within the building or outdoors. Toilet facilities shall be available at all times the building is occupied.**

Required toilet facilities for employees and customers located in shopping malls or centers shall be permitted to be met by providing a centrally located toilet facility accessible to several stores. The maximum travel distance from entry to any store to the toilet facility shall not exceed 300 feet (91 440 mm).

Required toilet facilities for employees and customers in other than shopping malls or centers shall have a maximum travel distance not to exceed 500 feet (152 m).

SUBSTANTIATION:
The code needs clarity on the intent of toilet facilities for public use. These provisions will clarify that such toilet facilities for the public are only required to have public access when the building is being occupied and that such facility can be either inside the building or outside the building.
422.4 Toilet Facilities Serving Employees and Customers. Each building or structure shall be provided with toilet facilities for employees and customers. Requirements for customers and employees shall be permitted to be met with a single set of restrooms accessible to both groups. Required toilet facilities for employees and customers located in shopping malls or centers shall be permitted to be met by providing a centrally located toilet facility accessible to several stores. The maximum travel distance from entry to any store to the toilet facility shall not exceed 300 feet (91 440 mm). Required toilet facilities for employees and customers in other than shopping malls or centers shall have a maximum travel distance not to exceed 500 feet (152 m).

Exceptions:
1. A toilet facility shall be required for customers where a business has only a drive-through and no seating area.
2. A toilet facility shall be required in parking garages with no parking attendants or working staff.

SUBSTANTIATION:
There are jurisdictions that recognize these exceptions when establishments are intended for drive through and pick-up only. These exceptions are intended for establishments that do not have persons working in garages and is self-sustained. Additionally, drive-throughs that do not have a lounge, eating area, or standing waiting area would be exempt from requiring public access to toilet facilities.
TABLE 422.1
MINIMUM PLUMBING FACILITIES

<table>
<thead>
<tr>
<th>TYPE OF OCCUPANCY</th>
<th>WATER CLOSETS (FIXTURES PER PERSON)</th>
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</tr>
</tbody>
</table>

Notes:
1-7 (remaining text unchanged)
8 High and Low drinking fountains shall be considered as a single unit.

(portions of table not shown remain unchanged)

SUBSTANTIATION:
There is confusion as to what a combination high and low drinking fountain is considered as “two” drinking fountains. This note states that a drinking fountain assembly which contains a high and low outlet is considered one appliance with two outlets. The reasoning for this consideration is that drinking fountains with two spouts (upper and lower) contain a single set of components (i.e. compressor, drain, water connection, etc.) and are manufactured, tested and listed as a single unit. The intent is that this single appliance can be replaced with a drinking fountain containing a single spout. Thus, the single appliance fixture would no longer meet the minimum requirement if the single appliance was intended as two fountains.
SUBMITTER:
IAPMO Staff

Organization Name:
IAPMO

Organization Representation:
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

Proposed Text:

504.0 Water Heater Requirements.

504.5 Temperature Limiting Devices. A water heater or a hot water storage vessel installation, vessels, shall be provided with overtemperature protection by means of an approved, listed device installed in accordance with the terms of its listing and the manufacturer's installation instructions. ([NFPA 54:10.26.5])

504.6 Temperature, Pressure, and Vacuum Relief Devices. Temperature, pressure, and vacuum relief devices, or combinations thereof, and automatic gas shutoff devices shall be installed in accordance with the terms of their listings and the manufacturer's installation instructions. A shutoff valve shall not be placed between the relief valve and the water heater or on discharge pipes between such valves and the atmosphere. The hourly British thermal units (Btu) (kW•h) discharge capacity or the rated steam relief capacity of the device shall not be less than the input rating of the water heater. ([NFPA 54:10.26.6]) Discharge piping shall be installed in accordance with Section 608.5.

506.0 Air for Combustion and Ventilation.

506.1 General. Air for combustion, ventilation, and dilution of flue gases for appliances installed in buildings shall be obtained by application of one of the methods covered in Section 506.2 through Section 506.7.3. Where the requirements of Section 506.2 are not met, outdoor air shall be introduced in accordance with methods covered in Section 506.4 through Section 506.7.3.

Exceptions:
(1) This provision shall not apply to direct vent appliances.
(2) Type 1 clothes dryers that are provided with makeup air in accordance with the mechanical code. ([NFPA 54:9.3.1.1])

506.1.3 Makeup Air. Where exhaust fans, clothes dryers, and kitchen ventilation systems interfere with the operation of appliances, makeup air shall be provided. ([NFPA 54:9.3.1.5])

506.8 Louvers, and Grilles, and Screens. The required size of openings for combustion, ventilation, and dilution air shall be based on the net free area of each opening. Where the free area through a design of louver, grille, or screen is known, it shall be used in calculating the size opening required to provide the free area specified. Where the louver and grille design and free area are not known, it shall be assumed that wood louvers have 25 percent free area, and metal louvers and grilles have 75 percent free area. Nonmotorized louvers and grilles shall be fixed in the open position. ([NFPA 54:9.3.7.1])

507.0 Appliance and Equipment Installation Requirements.

507.3 Appliance Support. (remaining text unchanged)

507.3.1 Structural Capacity. At the locations selected for installation of appliances and equipment, the dynamic and static load carrying capacities of the building structure shall be checked to determine whether they are
adequate able to carry the additional loads. The appliances and equipment shall be supported and shall be connected to the piping so as not to exert undue stress on the connections. [NFPA 54:9.1.8.2]

507.10 Protection of Gas Appliances from Fumes or Gases other than Products of Combustion. Non-direct-vent appliances installed in beauty shops, barber shops, or other facilities where chemicals that generate corrosive or flammable products such as aerosol sprays are routinely used, one of the following shall apply to fired appliances where these chemicals enter combustion air:
(1) Fired appliances shall be located in a mechanical room separate or partitioned off from other areas with provisions for combustion and dilution air from outdoors. Direct-vent appliances in such facilities shall be in accordance with the appliance manufacturer’s installation instructions.
(2) The appliances shall be direct vent and installed in accordance with the appliance manufacturer’s installation instructions. [NFPA 54:9.1.6.2]

507.13 Installation in Residential Garages. Appliances in residential garages and in adjacent spaces that open to the garage and are not part of the living space of a dwelling unit shall be installed so that all heating elements, switches, burners, and burner-ignition devices are located not less than 18 inches (457 mm) above the floor.
Exception: Listed flammable vapor ignition resistant (FVIR) appliances. {NFPA 54:9.1.10.1}

507.17 Extra Device or Attachment. No device or attachment shall be installed on any appliance that could in any way impair the combustion of gas. [NFPA 54:9.1.15]

507.18 Addition to Existing System. When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has adequate capacity. If the capacity of the system is determined to be inadequate for the additional appliances, the existing system one or more of the following modifications shall be enlarged as made to provide required, or separate minimum gas piping of adequate capacity shall be provided; pressures to each appliance:
(1) The existing system is enlarged as required.
(2) Separate gas piping of adequate capacity is provided.
(3) The gas pressure is increased within the limitations of the existing piping system and connected appliances. [NFPA 54:5.1.2.5.1.2.1, 51.2.2]

507.25 Accessibility for Service. All appliances shall be located with respect to building construction and other equipment so as to permit access for repair or replacement of the appliance. [NFPA 54:9.2.1.1] Clearances shall be maintained to permit servicing the appliances: removal of the appliance; cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where necessary; the adjustment and cleaning of burners and pilates; and the proper functioning of explosion vents, if provided. For attic installation, the passageway and servicing area adjacent to the appliance shall be in accordance with Section 508.4. {NFPA 54:9.2.1} The passageway to and the servicing area adjacent to attic appliances shall be provided with flooring. [NFPA 54:9.2.1.3] Unless otherwise specified, clearances of not less than 30 inches (762 mm) in depth, width, and height of working space shall be maintained.

508.0 Appliances on Roofs, in Attics or Under-Floor Spaces.

508.3 Appliances on Roofs. (remaining text unchanged)

508.3.2 Access Type. The inside means of access shall be a permanent or foldaway inside stairway or ladder, terminating in an enclosure, scuttle, or trapdoor. Such scuttles or trapdoors shall be at least 22 inches by 24 inches (559 mm by 610 mm) in size, shall open easily and safely under all conditions, especially snow, and shall be...
constructed so as to permit access from the roof side unless deliberately locked on the inside. At least 6 feet (1829 mm) of clearance shall be available between the access opening and the edge of the roof or similar hazard, or rigidly fixed rails or guards a minimum of 42 inches (1067 mm) in height shall be provided on the exposed side. Where parapets or other building structures are utilized in lieu of guards or rails, they shall be a minimum of 42 inches (1067 mm) in height. [NFPA 54:9.4.3.3]

508.4 Appliances in Attics and Under-Floor Spaces. An attic or under floor space in which an appliance is installed shall be accessible through an opening and passageway larger than at least as large as the largest component of the appliance, and not less than 22 inches by 30 inches (559 mm by 762 mm). {NFPA 54:9.5.1}

509.0 Venting of Appliances.

509.5 Masonry, Metal, and Factory-Built Chimneys. (remaining text unchanged)

509.5.4 Termination. (remaining text unchanged)

509.5.4.3 Decorative Shrouds. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where such shrouds are listed and labeled for use with the specific factory-built chimney system and are installed in accordance with the manufacturer's installation instructions. [NFPA 54:12.6.2.4]

509.5.10 Space Surrounding Lining or Vent. The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping shall be in accordance with Section 509.5.10.1 and Section 509.5.10.2.

509.5.10.1 Appliance Venting. The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry chimney shall not be used to vent another appliance.

Exception: The insertion of another liner or vent within the chimney as provided in this code and the liner or vent manufacturer's instructions. [NFPA 54:12.6.8.1]

509.5.10.2 Combustion Air. The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry, metal, or factory-built chimney flue shall not be used to supply combustion air.

Exception: Direct-vent appliances designed for installation in a solid fuel-burning fireplace where installed in accordance with the manufacturer's installation instructions. [NFPA 54:12.6.8.2]

509.5.11 Insulation Shield. Where a factory-built chimney passes through insulated assemblies, an insulation shield constructed of steel having a thickness of not less than 0.0187 in. (0.4712 mm) (nominal 26 gage) shall be installed to provide clearance between the chimney and the insulation material. The clearance shall not be less than the clearance to combustibles specified by the chimney manufacturer's installation instructions. Where chimneys pass through attic space, the shield shall terminate not less than 2 inches (51 mm) above the insulation materials and shall be secured in place to prevent displacement. [NFPA 54:12.6.9]

509.7 Single-Wall Metal Pipe.

509.7.3 Installation with Appliances Permitted by Section 509.4.

509.7.3.4 Clearances. Minimum clearances from single-wall metal pipe to combustible material shall be in accordance with Table 509.7.3.4(1). Reduced clearances from single-wall metal pipe to combustible material shall be as specified for vent connectors in accordance with Table 509.7.3.4(2). [NFPA 54:12.8.4.4]

509.7.4 Size of Single-Wall Metal Pipe. Single-wall metal piping shall comply with the following requirements: (1) A venting system of a single-wall metal pipe shall be sized in accordance with one of the following methods and the appliance manufacturer's instructions:
(a) For a draft hood-equipped appliance, in accordance with Section 510.0.
(b) For a venting system for a single appliance with a draft hood, the areas of the connector and the pipe each shall not be less than the area of the appliance flue collar or draft hood outlet, whichever is smaller. The vent area shall not be greater than seven times the draft hood outlet area.
(c) Approved engineering methods.

509.8 Through-the-Wall Vent Termination.
509.8.1 Clearance for Through-the-Wall Vent Termination. The clearance for through-the-wall direct vent and non-direct vent terminals shall be in accordance with Table 509.8.1 and Figure 509.8.1.
Exception: The clearances in Table 509.8.1 shall not apply to the combustion air intake of a direct vent appliance. [NFPA 54:12.9.1]

509.10 Vent Connectors for Category I Appliances. (remaining text unchanged)

509.10.5 Joints. Joints between sections of connector piping and connections to flue collars or draft hood outlets shall be fastened in accordance with one of the following methods:(1) Mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint. (2)-(3) (remaining text unchanged) [NFPA 54:12.11.6]

509.14 Automatically Operated Vent Dampers. An automatically operated vent damper shall be listed. [NFPA 54:12.15]

510.0 Sizing of Category I Venting Systems.

510.1.9 Draft Hood Conversion Accessories. Draft hood conversion accessories for use with masonry chimneys venting listed Category I fan-assisted appliances shall be listed and installed in accordance with the listed accessory manufacturer’s installation instructions. [NFPA 54:13.1.10]

510.2.11 Vent Connector Rise. The vent connector rise (R) for each appliance connector shall be measured from the draft hood outlet or flue collar to the centerline where the vent gas streams come together. [NFPA 54:13.2.12]

510.2.15 Multistory Type B Vents Required. Where used in multistory systems, vertical common vents shall be in accordance with the following:
(1) Type B double wall and shall be installed
(2) Installed with a listed vent cap. [NFPA 54:13.2.16]

510.2.20 Connections to Chimney Liners. Where double-wall connectors are required, tee and wye fittings used to connect to the common vent chimney liner shall be listed double-wall fittings. Connections between chimney liners and listed double-wall fittings shall be made with listed adapter fittings designed for such purpose. [NFPA 54:13.2.21]

(renumber remaining sections)

<table>
<thead>
<tr>
<th>TABLE 509.7.3.4(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEARANCES FOR CONNECTORS (NFPA 54: TABLE 12.8.4.4)*</td>
</tr>
</tbody>
</table>
### MINIMUM DISTANCE FROM COMBUSTIBLE MATERIAL (inches)

<table>
<thead>
<tr>
<th>APPLIANCE</th>
<th>LISTED TYPE B GAS VENT MATERIAL</th>
<th>LISTED TYPE L VENT MATERIAL</th>
<th>SINGLE-WALL METAL PIPE</th>
<th>FACTORY-BUILT CHIMNEY SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listed gas-fired toilets</td>
<td>Not permitted</td>
<td>As listed</td>
<td>As listed</td>
<td>As listed</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25.4 mm

* These clearances shall apply unless the installation instructions of a listed appliance or connector specify different clearances, in which case the listed clearances shall apply.

(portions of table not shown remain unchanged)

#### TABLE 509.7.3.4(2)

REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION

<table>
<thead>
<tr>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10 (remaining text unchanged)</td>
</tr>
<tr>
<td>11 Listed single-wall connectors shall be installed in accordance with the terms of their listing and the manufacturer's installation instructions.</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

#### SUBSTANTIATION:

In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 5 is being revised to the latest edition of NFPA 54-2024.
Proposed Text:

501.0 General.

501.1 Applicability. The regulations of this chapter shall govern the construction, location, and installation of fuel-burning and other types of water heaters heating potable water, together with chimneys, vents, and their connectors. The minimum capacity for storage water heaters shall be in accordance with the first-hour rating listed in Table 501.1(2). A list of accepted water heater appliance standards is referenced in Table 501.1(1). Unlisted water heaters shall be permitted in accordance with Section 504.3.2. Water heaters utilized for combined space-heating and potable water-heating applications shall comply with the standards referenced in Table 501.1(1), 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 and the space heating design requirements corrected for hot water first-hour draw recovery. Solar thermal water heaters shall comply with this code and the Uniform Solar, Hydronics and Geothermal Code (USHGC).

Water heaters shall be installed in accordance with the manufacturer’s installation instructions. The final installation shall be approved by the Authority Having Jurisdiction.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO/ANSI USHGC meets the requirements for mandatory referenced standards in accordance with Section 3- 3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed text brings in provisions that recognize combined space heating and potable water heating applications. These provisions will align with language in the Uniform Solar, Hydronics, and Geothermal Code with regards to dual purpose water heaters.
501.0 General.

501.1 Applicability. The regulations of this chapter shall govern the construction, location, and installation of fuel-burning and other types of water heaters heating potable water, together with chimneys, vents, and their connectors. The minimum capacity for storage water heaters serving one- and two-family dwellings, townhomes, and individual apartments shall be in accordance with the first-hour rating listed in Table 501.1(2). A list of accepted water heater appliance standards is referenced in Table 501.1(1). Listed appliances shall be installed in accordance with the manufacturer’s installation instructions. Unlisted water heaters shall be permitted in accordance with Section 504.3.2.

Water heaters shall be installed in accordance with the manufacturer’s installation instructions. The final installation shall be approved by the Authority Having Jurisdiction.

SUBSTANTIATION:
The wording of the text related to Table 501.1(2) appears to be related to only one- and two-family dwellings, townhomes, and individual apartments. The addition of this text will make this clear to the end user. However, this observation brings to light that this chapter needs to be expanded to include minimum hot water volume provisions to address other occupancies.
501.0 General.

501.2 Water Heater as Space-Heater. 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 shall be provided to limit the water supplied to the potable hot water distribution system to a temperature of 140°F (60°C) or less.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCED STANDARDS</td>
</tr>
<tr>
<td>STANDARD NUMBER</td>
</tr>
<tr>
<td>ASSE 1017-2023</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

<table>
<thead>
<tr>
<th>TABLE 1701.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</td>
</tr>
<tr>
<td>DOCUMENT NUMBER</td>
</tr>
<tr>
<td>ASSE 1017-2009</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

Note: ASSE 1017 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Equipment exists that can perform both space-heating and domestic potable water-heating. The use of the ASSE 1017 would protect the potable water distribution from possible extreme temperatures.
501.0 General.

501.2 Air-Source HPWHs. Air-source heat pump water heaters (HPWH) be installed in accordance with the manufacturer’s installation instructions, and Section 501.2.1 through Section 501.2.4.2. Commercial air-source HPWHs shall comply with AHRI 1300.

501.2.1 Ventilation. Air-source HPWHs shall be installed with a net free area in accordance with Table 501.2.1. The net free area shall be equally distributed between the upper and lower points of the space. Exception: Where the net free area requirements cannot be met, the air-source HPWH shall be ducted in accordance with the manufacturer’s installation instructions.

501.2.1.1 Air Intake and Exhaust. The air intake and exhaust openings or ducts shall be located such that both intake and exhaust are within the same pressure zone.

<table>
<thead>
<tr>
<th>VOLUME OF SPACE (cubic feet)</th>
<th>MINIMUM NET FREE AREA (square inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 2100</td>
<td>0</td>
</tr>
<tr>
<td>≥ 700 and &lt; 2100</td>
<td>0</td>
</tr>
<tr>
<td>≥ 600 and &lt; 700</td>
<td>40</td>
</tr>
<tr>
<td>≥ 500 and &lt; 600</td>
<td>80</td>
</tr>
<tr>
<td>≥ 400 and &lt; 500</td>
<td>120</td>
</tr>
<tr>
<td>≥ 300 and &lt; 400</td>
<td>160</td>
</tr>
<tr>
<td>≥ 200 and &lt; 300</td>
<td>200</td>
</tr>
<tr>
<td>≥ 100 and &lt; 200</td>
<td>240</td>
</tr>
<tr>
<td>&lt; 100</td>
<td>280</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot = 0.0283 m³, 1000 British thermal units per hour = 0.293 kW

501.2.2 Condensate Drains. Condensate drain lines from air-source HPWHs shall be in accordance with Section 814.4.

501.2.3 Obstructions. Air intakes, exhaust outlets, filters, heating elements, wiring connections, unit controls,
501.2.4 Supports and Anchorage. Air-source HPWHs shall be anchored or strapped to resist horizontal displacement due to earthquake motion. Seismic restraints shall be in accordance with Section 501.2.4.1 for unitary air-source HPWHs, and Section 501.2.4.2 for split system air-source HPWHs.

501.2.4.1 Unitary Air-Source HPWHs. Seismic restraints for unitary air-source HPWHs shall be located at points within the upper and lower one-third of the storage tank’s vertical dimensions and shall not be located over the portion of the storage tank containing the heat pump.

501.2.4.2 Split System Air-Source HPWHs. Seismic restraints for the storage tanks in split system air-source HPWHs shall be located at points within the upper and lower one-third of the tank’s vertical dimensions. Seismic restraints for the heat pump shall be in accordance with the manufacturer’s installation instructions.

507.0 Appliance and Equipment Installation Requirements.

507.2 Seismic Provisions. Water heaters shall be anchored or strapped to resist horizontal displacement due to earthquake motion. Strapping shall be at points within the upper one-third and lower one-third of its vertical dimensions. At the lower point, a distance of not less than 4 inches (102 mm) shall be maintained from the controls with the strapping.

Exception: Seismic restraints for air-source HPWHs shall be in accordance with Section 501.2.4.

210.0 - H -

Heat Pump Water Heater, Air-Source. A water heating system, containing a heat pump and storage tank, where the heat pump uses ambient air as a heat source to heat water. There are two types:
(1) Unitary systems where the heat pump and storage tank are a single assembly.
(2) Split systems where the heat pump and storage tank are separate assemblies.

### TABLE 1701.1
REFERRED STANDARDs

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

NOTE: AHRI 1300 meets the requirements for a mandatory reference standard in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**

Air source heat pump water heaters (HPWH) have become an integral and growing part of the types of water heaters installed in many jurisdictions. Air source HPWH function by extracting heat from the ambient air and using it to heat water, offering an alternative to conventional electric or gas water heaters.

There are two types of air source HPWH, unitary and split. The air flow needs of each type are different and need to be considered separately.
The provisions of this chapter do not adequately address the requirements for the air needed to enable these water heaters to operate in heat pump mode. To work properly, the heat pump portion of these water heaters requires adequate space around it to allow the HPWH to extract heat from the ambient air and dissipate “coolth” from the discharge side of the condenser. If there isn't enough space, then the HPWHs need to be passively vented or actively ducted to a space that is large enough to handle both sides of the energy exchange.

The size of this passive or active ventilation depends on the capacity of the heat pump in BTU/hour. Higher heat rates are accompanied with higher fan speeds in cubic feet per minute (CFM). Larger capacities require larger vents and larger ducts. Net free area is generally used to describe the requirements for passive ventilation. Equally distributing the net free area between the upper and lower parts of the space ensures a steady flow of air across the heat pump’s components, facilitating a natural convection process. This configuration allows “warm” air to enter from above while “cool” air exits from the bottom.

Equally distributing the net free area between the upper and lower parts of the space ensures a steady flow of air across the heat pump’s components, facilitating a natural convection process. This configuration allows cool air to enter from below while expelling warmer air from the top, minimizing the chance of hot air recirculation.

Positioning air intake and exhaust openings or ducts within the same pressure zone promotes balanced pressure conditions and avoids potential complications such as inefficient operation, higher energy usage, or the inadvertent introduction of combustion gases into inhabited areas.

Appropriate reference is being made to existing requirements in Section 814.4 (Appliance Condensate Drains) for condensate drain lines.

Air intakes, exhaust outlets, filters, heating elements, wiring connections, unit controls, condensate drains, and temperature and pressure relief valves on air-source heat pump water heaters must remain unobstructed and easily accessible. This accessibility allows for regular maintenance and the timely replacement of components.

Air-source HPWHs need to be securely anchored or strapped to mitigate horizontal movement during earthquakes. This requirement is detailed in Section 501.2.4 (Supports and Anchorage), with specific guidelines provided for both unitary and split system air-source HPWHs to ensure they are properly restrained against seismic activity. Additionally, Section 507.2 (Seismic Provisions) is being revised to reference this new section.

AHRI 1300 (Performance Rating of Commercial Heat Pump Water Heaters) is being referenced as it applies to commercial HPWHs and includes requirements for measuring various performance metrics such as heating capacity, energy efficiency, and coefficient of performance (COP). It is beneficial to the code because it provides a clear and standardized method for evaluating and reporting the capabilities of these systems.

In support of these new requirements, a definition of “air-source heat pump water heater” is provided which identifies and describes both unitary and split system types.

Although it might appear that these provisions align more closely with energy code concerns, their inclusion in the plumbing code is essential to ensure that the industry responsible for installing HPWHs is well-informed about proper installation techniques. Furthermore, incorrect installation could compromise occupant health and safety by adversely affecting the building’s ventilation, heating, and cooling systems due to improper air flow management from the HPWH.
TABLE 501.1 (1)
WATER HEATERS

<table>
<thead>
<tr>
<th>TYPE*</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric, Household Storage</td>
<td>UL 174</td>
</tr>
<tr>
<td>Oil-Fired Storage Tank</td>
<td>UL 732</td>
</tr>
<tr>
<td>Gas-Fired, 75 000 Btu/h or less, Storage</td>
<td>CSA/ANSI Z21.10.1/CSA 4.1</td>
</tr>
<tr>
<td>Gas-Fired, Above 75 000 Btu/h, Storage and Instantaneous</td>
<td>CSA/ANSI Z21.10.3/CSA 4.3</td>
</tr>
<tr>
<td>Electric, Commercial Storage</td>
<td>UL 1453</td>
</tr>
<tr>
<td>Solid Fuel-Fired</td>
<td>UL 2523</td>
</tr>
<tr>
<td>Electric Instantaneous</td>
<td>UL 499</td>
</tr>
<tr>
<td>Heat Pump</td>
<td>UL 60335-2-40</td>
</tr>
</tbody>
</table>

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

* Dual purpose water heaters shall be installed in accordance with this code and the manufacturer's installation instructions.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD NUMBER</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 60335-2-40-2022</td>
<td>Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers</td>
<td>Appliances</td>
<td>Table 501.1(1)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 60335-2-40 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Adds product safety standard for heat pump water heaters, which addresses concerns associated with low-GWP refrigerants required by EPA Significant New Alternative Policy Program (SNAP) rules.
RECOMMENDATION:
Add new text

Proposed Text:
505.0 Oil-Burning and Other Water Heaters.

505.4 Indirect-Fired Water Heaters. (remaining text unchanged)

505.5 Heat Interface Unit. Heat interface units (HIU) shall comply with the applicable standard in accordance with Table 501.1 (1). Heat interface units shall contain a double wall heat exchanger.

**TABLE 501.1(1)**
WATER HEATERS

<table>
<thead>
<tr>
<th>TYPE*1</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric, Household Storage</td>
<td>UL 174</td>
</tr>
<tr>
<td>Oil-Fired Storage Tank</td>
<td>UL 732</td>
</tr>
<tr>
<td>Gas-Fired, 75 000 Btu/h or less, Storage</td>
<td>CSA/ANSI Z21.10.1/CSA 4.1</td>
</tr>
<tr>
<td>Gas-Fired, Above 75 000 Btu/h, Storage and Instantaneous</td>
<td>CSA/ANSI Z21.10.3/CSA 4.3</td>
</tr>
<tr>
<td>Electric, Commercial Storage</td>
<td>UL 1453</td>
</tr>
<tr>
<td>Solid Fuel-Fired</td>
<td>UL 2523</td>
</tr>
<tr>
<td>Electric Instantaneous</td>
<td>UL 499</td>
</tr>
<tr>
<td><strong>Heat Interface Units</strong></td>
<td><strong>ASSE 1379</strong></td>
</tr>
</tbody>
</table>

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

*1 Dual purpose water heaters shall be installed in accordance with this code and the manufacturer’s installation instructions.

*2 Where installed, heat interface units with proportional control valves shall be listed according to ASSE 1379.

210.0 - H -
**Heat Interface Unit.** A unit including one or more double wall heat exchangers and control devices for transferring heat from a primary to a secondary system. The primary system may be a hot water heating system. The secondary system is the domestic hot water system within the dwelling or other space.

211.0 - I -
**Indirect-Fired Water Heater.** A water heater consisting of a storage tank equipped with an internal or external heat exchanger used to transfer heat from an external source to heat potable water. The equipment storage tank either contains heated potable water or water supplied from an external source, such as a boiler.

(below shown for informational purposes)
505.4.1 Single-Wall Heat Exchanger. An indirect-fired water heater that incorporates a single-wall heat exchanger shall be in accordance with the following requirements:

1. The heat transfer medium shall be either potable water or contain fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.

2. Bear a label with the word “Caution,” followed by the following statements:
   a. The heat-transfer medium shall be potable 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 in letters shall have an uppercase height of not less than 0.120 of an inch (3.048 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 compatible with the uppercase letter size specification.

### TABLE 1701.1

**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1379-20XX</td>
<td>Proportional Flow Control Devices, with Protection from Cross Connection via Hydronic Water, for use in Potable Water Installations</td>
<td>Appliances</td>
<td>Table 501.1(1)</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: ASSE 1379 is a working draft and is not completed at the time of this monograph.

**SUBSTANTIATION:**

This code change proposal is to include heat interface units in the code. A heat interface unit is used for heating domestic water by means of a hydronic hot water system. Designing a domestic hot water system using heat interface devices can significantly reduce the amount of piping in a building. By reducing the amount of piping the amount of fittings/connections is reduced as well as through penetrations. This is accomplished by removing the recirculation line as well as domestic hot water pipes throughout and utilizing the hydronic heating system to heat the domestic hot water.

This change allows the opportunity for indirect-fired water heaters to be used without a storage tank. Just like other water heaters (electric or gas) have the option to not contain a storage tank, indirect-fired water heaters should also have this same option. Also incorporated in this change is the performance requirements for a proportional control valve in an indirect-fired water heater, if one is installed. Currently, there are no performance requirements outside the Boiler and Pressure Vessel Code for indirect-fired water heaters. This change gives performance requirements for a proportional control valve if one is included in the indirect-fired water heater. This will help reduce risk of cross-contamination from non-potable systems.

This proposal does include testing and certification to ASSE 1379 to reduce the risk of cross-contamination between the hydronic water and the potable domestic hot water.

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**RECOMMENDATION:**
Add new text

**Proposed Text:**
505.0 Oil-Burning and Other Water Heaters.

505.5 Unfired Hot Water Storage Vessels. Unfired hot water storage tanks shall have an insulation rating of not less than R-12.5.

**SUBSTANTIATION:**
Hot water storage tanks are part of many water supply systems. As part of a hot water supply system, there is always a concern for energy waste in the form of heat loss. This provision provides what the federal laws already address as a minimum insulation requirement and the addition of this text will recognize unfired hot water storage and the minimum insulation requirements. The following link provides more information:
SUBMITTER: Jay Peters  
Organization Name: Codes and Standards International  
Organization Representation: IPS Corporation

RECOMMENDATION:  
Revise text

Proposed Text:  
507.0 Appliance and Equipment Installation Requirements.

507.5 Drainage Pan. Where a water heater is located in an attic, in or on an attic ceiling assembly, floor-ceiling assembly, floor-subfloor assembly or where damage results from a leaking water heater will result in damage to the structure, a watertight pan of corrosion-resistant material shall be installed beneath the water heater in accordance with the following:

(1) The drainage pan shall be provided with not less than 3/4 of an inch (20 mm) diameter drain to an approved location and. The terminating end of the drainpipe shall be readily visible or the pan shall be equipped with an approved device in compliance with section 606.9 to detect and automatically shut off the water supply to the water heater in the event of a leak.

(2) - (4) (remaining text unchanged)

SUBSTANTIATION:  
This proposal is specific to attics and locations where damage can occur from a water heater leak and is an option, not a requirement. These devices are reliable, self test, provide notification and shut off the water with a miniscule drop of moisture detected. Section 606.9 requires these devices to be in compliance with ANSI/CAN/IAPMO Z1349-2021 Devices for Detection, Monitoring or Control of Plumbing Systems.


"The ANSI/CAN/IAPMO Z1349 takes steps to avoid the waste of water and achieves a better and more sustainable future for all. The technology listed to the ANSI/CAN/IAPMO Z1349 standard has the capability of letting the homeowner know if there is a water leak with the use of a smartphone. Aside from preserving resources, a homeowner will save money on their water bill and insurance companies can have peace of mind that water leaks will be detected prior to causing major damage to the structure."

The pan and drainage piping are intended to relieve small leaks. Although it might be small, a leak should not occur and is the first sign of a possible pending catastrophic event with no indication to the owner of any possible problem, as it is typically out of sight. In other instances, it can be extremely onerous to provide piping to an approved location in existing construction.

These listed devices are approved as options in many jurisdictions across Texas, California and more. In some cases, they are required in lieu of a pan and/or drain. There are multiple manufacturers and well over a million units have been installed. Many water heater manufacturers, such as Rheem and AO Smith, have already incorporated this leak sensing technology into the equipment. This provision will raise the level of safety and protection for installations without integral devices.

The change above provides an option, raises the level of safety, has the potential to reduce injuries and save millions of dollars in water damages to structures.
Sample Local Jurisdiction Code Language:

Fort Worth, Texas

Exception: When a water heater retrofit or replacement occurs on a slab foundation and the line cannot be discharged to an approved location the T&P discharge line can be piped to the water heater pan provided with all of the following:

1. the water heater when water is detected inside the pan;

2. A device is installed that will sound an audible alarm when water is detected inside the pan to alert the occupants that a leak has occurred.

Frisco Texas

P2801.9 Water heaters installed in attics or with living space below: Water heaters, other than tankless, when located in an attic space or a space located above living space, shall be equipped with a WAGS, Floodstop or other approved device to automatically shut off the water supply if a water leak is detected. Exception: Replacement water heaters that were permitted on or before December 31, 2013, shall not be required to be equipped with an automatic Shut off device.
Proposed Text:
507.0 Appliance and Equipment Installation Requirements.

507.13 Installation in Residential Garages. Appliances in residential garages and in adjacent spaces that open to the garage and are not part of the living space of a dwelling unit shall be installed so that all heating elements, switches, burners, and burner-ignition devices are located not less than 18 inches (457 mm) above the floor.

Exception: Listed flammable vapor ignition resistant (FVIR) appliances. {NFPA 54:9.1.10.1}

SUBSTANTIATION:
The proposed change is removing reference to “heating elements” and “switches” from Section 507.13 (Installation in Garages). Typically, appliances which use heating elements and switches are electric. Electric appliances do not have an open flame that can ignite flammable vapors. Their heating elements and switches are generally enclosed, reducing the risk of directly igniting vapors. Therefore, these are not considered a source of ignition or a burner, and the provisions should not require heating elements and switches to be raised 18 inches from the ground.
Proposed Text:
507.0 Appliance and Equipment Installation Requirements.

507.13 Installation in Residential Garages. Appliances in residential garages and in adjacent spaces that open to
the garage and are not part of the living space of a dwelling unit shall be installed so that all heating elements,
switches, burners, and burner-ignition devices are located not less than 18 inches (457 mm) above the floor.

Exceptions:
(1) Listed flammable vapor ignition resistant (FVIR) appliances. {NFPA 54:9.1.10.1}

(2) Sealed direct-vent combustion appliances.

SUBSTANTIATION:
A sealed direct-vent combustion appliance is another necessary exemption to this requirement since these
appliances draw air for combustion from outside the building directly into the combustion chamber and expel the
combustion gases back outside. The combustion chamber in these appliances is completely sealed from the
indoor environment. This means that no indoor air is used for combustion and no combustion gases are released
indoors. Their overall risk profile for igniting flammable vapors is considered lower than that of gas-burning
appliances with open flames. For this reason, this new exception is necessary.
SUBMITTER:  
Thomas Smith

Organization Name:  
Nevada State Fire Marshal

ORGANIZATION REPRESENTATION:  
Self

RECOMMENDATION:  
Revise text

PROPOSED TEXT:
507.0 Appliance and Equipment Installation Requirements.

507.2 Seismic Provisions. Water heaters shall be anchored or strapped to resist horizontal displacement due to earthquake motion. Strapping shall be at points within the upper one-third and lower one-third of its vertical dimensions. At the lower point, a distance of not less than 4 inches (102 mm) shall be maintained from the controls with the strapping. Perforated iron strap (plumber’s tape) shall not be an acceptable material for strapping or bracing water heaters rated at 40 gallons or greater.

SUBSTANTIATION:
There concerns related to appropriate strapping of water heaters. While plumbers tape has been used for decades as a means of supporting piping, it is not necessarily appropriate for large capacity support. Seismic kits come with specific installation requirements and have specially designed anchoring mechanisms with seismic movement in mind. A 40-gallon water heater has a weight of approximately 333.2 pounds, plus the weight of the water heater itself.

Sudden jolt from seismic conditions will easily pull plumbers tape out of the wall if not sufficiently attached. The holes are small and can shear easily. Shearing strength is lower than tensile strength. The anchoring of large capacities should be installed with the bolts positioned to take on the tensile force. The commonly available P-tape is light gauge and 5/8-inch to 3/4-inch wide. It has a comparably low breaking strength compared to the weight of a shifting 500-pound water heater.

The dictionary defines shear and tensile as follows:

Shear strength measures the ability of a fastener to withstand a load at right angles to the access of a fixing connection (ie. Across the shaft of a fastener). Tensile strength measures the ability of a fastener to withstand a force along its access (ie. Along the shaft of the fastener).
Proposed Text:
507.0 Appliance and Equipment Installation Requirements.

507.2 Seismic Provisions. Water heaters shall be braced, anchored or strapped to resist falling or horizontal displacement due to earthquake motion. Strapping shall be at points within the upper one-third and lower one-third of its vertical dimensions. At the lower point, a distance of not less than 4 inches (102 mm) shall be maintained from the controls with the strapping.

SUBSTANTIATION:
The proposed text adds clarity and guidance for the end user indicating that “bracing” is important to implement for seismic conditions as seismic movements are not in uniform motions or directions, so bracing is very important for securing water heaters. Additionally, the term “falling” is being added as the intent of bracing, anchoring, and strapping to allow safely and adequately securing of the water heater to prevent injury and/or damage.
SUBMITTER:
Bruce Meiners

Organization Name:
Wisconsin DPH

Organization Representation:
Self

RECOMMENDATION:
Add new text

Proposed Text:
601.0 General.

601.2 Water Supply and Flushing. (remaining text unchanged)

601.2.2 Health Care Facilities. Hot water distribution systems in health care facilities shall be under constant recirculation to provide continuous hot water at each hot water outlet.

SUBSTANTIATION:
The proposed provision prevents water age in the hot water distribution system. Current plumbing code in Wisconsin contains such provisions and will benefit health care facilities and its occupants.
SUBMITTER: Armando Barragan

ORGANIZATION NAME: Self

ORGANIZATION REPRESENTATION: Self

RECOMMENDATION: Revise text

PROPOSED TEXT:
601.0 General.

601.3 Water Sources. Where geological and soil conditions permit and first approved by the Authority Having Jurisdiction, private wells shall be permitted as a source for potable water. Wells shall include dug, bored, driven type and drilled wells. Land bodies of water and land cisterns shall be permitted where first treated in accordance with the minimum local water quality requirements. Where no such water requirements exist, the requirements of NGWA-01 shall apply.

(renumber remaining sections)

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI/NGWA-01-2014</td>
<td>Water Well Construction Standard</td>
<td>Miscellaneous</td>
<td>601.3</td>
</tr>
</tbody>
</table>

Note: ANSI/NGWA 01 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The code needs to expand on the water sources used throughout the nation where a public water source is impractical or does not exist in remote locations. The UPC is applicable in all plumbing systems and should provide guidance on other water sources from the land and environments.
601.3 Identification of a Potable and Nonpotable Water System. (remaining text unchanged)

601.3.3 Alternate Water Sources. Alternate water source systems shall have a purple (Pantone color No. 512, 522C, or equivalent) background with uppercase lettering and shall be field or factory marked as follows: **CAUTION: NONPOTABLE WATER, DO NOT DRINK** in black letters.

(1) Gray water systems shall be marked in accordance with this section with the words **“CAUTION: NONPOTABLE GRAY WATER, DO NOT DRINK”** in black letters.

(2) Reclaimed (recycled) water systems shall be marked in accordance with this section with the words **“CAUTION: NONPOTABLE RECLAIMED (RECYCLED) WATER, DO NOT DRINK”** in black letters.

(3) On-site treated water systems shall be marked in accordance with this section with the words **“CAUTION: ON-SITE TREATED NONPOTABLE WATER, DO NOT DRINK”** in black letters.

(4) Rainwater catchment systems shall be marked in accordance with this section with the words **“CAUTION: NONPOTABLE RAINWATER, DO NOT DRINK”** in black letters.

**SUBSTANTIATION:**

Water is either potable or non-potable. Having four roll marks is unnecessary to protect human health, and complicates product selection, manufacturing, product storage, ordering, and tends to waste materials, one simple roll mark is sufficient to protect human health.
TABLE 603.2
BACKFLOW PREVENTION DEVICES, ASSEMBLIES, AND METHODS

<table>
<thead>
<tr>
<th>DEGREE OF HAZARD</th>
<th>DEVICE, ASSEMBLY, OR METHOD</th>
<th>APPLICABLE STANDARDS</th>
<th>POLLUTION (LOW HAZARD)</th>
<th>CONTAMINATION (HIGH HAZARD)</th>
<th>INSTALLATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Backflow preventer with intermediate atmospheric vent</td>
<td>ASSE 1012</td>
<td>X X - -</td>
<td>Installation of potable water connections to water boilers. No high-hazard chemicals shall be introduced into the system using such devices. Designed to operate under continuous pressure conditions. May discharge a small amount of water.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Backflow preventer with intermediate atmospheric vent and pressure reducing valve</td>
<td>ASSE 1081</td>
<td>X X - -</td>
<td>Installation of potable water connections to water boilers. No high-hazard chemicals shall be introduced into the system using such devices. Designed to operate under continuous pressure conditions. May discharge a small amount of water.</td>
<td></td>
</tr>
</tbody>
</table>

(ports of table not shown remain unchanged)

(above is shown for informational purposes only)

603.3.12 Backflow Preventer with Intermediate Atmospheric Vent. A backflow preventer with intermediate atmospheric vent consists of two independently acting check valves, force loaded to a normally closed position, and an intermediate chamber with a means for automatically venting to atmosphere, force loaded to a normally open position.

SUBSTANTIATION:
ASSE 1012 and 1081 provide adequate protection for backflow into the potable water system. There are no documented cases where a backflow incident occurred and contaminated the potable water system when ASSE 1012 or 1081 was installed to control the cross-connection where chemicals were used. Also, the term hazardous chemicals is not defined. All chemicals are hazardous including the chemicals used by the public water system i.e. chlorine. There is a low risk and low probability that a water boiler with or without chemicals would generate a backpressure situation sufficient to cause the water in a water boiler to be greater than the supply pressure, especially since the boiler system is a closed system. A loss of pressure in the supply system would create a backsiphonage situation. However, since the system is water boiler system is closed the non-portable boiler water would not enter the potable water system. Given the hydraulics of the water boiler system the installation of an ASSE 1012 or 1081 would provide sufficient protection with or without the addition of chemicals.

The alternative control for water boilers with chemicals is the installation of an ASSE 1013 which has the capability of discharging water and causing water damage since they are not in many instances installed without catastrophic discharge requirement.

Allowing the ASSE 1012 or ASSE 1081 to be installed on the water boiler would eliminate the water damage concern without compromising public health.
## Proposed Text:

### TABLE 603.2
BACKFLOW PREVENTION DEVICES, ASSEMBLIES, AND METHODS

<table>
<thead>
<tr>
<th>DEGREE OF HAZARD</th>
<th>DEVICE, ASSEMBLY, OR METHOD ¹</th>
<th>APPLICABLE STANDARDS</th>
<th>POLLUTION (LOW HAZARD)</th>
<th>CONTAMINATION (HIGH HAZARD)</th>
<th>INSTALLATION²,³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Double Check Valve Backflow Prevention Assembly (two independent check valves and means of field testing)</td>
<td><strong>ASSE 1015/CSA B64.5; AWWA C510; CSA B64.5 or CSA B64.5.1</strong></td>
<td>X</td>
<td>X</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Reduced Pressure Principle Backflow Prevention Assembly (two independently acting loaded check valves, a differential)</td>
<td><strong>ASSE 1013/CSA B64.4; AWWA C511; CSA B64.4 or CSA B64.4.1</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Horizontal unless otherwise listed. Access and clearance shall be in accordance with the manufacturer's instructions, and not less than a 12 inch clearance at the bottom for maintenance. May need platform/ladder for test and repair. Does not discharge water.
### DEGREE OF HAZARD

<table>
<thead>
<tr>
<th>DEVICE, ASSEMBLY, OR METHOD(^1)</th>
<th>APPLICABLE STANDARDS</th>
<th>POLLUTION (LOW HAZARD)</th>
<th>CONTAMINATION (HIGH HAZARD)</th>
<th>INSTALLATION(^2,3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure relief valve and means for field testing)</td>
<td>ASSE 1013-2021</td>
<td>Backsiphonage</td>
<td>Backpressure</td>
<td>platform/ladder for test and repair. May discharge water.</td>
</tr>
<tr>
<td></td>
<td>ASSE 1013/CSA B64.4-202X</td>
<td>Backsiphonage</td>
<td>Backpressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ASSE 1015-2021</td>
<td>Backsiphonage</td>
<td>Backpressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ASSE 1015/CSA B64.5-202X</td>
<td>Backsiphonage</td>
<td>Backpressure</td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

For SI units: 1 inch = 25.4 mm

**Notes:**

1. See the description of devices and assemblies in this chapter.
2. Installation in pit or vault requires previous approval by the Authority Having Jurisdiction.
3. Refer to the general and specific requirement for installation.
4. Not to be subjected to operating pressure for more than 12 hours in a 24-hour period.
5. For deck-mounted and equipment-mounted vacuum breaker, see Section 603.5.13. Shall be installed in accordance with Section 603.5.7.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1013-2021</td>
<td>Reduced Pressure Principle Backflow Prevention Assemblies</td>
<td>Backflow Protection</td>
<td>Table 603.2</td>
</tr>
<tr>
<td>ASSE 1013/CSA B64.4-202X</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ASSE 1015-2021</td>
<td>Double Check Backflow Prevention</td>
<td>Backflow Protection</td>
<td>Table 603.2</td>
</tr>
<tr>
<td>ASSE 1015/CSA B64.5-202X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

Note: ASSE 1013/CSA B4.4 and ASSE 1015/CSA B64.5 are working drafts and are not completed at the time of this monograph.

**SUBSTANTIATION:**

ASSE 1013 and ASSE 1015 are being updated as harmonized standards with CSA.
RECOMMENDATION:
Add new text

Proposed Text:
603.0 Cross-Connection Control.

603.3 Backflow Prevention Devices, Assemblies, and Methods. (remaining text unchanged)

603.3.13 Hose Connection Vacuum Breaker. A hose connection vacuum breaker consists of a check valve forced loaded, or biased, to a closed position, and an atmospheric vent valve, forced loaded, or biased, to an open position when the device is not under pressure.

SUBSTANTIATION:
Currently hose connection vacuum breakers are included within Table 603.2 but are not defined within Section 603.3.13 in the code. This text will add a description of these vacuum breakers and will assist the end users on its intended use.
Item #: 090  
Code Number: 2024 UPC  
Section Number: 206.0, 603.17

SUBMITTER: Herb Hoeptner  
Organization Name: Hoeptner Perfected Products  
Organization Representation: Hoeptner Perfected Products

RECOMMENDATION: 
Revise text

Proposed Text: 
603.0 Cross-Connection Control.

603.5 Specific Requirements. (remaining text unchanged)

603.5.17 Potable Water Outlets and Valves. Potable water outlets, freeze-proof yard hydrants, combination stop-and-waste valves, freeze resistant drinking fountains, or other fixtures that incorporate a stop and waste feature that drains into the ground shall not be installed underground. 
Exception: Freeze resistant sanitary drinking fountains shall be permitted to be installed underground.

206.0 -D-
Drinking Fountain, Freeze-Resistant. An outdoor point of use valve used for potable water systems that uses a stop and waste below the frost line to protect against freezing. The device is normally installed in a vertical position extending from below the frost line to above grade.

Drinking Fountain, Freeze-Resistant Sanitary. An outdoor point of use valve used for potable water systems that drains back into an internal reservoir below the frost line to protect against freezing. The device is normally installed in a vertical position extending from below the frost line to above grade.

SUBSTANTIATION:
An outside frost free drinking fountain is most common at Parks, Sports complexes, hiking trails, bike trails, dog parks and anywhere the public will need drinking water. The latest trend is to include bottle fillers and dog waterers. To prevent them from freezing they incorporate a stop and waste valve to drain the system into the soil. Standard yard hydrants (weep hole hydrants) that drain into the ground to prevent freezing, and all stop and waste valves are prohibited from being buried underground. An outside frost free drinking fountain drains into the soil the same as a weep hole hydrant or stop and waste and is currently not addressed as such in the UPC code. One can argue whether or not someone can get cross contamination from a stop and waste claiming the use is for filling bucket, but one cannot argue that the only purpose for a drinking fountain is to drink from it. Therefore it is imperative that we guarantee the quality of the water coming from a drinking fountain. Definitions: There is no current definition of Drinking Fountain Freeze Resistant or the subcategory, Drinking Fountain Freeze Resistant Sanitary. These are generally accepted definitions. 603.5.17 This text currently does not include outside frost free drinking fountains that use a stop and waste to protect from freezing. To prevent this text from being misinterpreted to read that all frost free drinking fountains including Sanitary frost free drinking fountains cannot be installed underground an exception needs to be added. Sanitary drinking fountains have been specifically designed to be installed below the frost line and supply potable drinking water. Currently there are three manufacturers that manufacture a Sanitary Drinking Fountain that does not drain into the soil to prevent freezing. For more information on Drinking fountains please see attached Is your outside drinking fountain safe for drinking? If you use or install outside drinking fountains or yard hydrants you might want to concern yourself with the inevitable possibility that your potable water can become contaminated with harmful bacteria located in the soil. Sure you hire the best contractors and you assume that you meet all the state and local requirements, but sometimes that is not enough. Some code
authorities adopt codes but don’t necessarily enforce them, leaving you liable for any problems that develop. Some code authorities are slow to adopt the most current standards available, thus newly adopt an old standard after you have completed your project again leaving you liable. In this litigious society, sometimes you need to do more to ensure you do not become entangled in the litigation process. How contaminated ground water can enter your potable water supply: Typical outside drinking fountains and yard hydrants prevent freeze-ups by draining out of a “weep hole” deep in the ground. They generally consist of a bubbler, or in the case of a yard hydrant, a head for attaching a hose, a riser pipe, and a shutoff valve deep below the frost level. The term “weep hole” is derived from the fact that, when the weep hole drinking fountain or yard hydrant is shut off, a hole in the side of the valve opens to drain all the water from the riser into the soil below the frost line. These are sometimes referred to as Stop & Waste valves. A typical problem for these “weep hole” devices is that, when the ground water level fluctuates, especially during the summer months, or the device is used repeatedly so drain water does not have a chance to percolate into the ground, the ground water level will rise above the weep hole filling the riser with soiled ground water that will be consumed by the public. Each time the device is shut off (fig. 1) and the weep hole opens, ground water will migrate into the drinking fountain or yard hydrant. Each time the drinking fountain or hydrant is turned on (fig. 2), that contaminated migrated water enters the potable water supply system and exits the bubbler. That first drink of water can be nothing but soiled, most likely contaminated water. A secondary, and more serious, problem occurs when the rubber seal in the shutoff valve or air valve deteriorates over time and begins to leak. When the valve on the kitchen sink leaks it is very noticeable as it will drip incessantly forcing you to replace the rubber seal. Unfortunately when your drinking fountain or yard hydrant leaks, it usually leaks out the weep hole deep in the ground undetected. From the surface no one is aware the device is leaking. When a back siphonage condition occurs (Fig. 3), that leak out will become a leak in, sucking contaminated muddy water into the supply line. If the hydrant is located in a horse arena or cow barn, animal by-products will leach into the potable water supply. In the first scenario the end user can consume contaminated water. In the second scenario, it is far more serious because the entire water supply can become contaminated which the public consumes. This means that possible contamination from one drinking fountain or yard hydrant, in one area, could cross contaminate the public in other areas or other commercial or private dwellings. Anyone connected to that water supply potentially can become contaminated. Lately, due to the deaths associated with e-coli outbreaks and other pathogens that have contaminated our water supplies, there has been great concern regarding cross contamination between the soil, which carries animal by-products, fertilizers and other waste, and the water supply. The liability toward each state became such a concern that many states created their own drinking fountain and yard hydrant requirements. Initially, states implemented requirements to isolate weep hole devices from the potable water supply. These requirements included installing a testable RPP backflow preventer upstream of the hydrant and then tagging the hydrant “danger unsafe water”. This solved two major concerns. First, it protected the potable water supply from siphoning contaminated water into the public water system, and secondly, it attempted to notify the public not to use the hydrant for any potable source. Naturally the obvious downside to this approach was that drinking fountains and yard hydrants had to be used as a potable source. Drinking fountains are only used for drinking, and yard hydrants are used for RV parks and campgrounds. A secondary down side is the cost associated with the purchase and installation of a testable RPP backflow preventer, the difficulty in finding a location for the backflow preventer to keep it from freezing and the added cost in annual inspection and testing of the backflow preventer. Innovative manufacturers soon developed a new breed of drinking fountains and yard hydrants to solve the problems associated with the new requirements imposed on weep hole devices. These new devices are called Sanitary Drinking Fountains (Fig. 4) and Sanitary Yard Hydrants. These Sanitary devices work much the same way as a Weep Hole device in that when they are shut off the water in the riser drains down and out a hole located below the frost line to prevent freezing. However, instead of draining out a hole and into the soil, the Sanitary Hydrant, or Sanitary Drinking Fountain (Fig. 4), drains into a sealed tank. When the hydrant is turned on again the water in the tank is expelled leaving the tank empty to repeat the cycle when the device is again shut off. Because the Sanitary drinking fountain and yard hydrant drain into a tank there is no cross contamination with the soil. Because the soil is not required for drainage the drinking fountain or yard hydrant can be placed in any soil condition, even clay. Fig. 4 With the advent of the Sanitary Drinking Fountain and Sanitary Yard Hydrant, states were
able to meet the needs and safety requirements of the public. The problem for the state or local code officials was the cost, manpower and liability in having to develop their own approval process and testing each manufacturer’s device for approval. In turn, the varying requirements by each state made it difficult for manufacturers to make one product for all states. ASSE (American Society of Sanitary Engineers) realized the need to develop a national standard to help states avoid this liability and give manufacturers the ability to meet one set of requirements. After six years of debate and research by code officials, manufacturers, engineers, consultants, and the public, ASSE Sanitary Yard Hydrant Standard 1057 was completed. This standard requires that the hydrant not drain directly into the ground and it must have a back flow preventer if a hose is capable of attachment. It stipulates required pressure and flow capabilities and ensures proper freeze protection. It’s obvious that over the past few years the sanitary issue for drinking fountains and yard hydrants has become an important issue for public safety, and although the 1057 Sanitary Yard Hydrant Standard has not yet specifically addressed drinking fountains, it is important to realize ones potential risk of cross contamination and possible liability when installing or specifying drinking fountains and yard hydrants. For yard hydrants, make sure they have been tested by an approved test lab and listed by a third party certifier to the ASSE 1057 standard. For drinking fountains make sure they are Sanitary drinking fountains where the freeze protection draining does not drain directly into the ground. For more information on Sanitary Drinking Fountains you can contact innovative manufacturers such as Murdock Inc., Stern-Williams or Elkay Mfg.

[Supporting documentation provided in KAVI for TC review]
SUBMITTER:
Herb Hoeptner

Organization Name:
Hoeptner Perfected Products

Organization Representation:
Hoeptner Perfected Products

RECOMMENDATION:
Add new text

Proposed Text:
603.0 Cross-Connection Control.

603.5 Specific Requirements. (remaining text unchanged)

603.5.17 Potable Water Outlets and Valves. Potable water outlets, freeze-proof yard hydrants, combination stop-and-waste valves, or other fixtures that incorporate a stop and waste feature that drains into the ground shall not be installed underground.

Exception: Freeze-resistant sanitary yard hydrants that comply with ASSE 1057 shall be permitted to be installed underground.

227.0 Yard Hydrant. A point of use valve used for nonpotable water systems that is protected against freezing by draining residual water onto the soil (which can be a source of cross-contamination). The device is normally installed in a vertical position extending from below the frost line to above grade.

Yard Hydrant, Sanitary. A point of use valve used for potable water systems that drains back into an internal reservoir below the frost line to protect against freezing. The device incorporates a backflow prevention device with hose connection outlet for potable water application. The device is normally installed in a vertical position extending from below the frost line to above grade.

Note: ASSE 1057 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Standard yard hydrants (weep hole hydrants) that drain into the ground to prevent freezing, are normally used for irrigation but are typically attached to a potable water supply. It has been determined that weep hole yard hydrants can cross contaminate to the potable water supply lines, contaminating homes and buildings upstream of the hydrant. Those same hydrants are also being used for potable water supply for campsites, recreational vehicles (RV) and trailer parks, creating more cross contamination problems for the end user's potable water.

An ASSE 1057 Sanitary Yard Hydrant approved device protects the water supply from cross contamination with the soil. These devices do not behave as a weep hole hydrant (such as a stop and waste device) as they do not have an opening into the soil to drain the excess water from the device. Devices capture water in an internal reservoir below the frost line to prevent cross contamination from the soil. They could be buried in a septic tank and still deliver clean potable water as they are totally isolated from the surrounding soil conditions. This is why they have been deemed Sanitary. The purpose of this proposed change is to clarify the definition and installation of freeze resistant sanitary yard hydrants which is currently not addressed in the UPC code.

Definitions
There is no current definition of Yard Hydrant or the subcategory, Sanitary Yard Hydrant. These are generally accepted definitions.
Section 603.5.17 (Potable Water Outlets and Valves): This text currently can be misinterpreted to read that all yard hydrants including Sanitary yard hydrants cannot be installed underground, when in fact the product is specifically designed to be installed below the frost line and supply potable water. Currently there are three manufacturers that are listed to ASSE 1057 Sanitary Yard Hydrant standard.

In summary, most states have taken it upon themselves to require Sanitary Yard Hydrants to meet the ASSE 1057 Standard. Any engineer who is familiar with ASSE 1057 will make it a requirement, even if the state does not, because they are concerned for their own liability. The UPC code currently does not address Sanitary Yard Hydrants. This verbiage, including the requirement to meet ASSE 1057, is currently used by most states. Any engineer who specifies a yard hydrant will always specify a 1057 approved device for their own liability. This Sanitary Yard Hydrant addition has been sorely neglected in the UPC codes.

Serious Cross Contamination In Yard Hydrants
Due to the deaths associated with e-coli outbreaks and other pathogens that have contaminated our water supplies, there has been great concern regarding cross contamination between the potable water supply and the soil, which carries animal by-products, fertilizers and other hazardous materials. Most of us are familiar with a standard "weep hole" Yard Hydrant as they have been around for years. Hundreds of thousands of them are sold each year. They are used in campgrounds, RV parks, ranches, farms, gardens and anywhere water is needed away from a building. However, most of us are unaware of the serious cross contamination potential associated with the weep hole at the base of the hydrant. The common weep hole yard hydrant consists of a head for attaching a hose, a riser pipe, and a shutoff valve deep below the frost level. The term "weep hole" is derived from the fact that, when the weep hole hydrant is shut off, a hole in the side of the valve opens up to drain all the water from the riser into the soil below the frost line, much like a Stop and Waste Valve. Some are placed in a backfill of gravel to aid in draining. Most states agencies recognize the cross contamination potential anytime a hose is connected to a hydrant. Hoses have the ability to be placed in high hazard environments, such as stock tanks, pesticide tanks or even lying on the ground in mud puddles.

Back Siphonage will cause these hazardous materials to be sucked back into the water supply. Back siphonage can occur whenever a supply line is broken or drained for repair. In addition, yard hydrants create a back siphonage each and every time they are shut off, as the mere act of draining the riser, creates a siphon at the hose bib. Because of this, many states have required vacuum breakers to be attached to all hydrants where a hose could be attached. Naturally this prevents cross contamination during back siphonage should the hose be placed in a contaminated environment.

What many agencies are starting to realize is, that there still exists a severe cross contamination potential associated with the weep hole being in contact with the soil. Because these weep hole hydrants function much the same way as a Stop and Waste Valve, they suffer the same cross contamination issues. For example, if the stopper in a standard “weep hole” hydrant ever leaks, it is undetectable at ground level as it is leaking out the weep hole deep into the ground. The hydrant weep hole drips continuously throughout the day and night, and from the surface no one is aware the hydrant is leaking.

When a back siphonage condition occurs, that leak out will become a leak in, sucking contaminated muddy water into the supply line. If the hydrant is located in a horse or cow barn, animal by-products will leach into the potable water supply. Even when the hydrant is working properly, in states where the ground water level fluctuates, this problem is exacerbated by the fact that when the water table rises above the weep hole, like when it rains, the backfill of gravel gets full of water. Any water higher that the weep hole will migrate contaminated water into the riser. Now every time one turns on the hydrant they will get a slug of contaminated water entering the potable water of an RV or camper. Each time the hydrant is shut off and the weep hole opens, permitting contaminated water to migrate into the hydrant. Each time the hydrant is turned on, that contaminated water enters the potable water supply system.
Outside drinking fountains operate the same way. Each time the fountain is turned on, the first drink of water is nothing but soiled, possibly contaminated, water.

The liability toward each state became such a concern that many states created their own yard hydrant requirements. Initially, states implemented requirements to isolate weep hole hydrants from the potable water supply. These requirements included installing a testable RPP backflow preventer upstream of the hydrant and then tagging the hydrant “danger unsafe water”. This solved two major concerns. First, it protected the potable water supply from siphoning contaminated water into the public water system, and secondly, it attempted to notify the public not to use the hydrant for any potable source. The downside to this approach was the cost associated with the purchase and installation of a testable RPP backflow preventer, the difficulty in finding a location for the RPP device to keep it from freezing, the added cost in annual inspection and testing of the RPP device, and the fact that the weep hole yard hydrant is not fit for potable water. RV parks and campgrounds were especially hard hit, as they required potable water from their hydrants.

Manufacturers soon developed a new breed of yard hydrants to solve the problems associated with the new requirements imposed on weep hole hydrants. These new hydrants are called Sanitary Yard Hydrants.

A Sanitary Yard Hydrant works much the same way as a Weep Hole Hydrant in that when they are shut off, the water in the riser drains down and out a hole located below the frost line to prevent freezing. However, instead of draining out a hole and into the soil, the Sanitary Hydrant drains into a sealed tank. When the hydrant is turned on again, the water in the tank is expelled leaving the tank empty to repeat the cycle when the hydrant is again shut off. Because the sanitary hydrant drains into a tank there is no cross contamination with the soil. Because the soil is not required for drainage the hydrant can be placed in any soil condition, even clay. With the addition of a vacuum breaker at the hose connection, the Sanitary Yard Hydrant protects the potable water supply and public from cross contamination from the soil and from the hose.

The problem for the state and local code officials was the cost, manpower, and liability in having to develop their own approval process and testing each manufacturer’s device for approval. In turn, the varying requirements by each state made it difficult for manufacturers to make one product for all states.

ASSE realized the need to develop a national standard to help states avoid this liability and give manufacturers the ability to meet one set of requirements. After six years of debate and research by code officials, manufacturers, engineers, consultants, and the public, ASSE’s Sanitary Yard Hydrant Standard 1057 was completed. This standard requires that the yard hydrant not drain directly into the ground and that it must have a back flow preventer if a hose is capable of attachment. In addition, it stipulates minimum required pressure and flow capabilities and ensures proper freeze protection and that all serviceable parts can be accomplished without the need to excavate. It also stipulates, the manufacturers must test their hydrants at an approved and regulated test lab. This standard reduces the liability, manpower, and costs for the state agencies to ensure proper protection of the water supply and the public. At the same time it helps manufacturers to have a base line from which to develop and improve yard hydrants in general. With the continued efforts by states for clean, safe, potable water and the high liability associated with cross contamination, greater concern must be given to the proper selection, installation and use of yard hydrants.

[Supporting documentation provided in KAVI for TC review]

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603.0 Cross-Connection Control.

603.5 Specific Requirements. (remaining text unchanged)

603.5.20 Pet Wash Stations Where pet wash stations are connected to a potable water supply system, the connection shall be protected against backflow in accordance with Table 603.2.

(Renumber remaining sections)

SUBSTANTIATION:
In the last few years pet wash areas, shower, tub use have exploded. As more people have pets as their companion, they treat them as part of their family. Bathing pets indoors became a norm. No matter how we like our pets, we need to think about backflow protection either it is accomplished by device or methods.

Residential - Pet washes in a residential/dwelling units are limited to single homes, where one person or family has control over the pet wash. Lot of times homeowner does not agree with the inspector about backflow device and wants to know where in the code it say that they need to have one, and simply showing the homeowner Table 603.2 - doesn’t tell them much. Having a section that will directly state backflow protection requirement for pet washes will settle this case.

Most homes that receive pet wash, have a shower tile pan built in their garages with a typical shower valve installed. There is no standing water. There is a hand held sprayer on the 5 foot hose. A shower vacuum breaker or AVB would be sufficient protection for such application. There is a high chance of shower vacuum breaker being removed by home owner as they are twist-on type. In this case AHJ may require an atmospheric vacuum breaker (6 inches above flood level rim) that is hard piped, can not be easily removed - yet can be serviced. With such approach, home owners will not bother tampering with such device, especially when it doesn’t require annual maintenance. We want to be practical with the devices/methods use while protecting the public. It shall be up to AHJ to follow Table 603.2 and decide which device or method to be used in each scenario.
MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BUILDING SUPPLY PIPE AND FITTINGS</th>
<th>WATER DISTRIBUTION PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>X¹</td>
<td>--</td>
<td>ASTM D1785, ASTM D2241, AWWA C900, CSA B137.3</td>
<td>ASTM D2464, ASTM D2466, ASTM D2467, ASTM F1970, AWWA C907, CSA B137.3 IAPMO PS 53</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Notes:
1 For building supply or exterior cold-water applications, not for water distribution piping.
2 For brazed fittings only.

REFERENCES

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B137.3-2023</td>
<td>Rigid polyvinylchloride (PVC) pipe and fittings for pressure applications</td>
<td>Pipe, Fittings</td>
<td>Table 604.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: CSA B137.3 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This proposal adds an additional standard for PVC pipe and fittings. As indicated in the standard scope; this standard covers rigid polyvinylchloride (PVC) pipe and fittings intended for use in pressure applications such as water mains, water service piping, and process piping. The fittings covered by this Standard include moulded, solvent-cemented, gasketed, or threaded fittings, and fittings that have been fabricated for use with any joining method.
TABLE 604.1  
MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BUILDING SUPPLY PIPE AND FITTINGS</th>
<th>WATER DISTRIBUTION PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPVC-AL-CPVC</td>
<td>X</td>
<td>X</td>
<td>ASTM F2855</td>
<td>ASSE 1061, ASTM D2846</td>
</tr>
<tr>
<td>PP</td>
<td>X</td>
<td>X</td>
<td>ASTM F2389, CSA B137.11</td>
<td>ASSE 1061, ASTM F2389, CSA B137.11</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Notes:
1 For building supply or exterior cold-water applications, not for water distribution piping.
2 For brazed fittings only.

Note: ASSE 1061 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The ASSE 1061 standard for push fit fittings includes Polypropylene and composite CPVC as a suitable piping material for the fittings.

[Supporting documentation provided in KAVI for TC review]
TABLE 604.1
MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BUILDING SUPPLY PIPE AND FITTINGS</th>
<th>WATER DISTRIBUTION PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPVC</td>
<td>X</td>
<td>X</td>
<td>ASTM D2846&lt;sup&gt;3&lt;/sup&gt;, ASTM F441/F441M&lt;sup&gt;3&lt;/sup&gt;, ASTM F442/F442M&lt;sup&gt;3&lt;/sup&gt;, CSA B137.6</td>
<td>ASSE 1061, ASTM D2846/D2846M&lt;sup&gt;3&lt;/sup&gt;, ASTM F437&lt;sup&gt;4&lt;/sup&gt;, ASTM F438&lt;sup&gt;4&lt;/sup&gt;, ASTM F439&lt;sup&gt;4&lt;/sup&gt;, ASTM F1970, CSA B137.6, IAPMO PS 53</td>
</tr>
<tr>
<td>CPVC-AL-CPVC</td>
<td>X</td>
<td>X</td>
<td>ASTM F2855</td>
<td>ASTM D2846/D2846M&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Notes:
1 For building supply or exterior cold-water applications, not for water distribution piping.
2 For brazed fittings only.
4 These standards do not specify requirements for venting of combustion gases. UL 1738 specifies requirements for pipe, fittings, and accessories intended for venting of combustion gases.

(portions of table not shown remain unchanged)

TABLE 701.2
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>BUILDING SEWER PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM D2661&lt;sup&gt;2&lt;/sup&gt;, ASTM D2680&lt;sup&gt;1&lt;/sup&gt;</td>
<td>ASME A112.4.4, ASTM D2661&lt;sup&gt;2&lt;/sup&gt;, ASTM D2680&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Co-Extruded ABS (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F628&lt;sup&gt;3&lt;/sup&gt;</td>
<td>ASME A112.4.4, ASTM D2661&lt;sup&gt;2&lt;/sup&gt;, ASTM D2680&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Co-Extruded Composite (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F1488</td>
<td>ASME A112.4.4, ASTM D2661&lt;sup&gt;2&lt;/sup&gt;, ASTM D2680&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Co-Extruded PVC (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F891&lt;sup&gt;2&lt;/sup&gt;, ASTM F1760</td>
<td>ASME A112.4.4, ASTM D2665&lt;sup&gt;2&lt;/sup&gt;, ASTM F794&lt;sup&gt;1&lt;/sup&gt;, ASTM F1866</td>
</tr>
<tr>
<td>PVC (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM D1785&lt;sup&gt;2&lt;/sup&gt;, ASTM D2665&lt;sup&gt;2&lt;/sup&gt;, ASTM F794&lt;sup&gt;1&lt;/sup&gt;</td>
<td>ASME A112.4.4, ASTM D2665&lt;sup&gt;2&lt;/sup&gt;, ASTM F794&lt;sup&gt;1&lt;/sup&gt;, ASTM F1866</td>
</tr>
</tbody>
</table>

<sup>1</sup>For building sewer applications.


<sup>3</sup>These standards do not specify requirements for venting of combustion gases. UL 1738 specifies requirements for pipe, fittings, and accessories intended for venting of combustion gases.

( порциями таблицы не показано, остается без изменений)

**TABLE 1701.1**

**REFERRED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA/ANSI Z21.13/CSA 4.9-2022</td>
<td>Gas-fired low-pressure steam and hot water boilers</td>
<td>Fuel Gas, Appliances</td>
<td>Table 604.1, Table 701.2</td>
</tr>
</tbody>
</table>
TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA/ANSI Z21.13-2017</td>
<td>Gas-Fired Low Pressure Steam and Hot Water Boilers (same as CSA 4.9)</td>
<td>Fuel Gas; Appliances</td>
</tr>
</tbody>
</table>


**SUBSTANTIATION:**
The purpose of the proposed notes to the tables is to make users of the UPC, including tradespersons, aware that those ASTM and CSA plastic piping standards expressly indicate that they do not contain specific provisions for venting of combustion gases.
TABLE 604.1
MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BUILDING SUPPLY PIPE AND FITTINGS</th>
<th>WATER DISTRIBUTION PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>X1</td>
<td>--</td>
<td>ASTM D2239, ASTM D2737, ASTM D3035, AWWA C901, CSA B137.1</td>
<td>ASTM D2609, ASTM D2683, ASTM D3261, ASTM F1055, ASTM F3536, CSA B137.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F3536-2022</td>
<td>Standard Specification for PE and PP Mechanical Fittings for Use on NPS 3 or Smaller Cold-Water Service Polyethylene (PE) or Crosslinked Polyethylene (PEX) Pipe or Tubing</td>
<td>Fittings</td>
<td>Table 604.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3536 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This proposal adds ASTM F3536 "Standard Specification for PE and PP Mechanical Fittings for use on NPS 3 or Smaller Cold-water Service Polyethylene (PE) or Crosslinked Polyethylene (PEX) Pipe or Tubing" as a recognized fitting Standard for PE water service fittings in Table 604.1.

ASTM F3536 is only applicable to cold water service lines and thus the Standard is NOT being added to the PEX line in Table 604.1, which applies to distribution lines as well.

The scope of ASTM F3536 covers plastic bodied mechanical fittings for PE or PEX water service pipe. Per the Standard, these fitting bodies may be produced from either PE or polypropylene (PP), and the body material does...
not need to match the pipe material as these are mechanical connections, not fusion fittings. These fittings, commonly produced by Philmac, have a history of successful field use. The ASTM Standard was written to recognize and standardize the performance requirements of this design, and includes sustained pressure, hydrostatic burst, and tensile force requirements. The F3536 Standard was published in 2022 narrowly missing the deadline for addition to the current 2024 edition of UPC, and thus this Proposal seeks to add it to the Code now.
SUBMITTER: Armando Barragan
Organization Name: Self
Organization Representation: Self

RECOMMENDATION: Revise text

Proposed Text:

TABLE 604.1
MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BUILDING SUPPLY PIPE AND FITTINGS</th>
<th>WATER DISTRIBUTION PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductile-Iron</td>
<td>X</td>
<td>X</td>
<td>AWWA C115, AWWA C151</td>
<td>ASME B16.4, AWWA C110, AWWA C153, AWWA C606, CSA B242, IAPMO PS 53</td>
</tr>
<tr>
<td>PE-RT</td>
<td>X</td>
<td>X</td>
<td>ASTM F2769, CSA B137.18</td>
<td>ASSE 1061, ASTM D3261, ASTM F1055, ASTM F1807, ASTM F2098, ASTM F2159, ASTM F2735, ASTM F2769, ASTM F3347, ASTM F3348, CSA B137.18</td>
</tr>
<tr>
<td>PEX-AL-HDPE</td>
<td>X</td>
<td>X</td>
<td>ASTM F1986</td>
<td>ASTM F1986</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Notes:

1 For building supply or exterior cold-water applications, not for water distribution piping.

2 For brazed fittings only.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B137.2</td>
<td>Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications</td>
<td>Fittings</td>
<td>Table 604.1</td>
</tr>
</tbody>
</table>

132
<table>
<thead>
<tr>
<th>Standard Code</th>
<th>Standard Title</th>
<th>Category</th>
<th>Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B137.3-2023</td>
<td>Rigid Poly(Vinyl Chloride) (PVC) Pipe for Pressure Applications</td>
<td>Piping, Fittings</td>
<td>Table 604.1</td>
</tr>
<tr>
<td>ASTM D2672-2020e1</td>
<td>Joints for IPS PVC Pipe Using Solvent Cement</td>
<td>Fittings</td>
<td>Table 604.1</td>
</tr>
<tr>
<td>ASTM F1467-2018</td>
<td>Standard Guide for Use of an X-Ray Tester (~10 kEV Photons) in Ionizing Radiation Effects Testing of Semiconductor Devices and Microcircuits</td>
<td>Fittings</td>
<td>Table 604.1</td>
</tr>
<tr>
<td>ASTM F2434-2019</td>
<td>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</td>
<td>Fittings</td>
<td>Table 604.1, 605.10.1</td>
</tr>
<tr>
<td>ASTM F3347-2023</td>
<td>Standard Specification for Metal 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</td>
<td>Fittings</td>
<td>Table 604.1</td>
</tr>
<tr>
<td>ASTM F3348-2023a</td>
<td>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</td>
<td>Fittings</td>
<td>Table 604.1</td>
</tr>
<tr>
<td>AWWA C115-2020</td>
<td>Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges</td>
<td>Piping</td>
<td>Table 604.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASTM, AWWA, and CSA standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

The proposed change adds additional standards to existing water supply and distribution piping and standards. There is also a new material being added, Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE) as a material for building supply and water distribution piping and fittings. The standard scopes are shown below.

**PEX-AL-HDPE:** This material is being added for pipe and fittings for water supply pipe and fittings. The scope of the standards for this material is as follows:

ASTM F1986 – Scope: 1.1 This specification covers requirements for multilayer pipe type 2 and compression fittings for hot and cold drinking-water systems, with a maximum pressure rating of 1000 kPa (145 psi) at 82°C (180°F).

Ductile Iron: An additional standards is being recommended. It’s scope is as follows:

AWWA C115 - This standard describes 3-in. through 64-in. (80-mm through 1,600-mm) flanged ductile-iron pipe with ductile-iron or gray-iron threaded flanges for potable water, wastewater, and reclaimed water service. Flanged pipe and flanges are rated for a maximum working pressure of 250 psi (1,720 kPa). However, 24-in. (600-mm) and smaller flange joints with ductile-iron flanges may be rated for a maximum working pressure of 350 psi (2,413 kPa).

**PVC:**

ASTM D2672 – ABSTRACT - This specification covers requirements, testing, and performance characteristics of joints for IPS PVC pipe using solvent cement. Testing requirements for both pressure and non-pressure pipe shall include socket dimensions, burst pressure, and joint tightness tests. PVC plastics, solvent cements, primer
materials, workmanship, sampling, conditioning, marking, and quality shall conform to the requirements of this specification.

SCOPE This specification covers the socket produced for solvent cement joints on both pressure and non-pressure IPS pipe. It also covers the testing of the joints on both pressure and non-pressure pipe, and includes requirements for socket dimensions, burst pressure, and joint tightness tests of the solvent cemented joints. The tests described are not intended for routine quality control, but rather to evaluate the performance characteristics of the joint.

CSA B137.2 – Scope 1.1 This Standard covers rigid polyvinylchloride (PVC) injection-moulded fittings that have gasketed joints and are intended for use in pressure applications such as water mains, water service piping, process piping, and fire lines. Fittings covered by this Standard are suitable for use with PVC pipes having outside diameter dimensions of cast iron pipe. Only one pressure rating, 1620 kPa at 23 °C (PC 235), is covered in this Standard and is suitable for use with compatible outside diameter PVC pipes having a dimension ratio (DR) of 18 or more.

CSA B137.3 – Scope 1.1 This Standard covers rigid polyvinylchloride (PVC) pipe and fittings intended for use in pressure applications such as water mains, water service piping, and process piping. The fittings covered by this Standard include molded, solvent-cemented, gasketed, or threaded fittings, and fittings that have been fabricated for use with any joining method.

PEX:
ASTM F1476 - 1. Scope* 1.1 This specification covers stainless steel clamps for use with five sizes of insert fittings that comply with F1807 or F2159, and cross-linked polyethylene (PEX) plastic tubing that complies with F876 and for use with polyethylene of raised temperature (PE-RT) tubing that complies with Specification F2769. These clamps are intended as an alternative to the copper-alloy crimp-rings of Specifications F1807 for use in 100 psi (689.5 kPa) cold- and hot-water distribution systems operating at temperatures up to and including 180°F (82°C). Included are requirements for materials, workmanship, dimensions and marking of the stainless steel clamps; requirements for deforming the clamps; which apply to assemblies of PEX tubing and Specifications F1807 and F2159, insert fittings secured with deformed clamps per this specification.

ASTM F2434 - 1.1 This specification covers metal insert fittings with o-ring seals and copper crimp rings for use with Cross-linked Polyethylene (PEX) and Cross-linked polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) tubing in 1/2, 3/4, 1, and 11/4 in. nominal diameters that meet the requirements for Specifications F876 or F3253, and F2262 respectively. These fittings are intended for use in 125 psi (861.9 kPa) (PEX-AL-P EX) and 100 psi (689.5 kPa) (PEX) cold- and hot-water distribution systems operating at temperatures up to and including 180 °F (82 °C). Included are the requirements for materials, workmanship, dimensions, performance, and markings to be used on the fittings and rings.

PE-RT:
ASTM F3347 - 1. Scope* 1.1 This specification covers copper alloy metal press insert fittings with factory assembled stainless steel press sleeves incorporating 3 view holes and tool locator ring. These fittings are for use with cross-linked polyethylene (PEX) tubing in nominal sizes 5/16 , 3/8, 1/2, 5/8, 3/4, 1, 11/4, 1 1/2, and 2 that meet the requirements for Specification F876 or F3253 and for use with polyethylene of raised temperature (PE-RT) tubing in nominal sizes 3/8, 1/2, 3/4, 1, 11/4, 11/2, and 2 that meet the requirements of Specification F2769. These fittings are intended for use in 100 psi (689.5 kPa) hot and cold water distribution systems operating at temperatures up to, and including, 180 °F (82 °C). The requirements for materials, workmanship, dimensions, and markings to be used on the fittings and sleeves are also included.

1.1.3 When used with PE-RT tubing in accordance with Specification F2769, the fittings covered by this specification are intended for use in residential and commercial, hot- and cold-potable water distribution systems, and building supply lines.

ASTM F3348 - 1. Scope* 1.1 This specification covers plastic press insert fittings with factory assembled stainless steel press sleeves incorporating 3 view holes and a tool locator ring. These fittings are for use with cross-linked polyethylene (PEX) tubing in nominal sizes 3/8, 1/2, 3, 1, 11/4, 11/2, and 2 that meet the requirements for Specification
F876 or F3253 and for use with polyethylene of raised temperature (PE-RT) tubing in nominal sizes $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $\frac{11}{4}$, $\frac{11}{2}$, and 2 that meet the requirements of Specification F2769. These fittings are intended for use in 100 psi (690 kPa) cold- and hot-water distribution systems operating at temperatures up to and including 180 °F (82 °C). Included are the requirements for material, molded part properties, performance, workmanship, dimensions, and markings to be used on the fittings and sleeves.

1.1.3 When used with PE-RT tubing in accordance with Specification F2769, the fittings covered by this specification are intended for use in residential and commercial, hot- and cold-potable water distribution systems, and building supply lines.
**RECOMMENDATION:**
Revise text

**Proposed Text:**

TABLE 604.1
MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BUILDING SUPPLY PIPE AND FITTINGS</th>
<th>WATER DISTRIBUTION PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>X</td>
<td>X</td>
<td>ASTM A269, ASTM A312, ASTM A554, ASTM A778</td>
<td>ASTM F3226, CSA B242, IAPMO PS 53, IAPMO PS 117, IAPMO/ANSI/CAN Z1117</td>
</tr>
</tbody>
</table>

Note: IAPMO/ANSI/CAN Z1117 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The IAPMO PS 117 standard is being superseded by IAPMO/ANSI/CAN Z1117 as an ANSI designated standard. The standard designation will be updated in Table 604.1 and Table 1701.1.
604.0 Materials.

604.1 Pipe, Tube, and Fittings. Pipe, tube, fittings, solvent cement, thread sealants, solders, and flux used in potable water systems intended to supply drinking water shall comply with NSF/ANSI/CAN 61 or Table 604.1. Where pipe fittings and valves are made from copper alloys containing more than 15 percent zinc by weight and are used in plastic piping systems, they shall be resistant to dezincification and stress corrosion cracking in compliance with NSF/ANSI 14.

Materials used in the water supply system, except valves and similar devices, shall be of a like material, except where otherwise approved by the Authority Having Jurisdiction.

Materials for building water piping and building supply piping shall comply with the applicable standards referenced in Table 604.1.

605.13 Stainless Steel Pipe and Joints. (remaining text unchanged)

605.13.2 Welded Joints. Welded joints shall be either fusion or resistance welded based on the selection of the base metal. The chemical composition of the filler metal shall comply with AWS A5.9 based on the alloy content of the piping material. Acceptable joint types are: Butt weld, O-lets, socket weld, T-joint, and socket weld.

TABLE 604.1

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BUILDING SUPPLY PIPE AND FITTINGS</th>
<th>WATER DISTRIBUTION PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>X</td>
<td>X</td>
<td>ASTM A269, ASTM A312,</td>
<td>ASTM F3226, CSA B242, IAPMO PS 53, IAPMO PS 117</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASTM A554, ASTM A778</td>
<td>ASTM A182, ASTM A403</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

TABLE 1701.1

REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A182-2011a</td>
<td>Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service</td>
<td>Piping, Fittings</td>
<td>Table 604.1</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: ASTM A182 and ASTM A403 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.
SUBSTANTIATION:
The proposed change adds text and referenced standards ASTM A182 & ASTM A403 to Table 604.1 for welded stainless steel pipe and fittings as these are acceptable welded joint types.
604.7 Malleable Iron Fittings. Malleable iron water fittings shall be galvanized.

Exception: In potable water distribution systems where copper flex connectors, copper pipe or other dissimilar metals are used, connections to instantaneous and tank type water heaters shall not be galvanized.

SUBSTANTIATION:
Galvanic corrosion occurs when two dissimilar metals merge at a particular point. For instance, if the fittings that connect the pipes to the water heater are copper and the pipes are galvanic corrosion may result. Usually, plastic tubing within the steel pipe (dielectric nipple) is designed to shield the metal from coming into contact with water, but this plastic may not be present at the point of connection. As a result, galvanic corrosion can lead to leaking by dissolving the steel pipe threading within the copper/brass fitting itself. The notion here is to create a long lasting, leak proof system which is not possible with galvanic corrosion on hand. If all of the building/system potable water supply piping is of plastic material - then galvanic corrosion is not a threat, and galvanized pipe/fittings may be used. This includes short galvanized nipple connector/couplers used near water heaters. Also when galvanic corrosion occurs, the pipe cross-sectional area is greatly diminished, hindering water flow capacity discussed in Table 610.3 [Water Supply Fixture Units (WSFU) and Minimum Fixture Branch Pipe Sizes].

[Supporting documentation provided in KAVI for TC review]
604.13 Water Heater Connectors. Flexible metallic (copper and stainless steel), reinforced flexible, braided stainless steel, or polymer braided with EPDM core connectors that connect a water heater to the piping system shall comply with ASME A112.18.6/CSA B125.6. Copper, copper alloy, or stainless steel flexible connectors shall not exceed 24 inches (610 mm). PEX, PEX-AL-PEX, PE-AL-PE, or PE-RT tubing shall not be installed within the first 18 inches (457 mm) of piping connected to a water heater.

Exception: PEX, PEX-AL-PEX, PE-AL-PE, and PE-RT tubing shall be permitted to be connected directly to instantaneous water heaters intended for domestic water applications.

SUBSTANTIATION:
Each of the piping materials listed in the proposed Exception are approved for potable water distribution. These materials are listed within Table 604.1 and are rated for operation of 100 psig at 180°F as a requirement of the required industry standards found within Table 604.1.

The four piping materials in the proposed exception are safe for direct connection to instantaneous non-storage water heaters. Instantaneous water heaters do not produce the thermal stacking that is common in storage tank-type water heaters, and therefore, there is no reason to prohibit direction connection of these piping materials to instantaneous (tankless) water heaters listed and labelled to CSA/ANSI Z21.10.3/CSA 4.3 and intended for domestic water applications. The proposed Exception will bring the UPC into harmonization with current industry practices.

This proposal is supported by the 2020 publication PPI Recommendation H “Direct Connection of Plastic Piping Materials to Tankless Water Heaters for Domestic (i.e. residential) Applications” published at:

https://plasticpipe.org/common/Uploaded files/1-PPI/RECOMMENDATIONS/Recommendation H.pdf

The Plastics Pipe Institute, Inc. (PPI) has conducted significant research on the topic of direct connection of plastic piping materials to instantaneous (also known as “tankless”) water heaters. This included the review of over 60 installation guides of instantaneous water heaters from 24 manufacturers supplying these appliances in the US. The core findings of PPI’s research are summarized in this paragraph: “Piping systems using the materials CPVC, PE-RT, PEX, and PP, which carry a pressure/temperature rating of 100 psi at 180°F (690 kPa @ 82°C), and which are intended and certified for hot and cold potable water distribution systems according to industry standards and relevant codes, may be connected directly to tankless water heaters which are intended for domestic (i.e. residential) applications, unless prohibited by local plumbing code or the specific water heater manufacture.”
604.13 Water Heater Connectors. Flexible metallic (copper and stainless steel), reinforced flexible, braided stainless steel, or polymer braided with EPDM core connectors that connect a water heater to the piping system shall comply with ASME A112.18.6/CSA B125.6. Copper, copper alloy, or stainless steel flexible connectors shall not exceed 24 inches (610 mm). PEX, PEX-AL-PEX, PE-AL-PE, or PE-RT tubing shall not be installed within the first 18 inches (457 mm) of piping connected to a water heater unless approved by the pipe manufacturer for such connections.

SUBSTANTIATION:
Tank type storage water heaters have consistent temperature without much fluctuation between hot and cold, typically staying in hot temperature. With modern technology more manufacturers are developing pex pipe that can handle hot water temperatures and allow pex pipe to be connected directly to storage tank type water heaters. Uponor & Zurn pipe manufacturer allows such practice.

Additional information may be accessed via the following links:

https://www.uponor.com/getmedia/f4358db7-7247-492d-9e24-6ab3c9bfeacf/residential-plumbing-install-guide.pdf?sitename=Canada#:~:text=Uponor%20AquaPEX%20may%20be%20connected%2C%20where%20allowed%20by%20local%20code.&text=Do%20not%20install%20within%20a%20minimum%20clearance%20of%201%22.

Proposed Text:
605.0 Joints and Connections.

605.12 PVC Plastic Pipe and Joints. PVC plastic pipe and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.12.1 through Section 605.12.3. PVC piping shall not be exposed to direct sunlight.

Exception: PVC piping in a location exposed to direct sunlight shall not exceed 24 inches (610 mm) in length and be wrapped with not less than 0.04 of an inch (1.02 mm) thick UV resistant tape or otherwise protected from UV degradation. Where PVC piping is exposed to direct sunlight or continuous UV radiation, such piping shall be protected from UV exposure in accordance with the manufacturer's installation instructions.

SUBSTANTIATION:
The language is overly complex and yet may omit specific details on UV protection methods by the manufacturer. Additionally, the specified 24 inch length seems misplaced and unneeded if the pipe is protected.
Proposed Text:

605.0 Joints and Connections.

605.17 Pitless Adapters, Pitless Units, and Sanitary Well Caps. Pitless adapters, pitless units, and sanitary well caps intended to supply drinking water shall comply with ASSE 1093/WSC PAS-97.

218.0 - P -

Pitless Adapter. A device designed to attach to one or more openings through a well casing, to provide access to water system parts within the well.

Pitless Unit. An assembly that extends the upper end of the well casing from below the frostline to above grade. Its purpose is to prevent the entrance of contaminants or pollutants into the well water supply, to conduct water from the well, to protect the water from freezing or extremes of temperature, and to provide full access to the well and to water system parts within the well.

221.0 - S -

Sanitary Well Cap. A device that covers and encloses the upper termination of a pitless unit or the well casing to provides protection to the top, exposed portion of the well casing.

225.0 - W -

Well. A well is a hole drilled into the ground to access water contained in an aquifer. A pipe and a pump are used to pull water out of the ground, and a screen filters out unwanted particles that could clog the pipe.

TABLE 1701.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1093/WSC PAS 97</td>
<td>Performance Requirements for Pitless Adapters</td>
<td>Miscellaneous</td>
<td>605.17</td>
</tr>
<tr>
<td>2019(R2023)</td>
<td>Pitless Units, and Well Caps</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASSE 1093/WSC PAS 97 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:

A common system for supplying potable water is a private water well. There are approximately 47 million people that are using private wells for water supply in the United States (US Geological Survey).

Well pits are potentially unsanitary method of providing access to lateral pipe connections below ground level on individual water systems. There is a health and safety concern for some unregulated systems because pits will
cause unsanitary conditions when not properly built and are commonly contaminated from near surface sources that can drain into the pit and well.

Pitless adapter wells are common replacements for above ground well houses and well pits, improving sanitation, convenience, frost protection, and vandalism security. The ASSE 1093/WSC PAS-97 is an ANSI designated standard which guides the end user with pitless well construction and sharply eliminates the possibility of contaminated water entering the well and system, allowing these systems to be more resilient to the surroundings.

While some products for well construction such as casing are covered in the UPC/IPC codes, there is a need to also include pitless adapters, pitless units, and sanitary well caps that provide the connection to the well casing. The pitless and the well cap are the connection of the water supply to the home from the well and protect the well from contamination. These well components are also often not covered by health departments or home inspections, as inspection requirements vary by state and local jurisdiction. Many state health departments do not have jurisdiction or require water well inspections. The source of water connection to the well and casing needs to be included in the plumbing code for the millions of homes with water wells.

The standard covers pitless adapters, pitless units, and sanitary well caps that are part of a pitless well system. These components are critical to well water supply systems as they protect the system's parts and potable water supply. The addition of the provision in the proposed Section 605.17 (Connections to Private Wells) will give the end user and local jurisdictions minimum necessary requirements for safety aspects and dependable performance standards. Additionally, Section 602.4 (Approved by Authority) is needed to guide the end user to Section 605.17 for private wells where permitted.
Proposed Text:

606.0 Valves.

606.1 General. Valves up to and including 2 inches (50 mm) in size shall be copper alloy or other approved material. Sizes exceeding 2 inches (50 mm) shall be permitted to have bodies of cast iron, copper alloy, or other approved materials. Each gate or ball valve shall be a fullway or full-port type with working parts of the non-corrosive material. Where valves are made from copper alloys containing more than 15 percent zinc by weight and are used in plastic piping systems, they shall be resistant to dezincification and stress corrosion cracking in compliance with NSF/ANSI 14. Valves carrying water used in potable water systems shall comply with the requirements of ASME A112.18.1/CSA B125.1, ASME A112.18.1/CSA B125.1, ASME B16.34, ASTM F1970, ASTM F2389, AWWA C500, AWWA C504, AWWA C507, IAPMO/ANSI Z1157, MSS SP-67, MSS SP-70, MSS SP-71, MSS SP-72, MSS SP-78, MSS SP-80, MSS SP-110, MSS SP-122, MSS SP-139, or NSF/ANSI 359. Valves intended to supply drinking water shall also comply with the requirements of NSF/ANSI/CAN 61.

Note: ASME A112.18.1/CSA B125.1, CSA B125, and MSS SP-139 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:

Additional standards are being added which also cover valves. The scope the added standards are as follows:

ASME A112.18.1/CSA B125.1 - This Standard covers plumbing supply fittings and accessories located between the supply stop and the terminal fitting, inclusive, as follows: a) automatic compensating valves for individual wall-mounted showering systems; b) bath and shower supply fittings; c) bidet supply fittings; d) clothes washer supply fittings; e) commercial pre-rinse spray valves; f) drinking fountain supply fittings; g) humidifier supply stops; h) kitchen, sink, and lavatory supply fittings; i) lawn and sediment faucets; k) low-pressure water dispensers; i) metering and self-closing supply fittings; m) showerheads, hand-held showers, and body sprays; and n) supply stops.

CSA B125.3 - This Standard covers plumbing fittings, including the following: a) automatic compensating valves other than those for individual wall-mounted showering systems; b) solenoid valves; c) temperature-actuated in-line mixing valves; d) thermal expansion relief valves; and e) trap primers.
**SUBMITTER:** Nate Taylor  
**Organization Name:** Don Alarm Company  

**RECOMMENDATION:**  
Add new text

**Proposed Text:**

608.0 Water Pressure, Pressure Regulators, Pressure Relief Valves, and Vacuum Relief Valves.

608.2 Excessive Water Pressure. Where static water pressure in the water supply piping exceeds 80 psi (552 kPa), an approved-type pressure regulator preceded by an adequate strainer shall be installed and the static pressure reduced to 80 psi (552 kPa) or less. Pressure regulators for potable water distribution systems shall comply with ASSE 1003 or AWWA C530. Pressure regulator(s) equal to or exceeding 1 1/2 inches (40 mm) shall not require a strainer. Such regulator(s) shall control the pressure to water outlets in the building unless otherwise approved by the Authority Having Jurisdiction. Each such regulator and strainer shall be accessibly located aboveground or in a vault equipped with a properly sized and sloped boresighted drain to daylight, shall be protected from freezing, and shall have the strainer readily accessible for cleaning without removing the regulator or strainer body or disconnecting the supply piping. Pipe size determinations shall be based on 80 percent of the reduced pressure where using Table 610.4. An approved expansion tank shall be installed in the cold water distribution piping downstream of each such regulator to prevent pressure exceeding 80 psi from developing due to thermal expansion. Expansion tanks used in potable water systems intended to supply drinking water shall comply with NSF/ANSI/CAN 61. The expansion tank shall be properly sized, securely fastened to the structure, and installed in accordance with the manufacturer's installation instructions and listing. Systems designed by a licensed plumbing contractor or registered design professionals shall be permitted to use approved pressure relief valves in lieu of expansion tanks provided such relief valves have a maximum pressure relief setting of 100 psi (689 kPa) or less. Water systems having a regulator, expansion tank, relief valve or other pressure management device shall have a pressure monitoring device with audible alerts. The pressure monitoring device shall continuously monitor system pressure and shall provide an audible alert when the water pressure exceeds 80 psi (552 kPa).

**SUBSTANTIATION:**

The current code recognizes the importance of limiting the water pressure to 80 psi and requires components be installed to manage pressure such as regulators, relief valves, expansion tanks, etc. These components frequently fail and the public is unaware that their system has high water pressure. Left unattended, high water pressure causes premature plumbing system failures, voided product warranties and water waste. Water leaks and floods from burst pipes, and failed fittings/connectors often lead to public health and safety issues such as mold exposure.

Pressure gauges can help users manage pressure but are often ignored, give false readings, and do not provide adequate notification to the public of a pressure problem.

The proposed code change will provide the public a clear indication that a plumbing safety device (e.g. expansion tank, regulator, etc.) has failed and requires attention (Fig. 1).

[Image is shown in supporting documents on the Kavi site]
Why now? Although water pressure management devices have been required by the code for many years, damage from high water pressure is still happening and is a big problem. The public often does not know their system has high water pressure. Changes in recent years that have made high water pressure a more common and widespread problem include:
- Installation of more backflow preventers and/or check-valves that create closed systems.
- Water chemistry that deteriorates plumbing components (e.g. regulator diaphragms, expansion tank bladders, etc.)
- Lower quality materials used in manufacture of plumbing components resulting in shorter life.
- Increase and variation in supply pressure from municipalities.

The current code intends to protect the public from the dangers of high water pressure, but falls short of achieving this because of the frequent and unexpected failure of pressure management devices such as regulators and expansion tanks.

Solution: The current code does not require any notification to the public that their system has high water pressure. This can be easily addressed by requiring the installation of a pressure monitoring device that would alert (beep) when the water system pressure exceeds the plumbing code maximum of 80 PSI. Figure 2 shows one such device that would accomplish this.

Figure 2. Water Pressure Monitor Located under Kitchen Sink.

High Water Pressure is a Nationwide Problem. High pressure problems occur throughout the country. Plumbers, insurance companies, water purveyors, home and building owners across the US report incidents of high water pressure as a root cause for water damage leading to medical related problems. Many homeowners have experienced floods and water damage from burst piping, failed water heaters and leaking fixtures caused by high water pressure.

Public Health / Safety. For many years, the UPC has required pressure regulators, expansion tanks and relief valves (Figures 3-5) be installed to prevent water pressure from exceeding 80 psi.

Figure 3. Pressure Regulator.

Figure 4. Thermal Expansion Tank.

Figure 5. Relief Valve.

These components (Figures 3-5) are critical for maintaining water pressure at safe levels. These components frequently fail and the public is unaware that their plumbing system has excessive pressure. The excessive pressure causes water leaks, ruptures, premature failure of fixtures and appliances, excessive wear on everything connected to the plumbing system. Water leaks often lead to public health and safety issues such as mold and bacterial growth, slip/fall hazards, soil erosion, corrosion of structural building members, electrical hazards. In many cases, these water leaks would not have occurred if the plumbing system had been properly maintained (i.e.
Excessive water pressure on fixtures such as toilets cause pathogens to spread further and can contribute to an increase in infections in people.

Problems Caused by High Water Pressure:
- Increased illnesses from exposure to mold, mildew.
- Water waste, increased water consumption.
- Unnecessary repairs, displacement of home owners / occupants to make repairs.
- Increased illnesses from pathogens spread greater distances when flushing toilets at high pressure.
- Premature failure of many plumbing components such as water heaters, safety valves, faucets, toilets, filtration systems, etc.
- Voided product warranties (water heaters, dishwashers, filtration systems, drinking fountains, equipment, toilets, sinks, valves, etc.).

Flushometer Toilets at High Pressure Spread more Pathogens

Research studies have shown high water pressure increases transmission of infections and diseases (AP-10, AP-11). I.e. bacteria and pathogens travel further from a toilet bowl when flushed at high pressure versus low pressure (Figure 6). Studies showed that COVID-19 virus was transmitted further and more often when flushing toilets at high pressure versus low pressure.

Useful Life. Many plumbing components required by and specified in the code last many years with no maintenance. Piping, fittings, tanks, valves, pipe supports/hangers, and many other components in the plumbing system can last 50-100+ years. Pressure regulators, expansion tanks, and relief valves are different. In some cases, these components may only last 1-5 years. They also frequently fail suddenly, without warning, and give little/no indication to the public they have failed. Some areas have 200-300 psi and only expect regulators to last 1-3 years (Figures 7 & 8).

Water Waste. Many fixtures such as hose bibs, utility sink faucets, drinking fountains, equipment, etc. use and waste more water at higher pressures as compared to lower pressures (Figure 9). High water pressure is often undetected which results in consumers using more water than needed. Water waste caused by high water pressure would be greatly reduced if users were made aware that the plumbing system had high water pressure and completed proper repairs.
**Water Pressure Dynamics.** Water pressure can change throughout the day and during the week/month based on water usage, supply conditions, temperature, equipment state, etc. On systems connected to a municipal water supply, the water pressure often increases at night or off-peak usage times (Figure 10). A properly functioning regulator will keep the building water supply below 80 PSI all of the time (Figure 11).

![Figure 10. Water Pressure from Utility Company ("Street Pressure").](image)

A fouled (Figure 12, 13), worn, or otherwise failed regulator may work intermittently. For example, if the “city supply” pressure is 140 psi, a failed regulator may allow 140 PSI to the building all of the time.

![Figure 12. Fouled Diaphragm.](image)

In another scenario, the regulator may keep the water pressure near 65 PSI while water is being used (e.g. system is not static). However, when the system is in a static state (no water usage) with a failed regulator, the water pressure may slowly increase up to the city supply pressure of 140+ PSI (Figure 14, 15).

![Figure 14. Water Pressure Changes with Failed Regulator and 145+ PSI Street Pressure.](image)

Water pressure regulator valve manufacturers recognize the different types of failures discussed above and provide recommendations on how to address them, as shown installation instructions below (Figure 16 & Appendix A-13).

![Figure 16. Zurn Wilkins References to Static, Sudden, and Creep Pressure Failures.](image)
A properly functioning thermal expansion tank will help maintain the water pressure below 80 PSI when water in the system is heated. However, a failed expansion tank (Figure 17) will allow the pressure to increase every time the system is static (closed system) and the water temperature is elevated. Failed expansion tanks often cause intermittent pressure spikes well above 80 PSI (Figures 18,19). If the system has a pressure relief valve, the valve may frequently discharge hot water, causing a potential safety hazard.

[Image is shown in supporting documents on the Kavi site]

**Figure 22. Failed Thermal Expansion Tank**

[Image is shown in supporting documents on the Kavi site]

**Figure 18. Pressure Spikes from Thermal Expansion & Failed Expansion Tank.**

[Image is shown in supporting documents on the Kavi site]

**Figure 19. Pressure Spikes from Thermal Expansion & Failed Expansion Tank.**

Continuous cycling of water pressure outside of code limits (15-80 PSI) fatigues the water distribution system and all components connected to it. This fatigue is similar to bending a paper clip back and forth; eventually the metal will yield and the paper clip will break. Cycling water pressure at high levels causes many premature failures of plumbing systems and can be avoided; the key is active pressure monitoring and notification of the high pressure condition.

**Deficiencies of Traditional Pressure Gauges.** As discussed above, water pressure can change at any time. A properly functioning plumbing system will maintain system pressure between 15 - 80 PSI (Figure 20). A system with a failed component (e.g. regulator, expansion tank, pump, relief valve, etc.) can cause the pressure to be low/high all of the time or intermittently. Intermittent pressure rises and drops are difficult to identify with a traditional pressure gauge because the user must be looking at the gauge at the precise moment of the rise or drop.

[Image is shown in supporting documents on the Kavi site]

**Figure 20. Typical Water Pressure with Functioning Regulator.**

Pressure gauges can be misleading and a false sense of pressure components working properly. For example, at 10am when a building is occupied, the gauge may indicate 60 psi. Due to a failed regulator, the pressure may creep up to street pressure (i.e. 140 PSI) during static conditions, which only occurs when everyone has left the building. During the night (when the building is unoccupied), the pressure increases all the way up the street pressure of 140 PSI.

Another example of how a traditional gauge can be misleading is when a thermal expansion tank fails. In this scenario, the user might observe 60 PSI on a gauge at 2pm when water has been used throughout the day. However, during the night when the system is static, the water heater turns on, heats the water and creates thermal...
expansion. With a failed thermal expansion tank in a closed system the pressure increases from 65 PSI up to 145 PSI or higher. A similar scenario can occur when ambient temperature rises (e.g. hot summer weather) on a closed system, which also increases the water pressure due to thermal expansion (Figure 19 above).

Traditional pressure gauges are passive instruments that are often ignored, poorly maintained, stuck (Figures 20-24), and not read at the correct time in order to provide accurate information about the failure of critical items like thermal expansion tanks and regulators. Traditional pressure gauges with peak pressure needle often give inaccurate readings caused by water hammer, fast pressure spikes, or someone tapping/handling the gauge.

Continuous Pressure Monitoring with Audible Alarm. Pressure regulators, thermal expansion tanks, and pressure relief valves are often unattended and forgotten about for many years. Figures 24-31 show regulators and thermal expansion tanks that have failed, causing high water pressure in the system.

The public is often unaware of the failed plumbing component and high water pressure condition until after a major damaging event occurs (water leak, pipe rupture, flood, etc.). In many cases, repairs are only made to the failed/leaking plumbing component(s) (e.g. fitting, supply hose, connector) and the water pressure problem is not addressed. For example, a water heater tank may rupture and leak due to wear combined with high water pressure (caused by a failed regulator or expansion tank). The water heater will often be replaced but the regulator is not replaced. The new water heater will likely fail prematurely (again) since the root cause (failed regulator) of the problem was not addressed.

A continuous water pressure monitoring device with an audible alert would notify the user immediately of the high pressure condition so that action can be taken to correct the problem before catastrophic damage occurs. This device would provide an active and necessary warning that a regulator, thermal expansion tank, relief valve or other critical plumbing safety device has failed.
Continuous monitoring of the pressure means intermittent or cyclical high pressure conditions would be quickly identified.

An audible alarm will quickly bring attention to the pressure issue. Unlike a gauge, an audible alarm is an active device and does not require a visual inspection. The audible alarm would bring attention to the high pressure condition.

Audible alarms are currently required on sump pumps to signal the failure of a pump (710.9 of 2024 UPC). Audible alarms are also required on medical gas and vacuum systems to signal a system failure (1317.0 of 2024 UPC).

Figure 25. Neglected, Failed Regulator Located in Valve Box.

Figure 26. Neglected, Failed Regulator Buried in Ground.

Figure 27. Failed Regulator.

Figure 28. Failed Regulator Manifold in Vault.

Figure 29. Failed Regulator on Water Riser.

Figure 30. Failed Regulator in Vault.

Figure 31. Failed Thermal Expansion Tank

**Conclusion.** The current code does not adequately protect the public from high water pressure. Many health incidents caused by high water pressure occur on systems which already have regulators, thermal expansion tanks, relief valves; but this is not enough. Requiring active and continuous water pressure monitoring would enhance public safety, reduce water waste, and protect the entire plumbing system.

Continuous monitoring of the water pressure is crucial to maintaining a safe and efficient plumbing system. Along with regulators, relief valves, and thermal expansion tanks, a continuous pressure monitoring device with audible
alert provides complete pressure management (Figure 32).

[Image is shown in supporting documents on the Kavi site]

**Figure 32. Complete Pressure Management Infographic**

Property damage, health problems and water waste caused by high water pressure can be greatly reduced (and eliminated in many cases) by proper maintenance. The key to this is making the public aware of the high pressure condition when it occurs.

Monitoring and audible alerts are already required in other parts of the code to notify of sump pump failures and pressure drops in medical gas systems.

A continuous water pressure monitoring device with audible alarm is an active device that would clearly indicate the plumbing system requires maintenance in order to comply with the code and thus keep water pressure at a safe level.

[Supporting documentation provided in Kavi for TC review]
Proposed Text:

608.2 Excessive Water Pressure. Where static water pressure in the water supply piping exceeds 80 psi (552 kPa), an approved-type pressure regulator preceded by an adequate strainer shall be installed and the static pressure reduced to 80 psi (552 kPa) or less. Pressure regulators for potable water distribution systems shall comply with ASSE 1003, ASSE 1103, or AWWA C530. Pressure regulator(s) equal to or exceeding 1\(\frac{1}{2}\) inches (40 mm) shall not require a strainer. Such regulator(s) shall control the pressure to water outlets in the building unless otherwise approved by the Authority Having Jurisdiction. Each such regulator and strainer shall be accessibly located aboveground or in a vault equipped with a properly sized and sloped boresighted drain to daylight, shall be protected from freezing, and shall have the strainer readily accessible for cleaning without removing the regulator or strainer body or disconnecting the supply piping.

Pipe size determinations shall be based on 80 percent of the reduced pressure where using Table 610.4. An approved expansion tank shall be installed in the cold water distribution piping downstream of each such regulator to prevent pressure exceeding 80 psi from developing due to thermal expansion. Expansion tanks used in potable water systems intended to supply drinking water shall comply with NSF/ANSI/CAN 61. The expansion tank shall be properly sized, securely fastened to the structure, and installed in accordance with the manufacturer's installation instructions and listing. Systems designed by a licensed plumbing contractor or registered design professionals shall be permitted to use approved pressure relief valves in lieu of expansion tanks provided such relief valves have a maximum pressure relief setting of 100 psi (689 kPa) or less.

TABLE 1701.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<td>ASSE 1103-202X</td>
<td>Pilot Operated Water Pressure Reducing Valves for Potable Water</td>
<td>Valve</td>
<td>602.8</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASSE 1103 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:

There are currently 2 types of pressure reducing valves allowed in the plumbing code. The ASSE 1003 Water Pressure Reducing Valves for Potable Water Distribution Systems, a directing acting valve in sizes \(\frac{1}{2}\)" through 4" and the AWWA C530 Pilot Operated Control Valve is, as the title states, a pilot operated valve in sizes 1-1/2" through 60". AWWA C530 valves were approved in the 2024 code cycle to provide an approved pressure reducing valve larger than 4" for systems that have larger volume requirements.

The new ASSE Standard 1103 "Pilot Operated Water Pressure Reducing Valves for Potable Water" will allow the use of pilot operated pressure control valves that are specifically intended for potable water applications. As such the standard requires compliance with NSF 61 and NSF 372.

The approval of this proposal will allow designers and AHJs the flexibility to design and approve potable water pressure controllers with a valve specifically intended for use in potable water systems.
608.3 Expansion Tanks, and Combination Temperature and Pressure-Relief Valves. A water system provided with a check valve, backflow preventer, or other normally closed device that prevents dissipation of building pressure back into the water main, independent of the type of water heater used, shall be provided with an approved, listed, and adequately sized expansion tank or other approved device having a similar function to control thermal expansion. Pre-pressurized water expansion tanks shall comply with IAPMO/ANSI Z1088. Such expansion tank or other approved device shall be installed on the building side of the check valve, backflow preventer, or other device and shall be sized, securely fastened to the structure, and installed in accordance with the manufacturer’s installation instructions.

A water system containing storage water heating equipment shall be provided with an approved, listed, adequately sized combination temperature and pressure-relief valve, except for listed nonstorage instantaneous heaters having an inside diameter of not more than 3 inches (80 mm). Each such approved combination temperature and pressure-relief valve shall be installed on the water-heating device in an approved location based on its listing requirements and the manufacturer’s installation instructions. Each such combination temperature and pressure-relief valve shall be provided with a drain in accordance with Section 608.5.

Exceptions:
(1) An expansion tank shall not be required for an instantaneous non-storage water heater.
(2) A non-storage water heater, instantaneous, or tankless water heater shall not be required to install temperature or pressure relief valve unless required by the manufacturer’s installation instructions.

SUBSTANTIATION:
This section has required a minimum of a three inch diameter to be exempt from requiring a temperature and pressure relieve valve. Tankless or instantaneous water heaters have been in use for quite sometime and they have proven safe when installed in accordance with the manufacturer’s installations instructions. The manufacturer will indicate when such a device is needed and not just based on a diameter of the internal piping of the instantaneous water heater. This update will not remove any safety parameters; on the contrary, it will remove any conflicts with the manufacturer’s requirements.
SUBMITTER:  Bruce Meiners
Organization Name: Wisconsin DPH
Organization Representation: Self

RECOMMENDATION:
Add new text

Proposed Text:
608.0 Water Pressure, Pressure Regulators, Pressure Relief Valves, and Vacuum Relief Valves.

608.3 Expansion Tanks, and Combination Temperature and Pressure-Relief Valves. (remaining text unchanged)
608.3.1 Expansion tanks in health care facilities. Expansion tanks installed in the hot water distribution systems in health care facilities shall be of the flow-through type.

SUBSTANTIATION:
I am the Legionella Industrial Hygienist for the Wisconsin Department of Health Services. I have conducted Legionella environmental assessments and doing sampling since 2017. We have discovered on at least 5 locations that the traditional type of hot water expansion tanks has been the source of the Legionella in the buildings. In one case the tank was 20 years old, that meant the water in the tank was 20 years old never being replaced with fresh water. The CFU count was extremely high seeding the hot water distribution system in the facility with Legionella creating an outbreak.

I proposed that this requirement be added to the Wisconsin Uniform Plumbing Code. it was approved and adopted into the Wisconsin plumbing code on October 1, 2023.

There have been studies and manufacturers are now making these flow through expansion tanks based on these known risks created by traditional hot water expansion tanks.
SUBMITTER: George Istefan
Organization Name: Watts Water Technologies
Organization Representation: Watts Water Technologies

RECOMMENDATION:
Revise text

Proposed Text:
608.0 Water Pressure, Pressure Regulators, Pressure Relief Valves, and Vacuum Relief Valves.

608.5 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. Discharge to a termination point that is readily visible and observable by the building occupants. If the discharge termination point is not readily visible and observable, a leak detection monitoring device with alarm notification (and not automatic shut-off) or building management system is required.

SUBSTANTIATION:
Approval of this code change will allow design flexibility, and more importantly, provide for the allowance of leak detection technology to warn building occupants and managers of a problem with a safety device. Current code language just requires visibility of the termination point, but if there is a significant discharge of the valve there may not be any awareness of the problem for an extended period. This can especially be a problem when a building is unoccupied and then significant flood damage can result.
This proposal does not intend to require the devices, just allow their use if the termination point is not visible. The allowance of leak detection technology makes for safer, smarter buildings.
608.7 Vacuum Relief Valves. Where a hot-water storage tank or an indirect water heater is located at an elevation above the fixture outlets in the hot-water system, a vacuum relief valve that complies with ANSI Z21.22/CSA 4.4 shall be installed on the storage tank or heater.

**Exception.** Tankless and instantaneous water heaters shall not require vacuum relief valves.

**SUBSTANTIATION:**
Quoted from 2021 illustrated training manual Notes explaining 608.7:

“If the water heater is installed above fixtures, there is a possibility of siphonage from the water heater. If the water supply is turned off or pressure drops as fixtures are being used, there is a possibility of a siphon being created because of the fixture water supply opening being lower than the tank. This could result in the tank emptying and possible steam being created in the tank. There have been instances where this siphonic action has been so powerful as to collapse the tank. For these reasons, a vacuum relief valve must be installed (see Figure 608.7).”

Tankless water heaters will not suffer from “tank collapse” as there is no tank.
RECOMMENDATION:
Revise text

Proposed Text:
608.0 Water Pressure, Pressure Regulators, Pressure Relief Valves, and Vacuum Relief Valves.

608.7 Vacuum Relief Valves. Where a hot-water storage tank or an indirect water heater is located at an elevation above the fixture outlets in the hot-water system, Bottom fed water heaters and bottom fed tanks connected to water heaters shall have a vacuum relief valve that complies with ANSI Z21.22/CSA 4.4 shall be installed on the storage tank or heater.

608.7.1 Water Heater Antisiphon Devices. Storage water heaters and storage tanks shall be protected against siphoning by an approved vacuum relief valve. A cold-water dip tube with a hole in the top of the water heater or storage tank shall be permitted as a means of protecting against siphonage.

SUBSTANTIATION:
This section is confusing regarding the location of a storage tank with respect to the fixtures. Water storage tanks should be protected against siphonage regardless of their location. Additionally, the change separates the concepts of an antisiphon device and a vacuum relief device, thus an additional section is being introduced under Section 608.7 (Vacuum Relief Valves) to address antisiphoning on its own.
609.10 Disinfection of Potable Water System. New or repaired potable water systems shall be disinfected prior to use where required by the Authority Having Jurisdiction. The method to be followed shall be that prescribed by the Health Authority or, in case no method is prescribed by it, the method shall follow that described by the American Water Works Association (AWWA) technical guidance document titled "Disinfecting Building Potable Water Plumbing in New or Repaired Systems." This AWWA technical guidance document includes the following steps and procedures:

1. The pipe system shall be flushed with clean, potable water until potable water appears at the points of the outlet. How to prepare the system with flushing prior to disinfection.

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 part thereof shall be valved-off and allowed to stand for 24 hours; or, the system or part 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. A summary of allowable disinfectants, disinfection equipment, the minimum level of disinfection residual and contact time needing to be achieved, how to disperse the disinfectant, how and where to measure disinfectant concentrations after the disinfection contact time has elapsed, and how to perform calculations of the minimum level of disinfection that has been achieved.

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. How to flush the system after disinfection is completed, and

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. A summary of minimum recommendations of microbial validation to be achieved by this disinfection process.

SUBSTANTIATION:
The methodology outlined and referenced in 609.10 originated from American Water Works Association (AWWA) Standard C651 and C652 which was/were developed to be applied toward disinfecting drinking water utility distribution system pipeline mains and storage tanks. These old standards were not meant to ever be applied as a procedure to be used within the building potable water plumbing system environment. Furthermore, recently revised C651 text specifically states that its methods should not be used in building potable water plumbing systems. The current 609.10 text is problematic in that it only prescribes very high disinfectant levels and contact times which are not practical for building plumbing systems and materials (it can cause excessive plumbing corrosion damage) and it does not provide adequate or appropriate instruction in how to prepare the system or confirm disinfection has been properly achieved. An AWWA Premise Plumbing Committee special working group (comprised of drinking water engineers, microbiologists, building contractors experienced in conducting disinfection of new plumbing, and state health department engineers) has spent 4 years in the development of the new technical document published by AWWA called "Disinfecting Building Potable Water Plumbing in New or
Repaired Systems." The revised text for 609.10 is entered to direct the reader to procedures documented in this new AWWA technical document.

While the new AWWA technical document (and revised text entered here for 609.10) are based on the same intentions of the original AWWA Standards C651 and C652 and original code section 609.10, it is much better tailored toward the specific activities and needs of disinfecting potable water plumbing in buildings. AWWA recommends this revision for the following reasons: It includes details in how to properly flush the entire plumbing system prior to conducting the disinfection step, it outlines multiple disinfectants that can be used to properly complete the disinfection step, it provides details on several options for disinfectant concentrations and contact times that will adequately achieve disinfection of the building plumbing system, it includes details in how to flush the plumbing system after the disinfection step is completed, and it describes how to conduct microbiological validation of the plumbing system upon completion of activities. Furthermore, all these steps are described in a way that keeps specificity on key elements required to successfully achieve disinfection effectiveness while still providing the authority having jurisdiction (AHJ) flexibility to prescribe their own method(s).

[Supporting documentation provided in KAVI for TC review]
609.10 Disinfection of Potable Water System. (remaning text unchanged)

609.10.1 Required Hot Water Distribution Disinfection. A hospital, community-based residential facility, inpatient hospice, and nursing homes shall be installed and maintained to provide disinfection by one of the following methods:

1. Water stored and circulation initiated at a minimum of 140°F (60°C) and with a return of a minimum of 124°F (51.1°C).
2. 0.5 parts per million (PPM) (0.5 mg/L) of residual chlorine.
3. Chloramine.
5. Using disinfectants provided by the municipality with an approved minimum residual disinfectant concentration at all points and individual site approval by Authority Having Jurisdiction.
6. Disinfection method approved by the department (AHJ).

SUBSTANTIATION:
Legionella prevention in the hot water distribution systems has been in the Wisconsin plumbing code since May of 2003. This is believed to have had success in buildings built after this date. The only time we have seen this fail is when the required method (system) was removed or was not maintained. I am the Legionella Industrial Hygienist for the state of Wisconsin and this is the findings from when I started investigating Legionella outbreaks in 2017.

Proposed Text TCC
609.11 Water Hammer. Building water supply systems where quick-acting valves are installed shall be provided with water hammer arrester(s) to absorb high pressures resulting from the quick closing of these valves. Water hammer arresters shall be approved mechanical devices that comply with ASSE 1010 or PDI-WH 201. Supply stops with integral water hammer arresters shall comply with IAPMO IGC 168. Devices shall be installed as close as possible to quick-acting valves.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tr>
<td>IAPMO IGC 168-</td>
<td>Supply Stops with Integral Water Hammer</td>
<td>Water Hammer</td>
<td>609.11</td>
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<td>2012 ©1</td>
<td>Arresters</td>
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(portions of table not shown remain unchanged)

Note: IAPMO IGC 168 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
This standard covers supply stops with integral water hammer arresters and specifies requirements for materials, physical characteristics, performance testing, and markings. IAPMO IGC 168 contains provisions for the water supply stops in addition to the water hammer arrestors. These devices are already in use throughout the nation. This standard will ensure that these valves meet the minimum health and safety requirements for both portions of the devices.

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RECOMMENDATION:
Revise text

Proposed Text:
609.0 Installation, Testing, Unions, and Location.

609.12 Pipe Insulation. (remaining text unchanged)
609.12.1 Insulation Requirements. Domestic hot water piping shall be insulated.

SUBSTANTIATION:
In many parts of the world summertime temperatures require as much or more time to run the cold water to get cold water as it does to run the hot water in the winter in cold climates. This section will save water.
SUBMITTER: Gary Klein

Organization Name: Gary Klein Associates

Organization Representation: Self

RECOMMENDATION:
Revise text

Proposed Text:
609.0 Installation, Testing, Unions, and Location.

609.12 Pipe Insulation. (remaining text unchanged)

609.12.1 Insulation Requirements. Domestic hot water piping shall be insulated. Where required, cold-water piping shall also be insulated in accordance with Section 609.12.2.

(shown for informational purposes)

609.12.2 Pipe Insulation Wall Thickness. Hot water pipe insulation shall have a minimum wall thickness of not less than the diameter of the pipe for a pipe up to 2 inches (50 mm) in diameter. Insulation wall thickness shall be not less than 2 inches (51 mm) for a pipe of 2 inches (50 mm) or more in diameter.

Exceptions:
(1) Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration.
(2) Hot water piping between the fixture control valve or supply stop and the fixture or appliance shall not be required to be insulated.

SUBSTANTIATION:
There are areas where it is important to insulate cold water in extreme hot conditions such as installation of cold water piping running in attic spaces our outside the walls. These provisions are silent and overlooked in many environments and climates. It is not uncommon for outside temperatures to reach over 100 degrees F. The insulation will assist in slowing down the heating of cold water where the water is being used throughout the day. Similar to the hot water loosing it’s heat, cold water is heated.
SUBMITTER: Samantha Liu
Organization Name: Self
Organization Representation:

RECOMMENDATION:
Revise text

Proposed Text:
609.0 Installation, Testing, Unions, and Location.

609.12 Pipe Insulation. (remaining text unchanged)

609.12.2 Pipe Insulation Wall Thickness. Hot water pipe insulation shall have a minimum wall thickness of not less than the diameter of the pipe for a pipe up to 2 inches (50 mm) in diameter. Insulation wall thickness shall be not less than 2 inches (51 mm) for a pipe of 2 inches (50 mm) or more in diameter.

Exceptions:
(1) Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration.
(2) Hot water piping between the fixture control valve or supply stop and the fixture or appliance shall not be required to be insulated.
(3) As required by the Authority Having Jurisdiction for an equivalent thermal insulation.

SUBSTANTIATION:
As written, the insulation requirements are very stringent in required a perceived insulation thickness. This is a concern as wall cavities that are limited in space and larger pipes will require thicker insulation which is not practical in limited spaces. The proposed text offers an alternative to the required thicknesses by installing insulators with higher or equivalent R-ratings and less thickness.

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609.12.2 Pipe Insulation Wall Thickness. Hot water pipe insulation shall have a minimum wall thickness of not less than the diameter of the pipe for a pipe up to 2 inches (50 mm) in diameter or shall have an R-Value of not less than R-7. Insulation wall thickness shall be not less than 2 inches (51 mm) or shall have an R-Value of not less than R-10 for a pipe of 2 inches (50 mm) or more in diameter.

Exceptions:
(1) Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration.
(2) Hot water piping between the fixture control valve or supply stop and the fixture or appliance shall not be required to be insulated.

SUBSTANTIATION:
A 2-inch insulation may be impractical in space constrained applications. The above update will allow the users to find an insulation with thinner wall thickness but with the same insulation intent. These values were taken from researching many standard of the shelf pipe insulators and averaged out with the suggested R-values. Through the research it should also be noted that different pipe materials have different heat transfer coefficients which result in varying insulation needs in order to meet the same intent of slowing down the heat loss.
609.0 Installation, Testing, Unions, and Location.

609.13 Water Distribution Mixing Valves. Mixing valves shall be in accordance with Section 609.13.1 through Section 609.13.3.

609.13.1 Master Mixing Valves. Master mixing valves shall comply with ASSE 1017.

609.13.2 Digital Master Mixing Valves. Digital master mixing valves shall comply with ASSE/IAPMO IGC 384.

609.13.3 Continuous Recirculation. For healthcare facilities, long term care facilities, hotels, or motels, when the recirculation pump is operated continuously, master mixing valves shall also be intended for continuous recirculation and comply with the manufacturer installation instructions.

203.0 – A –
Adiabatic Mixing. The mixing of two (or more) streams of fluid of differing temperatures to achieve a new mixed temperature.

206.0 – D –
Digital Master Mixing Valve. Master mixing valves that utilize electronic means such as digital controls to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

215.0 – M –
Master Mixing Valve. Temperature actuated mixing valves for hot water distribution systems are used for controlling water temperature in hot water systems. They are not intended for point-of-use temperature limiting, control, or end use applications including emergency eyewash and shower equipment. These devices consist of a hot water inlet connection, a cold water inlet connection, a mixed water outlet connection, a thermal element or thermostatic sensor and a means for adjusting the mixed water outlet temperature. These devices can be either be a mechanical master mixing valve which is mechanically actuated or a digital master mixing valve which is an electronically controlled device.

Mechanical Master Mixing Valve. Master Mixing Valve that utilizes mechanical means such as a thermostatic element to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

TABLE 1701.1
REFERENCED STANDARDS

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<td>ASSE 1017-2023</td>
<td>Temperature Actuated Mixing Valves for Hot Water Distribution Systems</td>
<td>Valves</td>
<td>609.13.1</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASSE 1017 and ASSE/IAPMO IGC 348 meet the requirements for mandatory referenced standards in accordance with Section 3- 3.7.1 of IAPMO's Regulations Governing Committee Projects.
### TABLE 1701.2

**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

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<td>ASSE 1017-2009</td>
<td>Temperature Actuated Mixing Valves for Hot Water Distribution Systems</td>
<td>Valves</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**

Hotels after healthcare facilities have the highest incidence rate of Legionnaires’ disease and thus need to be included in this list. The IECC 2015, 2018, and 2021 requires an aquastat and timer on ALL hot water recirculation pumps. The 2024 UPC added the allowance to operate recirculation pumps continuously; however, other hot water recirculation control devices may still end up adding an aquastat that turns off the recirculation pump thereby negating the positive impact of operating the recirculation pump continuously. An aquastat and timer can cause temperature stagnation of hot water distribution systems which can lead to proliferation of waterborne pathogens and directly conflicts with *NASEM Management of Legionella in Buildings*, *OSHA Technical Manual*, *ASHRAE 188*, *ASHRAE 12*, *ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems*, VA-1061, among others. A critical device that may end up inadvertently requiring the use of an aquastat is a water distribution system master mixing valve.

Water distribution system master mechanical mixing valves were not intended for continuous recirculation. An aquastat was needed on the recirculation pump in part due to the potential for an over-temperature safety related to the master mixing valve, also known as “temperature creep,” by the industry. Temperature creep occurs during zero demand on the system, when no cold water enters the system. The amount of heat being dissipated by the hot water supply and return piping system (total heat loss: radiant, conduction, convection) is less than the minimum heat being added to the system by all combined heat sources. Or, to put it another way, all mixing valves have a minimum inlet to outlet temperature, and temperature creep happens when the heat added to the piping system by the minimum hot water supply flow through the master mixing valve exceeds the piping system total heat loss. Because the mechanical mixing valve on its own couldn’t control a throttling valve was also required back to the heater to limit the amount of hot water entering the mixture of water flows at the water heater and mixing valve, minimizing temperature creep. Worth noting is that some Digital Master Mixing Valves also require an aquastat as they are subject to temperature creep. *ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems* indicates that Digital Master Mixing Valves should be utilized over Mechanical Master Mixing Valves for buildings water distribution systems such as healthcare and hospitality facilities.

By matching the requirement of master mixing valves ability to operate in such a way that allows continuous recirculation engineers, installers, and owners have the option to design, install, and operate hot water return systems in a manner that minimizes the risk of waterborne pathogen outbreaks, thus positively impacting public health and safety. By adding this exception language to the code, jurisdictions can better work with engineers, installers, and owners and become more aligned to the latest science in regard to hot water safety.

Substantiation provided by:

- Jeremiah Mastery, Institutional Product Mgr. – Hot Water Group, Armstrong International
- Paul Knight, Global Business Development, Armstrong International
- David D. Dexter, Master Plumber, CPI/CPE, PE, F.ASPE, F.NSPE, LEED AP BC+D. Sr. Engineer, 3D Engineering Consultants, LLC

Language from the ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems is provided as supporting documentation for TC review.

*[Supporting documentation provided in KAVI for TC review]*
609.0 Installation, Testing, Unions, and Location.

609.13 Location of Building Supply and Distribution Piping.

609.13.1 Building Supply Piping. The building supply piping that is located inside the building, but outside the thermal envelope shall be insulated in accordance with Section 609.12.

609.13.2 Location in Building Assemblies. No part of the water distribution system shall be located within a building assembly separating the conditioned space from the unconditioned space. Exception: Where the building water distribution system passes through the thermal envelope to get from unconditioned to conditioned space, the distribution piping shall be insulated in accordance with Section 609.12.

609.13.3 Location within the Thermal Envelope. Where the building water distribution system supplies water to a building that is thermally conditioned, the piping shall be located inside the thermal envelope of the building. Where it is necessary to locate a portion of the cold-water distribution system within two feet of the unconditioned space, the distribution piping shall be insulated in accordance with Section 609.12.

609.13.4 Location of Distribution Piping in Building Assemblies. Hot and cold-water distribution branch piping installed in the same building assembly, shall be in accordance with Section 609.13.4.1 through Section 609.13.4.1.2

609.13.4.1 Installation in Walls.

609.13.4.1.1 Horizontal and Diagonal Orientation of the Piping. The hot-water distribution piping shall be installed no less than 6 inches (152 mm) above the cold-water distribution piping.

609.13.4.1.2 Vertical Orientation of the Piping. The hot-water distribution piping shall be installed no less than 6 inches (152 mm) away from the cold-water distribution piping.

609.13.4.2 Installation in Floors and Ceilings.

609.13.4.2.1 Separation. The hot-water distribution piping shall be installed no less than 6 inches (152 mm) away from the cold-water distribution piping.

609.13.4.3 Insulation. The cold-water distribution branch piping shall be insulated in accordance with Section 609.12.

609.13.4.4 Location of Main and Large Branch Piping. The supply and return portions of a hot water circulation loop and the supply portions of electrically heat traced pipe shall not share the same building cavity with the cold-water distribution system piping. Exception: It is permissible to install the cold-water distribution piping in the same cavity with the supply and return portions of a hot water circulation loop and the supply portions of electrically heat traced pipe where both the cold and hot water piping is insulated with twice the wall thickness required in Section 609.12.

SUBSTANTIATION:

Building water distribution system piping installed so that it is subject to the variations in temperature caused by the environment, is often colder or hotter than is useful for use by the occupants of the building. For example, piping that is located in outdoor walls is subject to freezing in the winter and overheating in the summer. Same with piping located in attics. Locating the piping near the interior of a building assembly separating conditioned from
unconditioned space delays, but does not prevent, the effect that the outdoor temperatures have on the
temperature of the water in the pipe.

Given our concerns regarding Legionella and other water borne pathogen management, it does not make sense to
install the building water distribution system so that the water in these pipes spends significant time in the 85-105
Deg F range. Installing the water distribution piping inside the building thermal envelope provides better protection
for the health and safety of the occupants.

Some of the provisions in this section will minimize the transfer of heat from the hot water piping to the cold-water
piping. This will help minimize the risk of Legionella growth in the cold-water piping.
**TABLE 610.3**

**WATER SUPPLY FIXTURE UNITS (WSFU) AND MINIMUM FIXTURE BRANCH PIPE SIZES**

<table>
<thead>
<tr>
<th>APPLIANCES, APPURtenances or FIXTURES</th>
<th>MINIMUM FIXTURE BRANCH PIPE SIZE$^{1,4}$ (inches)</th>
<th>PRIVATE</th>
<th>PUBLIC</th>
<th>ASSEMBLY$^6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bidet$^9$</td>
<td>$\frac{1}{2}$</td>
<td>1.0</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Dishwasher, domestic$^8$</td>
<td>$\frac{1}{2}$</td>
<td>1.5</td>
<td>1.5</td>
<td>--</td>
</tr>
<tr>
<td>Lavatory$^9$</td>
<td>$\frac{1}{2}$</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Bar$^9$</td>
<td>$\frac{1}{2}$</td>
<td>1.0</td>
<td>2.0</td>
<td>--</td>
</tr>
<tr>
<td>Kitchen, domestic with or without dishwasher$^9$</td>
<td>$\frac{1}{2}$</td>
<td>1.5</td>
<td>1.5</td>
<td>--</td>
</tr>
<tr>
<td>Washup, each set of faucets$^9$</td>
<td>$\frac{1}{2}$</td>
<td>--</td>
<td>2.0</td>
<td>--</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

For SI units: 1 inch = 25 mm

**Notes:**

1 - 8 (remaining text unchanged)

$^9$ Nominal tubing size 3/8 inch (10 mm) shall be permitted to be used where pressure loss (i.e., hydraulic) calculations as described in Appendix A support the use of this size.

**SUBSTANTIATION:**

Recent research has been published by multiple organizations including IAPMO regarding the oversizing of water distribution pipes when following Hunter's Curve and historical pipe sizing tables. New information such as that found within Appendix M "Peak Water Demand Calculator" of the Code indicates that water distribution pipes are often oversized for the flow rates allowed by many current fixtures. Oversized pipes can lead to stagnant water and the potential health risk of Legionella growth. Oversize supply lines can also cause greater water usage when users flush hot water lines, wasting water and energy.
Many of the Appliances, Appurtenances or Fixtures which are currently approved for use are subject to water conservation regulations which reduce their WSFU demand, and therefore their required supply pipe sizing. The six (6) specific Appliances, Appurtenances or Fixtures to which footnote 9 is proposed to be added meet this description.

Plumbing system designers should have the option to supply these Appliances, Appurtenances or Fixtures with NTS 3/8 tubing where supported by pressure loss calculations which demonstrate sufficient flow and pressure supply. This will assist with conservation of water, because 3/8 tubing has approximately half the volume of 1/2 tubing, so hot-water fixtures will require less flushing of water before hot water arrives. The addition of Footnote 9 applies to all approved piping materials.

Example: 20 ft. of NTS ½ tubing has a volume of 0.24 US Gallons whereas 20 ft. of NTS 3/8 tubing has a volume of 0.15 US gallons, a reduction of 38%, translating to approximately 38% water savings when opening a faucet or fixture to get hot water.

This proposal recognizes that Section 610.5 allows that "Except as provided in Section 610.4, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A." Therefore, the method for sizing pipes correctly based on required flow and pressure are already established in the Code.

A separate proposal is being submitted to revise Table A103.1 in the same way for consistency throughout the Code.
## TABLE 610.3
WATER SUPPLY FIXTURE UNITS (WSFU) AND MINIMUM FIXTURE BRANCH PIPE SIZES<sup>3</sup>

<table>
<thead>
<tr>
<th>APPLIANCES, APPURTENANCES OR FIXTURES&lt;sup&gt;2&lt;/sup&gt;</th>
<th>MINIMUM FIXTURE BRANCH PIPE SIZE&lt;sup&gt;1,4&lt;/sup&gt; (inches)</th>
<th>PRIVATE</th>
<th>PUBLIC</th>
<th>ASSEMBLY&lt;sup&gt;6&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinal, 1.0 GPF Flushometer Valve&lt;sup&gt;9&lt;/sup&gt;</td>
<td>3/4</td>
<td>See Footnote&lt;sup&gt;7&lt;/sup&gt;</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm

Notes:

1-8 (remaining text unchanged)

<sup>9</sup> High efficiency urinals shall be permitted to use a 1/2 inch (15 mm) minimum fixture branch size.

**SUBSTANTIATION:**
The proposed note will recognize high efficiency urinals that require less water supply and thus a smaller pipe diameter will suffice for the operation of such urinals.
Proposed Text:
610.0 Size of Potable Water Piping.

610.5 Sizing per Appendices A, C, and M. Except as provided in Section 610.4, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A. For alternative methods of sizing water supply systems, see Appendix C or Appendix M.

A 103.0 Demand Load.
A 103.1 Supply Demand. Estimate the supply demand for the building main, the principal branches and risers of the system by totaling the fixture units on each, Table A 103.1, and then by reading the corresponding ordinate from Chart A 103.1(1) or Chart A 103.1(2), whichever is applicable.

Exception: For the applicable fixtures, the supply demand flow rate values calculated using Appendix M may be substituted for the flow rates calculated using the fixture units in Table A 103.1 and Chart A 103.1(1) or Chart A 103.1(2), whichever is applicable.

SUBSTANTIATION:
The proposed change adds reference to Appendix M (Water Demand Calculator) in Chapter 6, and Appendix A. The water demand calculator is adopted in many jurisdictions and is a proven alternative method for sizing water supply systems. Thus, the reference to the appendix is appropriate option to water supply sizing.
611.0 Drinking Water Treatment Units.
611.1 Application. (remaining text unchanged)

611.1.2 Scale Reduction Devices. Scale reduction devices that are in contact with the water shall comply with IAPMO/ANSI Z601.

SUBSTANTIATION:
The Z601 standard has been designed to provide identical results in whichever laboratory the test is conducted and in order to do this a synthetic water has been specified. The standard notes:

"Standardised tests cannot represent all types of water in all situations"

"Synthetic water is used for testing and actual results may vary"

Testing in IAPMO’s own laboratory shows very significant variations in performance between natural water and synthetic water when tested using a "non water contact electronic Scale Reduction Device".

A non water contact device used worldwide for thirty years that was evaluated under the IAPMO IGC 335 Rapid Scaling Test showed it reduced scaling by 83% in Las Vegas water from Lake Mead (Colorado River 40 million users) heated to 180 degrees F for 23 hours. The same device tested on the same test protocol but using synthetic water according to the Z601 protocol produced 42% MORE scale over the same period.

This proves that the Z601 defined water is completely unrepresentative of real world conditions and is not an appropriate test for this or other non water contact devices.

The effect of applying Z601 in its current form is to unreasonably exclude many types of perfectly effective devices that can be used to replace conventional softeners for treating hard water.

It is important to ensure that performance testing is designed in such a way that it fairly represents performance under real world conditions. Z601 is proven in the IAPMO Laboratory to fail to meet this requirement.

Some devices have successfully passed Z601 but these are primarily chemical dosing devices or media devices that do not modify the molecular structure of minerals in the water that are used by other devices to act as nucleation seeds in the scale reduction process. The latter devices, primarily non contact devices, will not perform in synthetic water which is not truly representative of natural water.
**RECOMMENDATION:**
Add new text

**Proposed Text:**
611.0 Drinking Water Treatment Units.

**TABLE 611.1**
**DRINKING WATER TREATMENT UNITS**

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>RESIDENTIAL</th>
<th>COMMERCIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>POINT OF USE</td>
<td>POINT OF ENTRY</td>
</tr>
<tr>
<td>Aesthetic Contaminant Reduction (filters)</td>
<td>NSF/ANSI 42</td>
<td>NSF/ANSI 42</td>
</tr>
<tr>
<td>Health Related Contaminant Reduction (filters)</td>
<td>NSF/ANSI 53</td>
<td>NSF/ANSI 53</td>
</tr>
<tr>
<td>Water Softener</td>
<td>-</td>
<td>NSF/ANSI 44</td>
</tr>
<tr>
<td>Ultraviolet Water Treatment</td>
<td>NSF/ANSI 55</td>
<td>NSF/ANSI 55</td>
</tr>
<tr>
<td>Reverse Osmosis</td>
<td>NSF/ANSI 58</td>
<td>NSF/ANSI/CAN 61</td>
</tr>
<tr>
<td>Distillation</td>
<td>NSF/ANSI 62</td>
<td>NSF/ANSI 62</td>
</tr>
<tr>
<td>Legionella Reduction and Treatment Devices</td>
<td>ASSE LEC 2011</td>
<td>ASSE LEC 2011</td>
</tr>
</tbody>
</table>

*Required for commercial modular systems only.

**TABLE 1701.1**
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE LEC 2011-2022</td>
<td>Listing Evaluation Criteria for Legionella Reduction and Treatment Devices</td>
<td>Legionella</td>
<td>Table 611.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** ASSE LEC 2011 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
Per the scope of ASSE LEC 2011 Listing Evaluation Criteria for *Legionella* Reduction and Treatment Devices 2022: “*Legionella reduction and treatment devices are designed to reduce the microorganisms in the genus Legionella (e.g., Legionella pneumophila) typically found in potable water systems. The devices reduce the number of the bacteria through inactivation and/or filtration. They can reduce or prevent the downstream bacterial colonization of a water system and thus ultimately the release of the bacteria into the product water. Devices are intended to be used at Point of Entry (POE) or Point-Of-Use (POU) in applications for hot or cold-water or both for drinking water, washing hands or showering.”
The 2022 ASSE LEC 2011 document defines performance criteria for devices designed to reduce *Legionella*. 

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RECOMMENDATION:
Revise text

Proposed Text:
611.0 Drinking Water Treatment Units.
611.1 Application. (remaining text unchanged)

611.1.1 Design. Point-of-use reverse osmosis drinking water treatment units shall comply with CSA B483.1 or NSF 58. Drinking water treatment units shall meet the requirements of CSA B483.1, NSF/ANSI 42, NSF/ANSI 44, NSF/ANSI 53 or NSF/ANSI 62. Commercial and food service water treatment equipment shall comply with ASSE 1087.

(renumber remaining sections)

TABLE 611.1
DRINKING WATER TREATMENT UNITS

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>POINT OF USE STANDARDS</th>
<th>POINT OF ENTRY</th>
<th>COMMERCIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic Contaminant Reduction (filters)</td>
<td>NSF/ANSI 42 or CSA B483.1</td>
<td>NSF/ANSI 42 or CSA B483.1</td>
<td>ASSE 1087 and NSF/ANSI 42*</td>
</tr>
<tr>
<td>Health Related Contaminant Reduction (filters)</td>
<td>NSF/ANSI 53 or CSA B483.1</td>
<td>NSF/ANSI 53 or CSA B483.1</td>
<td>ASSE 1087 and NSF/ANSI 53*</td>
</tr>
<tr>
<td>Water Softener</td>
<td></td>
<td></td>
<td>ASSE 1087</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;= 1-1/4 inch inlet NSF/ANSI 44, or CSA B483.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 1-1/4 inch inlet ASSE 1087</td>
<td></td>
</tr>
<tr>
<td>Ultraviolet Water Treatment</td>
<td>NSF/ANSI 55 or CSA B483.1</td>
<td>NSF/ANSI 55 or CSA B483.1</td>
<td>ASSE 1087</td>
</tr>
<tr>
<td>Reverse Osmosis</td>
<td>NSF/ANSI 58 or CSA B483.1</td>
<td>NSF/ANSI/CAN 61</td>
<td>ASSE 1087</td>
</tr>
<tr>
<td>Distillation</td>
<td>NSF/ANSI 62 or CSA B483.1</td>
<td>NSF/ANSI 62 or CSA B483.1</td>
<td>ASSE 1087</td>
</tr>
</tbody>
</table>

* Required for commercial modular systems only.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>
Note: The ASSE, CSA, and NSF standards meet the requirements for mandatory referenced standards in accordance with Section 3- 3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposal adds language and updates Table 611.1 (Drinking Water Treatment Units) to show what the ASSE 1087 standard covers in regards to the other standards listed currently in this section and what they cover in the Code.
**RECOMMENDATION:**
Revise text

**Proposed Text:**

**TABLE 611.1**

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>RESIDENTIAL</th>
<th></th>
<th>COMMERCIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic Contaminant Reduction (filters)</td>
<td>NSF/ANSI 42</td>
<td>NSF/ANSI 42</td>
<td>ASSE 1087 and NSF/ANSI 42*</td>
</tr>
<tr>
<td>Health Related Contaminant Reduction (filters)</td>
<td>NSF/ANSI 53</td>
<td>NSF/ANSI 53</td>
<td>ASSE 1087 and NSF/ANSI 53*</td>
</tr>
<tr>
<td>Water Softener</td>
<td>NSF/ANSI 44</td>
<td>NSF/ANSI 44</td>
<td>ASSE 1087</td>
</tr>
<tr>
<td>Ultraviolet Water Treatment</td>
<td>NSF/ANSI 55</td>
<td>NSF/ANSI 55</td>
<td>ASSE 1087</td>
</tr>
<tr>
<td>Reverse Osmosis</td>
<td>NSF/ANSI 58</td>
<td>NSF/ANSI/CAN 61</td>
<td>ASSE 1087</td>
</tr>
<tr>
<td>Distillation</td>
<td>NSF/ANSI 62</td>
<td>NSF/ANSI 62</td>
<td>ASSE 1087</td>
</tr>
</tbody>
</table>

* Required for commercial modular systems only.

205.0 - C -

Commercial Modular System. A drinking water treatment unit system consisting of multiple components attached to a manifold, produced specifically for food service applications, and not intended for use in residential applications.

Note: NSF/ANSI 44 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

WQA did not support the previous adoption of ASSE 1087-2018 into the UPC due to the overlap with existing American National Standards (ANSI Standards), and the confusion that overlap will and has created with plumbing officials and the general public. Our opposition has not changed and therefore, we are requesting the deletion of ASSE 1087 from the UPC.

The water treatment industry has a long history of supporting third-party certification to industry standards. WQA continues to support and is an active participating member in the development of voluntary consensus industry standards. We do not support the development of duplicate conflicting standards which counteract this goal by creating consumer confusion and adding additional cost and time to the manufacturer.

The publication of ANSI/ASSE 1807 has caused confusion in the marketplace and by incorporating the standard into the UPC, further confusion has been created. From the point ANSI/ASSE 1807 was published, it has not been clear what products or product applications are covered and no attempt has been made to try and clarify the confusion and inconsistencies.

Despite attempts by ASSE to incorporate ASSE 1087 into the NSF/ANSI Drinking Water Treatment Unit Standards as a normative reference, including Standards 42, 44, 53, 55, 58, 62, 244, and 401, the NSF Drinking Water
Treatment Unit Joint Committee, the consensus body responsible for the development and maintenance of these Standards, has twice rejected the proposal. Many of the comments for rejection related to a lack of clarity in its application and the risk and burden of unnecessary certifications for products already covered under existing, well established and utilized standards.

The confusion and lack of clarity of the scope and purpose of ANSI/ASSE 1087 are summarized below:

- **Lack of Scope Clarity**
  A significant contribution to the confusion in the marketplace is the lack of scope clarity related to ASSE 1087. While some have proposed its use in commercial systems only, as would be suggested by the title *Commercial and Food Service Water Treatment Equipment Utilizing Drinking Water*, ASSE has conversely provided clarification that the standard is much broader; “The scope of ASSE 1087 standard as written covers all drinking water treatment systems used in commercial buildings.” This would require, by example, a refrigerator filter used in an office building cafeteria to be certified to ASSE 1087 in addition to NSF/ANSI Standard 42. There is nothing applicable in ASSE 1087 for a refrigerator filter that adds value over the existing requirements of the NSF/ANSI Standards.

- **Use of the Term “Commercial”**
  The term “commercial” used in the ASSE 1087 is not defined in the body of the Standard. Without a definition of the term, it is not clear what is intended. In addition, the term “commercial” is not defined in the UPC.

It is understood that the term “commercial” is used throughout the UPC without a definition however, in the case of drinking water treatment systems, the lack of a definition causes significant confusion in the market since the standard means of defining drinking water treatment systems is using the terms Point-of-Use (POU) and Point-of-Entry (POE). Both terms are defined in the UPC and the nationally accepted NSF Standards. A review of the POE and POU definitions shows there is no differentiation between residential and commercial, and the term “building” is used in the definitions.

- **Term “Commercial Modular Systems”**
  The definition for “commercial modular systems” previously added to the UPC and included ASSE 1087 is directly taken from NSF/ANSI 330, Glossary of Drinking Water Treatment Unit Terminology. As indicated in the definition, the term is only related to food service applications and therefore, does not apply to the broader scope of commercial application inferred in the scope of ASSE 1087. The proposal deletes the definition since it is no longer relevant based on the changes proposed to Table 611.1.

- **Incorrect Scope Coverage of NSF/ANSI Standards in UPC**
  Table 611.1 does not adequately address the full coverage of NSF/ANSI Standards. As an example, the Table infers that NSF/ANSI 58 is only related to residential POU systems. However, NSF/ANSI 58 is not limited to a residential scope. It is limited to POU systems, however, these POU systems can be used in commercial settings.

- **Inconsistency in Test Procedures and Requirements**
  NSF/ANSI Standards already provide various performance and structural integrity tests such as: hydrostatic pressure tests, cycle tests, rated pressure drop, rated capacity and others. Some of these tests are included in ASSE 1087 which leads to potential confusion and potential conflict in the test procedures and criteria set in both standards without clear justification for the conflict.

- **Unclear Coverage of NSF and ASSE Standards**
  Table 611.1 implies that certain drinking water treatment systems intended for commercial use do not need to comply with any NSF/ANSI Standards due to referencing only ASSE 1087. ASSE 1087 references the NSF/ANSI Standards for some requirements but not for all. A product certified to ASSE 1087 would not be in full compliance with the NSF/ANSI Standards leading to unfair market conditions and confusion.
- **Adequate Plumbing Installation Requirements Provided**
   The NSF/ANSI Standards combined with existing requirements in the UPC address minimum requirements for the installation of drinking water treatment units to protect against back-flow. The NSF/ANSI Standard address these issues in both design requirements and labeling requirements.

- **Inconsistency in Marking and Labeling Requirements**
  Both the NSF/ANSI Standards and ASSE 1087 Standard have specific labeling requirements. These requirements are inconsistent and can easily cause confusion in the marketplace.

In addition to the issue of market confusion and conflict, there does not appear to be a market value to ASSE 1087. Since the publication of ASSE 1087 in 2018, and as of the date of this proposal, two companies have certified their products to ASSE 1087. One certified product line is a filter water dispenser. The same product models are also certified to NSF/ANSI Standards 42 and 53. It is not clear what additional value is added with ASSE 1087 when compared to requirements already covered under the NSF/ANSI Standards.

In conclusion, WQA continues to have significant concern with the inclusion of ASSE 1087 into the UPC and requests the Standard be removed from the UPC until such time as clarity and lack of conflict can be arrived at within the national standards development system.
SUBMITTER: Jason Shank
Organization Name: Plumbers Local #55 JATC
Organization Representation: ASSE International

RECOMMENDATION:
Add new text

Proposed Text:
611.0 Drinking Water Treatment Units.
611.1 Application. (remaining text unchanged)

611.1.3 Anion Exchange Nitrate Reduction Devices. Point of entry anion exchange and nitrate reduction devices shall comply with ASSE 1378.

Table 1701.1
Referenced Standards

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1378-202X</td>
<td>Point of Entry Anion Exchange - Nitrate Reduction</td>
<td>Appliances</td>
<td>611.1.3</td>
</tr>
</tbody>
</table>

Note: ASSE 1378 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
The water treatment systems covered in ASSE 1378 consist of self-regeneration anion exchange systems designed to reduce nitrates from drinking water. These systems use an anion exchange media that prevents nitrate dumping. This standard will ensure the correct design and functionality of these systems.
Proposed Text:
612.0 Residential Fire Sprinkler Systems.
612.1 Where Required. Where residential sprinkler systems are required in one and two-family dwellings, or townhouses, or tiny houses, the systems shall be installed by personnel, installer, or both, certified in accordance with ASSE/IAPMO/ANSI Series 7000 in accordance with this section or NFPA 13D. This section shall be considered equivalent to NFPA 13D. Partial residential sprinkler systems shall be permitted to be installed in buildings not required to be equipped with a residential sprinkler system.

SUBSTANTIATION:
The code is currently silent on the need for sprinkler systems for tiny houses. Text is being added to address the requirements for sprinkler systems as it is common for fire Sprinklers to be required for a new ADU if the existing primary residence has a fire sprinkler system.
701.2 Drainage Piping. Materials for drainage piping shall be in accordance with one of the referenced standards in Table 701.2 except that:

(1) - (6) (remaining text unchanged)

(7) For trenchless installation of cured-in-place pipe (CIPP) to line existing buried building drains, installation shall be in accordance with ASTM F1216, ASTM F2599, or ASTM F3541. Installation of seamless molded hydrophilic gaskets in CIPP shall be in accordance with ASTM F3240. CIPP materials shall be manufactured in compliance with applicable standards and certified as required in Section 301.2.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F1216-2022</td>
<td>Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube</td>
<td>Piping</td>
<td>715.3.1, 701.2(7)</td>
</tr>
<tr>
<td>ASTM F2599-2020</td>
<td>Standard Practice for the Sectional Repair of Damaged Pipe by Means of an Inverted Cured-In-Place Liner</td>
<td>Piping</td>
<td>715.3.1, 701.2(7)</td>
</tr>
<tr>
<td>ASTM F3240-2019</td>
<td>Standard Practice for Installation of Seamless Molded Hydrophilic Gaskets (SMHG) for Long-Term Watertightness of Cured-in-Place Rehabilitation of Main and Lateral Pipelines</td>
<td>Piping</td>
<td>715.3.1, 701.2(7)</td>
</tr>
<tr>
<td>ASTM F3541-2022</td>
<td>Standard Practice for Sectional Repair of Existing Gravity Flow Non-Pressure Pipelines and Conduits by Pushed or Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping</td>
<td>715.3.1, 701.2(7)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**

The proposed change adds note (7) to Section 701.2. The addition for the use of CIPP to rehabilitate for existing buried building drains, as included in existing sewers in Section 715.3.1, provides an alternative that minimizes health hazards during construction by repairing existing buried pipe without the need to excavate inside buildings.
RECOMMENDATION:

Add new text

**Proposed Text:**

701.0 General.

701.2 Drainage Piping. Materials for drainage piping shall be in accordance with one of the referenced standards in Table 701.2 except that:

(1) - (6) (remaining text unchanged)

(7) Cured-in-Place Pipe (CIPP) shall be listed and certified in accordance with Section 301.2 and installed in accordance with applicable standards referenced in Table 701.2. When the existing pipe is broken or breached inside a duct or plenum, the existing pipe shall be repaired before CIPP is installed, so that the CIPP is not exposed.

<table>
<thead>
<tr>
<th>TABLE 701.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL</td>
</tr>
<tr>
<td>Cured-in-Place Pipe (CIPP)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

<p>| TABLE 1701.1 |
|REFERENCE STANDARDS |
|STANDARD NUMBER | STANDARD TITLE | APPLICATION | REFERENCED SECTION |
|ASTM F1216-2021 | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube | Piping | Table 701.2, 715.3.1 |
|ASTM F1743-2022 | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP) | Piping | Table 701.2 |
|ASTM F2561-2020 | Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner | Piping | Table 701.2, 715.3.1 |</p>
<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F1743-2017</td>
<td>Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping, Plastic</td>
</tr>
</tbody>
</table>

Note: ASTM F1743 does not meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

Note: ASTM F1216, ASTM F2561, ASTM F2599, and ASTM F3541 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

The proposed change adds Cured-in-Place Pipe (CIPP) as a class of drainage piping materials for DWV applications. Additionally, the change adds CIPP into Table 701.2 (Materials for Drain, Waste, Vent Pipe and Fittings).

Incorporating CIPP into section 701.2 will make the additional UPC performance requirements for CIPP to be installed within building DWV pipes much clearer to AHJs; lack of inclusion currently results in no guidance. With the proposed language, all existing code requirements for DWV piping materials will govern (such as fire safety compliance within ducts and plenums); only CIPP installed to comply with the UPC requirements can be permitted for such building DWV piping applications.

ASTM F1216-2022, ASTM F2561 (a fittings - connection lining - standard, rather than a piping standard), ASTM F2599, and the new ASTM F3541-2022 are proposed to be added to Table 701.2 for broader DWV applications. The expected ASTM F1743-2024 with UPC compliant mandatory language is also proposed for inclusion if completed in time.

NOTE: There are separate, related proposals for adding ASTM F1743-2024 and ASTM F3541-2022 to Section 715.3.1 and into Table 1701.1
SUBMITTER:
Abraham Murra
Georg Fischer and Jets Vacuum AS
(Norway)

Organization Name:
Abraham Murra Consulting

Organization Representation:
Consultant

RECOMMENDATION:
Revise text

Proposed Text:

<table>
<thead>
<tr>
<th>TABLE 701.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL</td>
</tr>
<tr>
<td>----------</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>CSA B 182.13-2021</td>
</tr>
<tr>
<td>ASTM F3371-2022</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F1412, ASTM F3371, CSA B181.3, and CSA B182.13 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
PP is a widely used and accepted piping material and is being added to Tables 701.2 will give users of the UPC a broader choice of materials.
SUBMITTER: William Chapin
Organization Name: Professional Code Consulting, LLC
Organization Representation: William Chapin

RECOMMENDATION: Revise text

Proposed Text:

**TABLE 701.2**
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>BUILDING SEWER PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypropylene (PP)</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>IAPMO IGC 345, IAPMO IGC 348</td>
<td>IAPMO IGC 345, IAPMO IGC 348</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

**TABLE 1701.1**
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 345-2020a</td>
<td>Polypropylene (PP) DWV Pipe with a Mineral Filled Core and PP Fittings</td>
<td>DWV Piping and Fitting</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>IAPMO IGC 348-2020</td>
<td>Plastic Push Fit Tubular Fittings</td>
<td>DWV Piping</td>
<td>Table 701.2</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

Note: IAPMO IGC standards meet the requirements for mandatory referenced standards in accordance with Section 3· 3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Add new referenced standards to Table 701.2 (Materials for Drain, Waste, Vent Pipe and Fittings):
IAPMO IGC 345-2020 Polypropylene (PP) DWV Pipe with a Mineral Filled Core and PP Fittings | DWV Piping and Fittings | Table 701.2
IAPMO IGC 348-2020 Plastic Push Fit Tubular Fittings | DWV Piping | Table 701.2

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TABLE 701.2
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
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<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypropylene (PP)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F1412</td>
<td>ASTM F1412</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F1412 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Polypropylene is a long life, maintenance free resin that is chemically resistant to wastes associated with food and beverage, industrial and chemical processing and discharges that have elevated temperatures. Polypropylene systems are available in both single and dual wall/containment designs where enhanced protection is needed or desired.

Polypropylene fittings can be heat fused for a secure long term connection ensuring system integrity. ASTM Standard F1412 is for both pipe and fittings so it is a system standard.
TABLE 701.2
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>BUILDING SEWER PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypropylene, Mineral Filled (PP-M)</td>
<td>X</td>
<td></td>
<td>IAPMO IGC 345</td>
<td>IAPMO IGC 345</td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 345-2020a</td>
<td>Industry Standard for Polypropylene (PP) DWV Pipe with a Mineral Filled Core and PP Fittings</td>
<td>Fittings</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>IAPMO IGC 348-2020</td>
<td>Industry Standard for Plastic Push Fit Tubular Fittings</td>
<td>Fittings</td>
<td>Table 701.2</td>
</tr>
</tbody>
</table>

( порtions of table not shown remain unchanged)

Note: IAPMO IGC standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
IGC 345 covers DN 40 to DN 200 or 1-1/2 to 8 NPS polypropylene Drain, Waste and Vent (DWV) pipe with a mineral filled core and polypropylene fittings intended for use in commercial and residential applications and specifies requirements for materials, physical characteristics, performance testing, and markings.

IGC 348 covers reversible 1-1/4 and 1-1/2 NTS plastic push fit tubular fittings intended for quick assembly of PVC and PP waste tubing and tubular fittings applications, and specifies requirements for materials, physical characteristics, performance testing, and markings.

Pipe Characteristics:
• UV Resistance that allows the installation in contact to the UV rays without changing the mechanical characteristics.
• Resistant to saltiness in comparison to the metal systems (Stainless Steel and Galvanized Steel).
• Excellent sound insulation performance: the system reduces noise to just 12 dB(A) with a flow of 2 l/s.
• Absolute guarantee of watertight joints, thanks to the elastomeric seal factory fitted (from 1.5 to -800 mbar).
• Extremely fast and easy to install, the installation do not require the use of any special tools, glues or solvents.
• Lightweight of the products. White Marine® is 3 times lighter than Stainless Steel and 4 times lighter than Galvanized Steel.
• Wide range of diameters.
• Availability of transition accessories for connection to existing waste systems in different materials.
• Excellent impact resistance even at low temperatures (from -25°C to + 95°C).
• An high abrasion resistance and extremely smooth internal surfaces guarantee minimal pressure losses and no deposit formation.
• High resistance to a wide range of chemical compounds also at high temperatures; not affected by stray currents.

Example of typical pipe specifications when tested to existing Internation Standards

Minimum temperature of use -25°C
Maximum temperature of waste water:
+95°C (intermittent)
+80°C (continuous)
Minimum working pressure:

800 mbar @ 30°C max
600 mbar @ 60°C max -
Maximum working pressure: +1.5 bar -
Composition of waste water pH 2÷12 -

Density at 23°C pipes:
> 1200 kg/m3 (medium thickness) > 1800 kg/m3 (intermediate layer)
fittings:
> 1400 kg/m3
UNI EN ISO 1183-2
Tensile strength : 18 MPa
Elastic Module: 1500 MPa
Ultimate elongation:
Crystalline melting temperature: 160°C
Linear heat expansion coefficient: 0,08 mm/m·K
Suitable for use outdoors UV resistance 1000 klys
SUBMITTER:
Abraham Murra
Georg Fischer and Jets Vacuum AS, Norway

Organization Name:
Abraham Murra Consulting

Organization Representation:
Consultant

RECOMMENDATION:
Add new text

Proposed Text:

TABLE 701.2
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>BUILDING SEWER PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPVC Schedule 80</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>ASTM F441/F441M, CSA B181.2</td>
<td>ASTM F439, CSA B181.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B181.2: 2024</td>
<td>Polyvinylchloride (PVC) and chlorinated polyvinylchloride (CPVC) drain, waste, and vent pipe and pipe fittings</td>
<td>Piping, Fittings</td>
<td>Table 701.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F441/F441M and CSA B181 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
CPVC is a widely used and accepted piping material and adding it to Table 701.2 will give users of the UPC a broader choice of materials.
SUBMITTER: George Istefan  
Organization Name: Watts Water Technologies  
Organization Representation: Self  

RECOMMENDATION: Add new text  

Proposed Text:  

TABLE 701.2  
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>BUILDING SEWER PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyvinylidene fluoride (PVDF)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F1673</td>
<td>ASTM F1673</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F1673 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:  
Polyvinylidene fluoride (PVDF) is a long life, maintenance free resin that is chemically resistant to wastes associated with food and beverage, industrial and chemical processing and discharges that have elevated temperatures.

Polyvinylidene fittings can be heat fused for a secure long term connection ensuring system integrity. The ASTM F1673 Standard is for both pipe and fittings so it is a system standard.

Additionally, PVDF is approved for use in plenums where ASTM E84 smoke and flame spread compliance is required.
**TABLE 701.2**
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS</th>
<th>BUILDING SEWER PIPE AND FITTINGS</th>
<th>REFERENCED STANDARD(S) PIPE</th>
<th>REFERENCED STANDARD(S) FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM D2661, ASTM D2680*, ASTM F628, CSA B181.1</td>
<td>ASME A112.4.4, ASTM D2661, ASTM D2680*, ASTM F628, CSA B181.1</td>
</tr>
<tr>
<td>Cast-Iron</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM A74, ASTM A888, CISPI 301</td>
<td>ASME B16.12, ASTM A74, ASTM A888, CISPI 301</td>
</tr>
<tr>
<td>Concrete Pipe</td>
<td>---</td>
<td>---</td>
<td>X</td>
<td>ASTM C14, ASTM C76, CSA A257.1, CSA A257.2</td>
<td>---</td>
</tr>
<tr>
<td>Co-Extruded ABS (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F628, ASTM F1488</td>
<td>ASME A112.4.4, ASTM D2661, ASTM D2680*</td>
</tr>
<tr>
<td>Co-Extruded PVC (Schedule 40)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F891, ASTM F1760, ASTM F1488</td>
<td>ASME A112.4.4, ASTM D2665, ASTM F794, ASTM F1336*, ASTM F1866</td>
</tr>
<tr>
<td>Polyolefin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>ASTM F3371</td>
<td>ASTM F3371</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**TABLE 1701.1**
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C14:2020</td>
<td>Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe</td>
<td>Piping, Non-Metallic</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>ASTM C76:2022</td>
<td>Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe</td>
<td>Piping</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>ASTM F3371:2022</td>
<td>Standard Specification for Polyolefin Pipe and Fittings for Drainage, Waste, and Vent Applications</td>
<td>Piping, Fitting</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>CAN/CSA A257.1-2024</td>
<td>Non-reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings</td>
<td>Piping</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>CAN/CSA A257.2-2024</td>
<td>Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings</td>
<td>Piping</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>CSA B181.1:2024</td>
<td>Acrylonitrile-Butadiene-Styrene (ABS) Drain, Waste, and Vent Pipe and Pipe Fittings</td>
<td>Piping, Fitting</td>
<td>Table 701.2</td>
</tr>
<tr>
<td>CSA B181.2:2024</td>
<td>Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Drain, Waste, and Vent Pipe and Pipe Fittings</td>
<td>Piping, Fitting</td>
<td>Table 701.2</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)
TABLE 1701.2  
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C14-2020</td>
<td>Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe</td>
<td>Piping, Non-Metallic</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM and CSA standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed change adds recognized standards used in other codes and standards for drain waste, vent pipe, and fittings. New materials are being added for concrete pipe (building sewer only) and Polyolefin (for DWV piping).

ABS:
ASTM F628 - 1. Scope 1.1 This specification covers coextruded acrylonitrile-butadiene-styrene (ABS) plastic drain, waste, and vent pipe made to Schedule 40 iron pipe sizes (IPS) and produced by the coextrusion process with concentric inner and outer solid ABS layers and the core consisting of closed-cell cellular ABS. Plastic which does not meet the material requirements specified in Section 5 is excluded from single layer and all coextruded layers.


PVC:
ASTM D2949 - 1. Scope

1.1 This specification covers requirements and test methods for materials, dimensions and tolerances, deflection load, crush resistance, flattening resistance, impact resistance, and solvent cement. A form of marking is also included. Plastic which does not meet the material requirements specified in Section 5 is excluded. NOTE 1—This specification was formerly issued under the title, 3-in. Thin Wall Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.


Co-Extruded ABS and PVC:
ASTM F1488 - This specification covers coextruded composite pipe, produced by a coextrusion die system, in which the concentric layers are formed and combined before exiting the die. Coextruded composite pipe conforming to the requirements prescribed are used for different applications: IPS Schedule 40 Series-coextruded composite pipe is used for above or below ground installation for communication conduit, electrical conduit, drain, waste, and vent pipe, and plastic underdrain systems for highway, airport, and similar drainage, where a Schedule 40 IPS is required; IPS-DR-PS Series-coextruded composite pipe is used for above or below ground installation for communication conduit, electrical conduit, and drain, waste, and vent pipe; and Sewer and Drain DR-PS Series-coextruded composite pipe is used for gravity flow sewer and drain pipe, and plastic underdrain systems for highway, airport, and similar drainage. The pipe stiffness, impact resistance, and bond strength shall be tested to meet the requirements prescribed.

1. Scope

1.1 This specification covers coextruded composite pipe, produced by a coextrusion die system, in which the concentric layers are formed and combined before exiting the die.

1.1.1 Materials listed in the material section are permitted to be used in any layer of the coextruded composite pipe. When coextruded composite pipe is produced with three layers, the middle layer is permitted to be solid or thermally foamed.

1.1.2 The function of this specification is to provide standardization of product, to produce technical data, and to serve as a purchasing guide.

Concrete pipe standard scopes are as follows:
ASTM C14 - This covers nonreinforced concrete pipe intended to be used for the conveyance of sewage, industrial wastes, storm water, and for the construction of culverts.

ASTM C76 - This specification covers reinforced concrete pipe intended to be used for the conveyance of sewage, industrial wastes, and storm water, and for the construction of culverts.

CAN/CSA A257.1 - Pertains to nonreinforced circular concrete pipe and fittings intended to be used for the conveyance of sewage, industrial wastes, storm water, and for the construction of culverts.

CSA A257.2 - This Standard applies to reinforced circular concrete pipe and accessories intended for use as sewer pipe for the conveyance of sewage, industrial waste, and storm water, and the construction of culverts.

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### Proposed Text:

#### TABLE 703.2

MAXIMUM UNIT LOADING AND MAXIMUM LENGTH OF DRAINAGE AND VENT PIPING

<table>
<thead>
<tr>
<th>SIZE OF PIPE (inches)</th>
<th>1(\frac{1}{4})</th>
<th>1(\frac{1}{2})</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Units</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drainage Piping(^1)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical</td>
<td>1</td>
<td>2(^2,7)</td>
<td>16(^3)</td>
<td>48(^4)</td>
<td>256</td>
<td>600</td>
<td>1380</td>
<td>3600</td>
<td>5600</td>
<td>8400</td>
</tr>
<tr>
<td>Horizontal</td>
<td></td>
<td>8(^3)</td>
<td>35(^4)</td>
<td>216(^5)</td>
<td>720(^5)</td>
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<td></td>
<td></td>
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<tr>
<td><strong>Maximum Length</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drainage Piping</td>
<td>45</td>
<td>65</td>
<td>85</td>
<td>212</td>
<td>300</td>
<td>390</td>
<td>510</td>
<td>750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical, (feet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vent Piping</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal and Vertical(^6)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Units</td>
<td>1</td>
<td>8(^3)</td>
<td>24</td>
<td>84</td>
<td>256</td>
<td>600</td>
<td>1380</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Lengths, (feet)</td>
<td>45</td>
<td>60</td>
<td>120</td>
<td>212</td>
<td>300</td>
<td>390</td>
<td>510</td>
<td>750</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

**Notes:**

(1) - (7) (remaining text unchanged)

\(^8\) For residential buildings and hotels, a 4 inch drain may receive the drainage of up to 30 dwelling units and a 6 inch drain may receive the drainage of up to 100 dwelling units. For fixtures located outside of dwellings, a maximum of 50 DFUs additional DFUs may be added to the 4 inch drain and a maximum of 100 DFUs may be added to the 6 inch drain.

**SUBSTANTIATION:**

A comparison of the maximum drainage loading featured in the UPC with 11 other plumbing codes used internationally reveal significant oversizing, even among some of the more conservative plumbing codes (see graphic attached here). While a robust reworking of the Drainage Fixture Unit methodology is warranted to precisely reflect the hydraulic conditions associated with 21st century plumbing systems, a simplified approach is proposed here for the 2027 Uniform Plumbing Code in an effort to support the performance of modern sanitary drainage systems following water efficiency measures that have been implemented since the methodology was introduced in 1928.
Research from Germany suggest that the maximum drainage flow approximatively correlates to double that of the maximum water supply flow. Assuming this 2-to-1 ratio along with the Water Demand Calculator, it can be observed that drainage capacity, measured by the quantity of multifamily dwellings served, can be expanded significantly without exceeding recommendations in other established plumbing codes used internationally. The optimal drain performance occurs in drains that are small enough to provide a 'cleansing force' of approximately 2.5 N/m² during at least 1 daily peak drainage flow while being large enough to maintain a pressure differential within ±1 inch of water column (250 Pascals). While the Water Demand Calculator was not intended to be used to draw assumptions based on the drainage system characteristics, it can be a useful tool in this regard to roughly demonstrate the magnitude of oversizing.

Using the Colebrook-White equation, it can be seen that flow of a cast-iron pipe flowing 50% full sloped at 2% is 59 gpm. The estimated water supply flow using the Water Demand Calculator of 30 standard* residential units is equal to 21 gpm. It may be assumed therefore that a 4 inch drain may serve up to 30 units without exceeding a filling height of 42%, providing significant spare capacity. Similarly, a 6 inch drain sloped at 2% with a filling height of 50% will flow at 174 gpm. The estimated water supply flow using the Water Demand Calculator of 200 standard* residential units is equal to 56.7 gpm. Assuming a relationship of 2-to-1 for drainage and water flow, it may be safely assumed that a 6 inch drain may serve 200 dwelling units without exceeding a filling height of 40%, still providing significant spare capacity.

*Standard is defined here as consisting of 1 water closet, 1 lavatory, 1 combination bathtub shower, 1 kitchen sink, 1 dishwasher, and 1 clothes washer.

[Supporting documentation provided in KAVI for TC review]
Proposed Text:
704.0 Fixture Connections (Drainage).

704.3 Commercial Sinks. Pot sinks, scullery sinks, dishwashing sinks, silverware sinks, and other similar fixtures shall be connected by indirect waste pipe discharge into the building drainage system through an air gap into a floor sink.

Exception. Where a commercial sink is connected directly to the drainage system, a floor drain shall be provided adjacent to the fixture and shall be connected on the sewer side of the sink. No other drainage line shall be connected between the floor drain waste connection and the fixture drain. The fixture and floor drain shall be trapped and vented in accordance with this code.

SUBSTANTIATION:
There is a conflict between the UPC and health codes regarding warewashing sink waste. As an example, Section 114193(a) of the California Retail Food Code requires that "discharge liquid waste shall be drained by means of indirect waste pipes, and all wastes discharge through an airgap into a floor sink." Per Section 114193(e) of the California Retail Food Code, directly plumbed warewashing sinks are only allowed "when the local building official determines that the sink should be directly plumbed." A similar case is true with the FDA Food Code 2022 Section 5-402.11(A) which states, "...a direct connection may not exist between the sewage system and a drain originating from equipment in which food, portable equipment, or utensils are places."

In contrast, Section 704.3 of the UPC requires a commercial sinks (i.e. a warewashing sink) to be directly connected to the drainage system. This causes significant confusion over what method is acceptable.

The proposed revisions to the UPC align with food safety codes and will avoid confusion during design and inspection of commercial sink drainage.

[Supporting documentation provided in KAVI for TC review]
Proposed Text:

705.0 Joints and Connections.

705.1 ABS and ABS Co-Extruded Plastic Pipe and Joints.

705.1.1 Mechanical Joints. Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint. The push-on joint shall include an elastomeric gasket that complies with ASTM D3212 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal. Nonremovable push fit fittings that employ quick assembly push fit connectors shall be in accordance with ASME A112.4.4.

705.6 PVC and PVC Co-Extruded Plastic Pipe and Joining Methods.

705.6.1 Mechanical Joints. Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint type. The push-on joint shall include an elastomeric gasket that complies with ASTM D3212 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal. Nonremovable push fit fittings that employ quick assembly push fit connectors shall be in accordance with ASME A112.4.4.

Note: ASME A112.4.4 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The fittings are already allowed per code and this standard is referenced in Table 701.2. This change is for clarification purposes.
RECOMMENDATION:
Revise text

Proposed Text:

705.0 Joints and Connections.

705.6 PVC and PVC Co-Extruded Plastic Pipe and Joining Methods. (remaining text unchanged)

705.6.2 Solvent Cement Joints. 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 that complies with ASTM F656. Primer shall be applied to the surface of the pipe and fitting is softened. Solvent cement that comply 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.

Exception: A primer is not required where the following conditions apply:
(1) The solvent cement used complies with ASTM D2564.
(2) The solvent cement is used only for joining PVC drain, waste and vent pipe and fittings in nonpressure applications in sizes up to and including 4 inches (102 mm) in diameter.
(3) The joint is made in accordance with ASTM F3328.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F3328-2018</td>
<td>Standard Practice for the One-Step (Solvent Cement Only) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets</td>
<td>Joints</td>
<td>705.6.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3328 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
With the introduction of ASTM F3328-18 - Standard Practice for the One-Step (Solvent Cement Only) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets, the use of one-step PVC Cement is now acceptable. The ability to use a one-step PVC Cement on DWV application up to 4-inch will save millions of pounds (>450 Mg) of VOC (Volatile Organic Compound) from being released into the atmosphere. The required primers currently emit nearly 4.2 lbs./gallon (500 g/l). Along with lessening environmental damage, the cost to the plumbing contractor will be reduced in both labor savings and overall product cost. In addition, the potential for property damage due to the staining properties of Purple Primer will be eliminated.
Furthermore, various other local codes allow this method of solvent cementing joints.

[Supporting documentation provided in KAVI for TC review]
SUBMITTER: George Istefan
Organization Name: Watts Water Technologies
Organization Representation: Watts Water Technologies

RECOMMENDATION:
Revise text

Proposed Text:
705.0 Joints and Connections.

705.7 Stainless Steel Pipe and Joints.
705.7.1 Mechanical Joints. Mechanical joints between stainless steel pipe and fittings shall be of the compression, grooved coupling, push-fit, hydraulic press-connect fittings, or flanged.

SUBSTANTIATION:
With approval, this proposal would allow the use of an additional type of mechanical joint for sanitary drainage systems. Push-Fit connections have been approved for pressure applications for several years and are therefore suitable for non-pressure sanitary drainage applications. Included are examples of some of the different manufacturers of push-fit fitting systems.

Push-fit systems have also been used in marine sanitary drainage systems for many years and provide a secure connection system.
RECOMMENDATION:
Revise text

Proposed Text:
706.0 Changes in Direction of Drainage Flow.

706.4 Vertical to Horizontal. Vertical drainage lines connecting with horizontal drainage lines shall enter through 45 degree (0.79 rad) wye branches, combination wye and one-eighth bend branches, or other approved fittings of equivalent sweep. Branches or offsets of 60 degrees (1.05 rad) shall be permitted to be used where installed in a true vertical position. Quarter bends shall be permitted to be used for cleanouts on the end of horizontal branches.

SUBSTANTIATION:
Chapter 7 does not permit quarter bends to be used from both horizontal-to-horizontal and vertical-to-horizontal transitions, and unless of course it is serving one fixture drain that is 2 inch in pipe diameter and under. The proposal requests an exception to be added for a “quarter bend.” Quarter bends of any diameter can be used to serve floor cleanouts on the end of the line for horizontal branches. Typically cleanouts at the end of the line do not receive any waste, nor anything of that manner. This will save a lot of elevation when running DWV systems both in the air and in underground installations.
RECOMMENDATION:
Revise text

Proposed Text:
707.0 Cleanouts.

707.4 Location. (remaining text unchanged)

707.4.1 Load Rated Cover. Cleanout floor covers and top rims meant to take loads shall be rated for the loading in accordance with ASME A112.36.2M/CSA B79.2.

TABLE 707.2
CLEANOUT MATERIALS FOR DRAIN, WASTE, AND VENT

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>ASTM D2661, ASME A112.36.2/CSA B79.2, IAPMO IGC 78, IAPMO IGC 224</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>ASME A112.36.2M/CSA B79.2, ASTM A888, CISPI 301, CSA B79, IAPMO IGC 224</td>
</tr>
<tr>
<td>Copper or Copper Alloy</td>
<td>ASME A112.36.2M/CSA B79.2, CSA B79</td>
</tr>
<tr>
<td>Ductile Iron</td>
<td>ASME A112.36.2/CSA B79.2</td>
</tr>
<tr>
<td>Elastomers</td>
<td>ASME A112.36.2/CSA B79.2, IAPMO PS 90</td>
</tr>
<tr>
<td>Polyethylene (PE)</td>
<td>ASME A112.36.2/CSA B79.2</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>ASME A112.36.2/CSA B79.2</td>
</tr>
<tr>
<td>PVC</td>
<td>ASTM D2665, ASME A112.36.2/CSA B79.2, IAPMO IGC 78, IAPMO IGC 224</td>
</tr>
<tr>
<td>Polvynilidene Fluoride (PVDF)</td>
<td>ASME A112.36.2/CSA B79.2</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>ASME A112.36.2/CSA B79.2</td>
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</table>

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.36.2M/</td>
<td>Cleanouts</td>
<td>DWV Components</td>
<td>Table 707.2, 707.4.1</td>
</tr>
<tr>
<td>CSA B79.2 1991 (R2017) 2022</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.36.2/CSA B79.2 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The ASME A112.36.2 standard was harmonized with the CSA B79 standard. The proposed sections and tables are being updated to reflect the change.
Proposed Text:
708.0 Grade of Horizontal Drainage Piping.
708.1 General. Building drain and other horizontal drainage piping shall be run in practical alignment and a uniform slope of not less than $\frac{1}{4}$ inch per foot (20.8 mm/m) or 2 percent toward the point of disposal.

Where it is impractical due to the depth of the street sewer, structural features, or to the arrangement of a building or structure to obtain a slope of $\frac{1}{4}$ inch per foot (20.8 mm/m) or 2 percent, building drain piping 4 inches (100 mm) or larger in diameter shall be permitted to have a slope of not less than $\frac{1}{8}$ inch per foot (10.4 mm/m) or 1 percent, when first approved by the Authority Having Jurisdiction.

Building drain and other horizontal piping shall not exceed $\frac{1}{2}$ inch per foot (41.6 mm/m) or 3 percent slope.

SUBSTANTIATION:
The general rule is 1/4" of pitch per foot of run. An extreme amount of pitch can cause the waste water inside the drain to flow extremely fast where liquids will separate from solids, leaving solids behind in the pipe. This can be critical in the remote drains that are seldomly used - allowing “left behind solids” to dry up, and minimize cross sectional pipe area.
Proposed Text:

708.0 Grade of Horizontal Drainage Piping.

708.1 General. Building drain and other horizontal drainage piping shall be run in practical alignment and a uniform continuous slope of not less than $\frac{1}{4}$ inch per foot (20.8 mm/m) or 2 percent toward the point of disposal.

Where it is impractical due to the depth of the street sewer, structural features, or to the arrangement of a building or structure to obtain a slope of $\frac{1}{4}$ inch per foot (20.8 mm/m) or 2 percent, building drain piping 4 inches (100 mm) or larger in diameter shall be permitted to have a slope of not less than $\frac{1}{8}$ inch per foot (10.4 mm/m) or 1 percent, when first approved by the Authority Having Jurisdiction.

SUBSTANTIATION:

The term “uniform” is being replaced as it is overly stringent. Being uniform means to be the same. It is impractical to maintain a perfect slope as there will be spots were you deviate slightly from the required slope; however, you are always required to maintain a slope.
SUBMITTER: Grant Whittle
Organization Name: Nu Flow Technologies
Organization Representation: Self

RECOMMENDATION:
Add new text

Proposed Text:
708.0 Grade of Horizontal Drainage Piping.

708.2 Pipe Replacement. When pipe replacement is required, cured-in-place Pipe (CIPP) shall not be used for
restoring non-compliant grade. Existing flow obstructions, such as grease, scale, turbirculation, debris, sediment,
etc., shall be cleaned prior to CIPP lining to ensure compliance with the grade requirements of Section 708.1 and
with the sizing requirements of Section 703.0. Any obstructive grade deviations from piping misalignments shall be
reviewed after pipe cleaning, and repaired or replaced as required by the Authority Having Jurisdiction prior to
installing the CIPP.

SUBSTANTIATION:
The proposed change adds unique grade considerations pertaining to CIPP as a subsectoin of Section 708.0
(Grade Requirements).

The capabilities and limitations of CIPP lining projects in regards to restoring proper flow are widely misunderstood
by AHJs; they could benefit from additional UPC guidance within Section 708.0.

It is frequently not possible to identify the presence or absence of non-compliant grade prior to pipe cleaning,
especially with severe scaling or tuberculation. Such flow obstructions can cause pooling of water mimicking
apparent grade issues, however, the preparatory cleaning will frequently re-establish proper flow and reveal no
grade non-compliance of the pipe.

Substantiation documentation has been uploaded demonstrating the types of specialty piping equipment used to
clean scaling and tuberculation from inside of plumbing pipes, thereby helping to restore the proper flow line of the
existing piping.

However, plumbing contractors have also been known to improperly line pipes suffering from improper grade. If
improper grade is determined after cleaning, point repair or replacement to correct the grade may be required
before CIPP lining.

Minor grade deviations will generally not preclude a CIPP lined pipe from achieving code compliant flow
characteristics. The increased scouring velocity generally precludes further debris fall-out and sedimentation. The
CIPP likewise tends to reduce grease and scale deposits, while protecting metal pipes from corrosion, scaling, &
tuberculation. In fact, CIPP lining has also been known to help correct solids sedimentation issues from low grade
installations exacerbated by over-capacity pipe sizing and modern low flow fixtures.

A flow capacity analysis has also been uploaded comparing the flow characteristics before and after lining. The
analysis makes it clear that DFU volume capacities are not lost with typical CIPP liner thicknesses. Where new pipe
is being lined, the CIPP material Manning’s coefficient of 0.009 was used in the analysis. Where aged pipe is being
lined, a more conservative 0.010 coefficient is used in the analysis, to account for tight conformance to the
inherently rougher surface (even after cleaning) of the aged pipe materials.
Furthermore, actual DFU design is conservatively based upon iron pipe flow data regardless of the pipe type. Comparing CIPP to standard DFU pipe capacity design, CIPP restores the expected DFU capacity and the scouring velocities increase significantly, resulting in less issues with sedimentation of solids.

[Supporting documentation provided in KAVI for TC review]
**Proposed Text:**

710.0 Drainage of Fixtures Located Below the Next Upstream Manhole or Below the Main Sewer Level.

710.6 Backwater Valves. Backwater valves, gate valves, fullway ball valves, unions, motors, compressors, air tanks, and other mechanical devices required by this section shall be located where they will be accessible for inspection and repair and, unless continuously exposed, shall be enclosed in a masonry pit fitted with an adequately sized removable cover.

Backwater valves shall comply with ASME A112.14.1, CSA B70, CSA B181.1, CSA B181.2, or IAPMO IGC 305, and have bodies of cast-iron, plastic, copper alloy, or other approved materials; shall have noncorrosive bearings, seats, and self-aligning discs; and shall be constructed to ensure a positive mechanical seal. Such backwater valves shall remain open during periods of low flows to avoid screening of solids and shall not restrict capacities or cause excessive turbulence during peak loads. Unless otherwise listed, valve access covers shall be bolted type with gasket, and each valve shall bear the manufacturer's name cast into the body and the cover.

**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B70-2019</td>
<td>Cast iron soil pipe, fittings, and means of joining</td>
<td>Backwater Valve</td>
<td>710.6</td>
</tr>
<tr>
<td>CSA B181.1-2024</td>
<td>Acrylonitrile-Butadiene-Styrene (ABS) Drain, Waste, and Vent Pipe and Pipe Fittings</td>
<td>Backwater Valve</td>
<td>710.6</td>
</tr>
<tr>
<td>CSA B181.2-2024</td>
<td>Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Drain, Waste, and Vent Pipe and Pipe Fittings</td>
<td>Backwater Valve</td>
<td>710.6</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

**Note:** CSA B70, CSA B181.1 and CSA B181.2 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The proposed change adds appropriate standards for backwater valves. The scopes for the standards referenced are as follows:

CSA B70 – Scope 1.1 This Standard covers cast iron soil pipe and fittings for installation in gravity-flow plumbing systems inside and outside of buildings, above and below grade. 1.2 This Standard covers requirements for cast iron soil pipe, fittings, backwater valves, and means of joining these components, including dimensions, material specifications, crush strength, pressure testing, and marking.
CSA B181.1 – Scope 1.1 General This Standard specifies requirements for acrylonitrile-butadiene-styrene (ABS) drain, waste, and vent (DWV) pipe, pipe fittings, and accessories such as factory-assembled expansion joints, closet flanges, and backwater valves.

CSA B181.2 – Scope 1.1 General This Standard specifies requirements for polyvinylchloride (PVC) and chlorinated polyvinylchloride (CPVC) drain, waste, and vent (DWV) pipe, pipe fittings, and accessories such as factory-assembled expansion joints, closet flanges, backwater valves, and fire-stop fittings.
710.0 Drainage of Fixtures Located Below the Next Upstream Manhole or Below the Main Sewer Level.

C-501.0 Vacuum Drainage Systems.

C-501.1 General. This section regulates the design and installation provisions for vacuum waste drainage systems. Plans for vacuum waste drainage systems shall be submitted to the Authority Having Jurisdiction for approval and shall be considered an engineered designed system. Such plans shall be prepared by a registered design professional to perform plumbing design work. Details are necessary to ensure compliance with the requirements of this section, together with a full description of the complete installation including quality, grade of materials, equipment, construction, and methods of assembly and installation. Components, materials, and equipment shall comply with standards and specifications listed in Chapter 17 of this code or approved by the Authority Having Jurisdiction and other national consensus standards applicable to plumbing systems and materials. Where such standards and specifications are not available, alternate materials and equipment shall be approved in accordance with Section 301.3.

C-501.2 System Design. Vacuum waste drainage systems shall be designed and installed in accordance with the manufacturer’s installation instructions. A vacuum waste drainage system shall include a vacuum generating system, waste collection center, piping network, vacuum valve, and control components used to isolate the vacuum piping network from atmospheric pressure and to collect waste at its point of origin. Where a vacuum system provides the only means of sanitation, the duplicate vacuum generating equipment set to operate automatically shall be installed to allow the system to continue in operation during periods of maintenance.

C-501.2.1 Vacuum Generating System. The vacuum generating station shall include vacuum pumps to create a constant vacuum pressure within the piping network and storage tanks. The operation of pumps, collection tanks, and alarms shall be automated by controls. The vacuum pumps shall be activated on demand and accessible for repair or replacement. The vent from the vacuum pump shall be provided for vacuum pump air exhaust and shall be of a size capable of handling the total air volume of the vacuum pump.

C-501.2.2 Waste Collection Center or Storage Tanks. Vacuum collection center or storage tanks shall be of such capacity as to provide storage of waste to prevent fouling of the system. Such collection or storage tank shall be capable of withstanding 150 percent of the rated vacuum (negative pressure) created by the vacuum source without leakage or collapse. Waste collection center or storage tanks shall be accessible for adjustment, repair, or replacement.

C-501.2.3 Piping Network. The piping network shall be under a continuous vacuum and shall be designed to withstand 150 percent of the vacuum (negative pressure) created by the vacuum source within the system without leakage or collapse. Sizing the piping network shall be in accordance with the manufacturer’s instructions. The water closet outlet fitting shall connect with a piping network having not less than an $1\frac{1}{2}$ inch (40 mm) nominal inside diameter.

C-501.2.4 Vacuum Interface Valve. A closed vacuum interface valve shall be installed to separate the piping network vacuum from atmospheric pressure. A control device shall open the vacuum interface valve where a signal is generated to remove waste from the plumbing fixture.

C-501.2.5 Control Components. Where a pneumatic signal is generated at the controller, a vacuum from
the system to open the extraction valve shall be designed to operate where vacuum pressure exists to remove the accumulated waste. Each tank shall incorporate a level indicator switch that automatically controls the discharge pump and warns of malfunction or blockage as follows:

(1) Start discharge.
(2) Stop discharge.
(3) Activate an audible alarm where the level of effluent is usually high.
(4) Warning of system shutdown where the tank is full.

C 501.3 710.14.3 Fixtures. Fixtures utilized in a vacuum waste drainage system shall be in accordance with referenced standards listed in Chapter 17. Components shall be of corrosion resistant materials. The water closet outlet shall be able to pass a 1 inch (25.4 mm) diameter ball and shall have a smooth, impervious surface. The waste outlet and passages shall be free of obstructions, recesses, or chambers that are capable of permitting fouling. The mechanical valve and its seat shall be of such materials and design to provide a leakfree connection where at atmospheric pressure or under vacuum. The flushing mechanism shall be so designed as to ensure proper cleansing of the interior surfaces during the flushing cycle at a minimum operating flow rate. Mechanical seal mechanisms shall withdraw completely from the path of the waste discharge during the flushing operation. Each mechanical seal vacuum water closet shall be equipped with a listed vacuum breaker. The vacuum breaker shall be mounted with the critical level or marking not less than 1 inch (25.4 mm) above the flood-level rim of the fixture. Vacuum breakers shall be installed on the discharge side of the last control valve in the potable water supply line and shall be located to be protected from physical damage and contamination.

C 501.4 710.14.4 Drainage Fixture Units. Drainage fixture units shall be determined by the manufacturer’s instructions. The pump discharge load from the collector tanks shall be in accordance with this appendix.

C 501.5 710.14.5 Water Supply Fixture Units. Water supply fixture units shall be determined by the manufacturer’s instructions.

C 501.6 710.14.6 Materials. Materials used for water distribution pipe and fittings shall be in accordance with Table 604.1. Materials used for aboveground drainage shall be in accordance with Table 701.2 and shall have a smooth bore, and be constructed of non-porous material.

C 501.7 710.14.7 Traps and Cleanouts. Traps and cleanouts shall be installed in accordance with Chapter 7 and Chapter 10.

C 501.8 710.14.8 Testing. The entire vacuum waste system shall be subjected to a vacuum test of 29 inches of mercury (98 kPa) or not less than the working pressure of the system for 30 minutes. The system shall be gastight and watertight at all points. Verification of test results shall be submitted to the Authority Having Jurisdiction.

C 501.9 710.14.9 Manufacturer’s Instructions. Manufacturer’s instructions shall be provided to provide information regarding safe and proper operating instructions whether or not as part of the condition of listing to determine compliance. Such instructions shall be submitted and approved by the Authority Having Jurisdiction.

(renumber remaining sections)

SUBSTANTIATION:

This new section is intended to move vacuum drainage systems from Appendix C to Chapter 7. Vacuum drainage systems are a vital part of the DWV system for many commercial buildings where an occupant often times have to arrange freezers, coolers and other appliances in order to restructure based on need. Vacuum drainage should not be considered an alternate design as these systems are more common and should be included in Chapter 7 to ensure installers are trained and familiar with their installation and components required.
711.0 Suds Relief.

711.1 General. Drainage connections shall not be made into a drainage piping system within 8 feet (2438 mm) in all directions of a vertical to horizontal change of direction of a stack containing suds-producing fixtures. Bathtubs, laundries, washing machine standpipes, kitchen sinks, and dishwashers shall be considered suds-producing fixtures. Where parallel vent stacks are required, they shall connect to the drainage stack at a point 8 feet (2438 mm) above the lowest point of the drainage stack.

Exceptions:
(1) Single-family residences.
(2) Stacks receiving the discharge from less than three stories of plumbing fixtures.

SUBSTANTIATION:
The distance requirement is 8 feet in all directions from the vertical to horizontal change in direction. The horizontal branches do not have a restriction. The addition of this phrase will clarify the vicinity intended for these provisions.
712.0 Testing.

712.1 Drainage and Vent Media. The piping of the plumbing, drainage, and venting systems shall be tested with water or air except that plastic pipe shall not be pressure tested with air. The Authority Having Jurisdiction shall be permitted to require the removal of cleanouts, etc., to ascertain whether the pressure has reached all parts of the system. After the plumbing fixtures have been set and their traps filled with water, they shall be submitted to a final test.

712.2 Drainage and Vent Water Test. The water test shall be applied to the drainage and vent systems either in its entirety or in sections. Where the test is applied to the entire system, openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. Where the system is tested in sections, each opening shall be tightly plugged, except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10 foot head of water (30 kPa). In testing successive sections, not less than the upper 10 feet (3048 mm) of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 feet (3048 mm) of the system) shall have been submitted to a test of less than a 10 foot head of water (30 kPa). The water shall be kept in the system, or in the portion under test, for not less than 15 minutes before inspection starts. The system shall then be tight at all points.

712.3 Drainage and Vent Air Test. Plastic piping shall not be pressure tested using air. The air test shall be made by attaching an air compressor testing apparatus to a suitable opening and, after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 5 pounds-force per square inch (psi) (34 kPa) or sufficient to balance a column of mercury 10 inches (34 kPa) in height. The pressure shall be held without the introduction of additional air for a period of not less than 15 minutes.

712.4 Drainage and Vent Vacuum Test. The vacuum test on the drainage and vent system shall evacuate the air by use of a vacuum-type pump to achieve a uniform gauge pressure of -5 pounds per square inch or -10 inches of mercury column (-34 kPa). This vacuum shall be held without the removal of additional air for a period of not less than 15 minutes. Plastic pipe shall be permitted to be vacuum tested.

SUBSTANTIATION:
Section 712.3 (Drainage and Vent Air Test) is being updated. Plastic piping is not intended to be pressurized by air. It is a dangerous practice as the pipe can explode. While the verbiage already exists in Section 712.1 (Media), it is not readily visible when searching for “air test” methods of the DWV system. This will assist a person inadvertently testing plastic with air.

A new section 712.4 (Drainage and Vent Vacuum Test) is being added to add a vacuum test. There are parts of the nation prone to freezing conditions where water testing is not feasible. Additionally, air tests on plastic piping is dangerous and should not be attempted. Vacuum testing of the drainage and vent plumbing system can be a third method that will permit testing in freezing conditions, also it is a safe method of testing plastic piping. This practice of testing has been permitted to be used in many jurisdictions and is missing from this code.
SUBMITTER: Grant Whittle
Organization Name: Nu Flow Technologies
Organization Representation: Nu Flow Technologies

RECOMMENDATION:
Revise text

Proposed Text:
715.0 Building Sewer Materials.

715.3 Existing Sewers. (remaining text unchanged)

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, or ASTM F2599, or ASTM F3240.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>ASTM F2599-2020</td>
<td>Standard Practice for the Sectional Repair of Damaged Pipe by Means of an Inverted Cured-In-Place Liner</td>
</tr>
<tr>
<td>ASTM F3240-2019</td>
<td>Standard Practice for Installation of Seamless Molded Hydrophilic Gaskets (SMHG) for Long-Term Watertightness of Cured-in-Place Rehabilitation of Main and Lateral Pipelines</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASTM F2599 standard meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

<table>
<thead>
<tr>
<th>TABLE 1701.2</th>
<th>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOCUMENT NUMBER</td>
<td>DOCUMENT TITLE</td>
</tr>
<tr>
<td>ASTM F3240-2019 (R2023)</td>
<td>Standard Practice for Installation of Seamless Molded Hydrophilic Gaskets (SMHG) for Long-Term Watertightness of Cured-in-Place Rehabilitation of Main and Lateral Pipelines</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The proposed change removes ASTM F3240 from Section 715.3.1 (Sewer Pipe Lining) and relocated the standard to Table 1701.2 (Standards, Publications, Practices, and Guides) for reference. Additionally, the change update ASTM F2599 to the latest edition (2022).
ASTM F3240 is the gasket standard referenced within ASTM F2561 and ASTM F2599 standards for Cured-in-Place Pipe (CIPP) and is not a pipe lining standard.

No product has ever been certified by IAPMO R&T to ASTM F3240 [nor to the associated CIPP standards, ASTM F2561 or ASTM F2599, which reference ASTM F3240]. Please review the screen captures from the IAPMO R+T Listing Directory provided as supporting documents.

All CIPP lining products, including those claiming to comply with these standards, are (and likely will be) certified by IAPMO R&T to the performance requirements contained within either ASTM F1216 or ASTM F1743.

As no products have been certified and listed by IAPMO R&T for code compliant usage, we recommend that ASTM F3240 be removed from Section 715.3.1 and relocated from Table 1701.1 to Table 1701.2; products will still have the opportunity to prospectively be certified and listed to this standard, and CIPP products still have the opportunity to be certified and listed to the performance requirements of the relevant CIPP standards (including ASTM F2561 & ASTM F2599) still referenced within Section 715.3.1.
SUBMITTER: Grant Whittle
Organization Name: Nu Flow Technologies
Organization Representation: Nu Flow Technologies

RECOMMENDATION: Revise text

Proposed Text:
715.0 Building Sewer Materials.

715.3 Existing Sewers. (remaining text unchanged)

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, or ASTM F3240, or ASTM F3541.

TABLE 1701.1
REFERREDenced STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F3541-2022</td>
<td>Standard Practice for Sectional Repair of Existing Gravity Flow, Non-Pressure Pipelines and Conduits by Pushed or Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping</td>
<td>715.3.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3541 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed change adds ASTM F3541, the new ASTM standard for sectional lining with CIPP utilizing push or pull-in-place installation practices. This practice is widely employed for plumbing pipe repair and most closely reflects one of the most common installation practices routinely utilized in the plumbing sector.
ITEM #: 156  
CODE NUMBER: 2024 UPC  
SECTION NUMBER: 715.3.1, Table 1701.1

SUBMITTER: Sidney Cavanaugh  
ORGANIZATION NAME: Cavanaugh Consulting  
ORGANIZATION REPRESENTATION: Cavanaugh Consulting

RECOMMENDATION: Revise text

PROPOSED TEXT:
715.0 Building Sewer Materials.

715.3 Existing Sewers. (remaining text unchanged)
715.3.1 Sewer Pipe Lining. For trenchless installations of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, or ASTM F3541 used in combination with gaskets/o-rings complying with ASTM F3240.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F3541-2022</td>
<td>Wastewater Standard Practice for Sectional Repair of Existing Gravity Flow, Non-Pressure Pipelines and Conduits by Pushed or Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping</td>
<td>715.3.1</td>
</tr>
</tbody>
</table>

(remainders of table not shown remain unchanged)

NOTE: ASTM F3541 meets the requirements for mandatory a referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
ASTM F3541 is used for sectional repair and rehabilitation using CIPP (cured-in-place-pipe). ASTM F3240 is referenced in ASTM F2561 and ASTM F2599 as it provides a superior sealing mechanism and should be used in all applications of CIPP to avoid water infiltration and exfiltration and to ensure water tightness at the ends of the lining material.
715.3 Existing Sewers. (remaining text unchanged)

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, ASTM F3541 and ASTM F3240. Inspection shall include a pre-installation video camera survey, a test in accordance with Section 712.0, and a post-installation recorded video camera survey.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
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<td>ASTM F3541-2022</td>
<td>Standard Practice for Sectional Repair of Existing Gravity Flow, Non-Pressure Pipelines and Conduits by Pushed or Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping</td>
<td>715.3.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3541 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
ASTM F3541 is used for sectional repair and rehabilitation using CIPP (Cured-in-place-pipe). The "or" is being deleted as ASTM F3240 is referenced in all the other standards currently referenced in the code and should be used in all applications of CIPP to avoid ground water penetration and ensure water tightness at the ends of the lining material. Inspection requirements need to be added to assure compliance with referenced standards, this code and proper installation.
715.0 Building Sewer Materials.

715.3 Existing Sewers. Where permitted by the Authority Having Jurisdiction, trenchless methods of rehabilitation of existing building sewer and building storm sewers shall be installed in accordance with Section 715.3.1 or Section 715.3.2.

715.3.1 Sewer Pipe Lining. For trenchless installation of cured-in-place pipe (CIPP), resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, or ASTM F3541. Installation of seamless molded hydrophilic gaskets in CIPP shall be in accordance with ASTM F3240. CIPP materials shall be manufactured in compliance with applicable standards and certified as required in Section 301.2.

205.0 – C –

Cured-In-Place Pipe (CIPP). A rehabilitation method used to repair existing pipelines by inserting and curing a resin-saturated flexible tube inside of damaged piping to repair leaks, cracks, and other defects.

<table>
<thead>
<tr>
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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
<tbody>
<tr>
<td>ASTM F1216-2022</td>
<td>Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube</td>
<td>Piping</td>
<td>715.3.1</td>
</tr>
<tr>
<td>ASTM F3541-2022</td>
<td>Standard Practice for Sectional Repair of Existing Gravity Flow, Non-Pressure Pipelines and Conduits by Pushed or Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping</td>
<td>715.3.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:

As is the case with all plumbing-related pipe, materials, fittings and fixtures, in order to ensure quality and appropriateness for the intended use, relining materials must be manufactured in accordance with an industry standard. The inclusion of ASTM F3541 provides requirements for the installation of CIPP when using the pushed or pulled-in-place installation method.

The scope of ASTM F3240 covers the requirements for the installation of seamless molded hydrophilic gaskets in CIPP rehabilitation of main and lateral pipelines. This standard does not cover the installation of CIPP and is clarified with the proposed change. The 2022 update to ASTM F1216 and the addition of ASTM F3541 are written using mandatory language.
Additionally, the definition for Cured-In-Place (CIPP) is needed for industry term proposed to be included in Section 715.3.1 (Sewer Pipe Lining) and Section 701.2(7) (Drainage Piping) for clarity and cross-reference with mandatory referenced standards.
Proposed Text:

715.0 Building Sewer Materials.

715.3 Existing Sewers. (remining text unchanged)

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, ASTM F3541, and/or ASTM F3240.

Sectional cure-in-place rehabilitation of building sewer piping and sewer service lateral piping shall be in accordance with ASTM F2599 and ASTM F3541. Main and lateral cure-in-place rehabilitation of building sewer and sewer service lateral pipe and their connection to the Main sewer pipe shall be in accordance with ASTM F2561. Hydrophilic rings or gaskets shall be used in any cure-in-place rehabilitation of building sewer piping and sewer service laterals and they shall be in accordance with ASTM F3240 to ensure water tightness and elimination of ground water penetration.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>ASTM F3541-2022</td>
<td>Standard Practice for Sectional Repair for Existing Gravity Flow, Non-Pressure Pipelines and Conduits by Pushed or Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping</td>
<td>715.3.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:

It is not only important to list appropriate standards in the code but to also clarify their application and use in the code. This change will require appropriate standards are used for their intended purpose which will help installers and inspectors.
SUBMITTER: Grant Whittle
Organization Name: Nu Flow Technologies
Organization Representation: Nu Flow Technologies

RECOMMENDATION:
Revise text

Proposed Text:

715.0 Building Sewer Materials.

715.3 Existing Sewers. (remaining text unchanged)

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F1743, ASTM F2561, ASTM F2599, or ASTM F3240.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F1743-2022</td>
<td>Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-inPlace Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping</td>
<td>715.3.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F1743-2022 does not meet the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F1743-2017</td>
<td>Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled in Place Installation of Cured in Place Thermosetting Resin Pipe (CIPP)</td>
<td>Piping, Plastic</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:

With the pending, expected 2024 revision of ASTM F1743 to bring it into compliance with IAPMO mandatory language requirements, we propose adding the expected, revised, compliant version to Table 1701.1 (and therefore also removing it from Table 1701.2).

Note: Pending revision, the current version is ASTM F1743-2022 and Table 1701.1 should reflect this update if ASTM F1743-2024 does not get passed in time for inclusion.

With the permission from the ASTM Staff for Committee F17, a draft copy of ASTM F1743-2024 (DRAFT) has been provided for the Technical Committee (TC) review.
Proposed Text:

715.0 Building Sewer Materials.

715.3 Existing Sewers. Where permitted by the Authority Having Jurisdiction, trenchless methods of rehabilitation of existing building sewers and building storm sewers shall be installed in accordance with Section 715.3.1 or Section 715.3.2.

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing cured-in-place pipe (CIPP) to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, or ASTM F3240.

205.0 - C -
Cured-in-Place Pipe (CIPP). A piping system consisting of resin-impregnated flexible tubing used to rehabilitate existing pipe in-place by insertion and cure within an existing pipe.

218.0 - P -
Pipe Bursting. A pipe replacement method that involves breaking and displacing the existing buried piping while simultaneously replacing it with new pipe.

(Shown for information purposes only)

715.3.2 Sewer Pipe Replacement. For trenchless installation of polyethylene (PE) pipe using the pipe bursting method to replace existing building sewers and building storm sewers materials shall be in accordance with ASTM F714.

SUBSTANTIATION:

Cured-in-Place Pipe (CIPP) is the familiar terminology to many plumbing professionals. Cured-in-Place Pipe (CIPP) is the technology included in Section 715.3.1 Sewer Pipe Lining. Adding a definition to 202 will provide greater clarity for its usage within the UPC, especially with the frequent confusion with Pipe bursting in Section 715.3.2.

Updating the language of Section 715.3.1 to use the newly defined term, Cured-in-Place Pipe, will provide needed clarity.

Pipe Bursting is included in Section 715.3.2 Sewer Pipe Replacement. A definition in 202 would provide additional clarity. The proposed language is a simplified definition adapted from an USEPA publication on pipe bursting. See support document (p.1 General Description).

[Supporting documentation provided in KAVI for TC review]
Proposed Text:

715.0 Building Sewer Materials.

715.4 Inspection for CIPP Relining.
715.4.1. Preinstallation requirements. Prior to commencement of the relining installation, the existing piping sections to be relined shall be descaled and cleaned. After the cleaning process has occurred and water has been flushed through the piping, the piping shall be inspected internally by a recorded video camera survey. The video camera survey shall include verification of the project address, notations of cleanout and fitting locations, and approximate depth of the existing piping. No permit shall be issued until the code official has evaluated the preinstallation video camera survey to determine if the piping is able to be relined in accordance with the proposed lining system manufacturer’s installation requirements and the applicable referenced standards.
715.4.2. Installation and Testing. The installation of the relining material shall be installed in accordance with the manufacturer’s installation instructions, applicable referenced standards, this code and tested in accordance with Section 712.0.
715.4.3 Post-Installation Requirements. The completed, relined piping shall be inspected internally by a recorded video camera survey. The video shall be submitted to the code official prior to finalization of the permit. A certification shall be provided in writing to the code official, from the permit holder, that the relining materials have been installed in accordance with the manufacturers installation instructions, the applicable standards and this code.

SUBSTANTIATION:
It is critical that inspection requirements for CIPP rehabilitation be added to the code as there is currently confusion over this issue with inspectors and installers.
SUBMITTER:  
Sidney Cavanaugh  

Organization Name:  
Cavanaugh Consulting  

Organization Representation:  
Cavanaugh Consulting  

RECOMMENDATION:  
Revise text  

Proposed Text:  
715.0 Building Sewer Materials.  

715.3 Existing Sewers. (remaining text unchanged)  

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, or ASTM F3240. *The cured-in-place-pipe (CIPP) installation shall be inspected by personnel certified in accordance with ASSE/IAPMO 28020.*  

TABLE 1701.1  
REFERENCED STANDARDS  

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ASSE 28020-202X</td>
<td>Professional Qualifications Standard for Inspectors of CIPP (Cured-in-Place-Pipe). Rehabilitation of Building Sewer and Drain, Waste and Vent Piping Systems.</td>
<td>Professional Qualifications</td>
<td>715.3.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)  

Note: IAPMO/ASSE 28020 is a working draft and is not completed at the time of this monograph.  

SUBSTANTIATION:  
It is critical that CIPP systems/rehabilitation inspections be performed by qualified inspectors who will know and understand all requirements needed for proper use of appropriate standards and installation of CIPP. This new standard will assure that.
RECOMMENDATION:
Add new text

Proposed Text:
715.0 Building Sewer Materials.

715.3 Existing Sewers. (remaining text unchanged)

715.3.1 Sewer Pipe Lining. For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, ASTM F3541, and ASTM F3240.
Sectional cure-in-place rehabilitation of building sewer piping and sewer service lateral piping shall be in accordance with ASTM F2599 and ASTM F3541. Main and lateral cure-in-place rehabilitation of building sewer and sewer service lateral pipe and their connection to the Main sewer pipe shall be in accordance with ASTM F2561. Hydrophilic rings or gaskets shall be used in any cure-in-place rehabilitation of building sewer piping and sewer service laterals and they shall be in accordance with ASTM F3240 to ensure water tightness and elimination of ground water penetration.

715.4 Inspection for CIPP relining. The cured-in-place-pipe (CIPP) installation shall be inspected by personnel certified in accordance with ASSE/IAPMO 28020. Inspection shall include pre installation video camera survey, a pressure test per Section 712.0, and a post-installation recorded video camera survey.
715.4.1. Preinstallation requirements. Prior to commencement of the relining installation, the existing piping sections to be relined shall be descaled and cleaned. After the cleaning process has occurred and water has been flushed through the piping, the piping shall be inspected internally by a recorded video camera survey. The video camera survey shall include verification of the project address, notations of cleanout and fitting locations, and approximate depth of the existing piping. No permit shall be issued until the code official has evaluated the preinstallation video camera survey to determine if the piping is able to be relined in accordance with the proposed lining system manufacturers installation requirements and the applicable referenced standards.

715.4.2. Testing. The installation of the relining material shall be installed in accordance with the manufacturer’s installation instructions, applicable referenced standards, this code and tested in accordance with Section 712.0. 715.4.3 Post-installation requirements. The completed, relined piping shall be inspected internally by a recorded video camera survey. The video shall be submitted to the code official prior to finalization of the permit. A certification shall be provided in writing to the code official, from the permit holder, that the relining materials have been installed in accordance with the manufacturer’s installation instructions, the applicable standards and this code.

TABLE 1701.1
REFERENCED STANDARDS

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<tr>
<td>IAPMO/ASSE 28020-202X</td>
<td>Professional Qualifications Standard for Inspectors of CIPP (Cured-in-Place-Pipe) Rehabilitation of Building Sewer and Drain, Waste</td>
<td>Professional Qualifications</td>
<td>715.4</td>
</tr>
</tbody>
</table>
Note: IAPMO/ASSE 28020 is a working draft and is not completed at the time of this monograph.

Note: ASTM F2561, ASTM F2599, ASTM F3240, and ASTM F3541 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
This code change incorporates neccessary changes to improve Section 715.3.1. It adds necessary inspections and inspector requirements and clarifies the use of each referenced standard currently in the code.
Item #: 165  
Code Number: 2024 UPC  
Section Number: 801.3.4  

SUBMITTER: Dave Svoboda  
Organization Name: Clark County Building Dept.  
Organization Representation: Plans Examination  

RECOMMENDATION:  
Add new text  

Proposed Text:  

801.0 General.  
801.3 Food and Beverage Handling Establishments. (remaining text unchanged)  

801.3.4 Floor Sinks. Flood level rim of floor sinks shall be installed with the finished floor, sealed with no gaps, and shall be accessible for cleaning.  

SUBSTANTIATION:  
The intent is to stay consistant with local health district requirements. For what ever reason the installation of a floor sink in relation to health district requirements has been a problem in our area. Floor sinks installed too low or too high are being failed by health inspection, and are being re-installed at the proper elevation, causing unwanted material and labor costs. Adding this specific language to the code will clearly state the proper installation practice.
Proposed Text:

804.0 Indirect Waste Receptors.

804.1 Standpipe Receptors. Plumbing fixtures or other receptors receiving the discharge of indirect waste pipes shall be approved for the use proposed and shall be of such shape and capacity as to prevent splashing or flooding and shall be located where they are readily accessible for inspection and cleaning. No standpipe receptor for a clothes washer shall extend more than 30 inches (762 mm), or not less than 18 inches (457 mm) above its trap weir. No trap for a clothes washer standpipe receptor shall be installed below the floor, but shall be roughed in not less than 6 inches (152 mm) and not more than 18 inches (457 mm) above the floor. No indirect waste receptor shall be installed in a toilet room, closet, cupboard, or storeroom, or in a portion of a building not in general use by the occupants thereof; except standpipes for clothes washers shall be permitted to be installed in toilet and bathroom areas where the clothes washer is installed in the same room.

Indirect waste piping, other than the discharge from the clothes washer, shall be permitted to terminate into a listed clothes washer box. The second port, on a multiport box shall be permanently connected to the vertical receptor standpipe via a wye branch fitting.

SUBSTANTIATION:
The proposed change will clarify the requirements for the various forms of relief lines and condensate discharge. The 2nd port on a multi-port washer box should be permanently connected to the drainage system to eliminate the potential of a flood by indirect waste being tied into the wrong side of the washer box.
807.3 Domestic Dishwashing Machine. No domestic dishwashing machine shall be directly connected to a drainage system or food waste disposer without the use of an approved dishwasher air gap fitting on the discharge side of the dishwashing machine. Listed dishwasher air gap fittings shall be installed with the flood-level (FL) marking at or above the flood level of the sink or drainboard, whichever is higher. Direct connection to the drainage system shall be on the fixture tailpiece, upstream of the fixture trap. No connections shall be made to the trap arm unless the connection is protected by a backflow preventor.

SUBSTANTIATION:
There seems to be confusion on where a dishwashing machine is required to connect to the drainage system. This text will add clarity on such installations. Connections should be before the trap as there are no sewer gases present before the trap. If a connection is made after the trap, it would tie into the open drainage systems and allow sewer gases to enter that connection. Such connection is prohibited and is a health concern. This added text will assist the end users to make the appropriate connections.
811.0 Chemical Wastes.

811.2 Waste and Vent Pipes. Each waste pipe receiving or intended to receive the discharge of a fixture into which acid or corrosive chemical is placed, and each vent pipe connected thereto, shall be constructed of chlorinated polyvinyl chloride (CPVC), polypropylene (PP), polyvinylidene fluoride (PVDF), chemical-resistant glass, high-silicon iron pipe, or lead pipe with a wall thickness of not less than \( \frac{1}{8} \) of an inch (3.2 mm); an approved type of ceramic glazed or unglazed vitrified clay; or other approved corrosion-resistant materials. CPVC pipe and fittings shall comply with ASTM F2618. PP pipe and fittings shall comply with ASTM F1412 or CSA B181.3. PVDF pipe and fittings shall comply with ASTM F1673 or CSA B181.3. Chemical-resistant glass pipe and fittings shall comply with ASTM C1053. High-silicon iron pipe and fittings shall comply with ASTM A861 or ASTM A518.

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(portions of table not shown remain unchanged)

Note: ASTM A518 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The proposed change adds an additional recognized standard for high-silicon-iron for chemical waste. The scope of the standard is as follows: This specification covers high-silicon cast iron castings intended for corrosion-resistant service. 1.2 This specification covers three grades. Selection of grade depends on the corrosive service to be experienced by the casting. All three grades are suited for application in severe corrosive environments. However, Grade 2 is particularly suited for application in strong chloride environments, and Grade 3 is recommended for impressed current anodes.
RECOMMENDATION:
Revise text

Proposed Text:
901.0 General.

901.2 Vents Required. Each plumbing fixture trap, except as otherwise provided in this code, shall be protected against siphonage and backpressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vent pipes to the outdoors installed in accordance with the requirements of this chapter and as otherwise required by this code.

SUBSTANTIATION:
This further clarifies that all plumbing fixtures are protected against siphonage and backpressure with vents that terminate to the outdoors.
RECOMMENDATION:
Revise text

Proposed Text:
901.0 General.

901.2 Vents Required. **Every** plumbing fixture trap, except as otherwise provided in this code, shall be protected against siphonage and backpressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vent pipes installed in accordance with the requirements of this chapter and as otherwise required by this code.

SUBSTANTIATION:
This change is clerical in nature, however, will add clarity that the section is speaking on all plumbing fixture traps.
RECOMMENDATION:
Revise text

Proposed Text:
902.0 Vents Not Required.
902.1 Interceptor. Vent piping shall be permitted to be omitted on an interceptor where such interceptor has a path for the air to travel through the interceptor acts as a primary settling tank and discharges through a horizontal indirect waste pipe into a secondary interceptor. Otherwise, all interceptors that do not have internal vent passageways shall be properly trapped and vented.

SUBSTANTIATION:
This language clarifies that all ASME compliant interceptors have a path for air to go through the interceptors. Site-built concrete interceptors may not always have a path for air to vent through the interceptor, and in those cases they may need to be vented properly. Traps should not be installed on interceptors.
REVISE TEXT

Proposed Text:
903.0 Materials.
903.1 Applicable Standards. Vent pipe and fittings shall comply with the applicable standards referenced in Table 701.2, except that:

(1) - (2) (remaining text unchanged)

(3) Cured-in-place pipe (CIPP) installations shall be listed and certified in accordance with Section 301.2 and installed in accordance with applicable standards referenced in Table 701.2. When the existing pipe is broken or breached inside a duct or plenum, the existing pipe shall be repaired before CIPP is installed so that the CIPP is not exposed.

SUBSTANTIATION:
Incorporating CIPP into Section 903.1 (Applicable Standards) will make the additional UPC performance requirements for CIPP to be installed within building vent pipes and fittings much clearer to AHJs; lack of inclusion currently results in no guidance. With the proposed language, all existing code requirements for vent piping materials will govern (such as fire safety compliance within ducts and plenums); only CIPP installed to comply with the UPC requirements can be permitted for building DWV piping applications.

In a separate but related proposal, ASTM F1216-2022, ASTM F2561, ASTM F2599, and the new ASTM F3541-2022 are proposed to be added to Table 701.2 for broader DWV applications. The expected new edition of ASTM F1743-2024 with UPC compliant mandatory language is also proposed for inclusion if completed in time.
905.0 Vent Pipe Grades and Connections.

905.2 Horizontal Drainage Pipe. Where dry vents connect to a horizontal drainage pipe, each vent pipe shall have its invert taken off above the drainage centerline. The dry vent shall connect downstream of the fixture trap being served.

211.0 - I -

Invert. The lowest portion of the inside of a horizontal pipe.

SUBSTANTIATION:
Section 905.2 (Horizontal Drainage Pipe) is being revised along with the definition for “invert.” First, adding the term “dry” will clarify that the section is speaking on dry vents. The section is being separated into two sentences since there are two distinct criteria required here.

The first sentence speaks on the “dry vent” pipe connection to the horizontal drain line requiring the “invert” portion of the “dry vent” pipe to be above the drainage (pipe) centerline. The pipe is not necessarily in the “horizontal” position when referencing the “invert” portion and the definition is being revised to remove the term “horizontal” as it causes confusion and it is not necessary.

The second condition the section speaks on is that the vent must connect downstream of the fixture trap. This change adds clarity to the two concepts by separating them in their own sentence.
RECOMMENDATION:
Add new text

Proposed Text:

905.0 Vent Pipe Grades and Connections.

905.4 Roof Termination. Vent pipes shall extend undiminished in size and shall either be extended above the roof, or shall be reconnected with soil or waste vent of the proper size, or connected to a stack-type air admittance valve that conforms to ASSE 1050 and installed in accordance with the manufacturer's instructions.

906.0 Vent Termination.

906.1 Roof Termination. Each vent pipe or stack shall extend through its flashing and shall terminate vertically not less than 6 inches (152 mm) above the roof nor less than 1 foot (305 mm) from a vertical surface. ABS and PVC piping exposed to sunlight shall be protected by water based synthetic latex paints.

Exception: Vents shall be permitted to terminate to a stack-type air admittance valve conforming to ASSE 1050 and installed in accordance with the manufacturer's instructions.

906.2 Clearance. Each vent shall terminate not less than 10 feet (3048 mm) from, or not less than 3 feet (914 mm) above, an openable window, door, opening, air intake, or vent shaft, or not less than 3 feet (914 mm) in every direction from a lot line, alley and street excepted.

Exception: Vents shall be permitted to terminate to a stack-type air admittance valve conforming to ASSE 1050 and installed in accordance with the manufacturer's instructions.

906.3 Use of Roof. When vent pipes shall be extended separately or combined, of full required size, above the roof or firewall, they shall be extended not less than 6 inches (152 mm) above the roof or firewall. Flagpoling of vents shall be prohibited except where the roof is used for assembly purposes or parking. Vents within 10 feet (3048 mm) of a part of the roof that is used for assembly purposes or parking shall extend not less than 7 feet (2134 mm) above such roof and shall securely stay, unless the vent terminates to a stack-type air admittance valve conforming to ASSE 1050, and installed in accordance with the manufacturer's instructions with a UV-rated cover.

224.0 – V –

Valve, Air Admittance. A one-way device that is connected to the drainage system that opens under negative pressure, uses gravity to close, and seals under neutral or positive pressure from the drainage system, preventing sewer gas from escaping into the structure.

TABLE 1701.1

REFERENCED STANDARDS

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<tr>
<td>ASSE 1050-2021</td>
<td>Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage</td>
<td>Miscellaneous</td>
<td>905.4, 906.1, 906.3</td>
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</tbody>
</table>

(portions of the table not shown remain unchanged)
Note: ASSE 1050 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
Section 905.4 & 906.1: This code change clarifies existing language and allows a stack-type air admittance valve to be installed below the roof in lieu of a vent through the roof. This code change requires compliance with the manufacturer’s instructions, which requires one vent to open atmosphere for each building sewer connection to the public sewer, to address positive pressures from storm surges in combined sewers.

Section 906.2: There is no need for clearance distances when an stack-type air admittance valve is installed on a vent terminal because sewer gas does not exit from an air admittance valve.

Section 906.3: Stack type AAVs have been used for decades for rooftop promenades, restaurants, bars, sunbathing decks, or observation decks to eliminate sewer gas odors on the rooftop environment.

**Definition:** The definition is provided for the emerging technology vent device that deals with negative pressures in the plumbing system and that is proposed for inclusion in the plumbing code.

[Supporting documentation provided in KAVI for TC review]
Add new text

Proposed Text:
906.0 Vent Termination.

906.1 Roof Termination. (remaining text unchanged)

906.1.1 Roof Termination When Protected. Where unrelated construction elements are located above rooftop plumbing vent terminations, construction shall comply with the following conditions:

1. The vent termination is a minimum of 2 inches (51 mm) above the roof surface.
2. The open space between the vent pipe and the unrelated construction shall have a clear height not less than the inside diameter of the vent pipe.
3. The vent terminal is protected from negative effects from the accumulation of snow on the roof.
4. The vent terminal opening is protected by an approved means such as a vent terminal debris guard complying with IAPMO IGC 323 and installed according to the installation instructions.
5. The waterproofing and integrity of the vent is maintained.
6. Roof slope is greater than 2 inches per foot (167 mm/m).

TABLE 1701.1

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<tr>
<td>IAPMO IGC 323-2015</td>
<td>Vent Terminal Debris Guards</td>
<td>Miscellaneous</td>
<td>906.1</td>
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</table>

Note: IGC 323 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The combination of existing plumbing and fire code restrictions may reduce the available roof space for a PV system, which may prevent meeting the minimum PV system size requirements found in state energy codes. Establishing clearances above plumbing vent termination and unrelated construction elements increases design flexibility and helps to meet renewable energy goals.

It is not clear if existing plumbing codes require clearance above rooftop plumbing vents, and this proposal seeks to clarify the required clearance when unrelated construction occurs above a plumbing vent termination. This proposal does not modify the requirements for combustion or forced air vents.

Solar panels are large rectangles typically mounted with the bottom of the frame 4-8” above the roof using a 2-4” tall mounting system. This code proposal increases the flexibility of the PV installation height and location, so plumbing vent terminations do not conflict with PV collector locations. Each solar panel that cannot be installed due to a conflict with the location of an existing plumbing vent, may reduce the financial benefit of the solar installation by thousands of dollars over system life.
The size, length, and location of vent terminals has been thoroughly discussed, and the requirements are well known. Most of the current code requirements originate from the recommendations of the National Bureau of Standards (NBS) in 1954 published one of the most complete papers entitled, "Frost Closure of Roof Vents in Plumbing Systems" by Nerbert Eaton and Robert Wyly.

The NBS report recommends a minimum of 2-inch penetration above the roof to prevent rainwater from entering the plumbing vent. Our proposal is restricted to steep slope roofs because low slope roofs can have a greater accumulation of water, and require the plumbing vent to be at a higher elevation. Additionally, the NBS report determined that plumbing vents that terminate at the roof surface have a lower potential for frost closure compared to vents higher off the roof surface, so lowering the vent will not increase the potential for frost closure.

The Residential Code requires the termination to be 6 inches above the roof with adjustments for jurisdictional required snow cover depth. However, plumbing vents protected by a solar panel or architectural feature are inherently sheltered from snow cover. Therefore, having a 2 inch height clearance above a plumbing vent on a steep sloped roof would be sufficient to preserve the venting function.

Numerous code-compliant flashing products and systems exist today that waterproof a roof vent termination that has 2 inches of vent pipe exposed. Plumbing vents are not required to remain readily accessible since these vents are not designed as cleanouts. Therefore installing solar panels above the vent should not cause accessibility concerns. Plumbing codes already define where a cleanout is required for service operations.

Rooftop vent terminations allow small amounts of sewer gas to escape and equipment installed on the roof must resist these corrosive effects. Since solar panels are listed to IEC 62716 and UL 61730 standards which include corrosion testing, the gasses would not have a negative impact on panel life.

When PV solar collectors or other roof coverings, and plumbing vent terminations are installed on the same roof plane, there will be no sacrifice to function or public health. This code proposal will help states, cities and homeowners meet their renewable energy generation goals.

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RECOMMENDATION:
Add new text

Proposed Text:
906.0 Vent Termination.

906.2 Clearance. (remaining text unchanged)

906.2.1 Roof Termination Offsets. Roof panels or similar objects shall not be placed over roof vent terminations. Where permitted, vent terminations shall be permitted to be offset. Vent offsets shall be made using approved vent piping. The vent pipe shall not be decreased in size and shall maintain a slope not less than \(\frac{1}{4}\) inch per foot (20.8 mm/m) towards the drainage. The vent termination shall be secured to prevent movement and keep the terminating end in a vertical position. The vent terminal shall contain a screen to prevent birds or rodents from entering. In areas prone to freezing the offset shall be made inside the building not less than 1 foot (305 mm) below the roof in an insulated space and terminate not less than 10 inches (254 mm) above the roof and 6 inches (152 mm) horizontally from a panel or obstruction.

SUBSTANTIATION:
Panels on roofs are very common and “through the roof” terminations should be permitted to be offset where permitted and installed in an approved manner. An approved manner will allow vents to offset while still functioning to serve their original purpose.
906.0 Vent Termination. Where permitted to vent through a side wall, such vents shall comply with the following:

(1) Vent terminals extending through the wall shall terminate not less than 10 feet (3048 mm) from a lot line.
(2) Vents shall terminate not less than 10 feet (3048 mm) above the highest adjacent grade within a 10 foot (3048 mm) horizontal distance as measured from the vent terminal.
(3) Vent terminals shall not terminate under an overhang of a structure that contains soffit vents.
(4) Sidewall vents terminals shall be protected to prevent birds and rodents from entering or blocking the vent opening.

SUBSTANTIATION:
There are applications where a side vent may be the only option, however, is silent in the code. This section will guide the end user and local authority with a minimum baseline of requirements when such an installation is needed. The provisions align with other jurisdictions that permit sidewall venting and align with distance requirements for venting systems in the plumbing code.
Proposed Text:

907.0 Vent Stacks and Relief Vents.

907.1 Drainage Stack. Each drainage stack that extends 10 or more stories shall be served by a parallel vent stack, which shall extend undiminished in size from its upper terminal and connect to the drainage stack at or immediately below the lowest fixture drain. Each such vent stack shall also be connected to the drainage stack at each fifth floor, counting down from the uppermost fixture drain, using a yoke vent, the size of which shall be not less in diameter than either the drainage or the vent stack, whichever is smaller, or a positive pressure reduction device conforming to ASSE 1030.

218.0 – P –
Positive Pressure Reduction Device. A device intended for single stack soil or waste systems that absorbs positive pressures and can address negative pressures.

227.0 – Y –
Yoke Vent. A pipe connecting upward from soil or waste stack to a vent stack to prevent pressure changes in the stacks; or a positive pressure reduction device on a single stack soil or waste stack system.

TABLE 1701.1
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<tbody>
<tr>
<td>ASSE 1030-2016</td>
<td>Performance Requirements for Positive Pressure Reduction Devices for Sanitary Drainage Systems</td>
<td>Miscellaneous</td>
<td>907.1</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

Note: ASSE 1030 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:

*This code change adds a new venting method utilizing a combination of air admittance valves (AAVs) and positive pressure reduction devices (PPRDs.) AAVs address negative pressures within the drainage system and PPRDs address positive pressures within the drainage system. The manufacturer’s engineered instructions provide information how and where to install AAVs and PPRDs.
Definitions:
Yoke Vent: This change expands the definition of the yoke vent to include positive pressure reduction devices on a soil or waste stack system. A positive pressure reduction device is a device that absorbs positive pressures in the drainage system and can address negative pressures when installed in accordance with the manufacturer’s instructions.

Possitive Pressure Reduction Device: This definition is for an emerging technology device that deals with positive and negative pressures in the plumbing system. This definition will accompany a separate change proposed for inclusion in the plumbing code.

[ Supporting documentation provided in KAVI for TC review ]
SUBMITTER:
John Lansing

Organization Name:
PAE Consulting Engineers

RECOMMENDATION:
Add new text

Proposed Text:
**908.0 Single Stack Vent System:**

908.1 Sanitary Stack. A sanitary stack serving not more than 1 water closet or urinal per floor with a minimum of 4 inches (102 mm) in diameter and not exceeding 15 floors in height shall be permitted to be designed in accordance with Section C 601. A sanitary stack serving fixtures other than water closets or urinals and not exceeding 9 DFU per floor shall be a minimum of 3 inches (80 mm) in diameter if less than 4 levels in height and not less than 4 inches (102 mm) if serving 4 to 15 levels in height. Alternative sizing requirements are provided in C Table 601.2.

(SUBSTANTIATION:)

The theory and performance of the single stack drainage configuration has been utilized in Philadelphia for over a century and remains common plumbing practice. As part of the post-war rebuilding effort in 1942, the Building Research Station in the United Kingdom began investigating the merits of eliminating individual vents serving fixtures, provided that fixtures were in close proximity to the drainage stack to prevent siphonage of the traps. The configuration became widespread throughout the UK, continental Europe, Asia, and Africa in the following decades. Research on airflow and drainage flow continued in the UK throughout the later half of the 20th century culminating in the formulation of the mathematical relationship between airflow and drainage flow in the late 1990s at Heriot Watt University.

While there have been significant gains in international research regearing drainage and airflow theory, North American plumbing codes remain based predominantly on mid-century venting guidance from the National Bureau of Standards, requiring in many cases, unnecessary venting piping at fixtures while providing inadequate vent piping at the termination to atmosphere to relieve negative pressure produced in the drainage stack. Provided that the flow in the stack is limited and the stack is not excessive in height, vent piping can be mostly eliminated entirely except for the stack vent, which must extend full-size and terminate to the atmosphere.

New challenges are presented in the 21st century which make water recycling an imperative necessity to address growing water stress, particularly in the western regions of the US. Providing onsite greywater diversion with water recycling under the current code requirements essentially requires double the amount of drainage and vent piping, which even under regions with higher water utility costs, generally results in a negative return on investment and is therefore rarely installed outside of special scenarios, such as local ordinances which require the installation. Given that the single stack drainage configuration reduces the amount of piping by approximately 40% and also limits the simultaneous loading factors on the drainage stack, this configuration is well suited to help facilitate the necessary transition to water recycling.

Two research papers are provided for TC review. The first of which was put together by Dr. Michael Gormley PhD CEng MCIBSE and funded by ASPE Portland and demonstrates, using airflow simulation modeling, that a 10 story building with a high level of drainage flow can be adequately served by a single stack, providing in some cases higher levels of trap seal retention that a conventionally vented approach, due to the full diameter stack extension. The second paper was presented by the proponent in Leuven, Belgium at the CIB W062 International Symposium.
for Water Supply and Drainage for Buildings and reviewed design standards for the single stack in 12 different regions of the world. The limitations proposed here are intended provide allowances to support the adoption of onsite water recycling and are therefore more conservative than what is necessary to ensure the performance of the system.

[SUPPORTING DOCUMENTATION PROVIDED IN KAVI FOR TC REVIEW]
RECOMMENDATION:
Add new text

Proposed Text:
902.0 Vents Not Required.

902.2 Bars, Soda Fountains, and Counter. Traps serving sinks that are part of the equipment of bars, soda fountains, and counters need not be vented where the location and construction of such bars, soda fountains, and counters are such as to make it impossible to do so. Where such conditions exist, said sinks shall discharge using approved indirect waste pipes into a floor sink or other approved type of receptor, or when vented by an approved device conforming to ASSE 1051.

909.0 Special Venting for Island Fixtures.
909.1 General. Traps for island sinks and similar equipment shall be roughed in above the floor and shall be permitted to be vented by extending the vent as high as possible, but not less than the drainboard height and then returning it downward and connecting it to the horizontal sink drain immediately downstream from the vertical fixture drain. The return vent shall be connected to the horizontal drain through a wye-branch fitting and shall, in addition, be provided with a foot vent taken off the vertical fixture vent by means of a wye branch immediately below the floor and extending to the nearest partition and then through the roof to the open air, or shall be permitted to be connected to other vents at a point not less than 6 inches (152 mm) above the flood-level rim of the fixtures served. Drainage fittings shall be used on the vent below the floor level, and a slope of not less than $\frac{1}{4}$ inch per foot (20.8 mm/m) back to the drain shall be maintained. The return bend used under the drainboard shall be a one-piece fitting or an assembly of a 45 degree (0.79 rad), a 90 degree (1.57 rad), and a 45 degree (0.79 rad) elbow in the order named. Pipe sizing shall be as elsewhere required in this code. The island sink drain, upstream of the returned vent, shall serve no other fixtures. An accessible cleanout shall be installed in the vertical portion of the foot vent. Where permitted, install an air admittance valve conforming to ASSE 1051 in accordance with the manufacturer's instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1051-2021</td>
<td>Performance Requirements for Individual and Branch Type Air Admittance Valves for Sanitary Drainage Systems</td>
<td>Miscellaneous</td>
<td>902.2, 909.1</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)
Note: ASSE 1051 meets the requirements for mandatory referenced standards in accordance with Section 3- 3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

**Section 902.2:** This code change allows an option for venting traps serving sinks that are part of the equipment of bars, soda fountains, and counters with air admittance valves.

**Section 909.1:** This code change allows for a branch-type air admittance valve to be installed to vent the trap on island sinks and similar applications.

[Supporting documentation provided in KAVI for TC review]
910.0 Combination Waste and Vent Systems.

910.5 Vertical Waste Pipe. No vertical waste pipe shall be used in such a system, except the tailpiece or connection between the outlet of a plumbing fixture and the trap. Such tailpieces or connections shall be as short as possible, and in no case shall exceed 2 feet (610 mm).

Exceptions:
(1) Branch lines shall be permitted to have 45 degree (0.79 rad) vertical offsets.
(2) Except where air admittance valves conforming to ASSE 1050 or 1051 and positive pressure reduction devices conforming to ASSE 1030 are installed in accordance with the manufacturer’s instructions as part of an engineered system.

911.0 Circuit Venting.

911.3 Relief Vent. A 2 inch (50 mm) relief vent shall be provided for circuit-vented horizontal branches receiving the discharge of four or more water closets when connecting to a drainage stack that receives the discharge of soil or waste from upper horizontal branches.

Exception: Where an air admittance valves conforming to ASSE 1050 or 1051 and positive pressure reduction devices conforming to ASSE 1030 are installed in accordance with the manufacturer’s instructions as part of an engineered system.

911.3.1 Connection and Installation. The relief vent shall connect to the horizontal branch between the stack and the most downstream trap arm of the circuit vent. The relief vent shall be installed on the vertical to the horizontal branch.

Exception: Except where air admittance valves conforming to ASSE 1050 or 1051 and positive pressure reduction devices conforming to ASSE 1030 are installed in accordance with the manufacturer’s instructions as part of an engineered system.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tr>
<td>ASSE 1050-2021</td>
<td>Performance Requirements for Stack Air Admittance</td>
<td>Miscellaneous</td>
<td>910.5, 911.3,</td>
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<td></td>
<td>Valves for Sanitary Drainage</td>
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<td>911.3.1</td>
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<td>ASSE 1051-2021</td>
<td>Performance Requirements for Individual and Branch</td>
<td>Miscellaneous</td>
<td>910.5, 911.3,</td>
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<td></td>
<td>Type Air Admittance Valves for Sanitary Drainage</td>
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<td>911.3.1</td>
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<td></td>
<td>Systems</td>
<td></td>
<td></td>
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</tbody>
</table>
(portions of the table not shown remain unchanged)

Note: ASSE 1050, ASSE 1051, and ASSE 1030 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Air admittance valves and positive pressure devices work well with a combination waste and vent system when installed in accordance with the manufacturer's instructions.

[Supporting documentation provided in KAVI for TC review]
911.1 Circuit Vent Permitted. A maximum of eight fixtures, floor outlet water closets, showers, bathtubs, or floor drains connected to a horizontal branch shall be permitted to be circuit vented. Each trap arm shall connect horizontally to the horizontal branch being circuit vented in accordance with Table 1002.2. The horizontal branch shall be classified as a drain and a vent from the most downstream trap arm connection to the most upstream trap arm connection to the horizontal branch.

Exception: Back-outlet and wall-hung water closets shall be permitted to be circuit vented provided that no floor outlet fixtures are connected to the same horizontal branch. Back-outlet and wall-hung water closets shall connect horizontally to the horizontal circuit vented drain.

SUBSTANTIATION:
A proposal in the 2021 UPC revised the wording of circuit venting section to provide better clarity. The proposal however went further to introduce language permitted circuit vent installations to only serve a limited type of floor mounted fixtures without substantiation. The language now prohibits circuit vents from being used with floor sinks, urinals, lavatories, sinks, and many other fixtures. The principles of circuit venting are not limited to the application of the fixture types currently listed in section 911.1 and had been permitted since circuit venting was first introduced in the Uniform Plumbing Code. The origins of circuit venting date back to the early 20th century in the US and are now used throughout the world, including in Europe, Japan, China, Brazil, South Africa, Australia, New Zealand, and many other regions.

Attached is an example of a laundry room in a 90 unit affordable housing building in Oregon that was designed according to the requirements outlined in the 2018 UPC and revised to comply with the language introduced in the 2021 UPC. Additional attachments include circuit venting examples used in other parts of the world.

[Supporting documentation provided in KAVI for TC review]
Proposed Text:

911.0 Circuit Venting.

911.1 Circuit Vent Permitted. A maximum of eight floor-outlet water closets, showers, bathtubs, or floor drains connected to a horizontal branch shall be permitted to be circuit vented. Each trap arm shall connect horizontally to the horizontal branch being circuit vented in accordance with Table 1002.2. The horizontal branch shall be classified as a drain and a vent from the most downstream trap arm connection to the most upstream trap arm connection to the horizontal branch.

Exception: Back-outlet and wall hung water closets shall be permitted to be circuit vented provided that no floor-outlet fixtures are connected to the same horizontal branch. Back-outlet and wall hung water closets shall connect horizontally to the horizontal circuit vented drain.

SUBSTANTIATION:

The leading sentence of Section 911.1 (Circuit Vent Permitted) provides clear guidance as to what fixtures are permitted and how the piping systems is to be designed and utilized. For this reason, the exception is being removed as it is being misinterpreted by installers, designers, and authorities having jurisdiction.

Some examples of the confusion include:
1. Building officials in the mid-West interpret that the main branch line shall be a minimum of 2.5 feet below grade if back-outlet fixtures are installed in accordance with the exception.
2. The second largest city in the United States has excluded the exception of Section 911.1 (Circuit Vent Permitted) in order to utilize Section 911.0 (Circuit Venting).
3. Other large cities have excluded the use of the entire Section 911.0 (Circuit Venting) due the confusion of the exception in Section 911.1 (Circuit Vent Permitted).
Proposed Text:

C 601.0 Single-Stack Vent System.

C 601.1 Where Permitted. Single-stack venting shall be designed by a registered design professional as an engineered design. A drainage stack shall be permitted to serve as a single-stack vent system where sized and installed in accordance with Section C 601.2 through Section C 601.10. The drainage stack and branch piping in a single-stack vent system shall provide for the flow of liquids, solids, and air without exceeding the pressure differential described in Section 901.3.

C 601.2 Stack Size. Drainage stacks shall be sized in accordance with Table C 601.2. Not more than two water closets shall be permitted to discharge to a 3 inch (80 mm) stack. Stacks shall be uniformly sized based on the total connected drainage fixture unit load, with no reductions in size.

C 601.2.1 Stack Vent. The drainage stack vent shall have a stack vent of the same size terminating to the outdoors.

C 601.3 Branch Size. Horizontal branches connecting to a single-stack vent system shall be sized in accordance with Table 703.2.

Exceptions:

1. Not more than one water closet within 18 inches (457 mm) of the stack horizontally shall be permitted on a 3 inch (80 mm) horizontal branch.

2. A water closet within 18 inches (457 mm) of a stack horizontally and one other fixture with up to ¹¹⁄₈ inch (40 mm) fixture drain size shall be permitted on a 3 inch (80 mm) horizontal branch where connected to the stack through a sanitary tee.

C 601.4 Length of Horizontal Branches. Water closets shall be not more than 4 feet (1219 mm) horizontally from the stack. Exception: Water closets shall be permitted to be up to 8 feet (2438 mm) horizontally from the stack where connected to the stack through a sanitary tee.

C 601.4.1 Other Fixtures. Fixtures other than water closets shall be not more than 12 feet (3658 mm) horizontally from the stack.

C 601.4.2 Length of Vertical Piping. The length of vertical piping from a fixture trap to a horizontal branch shall not be considered in computing the fixture's horizontal distance from the stack.

C 601.5 Maximum Vertical Drops from Fixtures. Vertical drops from fixture traps to horizontal branch piping shall be one size larger than the trap size, but not less than 2 inches (50 mm) in diameter. Vertical drops shall be 4 feet (1219 mm) maximum length. Fixture drains that are not increased in size, or have a vertical drop exceeding 4 feet (1219 mm) shall be individually vented.

C 601.6 Additional Venting Required. Additional venting shall be provided where more than one water closet is on a horizontal branch and where the distance from a fixture trap to the stack exceeds the limits in Section C 601.4. Where additional venting is required, the fixture(s) shall be vented by one of the methods described in Sections 908.0 through Section 911.5. The dry vent extensions for the additional venting shall connect to a branch vent, vent stack, stack vent, or be extended outdoors and terminate to the open air.
## TABLE C601.2913.2
### SINGLE STACK SIZE*

<table>
<thead>
<tr>
<th>STACK SIZE (inches)</th>
<th>STACKS LESS THAN 75 FEET IN HEIGHT</th>
<th>STACK 75 FEET TO LESS THAN 160 FEET IN HEIGHT</th>
<th>STACK 160 FEET OR GREATER IN HEIGHT</th>
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<tbody>
<tr>
<td>3</td>
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<tr>
<td>4</td>
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<td>12</td>
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<td>4500</td>
<td>2320</td>
</tr>
<tr>
<td>15</td>
<td>13 600</td>
<td>8100</td>
<td>4500</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

* NP = Not permitted

**C 601.7 913.7 Stack Offsets.** Where there are no fixture drain connections below a horizontal offset in a stack, the offset does not need to be vented. Where there are fixture drain connections below a horizontal offset in a stack, the offset shall be vented. There shall be no fixture connections to a stack within 2 feet (610 mm) above and below a horizontal offset.

**C 601.8 913.8 Prohibited Connections Near Base of Stack.** Where stacks are more than 75 feet (22 860 mm) high, a separate stack shall be provided for the fixtures on the lower two stories. The stack for the lower two stories shall be permitted to be connected to the branch of the building drain that serves the stack for the upper stories at a point that is not less than 8 feet (2438 mm) downstream from the base of the upper stack. Where stacks are less than 75 feet (22 860 mm) high but more than two stories high, the lowest story shall not connect within 8 feet (2438 mm) downstream from the base of the stack. Venting for the lowest story shall be provided in accordance with Section C 601.8.1 913.8.1 and Section C 601.8.2 913.8.2.

**C 601.8.1 913.8.1 Conditional Vent.** Venting of fixtures on the lowest floor shall be in accordance with Section 908.0 through Section 911.5 and may connect into the single-stack as a conditional vent. The conditional vent connects into the stack by means of a wye-fitting to prevent ingress of drainage into the vent. No more than 12 drainage fixture units (DFU) may be connected into the conditional vent and shall connect not less than 8 feet (2438 mm) above the stack base.

**C 601.8.2 913.8.2 Other Branch Vent.** Other branch vents shall be vented in accordance with Section 908.0 through Section 911.5.

**C 601.9 913.9 Sizing Building Drains and Sewers.** In a single-stack vent system, the building drain and branches thereof shall be sized in accordance with Table 703.2, and the building sewer shall be sized in accordance with Table 717.1.

**C 601.10 913.10 Parallel Vent Stacks.** Drainage stacks extending more than 75 feet (22 860 mm) shall be provided with a parallel vent stack and shall meet the requirements of Section 907.0.

**SUBSTANTIATION:**
The single stack vent system is a suitable means of maintaining pressure differentials within the drainage system to protect water seals and complies with the performance requirements of Section 901.3 (Trap Seal Protection). Due to the proven performance of such systems, it is recommended to transition Section C 601.1 (Single Stack Vent System) and its sub-sections into the main body of the text.
Proposed Text:

913.0 Air Admittance Valves.

913.1 General. Vent systems utilizing air admittance valves shall comply with this section. Stack-type air admittance valves shall conform to ASSE 1050. Individual and branch-type air admittance valves shall conform to ASSE 1051.

913.2 Installation. The valves shall be installed in accordance with the requirements of this section and the manufacturer's instructions. Air admittance valves shall be installed after the DWV testing required by Section 312.2 or Section 312.3 has been performed.

913.3 Where Permitted. Individual branch and circuit vents shall be permitted to terminate with a connection to an individual or branch-type air admittance valve in accordance with Section 913.3.1. Stack vents and vent stacks shall be permitted to terminate to stack-type air admittance valves in accordance with Section 913.3.2.

913.3.1 Horizontal branches. Individual and branch-type air admittance valves shall vent only fixtures that are on the same floor level and connect to a horizontal branch drain. Where the horizontal branch is located more than four branch intervals from the top of the stack, the horizontal branch shall be provided with a relief vent that shall connect to a vent stack or stack vent, or extend outdoors to the open air. The relief vent shall connect to the horizontal branch drain between the stack and the most downstream fixture drain connected to the horizontal branch drain. The relief vent shall be sized in accordance with Section 906.2 and installed in accordance with Section 905.0. The relief vent shall be permitted to serve as the vent for other fixtures.

913.3.2 Stack. Stack-type air admittance valves shall be prohibited from serving as the vent terminal for vent stacks or stack vents that serve drainage stacks having more than six branch intervals.

913.4 Prohibited Installations. Air admittance valves shall not be installed in nonneutralized special waste systems as described in Chapter 8, except where such valves are in compliance with ASSE 1049, are constructed of materials approved in accordance with Section 702.5, and are tested for chemical resistance in accordance with ASTM F1412. Air admittance valves shall not be located in spaces utilized as supply or return air plenums. Air admittance valves shall not be used to vent sumps or tanks except where the vent system for the sump or tank has been designed by an engineer. Air admittance valves shall not be installed on outdoor vent terminals for the sole purpose of reducing clearances to gravity air intakes or mechanical air intakes.

913.5 Chemical Waste Vent Systems. The vent system for a chemical waste system shall be independent of the sanitary vent system and shall terminate separately through the roof to the outdoors or to an air admittance valve that complies with ASSE 1049. Air admittance valves for chemical waste systems shall be constructed of materials approved in accordance with Section 702.6 and shall be tested for chemical resistance in accordance with ASTM F1412.

913.4 Location. Individual and branch-type air admittance valves shall be located not less than 4 inches (102 mm) above the horizontal branch drain or fixture drain being vented. Stack-type air admittance valves shall be located not less than 6 inches (152 mm) above the flood level rim of the highest fixture being vented. The air admittance valve shall be located within the maximum developed length permitted for the vent. The air admittance valve shall be installed not less than 6 inches (152 mm) above insulation materials.

913.5 Access and ventilation. Access shall be provided to all air admittance valves. Such valves shall be installed in
a location that allows air to enter the valve.

913.6 Size. The air admittance valve shall be rated in accordance with the standard for the size of the vent to which the valve is connected.

913.7 Vent required. Within each plumbing system, not less than one stack vent or vent stack shall extend outdoors to the open air.

913.8 Prohibited installations. Air admittance valves shall not be installed in nonneutralized special waste systems as described in Chapter 8 except where such valves are in compliance with ASSE 1049, are constructed of materials approved in accordance with Section 702.5, and are tested for chemical resistance in accordance with ASTM F1412. Air admittance valves shall not be located in spaces utilized as supply or return air plenums. Air admittance valves shall not be used to vent sumps or tanks except where the vent system for the sump or tank has been designed by an engineer. Air admittance valves shall not be installed on outdoor vent terminals for the sole purpose of reducing clearances to gravity air intakes or mechanical air intakes.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1049-2009</td>
<td>Individual and Branch Type Air Admittance Valves for Chemical Waste System Vents</td>
<td>Sanitary Drainage Systems Vents</td>
<td>913.4, 913.5</td>
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<tr>
<td>ASSE 1050-2021</td>
<td>Stack Air Admittance Valves for Sanitary Drainage Systems Vents</td>
<td>Sanitary Drainage Systems Vents</td>
<td>913.1</td>
</tr>
<tr>
<td>ASSE 1051-2021</td>
<td>Individual and Branch Type Air Admittance Valves</td>
<td>Sanitary Drainage Systems Vents</td>
<td>913.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASSE 1049, ASSSE 1050, ASSE 1051 and ASTM F1412 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The proposed change adds detailed provisions required for the proper installation of Air Admittance Valves and indicates where such valves should not be used. Including these Air Admittance Valves provides another option of venting a drainage system and guides the end users and local jurisdictions to make valid decisions on where and when such valves may be appropriate.
RECOMMENDATION:
Add new text

Proposed Text:
1007.0 Trap Seal Protection.

1007.3 Barrier-Type Trap Seal Protection Device. A barrier-type trap seal protection device shall be permitted to protect the floor drain trap seal from evaporation. Barrier-type floor drain trap seal protection devices shall comply with ASSE 1072. The devices shall be installed in accordance with the manufacturer's instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tbody>
<tr>
<td>ASSE 1072-2020</td>
<td>Performance Requirements for Barrier Type Trap Seal Protection for Floor Drains</td>
<td>Miscellaneous</td>
<td>1007.3</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

Note: ASSE 1072 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The ASSE 1072 standard for barrier-type trap seal protection devices provides another option for protecting trap seal loss in a drainage system. The standard will ensure that such devices meet minimum quality requirements for the intended purpose.
TABLE 1009.1
APPROVED INTERCEPTORS (CLARIFIERS)

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>STANDARD</th>
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<tbody>
<tr>
<td>Solid Waste</td>
<td>IAPMO IGC 167, IAPMO/ANSI/CAN Z1167</td>
</tr>
<tr>
<td>Non-petroleum Oil</td>
<td>ASME A112.14.6, IAPMO PS 80, PDI G-102</td>
</tr>
<tr>
<td>Petroleum Oil</td>
<td>ASTM D6104, IAPMO IGC 183, IAPMO IGC 325</td>
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TABLE 1701.1
REFERRED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>IAPMO IGC 167-2011a (R2021)</td>
<td>Solid Waste Containment Interceptors</td>
<td>Interceptors</td>
<td>Table 1009.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO/ANSI/CAN Z1167 meets the requirements for mandatory a referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
IAPMO IGC 167 is being superseded by IAPMO/ANSI/CAN Z1167 as an ANSI designated standard. The standard designation will be updated in Table 1009.1 [Approved Interceptors (Clarifiers)] and Table 1701.1 (Referenced Standards).
1014.0 Grease Interceptors.

1014.1 General. Where it is determined by the Authority Having Jurisdiction that waste pretreatment is required, an approved type of grease interceptor(s) shall comply with ASME A112.14.3/CSC B481.1, ASME A112.14.4/CSC B481.3, ANSI/CAN/IAPMO Z1001, PDI G-101, or PDI G-102, and sized in accordance with Section 1014.2.1 or Section 1014.3.6, shall be installed in accordance with the manufacturer’s installation instructions to receive the drainage from fixtures or equipment that produce grease-laden waste. Grease-laden waste fixtures shall include, but not be limited to, sinks and drains, such as floor drains, floor sinks, and other fixtures or equipment in serving establishments, such as restaurants, cafes, lunch counters, cafeterias, bars and clubs, hotels, hospitals, sanitariums, factory or school kitchens, or other establishments where grease is introduced into the drainage or sewage system in quantities that can effect line stoppage or hinder sewage treatment or private sewage disposal systems. A combination of hydromechanical, gravity grease interceptors and engineered systems shall be allowed to meet this code and other applicable requirements of the Authority Having Jurisdiction where space or existing physical constraints of existing buildings necessitate such installations. A grease interceptor shall not be required for individual dwelling units or private living quarters. Water closets, urinals, and other plumbing fixtures conveying human waste shall not drain into or through the grease interceptor.

### TABLE 1009.1
APPROVED INTERCEPTORS (CLARIFIERS)

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<tr>
<td>ASME A112.14.3/CSC B481.1-20182022</td>
<td>Hydromechanical Grease Interceptors</td>
<td>Fixtures</td>
<td>1014.1, Table 1009.1</td>
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<tr>
<td>ASME A112.14.4/CSC B481.3-2001(R2017)2022</td>
<td>Grease Removal Devices</td>
<td>Fixtures</td>
<td>1014.1, Table 1009.1</td>
</tr>
</tbody>
</table>
Note: ASME/CSA standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The ASME A112.14.3 and ASME A112.14.4 standard was harmonized with the CSA B481 standard. This update provides the latest edition of the new harmonized standard.
Proposed Text:
1014.0 Grease Interceptors.

1014.1 General. (remainin text unchanged)

1014.1.3 Food Waste Disposers and Dishwashers. No food waste disposer or dishwasher shall be connected to or discharge into a grease interceptor. Commercial food waste disposers shall be permitted to discharge directly into the building's drainage system.

Exception: Food waste disposers and dishwashers shall be permitted to discharge to grease interceptors that are designed to receive the discharge of food waste or dishwasher waste.

SUBSTANTIATION:
Gravity Grease interceptors allow for the connection of dishwashers in Section 1014.3.2. Larger hydromechanical interceptors can accept dishwasher waste when properly designed.
SUBMITTER: Samantha Liu
Organization Name: Self
Organization Representation: Self

RECOMMENDATION:
Revise text

Proposed Text:
1014.0 Grease Interceptors.

1014.1 General. (remaing text unchanged)

1014.1.3 Food Waste Disposers and Dishwashers. No food waste disposer or dishwasher shall be connected to or discharge into a grease interceptor. Commercial Food waste disposers shall be permitted to discharge directly into the building's drainage system.

Exception: Food waste disposers shall be permitted to discharge to grease interceptors that are designed to receive the discharge of food waste.

SUBSTANTIATION:
The proposed change removes the reference to “commercial” as both commercial and residential food waste disposal units are permitted to discharge to the building drainage system.
SUBMITTER:  
Eric Thompson

Organization Name:  
Schier Products

RECOMMENDATION:
Revise text

Proposed Text:
1014.0 Grease Interceptors.

1014.2 Hydromechanical Grease Interceptors. (remaining text unchanged)

1014.2.2 Vent. A vent shall be installed downstream of hydromechanical grease interceptors or in accordance with the manufacturer's installation instructions, with the requirements of this code.

SUBSTANTIATION:
This code section is overly stringent. Gravity Grease Interceptors do not have this requirement. No other model codes contain this requirement specifically for hydromechanical grease interceptors. Not all manufacturers require venting after the interceptor and should be updated.
1014.0 Grease Interceptors.

1014.2 Hydromechanical Grease Interceptors. (remaining text unchanged)

1014.2.1 Capacity and Sizing Criteria. Hydromechanical Interceptors shall be sized in accordance with Table 1014.2.1 using gravity flow rates, fixture capacity or as per manufacturer's instructions. The total capacity in gallons (gal) (L) of fixtures discharging into a hydromechanical grease interceptor shall not exceed two and one-half times the certified gallon per minute (gpm) (L/s) flow rate of the interceptor in accordance with Table 1014.2.1.

For this section, the term “fixture” shall mean and include each plumbing fixture, appliance, apparatus, or other equipment required to be connected to or discharged into a grease interceptor by a provision of this section.

(below shown for informational purposes)

**TABLE 1014.2.1**

**HYDROMECHANICAL GREASE INTERCEPTOR SIZING USING GRAVITY FLOW RATES**

<table>
<thead>
<tr>
<th>DIAMETER OF GREASE WASTE PIPE (inches)</th>
<th>MAXIMUM FULL PIPE FLOW (gpm)²</th>
<th>SIZE OF GREASE INTERCEPTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ONE-MINUTE DRAINAGE PERIOD (gpm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>150</td>
</tr>
<tr>
<td>4</td>
<td>125</td>
<td>250</td>
</tr>
<tr>
<td>5</td>
<td>230</td>
<td>375</td>
</tr>
<tr>
<td>6</td>
<td>375</td>
<td>400</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s

Notes:
For interceptor sizing by the fixture capacity see the example below.

1/4 inch slope per foot (20.8 mm/m) based on Manning's formula with friction factor N = 0.012.

SUBSTANTIATION:
Currently, there is no explanation for the table values and examples shown in this section. Both Section 1014.3.6 (Gravity Interceptors) and Section 1015.3 (FOG Removal Systems) have sections regarding sizing. This update will explain how the table is used for the end users.
RECOMMENDATION:
Revise text

Proposed Text:
1014.0 Grease Interceptors.

1014.2 Hydromechanical Grease Interceptors. Plumbing fixtures or equipment connected to a Type A and B hydromechanical grease interceptor shall discharge through an approved type of vented flow control installed in a readily accessible and visible location. **Type C and Type D flow control devices shall comply with ASME A112.14.3 or CSA B481.1 and be installed in accordance with the manufacturer’s installation instructions.** Flow control devices shall be designed and installed so that the total flow through such device or devices shall at no time be greater than the rated flow of the connected grease interceptor. **No flow control device having adjustable or removable parts shall be approved:** The vented flow control device shall be located such that no system vent shall be between the flow control and the grease interceptor inlet. The vent or air inlet of the flow control device shall connect with the sanitary drainage vent system, as elsewhere required by this code, or shall terminate through the roof of the building, and shall not terminate to the free atmosphere inside the building. **Exception:** Listed grease interceptors with integral flow controls or restricting devices shall be installed in an accessible location in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
The ASME A112.14.3 (Hydromechanical Grease Interceptors) product standard allows for flow controls certified to Type C (without external flow control, directly connected or internal flow control) and Type D of the standard, (without external flow control, indirectly connected or no flow control installed). These flow control types can be removed or may not be installed based upon the standard.
**RECOMMENDATION:**
Revise text

**Proposed Text:**
1014.0 Grease Interceptors.

1014.3 Gravity Grease Interceptors. (remaining text unchanged)

1014.3.2 Waste Discharge Requirements. Waste discharge in establishments from fixtures and equipment which contain grease, including but not limited to, scullery sinks, pot and pan sinks, **dishwashers**, soup kettles, and floor drains located in areas where grease-containing materials exist, shall be permitted to be drained into the sanitary waste through the interceptor where approved by the Authority Having Jurisdiction.

**SUBSTANTIATION:**
Removing dishwashers from the list of "equipment which contain grease" in Section 1014.3.2 avoids the conflict with Section 1014.1.3 which indicates, "No food waste disposer or dishwasher shall be connected to or discharge into a grease interceptor."
RECOMMENDATION:
Revise text

Proposed Text:
1014.0 Grease Interceptors.

1014.3 Gravity Grease Interceptors. (remaining text unchanged)

1014.3.3 Design. Gravity interceptors shall be constructed in accordance with ANSI/CAN/IAPMO Z1001, with the applicable standard in Chapter 17 or the design approved by the Authority Having Jurisdiction.

Note: ANSI/CAN/IAPMO Z1001 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Gravity grease interceptors now have a national standard for design, ANSI/CAN/IAPMO Z1001-2021 (Prefabricated Gravity Grease Interceptors), and all manufactures should certify to this standard. The phrase "... with the applicable standard in Chapter 17 or the design approved by the AHJ" is being stricken as the appropriate standards are already addressed in Section 1014.1 (General) and also calls out ANSI/CAN/IAPMO Z1001. Section 1014.1 is shown below for informational purposes:

"1014.1 General. Where it is determined by the Authority Having Jurisdiction that waste pretreatment is required, an approved type of grease interceptor(s) shall comply with ASME A112.14.3, ASME A112.14.4, CSA B481, ANSI/CAN/IAPMO Z1001, PDI G-101, or PDI G-102, and ..."
SUBMITTER: Ted Hansen
Organization Name: City of Kodiak/Kodiak Island Borough
Organization Representation: Self

RECOMMENDATION:
Revise text

Proposed Text:
1016.0 Sand Interceptors.
1016.1 Discharge. Where the discharge of a fixture or drain contains solids or semi-solids heavier than water that would be harmful to a drainage system or cause a stoppage within the system, the discharge shall be through a sand interceptor. Multiple floor drains shall be permitted to discharge into one sand interceptor. Floor or trench drains discharging into sand interceptors shall not be required to be trapped in accordance with Section 1001.2.

Floor or trench drains discharging into sand interceptors shall not be required to be trapped in accordance with Section 1001.2.

1001.2 Where Required. Each plumbing fixture shall be separately trapped by an approved type of liquid seal trap. This section shall not apply to fixtures with integral traps. Not more than one trap shall be permitted on a trap arm. Food waste disposers installed with a set of restaurant, commercial, or industrial sinks shall be connected to a separate trap.

Each domestic clothes washer and each laundry sink shall be connected to a separate and independent trap, except that a trap serving a laundry sink shall also be permitted to receive the waste from a clothes washer set adjacent to it.

The vertical distance between a fixture outlet and the trap weir shall be as short as practicable, but in no case shall the tailpiece exceed 24 inches (610 mm) in length.

One trap shall be permitted to serve a set of not more than three single compartment sinks or laundry sinks of the same depth or three lavatories immediately adjacent to each other and in the same room where the waste outlets are not more than 30 inches (762 mm) apart, and the trap is centrally located where three compartments are installed.

SUBSTANTIATION:
Section 1016.1 (Discharge) does not specifically state that traps are not required on the drains discharging into a sand interceptor. The illustrated Training Manual (ITM) states this in the commentary and makes it unclear. If it is the intent of the code to allow the traps to be eliminated in this instant that are required on each plumbing fixture by Section 1001.2 then it must be stated in the code language because we all know commentary is not enforceable.
1017.0 Oil and Flammable Liquid Interceptors.

1017.1 Interceptors Where Required. Repair garages and gasoline stations with grease racks or grease pits, and factories that have oily, flammable, or both types of wastes as a result of manufacturing, storage, maintenance, repair, or testing processes, shall be provided with an oil or flammable liquid interceptor. Floor drains in such locations shall be connected directly to oil and flammable liquid interceptors.

Except for individual single-family dwelling units, floor drains shall connect directly to an oil interceptor for the following facilities:

(1) Automobile service or repair garages.

(2) Facilities where automobiles are washed.

(3) Vehicle parking areas not intended for storm drainage.

(4) Manufacturing, storage, maintenance, repair, or testing process facilities that have oily, flammable, or both types of wastes.

(5) Liquid waste that is pumped or drained from hydraulic elevator pits.

1017.2 Interceptor Design Alternatives Standards Compliance. Oil interceptors shall comply with IAPMO IGC 183 or IAPMO IGC 325 be in accordance with Section 1017.3 through Section 1017.4.

1017.3 Interceptor Details System Design. Oil and flammable liquid interceptors shall be in accordance with the following:

(1) The separation or vapor compartment shall be independently vented to the outer air. Where two or more separation or vapor compartments are used, whereby air cannot flow between said compartments, each shall be vented to the outer air or shall be permitted to connect to a header that is installed at a minimum of 6 inches (152 mm) above the spill line of the lowest floor drain and vented independently to the outer air.

(2) The minimum size of an flammable oil interceptor vapor vent shall be not less than 2 inches (50 mm), and, where vented through a sidewall, the vent shall be not less than 10 feet (3048 mm) above the adjacent level at an approved location.

(3) The outlet piping of the interceptor shall be vented on the sewer side to prevent siphon and shall not connect to a flammable vapor vent. Oil and flammable interceptors shall be provided with gastight cleanout covers that shall be readily accessible.

(4) The interceptor outlet opening shall contain a water seal waste line shall be not less than 3 inches (80 mm) in diameter with a full-size cleanout to grade.

1017.4 Design of Interceptors Sizing. The size of an oil separator shall be based on one of the following methods Each manufactured interceptor that is rated shall be stamped or labeled by the manufacturer with an indication of its full discharge rate in gpm (L/s). The following shall apply:
(1) Where vehicles are serviced and not stored, interceptor capacity shall be based on a net capacity of 1 cubic foot (0.03 m$^3$) for each 100 square feet (9.29 m$^2$) of the surface to be drained into the interceptor, with a minimum of 6 cubic feet (0.2 m$^3$).

(2) Where not more than three motor vehicles are stored, interceptors shall have a minimum capacity of 6 cubic feet (0.2 m$^3$), and 1 cubic foot (0.03 m$^3$) of capacity shall be added for each vehicle up to 10 vehicles.

(a) For more than 10 vehicles, an additional 0.15 cubic foot (0.004 m$^3$) per vehicle shall be added to the interceptor's total capacity.

(3) A method approved by the Authority Having Jurisdiction.

(1) The full discharge rate to such an interceptor shall be determined at full flow. Each interceptor shall be rated equal to or greater than the incoming flow and shall be provided with an overflow line to an underground tank. (2) Interceptors not rated by the manufacturer shall have a depth of not less than 2 feet (610 mm) below the invert of the discharge drain. The outlet opening shall have not less than an 18 inch (457 mm) water seal and shall have a minimum capacity as follows:

(a) Where not more than three motor vehicles are serviced, stored, or both, interceptors shall have a minimum capacity of 6 cubic feet (0.2 m$^3$), and 1 cubic foot (0.03 m$^3$) of capacity shall be added for each vehicle up to 10 vehicles.

(b) Above 10 vehicles, the Authority Having Jurisdiction shall determine the size of the interceptor required.

(c) Where vehicles are serviced and not stored, interceptor capacity shall be based on a net capacity of 1 cubic foot (0.03 m$^3$) for each 100 square feet (9.29 m$^2$) of the surface to be drained into the interceptor, with a minimum of 6 cubic feet (0.2 m$^3$).

Note: IAPMO IGC 325 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

Section 1017.1

A numbered list format is more legible and comprehensible.

Removed "...with grease racks or grease pits..." for two reasons. First, some automobile service garages produce oily waste without a grease rack or pit. Second, the term "grease" is generally used to describe polar oils from commercial kitchen applications. This is not applicable in non-polar oil interceptor applications.

Added "Vehicle parking areas" in this section to rectify confusion since "vehicle storage" is referenced in 1017.4 but not in 1017.1.

Added hydraulic elevator pits as an application. Hydraulic elevators are susceptible to drain oil into the elevator sump or drain, and therefore should require a means to interceptor said oil prior to discharge to sanitary.

Section 1017.2

Removing design alternative language altogether and providing two standards specific to oil interceptors (also referred to as oil separators). IGC 183 is a design-based standard, and IGC 325 is a performance-based standard. Since those exist, there is no reason for additional alternatives to be listed in UPC. The two standards are very robust in their requirements, and should supersede the minimal language referenced in the subsequent sections.

Section 1017.3:

Changed to "System Design" since some of the following content provided guidance on factors that did not pertain to the interceptor itself.
Added that a water seal should be present for all interceptors, not just rated interceptors in section 1017.4.

Removed minimum outlet size since that isn't typically enforced, and doesn't carry any specific logic to be present.

Removed entire section on overflow since that is typically not enforced and also is confusing and nonsensical. For example, you could theoretically have an oil interceptor with less than 100 gal. of capacity and it would require a much larger 550 gal. overflow tank.

**Section 1017.4:**

Rewrote this section to be more cut and dry in a list format. Retained the square footage sizing method. Added to the parking method to provide guidance on parking areas larger than 10 vehicles, which is a common application. The logic behind 0.15 cu. ft. for each additional vehicle is due to the average vehicle holding between 4-6 quarts of oil, which translates to roughly 0.15 cu. ft.

Removed language about being rated since it was confusing. "Rated" does not carry a definition with it, so it created an issue where disparate parties translated this section differently.
Proposed Text:
1101.0 General.

1101.4 Material Uses. (remaining text unchanged)

1101.4.4 Underground Building Storm Drains. Underground building storm drains shall comply with the applicable standards referenced in Table 1101.4.4 for storm sewer and drains or Table 701.2 for underground drain, waste, and vent pipe.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>REFERENCED STANDARD(S)</th>
<th>REFERENCED STANDARD(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforced Concrete Pipe (RCP)</td>
<td>ASTM C76</td>
<td>ASTM C443</td>
</tr>
<tr>
<td>Corrugated High Density Polyethylene (HDPE) Pipe</td>
<td>ASTM F2306</td>
<td>ASTM D3212, ASTM F2510</td>
</tr>
<tr>
<td>Corrugated Polypropylene (PP) Pipe</td>
<td>ASTM F2764</td>
<td>ASTM D3212, ASTM F2510</td>
</tr>
</tbody>
</table>
### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C76-2022</td>
<td>Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe</td>
<td>Piping</td>
<td>Table 1101.4.4</td>
</tr>
<tr>
<td>ASTM C443-2021</td>
<td>Joints for Concrete Pipe and Manholes, Using Rubber Gaskets</td>
<td>Fittings</td>
<td>Table 1101.4.4</td>
</tr>
<tr>
<td>ASTM F2306-2021</td>
<td>12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications</td>
<td>Piping, Plastic</td>
<td>Table 1101.4.4</td>
</tr>
<tr>
<td>ASTM F2764-2023</td>
<td>Standard Specification for 6 in. to 60 in. [150 mm to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications</td>
<td>Piping, Plastic</td>
<td>Table 1101.4.4</td>
</tr>
<tr>
<td>ASTM F2510-2022</td>
<td>Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes</td>
<td>Fittings</td>
<td>Table 1101.4.4</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** The ASTM standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

### TABLE 1701.2
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C443-2012 (R2017)</td>
<td>Joints for Concrete Pipe and Manholes, Using Rubber Gaskets</td>
<td>Joints</td>
</tr>
<tr>
<td>ASTM F2306/F2306M-2018</td>
<td>12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications</td>
<td>Piping, Plastic</td>
</tr>
</tbody>
</table>

(portions of tables not shown remain unchanged)

**SUBSTANTIATION:**
Currently Reinforced Concrete Pipe (RCP) and corrugated plastic products such as HDPE and PP are very commonly used for underground storm drainage on sites within the jurisdiction of the plumbing code (ie. within 10 feet of the building or 10 feet of a watermain). In these situations, since the pipe is not listed in the table these
products currently are requiring special approval causing extra work and time for designers, owners, and plumbing code enforcers. Adding these products into a table will save time for all parties involved.
SUBMITTER: Sidney Cavanaugh  
Organization Name: Cavanaugh Consulting  
Organization Representation: Cavanaugh Consulting

RECOMMENDATION: Add new text

Proposed Text:
1101.0 General.

1101.4 Material Uses. (remaining text unchanged)

1101.4.5 Building Storm Sewers. Building storm sewers shall comply with the applicable standards referenced in Table 701.2 for building sewer pipe.  
1101.4.5.1 Storm Drain Lining. Rehabilitation/lining of storm drain systems using CIPP shall be in accordance with ASTM F2599.

Note: ASTM F2599 meets the requirements for mandatory a referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:  
Storm drainage systems are candidates for rehabilitation/lining using CIPP due to infrastructure and other potential problems after installation. These same issues are addressed in Chapter 7 for building sewers and building storm sewers.
TABLE 1101.4.6
MATERIALS FOR SUBSOIL DRAINPIPE AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>REFERENCED STANDARD(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast-Iron</td>
<td>ASTM A74, ASTM A888, CISPI 301</td>
</tr>
<tr>
<td>PE</td>
<td>ASTM F667</td>
</tr>
<tr>
<td>PVC</td>
<td>ASTM D2729</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>ASME A112.3.1</td>
</tr>
<tr>
<td>Vitrified Clay (Extra strength)</td>
<td>ASTM C4, ASTM C700</td>
</tr>
</tbody>
</table>

Note: ASME A112.3.1, ASTM A74, ASTM A888, and CISPI 301 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The recommendation adds additional standards and updates the materials used in subsoil drains.

Cast Iron:
ASTM A74 - 1. Scope 1.1 This specification covers cast iron soil pipe and fittings for use in gravity flow plumbing, drain, waste and vent sanitary, and storm water applications. It establishes standards covering material, manufacture, mechanical and chemical properties, coating, test methods, inspection, certification, product markings, dimensions, and dimensional tolerances for extra-heavy and service cast iron soil pipe and fittings. These pipe and fittings are not intended for pressure applications as the selection of the proper size for sanitary drain, waste, vent, and storm drain systems allows free air space for gravity drainage.

ASTM A888 - 1. Scope 1.1 This specification covers hubless cast iron soil pipe and fittings for use in gravity flow applications. It establishes standards covering material, manufacture, mechanical and chemical properties, dimensions, coating, test methods, inspection, certification, and product marking for hubless cast iron soil pipe and fittings. These pipe and fittings are intended for non-pressure applications, as the selection of the proper size for sanitary drain, waste, vent, and storm drain systems allows free air space for gravity drainage.

Stainless Steel:
ASME A112.3.1 - This Standard covers performance and installation requirements for socket-type, seam-welded stainless steel pipe, fittings, joints, and drains for use in plumbing sanitary and storm drain, waste, and vent(DWV), and chemical waste systems.
1101.4 Material Uses. (remaining text unchanged)

1101.4.7 Cured-in-Place Pipe (CIPP). Cured-in-Place Pipe (CIPP) shall be listed and certified as per Section 301.2 and installed in accordance with applicable standards referenced in Table 701.2. When the existing pipe is broken or breached inside a duct or plenum, the existing pipe shall be repaired before CIPP is installed, so that the CIPP is not exposed.

1102.0 Roof Drains.

1102.4 Cured-in-Place Pipe (CIPP). Cured-in-Place Pipe (CIPP) shall be listed and certified as per Section 301.2 and installed in accordance with applicable standards referenced in Table 701.2. When the existing pipe is broken or breached inside a duct or plenum, the existing pipe shall be repaired before CIPP is installed, so that the CIPP is not exposed.

SUBSTANTIATION:
Incorporating CIPP into Section 1101.4 & Section 1102 will make the additional UPC performance requirements for CIPP to be installed within building storm drainage pipes much clearer to AHJs; lack of inclusion currently results in no guidance. With the proposed language, all existing code requirements for storm drainage piping materials will govern (such as fire safety compliance within ducts and plenums); only CIPP installed to comply with the UPC requirements can be permitted for building DWV piping applications.

In a separate but related proposal, ASTM F1216-2022, ASTM F2561, ASTM F2599, and the new ASTM F3541-2022 are proposed to be added to Table 701.2 for broader DWV applications. The expected ASTM F1743-2024 with UPC compliant mandatory language is also proposed for inclusion if completed in time.
Proposed Text:

1101.12.2 Secondary Drainage. (remaining text unchanged)

1101.12.2.2 Secondary Roof Drain. (remaining text unchanged)

1101.12.2.2.2 Combined System. The secondary roof drains shall connect to the vertical piping of the primary storm drainage conductor downstream of the last horizontal offset located below the roof. The primary storm drainage system shall connect to the building storm water that connects to an underground public storm sewer. The combined secondary and primary roof drain systems shall be sized in accordance with Section 1103.0 based on double the rainfall rate for the local area. The primary and secondary system piping between the roof drain and upstream of the vertical connection to the combined system shall be sized in accordance with Section 1101.12.1 based on the rainfall rate for which the primary system is sized.

(shown for informational purpose)

1101.0 General.

1101.12 Roof Drainage. (remaining text unchanged)

1101.12.1 Primary Roof Drainage. Roof areas of a building shall be drained by roof drains or gutters. The location and sizing of drains and gutters shall be coordinated with the structural design and pitch of the roof. Unless otherwise required by the Authority Having Jurisdiction, roof drains, gutters, vertical conductors or leaders, and horizontal storm drains for primary drainage shall be sized based on a storm of 60 minutes duration and 100 year return period. Refer to Table D 101.1 (in Appendix D) for 100 years, 60-minute storms at various locations.

SUBSTANTIATION:

This language explicitly states the intent of this section that the primary and secondary systems, while independent pipes, should be sized based on Section 1101.12.1. With the code as written, we have experienced AHJs interpreting the language to imply that the primary system upstream of secondary roof drain tie in and the secondary system upstream of the connection to the vertical piping (i.e. before the create a combined system) both need to be sized for double the rainfall rate.
Item #: 203  
Code Number: 2024 UPC  
Section Number: 1101.12.2.3, Table 1701.1

**SUBMITTER:** Amanda Hickman  
**Organization Name:** The Hickman Group  
**Organization Representation:** The Single-Ply Roofing Industry (SPRI)

**RECOMMENDATION:**
Add new text

**Proposed Text:**

1101.0 General.

1101.12 Roof Drainage. (remaining text unchanged)

1101.12.2 Secondary Drainage. (remaining text unchanged)

1101.12.2.3 Gutters. Gutters shall be tested in accordance with test methods G-1, G-2 and G-3 of ANSI/SPRI GT-1.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI/SPRI GT-1-2016 (R2022)</td>
<td>Test Standard for External Gutter Systems</td>
<td>Gutters</td>
<td>1101.12.2.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ANSI/SPRI GT-1 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
It is essential for gutters to be properly tested and installed to ensure that the gutter performs properly. Plumbing experts responsible for gutter installation should be mindful of the necessity to adhere to the specified testing procedures. This will ensure that gutters function effectively as an integral part of the roof system.

All SPRI standards are free for download via this link: [https://www.spri.org/standards/](https://www.spri.org/standards/)
1102.0 Roof Drains.

1102.1 Applications. Roof drains shall be constructed of aluminum, cast-iron, copper alloy of not more than 15 percent zinc, leaded nickel bronze, stainless steel, ABS, PVC, polypropylene, polyethylene, or nylon and shall comply with ASME A112.3.1 or ASME A112.6.4/CSA B79.4.

**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.6.4/CSA B79.4-2003 (R2012) 2022</td>
<td>Roof, Deck, and Balcony Drains</td>
<td>Fixtures</td>
<td>1102.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.6.4/CSA B79.4 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The ASME A112.6.4 standard was harmonized with the CSA B79 standard.
SUBMITTER:
David Dexter

Organization Name:
3D Engineering Consultants, LLC

Organization Representation:
3D Engineering Consultants, LLC

RECOMMENDATION:
Revise text

Proposed Text:
1103.0 Size of Leaders, Conductors, and Storm Drains.

1103.1 Vertical Conductors and Leaders. Vertical conductors and leaders shall be sized by the maximum projected roof area and Table 1103.1, Table 1103.1(1), Table 1103.1(2), Table 1103.1(3), and Table 1103.1(4). Leaders shall be sized in accordance with Table 1103.1(3).

**Table 1103.1**

**SIZING ROOF DRAINS, LEADERS, AND VERTICAL RAINWATER PIPING**

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Flow (gpm)</th>
<th>1 (in/h)</th>
<th>2 (in/h)</th>
<th>3 (in/h)</th>
<th>4 (in/h)</th>
<th>5 (in/h)</th>
<th>6 (in/h)</th>
<th>7 (in/h)</th>
<th>8 (in/h)</th>
<th>9 (in/h)</th>
<th>10 (in/h)</th>
<th>11 (in/h)</th>
<th>12 (in/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>72</td>
<td>6.930</td>
<td>3.465</td>
<td>2.310</td>
<td>1.733</td>
<td>1.386</td>
<td>1.155</td>
<td>0.990</td>
<td>0.866</td>
<td>0.770</td>
<td>0.693</td>
<td>0.630</td>
<td>0.578</td>
</tr>
<tr>
<td>3</td>
<td>208</td>
<td>20.020</td>
<td>10.010</td>
<td>6.673</td>
<td>5.005</td>
<td>4.004</td>
<td>3.337</td>
<td>2.860</td>
<td>2.503</td>
<td>2.224</td>
<td>2.027</td>
<td>1.820</td>
<td>1.668</td>
</tr>
<tr>
<td>8</td>
<td>2,658</td>
<td>255.833</td>
<td>127.917</td>
<td>85.278</td>
<td>63.938</td>
<td>51.167</td>
<td>42.639</td>
<td>36.548</td>
<td>31.979</td>
<td>28.426</td>
<td>25.583</td>
<td>23.258</td>
<td>21.319</td>
</tr>
<tr>
<td>10</td>
<td>4,876</td>
<td>469.317</td>
<td>234.658</td>
<td>156.439</td>
<td>117.329</td>
<td>93.863</td>
<td>78.219</td>
<td>67.045</td>
<td>58.665</td>
<td>52.746</td>
<td>46.932</td>
<td>42.665</td>
<td>39.110</td>
</tr>
<tr>
<td>12</td>
<td>7,778</td>
<td>748.635</td>
<td>374.318</td>
<td>249.545</td>
<td>187.159</td>
<td>149.722</td>
<td>124.773</td>
<td>106.948</td>
<td>93.579</td>
<td>83.182</td>
<td>74.864</td>
<td>68.058</td>
<td>62.386</td>
</tr>
<tr>
<td>14</td>
<td>10,017</td>
<td>964.140</td>
<td>482.070</td>
<td>321.380</td>
<td>241.035</td>
<td>192.288</td>
<td>160.690</td>
<td>137.734</td>
<td>120.517</td>
<td>107.127</td>
<td>96.414</td>
<td>87.649</td>
<td>80.345</td>
</tr>
</tbody>
</table>

Notes:
1. Maximum discharge capacity, gpm (L/s), with approximately 1 3/4 inch (44 mm) head of water at the drain.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.
3. Vertical piping shall be round, square, or rectangular. Square pipe shall be sized to enclose its equivalent round pipe. Rectangular pipe shall have not less than the same cross-sectional area as its equivalent round pipe, except that the ratio of its side dimensions shall not exceed 3 to 1.

**Table 1103.1(1)**

**Sizing Roof Drains and Vertical Plastic Conductors for Rainwater Piping**

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Flow (gpm)</th>
<th>1 (in/h)</th>
<th>2 (in/h)</th>
<th>3 (in/h)</th>
<th>4 (in/h)</th>
<th>5 (in/h)</th>
<th>6 (in/h)</th>
<th>7 (in/h)</th>
<th>8 (in/h)</th>
<th>9 (in/h)</th>
<th>10 (in/h)</th>
<th>11 (in/h)</th>
<th>12 (in/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>72</td>
<td>6.930</td>
<td>3.465</td>
<td>2.310</td>
<td>1.733</td>
<td>1.386</td>
<td>1.155</td>
<td>0.990</td>
<td>0.866</td>
<td>0.770</td>
<td>0.693</td>
<td>0.630</td>
<td>0.578</td>
</tr>
<tr>
<td>3</td>
<td>208</td>
<td>20.020</td>
<td>10.010</td>
<td>6.673</td>
<td>5.005</td>
<td>4.004</td>
<td>3.337</td>
<td>2.860</td>
<td>2.503</td>
<td>2.224</td>
<td>2.027</td>
<td>1.820</td>
<td>1.668</td>
</tr>
<tr>
<td>8</td>
<td>2,658</td>
<td>255.833</td>
<td>127.917</td>
<td>85.278</td>
<td>63.938</td>
<td>51.167</td>
<td>42.639</td>
<td>36.548</td>
<td>31.979</td>
<td>28.426</td>
<td>25.583</td>
<td>23.258</td>
<td>21.319</td>
</tr>
<tr>
<td>10</td>
<td>4,876</td>
<td>469.317</td>
<td>234.658</td>
<td>156.439</td>
<td>117.329</td>
<td>93.863</td>
<td>78.219</td>
<td>67.045</td>
<td>58.665</td>
<td>52.746</td>
<td>46.932</td>
<td>42.665</td>
<td>39.110</td>
</tr>
<tr>
<td>12</td>
<td>7,778</td>
<td>748.635</td>
<td>374.318</td>
<td>249.545</td>
<td>187.159</td>
<td>149.722</td>
<td>124.773</td>
<td>106.948</td>
<td>93.579</td>
<td>83.182</td>
<td>74.864</td>
<td>68.058</td>
<td>62.386</td>
</tr>
<tr>
<td>14</td>
<td>10,017</td>
<td>964.140</td>
<td>482.070</td>
<td>321.380</td>
<td>241.035</td>
<td>192.288</td>
<td>160.690</td>
<td>137.734</td>
<td>120.517</td>
<td>107.127</td>
<td>96.414</td>
<td>87.649</td>
<td>80.345</td>
</tr>
</tbody>
</table>

Notes:
1. Vertical drain capacity based on the equation $Q=65.2 \times (r_{s} \frac{1}{3}) \times d_{f}^{2/3}$ with $r_{s}=\frac{1}{3}$.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.
3. Vertical piping shall be round.
4. Plastic conductors include ABS Schedule 40, Polyethylene, and PVC Schedule 40.
### Table 1103.1(3)

**Sizing Roof Drains and Vertical Copper DWV Conductors for Rainwater Piping**

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Flow (gpm)</th>
<th>Maximum Allowable Horizontal Projected Roof Areas at Various Rainfall Rates (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td>2,599</td>
</tr>
<tr>
<td>3</td>
<td>91</td>
<td>7,799</td>
</tr>
<tr>
<td>4</td>
<td>173</td>
<td>16,651</td>
</tr>
<tr>
<td>5</td>
<td>315</td>
<td>30,319</td>
</tr>
<tr>
<td>6</td>
<td>516</td>
<td>49,665</td>
</tr>
<tr>
<td>8</td>
<td>1,118</td>
<td>107,608</td>
</tr>
<tr>
<td>10</td>
<td>2,035</td>
<td>195,869</td>
</tr>
<tr>
<td>15</td>
<td>5,106</td>
<td>491,454</td>
</tr>
</tbody>
</table>

1. Vertical drain capacity based on the equation \( Q = 27.8 \times r_s^{5/3} \times d^{8/3} \) with \( r_s = 1/3 \)

2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4mm/h) column by the desired rainfall rate.

3. Vertical piping shall be round.

### Table 1103.1(4)

**Sizing Roof Drains and Vertical Stainless-Steel Conductors for Rainwater Piping**

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Flow (gpm)</th>
<th>Maximum Allowable Horizontal Projected Roof Areas at Various Rainfall Rates (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>177</td>
<td>17,036</td>
</tr>
<tr>
<td>4</td>
<td>492</td>
<td>47,355</td>
</tr>
<tr>
<td>6</td>
<td>1,337</td>
<td>128,687</td>
</tr>
<tr>
<td>8</td>
<td>2,419</td>
<td>232,830</td>
</tr>
<tr>
<td>10</td>
<td>4,389</td>
<td>422,443</td>
</tr>
</tbody>
</table>

1. Vertical drain capacity based on the equation \( Q = 65.2 \times r_s^{5/3} \times d^{8/3} \) with \( r_s = 1/3 \)

2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4mm/h) column by the desired rainfall rate.

3. Vertical piping shall be round.
Table 1103.1(3)
Size of Vertical Leaders

<table>
<thead>
<tr>
<th>Diameter of Leader, in. (mm)</th>
<th>Maximum Discharge Capacity, gpm (L/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (50.8)</td>
<td>30 (1.2)</td>
</tr>
<tr>
<td>2 × 2 (50.8 × 50.8)</td>
<td>30 (1.2)</td>
</tr>
<tr>
<td>1½ × 2½ (38.1 × 63.5)</td>
<td>30 (1.2)</td>
</tr>
<tr>
<td>2 (63.5)</td>
<td>54 (3.4)</td>
</tr>
<tr>
<td>2½ × 2½ (63.5 × 63.5)</td>
<td>54 (3.4)</td>
</tr>
<tr>
<td>3 (76.2)</td>
<td>92 (5.8)</td>
</tr>
<tr>
<td>2 × 4 (50.8 × 101.6)</td>
<td>92 (5.8)</td>
</tr>
<tr>
<td>2½ × 3 (63.5 × 76.2)</td>
<td>92 (5.8)</td>
</tr>
<tr>
<td>4 (101.6)</td>
<td>192 (12.1)</td>
</tr>
<tr>
<td>3 × 4½ (76.2 × 107.6)</td>
<td>192 (12.1)</td>
</tr>
<tr>
<td>3½ × 4 (88.9 × 101.6)</td>
<td>192 (12.1)</td>
</tr>
<tr>
<td>5 (127)</td>
<td>360 (22.7)</td>
</tr>
<tr>
<td>4 × 5 (101.6 × 127)</td>
<td>360 (22.7)</td>
</tr>
<tr>
<td>4½ × 4½ (114.3 × 114.3)</td>
<td>360 (22.7)</td>
</tr>
<tr>
<td>6 (152.4)</td>
<td>563 (35.5)</td>
</tr>
<tr>
<td>5 × 6 (127 × 152.4)</td>
<td>563 (35.5)</td>
</tr>
<tr>
<td>5½ × 5½ (139.7 × 139.7)</td>
<td>563 (35.5)</td>
</tr>
<tr>
<td>6 (203.2)</td>
<td>1,208 (76.2)</td>
</tr>
<tr>
<td>6 × 8 (152.4 × 203.2)</td>
<td>1,208 (76.2)</td>
</tr>
</tbody>
</table>

1 With approximately 1 3/4-inch (45mm) head of water at the drain

SUBSTANTIATION:
A peer-reviewed paper, Capacities of Stacks and Horizontal Drains in Storm Drainage Systems (2023), demonstrates that flow rates in drainage pipes significantly vary depending on the type of pipe material. The existing tables in the 2024 UPC for sizing conductors (Table 1103.1) and horizontal piping (Table 1103.2) are believed to assume cast iron piping thus restricting the allowable capacities for other pipe material resulting in oversizing pipes.

It is important that the user understands the basis of the tables development. As engineers, designers, contractors and Authorities-Having-Jurisdiction (AHJ) all understand the appropriate use of the tables within the codes. Hence, one must know the materials used as a basis for the table and the material characteristics that impact the capacities of each material. It is also important to remember, that when mixing materials, the most restrictive will drive the design.

The existing Tables 1103.1 and 1103.2 were created using approved engineering equations. The same engineering equations were used to create the new tables in this proposal by adjusting the friction coefficient applicable to the type of material and using the inside diameter of each pipe material rather than the nominal pipe size.

For conductors, the flow rate was determined using the accepted engineering equation from NBS Monograph 31 for stack capacities. The constant, 27.8, is derived from the roughness of cast iron pipe. This constant will change for pipes having differing roughness coefficients. Therefore, new separate tables were created for plastic pipe, cast-iron, copper DWV, and stainless-steel pipe. The adjusted equations corresponding to the pipe roughness are noted in footnote 1 in each table. These adjustments are based on the peer-reviewed paper cited above.

For horizontal drain capacities, the peer-reviewed paper compared two engineering equations, Darcy-Weisbach and Manning, and found that the Manning equation was more conservative in calculating flow rates. The new tables for horizontal storm drains use the more conservative Manning equation. The current 2024 UPC Table 1103.2 corresponds closely to the Manning equation when using nominal pipe sizes and the coefficient of roughness for cast iron pipe (0.015). The Manning's n-value and the internal pipe diameters differ for different types of pipe material. Therefore, separate tables are made for plastic pipe, cast iron and galvanized pipe, copper DWV, and stainless-steel pipe. The Manning equation and the n-value are shown in footnote 1 in each table. When using the Manning equation, the greatest flow rate is when the hydraulic depth is 94% of the diameter of the pipe as explained in the peer-reviewed paper, and mentioned in Footnote 1.

A new Table 1103.1(3) is added for vertical leaders separate from the tables for conductors, which are only for round pipe as indicated in footnote 3. Leaders may have various geometric shapes – round, square, and rectangular. Table 1103.1(3) agrees with the ASPE Handbook, Vol II, Table 4-6 for vertical leaders.

Documents submitted:

[Supporting documentation provided in KAVI for TC review]
1103.2 Size of Horizontal Storm Drains and Sewers. The size of building storm drains, or building storm sewers or their horizontal branches shall be based on the maximum projected roof or paved area to be handled and Table 1103.2(1), Table 1103.2(2), Table 1103.2(3), and Table 1103.2(4).

**TABLE 1103.2**

**SIZING OF HORIZONTAL RAINWATER PIPING**

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Flow</th>
<th>Maximum Allowable Horizontal Projected Roof Areas at Various Rainfall Rates (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>inches</td>
<td>gpm</td>
<td>1 (in/h)</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>2288</td>
</tr>
<tr>
<td>4</td>
<td>52</td>
<td>5556</td>
</tr>
<tr>
<td>6</td>
<td>80</td>
<td>8000</td>
</tr>
<tr>
<td>8</td>
<td>108</td>
<td>10800</td>
</tr>
<tr>
<td>10</td>
<td>135</td>
<td>13500</td>
</tr>
<tr>
<td>12</td>
<td>162</td>
<td>16200</td>
</tr>
<tr>
<td>15</td>
<td>198</td>
<td>19800</td>
</tr>
</tbody>
</table>

Notes:
1. The sizing data for horizontal piping are based on the pipes flowing full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.
3. For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, \(\frac{1}{8}\) inch per foot = 10.4 mm/m, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m\(^2\).
### Size of Pipe (1/4 inch per foot slope)

<table>
<thead>
<tr>
<th>Inches</th>
<th>gpm</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>89</td>
<td>81</td>
<td>84</td>
<td>87</td>
<td>90</td>
<td>93</td>
<td>96</td>
<td>100</td>
<td>103</td>
<td>106</td>
<td>109</td>
<td>112</td>
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<tr>
<td>4</td>
<td>4</td>
<td>146</td>
<td>150</td>
<td>154</td>
<td>158</td>
<td>163</td>
<td>167</td>
<td>172</td>
<td>177</td>
<td>182</td>
<td>187</td>
<td>192</td>
<td>197</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>200</td>
<td>205</td>
<td>210</td>
<td>216</td>
<td>222</td>
<td>228</td>
<td>234</td>
<td>240</td>
<td>246</td>
<td>252</td>
<td>258</td>
<td>264</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>229</td>
<td>235</td>
<td>241</td>
<td>247</td>
<td>254</td>
<td>260</td>
<td>266</td>
<td>273</td>
<td>279</td>
<td>286</td>
<td>292</td>
<td>299</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>357</td>
<td>364</td>
<td>371</td>
<td>379</td>
<td>386</td>
<td>394</td>
<td>402</td>
<td>410</td>
<td>418</td>
<td>426</td>
<td>434</td>
<td>442</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>500</td>
<td>510</td>
<td>520</td>
<td>530</td>
<td>540</td>
<td>550</td>
<td>560</td>
<td>570</td>
<td>580</td>
<td>590</td>
<td>600</td>
<td>610</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>667</td>
<td>680</td>
<td>694</td>
<td>708</td>
<td>722</td>
<td>736</td>
<td>750</td>
<td>764</td>
<td>778</td>
<td>792</td>
<td>806</td>
<td>820</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
<td>772</td>
<td>788</td>
<td>804</td>
<td>820</td>
<td>836</td>
<td>853</td>
<td>870</td>
<td>887</td>
<td>904</td>
<td>921</td>
<td>938</td>
<td>955</td>
</tr>
</tbody>
</table>

1. The sizing for horizontal piping is based on the Manning equation \( q = \frac{666.96}{n} \times A \times R \) \( \frac{1}{10} \) with \( n=0.010 \) and hydraulic depth 94% of pipe diameter.

2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4mm/h) column by the desired rainfall rate.

3. Plastic horizontal pipe include ABS Schedule 40, Polyethylene, and PVC Schedule 40.

### Flow (1/8 inch per foot slope)

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Maximum Allowable Horizontal Projected Roof Areas at Various Rainfall Rates (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>gpm</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>98</td>
</tr>
</tbody>
</table>

---

Table 1103.2(2)

**Sizing of Horizontal Cast Iron And Galvanized Steel Rainwater Piping**

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Flow (1/4 inch per foot slope)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>gpm</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

---

1. The sizing for horizontal piping is based on the Manning equation \( q = \frac{666.96}{n} \times A \times R \) \( \frac{1}{10} \) with \( n=0.010 \) and hydraulic depth 94% of pipe diameter.

2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4mm/h) column by the desired rainfall rate.

3. Plastic horizontal pipe include ABS Schedule 40, Polyethylene, and PVC Schedule 40.
The existing Tables 1103.1 and 1103.2 were created using approved engineering equations. The same engineering equations were used to create the new tables in this edition of the code. It is important that the user understand the basis of the tables development. As engineers, designers, contractors and Authorities-Having-Jurisdiction (AHJ) all understand the appropriate use of the tables within the codes. Hence, one must know the materials used as a basis for the table and the material characteristics' that impact the capacities of each material. It is also important to remember, that when mixing materials, the most restrictive will drive the design.

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For conductors, the flow rate was determined using the accepted engineering equation from NBS Monograph 31 for stack capacities. The constant, 27.8, is derived from the roughness of cast iron pipe. This constant will change for pipes having differing roughness coefficients. Therefore, new separate tables were created for plastic pipe, cast-iron, copper DWV, and stainless-steel pipe. The adjusted equations corresponding to the pipe roughness are noted in footnote 1 in each table. These equations are based on the peer-reviewed paper cited above.
For horizontal drain capacities, the peer-reviewed paper compared two engineering equations, Darcy-Weisbach and Manning, and found that the Manning equation was more conservative in calculating flow rates. The new tables for horizontal storm drains use the more conservative Manning equation. The current 2024 UPC Table 1103.2 corresponds closely to the Manning equation when using nominal pipe sizes and the coefficient of roughness for cast iron pipe (0.015). The Manning's n-value and the internal pipe diameters differ for different types of pipe material. Therefore, separate tables are made for plastic pipe, cast iron and galvanized pipe, copper DWV and stainless-steel pipe. The Manning equation and the n-value are shown in footnote 1 in each table. When using the Manning equation, the greatest flow rate is when the hydraulic depth is 94% of the diameter of the pipe as explained in the peer-reviewed paper, and mentioned in Footnote 1.

A new Table 1103.1(3) is added for vertical leaders separate from the tables for conductors, which are only for round pipe as indicated in footnote 3. Leaders may have various geometric shapes – round, square, and rectangular. Table 1103.1(3) agrees with the ASPE Handbook, Vol II, Table 4-6 for vertical leaders.

Documents submitted:

[Supporting documentation provided in KAVI for TC review]


**RECOMMENDATION:**
Revise text

**Proposed Text:**
1106.0 Engineered Storm Drainage System.

1106.3 Siphonic Roof Drains. Siphonic roof drains shall comply with ASME A112.6.9/CSA B79.9.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
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<td>REFERENCED STANDARDS</td>
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<table>
<thead>
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<th>STANDARD TITLE</th>
<th>APPLICATION</th>
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<td>Siphonic Roof Drains</td>
<td>DWV Components</td>
<td>1106.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.6.9/CSA B79.9 meets the requirements for mandatory a referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The ASME A112.6.9 standard was harmonized with the CSA B79 standard.
1202.2 Piping System Requirements. Requirements for piping systems shall include design, materials, components, fabrication, assembly, installation, testing, inspection, purging, operation, and maintenance. [NFPA 54.1.1.1.1(E)]

1202.3 Applications. This chapter shall not apply to the following items:
(1) to (8) (text remains unchanged)
(9) Liquefied natural gas (LNG) systems.
(10) to (20) (text remains unchanged)

1208.0 Gas Piping System Design, Materials, and Components.

1208.1 Installation of Piping System. Where required by the Authority Having Jurisdiction, a piping sketch or plan shall be prepared before proceeding with the installation. The plan shall show the proposed location of piping, the size of different branches, the various load demands, and the location of the point of delivery, the location of isolation valves, and accommodations for meeting the safe purging requirements as required in this chapter. [NFPA 54.5.1.1, 5.1.1.2]

1208.1.1 Addition to Existing System. When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has adequate capacity. If the capacity of the system is determined to be inadequate for the additional appliances, one or more of the following modifications shall be made to provide required minimum gas pressures to each appliance:
(1) The existing system shall be enlarged as required, or separate piping shall be provided.
(2) Separate gas piping of adequate capacity shall be provided.
(3) The gas pressure is increased within the limitations of the existing piping system and connected appliances. [NFPA 54.5.1.2.1, 5.1.2.2]

1208.3 Sizing of Gas Piping Systems General Considerations. Gas piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance. [NFPA 54.5.3.1]

1208.3.1 Maximum Gas Demand. The volumetric flow rate of gas to be provided shall be the sum of the maximum input of the appliances served. The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2000 feet (610 m). [NFPA 54.5.3.2.1 – 5.3.2.2] Where the input rating is not indicated, the gas supplier, appliance manufacturer, or a qualified agency shall be contacted, or the rating from Table 1208.3.1 shall be used for estimating the volumetric flow rate of gas to be supplied.

1208.3.2 Total Connected Hourly Load. The total connected hourly load shall be used as the basis for piping sizing, assuming all appliances are operating at full capacity simultaneously.

Exception: Sizing shall be permitted to be based upon established load diversity factors. [NFPA 54.5.3.2.3]

1208.4 Maximum Operating Pressure in Buildings. (remaining text unchanged)

(1) (remaining text unchanged)
(2) The piping is joined by fittings listed to CSA/ANSI LC 4/CSA 6.32 and installed according to the manufacturer’s installation instructions.
1208.5 Acceptable Piping Materials and Joining Methods. Materials used for piping systems shall either comply with the requirements of Section 1208.5.1 through Section 1208.5.6.3 or be acceptable to the Authority Having Jurisdiction. {NFPA 54:5.5.1.1}

1208.5.2 Metallic Pipe. (remaining text unchanged)

1208.5.2.3 Copper and Copper Alloy Pipe. Copper and copper alloy pipe shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet (scf) of gas (0.7 mg/100 L). Threaded copper, copper alloy, or aluminum alloy pipe shall not be used with gases corrosive to such material. [NFPA 54:5.5.2.3 – 5.5.2.4]

1208.5.5 Regulator Vent Piping. Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to UL 651, {Schedule 40 and 80; Rigid PVC Conduit and Fittings}. PVC vent piping shall not be installed indoors. {NFPA 54:5.5.4.2}

1208.5.6 Anodeless Risers. (remaining text unchanged)

1208.5.6.1 Factory-Assembled Anodeless Risers. Anodeless risers shall comply with the following:
(1) Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used and shall be leak tested by the manufacturer in accordance with written procedures. [NFPA 54:5.5.4.3(1)]

1208.5.6.2 Service Head Adapters and Field-Assembled Anodeless Risers. (2) Service head adapters and field-assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used and shall be design-certified to meet the requirements of Category I of ASTM D2513 and 49 CFR 192.281(e). The manufacturer shall provide the user qualified installation instructions as prescribed by 49 CFR 192.283(b). [NFPA 54:5.5.4.3(2)]

1208.5.6.3 Undiluted Liquefied Petroleum Gas Piping. (3) The use of plastic pipe, tubing, and fittings in undiluted LP-Gas piping systems shall be in accordance with NFPA 58. [NFPA 54:5.5.4.3(3)]

1208.5.7 Workmanship and Defects. Gas pipe, tubing, and fittings at the time of installation shall meet the following requirements:
(1) Gas pipe, tubing, and fittings shall be clear and free from cutting burrs and visible defects in structure or threading.
(2) Gas pipe, tubing, and fittings shall be thoroughly brushed and cleaned to remove chip and scale blown. Defects and debris.
(3) Visible defects in pipe, tubing, and fittings shall not be repaired.
(4) Defective pipe, tubing, and fittings with visible defects shall be replaced. [NFPA 54:5.5.5]

1208.5.8 Metallic Specifications for Pipe Threads. Metallic pipe and fitting threads shall be taper pipe threads and shall comply with ANSI/ASME B1.20.1. [NFPA 54:5.5.6.1]

1208.5.8.1 Damaged Threads. Pipe with threads that are stripped, chipped, corroded, or otherwise damaged shall not be used. Where a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used. [NFPA 54:5.5.6.2.1, 5.5.6.2.2]

1208.5.8.3 Thread Joint Sealing. Threaded joints shall be made using a thread joint sealing material. [NFPA 54:5.5.6.4.1]

1208.5.8.3 Thread joint sealing materials shall be compatible with the pipe and fitting material on which the compounds are used. [NFPA 54:5.5.6.4.2]

Thread joint sealing materials shall be non-hardening and shall be resistant to the chemical constituents of the gases to be conducted through the piping. {NFPA 54:5.5.6.4.3}

1208.5.9 Metallic Piping Joints and Fittings. The type of piping joint used shall be conform to the following:
(1) Be suitable for the pressure and temperature conditions and shall be
(2) Be selected giving consideration to joint tightness and mechanical strength under the service conditions. The
joint shall be able to sustain the maximum end force due to the internal pressure and any additional forces due to inclusive of temperature expansion or contraction, vibration, fatigue, internal pressure, or the weight of the pipe and its contents. [NFPA 54:5.5.7]

1208.5.9.1 Pipe Joints. Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded, or assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32. Pipe lighter than Schedule 40 shall be connected using press-connect fittings, flanges, brazing, or welding.

(1) Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1000°F (538°C).
(2) Brazing alloys shall not contain more than 0.05 percent phosphorus. {NFPA 54:5.5.7.1}

1208.5.9.2 Copper Tubing Joints. Copper tubing joints shall be assembled with approved gas tubing fittings, shall be brazed with a material having a melting point in excess of 1000°F (538°C), or shall be assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32. Brazing alloys shall not contain more than 0.05 percent phosphorus. [NFPA 54:5.5.7.2]

1208.5.9.5 Metallic Pipe Fittings. Metallic fittings shall comply with the following:
(1) - (4) (remaining text unchanged)
(5) Cast-Iron Fittings. Cast-iron fittings shall comply with the following:
(a) - (c) (remaining text unchanged)
(d) Fittings in sizes 4 inches (100 mm) and larger shall not be used indoors unless approved by the Authority Having Jurisdiction.
(e) Fittings in sizes 6 inches (150 mm) and larger shall not be used unless approved by the Authority Having Jurisdiction.
(6) Aluminum alloy fitting threads shall not form the joint seal.
(7) Zinc-Aluminum Alloy Fittings. Fittings shall not be used in systems containing flammable gas-air mixtures.
(8) Special Fittings. Fittings such as couplings, proprietary type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression type tubing fittings shall be as follows:
(remaining text unchanged)[NFPA 54:5.5.7.5]

1208.5.11.3 Non-Ferrous Flanges. Non-ferrous flanges shall be in accordance with ASME B16.24.
Exception: Listed components using aluminum flange connections constructed in accordance with the dimensional specifications of ASME B16.5 or ASME B16.1. {NFPA 54:5.5.9.1.3}

1208.5.12.2 Metallic Flange Gaskets. Metallic flange gaskets shall be in accordance with ANSI/ASME B16.20. [NFPA 54:5.5.10.2.1]

1208.5.12.3 Non-Metallic Flange Gaskets. Non-metallic flange gaskets shall be in accordance with ANSI/ASME B16.21. [NFPA 54:5.5.10.2.2]

1208.6 Gas Meters. Capacity. Gas meters shall be selected for the maximum expected pressure and permissible pressure drop. [NFPA 54:5.6.1]

1208.6.1.1 Protection from Damage. Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls, or where they will be subject to excessive corrosion or vibration. [NFPA 54:5.6.2.2]

1208.6.2 Supports. Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters. Where flexible connectors are used to connect a gas meter to downstream piping at manufactured homes in manufactured-home parks and mobile homes in mobile home parks, the meter shall be supported by a post or bracket placed in a firm footing or by other means providing equivalent support. [NFPA 54:5.6.3.1, 5.6.3.2]

1208.7 Gas Pressure Regulators Where Required. A line pressure regulator shall be installed where the gas supply pressure exceeds the maximum allowable inlet pressure of the appliance served. [NFPA 54:5.7.1]
1208.7.1 Listing. Line pressure regulators shall be listed in accordance with CSA/ANSI Z21.80/CSA 6.22 where the outlet pressure is set to 2 psi (14 kPa) or less. [NFPA 54:5.7.2]

1208.7.6 Regulator Removal. A union shall be installed either upstream or downstream of a regulator with threaded pipe connections. [NFPA 54:5.7.7]

1208.8 Overpressure Protection Where Required. Where the serving gas supplier delivers gas at a pressure greater than 2 psi (14 kPa) for piping systems serving appliances designed to operate at a gas pressure of 14 inches water column (3.5 kPa) or less, overpressure protection devices shall be installed. Piping systems serving equipment designed to operate at inlet pressures greater than 14 inches water column (3.5 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer's installation instructions. [NFPA 54:5.8.1]

1208.9 Overpressure Protection Devices. Overpressure protection devices shall be one of the following:
1. Pressure relief valve.
3. Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator to the maximum values specified by Section 1208.10 or less.
4. Automatic shutoff device installed in series with the line pressure regulator and set to shut off when the pressure on the downstream piping system reaches the maximum values specified by Section 1208.10 or less. This device shall be designed so that it will remain closed until manually reset. [NFPA 54:5.8.3.1]

1208.9.7 Size of Fittings, Pipe, and Openings. The fittings, pipe, and openings located between the system to be protected and the pressure relieving device shall be sized to prevent hammering of the valve and to prevent impairment of relief capacity. [NFPA 54:5.8.9]

1208.14 Expansion and Flexibility Design. Piping systems shall be designed to prevent failure from thermal expansion or contraction. [NFPA 54:5.13.1]

1208.15 Pressure Regulator and Pressure Control Venting. The venting of the atmospheric side of diaphragms in line pressure regulators, gas appliance regulators, and gas pressure limit controls shall be in accordance with all of the following:
1. An independent vent pipe to the outdoors, sized in accordance with the device manufacturer's instructions, shall be provided where the location of a device is such that a discharge of fuel gas will cause a hazard. For devices other than appliance
2. Independent vents for multiple regulators, vents are shall not be required to be independent where the vents are connected to a common manifold designed in accordance with engineering methods to minimize backpressure in the event of diaphragm failure and such design is approved. Exceptions:
3. A regulator and vent limiting means combination listed as complying in accordance with CSA/ANSI Z21.80/CSA 6.22, shall not be required to be vented to the outdoors.
4. A listed gas appliance regulator factory equipped with a vent limiting device is shall not be required to be vented to the outdoors.
5. A listed gas pressure limit control that is factory equipped with a vent limiting device and in accordance with UL 353, Limit Controls, or UL 60730-2-6, Automatic Electrical Controls for Household and Similar Use, Part 2, shall not be required to be vented to the outdoors.
6. Materials for vent piping shall be in accordance with Section 1208.5 through Section 1208.5.12.5.
7. The vent terminus shall be designed to prevent the entry of water, insects, and other foreign matter that could cause blockage.
8. Vent piping shall be installed to minimize static loads and bending moments placed on the regulators and gas pressure control devices.
9. Vents shall terminate not less than 3 feet (914 mm 0.9 m) from a possible source of ignition.
At locations where a vent termination could be submerged during floods or snow accumulations, one of the following shall apply:
(a) An anti-flood-type breather vent fitting shall be installed, or the vent terminal shall be located above the height of the expected flood waters or snow.
(b) Vent piping from pressure regulators and gas pressure controls shall not be connected to a common manifold that serves a bleed line from a diaphragm-type gas valve. [NFPA 54:5.14]

1209.1 General. Where automatic excess flow valves are installed, they shall be listed in accordance with ANSI Z21.93/CSA 6.30 and shall be sized and installed in accordance with the manufacturers’ instructions. [NFPA 54:5.12]

1210.1.3 Corrosion Protection. Steel pipe and steel tubing installed underground shall be installed in accordance with Section 1210.1.3.1 through Section 1210.1.3.9. [NFPA 54:7.1.3]

1210.1.7.1 Connections Between Metallic and Plastic Piping. Connections made between metallic and plastic piping shall be made with fittings conforming to one of the following:
(1) ASTM D2513, Category I transition fittings
(2) ASTM F1973
(3) ASTM F2509 [NFPA 54:7.1.7.2]

1210.1.7.2 Tracer Wire. An electrically continuous corrosion-resistant tracer shall be buried with the plastic pipe to facilitate locating. The tracer shall be one of the following:
(1) A product specifically designed for that purpose.
(2) Insulated copper conductor not less than 14 AWG.
(3) Tracer wire listed and labeled in accordance with UL 2989.
Where tracer wire is used, access shall be provided from aboveground, or one end of the tracer wire or tape shall be brought aboveground at a building wall or riser. [NFPA 54:7.1.7.3 – 7.1.7.3.2]

1210.3.5 Hangers, Supports, and Anchors. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and equipment and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of ANSI/MSS SP-58. [NFPA 54:7.2.6.1]

1210.3.5.1 Spacing. Spacing of supports in gas piping installations shall not be greater than shown in Table 1210.3.5.1. Spacing of supports of CSST shall be in accordance with the CSST manufacturer’s instructions. [NFPA 54:7.2.6.2]

1210.3.5.2 Expansion and Contraction. Supports, hangers, and anchors shall be installed so as not to interfere with the free expansion and contraction of the piping between anchors. All parts of the supporting system shall be designed and installed so they are not disengaged by movement of the supported piping. [NFPA 54:7.2.6.34]

1210.3.5.3 Piping on Roofs. Gas piping installed on the roof surfaces shall be supported in accordance with Table 1210.3.5.1. Gas piping shall be elevated not less than 3½ inches (89 mm) above the roof surface. [NFPA 54:7.2.6.4.1, 7.2.6.4.2, 7.2.6.5.1, 7.2.6.5.2]

1210.4.5 Other Occupancies. In other than industrial Gas piping in nonindustrial occupancies and where approved by the Authority Having Jurisdiction, gas piping shall not be embedded in concrete floor slabs constructed with portland cement Unless in accordance with the following:
(1) The installation shall be approved.
(2) Embedded gas piping shall be surrounded with a minimum of 1 1/2 inches (38 mm) of concrete and,
(3) Embedded gas piping shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors.
(4) All piping, fittings, and risers shall be protected against corrosion in accordance with Section 1210.3.1.
Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate. [NFPA 54:7.3.5.2 – 7.3.5.2.5]

1210.4.6 Shutoff Valves in Tubing Systems. Shutoff valves in tubing systems in concealed locations shall be rigidly and securely supported independently of the tubing. [NFPA 54:7.3.6]

1210.7 Provided Drips and Sediment Traps Where Necessary. For other than dry gas conditions, a drip shall be provided at any point in the line of pipe where condensate could collect. Where required by the Authority Having Jurisdiction or the serving gas supplier, a drip shall also be provided at the outlet of the meter. This drip shall be installed so as to constitute a trap wherein an accumulation of condensate shuts off the flow of gas before it runs back into the meter. [NFPA 54:7.6.1]

1210.9 Manual Gas Shutoff Valves Valves at Regulators. An accessible gas shutoff valve shall be provided upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator. [NFPA 54:7.8.2]

1210.9.1 Accessibility of Gas Valves. System shutoff valves shall be readily accessible for operation and installed so as to be protected from physical damage. System shutoff valves shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified. [NFPA 54:7.8.1.1 – 7.8.1.2, 7.8.1.1, 7.8.1.2]

1210.9.4 Shutoff Valve for Laboratories. Each laboratory space containing two or more gas outlets installed on tables, benches, or in hoods in educational, research, commercial, and industrial occupancies shall have a single shutoff valve through which all such gas outlets are supplied. The shutoff valve shall be accessible, located within the laboratory or adjacent to the laboratory’s egress door, and identified. [NFPA 54:7.8.3.3]

1210.12.5.1 Location. The gas-mixing machine shall be located in a well-ventilated area or in a detached building or cutoff room provided with room construction and explosion vents in accordance with engineering methods. Such rooms or below-grade installations shall have adequate positive ventilation. [NFPA 54:7.11.5.1]

1210.12.5.2 Electrical Requirements. Where gas-mixing machines are installed in well-ventilated areas, the type of electrical equipment shall be in accordance with NFPA 70 for general service conditions unclassified areas unless other hazards require classification of the area prevail. Where gas-mixing machines are installed in small detached buildings or cutoff rooms, the electrical equipment and wiring shall be installed in accordance with NFPA 70 for hazardous locations (Articles 500 and 501, classified Class I, Division 2). [NFPA 54:7.11.5.2, 7.11.5.2.2]

1211.1 Pipe and Tubing Other than CSST. Each aboveground portion of a gas piping system, other than CSST, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than CSST, shall be considered to be bonded when it is connected to one or more appliances that are connected to the appliance equipment grounding conductor of the circuit supplying that appliance(s). [NFPA 54:7.12.1.1, 7.12.1.2]

1211.2 Bonding of CSST Gas Piping. CSST gas piping systems, and gas piping systems containing one or more segments of CSST, shall be electrically continuous and bonded to the electrical service grounding electrode system or, where provided, lightning protection grounding electrode system. [NFPA 54:7.12.2]

1211.3 Arc-Resistant Jacketed CSST. CSST listed with an arc-resistant jacket or coating system shall be listed as arc-resistant in accordance with CSA/ANSI LC 1/CSA 6.26. Arc-resistant jacketed CSST shall be electrically continuous and bonded to an effective ground-fault current path. Where any CSST component of a piping system does not have an arc-resistant jacket or coating system, the bonding requirements of Section 1211.2 shall apply. Arc-resistant jacketed CSST shall be considered to be bonded when it is connected to one or more appliances that are connected to the appliance equipment grounding conductor of the circuit supplying that appliance(s). Where any CSST used in a piping system does not have an arc-resistant jacket or coating system, the bonding requirements of Section 1211.2 shall apply. [NFPA 54:7.12.3.1-7.12.3.4]

1211.4 Prohibited Use Electrical Isolation. Gas piping shall not be used as a grounding conductor or
electrode. Underground metallic piping shall be provided with a dielectric fitting installed at building penetrations. Dielectric fittings shall not be installed underground. [NFPA 54:7.12.4.1 - 7.12.4.2.1]

1211.5 Lightning Protection Systems. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780. [NFPA 54:7.12.5]

1211.7.1 Safety Control. Any essential safety control depending on electric current as the operating medium shall be of a type that shuts off (fail safe) the flow of gas in the event of current failure. Electrically operated safety devices shall fail safe and shut off the flow of gas in the event of electrical power failure. [NFPA 54:7.14.2]

1212.1.3 Restraining Device Restrainment. Movement of appliances with casters shall be limited by a restraining device installed in accordance with the connector and appliance manufacturer's installation instructions. [NFPA 54:9.6.1.4]

1212.5.1 Swivel Joints or Couplings. Where industrial appliances requiring mobility are connected to the rigid piping by the use of swivel joints or couplings, the swivel joints or couplings shall be suitable for the service required; and only the minimum number required shall be installed. [NFPA 54:9.6.4.2]

1212.6 Appliance Shutoff Valves and Connections. Each appliance connected to a piping system shall have an accessible, approved manual shutoff valve with a nondisplaceable valve member, or a listed gas convenience outlet. Appliance shutoff valves and convenience outlets shall serve a single appliance only and shall be installed in accordance with Section 1212.6.1 through Section 1212.6.3. [NFPA 54:9.6.5]

**1212.6.1 Location.** The shutoff valve shall be located within 6 feet (1829 mm) of the appliance it serves. [NFPA 54:9.6.5.1]

**Exceptions:**
(1) Shutoff valves serving appliances installed in vented fireplaces and ventless firebox enclosures shall not be required to be located within 6 feet (1829 mm) of the appliance where such valves are readily accessible and permanently identified. The piping from the shutoff valve to within 6 feet (1829 mm) of the appliance shall be designed, sized, installed, and tested in accordance with this chapter. [NFPA 54:9.6.5.2]
(2) Where installed at a manifold, the appliance shutoff valve shall be located within 50 feet (15 240 mm) of the appliance served and shall be readily accessible and permanently identified. The piping from the manifold to within 6 feet (1829 mm) of the appliance shall be designed, sized, installed, and tested in accordance with this chapter. [NFPA 54:9.6.5.3]

1212.8 Gas Convenience Outlets. Appliances shall be permitted to be connected to the building piping by means of a listed gas convenience outlet, in conjunction with a listed appliance connector, installed in accordance with the manufacturer's installation instructions. Gas convenience outlets shall be listed in accordance with CSA/ANSI Z21.90/CSA 6.24 and installed in accordance with the manufacturer's installation instructions. [NFPA 54:9.6.7]

1213.1.2 Repairs and Additions. Where repairs or additions are made following the pressure test, the affected piping shall be tested. Minor repairs and additions are shall not be required to be pressure tested, provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other approved leak-detecting methods approved by the Authority Having Jurisdiction. [NFPA 54:8.1.1.3, 8.1.1.4]

1213.1.3 New Branches. Where new branches are installed to new appliance(s), only the newly installed branch(es) Minor repairs and additions shall not be required to be pressure tested. Connections between the new piping and the existing piping shall be connections are tested with a noncorrosive leak-detecting fluid or other approved leak-detecting methods. [NFPA 54:8.1.1.4]

1213.1.4 Piping System. A piping system shall be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section of the piping system and test medium in an adjacent section, unless a double block and bleed valve system is installed. A valve shall not be subjected to the...
test pressure unless it can be determined that the valve, including the valve closing mechanism, is designed to safely withstand the pressure. [NFPA 54:8.1.1.5 - 8.1.1.9]

1213.1.5 Regulators and Valves. Regulator and valve assemblies fabricated independently of the piping system in which they are to be installed shall be permitted to be tested with inert gas or air at the time of fabrication. [NFPA 54:8.1.1.6 - 8.1.1.10]

1213.4.1 Detecting Leaks. The leakage shall be located by means of an approved listed combustible gas detector, a noncorrosive leak detection fluid, or other approved leak detection methods. [NFPA 54:8.1.5.2]

1213.5 Piping System Leak Test Gases. Leak checks using fuel gas shall be permitted in piping systems that have been pressure tested in accordance with Section 1213.0 through Section 1213.4.2. [NFPA 54:8.2.1]

1213.6.1 Piping Systems Required to be Purged Outdoors. The purging of piping systems shall be in accordance with Section 1213.6.1.1 through Section 1213.6.1.5 where the piping system meets either of the following:

1. The design operating gas pressure is greater than 2 psig (14 kPag).
2. The piping being purged contains one or more sections of pipe or tubing meeting the size and length criteria of Table 1213.6.1. [NFPA 54:8.3.1]

1215.1 Pipe Sizing Methods. Where the pipe size is to be determined using any of the methods in Section 1215.1.1 through Section 1215.1.3, the diameter of each pipe segment shall be obtained from the pipe sizing tables in Section 1215.2, the sizing tables included in a listed piping system manufacturer’s installation instructions, or from the sizing equations in Section 1215.3. [NFPA 54:6.1]

1215.1.1 Longest Length Method. The pipe size of each section of gas piping shall be determined using the longest length of piping from the point of delivery to the most remote outlet and the load of the section. [NFPA 54:6.1.1 - 6.1.2] (see calculation example in Figure 1215.1.1)

1215.1.2 Branch Length Method. Pipe shall be sized as follows:

1. Pipe size of each section of the longest pipe run from the point of delivery to the most remote outlet shall be determined using the longest run of piping and the load of the section.
2. The pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the point of delivery to the most remote outlet in each branch and the load of the section. [NFPA 54:6.1.23]

1215.1.3 Hybrid Pressure. The pipe size for each section of higher pressure gas piping shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator. The pipe size from the line pressure regulator to each outlet shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator. [NFPA 54:6.1.34]

1215.3 Sizing Equations. The inside diameter of smooth wall pipe or tubing shall be determined by the sizing equations in Equation 1215.3(1), Equation 1215.3(2) and Table 1215.3 using the equivalent pipe length determined by the methods in Section 1215.1.1 through Section 1215.1.3. [NFPA 54:6.4]

LOW-PRESSURE GAS FORMULA (LESS THAN 1.5 psi)

\[ D = \frac{Q^{0.381}}{19.17 \left( \frac{\Delta H}{Cr \times L} \right)^{0.206}} \]

[Equation 1215.3(1)]
### TABLE 1215.2(1)

**Schedule 40 Metallic Pipe [NFPA 54: Table 6.2.1(a)]**

<table>
<thead>
<tr>
<th>Gas: Natural</th>
<th>Inlet Pressure: Less than 2 psi</th>
<th>Pressure Drop: 0.3 in. w.c.</th>
<th>Specific Gravity: 0.60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Size (in.)</td>
<td>Nominal: 1/2 3/4 1 1 1/4 1 1/2 2 2 1/2 3 4 5 6 8 10 12</td>
<td>Actual ID: 0.622 0.824 1.049 1.380 1.610 2.067 2.469 3.068 4.026 5.047 6.065 7.981 10.020 11.938</td>
<td></td>
</tr>
<tr>
<td>Length (ft)</td>
<td>Capacity in Cubic Feet of Gas per Hour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>131 273 514 1.060 1.580 3.050 4.860 8.580 17500 31700 51300 105000 191000 303000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>90 188 353 726 1.090 2.090 3.340 5.900 12000 21800 35300 72400 132000 208000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>72 151 284 583 873 1.680 2.680 4.740 9.660 17500 28300 58200 106000 167000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>62 129 243 499 747 1.440 2.290 4.050 8.270 15000 24200 49800 90400 143000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>55 114 215 442 662 1.280 2.030 3.590 7.330 13300 21500 44100 80100 127000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>50 104 195 400 600 1.160 1.840 3.260 6.640 12000 19500 40000 72600 115000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>46 95 179 368 552 1.060 1.690 3.000 6.110 11100 17900 36800 66800 106000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>42 89 167 343 514 989 1.580 2.790 5.680 10300 16700 34200 62100 98400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>40 83 157 322 482 928 1.480 2.610 5.330 9650 15600 32100 58300 92300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>38 79 148 304 455 877 1.400 2.470 5.040 9110 14800 30300 55100 87200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>33 70 131 269 403 777 1.240 2.190 4.460 8080 13100 26900 48800 77300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>30 63 119 244 366 704 1.120 1.980 4.050 7320 11900 24300 44200 70000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>28 58 109 224 336 648 1.030 1.820 3.720 6730 10900 22400 40700 64400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>26 54 102 209 313 602 960 1.700 3.460 6.260 10100 20800 37900 59900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>23 48 90 185 277 534 851 1.500 3.070 5.550 8990 18500 33500 53100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>21 43 82 168 251 484 771 1.360 2.780 5.030 8150 16700 30400 48100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>350</td>
<td>19 38 71 154 237 444 668 1.240 2.200 4.580 7010 13800 27600 47200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>17 33 63 135 218 371 573 1.120 1.820 3.690 6230 11700 23400 42400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>450</td>
<td>15 29 54 116 199 304 493 1.030 1.610 3.430 5540 10400 20800 36600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>13 25 48 108 189 256 379 0.940 1.420 3.190 4950 9200 18400 31800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>11 22 42 90 169 222 314 0.860 1.230 2.970 4370 8000 15300 26500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>700</td>
<td>9 19 36 79 149 194 271 0.790 1.040 2.760 3890 7000 13200 22600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>7 16 30 69 129 166 230 0.720 0.860 2.560 3410 6000 11100 19900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>5 13 24 59 109 140 197 0.660 0.690 2.360 2940 5100 9800 16700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>3 10 18 49 90 111 174 0.600 0.520 2.160 2470 4200 8500 14400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

309
For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 cubic foot per hour = 0.0283 m³/h, 1 pound-force per square inch = 6.8947 kPa,

1 inch water column = 0.249 kPa

Notes:
1. Table entries are rounded to 3 significant digits.
2. NA means a flow of less than 10 ft³/h (0.283 m³/h).
### TABLE 1208.3.1
APPROXIMATE GAS INPUT FOR TYPICAL APPLIANCES
[NFPA 54: TABLE A.5.3.2.1]

<table>
<thead>
<tr>
<th>APPLIANCE</th>
<th>INPUT (Btu/h approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Space Heating Units</strong></td>
<td></td>
</tr>
<tr>
<td>Warm air furnace</td>
<td></td>
</tr>
<tr>
<td>Single family</td>
<td>100 000</td>
</tr>
<tr>
<td>Multifamily, per unit</td>
<td>60 000</td>
</tr>
<tr>
<td>Hydronic boiler</td>
<td></td>
</tr>
<tr>
<td>Single family</td>
<td>100 000</td>
</tr>
<tr>
<td>Multifamily, per unit</td>
<td>60 000</td>
</tr>
<tr>
<td><strong>Space and Water Heating Units</strong></td>
<td></td>
</tr>
<tr>
<td>Hydronic boiler</td>
<td></td>
</tr>
<tr>
<td>Single-family</td>
<td>120 000</td>
</tr>
<tr>
<td>Multifamily, per unit</td>
<td>75 000</td>
</tr>
<tr>
<td><strong>Water Heating Appliances</strong></td>
<td></td>
</tr>
<tr>
<td>Water heater, automatic storage</td>
<td></td>
</tr>
<tr>
<td>30 to 40 gallon tank</td>
<td>35 000</td>
</tr>
<tr>
<td>Water heater, automatic storage</td>
<td></td>
</tr>
<tr>
<td>50 gallon tank</td>
<td>50 000</td>
</tr>
<tr>
<td>Water heater, automatic instantaneous</td>
<td></td>
</tr>
<tr>
<td>Capacity at 2 gallons per minute</td>
<td>142 800</td>
</tr>
<tr>
<td>Capacity at 4 gallons per minute</td>
<td>285 000</td>
</tr>
<tr>
<td>Capacity at 6 gallons per minute</td>
<td>428 400</td>
</tr>
<tr>
<td>Water heater, circulating or side-arm</td>
<td>35 000</td>
</tr>
<tr>
<td><strong>Cooking Appliances</strong></td>
<td></td>
</tr>
<tr>
<td>Range, freestanding, domestic</td>
<td>65 000</td>
</tr>
<tr>
<td>Built-in oven or broiler unit, domestic</td>
<td>25 000</td>
</tr>
<tr>
<td>Built-in top unit, domestic</td>
<td>40 000</td>
</tr>
<tr>
<td><strong>Other Appliances</strong></td>
<td></td>
</tr>
<tr>
<td>Refrigerator</td>
<td>3000</td>
</tr>
<tr>
<td>Clothes dryer, Type 1 (domestic)</td>
<td>35 000</td>
</tr>
<tr>
<td>Gas fireplace direct-vent</td>
<td>40 000</td>
</tr>
<tr>
<td>Gas log</td>
<td>80 000</td>
</tr>
<tr>
<td>Barbecue</td>
<td>40 000</td>
</tr>
<tr>
<td>Gaslight</td>
<td>2500</td>
</tr>
</tbody>
</table>

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

### TABLE 1701.1
REFERENCED STANDARDS
<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 353-1994</td>
<td>Standard for Safety Limit Controls</td>
<td>Miscellaneous</td>
<td>1208.15</td>
</tr>
<tr>
<td>UL 2989-2022</td>
<td>Outline of Investigation for Tracer Wire</td>
<td>Tracer Wire</td>
<td>1210.1.7.2</td>
</tr>
<tr>
<td>UL 607302-6-2016</td>
<td>Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements (with revisions until November 30, 2021)</td>
<td>Miscellaneous</td>
<td>1208.15</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASME and UL standards meet the requirements for mandatory referenced standards in accordance with Section 3- 3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 12 is being revised to the latest edition of NFPA 54-2024.
SUBMITTER: Chris Cheek
Organization Name: P.I.P.E.

RECOMMENDATION:
Revise text

Proposed Text:
1202.0 Coverage of Piping System.

1202.3 Applications.
(1) - (18) (remaining text unchanged)
(19) Fuel gas systems using exceeding 20 percent hydrogen admixture as a fuel.
(20) Construction of appliances. {NFPA 54:1.1.1.2}

SUBSTANTIATION:
The global shift towards a hydrogen economy is gaining momentum. Hydrogen is emerging as a significant player in the renewable energy sector, particularly for its potential in reducing carbon emissions. Incorporating hydrogen into existing natural gas infrastructure is a strategic step towards a more sustainable energy future. Recent advancements in technology have made the blending of hydrogen with natural gas feasible and safe for the built environment. These technological improvements address concerns related to hydrogen's low energy density, making it compatible with existing gas pipelines. Utilizing the existing natural gas infrastructure for hydrogen delivery minimizes the need for new construction, thereby reducing costs and the environmental impact of new pipeline installations during the energy transition. In summary, updating Section 1202.3 of the UPC to include hydrogen admixtures aligns with technological advancements, environmental goals, safety standards, and economic benefits. It represents a proactive step towards a sustainable and secure energy future.
RECOMMENDATION:
Revise text

Proposed Text:
1208.0 Gas Piping System Design, Materials, and Components.

1208.5 Acceptable Piping Materials and Joining Methods. (remaining text unchanged)

1208.5.2 Metallic Pipe. (remaining text unchanged)
1208.5.2.2 Steel, Stainless Steel, and Wrought-Iron Pipe. Steel, stainless steel, and wrought-iron pipe shall be at least Schedule 40 and shall comply with the dimensional standards of ASME B36.10M and one of the following: (1) ASTM A53 (2) ASTM A106 (3) ASTM A312 ([NFPA 54:5.5.2.2])

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 12 is being revised to the latest edition of NFPA 54-2024.
1208.0 Gas Piping System Design, Materials, and Components.

1208.5 Acceptable Piping Materials and Joining Methods. (remaining text unchanged)

1208.5.4 Polyethylene Plastic Pipe, Tubing, and Fittings. Polyethylene plastic pipe, tubing, and fittings used to supply fuel gas shall conform to ASTM D2513. Pipe to be used shall be marked “gas” and “ASTM D2513.” [NFPA 54:5.5.4.1.1]

1208.5.4.1 Polyamide Mechanical Fittings. Polyamide mechanical fittings for use with polyethylene pipe or tubing shall conform to ASTM F1924.

1208.5.5 Polyamide Plastic Pipe, Tubing, and Fittings. Polyamide pipe, tubing, and fittings shall be identified in and conform to ASTM F2945. Pipe to be used shall be marked “gas” and “ASTM F2945.” Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) plastic pipe, tubing, and fittings shall not be used to supply fuel gas. [NFPA 54:5.5.4.1.3]

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F1924:2019</td>
<td>Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing</td>
<td>Fittings</td>
<td>1208.5.4.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F1924 meets the requirements for mandatory a referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
ASTM F1924 “Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing” is an established standard for mechanical fittings used in PE gas piping systems. The Code will be improved and clarified by adding this Standard to allow a PA-bodied fitting to be used on PE pipe as designed. The current Code essentially only allows use of fusion fittings (PE fitting with PE pipe, PA fitting with PA pipe), and that restriction should be removed to allow proven mechanical fittings under F1924 to be recognized. Mechanical fittings such as this have been used in gas distribution systems for decades and been proven to be a safe technology, and while they must be compatible with the pipe used on, it is not necessary for them to be the same material.
Realizing that the existing Section is an NFPA 54 extract, NFPA is being approached to revise the text in their document. Adding this new text to UPC now will allow ASTM F1924 fittings to be used in the interim until NFPA 54 can be revised and the extract updated in UPC.
Proposed Text:
1210.0 Gas Piping Installation.
1210.1 Piping Underground. (remaining text unchanged)

1210.1.3 Protection Against Corrosion. (remaining text unchanged)
1210.1.3.2 Underground Piping. Underground piping shall comply with one or more of the following unless approved technical justification is provided to demonstrate that protection is unnecessary:
(1) The piping shall be made of corrosion-resistant material that is suitable for the environment in which it will be installed.
(2) Pipe shall have a factory-applied, electrically insulating coating. Fittings and joints between sections of coated pipe shall be coated in accordance with the coating manufacturer’s instructions.
(3) The piping shall have a cathodic protection system installed, and the system shall be maintained in accordance with Section 1210.1.3.3 or Section 1210.1.3.6. [NFPA 54:7.1.3.2]
(4) The piping shall employ an encasement system complying with IAPMO IGC 201 for underground installation.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 201:</td>
<td>Polyethylene Sleeved-Corrugated Stainless-Steel Tubing for Use in Fuel Gas Piping Systems</td>
<td>Gas Tubing</td>
<td>1210.1.3.2</td>
</tr>
<tr>
<td>2018e1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO IGC 201 meets the requirements for a mandatory referenced standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed standard covers polyethylene sleeved-corrugated stainless steel tubing (CSST) which is used in fuel gas systems. PE sleeved CSST has been tested and installed for over 10 years and continues to be installed today. Reference to the proper standard for this product will ensure public health and safety by clearly identifying products that are approved for this application assisting to the installers, inspectors, and other end users of the code.
1210.0 Gas Piping Installation.
1210.1 Piping Underground. (remaining text unchanged)

1210.1.6 Piping Underground Beneath Buildings. Gas piping installed under a slab shall be capable of being removed and replaced without disturbing the slab. Where gas piping is installed underground beneath any buildings, structure or appurtenance including but not limited to, porches and steps, whether covered or uncovered, breezeways, roofed porte-cocheres, roofed patios, carports, covered walks, and covered driveways, the piping shall be either of the following:

(1) Encased in an approved conduit that shall be not less than one-half (1/2) inch larger than the outside diameter of the gas piping, not less than schedule 40, designed to withstand the imposed loads and installed in accordance with Section 1210.1.6.1 or Section 1210.1.6.2.

(2) A piping/encasement system listed for installation beneath buildings. \(\text{[NFPA 54:7.1.6]}\)

1210.1.6.1 Conduit with One End Terminating Outdoors. The conduit shall extend into an accessible portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage. Where the end sealing is of a type that retains the full pressure of the pipe, the conduit shall be designed for the same pressure as the pipe. The conduit shall extend at least 12\(\frac{4}{16}\) inches (305.102 mm) outside the building, be vented outdoors above finished ground level, and be installed so as to prevent the entrance of water and insects. \(\text{[NFPA 54:7.1.6.1]}\)

SUBSTANTIATION:
Gas piping under a slab should have the ability to be removed and replaced if a puncture or leak occurs without disturbing a concrete slab. By not having a requirement on the conduit size in relation to the piping passing through it could affect the ability to remove the piping to replace it.

Expanding on buildings, structures, and appurtenances were added to the language to clarify the intent of the code, and where it is required.

Changing the 4" requirement to 12" is to provide additional access to that area of the conduit extending outside the building. In some cases the concrete footing may have additional concrete blowout covering the 4" access with concrete.
Proposed Text:
1210.0 Gas Piping Installation.

1210.3 Installation of Aboveground Piping. (remaining text unchanged)

1210.3.5 Hangers, Supports, and Anchors. (remaining text unchanged)
1210.3.5.1 Spacing. Spacing of supports in gas piping installations shall not be greater than shown in Table 1210.3.5.1. Spacing of supports of CSST shall be in accordance with the CSST manufacturer’s instructions. [NFPA 54:7.2.6.2] Gas piping shall be permitted to extend 12 inches (305 mm) horizontally from a wall or support. Piping extending beyond 12 inches (305 mm) horizontally from a wall or structure shall be supported at not less than every 12 inches (305 mm).

SUBSTANTIATION:
The code is currently silent with regards to piping extending away from a wall towards an appliance. There have been installations where the pipe extents 5 feet away from a wall or structure with no support since Table 1210.3.5.1 contains the minimum support distances to be 6 feet (for example of ½ inch diameter steel pipe. This distance is too far without support. Additionally, the shut off valve will be at the end of the pipe run, and followed by a flexible hose to the appliance. This will cause strain on the piping and fittings, and will also leaves the possibility of damage to the piping. The addition of this language is addressing a health and safety concern regarding fuel gas piping and will assist the end users to install piping in a safe manner to avoid possible damage.
SUBMITTER: Thomas Smith
Organization Name: Nevada State Fire Marshal
Organization Representation: Self

RECOMMENDATION:
Revise text

Proposed Text:
1212.0 Appliance and Equipment Connections to Building Piping.

1212.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with Section 1212.6 through Section 1212.8 by one of the following:
(1) Rigid metallic pipe and fittings.
(2) Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
(3) A connector for gas appliances listed in accordance with ANSI Z21.24/CSA 6.10. The connector shall be used in accordance with the manufacturer’s installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
(4) A connector for outdoor gas appliances and manufactured homes listed in accordance with ANSI Z21.75/CSA 6.27. Only one connector shall be used per appliance.
(5) CSST where installed in accordance with the manufacturer’s installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.
(6) Listed nonmetallic gas hose connectors in accordance with Section 1212.3.
(7) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with Section 1212.4. [NFPA 54:9.6.1]

Exception: Rigid metallic pipe and fittings shall not be permitted to connect appliances and equipment to the building piping where the appliance is prone to vibration, movement, or seismic activity.

SUBSTANTIATION:
The UPC is currently silent on the connecting end of the fuel supply to the appliance connection in seismic designated areas. There is a concern where “rigid” piping is directly connected to an appliance with no allowance to absorb or accommodate vibration or movement due to sudden earthquake jolts or shifting.
1212.0 Appliance and Equipment Connections to Building Piping.

1212.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with Section 1212.6 through Section 1212.8 by one of the following:
(1) Rigid metallic pipe and fittings.
(2) Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
(3) A connector for gas appliances listed in accordance with ANSI Z21.24/CSA 6.10. The connector shall be used in accordance with the manufacturer’s installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
(4) A connector for outdoor gas appliances and manufactured homes listed in accordance with ANSI Z21.75/CSA 6.27. Only one connector shall be used per appliance.
(5) CSST where installed in accordance with the manufacturer’s installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.
(6) Listed nonmetallic gas hose connectors in accordance with Section 1212.3.
(7) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with Section 1212.4. [NFPA 54:9.6.1]

Exception. Rigid metallic pipe and fittings shall not be permitted to connect appliances and equipment to the building piping where the appliance is prone to vibration, movement, or seismic activity. Connectors designed to absorb vibrations or movement shall be used for such applications.

SUBSTANTIATION:
There is always a concern when connecting a rigid fuel supply pipe to an appliance connection in seismic designated areas, or where the appliance or equipment is prone to vibration. There is a concern where “rigid” piping is directly connected to an appliance with no allowance to absorb or accommodate vibration or movement due to sudden earthquake jolts or shifting. This additional text will assist from such situations occurring which are a safety concern.
Category 3 Vacuum System. A Category 3 vacuum distribution system that can be either a wet system designed to remove liquids, air-gas, or solids from the treated area; or a dry system designed to trap liquid and solids before the service inlet and to accommodate air-gas only through the service inlet. [NFPA 99:3.3.20]

1301.0 General Requirements.

1301.5 Existing Systems. Only the altered, renovated, or modernized portion of an existing system or individual component shall be required to meet the installation and equipment requirements stated in this code. If the alteration, renovation, or modernization adversely impacts the existing performance requirements of a system or component, additional upgrading shall be required. Continued use of an existing system that is not in strict compliance with the provisions of this code shall be permitted to be continued in use, unless the Authority Having Jurisdiction has determined that such use constitutes a distinct hazard to life. [NFPA 99:1.3.2.1 – 1.3.2.3]

1302.0 Design Requirements. Fundamentals.

1302.1 Risk Categories. All activities, as well as systems or equipment that are new or altered, shall be designed to meet Category 1 through Category 4 requirements, as detailed in this chapter. [NFPA 99:4.1]

1302.1.1 Category 1. Activities, systems, or equipment whose failure is likely to cause major injury or death of patients, staff, or visitors shall be designed to meet Category 1 requirements, as detailed in this code. [NFPA 99:4.1.1]

1302.1.2 Category 2. Activities, systems, or equipment whose failure is likely to cause minor injury of patients, staff, or visitors shall be designed to meet Category 2 requirements, as detailed in this code. [NFPA 99:4.1.2]

1302.1.3 Category 3. Activities, systems, or equipment whose failure is not likely to cause injury to patients, staff, or visitors, but can cause discomfort, shall be designed to meet Category 3 requirements, as detailed in this code. [NFPA 99:4.1.3]

1302.1.4 Category 4. Activities, systems, or equipment whose failure would have no impact on patient care shall be designed to meet Category 4 requirements, as detailed in this code. [NFPA 99:4.1.4]

1302.1.4 Higher Risk Category. Activities, systems, and equipment shall be permitted to be designed to a higher
1302.2 Risk Assessment. Risk assessment shall be in accordance with Section 1302.2.1 and Section 1302.2.2. [NFPA 99:4.2]

(renumber remaining sections)

1302.3 Anesthesia. It shall be the responsibility of the health care facility’s governing body to designate all anesthetizing locations. [NFPA 99:1.3.4.2]

1302.5 Category Application. The Category definitions in Section 1302.1 shall apply to this code, except as modified in specific sections. [NFPA 99:4.3]

1307.0 Central Supply Systems.

1307.1 Terms. Where the terms medical gas or medical support gas occur, the provisions shall apply to all piped systems for oxygen, nitrous oxide, medical air, carbon dioxide, helium, nitrogen, instrument air, and mixtures thereof. Wherever the name of a specific gas service occurs, the provision shall apply only to that gas. [NFPA 99:5.1.1.3 5.1.1.2]

1307.4 Materials. Materials used in central supply systems shall meet the following requirements:

(1) In those portions of systems intended to handle oxygen at gauge pressures greater than 250435 pounds-force per square inch (psi) (24133000 kPa), interconnecting hose shall contain no polymeric materials.

(2) In those portions of systems intended to handle oxygen or nitrous oxide at gauge pressures of less than 435 psi (3000 kPa), construction shall be compatible with oxygen under the temperatures and pressures to which the components can be exposed in the containment and use of oxygen, nitrous oxide, mixtures of these gases, or mixtures containing more than 23.5 percent oxygen.

(3) If potentially exposed to cryogenic temperatures, materials shall be designed for low temperature service.

(4) If intended for outdoor installation, materials shall be installed in accordance with the manufacturer’s requirements. [NFPA 99:5.1.3.5.4]

1307.5 Design and Construction. Medical gas and vacuum systems shall be designed by one of the following:

(1) A party technically competent and experienced in the field of medical gas and vacuum system design and meeting the requirements of ASSE/IAPMO/ANSI 6060.

(2) A party deemed technically competent through other qualification(s) deemed sufficient by the health care facility’s governing body. [NFPA 99:5.1.3.3.2.1]

1308.0 Pressure-Regulating Equipment.

1308.2 Pressure Relief Valves. All pressure relief valves shall meet the following requirements:

(1) They shall be of brass, bronze, or stainless steel construction. (2) They shall be designed for the specific gas service. (3) They shall have a relief pressure setting not higher than the maximum allowable working pressure (MAWP) of the component with the lowest working pressure rating in the portion of the system being protected. (4) They shall be vented to the outside of the building, except that relief valves for compressed air systems having less than 3000 cubic feet (84 950 L) at STP shall be permitted to be diffused locally by means that will not restrict the flow. (5) They shall have a vent discharge line that is not smaller than the size of the relief valve outlet or $\frac{3}{4}$ NPS (20 mm), whichever is larger. (6) Where two or more relief valves discharge into a common vent line, the internal cross-sectional area of the common line shall be not less than the aggregate cross-sectional area of all relief valve vent discharge lines served. (7) They shall not discharge into locations creating potential hazards to open air such that escaping gas does not impinge on personnel, equipment, or adjacent structures or enter into enclosed spaces. (8) They shall have the discharge terminal turned down and screened to prevent the entry of rain, snow, or vermin. (9) They shall be designed in accordance with ASME B31.3. [NFPA 99:5.1.3.5.6.1]
1308.3 Pressure-Relief Valve Requirements. Central supply systems for positive-pressure gases shall include one or more relief valves, all meeting the following requirements:
(1) They shall be located between each final line regulator and the source valve.
(2) They shall have a relief setting that is 50 percent above the normal system operating pressure, as indicated in Table 1305.1. [NFPA 99:5.1.3.5.6.4]

1309.0 Oxygen Concentrator Supply Units.

1309.5 Oxygen Concentrator Components. The components that make up the oxygen concentrator unit shall be as follows:
(1) The manufacturer of the concentrator unit shall be permitted to use such components and arrangement of such components as needed to produce oxygen complying with Section 1309.1 in the quantity as required by the facility, except where otherwise specifically defined in this code.
(2) Air receivers and oxygen accumulators, where used, shall comply with Section VIII-F, "Unfired Pressure Vessels," of the ASME Boiler and Pressure Vessels Code and be provided with overpressure relief valves. [NFPA 99:5.1.3.9.1.5]

1309.13 Oxygen Concentration Monitor. The oxygen concentrator supply unit shall be provided with an oxygen concentration monitor with the following characteristics:
(1) The monitor shall be capable of monitoring 99 percent oxygen concentration with 1 percent accuracy.
(2) The monitor shall continuously display the oxygen concentration and shall activate the local alarm and master alarms in accordance with NFPA 99 when a concentration lower than 91 percent is observed.
(3) The monitor shall continuously display the oxygen concentration.
(4) The monitor shall be permitted to be inserted into the pipeline without a demand check. [NFPA 99:5.1.3.9.1.13]

1310.0 Category 1 Medical Air Central Supply Systems.

1310.2 Uses of Medical Air. Medical air sources shall be connected to the medical air distribution system only and shall be used only for air in the application of human respiration and, in the calibration of medical devices for respiratory application, and in simulation centers for the education, training, and assessment of health care professionals in accordance with Section 1307.3. [NFPA 99:5.1.3.6.2]

1311.0 Compressor Intake.

1311.2 Medical Air Compressor Source. The medical air compressors shall draw their air from a source of clean air. [NFPA 99:5.1.3.6.3.11(A)] If an air source equal to or better than outside air (e.g., air already filtered for use in operating room ventilating systems) is available, it shall be permitted to be used for the medical air compressors with the following provisions:
(1) This alternate source of supply air shall be available on a continuous 24 hours per-day, 7 day-per-week basis.
(2) Ventilating systems having fans with motors or drive belts located in the airstream shall not be used as a source of medical air intake. [NFPA 99:5.1.3.6.3.11(E)]

1311.5 Separate Compressors. Air intakes for separate compressors shall be permitted to be joined together to one common intake where the following conditions are met:
(1) The common intake is sized to minimize backpressure in accordance with the manufacturer’s recommendations.
(2) Each compressor can be isolated by manual or check valve, blind flange, or tube cap to prevent open inlet piping
when the compressor(s) is removed for service from the consequent backflow of room air into the other compressor(s). [NFPA 99:5.1.3.6.3.11(G)]

1312.0 Medical Surgical Vacuum Central Supply Systems.

1312.3 Vacuum Receivers. Receivers for vacuum shall meet the following requirements:
(1) They shall be made of materials deemed suitable by the manufacturer.
(2) They shall comply with Section VIII, “Unfired Pressure Vessels,” of the ASME Boiler and Pressure Vessel Code.
(3) They shall be capable of withstanding a gauge pressure of 60 psi (414 kPa) and 30 inch (762 mm) gauge HgV.
(4) They shall be equipped with a manual drain.
(5) They shall be of a capacity based on the technology of the pumps. [NFPA 99:5.1.3.7.3]

1312.4 Vacuum Filtration. Central supply systems for vacuum other than liquid ring pumps shall be provided with inlet filtration with the following characteristics:
(1) Filtration shall be at least duplex to allow one filter to be exchanged without impairing the vacuum system.
(2) Filtration shall be located on the patient side of the vacuum producer.
(3) Filters shall be efficient to 0.3 µm and 99.97 percent HEPA or better, per in accordance with DOE-STD-3020.
(4) Filtration shall be sized for 100 percent of the peak calculated demand while one filter or filter bundle is isolated.
(5) It shall be permitted to group multiple filters into bundles to achieve the required capacities shall be permitted.
(6) The system shall be provided with isolation valves on the source side of each filter or filter bundle and isolation valves on the patient side of each filter or filter bundle, permitting the filters to be isolated without shutting off flow to the central supply system.
(7) A means shall be available to allow the user to observe any accumulations of liquids.
(8) A vacuum relief petcock shall be provided to allow vacuum to be relieved in the filter canister during filter replacement.
(9) Filter elements and canisters shall be permitted to be constructed of materials as deemed suitable by the manufacturer.
(10) In normal operation, one filter or filter bundle shall be isolated from the system to be available for service should a blockage in the operating filter occur or rotation of the filters be desired after filter element exchange. [NFPA 99:5.1.3.7.4]

1314.0 Valves.
1314.1 Gas and Vacuum Shutoff Valves. Shutoff valves shall be provided to isolate sections or portions of the piped distribution system for maintenance, repair, emergencies, or planned future expansion needs and to facilitate periodic testing. [NFPA 99:5.1.4.1.1]

1314.2 Security. All valves, except valves in zone valve box assemblies, shall be secured by any of the following means:
(1) Located in secured areas;
(2) Locked or latched in their operating position;
(3) Located above ceilings, but remaining accessible and not obstructed; [NFPA 99:5.1.4.1.2]

1314.3 Labeled. All valves shall be labeled as to gas supplied and the area(s) controlled, in accordance with Section 1323.14. [NFPA 99:5.1.4.1.3]

1314.5 Valve Types. New or replacement valves shall be permitted to be of any type as long as they meet the following conditions:
(1) They have a minimum Cv factor in accordance with either Table 1314.5(1) or Table 1314.5(2).
(2) They use a quarter turn to off.
(3) They are constructed of materials suitable for the service.
(4) They are provided with copper tube extensions by the manufacturer for brazing or with corrugated medical
tubing (CMT) fittings.
(5) They indicate to the operator if the valve is open or closed.
(6) They permit in-line serviceability.
(7) They are cleaned for oxygen service by the manufacturer if used for any positive-pressure service.
(8) They have threaded purge ports on the patient side and the source side.
(9) They have a minimum working pressure equal to or greater than the relief valve protecting the piping system on
which the valve is installed for any positive-pressure service.
(10) Seals necessary for the operation of the valve and prevention of leaks comply with Section 1307.4 and are
replaceable. [NFPA 99:5.1.4.1.6]

1314.8 Riser Valves. Each riser supplied from the main line shall be provided with a shutoff valve in the riser
adjacent to the main line. [NFPA 99:5.1.4.4]

1314.10.1 Readily Accessible. A zone valve in each medical gas or vacuum line shall be provided for each
Category 1 space and anesthetizing location for moderate sedation, deep sedation, or general anesthesia specific
for the occupancy, and shall be located as follows:
(1) They are installed in patient care spaces that are not anesthetizing locations, they shall be immediately outside
the area or zone being controlled.
(2) They are installed where they are visible and accessible at all times in anesthetizing locations, they shall be
installed immediately outside each room. [NFPA 99:5.1.4.6.2]

1314.13 In-Line Check Valves. New or replacement check valves shall be as follows:
(1) They shall be of brass or bronze construction.
(2) They shall have brazed extensions.
(3) They shall have in-line serviceability.
(4) They shall not have threaded connections.
(5) They shall have threaded purge points of ¹⁄₄ in. NPT.
(6) They shall be sized to have a maximum velocity which does not exceed the manufacturer's recommendations.
[NFPA 99:5.1.4.9]

1315.0 Station Outlets and Inlets.

1315.11 Factory-Installed Copper Outlet Tubes. Factory-installed copper outlet tubes on station inlets extending
no further than 8 inches (203 mm) from the body of the terminal shall be not less than DN10 (NPS 3/8) (1/2 in.
O.D.) size, with 0.4 inch (10.2 mm) minimum inside diameter. [NFPA 99:5.1.5.12]

1315.14 Down Facing Outlets and Inlets. Where installed in a down-facing position, such as in a ceiling or ceiling
column, station outlets/inlets shall be D.I.S.S. connectors. [NFPA 99:5.1.5.17]

1317.0 Warning Systems.
1317.1 Category 1. All master, area, and local alarm systems used for medical gas and vacuum systems shall
include the following:
(1) Separate visual indicators for each condition monitored, except as permitted in Section 1317.1.2 NFPA 99 for
local alarms that are displayed on master alarm panels;
(2) Visual indicators that remain in alarm until the situation that has caused the alarm is resolved;
(3) Cancelable audible indication of each alarm condition that produces a sound with a minimum level of 80 dBA at
3 feet (914 mm);
(4) Means to indicate a lamp or LED failure and audible failure;
(5) Visual and audible indication that the communication with an alarm-initiating device is disconnected.
(6) Labeling of each indicator, indicating the condition monitored;
(7) Labeling of each alarm panel for its area of surveillance;
(8) Reinitiating of the audible signal if another alarm condition occurs while the audible alarm is silenced;
(9) Power for master alarms, area alarms, sensors, and switches from the life safety branch of the essential electrical system as described in NFPA 99;
(10) Power for local alarms, dew point sensors, and carbon monoxide sensors permitted to be from the same essential electrical branch as is used to power the air compressor system;
(11) Where used for communications, wiring from switches or sensors that is supervised or protected as required by NFPA 70 for life safety and critical branches circuits in which protection is any of the following types:
   (a) Conduit
   (b) Free air
   (c) Wire
   (d) Cable tray
   (e) Raceways
(12) Communication devices that do not use electrical wiring for signal transmission and are supervised such that failure of communication initiates an alarm;
(13) Assurance by the responsible authority of the facility that the labeling of alarms, where room numbers or designations are used, is accurate and up-to-date;
(14) Provisions for automatic restart after a power loss of 10 seconds (e.g., during generator start-up) without giving false signals or requiring manual reset;
(15) Alarm switches/sensors installed so as to be removable and accessible for service and testing. [NFPA 99:5.1.9.1]

1317.1.2 Master Alarm Signal. The master alarm shall include at least one signal from the source equipment to indicate a problem with the source equipment at this location. This master alarm signal shall activate when any of the required local alarm signals for this source equipment activates. [NFPA 99:5.1.9.5.2]

1321.0 Brazed Joints.
1321.1 Brazed Joints and Fittings. Fittings shall be wrought copper capillary fittings complying with ASME B16.22, or brazed fittings complying with ASME B16.50. Cast copper alloy fittings shall not be permitted. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 1000°F (538°C) to retain the integrity of the piping system in the event of fire exposure. [NFPA 99:5.1.10.4.1.1 – 5.1.10.4.1.3]

1321.3 Filler Metals. Filler metals shall bond with and be metallurgically compatible with the base metals being joined. Filler metals shall comply with AWS A5.8. [NFPA 99:5.1.10.4.1.5, 5.1.10.4.1.6]

1321.9.3 Short Sections of Copper. Where possible, short sections of copper tube shall be brazed onto the non-copper component, and the interior of the subassembly shall be cleaned of flux prior to installation in the piping system. [NFPA 99:5.1.10.4.4.5]

1322.0 Welded Joints.
1322.1.5 Test Coupons. Test coupons shall be welded and inspected, as a minimum, at the start of work and every 4 hours thereafter, or when the machine is idle for more than 30 minutes, and at the end of the work period. Test coupons shall be inspected on the I.D. and O.D. by a qualified quality control inspector. Test coupons shall also be welded at change of operator, weld head, welding power supply, or gas source. [NFPA 99:5.1.10.5.1.7 – 5.1.10.5.1.9]

1322.6.1 Dielectric Fittings with Internal Seals. Dielectric fittings that comply with the following requirements shall be permitted only where required by the manufacturer of special medical equipment to electrically isolate the equipment from the system distribution piping:

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(1) The fittings shall be of brass or copper construction with an approved dielectric.
(2) They shall be permitted to be a union.
(3) Internal seals, insulators, and other polymeric materials shall be limited only to those parts essential for sealing or creating the dielectric break.
(4) Internal seals, insulators, and other elastomeric materials shall be replaceable.
(5) They shall be cleaned for oxygen when used for medical gases and/or medical support gases.
(6) The fittings shall be installed only where visible and accessible, allowing for testing and servicing. [NFPA 99:5.1.10.9.2]

1323.0 Installation of Piping and Equipment.

1323.0 Installation of Piping and Equipment.

1323.1 Required Pipe Sizing. Piping systems shall be designed and sized to deliver the required flow rates at the utilization pressures. [NFPA 99:5.1.10.11.1]

1323.1.1 Mains and Branches. Mains and branches in medical gas piping systems shall be not less than DN15 (NPS 1/2) (5/8 inch O.D.) size. Mains and branches in medical surgical vacuum systems shall be not less than DN20 (NPS 3/4) (7/8 inch O.D.) size. [NFPA 99:5.1.10.11.1.2, 5.1.10.11.1.3]

1323.1.2 Drops to Individual Stations. Drops to individual station outlets and inlets shall be not less than DN15 (NPS 1/2) (5/8 inch O.D.) size. [NFPA 99:5.1.10.11.1.4]

1323.1.3 Runouts and Connecting Tubing. Runouts to alarm panels and connecting tubing for gauges and alarm devices shall be permitted to be DN8 (NPS 1/4) (3/8 inch O.D.) size. [NFPA 99:5.1.10.11.1.5]

1323.0 Pipe Sizing and System Design.

1323.1 Pipe Sizing and Design. Pipe sizing shall be in accordance with Section 1323.1.1 through Section 1323.1.3.

1323.1.1 Pipe Sizing. The system designer shall size the piping such that calculated pressure or vacuum losses across the piping as designed do not exceed 10 percent of the intended operating pressure or vacuum at the source valve. [NFPA 99:5.1.10.11.5.1.10.11.1.1]

1323.1.2 Pressure Drop. The pressure drop calculations required by Section 1323.1.1 shall become part of the facility’s permanent records. [NFPA 99:5.1.10.11.1.2]

1323.1.3 Design and Installation of Piping. The design and installation of piping shall meet the following requirements:

(1) Mains and branches supplying medical gas to more than a single terminal shall not be smaller than DN15 (NPS 1/2) (5/8 inch O.D.) size.
(2) Mains and branches supplying medical vacuum to more than a single terminal shall not be smaller than DN20 (NPS 3/4) (7/8 inch O.D.) size.
(3) Mains and branches supplying WAGD or support gases to more than a single terminal shall not be smaller than DN15 (NPS 1/2) (5/8 inch O.D.) size.
(4) Drops to individual terminals shall not be smaller than DN15 (NPS 1/2) (5/8 inch O.D.) size.
(5) Runouts to pressure sensing devices shall be permitted to be DN8 (NPS 1/4) (3/8 inch O.D.) size. [NFPA 99:5.1.10.11.1.3]

1323.2 Pipe Protection of Piping. Piping shall be protected against freezing, corrosion, and physical damage. [NFPA 99:5.1.10.11.2]

1323.3 Approved Locations. Medical gas piping shall be permitted to be installed in the same service trench or tunnel with as fuel gas lines, fuel oil lines, electrical lines, steam lines, and similar utilities, provided that if the space is ventilated (naturally or mechanically) and the ambient temperature around the medical gas piping is limited to 130°F (54°C) maximum. [NFPA 99:5.1.10.11.3.3]
1323.4.3 Damp Locations. In potentially damp locations, copper tube hangers or supports that are in contact with the tube shall be plastic-coated or otherwise be electrically insulated from the tube by a material that will not absorb moisture. [NFPA 99:5.1.10.11.4.5]

1323.5.2 Conduit, Cover, or Enclosure. If underground piping is protected by a conduit, cover, or other enclosure, the following requirements shall be met:
(1) Access shall be provided at the joints, prior to backfilling over them, for visual inspection and leak testing.
(2) The conduit, cover, or enclosure shall be self-draining and not retain groundwater in prolonged contact with the pipe. [NFPA 99:5.1.10.11.5.3]

1323.5.4 Minimum Backfill. The minimum backfilled cover above the top of the pipe or its enclosure for buried piping outside of buildings shall be 36 inches (914 mm), except that the minimum cover comply with the following requirements:
(1) Except as permitted by Section 1323.5.4(2), it shall be 36 inches (914 mm).
(2) It shall be permitted to be reduced to 18 inches (457 mm) where there is no potential for damage from surface loads or surface conditions. [NFPA 99:5.1.10.11.5.5]

1323.5.5 Trenches. Trenches shall be excavated such that the pipe or its enclosure has firm, substantially continuous bearing on the bottom of the trench. [NFPA 99:5.1.10.11.5.6]

1323.5.8 Warning. A continuous warning means shall also be provided above the pipeline at approximately one-half the depth of burial. [NFPA 99:5.1.10.11.5.9]

1323.6 Connectors. Metallic and nonmetallic hose and flexible connectors, both metallic and nonmetallic, shall be no longer than necessary and shall not penetrate or be concealed in walls, floors, ceilings, or partitions. [NFPA 99:5.1.10.11.6.1]

1323.6.1 Flexible Connectors. Metallic or nonmetallic flexible connectors shall have a minimum burst pressure, with a gauge pressure of 6895 kPa (1000 psi) (6895 kPa). [NFPA 99:5.1.10.11.6.2 5.1.10.11.6.3]

1323.6.2 Metallic Flexible Joints. Metallic flexible joints shall be permitted in the pipeline where required for expansion joints, seismic protection, thermal expansion, or vibration control and shall be as follows meet the following requirements:
(1) For all wetted surfaces, made of bronze, copper, or stainless steel;
(2) Cleaned at the factory for oxygen service and received on the job site with certification of cleanliness.
(3) Suitable for service at 300 psig (2068 kPa) or above and able to withstand temperatures of 1000°F (538°C);
(4) Provided with brazing extensions to allow brazing into the pipeline per in accordance with, Section 1321.0;
(5) Supported with pipe hangers and supports as required for their additional weight. [NFPA 99:5.1.10.11.6.3 5.1.10.11.6.4]

1323.8 Manufacturer's Instructions. The installation of individual components shall be made in accordance comply with the manufacturer's instructions of the manufacturer. The manufacturer's instructions shall include directions and information deemed by the manufacturer to be adequate for attaining proper operation, testing, and maintenance of the medical gas and vacuum systems. Copies of the manufacturer's instructions shall be left with the system owner. [NFPA 99:5.1.10.11.8.1 − 5.1.10.11.8.3]

1323.9 Changes in System Use. Where a positive-pressure medical gas piping distribution system originally used or constructed for use at one pressure and for one gas is converted for operation at another pressure or for another gas, all provisions of Section 1318.0 through Section 1323.12 shall apply as if the system were new. [NFPA 99:5.1.10.11.9.1]
1323.10.1 Brazing. Brazing shall be performed by individuals who are qualified in accordance with the provisions of Section 1323.11. [NFPA 99:5.1.10.11.10.5]

1323.10.2 Documentation. Prior to any installation work, the installer of medical gas and vacuum piping shall provide and maintain documentation on the job site for the qualification of brazing procedures and individual brazers that is required under Section 1323.11. [NFPA 99:5.1.10.11.10.6]

1323.11.3 Documentation. The brazing procedure qualification record and the record of brazer performance qualification shall document filler metal used, base metals, cleaning, joint clearance, overlap, internal purge gas and flow rate during brazing of coupon, and absence of internal oxidation in the completed coupon. [NFPA 99:5.1.10.11.11.4]

1323.11.5 Conditions of Acceptance. An employer shall be permitted to accept brazer qualification records of a previous employer under the following conditions:

1. The brazer has been qualified following the same or an equivalent procedure that the new employer uses.
2. The new employer obtains a copy of the record of brazer performance qualification tests from the previous employer and signs and dates these records, thereby accepting responsibility for the qualifications performed by the previous employer. [NFPA 99:5.1.10.11.11.6]

1323.13 Labeling, Identification, and Operating Pressure. Color and pressure requirements shall be in accordance with Table 1305.1. [NFPA 99:5.1.11]

1323.13.3 WAGD System Labeling. Where vacuum systems are used to serve WAGD systems in accordance with NFPA 99, piping in the immediate area of the WAGD system shall be labeled to indicate both systems. [NFPA 99:5.1.11.1.3]

1323.13.4 Location of Pipe Labeling. Pipe labels shall be located as follows:

1. At intervals of not more than 20 feet (6096 mm).
2. At least once in or above every room.
3. On both sides of walls or partitions penetrated by the piping.
4. At least once in every story height traversed by risers. [NFPA 99:5.1.11.1.4]

1323.13.5 Paint. Medical gas piping shall not be painted. [NFPA 99:5.1.11.1.5]

1323.13.6 Compressor, Vacuum, Relief Valve Labeling. Labeling of piping for compressor intakes, vacuum exhausts, and relief valve vent lines shall meet the requirements of Section 1323.13.1 and state the specific function to distinguish them from the patient supply piping. [NFPA 99:5.1.11.1.6]

1323.14.2 Source Valves. Source valves shall be labeled in substance as follows:

SOURCE VALVE FOR THE (GAS/VACUUM NAME) SERVING (NAME OF THE AREA/BUILDING SERVED BY THE (SOURCE NAME VALVE). [NFPA 99:5.1.11.2.4]

1324.0 Performance Criteria and Testing Category 1 (Gases, Medical Surgical Vacuum).

1324.2 Breached Systems. All systems that are breached and components that are subject to additions, renovations, or replacement (e.g., new gas sources: bulk, manifolds, compressors, dryers, alarms) shall be inspected and tested. Systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition. Breached portions of the systems subject to inspection and testing shall be confined to only the specific altered zone and components in the immediate zone or area that is located upstream for vacuum systems and downstream for pressure gases at the point or area of intrusion and any other areas affected by the breach. [NFPA 99:5.1.12.1.3 – 5.1.12.1.5]

1324.3 New Medical Gas and Vacuum Pipeline. New medical gas and vacuum pipeline distribution systems shall not be connected to the existing in-use systems until the initial pressure test is successfully completed in accordance with Section 1324.5. [NFPA 99:5.1.12.1.11]
1324.4 Initial Piping Blowdown. Piping in medical gas and vacuum distribution systems shall be blown clear by means of oil-free, dry nitrogen NF after installation of the distribution piping but before installation of station outlet/inlet rough-in assemblies and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, pressure relief valves, manifolds, source equipment). [NFPA 99:5.1.12.2.2]

1324.5 Initial Pressure Tests – Medical Gas and Vacuum Systems. Each section of the piping in medical gas and vacuum systems shall be pressure tested. Initial pressure tests shall be conducted as follows:

(1) After blowdown of the distribution piping.
(2) After installation of station outlet/inlet rough-in assemblies.
(3) Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, line pressure relief valves). [NFPA 99:5.1.12.2.3.1, 5.1.12.2.3.2]

1324.5.1 Shutoff Valve. The source shutoff valve shall remain closed during the tests specified in Section 1324.5 through Section 1324.5.1.2. [NFPA 99:5.1.12.2.3.3]

1324.5.3 Initial Piping Purge Tests. The outlets in each medical gas piping system shall be purged to remove any particulate matter from the distribution piping. [NFPA 99:5.1.12.2.5]

1324.5.4 Standing Pressure Tests – for Positive Pressure Medical Gas Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, medical gas distribution piping shall be subjected to a standing pressure test. [NFPA 99:5.1.12.2.6]

1324.5.5 Standing Pressure Tests – Medical Vacuum Test for Vacuum Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, vacuum distribution piping shall be subjected to a standing vacuum test. [NFPA 99:5.1.12.2.7]

1324.5.6.4 Qualifications. Where systems have not been installed by inhouse personnel, inspections shall be permitted by personnel of the organization who meet the requirements of Section 1324.5.6.2. [NFPA 99:5.1.12.3.1.5]

1324.5.8 Particulate Matter Piping Purge Test. In order to remove any traces of particulate matter deposited in the pipelines as a result of construction, a heavy, intermittent purging of the pipeline shall be done. [NFPA 99:5.1.12.4.6]

1324.5.10.2 Oxygen and Medical Air Outlets. Oxygen and medical air outlets serving Category 1 space shall allow a transient flow rate of 6 SCFM (170 SLPM) for 3 seconds and a pressure drop of not more than 10 psi (70 kPa) gauge. [NFPA 99:5.1.12.4.10.5]

1325.0 Category 2 Piped Gas and Vacuum Systems.

1325.1 General. Category 2 piped gas or piped vacuum system requirements shall be permitted when all of the following criteria are met:

(1) Only moderate sedation (as defined in Chapter 2), minimal sedation (as defined in Chapter 2); or no sedation is performed. Deep sedation and general anesthesia shall not be permitted.
(2) The loss of the piped gas or piped vacuum systems is likely to cause minor injury to patients, staff, or visitors.
(3) The facility piped gas or piped vacuum systems are intended for Category 2 patient care space as defined in Chapter 2. [NFPA 99:5.2.1.2] These requirements shall apply to health care facilities that require Category 2 systems as referenced in Section 1302.1.

1326.0 Category 3 Piped Gas and Vacuum Systems.

1326.1 General. Category 3 piped gas and vacuum systems shall be permitted when all of the following criteria are met:

(1) Only minimal sedation, as defined in Chapter 2; or no sedation is performed. Deep sedation, moderate sedation, and general anesthesia are not performed.
(2) The loss of the piped gas and vacuum systems is not likely to cause injury to patients, staff, or visitors, but can
cause discomfort.
(3) The facility piped gas and vacuum systems are intended for Category 3 patient care rooms as defined in Chapter 2. [NFPA 99: 5.3.1.2] These requirements shall apply to health care facilities that require Category 3 systems as referenced in Section 1302.1. [NFPA 99: 5.3.1.1]

1326.11 Performance Criteria and Testing - Gas, Medical–Surgical Vacuum, and WAGD. Category 3 systems shall comply with Section 1324.0. [NFPA 99: 5.2.12]

1327.0 Dental Gas and Vacuum Systems.

1327.2 Emergency Shutoff Valves (Oxygen and Nitrous Oxide).
(1) All Category 2 medical gas systems shall have an emergency shutoff valve accessible from all use-point locations in an emergency.
(2) Where a central medical gas supply system supplies two treatment facilities, each facility shall be provided with an emergency shutoff valve located in that treatment facility so as to be accessible from all use-point locations in an emergency.
(3) Each emergency shutoff valves shall be labeled to indicate the gas controlled by the shutoff valve and shall shut off only the gas to the treatment facility that they serve.
(4) A remotely activated shutoff valve at a gas supply manifold shall not be used for emergency shutoff. For clinical purposes, such a remote valve actuator shall not fail-close in the event of loss of electric power. Where remote actuators are the type that fail-open, it shall be mandatory that cylinder shutoff valves shall be closed whenever the system is not in use. [NFPA 99: 15.4.2.6.1 – 15.4.2.6.4.2]

1327.6 Leaks. Any leaks shall be located, repaired (if permitted), or replaced (if required) by the installer, and retested. The piping shall be repurged if necessary. [NFPA 99: 15.4.7.4.6.7]

1328.0 Liquid Withdrawal and Piping.
1328.1 General. Liquid withdrawal piping shall be in accordance with NFPA 99.

<p>| TABLE 1305.1 |
| STANDARD DESIGNATION COLORS AND OPERATING PRESSURES FOR GAS AND VACUUM SYSTEMS [NFPA 99: TABLE 5.1.11] |</p>
<table>
<thead>
<tr>
<th>GAS SERVICE</th>
<th>ABBREVIATED NAME</th>
<th>COLORS (BACKGROUND/ TEXT)</th>
<th>STANDARD GAUGE PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>N₂</td>
<td>Black/white</td>
<td>55–185 psi/0–300 psi</td>
</tr>
<tr>
<td>Instrument air</td>
<td>--</td>
<td>Red/white</td>
<td>50–185 psi/0–300 psi</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

For SI units: 1 pound-force per square inch = 6.8947 kPa, 1 inch of mercury vacuum (HgV) = 3.386 kPa

| TABLE 1314.5(1) |
| POSITIVE-PRESSURE GASES [NFPA 99: TABLE 5.1.4.1.6(a)] |

| TABLE 1701.1 |
| REFERENCED STANDARDS |
| STANDARD NUMBER | STANDARD TITLE | APPLICATION | REFERENCED SECTION |
| ASSE/IAPMO/ANSI 6060-2021 | Medical Gas Systems Designer | Medical Gas | 1307.5 |

(portions of table not shown remain unchanged)
Note: ASSE/IAPMO/ANSI 6060 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 13 is being revised to the latest edition of NFPA 99-2024.
1318.0 Piping Materials for Field-Installed Positive Pressure Medical Gas Systems.

1318.4 Tubes for Medical Gas Systems. Tubes shall be one of the following:

1. Hard-drawn seamless copper in accordance with ASTM B819, medical gas tube, Type L, except Type K shall be used where operating pressures are above a gauge pressure of 185 psi (1276 kPa) and the pipe sizes are larger than DN80 [(NPS 3) (31/8 inches O.D.)].

2. Listed corrugated medical tubing (CMT) fabricated from copper alloy No. 51000 strip, meeting ASTM B103 with a design margin of 3.5, externally coated with a nonmetallic sheath marked with the manufacturer’s marking. The listing shall include testing to demonstrate that CMT systems can be consistently gas-purged with results equivalent to comparable medical gas copper tubing. ([NFPA 99:5.1.10.1.4])

1318.4.1 Corrugated Medical Tube (CMT) Material. CMT shall have a flame spread index of 25 or less and a smoke developed index of 50 or less as determined by ASTM E84. ([NFPA 99:5.1.10.1.5])

1318.4.2 Corrugated Medical Tube (CMT) for Oxygen Service. CMT shall be identified by the manufacturer as suitable for oxygen service at a minimum of every 3 feet (914 mm). ([NFPA 99:5.1.10.1.6])

1319.0 Piping Materials for Field-Installed Medical-Surgical Vacuum Systems.

1319.1 Tubes for Medical Vacuum Systems. Piping for vacuum and WAGD systems at vacuums greater than 5 inches (125 mm) HgV shall be constructed of any of the following:

1. Hard-drawn seamless copper tube in accordance with the following:
   a. ASTM B88, copper tube (Type K, Type L, or Type M)
   b. ASTM B280, copper ACR tube
   c. ASTM B819, copper medical gas tubing (Type K or Type L)

2. Stainless steel tube in accordance with the following:
   a. ASTM A269 TP304L or 316L
   b. ASTM A312 TP304L or 316L
   c. ASTM A312 TP 304L/316L, Schedule 5S pipe, and ASTM A403 WP304L/316L, Schedule 5S fittings

3. CMT meeting the requirements of 1318.4(2). ([NFPA 99:5.1.10.2.1])

1319.1.1 Tubes for Vacuum or WAGD. Copper tubing for vacuum or WAGD service that is installed along with any medical gas tubing shall, prior to installation, be prominently labeled or otherwise identified to preclude using materials or installation procedures in the medical gas system that are not suitable for oxygen service. ([NFPA 99:5.1.10.2.2.1])

1319.1.2 Where Not Required. If medical gas tube in accordance with ASTM B819, Standard Specification for Seamless Copper Tube for Medical Gas Systems, or CMT in accordance with Section 1318.4(2), Section 1318.4.1, and Section 1318.4.2 is used for vacuum or WAGD piping, such special marking in accordance with Section 1319.1.1 shall not be required. ([NFPA 99:5.1.10.2.2.2])

1320.0 Joints and Connections.
1320.2 Changes in Direction. Positive pressure patient gas systems, medical support gas systems, and vacuum systems, and WAGD systems constructed of hard-drawn seamless copper or stainless steel tubing shall have all turns, offsets, and other changes in direction made using fittings or techniques appropriate to any of the following acceptable joining methods:

(1) Brazing, as described in Section 1321.0.
(2) Welding, as described in Section 1322.1 through Section 1322.2.1.
(3) Memory metal fittings, as described in Section 1322.3.
(4) Axially swaged, elastic preload fittings, as described in Section 1322.4.
(5) Threaded, as described in Section 1322.5. [NFPA 99:5.1.10.3.1]

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM B103/B103M-2023</td>
<td>Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar Piping</td>
<td>Piping</td>
<td>1318.4(2)</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM B103 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 13 is being revised to the latest edition of NFPA 99-2024.
CHAPTER 13
HEALTH CARE FACILITIES AND MEDICAL GAS AND MEDICAL VACUUM SYSTEMS
Part I – General Requirements.

1301.0 General Requirements.
1301.1 Applicability. This chapter applies to the special fixtures and systems in health care facilities; the special plumbing requirements for such facilities; and the installation, testing, and verification of Categories 1, 2, and 3 medical gas and medical vacuum piping systems, except as otherwise indicated in this chapter, from the central supply system to the station outlets or inlets in hospitals, clinics, and other health care facilities. Other plumbing in such facilities shall comply with other applicable sections of this code. For Category 3 medical gas systems, only oxygen and nitrous oxide shall be used.

**1301.2 Nonflammable Medical Gas Systems.** Inhalation anesthetic systems, and vacuum piping systems shall be installed, tested, and labeled in accordance with NFPA 99 and this chapter.

**1301.2.1 Nonflammable Medical Gas Systems.** Inhalation anesthetic systems, and vacuum piping systems in dental healthcare facilities shall be installed, tested, and labeled in accordance with NFPA 99.

(remaining text unchanged)

1301.2 Where Not Applicable. This chapter does not apply to the following except as otherwise addressed in this chapter:
1. Cylinder and container management, storage, and reserve requirements
2. Bulk supply systems
3. Electrical connections and requirements
4. Motor requirements and controls
5. Systems having nonstandard operating pressures
6. Waste anesthetic gas disposal (WAGD) systems
7. Surface-mounted medical gas rail systems
8. Breathing air replenishment (BAR) systems
9. Portable compressed gas systems
10. Medical support gas systems
11. Gas-powered device supply systems
12. Scavenging systems

1301.3 Conflict of Requirements. The requirements of this chapter shall not be interpreted to conflict with the requirements of NFPA 99. For requirements of portions of medical gas and vacuum systems not addressed in this chapter or medical gas and vacuum systems beyond the scope of this chapter refer to NFPA 99.

1301.4 Where Required. Construction and equipment requirements shall be applied only to new construction and new equipment, except as modified in individual sections of this chapter. (NFPA 99:1.3.2)

1301.5 Existing Systems. Only the altered, renovated, or modernized portion of an existing system or individual component shall be required to meet the installation and equipment requirements stated in this code. If the alteration, renovation, or modernization adversely impacts the existing performance requirements of a system or component, additional upgrading shall be required. An existing system that is not in strict compliance with the provisions of this code shall be permitted to be continued in use, unless the Authority Having Jurisdiction has determined that such use constitutes a distinct hazard to life. [NFPA 99:1.3.2.1 – 1.3.2.3]

1302.0 Design Requirements:
1302.1 Risk Categories. All activities, as well as systems or equipment that are new or altered, shall be designed to meet Category 1 through Category 4 requirements, as detailed in this chapter. (NFPA 99:4.1)
1302.1.1 Processes and Operations. The health care facility’s governing body shall establish the processes and operations that are planned for the health care facility. [NFPA 99:4.2.1]

1302.1.1.1 Risk Categories. The governing body shall conduct risk assessments and shall determine risk categories based on the character of the processes and operations conducted in the health care facility. [NFPA 99:4.2.1.1]

1302.1.2 Risk Assessment. Risk categories shall be classified by the health care facility’s governing body by following and documenting a defined risk assessment procedure. [NFPA 99:4.2.2]

1302.1.2.1 Documents to the Authority Having Jurisdiction. Where required by the Authority Having Jurisdiction (AHJ), the risk assessment shall be provided to the AHJ for review based on the character of the processes and operations conducted in the health care facility. [NFPA 99:4.2.2.1]

1302.1.3 Documented Risk Assessment. A documented risk assessment shall not be required where Category 1 is selected. [NFPA 99:4.2.3]

1302.2 Patient Care Spaces. The health care facility’s governing body or its designee shall establish the following areas in accordance with the type of patient care anticipated (see definition of patient care space in Chapter 2):

1. Category 1 spaces
2. Category 2 spaces
3. Category 3 spaces
4. Category 4 spaces [NFPA 99:1.3.4.1]

1302.3 Anesthesia. It shall be the responsibility of the health care facility’s governing body to designate anesthetizing locations. [NFPA 99:1.3.4.2]

1302.4 Wet Procedure Locations. It shall be the responsibility of the health care facility’s governing body to designate wet procedure locations. [NFPA 99:1.3.4.3]

1304.0 Medical Gas and Medical Vacuum Piping Systems. 1304.1 General. The installation of medical gas and medical vacuum piping systems shall comply with the requirements of this chapter.

1304.2 Certification of Systems. Certification of medical gas and vacuum systems shall comply with the requirements of Section 1306.0:

1306.0 System Certification.

1306.1 Certification. Prior to a medical gas or vacuum system being placed in service, such system shall be certified in accordance with Section 1306.2;

1306.2 Certification Tests. Certification tests, verified and attested to by the certification agency, shall include the following:

1. Verifying in accordance with the installation requirements.
2. Testing and checking for leakage, correct zoning, and identification of control valves.
3. Checking for identification and labeling of pipelines, station outlets, and control valves.
4. Testing for cross-connection, flow rate, system pressure drop, and system performance.
5. Functional testing of pressure relief valves and safety valves.
6. Functional testing of sources of supply.
7. Functional testing of alarm systems, including accuracy of system components.
8. Purge flushing of system and filling with specific source gases.
10. Testing for specific gas identity at each station outlet.

1306.3 Report Items. A report that includes the specific items addressed in Section 1306.2, and other information required by this chapter, shall be delivered to the Authority Having Jurisdiction prior to acceptance of the system.

1306.4 Components. Functioning of alarm components shall be verified in accordance with the testing and monitoring requirements of the manufacturer and the Authority Having Jurisdiction.
1307.0 Central Supply Systems.

1307.1 Terms. Where the terms medical gas or medical support gas occur, the provisions shall apply to all piped systems for oxygen, nitrous oxide, medical air, carbon dioxide, helium, nitrogen, instrument air, and mixtures thereof. Wherever the name of a specific gas service occurs, the provision shall apply only to that gas. [NFPA 99:5.1.1.3]

1307.2 Nature of Hazards of Gas and Vacuum Systems. Potential fire and explosion hazards associated with positive pressure gas central piping systems and medical—surgical vacuum systems shall be considered in the design, installation, testing, operation, and maintenance of these systems. [NFPA 99:5.1.2]

1307.3 Permitted Locations for Medical Gases. Central supply systems for oxygen, medical air, nitrous oxide, carbon dioxide, and all other patient medical gases shall be piped only to medical gas outlets complying with Section 1315.0, into areas where the gases will be used under the direction of licensed medical professionals for purposes congruent with the following:

(1) Direct respiration by patients.
(2) Clinical application of the gas to a patient, such as the use of an insufflator to inject carbon dioxide into patient body cavities during laparoscopic surgery and carbon dioxide used to purge heart-lung machine blood flow ways.
(3) Medical device applications directly related to respiration.
(4) Power for medical devices used directly on patients.
(5) Calibration of medical devices intended for Section 1307.3(1) through Section 1307.3(4).
(6) Simulation centers for the education, training, and assessment of health care professionals. [NFPA 99:5.1.3.5.2]

1307.4 Materials. Materials used in central supply systems shall meet the following requirements:

(1) In those portions of systems intended to handle oxygen at gauge pressures greater than 350 pounds-force per square inch (psi) (2413 kPa), interconnecting hose shall contain no polymeric materials.
(2) In those portions of systems intended to handle oxygen or nitrous oxide material, construction shall be compatible with oxygen under the temperatures and pressures to which the components can be exposed in the containment and use of oxygen, nitrous oxide, mixtures of these gases, or mixtures containing more than 23.5 percent oxygen.
(3) If potentially exposed to cryogenic temperatures, materials shall be designed for low temperature service.
(4) If intended for outdoor installation, materials shall be installed per the manufacturer’s requirements. [NFPA 99:5.1.3.5.4]

1308.0 Pressure Regulating Equipment.

1308.1 Where Required. Pressure-regulating equipment shall be installed in the supply main upstream of the final line pressure valve. Where multiple piping systems for the same gas at different operating pressures are required, separate pressure-regulating equipment, relief valves, and source shutoff valves shall be provided for each pressure.

1308.2 Pressure Relief Valves. All pressure relief valves shall meet the following requirements:

(1) They shall be of brass, bronze, or stainless steel construction.
(2) They shall be designed for the specific gas service.
(3) They shall have a relief pressure setting not higher than the maximum allowable working pressure (MAWP) of the component with the lowest working pressure rating in the portion of the system being protected.
(4) They shall be vented to the outside of the building, except that relief valves for compressed air systems having less than 3000 cubic feet (84 950 L) at STP shall be permitted to be diffused locally by means that will not restrict the flow.
(5) They shall have a vent discharge line that is not smaller than the size of the relief valve outlet or 3/4 NPS (20 mm), whichever is larger.
(6) Where two or more relief valves discharge into a common vent line, the internal cross-sectional area of the common line shall be not less than the aggregate cross-sectional area of all relief valve vent discharge lines served.
(7) They shall not discharge into locations creating potential hazards.
(8) They shall have the discharge terminal turned down and screened to prevent the entry of rain, snow, or vermin.
(9) They shall be designed in accordance with ASME B31.3. [NFPA 99:5.1.3.5.6.1]
1308.3 Pressure-Relief Valve Requirements. Central supply systems for positive pressure gases shall include one or more relief valves, all meeting the following requirements:

(1) They shall be located between each final line regulator and the source valve.
(2) They shall have a relief setting that is 50 percent above the normal system operating pressure, as indicated in Table 1305.1. [NFPA 99:5.1.3.5.6.4]

1309.0 Oxygen Concentrator Supply Units

1309.1 Oxygen Requirements. Oxygen concentrator supply units for use with medical gas pipelines shall produce oxygen meeting the requirements of Oxygen 93 USP or Oxygen USP. [NFPA 99:5.1.3.9.1.1]

1309.2 Particulate Size. Output shall have less than or equal to $1.686 \times 10^{-6}$ pounds per cubic yard (1 mg/m$^3$) of permanent particulates sized 1 micron or larger at normal atmospheric pressure. [NFPA 99:5.1.3.9.1.2]

1309.3 Suitability. Materials of construction on the air side of the oxygen concentrator unit shall be suitable for the service as determined by the manufacturer. [NFPA 99:5.1.3.9.1.3]

1309.4 Compatible Materials. Materials of construction on the oxygen side of the oxygen concentrator unit shall comply with Section 1307.4. [NFPA 99:5.1.3.9.1.4]

1309.5 Oxygen Concentrator Components. The components that make up the oxygen concentrator unit shall be as follows:

(1) The manufacturer of the concentrator unit shall be permitted to use such components and arrangement of such components as needed to produce oxygen complying with Section 1309.1 in the quantity as required by the facility, except where otherwise specifically defined in this code.
(2) Air receivers and oxygen accumulators, where used, shall comply with Section VIII.1, “Unfired Pressure Vessels,” of the ASME Boiler and Pressure Vessels Code and be provided with overpressure relief valves. [NFPA 99:5.1.3.9.1.5]

1309.6 Supply Air Quality. The supply air to the concentrator(s) shall be of a quality to ensure the oxygen concentrator unit can produce oxygen complying with Section 1309.1 and shall not be subject to normally anticipated contamination (e.g., vehicle or other exhausts, gas leakage, discharge from vents, flooding). [NFPA 99:5.1.3.9.1.6]

1309.7 Electrical Components. The oxygen concentrator supply unit and any associated electrical equipment shall be provided with, at a minimum, the following electrical components:

(1) Either a disconnect switch for each major electrical component or a single disconnect that deactivates all electrical components in the concentrator unit.
(2) Motor starting devices with overload protection for any component with an electrical motor over 2 hp (1.5 kW). [NFPA 99:5.1.3.9.1.7]

1309.8 Vent Valve. A vent valve shall be provided as follows:

(1) Located on the source side of the concentrator outlet isolation valve to permit the operation of the oxygen concentrator unit for validation, calibration, and testing while the unit is isolated from the pipeline system.
(2) Sized to allow for at least 25 percent of the oxygen concentrator unit flow.
(3) Vented to a location compliant with Section 1309.8.1. [NFPA 99:5.1.3.9.1.8]

1309.8.1 Venting of Relief Valves. Indoor supply systems shall have all relief valves vented per Section 1308.2(4) through Section 1308.2(9). [NFPA 99:5.1.3.9.1.9]

1309.9 Valved Sample Port. A DN8 (NPS 1/4) valved sample port shall be provided near the oxygen concentration monitor sensor connection for sampling of the gas from the oxygen concentrator unit. [NFPA 99:5.1.3.9.1.10]

1309.10 Suitable Filter. At least one 0.1 micron filter suitable for oxygen service shall be provided at the outlet of the oxygen concentrator supply unit. [NFPA 99:5.1.3.9.1.10]

1309.11 Check Valve. A check valve shall be provided at the outlet of the oxygen concentrator supply unit to prevent backflow into the oxygen concentrator supply unit and to allow service to the unit. [NFPA 99:5.1.3.9.1.11]

1309.12 Outlet Valve. An outlet valve shall be provided to isolate all components of the oxygen concentrator from the pipeline with the following characteristics:
(1) The valve shall have both manual and automatic actuation with visual indication of open or closed.
(2) The valve shall close automatically whenever the oxygen concentrator unit is not producing oxygen of a concentration equal to that in Section 1309.1.
(3) Continuing operation of the oxygen concentrator supply unit through the vent mode shall be permitted with the isolating valve closed.
(4) The isolating valve, when automatically closed due to low concentration, shall require manual reset to ensure the oxygen concentrator supply unit is examined prior to return to service.
(5) Closing the isolating valve, whether automatically or manually, shall activate an alarm signal at the master alarms (see Section 1317.1.1) indicating that the oxygen concentrator supply unit is disconnected. [NFPA 99:5.1.3.9.1.12]

1309.13 Oxygen Concentration Monitor. The oxygen concentrator supply unit shall be provided with an oxygen concentration monitor with the following characteristics:
(1) The monitor shall be capable of monitoring 99 percent oxygen concentration with 1 percent accuracy.
(2) The monitor shall continuously display the oxygen concentration and shall activate local alarm and master alarms per NFPA 99 when a concentration lower than 91 percent is observed.
(3) The monitor shall continuously display the oxygen concentration.
(4) It shall be permitted to insert the monitor into the pipeline without a demand check. [NFPA 99:5.1.3.9.1.13]

1310.0 Category 1 Medical Air Central Supply Systems:
1310.1 Quality of Medical Air. Medical air shall be required to have the following characteristics:
(1) It shall be supplied from cylinders, bulk containers, or medical air compressor sources, or it shall be reconstituted from oxygen USP and oil-free, dry nitrogen NF.
(2) It shall meet the requirements of medical air USP.
(3) It shall have no detectable liquid hydrocarbons.
(4) It shall have less than 25 ppm gaseous hydrocarbons.
(5) It shall have equal to or less than \(1.686 \times 10^{-6}\) pounds per cubic yard \((1 \text{ mg/m}^3)\) of permanent particulates sized 1 micron or larger in the air at normal atmospheric pressure. [NFPA 99:5.1.3.6.1]

1310.2 Uses of Medical Air. Medical air sources shall be connected to the medical air distribution system only and shall be used only for air in the application of human respiration and calibration of medical devices for respiratory application. [NFPA 99:5.1.3.6.2]

1310.3 Medical Air Compressors. Medical air compressors shall be installed in a well-lit, ventilated, and clean location and shall be accessible. The location shall be provided with drainage facilities in accordance with this code. The medical air compressor area shall be located separately from medical gas cylinder system sources, and shall be readily accessible for maintenance:

1310.3.1 Category 1 Medical Air Compressor. Medical air compressors shall be sufficient to serve the peak calculated demand with the largest single compressor out of service. In no case shall there be fewer than two compressors. [NFPA 99:5.1.3.6.3.9(B)]

1310.3.2 Required Components. Medical air compressor systems shall consist of the following:
(1) Components shall be arranged to allow service and a continuous supply of medical air in the event of a single fault failure. Component arrangement shall be permitted to vary as required by the technology(ies) employed, provided that an equal level of operating redundancy and medical air quality is maintained. [NFPA 99:5.1.3.6.3.9(A)(1), 5.1.3.6.3.9(A)(2)]
(2) Automatic means to prevent backflow from all oncycle compressors through all off-cycle compressors.
(3) Manual shutoff valve to isolate each compressor from the centrally piped system and from other compressors for maintenance or repair without loss of pressure in the system.
(4) Intake filter muffler(s) of the dry type.
(5) Pressure relief valve(s) set at 50 percent above line pressure.
(6) Piping and components between the compressor and the source shutoff valve that do not contribute to
contaminant levels.

(7) Except as defined in Section 1310.3.2(1) through Section 1310.3.2(6), materials and devices used between the medical air intake and the medical air source valve that are of any design or construction appropriate for the service as determined by the manufacturer. [NFPA 99:5.1.3.6.3.2(2-7)]

1310.4 Medical Air Receivers. Receivers for medical air shall meet the following requirements:
(1) They shall be made of corrosion-resistant materials or otherwise be made corrosion resistant.
(2) They shall comply with Section VIII.1, “Unfired Pressure Vessels,” of the ASME Boiler and Pressure Vessel Code.
(3) They shall be equipped with a pressure relief valve, automatic drain, manual drain, sight glass, and pressure indicator.
(4) They shall be of a capacity sufficient to prevent the compressors from short-cycling. [NFPA 99:5.1.3.6.3.6]

1310.5 Valves. A medical air receiver(s) shall be provided with proper valves to allow the flow of compressed air to enter and exit out of separate receiver ports during normal operation and allow the receiver to be bypassed during service without shutting down the supply of medical air. [NFPA 99:5.1.3.6.3.9(D)]

1311.0 Compressor Intake. 1311.1 Air Sources. Air sources for medical air compressors shall comply with Section 1311.2 through Section 1311.6.

1311.2 Medical Air Compressor Source. The medical air compressors shall draw their air from a source of clean air. [NFPA 99:5.1.3.6.3.11(A)]

If an air source equal to or better than outside air (e.g., air already filtered for use in operating room ventilating systems) is available, it shall be permitted to be used for the medical air compressors with the following provisions:
(1) This alternate source of supply air shall be available on a continuous 24 hours-per-day, 7 day-per-week basis.
(2) Ventilating systems having fans with motors or drive belts located in the airstream shall not be used as a source of medical air intake. [NFPA 99:5.1.3.6.3.11(E)]

1311.3 Air Intakes. Compressor intake piping shall be permitted to be made of materials and use a joining technique as permitted under Section 1319.0 and Section 1320.0. [NFPA 99:5.1.3.6.3.11(F)]

1311.4 Location. Medical air intakes shall be located as follows:
(1) The medical air intake shall be located a minimum of 25 feet (7620 mm) from ventilating system exhausts, fuel storage vents, combustion vents, plumbing vents, vacuum and WAGD discharges, or areas that can collect vehicular exhausts or other noxious fumes.
(2) The medical air intake shall be located a minimum of 20 feet (6096 mm) above ground level.
(3) The medical air intake shall be located a minimum of 10 feet (3048 mm) from any door, window, or other opening in the building. [NFPA 99:5.1.3.6.3.11(B-D)]

1311.5 Separate Compressors. Air intakes for separate compressors shall be permitted to be joined together to one common intake where the following conditions are met:
(1) The common intake is sized to minimize backpressure in accordance with the manufacturer’s recommendations.
(2) Each compressor can be isolated by manual or check valve, blind flange, or tube cap to prevent open inlet piping when the compressor(s) is removed for service from the consequent backflow of room air into the other compressor(s). [NFPA 99:5.1.3.6.3.11(G)]

1311.6 Screening. The end of the intake shall be turned down and screened or otherwise be protected against the entry of vermin, debris, or precipitation by screening fabricated or composed of a noncorroding material. [NFPA 99:5.1.3.6.3.11(H)]

1312.0 Medical-Surgical Vacuum Central Supply Systems. 1312.1 General. The vacuum plant shall be installed in a well-lit, ventilated, and clean location with accessibility. The location shall be provided with drainage facilities in accordance with this code. The vacuum plant, where installed as a source, shall be located separately from other medical vacuum system sources and shall be readily accessible for maintenance.

1312.2 Medical-Surgical Vacuum Sources. Medical-surgical vacuum central supply systems shall consist of the following:
(1) Two or more vacuum pumps sufficient to serve the peak calculated demand with the largest single vacuum pump out of service.
(2) Automatic means to prevent backflow from any on-cycle vacuum pumps through any off-cycle vacuum pumps.
(3) Shutoff valve or other isolation means to isolate each vacuum pump from the centrally piped system, and other vacuum pumps for maintenance or repair without loss of vacuum in the system.
(4) Vacuum receiver.
(5) Piping between the vacuum pump(s), discharge(s), receiver(s), and vacuum source shutoff valve in accordance with Section 1319.0, except brass, galvanized, or black steel pipe, which is permitted to be used as recommended by the manufacturer.
(6) Except as defined in Section 1312.2(1) through Section 1312.2(5), materials and devices used between the medical vacuum exhaust and the medical vacuum source that are permitted to be of any design or construction appropriate for the service as determined by the manufacturer.
(7) Vacuum filtration per Section 1312.4. [NFPA 99:5.1.3.7.1.1]

1312.3 Vacuum Receivers. Receivers for vacuum shall meet the following requirements:
(1) They shall be made of materials deemed suitable by the manufacturer.
(2) They shall comply with Section VIII.1, “Unfired Pressure Vessels,” of the ASME Boiler and Pressure Vessel Code.
(3) They shall be capable of withstanding a gauge pressure of 60 psi (414 kPa) and 30 inch (762 mm) gauge HgV.
(4) They shall be equipped with a manual drain.
(5) They shall be of a capacity based on the technology of the pumps. [NFPA 99:5.1.3.7.3]

1312.4 Vacuum Filtration. Central supply systems for vacuum other than liquid ring pumps shall be provided with inlet filtration with the following characteristics:
(1) Filtration shall be at least duplex to allow one filter to be exchanged without impairing the vacuum system.
(2) Filtration shall be located on the patient side of the vacuum producer.
(3) Filters shall be efficient to 0.3 µ and 99.97 percent HEPA or better, per DOE-STD-3020.
(4) Filtration shall be sized for 100 percent of the peak calculated demand while one filter or filter bundle is isolated.
(5) It shall be permitted to group multiple filters into bundles to achieve the required capacities.
(6) The system shall be provided with isolation valves on the source side of each filter or filter bundle and isolation valves on the patient side of each filter or filter bundle, permitting the filters to be isolated without shutting off flow to the central supply system.
(7) A means shall be available to allow the user to observe any accumulations of liquids.
(8) A vacuum relief petcock shall be provided to allow vacuum to be relieved in the filter canister during filter replacement.
(9) Filter elements and canisters shall be permitted to be constructed of materials as deemed suitable by the manufacturer.
(10) In normal operation, one filter or filter bundle shall be isolated from the system to be available for service should a blockage in the operating filter occur or rotation of the filters be desired after filter element exchange. [NFPA 99:5.1.3.7.4]

1312.5 Piping Arrangement and Redundancies. Piping arrangement shall be as follows:
(1) Piping shall be arranged to allow service and a continuous supply of medical-surgical vacuum in the event of a single fault failure.
(2) Piping arrangement shall be permitted to vary based on the technology(ies) employed, provided that an equal level of operating redundancy is maintained.
(3) Where only one set of vacuum pumps is available for a combined medical-surgical vacuum system and an analysis, a research, or a teaching laboratory vacuum system, such laboratories shall be connected separately from the medical-surgical system directly to the receiver tank through its own isolation valve and fluid trap located at the receiver, and between the isolation valve and fluid trap, a scrubber shall be permitted to be installed. [NFPA 99:5.1.3.7.5.5.1.3.7.5.1]

1312.6 Piping Serviceability. The medical-surgical vacuum receiver(s) shall be serviceable without shutting down the medical-surgical vacuum system by any method to ensure continuation of service to the facility’s medical-
surgical pipeline distribution system. [NFPA 99:5.1.3.7.5.2]

1312.7 Shutoff Valve. Medical surgical vacuum central supply systems shall be provided with a source shutoff valve per Section 1314.6. [NFPA 99:5.1.3.7.5.3]

1313.0 Medical-Surgical Vacuum Exhaust.

1313.1 Vacuum Source Exhausts. The medical-surgical vacuum pumps shall exhaust in a manner and location that minimizes the hazards of noise and contamination to the facility and its environment. [NFPA 99:5.1.3.7.7.1]

1313.2 Location. The exhaust shall be located as follows:
(1) Outdoors.
(2) At least 25 feet (7620 mm) from any door, window, air intake, or other openings in buildings or places of public assembly.
(3) At a level different from air intakes.
(4) Where prevailing winds, adjacent buildings, topography, or other influences will not divert the exhaust into occupied areas or prevent dispersion of the exhaust. [NFPA 99: 5.1.3.7.7.2]

1313.3 Screening. The end of the exhaust shall be turned down and screened or otherwise be protected against the entry of vermin, debris, or precipitation by screening fabricated or composed of a noncorroding material. [NFPA 99:5.1.3.7.7.3]

1313.4 Dips and Loops. The exhaust shall be free of dips and loops that might trap condensate or oil or provided with a drip leg and valved drain at the bottom of the low point. [NFPA 99:5.1.3.7.7.5]

1313.5 Multiple Pumps. Vacuum exhausts from multiple pumps shall be permitted to be joined together to one common exhaust where the following conditions are met.
(1) The common exhaust is sized to minimize back pressure in accordance with the pump manufacturer's recommendations.
(2) Each pump can be isolated by manual or check valve, blind flange, or tube cap to prevent open exhaust piping when the pump(s) is removed for service from consequent flow of exhaust air into the room. [NFPA 99:5.1.3.7.7.6]

1314.0 Valves.

1314.1 Gas and Vacuum Shutoff Valves. Shutoff valves shall be provided to isolate sections or portions of the piped distribution system for maintenance, repair, or planned future expansion need and to facilitate periodic testing. [NFPA 99:5.1.4.1.1]

1314.2 Security. All valves, except valves in zone valve box assemblies, shall be secured by any of the following means:
(1) Located in secured areas.
(2) Locked or latched in their operating position.
(3) Located above ceilings, but remaining accessible and not obstructed. [NFPA 99:5.1.4.1.2]

1314.3 Labeled. All valves shall be labeled as to gas supplied and the area(s) controlled, in accordance with Section 1323.14. [NFPA 99:5.1.4.1.3]

1314.4 Accessibility. Zone valves shall be installed in valve boxes with removable covers large enough to allow manual operation of valves.

Zone valves for use in certain areas, such as psychiatric or pediatric areas, shall be permitted to be secured with the approval of the Authority Having Jurisdiction to prevent inappropriate access. [NFPA 99:5.1.4.1.4]

1314.4.1 Flammable Gases. Valves for nonflammable medical gases shall not be installed with valves for flammable gases in the same zone valve box assembly with flammable gases. [NFPA 99:5.1.4.1.5]

1314.5 Valve Types. New or replacement valves shall be permitted to be of any type as long as they meet the following conditions:
(1) They have a minimum Cv factor in accordance with Table 1314.5(1) or Table 1314.5(2).
(2) They use a quarter turn to off.
(3) They are constructed of materials suitable for the service.
(4) They are provided with copper tube extensions by the manufacturer for brazing or with corrugated medical
tubing (CMT) fittings.

(5) They indicate to the operator if the valve is open or closed.
(6) They permit in-line serviceability.
(7) They are cleaned for oxygen service by the manufacturer if used for any positive-pressure service.
(8) They have threaded purge ports on the patient side and the source side.
(9) They have a minimum working pressure equal to or greater than the relief valve protecting the piping system on which the valve is installed for any positive-pressure service. [NFPA 99:5.1.4.1.6]

1314.6 Source Valves. A shutoff valve shall be placed at the immediate connection of each central supply system to the piped distribution system to allow the entire central supply system, including all accessory devices (e.g., air dryers, final line regulators), to be isolated from the facility. [NFPA 99:5.1.4.2.1]

1314.6.1 Location. The source valve shall be located in the immediate vicinity of the central supply system. [NFPA 99:5.1.4.2.2]

1314.7 Main Line Valve. A shutoff valve shall be provided in the main supply line inside of the buildings being served, except where one or more of the following conditions exist:
(1) The source and source valve are located inside the building served;
(2) The source system is physically mounted to the wall of the building served, and the pipeline enters the building in the immediate vicinity of the source valve. [NFPA 99:5.1.4.3.1]

1314.7.1 Location. The main line valve shall be located on the facility side of the source valve and outside of the source room, the enclosure, or where the main line first enters the building. [NFPA 99:5.1.4.3.2]

1314.8 Riser Valves. Each riser supplied from the main line shall be provided with a shutoff valve in the riser adjacent to the main line. [NFPA 99:5.1.4.4]

1314.9 Service Valves. Service valves shall be installed to allow servicing or modification of lateral branch piping from a main or riser without shutting down the entire main, riser, or facility. [NFPA 99:5.1.4.5.1]

1314.9.1 Branch Piping. Only one service valve shall be required for each branch off of a riser, regardless of how many zone valve boxes are installed on that lateral. Service valves shall be placed in the branch piping prior to any zone valve box assembly on that branch. [NFPA 99:5.1.4.5.2, 5.1.4.5.3]

1314.10 Zone Valves. All station outlets/inlets shall be supplied through a zone valve, which shall be placed as follows:
(1) It is installed so that a wall intervenes between the valve and the outlets/inlets that it controls.
(2) It is readily operable from a standing position.
(3) It is installed where it is visible and accessible at all times.
(4) It is not installed where it can be hidden from plain view, such as behind normally open or normally closed doors.
(5) It is not installed in a room with the station outlets/inlets that it controls.
(6) It is not installed in rooms, areas, or closets that can be closed or locked. [NFPA 99:5.1.4.6.1]

1314.10.1 Readily Accessible. A zone valve in each medical gas or vacuum line shall be provided for each Category 1 space and anesthetizing location for moderate sedation, deep sedation, or general anesthesia specific for the occupancy, and shall be located as follows:
(1) They are installed immediately outside the area controlled.
(2) They are installed where they are visible and accessible at all times. [NFPA 99:5.1.4.6.2]

1314.10.2 Arrangement. Piping on the patient side of zone valves shall be arranged to provide the following:
(1) Shutting off the supply of medical gas or vacuum to one zone will not affect the supply of medical gas or vacuum to another zone or the rest of the system.
(2) Service will only be to outlets/inlets located on that same story.
(3) All gas delivery columns, hose reels, ceiling tracks, control panels, pendants, booms, or other special installations are located on the patient side of the zone valve. [NFPA 99:5.1.4.6.3]

1314.10.3 Indicators. A pressure/vacuum indicator shall be provided on the station outlet/inlet side of each zone valve. [NFPA 99:5.1.4.6.4]
1314.11 In-Line Shutoff Valves. Optional in-line valves shall be permitted to be installed to isolate or shut off piping for servicing of individual rooms or areas. [NFPA 99:5.1.4.7]

1314.12 Valves for Future Connections. Future connection valves shall be labeled as to gas content. [NFPA 99:5.1.4.8.1]

1314.12.1 Downstream Piping. Downstream piping shall be closed with a brazed cap with tubing allowance for cutting and rebrazing. [NFPA 99:5.1.4.8.2]

1315.0 Station Outlets and Inlets:
1315.1 General. Each station outlet/inlet for medical gases or vacuums shall be gas-specific, whether the outlet/inlet is threaded or is a noninterchangeable quick coupler. [NFPA 99:5.1.5.1]

1315.2 Required Valves. Each station outlet shall consist of a primary and a secondary valve (or assembly). Each station inlet shall consist of a primary valve (or assembly) and shall be permitted to include a secondary valve (or assembly). [NFPA 99:5.1.5.2, 5.1.5.3]

1315.3 Secondary Valve. The secondary valve (or assembly) shall close automatically to stop the flow of gas (or vacuum, if provided) when the primary valve (or assembly) is removed. [NFPA 99:5.1.5.4]

1315.4 Identification. Each outlet/inlet shall be legibly identified in accordance with Section 1323.15. [NFPA 99:5.1.5.5]

1315.5 Threaded Outlets/Fittings. Threaded outlets/inlets shall be noninterchangeable connections complying with the mandatory requirements of CGA V-5. [NFPA 99:5.1.5.6]

1315.6 Gas-Specific Station Outlet/Inlet. Each station outlet/inlet, including those mounted in columns, hose reels, ceiling tracks, or other special installations, shall be designed so that parts or components that are required to be gas-specific for compliance with Section 1315.1 and Section 1315.8 cannot be interchanged between the station outlet/inlet for different gases. [NFPA 99:5.1.5.7]

1315.7 Common Parts. The use of common parts in outlets/inlets, such as springs, O-rings, fasteners, seals, and shutoff poppets, shall be permitted. [NFPA 99:5.1.5.8]

1315.8 Marking of Components. Components of a vacuum station inlet necessary for the maintenance of vacuum specificity shall be legibly marked to identify them as components or parts of a vacuum or suction system. [NFPA 99:5.1.5.9]

1315.9 Components Not Specific to a Vacuum. Components of inlets not specific to a vacuum shall not be required to be marked. [NFPA 99:5.1.5.10]

1315.10 Factory-Installed Copper Inlet Tubes. Factory-installed copper inlet tubes on station outlets extending no further than 8 inches (203 mm) from the body of the terminal shall be not less than DN6 (NPS 1/4) (3/8 inch O.D.) size, with 0.3 inch (7.6 mm) minimum inside diameter. [NFPA 99:5.1.5.11]

1315.11 Factory-Installed Copper Outlet Tubes. Factory-installed copper outlet tubes on station inlets extending no further than 8 inches (203 mm) from the body of the terminal shall be not less than DN10 (NPS 3/8) (1/2 in. O.D.) size, with 0.4 inch (10.2 mm) minimum inside diameter. [NFPA 99:5.1.5.12]

1315.12 Protection from Damage. Station outlets/inlets shall be permitted to be recessed or otherwise protected from damage. [NFPA 99:5.1.5.13]

1315.13 Multiple Wall Outlets/Inlets. When multiple wall outlets/inlets are installed, they shall be spaced to allow the simultaneous use of adjacent outlets/inlets with any of the various types of therapy equipment. [NFPA 99:5.1.5.14]

1315.14 Nonstandard Operation Pressures. Station outlets in systems having nonstandard operating pressures shall meet the following additional requirements:
(1) They shall be gas-specific;
(2) They shall be pressure-specific where a single gas is piped at more than one operating pressure [e.g., a station outlet for oxygen at 80 psi (552 kPa) shall not accept an adapter for oxygen at 50 psi (345 kPa)];
(3) If operated at a pressure in excess of 80 psi (552 kPa), they shall be either D.I.S.S. connectors or comply with Section 1315.14(4);
(4) If operated at a gauge pressure between 200 psi and 300 psi (1379 kPa and 2068 kPa), the station outlet shall...
be designed so as to prevent the removal of the adapter until the pressure has been relieved to prevent the adapter injuring the user or others when removed from the outlet. [NFPA 99:5.1.5.15]

1315.15 Post Installation. After installation of the piping, but before installation of the station outlets and inlets and other medical gas and medical gas system components (e.g., pressure-actuating switches for alarms, manifolds, pressure gauges, or pressure relief valves), the line shall be blown clear using oil-free, dry nitrogen NF.

1316.0 Pressure and Vacuum Indicator Locations.
1316.1 Isolation. A pressure-relief valve shall not be isolated from its intended use by a valve.
1316.2 Pressure and Vacuum Indicator Locations. Pressure/vacuum indicators shall be readable from a standing position. Pressure/vacuum indicators shall be provided at the following locations, as a minimum:
(1) Adjacent to the alarm-initiating device for source main line pressure and vacuum alarms in the master alarm system.
(2) At or in area alarm panels to indicate the pressure/vacuum at the alarm activating device for each system that is monitored by the panel.
(3) On the station outlet/inlet side of zone valves. [NFPA 99:5.1.8.2.1, 5.1.8.2.2]

1317.0 Warning Systems
1317.1 Category 1. All master, area, and local alarm systems used for medical gas and vacuum systems shall include the following:
(1) Separate visual indicators for each condition monitored, except as permitted in Section 1317.1.2 for local alarms that are displayed on master alarm panels.
(2) Visual indicators that remain in alarm until the situation that has caused the alarm is resolved.
(3) Cancelable audible indication of each alarm condition that produces a sound with a minimum level of 80 dBA at 3 feet (914 mm).
(4) Means to indicate a lamp or LED failure and audible failure.
(5) Visual and audible indication that the communication with an alarm initiating device is disconnected.
(6) Labeling of each indicator, indicating the condition monitored.
(7) Labeling of each alarm panel for its area of surveillance.
(8) Reinitializing of the audible signal if another alarm condition occurs while the audible alarm is silenced.
(9) Power for master alarms, area alarms, sensors, and switches from the life safety branch of the essential electrical system as described in NFPA 99.
(10) Power for local alarms, dew point sensors, and carbon monoxide sensors permitted to be from the same essential electrical branch as is used to power the air compressor system.
(11) Where used for communications, wiring from switches or sensors that is supervised or protected as required by NFPA 70 for life safety and critical branches circuits in which protection is any of the following types:
(a) Conduit
(b) Free air
(c) Wire
(d) Cable tray
(e) Raceways
(12) Communication devices that do not use electrical wiring for signal transmission and are supervised such that failure of communication initiates an alarm.
(13) Assurance by the responsible authority of the facility that the labeling of alarms, where room numbers or designations are used, is accurate and up-to-date.
(14) Provisions for automatic restart after a power loss of 10 seconds (e.g., during generator start-up) without giving false signals or requiring manual reset.
(15) Alarm switches/sensors installed so as to be removable and accessible for service and testing. [NFPA 99:5.1.9.1]

1317.1.1 Master Alarms. A master alarm system shall be provided to monitor the operation and condition of the
source of supply, the reserve source (if any), and the pressure in the main lines of each medical gas and vacuum piping system. [NFPA 99:5.1.9.2]

1317.1.2 Master Alarm Signal. The master alarm shall include at least one signal from the source equipment to indicate a problem with the source equipment at this location. This master alarm signal shall activate when any of the required local alarm signals for this source equipment activates. [NFPA 99:5.1.9.5.2]

1318.0 Piping Materials for Field Installed Positive Pressure Medical Gas Systems:

1318.1 General. The provisions of this section shall apply to field-installed piping for the distribution of medical gas systems:

1318.2 Cleaning. Tubes, valves, fittings, station outlets, and other piping components in medical gas systems shall have been cleaned for oxygen service by the manufacturer prior to installation in accordance with the mandatory requirements of CGA G-4.1, except that fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer. [NFPA 99:5.1.10.1.1]

Where tube ends, fittings or other components become contaminated before installation they shall be recleaned in accordance with Section 1321.8.7 and Section 1321.8.8.

1318.3 Delivery. Each length of tube shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation. Fittings, valves, and other components shall be delivered sealed and labeled and kept sealed until prepared for installation. [NFPA 99:5.1.10.1.2, 5.1.10.1.3]

1318.4 Tubes for Medical Gas Systems. Tubes shall be hard-drawn seamless copper in accordance with ASTM B819, medical gas tube, Type L, except Type K shall be used where operating pressures are above a gauge pressure of 185 psi (1276 kPa) and the pipe sizes are larger than DN80 [(NPS 3) (31/8 inches O.D.)]. [NFPA 99:5.1.10.1.4]

1318.5 Manufacturer Markings. ASTM B819, medical gas tube shall be identified by the manufacturer's markings “OXY,” “MED,” “OXY/MED,” “OXY/ACR,” or “ACR/MED” in blue (Type L) or green (Type K). [NFPA 99:5.1.10.1.7]

1318.6 Documentation. The installer shall furnish documentation certifying that all installed piping materials comply with the requirements of Section 1318.2. [NFPA 99:5.1.10.1.8]

1319.0 Piping Materials for Field Installed MedicalSurgical Vacuum Systems:

1319.1 Tubes for Medical Vacuum Systems. Piping for vacuum systems shall be constructed of any of the following:

(1) Hard-drawn seamless copper tube in accordance with the following:
   (a) ASTM B88, copper tube (Type K, Type L, or Type M)
   (b) ASTM B280, copper ACR tube
   (c) ASTM B819, copper medical gas tubing (Type K or Type L)

(2) Stainless steel tube in accordance with the following:
   (a) ASTM A269 TP304L or 316L
   (b) ASTM A312 TP304L or 316L
   (c) ASTM A312 TP 304L/316L, Schedule 5S pipe, and ASTM A403 WP304L/316L, Schedule 5S fittings (NFPA 99:5.1.10.2.1)

1319.1.1 Where Not Required. If medical gas tube in accordance with ASTM B819, Standard Specification for Seamless Copper Tube for Medical Gas Systems, is used for vacuum piping, such special marking shall not be required. [NFPA 99:5.1.10.2.2]

1320.0 Joints and Connections:

1320.1 General. This section sets forth the requirements for pipe joint installations for a medical gas or vacuum system:

1320.2 Changes in Direction. Positive pressure patient gas systems, medical support gas systems, and vacuum systems constructed of hard drawn seamless copper or stainless steel tubing shall have all turns, offsets, and other changes in direction made using fittings or techniques appropriate to any of the following acceptable joining methods:
1320.2.1 Medical Vacuum Systems. Vacuum systems and WAGD systems fabricated from copper tubing shall be permitted to have branch connections made using mechanically formed, drilled, and extruded tee branch connections that are formed in accordance with the tool manufacturer's instructions. Such branch connections shall be joined by brazing, as described in Section 1321.0. [NFPA 99:5.1.10.3.3]

1321.0 Brazed Joints.

1321.1 Brazed Joints and Fittings. Fittings shall be wrought-copper capillary fittings complying with ASME B16.22, or brazed fittings complying with ASME B16.50. Cast copper alloy fittings shall not be permitted. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 1000°F (538°C) to retain the integrity of the piping system in the event of re exposure. [NFPA 99:5.1.10.4.1.1 – 5.1.10.4.1.3]

1321.2 Tube Joints. Brazed tube joints shall be the socket type. [NFPA 99:5.1.10.4.1.4]

1321.3 Filler Metals. Filler metals shall bond with and be metallurgically compatible with the base metals being joined. Filler metals shall comply with AWS A5.8. [NFPA 99:5.1.10.4.1.5, 5.1.10.4.1.6]

1321.4 Copper-to-Copper Joints. Copper-to-copper joints shall be brazed using a copper–phosphorus or copper-phosphorus-silver brazing filler metal (BCuP series) without flux. [NFPA 99:5.1.10.4.1.7]

1321.5 Accessible. Joints to be brazed in place shall be accessible for necessary preparation, assembly, heating, filler application, cooling, cleaning, and inspection. [NFPA 99:5.1.10.4.1.9]

1321.6 Purging. Braze joints shall be continuously purged with nitrogen NF. [NFPA 99:5.1.10.4.1.10]

1321.7 Tube Ends. Tube ends shall be cut square using a sharp tubing cutter to avoid deforming the tube. [NFPA 99:5.1.10.4.2.1]

1321.7.1 Cutting Wheels. The cutting wheels on tubing cutters shall be free from grease, oil, or other lubricant not suitable for oxygen service. [NFPA 99:5.1.10.4.2.2]

1321.7.2 Cut Ends. The cut ends of the tube shall be rolled smooth or deburred with a sharp, clean deburring tool, taking care to prevent chips from entering the tube. [NFPA 99:5.1.10.4.2.3]

1321.8 Cleaning Procedures. The interior surfaces of tubes, fittings, and other components that are cleaned for oxygen service shall be stored and handled to avoid contamination prior to assembly and brazing. [NFPA 99:5.1.10.4.3.1]

1321.8.1 Exterior Surfaces. The exterior surfaces of tube ends shall be cleaned prior to brazing to remove any surface oxides. When cleaning the exterior surfaces of tube ends, no matter shall be allowed to enter the tube. [NFPA 99:5.1.10.4.3.2, 5.1.10.4.3.3]

1321.8.2 Interior Surfaces. If the interior surfaces of fitting sockets become contaminated prior to brazing, they shall be recleaned for oxygen in accordance with Section 1321.8.7 and be cleaned for brazing with a clean, oil-free, stainless steel or brass wire brush. [NFPA 99:5.1.10.4.3.4]

1321.8.3 Abrasive Pads. Clean, nonshedding, abrasive pads shall be used to clean the exterior surfaces of the tube ends. [NFPA 99:5.1.10.4.3.5]

1321.8.4 Prohibited. The use of steel wool or sand cloth shall be prohibited. The cleaning process shall not result in grooving of the surfaces to be joined. [NFPA 99:5.1.10.4.3.6, 5.1.10.4.3.7]

1321.8.5 Wiped. After being abraded, the surfaces shall be wiped using a clean, lint-free white cloth. [NFPA 99:5.1.10.4.3.8]

1321.8.6 Examination. Tubes, fittings, valves, and other components shall be visually examined internally before being joined to verify that they have not become contaminated for oxygen service and that they are free of obstructions or debris. [NFPA 99:5.1.10.4.3.9]

1321.8.7 On-Site Recleaning. The interior surfaces of tube ends, fittings, and other components that were cleaned
for oxygen service by the manufacturer, but that became contaminated prior to being installed, shall be permitted to
be recleaned on-site by the installer by thoroughly scrubbing the interior surfaces with a clean, hot water—alkaline
solution, such as sodium carbonate or trisodium phosphate, using a solution of 1 pound (0.5 kg) of sodium
carbonate or trisodium phosphate to 3 gallons (11 L) of potable water, and thoroughly rinsing them with clean, hot,
potable water.

Other aqueous cleaning solutions shall be permitted to be used for on-site recleaning permitted in this section,
provided that they are in accordance with the mandatory requirements of CGA G-4.1. [NFPA 99:5.1.10.4.3.10,
5.1.10.4.3.11]

1321.8.8 Contaminated Materials. Material that has become contaminated internally and is not clean for oxygen
service shall not be installed. [NFPA 99:5.1.10.4.3.12]

1321.8.9 Timeframe for Brazing. Joints shall be brazed within 8 hours after the surfaces are cleaned for brazing.
[NFPA 99:5.1.10.4.3.13]

1321.9 Brazing Dissimilar Metals. Flux shall only be used when brazing dissimilar metals, such as copper and
bronze or brass, using a silver (BAg series) brazing filler metal. [NFPA 99:5.1.10.4.4.1]

1321.9.1 Surface Cleaning. Surfaces shall be cleaned for brazing in accordance with Section 1321.8. [NFPA
99:5.1.10.4.4.2]

1321.9.2 Flux. Flux shall be applied sparingly to minimize contamination of the inside of the tube with flux. The flux
shall be applied and worked over the cleaned surfaces to be brazed using a stiff bristle brush to ensure complete
coverage and wetting of the surfaces with flux. [NFPA 99:5.1.10.4.4.3, 5.1.10.4.4.4]

1321.9.3 Short Sections of Copper. Where possible, short sections of copper tube shall be brazed onto the non-
copper component, and the interior of the subassembly shall be cleaned of flux prior to installation in the piping
system. [NFPA 99:5.1.10.4.4.5]

1321.9.4 Flux-Coated Brazing Rods. On joints DN20 (NPS 3/4) (7/8 inch O.D.) size and smaller, fluxcoated brazing
rods shall be permitted to be used in lieu of applying flux to the surfaces being joined. [NFPA 99:5.1.10.4.4.6]

1321.10 Nitrogen Purge. When brazing, joints shall be continuously purged with oil-free, dry nitrogen NF to prevent
the formation of copper oxide on the inside surfaces of the joint. [NFPA 99:5.1.10.4.5.1]

1321.10.1 Source. The source of the purge gas shall be monitored, and the installer shall be audibly alerted when
the source content is low. [NFPA 99:5.1.10.4.5.2]

1321.10.2 Flow Rate Control. The purge gas flow rate shall be controlled by the use of a pressure regulator and
flowmeter, or combination thereof.

Pressure regulators alone shall not be used to control purge gas flow rates. [NFPA 99:5.1.10.4.5.3, 5.1.10.4.5.4]

1321.10.3 Oxygen Analyzer. In order to ensure that all ambient air has been removed from the pipeline prior to
brazing, an oxygen analyzer shall be used to verify the effectiveness of the purge. The oxygen analyzer shall read
below 1 percent oxygen concentration before brazing begins. [NFPA 99:5.1.10.4.5.5]

1321.10.4 During Installation. During and after installation, openings in the piping system shall be kept sealed to
maintain a nitrogen atmosphere within the piping to prevent debris or other contaminants from entering the
system. [NFPA 99:5.1.10.4.5.6]

1321.10.5 Discharge Opening. While a joint is being brazed, a discharge opening shall be provided on the opposite
side of the joint from where the purge gas is being introduced. [NFPA 99:5.1.10.4.5.7]

1321.10.6 Temperature of Joint. The flow of purge gas shall be maintained until the joint is cool to the touch.
[NFPA 99:5.1.10.4.5.8]

1321.10.7 Opening to Be Sealed. After the joint has cooled, the purge discharge opening shall be sealed to prevent
contamination of the inside of the tube and maintain the nitrogen atmosphere within the piping system. [NFPA
99:5.1.10.4.5.9]

1321.10.8 Final Brazed Connection. The final brazed connection of new piping to an existing pipeline containing
the system gas shall be permitted to be made without the use of a nitrogen purge. [NFPA 99:5.1.10.4.5.10]

1321.10.9 Final Tie-In Test. After a final brazed connection in a positive pressure medical gas pipeline is made
without a nitrogen purge, an outlet in the immediate downstream zone of the affected portion(s) of both the new
and existing piping shall be tested in accordance with the final tie-in test in Section 1324.5.9 through Section
1324.5.9.4. [NFPA 99:5.1.10.4.5.11]  
1321.10.10 Autogenous Orbital Welding Process. When using the autogenous orbital welding process, joints shall be continuously purged inside and outside with inert gas(es) in accordance with the qualified welding procedure. [NFPA 99:5.1.10.4.5.12]  
1321.11 Assembling and Heating Brazed Joints. Tube ends shall be inserted into the socket, either fully or to a mechanically limited depth that is not less than the minimum cup depth (overlap) specified by ASME B16.50. [NFPA 99:5.1.10.4.6.1]  
1321.11.1 Heating of Joint. Where flux is permitted, the joint shall be heated slowly until the flux has liquefied. After flux is liquefied, or where flux is not permitted to be used, the joint shall be heated quickly to the brazing temperature, taking care not to overheat the joint. [NFPA 99:5.1.10.4.6.2, 5.1.10.4.6.3]  
1321.12 Inspection of Brazed Joints. After brazing, the outside of all joints shall be cleaned by washing with water and a wire brush to remove any residue and allow clear visual inspection of the joint. [NFPA 99:5.1.10.4.7.1]  
1321.12.1 Where Flux Is Used. Where flux has been used, the wash water shall be hot. [NFPA 99:5.1.10.4.7.2]  
1321.12.2 Visually Inspected. Each brazed joint shall be visually inspected after cleaning the outside surfaces. [NFPA 99:5.1.10.4.7.3]  
1321.12.3 Prohibited Brazed Joints. Joints exhibiting the following conditions shall not be permitted:  
(1) Flux or flux residue (when flux or flux coated BAg series rods are used with dissimilar metals).  
(2) Base metal melting or erosion.  
(3) Unmelted filler metal.  
(4) Failure of the filler metal to be clearly visible all the way around the joint at the interface between the socket and the tube.  
(5) Cracks in the tube or component.  
(6) Cracks in the braze filler metal.  
(7) Failure of the joint to hold the test pressure under the installer-performed initial pressure test (see Section 1324.5 through Section 1324.5.1.2) and standing pressure test (see Section 1324.5.4 or Section 1324.5.5). [NFPA 99:5.1.10.4.7.4]  
1321.12.4 Defective Brazed Joints. Brazed joints that are identified as defective under the conditions of Section 1321.12.3(2) or Section 1321.12.3(5) shall be replaced. [NFPA 99:5.1.10.4.7.5] Brazed joints that are identified as defective under the conditions of Section 1321.12.3(1), Section 1321.12.3(3), Section 1321.12.3(4), Section 1321.12.3(6) or Section 1321.12.3(7) shall be permitted to be repaired, except that no joint shall be reheated more than once before being replaced. [NFPA 99:5.1.10.4.7.6]  
1322.0 Welded Joints:  
1322.1 Welded Joints Procedure. Welded joints for medical gas and medical-surgical vacuum systems shall be permitted to be made using a gas tungsten arc welding (GTAW) autogenous orbital procedure. [NFPA 99:5.1.10.5.1.1]  
1322.1.1 Welder Qualification Procedure. The GTAW autogenous orbital procedure and the welder qualification procedure shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Welder qualification procedures shall include a bend test and a tensile test in accordance with Section IX of the ASME Boiler and Pressure Vessel Code on each tube size diameter. [NFPA 99:5.1.10.5.1.2, 5.1.10.5.1.3]  
1322.1.2 Welding Procedure Specification. Each welder shall qualify to a welding procedure specification (WPS) for each tube diameter. [NFPA 99:5.1.10.5.1.4]  
1322.1.3 Purging of Joints. GTAW autogenous orbital welded joints shall be purged during welding with a commercially available mixture of 75 percent helium (+/- 5 percent) and 25 percent argon (+/- 5 percent). [NFPA 99:5.1.10.5.1.5]  
1322.1.4 Shield Gas. The shield gas shall be as required in Section 1322.1.3. [NFPA 99:5.1.10.5.1.6]  
1322.1.5 Test Coupons. Test coupons shall be welded and inspected, as a minimum, at the start of work and every 4 hours thereafter, or when the machine is idle for more than 30 minutes, and at the end of the work period. Test coupons shall be inspected on the I.D. and O.D. by a qualified quality control inspector. Test coupons shall also be
welded at change of operator, weld head, welding power supply, or gas source. [NFPA 99:5.1.10.5.1.7 – 5.1.10.5.1.9]

1322.2 Welding for Stainless Tube. Stainless tube shall be welded using metal inert gas (MIG) welding, tungsten inert gas (TIG) welding, or other welding techniques suited to joining stainless tube. [NFPA 99:5.1.10.5.2.1]

1322.2.1 Qualifications. Welders shall be qualified to Section IX of the ASME Boiler and Pressure Vessel Code. [NFPA 99:5.1.10.5.2.2]

1322.3 Memory Metal Fittings. Memory metal fittings having a temperature rating not less than 1000°F (538°C) and a pressure rating not less than 300 psi (2068 kPa) shall be permitted to be used to join copper or stainless steel tube. Memory metal fittings shall be installed by qualified technicians in accordance with the manufacturer’s instructions. [NFPA 99:5.1.10.6.1, 5.1.10.6.2]

1322.4 Axially Swaged Fittings. Axially swaged fittings providing metal-to-metal seals, suitable for service at 300 psig (2070 kPa) and able to withstand a temperature of 1000°F (538°C) and that, when complete, are permanent and nonseparable shall be permitted to be used to join copper or stainless steel tube. Axially swaged fittings shall be installed by qualified technicians in accordance with the manufacturer’s instructions. [NFPA 99:5.1.10.7.1, 5.1.10.7.2]

1322.5 Threaded Fittings. Threaded fittings shall meet the following criteria:
(1) They shall be limited to connections for pressure and vacuum indicators, alarm devices, gas specific demand check fittings, and source equipment on the source side of the source valve.
(2) They shall be tapered pipe threads complying with ASME B1.20.1.
(3) They shall be made up with polytetrafluoroethylene (PTFE) tape or other thread sealant recommended for oxygen service, with sealant applied to the male threads only and care taken to ensure sealant does not enter the pipe. [NFPA 99:5.1.10.8]

1322.6 Other Types of Fittings. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint shall be permitted to be used. [NFPA 99:5.1.10.9.1]

1322.6.1 Dielectric Fittings. Dielectric fittings that comply with the following shall be permitted only where required by the manufacturer of special medical equipment to electrically isolate the equipment from the system distribution piping:
(1) They shall be of brass or copper construction with an approved dielectric.
(2) They shall be permitted to be a union.
(3) They shall be clean for oxygen where used for medical gases and medical support gases. [NFPA 99:5.1.10.9.2]

1322.7 Prohibited Joints. The following joints shall be prohibited throughout medical gas and vacuum distribution pipeline systems:
(1) Flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components.
(2) Other straight threaded connections, including unions.
(3) Pipe-crimping tools used to permanently stop the ow of medical gas and vacuum piping.
(4) Removable and nonremovable push-fit fittings that employ a quick assembly push fit connector. [NFPA 99:5.1.10.10]

1323.0 Installation of Piping and Equipment.

1323.1 Required Pipe Sizing. Piping systems shall be designed and sized to deliver the required ow rates at the utilization pressures. [NFPA 99:5.1.10.11.1.1]

1323.1.1 Mains and Branches. Mains and branches in medical gas piping systems shall be not less than DN15 (NPS 1/2) (5/8 inch O.D.) size. Mains and branches in medical-surgical vacuum systems shall be not less than DN20 (NPS 3/4) (7/8 inch O.D.) size. [NFPA 99:5.1.10.11.1.2, 5.1.10.11.1.3]

1323.1.2 Drops to Individual Stations. Drops to individual station outlets and inlets shall be not less than DN15 (NPS 1½) (¾ inch O.D.) size. [NFPA 99:5.1.10.11.1.4]

1323.1.3 Runouts and Connecting Tubing. Runouts to alarm panels and connecting tubing for gauges and alarm
devices shall be permitted to be DN8 (NPS 1/4) (⁹⁄₁₆ inch O.D.) size. [NFPA 99:5.1.10.11.1.5]

1323.2 Underground Piping. Piping underground within buildings or embedded in concrete floors or walls shall be installed in a continuous conduit. [NFPA 99:5.1.10.11.2.2]

1323.3 Location of Piping. Piping risers shall be permitted to be installed in pipe shafts if protected from physical damage, effects of excessive heat, corrosion, or contact with oil. [NFPA 99:5.1.10.11.3.1]

1323.3.1 Prohibited Locations. Piping shall not be installed in kitchens, stairwells, elevator shafts, elevator machine rooms, areas with open flames, electrical service equipment over 600 volts, and areas prohibited under NFPA 70 except for the following locations:

(1) Room locations for medical air compressor supply systems and medical-surgical vacuum pump supply systems
(2) Room locations for secondary distribution circuit panels and breakers having a maximum voltage rating of 600 volts [NFPA 99:5.1.10.11.3.2]

1323.3.2 Approved Locations. Medical gas piping shall be permitted to be installed in the same service trench or tunnel with fuel gas lines, fuel oil lines, electrical lines, steam lines, and similar utilities, provided that the space is ventilated (naturally or mechanically) and the ambient temperature around the medical gas piping is limited to 130°F (54°C) maximum. [NFPA 99:5.1.10.11.3.3]

1323.3.3 Prohibited Contact with Oil. Medical gas piping shall not be located where subject to contact with oil, including a possible flooding area in the case of a major oil leak. [NFPA 99:5.1.10.11.3.4]

1323.4 Pipe Support. Piping shall be supported from the building structure. [NFPA 99:5.1.10.11.4.1]

1323.4.1 Hangers and Supports. Hangers and supports shall comply with and be installed in accordance with MSS SP-58. [NFPA 99:5.1.10.11.4.2]

1323.4.2 Copper Tube. Supports for copper tube shall be sized for copper tube. [NFPA 99:5.1.10.11.4.3]

1323.4.3 Damp Locations. In potentially damp locations, copper tube hangers or supports that are in contact with the tube shall be plastic-coated or otherwise be electrically insulated from the tube by a material that will not absorb moisture. [NFPA 99:5.1.10.11.4.5]

1323.4.4 Maximum Spacing. Maximum support spacing shall be in accordance with Table 1323.4.4. [NFPA 99:5.1.10.11.4.6]

1323.4.5 Seismic Provisions. Where required, medical gas and vacuum piping shall be seismicly restrained against earthquakes in accordance with the applicable building code. [NFPA 99:5.1.10.11.4.7]

1323.5 Frost Protection. Buried piping outside of buildings shall be installed below the local level of frost penetration. [NFPA 99:5.1.10.11.5.1]

1323.5.1 Backfilling and Trenching. The installation procedure for underground piping shall protect the piping from physical damage while being backfilled. [NFPA 99:5.1.10.11.5.2]

1323.5.2 Conduit, Cover, or Enclosure. If underground piping is protected by a conduit, cover, or other enclosure, the following requirements shall be met:

(1) Access shall be provided at the joints for visual inspection and leak testing.
(2) The conduit, cover, or enclosure shall be self-draining and not retain groundwater in prolonged contact with the pipe. [NFPA 99:5.1.10.11.5.3]

1323.5.3 Excessive Stresses. Buried piping that will be subject to surface loads shall be buried at a depth that will protect the piping or its enclosure from excessive stresses. [NFPA 99:5.1.10.11.5.4]

1323.5.4 Minimum Backfill. The minimum backfilled cover above the top of the pipe or its enclosure for buried piping outside of buildings shall be 36 inches (914 mm), except that the minimum cover shall be permitted to be reduced to 18 inches (457 mm) where there is no potential for damage from surface loads or surface conditions. [NFPA 99:5.1.10.11.5.5]

1323.5.5 Trenches. Trenches shall be excavated so that the pipe or its enclosure has firm, substantially continuous bearing on the bottom of the trench. [NFPA 99:5.1.10.11.5.6]

1323.5.6 Composition of Backfill. Backfill shall be clean, free from material that can damage the pipe, and compacted. [NFPA 99:5.1.10.11.5.7]

1323.5.7 Marker. A continuous tape or marker placed immediately above the pipe or its enclosure shall clearly identify the pipeline by specific name. [NFPA 99:5.1.10.11.5.8]
1323.5.8 Warning. A continuous warning means shall also be provided above the pipeline at approximately one-half the depth of burial. [NFPA 99:5.1.10.11.5.9]

1323.5.9 Wall Sleeve. Where underground piping is installed through a wall sleeve, the outdoor end of the sleeve shall be sealed to prevent the entrance of groundwater into the building. [NFPA 99:5.1.10.11.5.10]

1323.6 Connectors. Hose and flexible connectors, both metallic and nonmetallic, shall be no longer than necessary and shall not penetrate or be concealed in walls, floors, ceilings, or partitions. [NFPA 99:5.1.10.11.6.1]

1323.6.1 Flexible Connectors. Flexible connectors, metallic or nonmetallic, shall have a minimum burst pressure, with a gauge pressure of 1000 psi (6895 kPa). [NFPA 99:5.1.10.11.6.2]

1323.6.2 Metallic Flexible Joints. Metallic flexible joints shall be permitted in the pipeline where required for expansion joints, seismic protection, thermal expansion, or vibration control and shall be as follows:

1. For all wetted surfaces, made of bronze, copper, or stainless steel.
2. Cleaned at the factory for oxygen service and received on the job site with certification of cleanliness.
3. Suitable for service at 300 psig (2068 kPa) or above and able to withstand temperatures of 1000°F (538°C).
4. Provided with brazing extensions to allow brazing into the pipeline per Section 1321.0.
5. Supported with pipe hangers and supports as required for their additional weight. [NFPA 99:5.1.10.11.6.3]

1323.7 Prohibited System Interconnections. Two or more medical gas or vacuum piping systems shall not be interconnected for installation, testing, or any other reason except as permitted by Section 1323.7.1. [NFPA 99:5.1.10.11.7.1]

1323.7.1 Medical Gas and Medical Vacuum. Medical gas and vacuum systems with the same contents shall be permitted to be interconnected with an inline valve installed between the systems. [NFPA 99:5.1.10.11.7.2]

1323.7.2 Leak Testing. Leak testing shall be accomplished by separately charging and testing each individual piping system. [NFPA 99:5.1.10.11.7.3]

1323.8 Manufacturer's Instructions. The installation of individual components shall be made in accordance with the instructions of the manufacturer. Manufacturer's instructions shall include directions and information deemed by the manufacturer to be adequate for attaining proper operation, testing, and maintenance of the medical gas and vacuum systems. Copies of the manufacturer's instructions shall be left with the system owner. [NFPA 99:5.1.10.11.8.1 – 5.1.10.11.8.3]

1323.9 Changes in System Use. Where a positive-pressure medical gas piping distribution system originally used or constructed for use at one pressure and for one gas is converted for operation at another pressure or for another gas, all provisions of Section 1318.0 through Section 1323.12 shall apply as if the system were new. [NFPA 99:5.1.10.11.9.1]

1323.9.1 Medical Vacuum System. A vacuum system shall not be permitted to be converted for use as a gas system. [NFPA 99:5.1.10.11.9.2]

1323.10 Qualifications of Installers. The installation of medical gas and vacuum systems shall be made by qualified, competent technicians who are experienced in performing such installations, including all personnel who actually install the piping system. Installers of medical gas and vacuum piped distribution systems, all appurtenant piping supporting pump and compressor source systems, and appurtenant piping supporting source gas manifold systems not including permanently installed bulk source systems, shall be certified in accordance with ASSE/IAPMO/ANSI 6010. [NFPA 99:5.1.10.11.10.1, 5.1.10.11.10.2]

1323.10.1 Brazing. Brazing shall be performed by individuals who are qualified in accordance with Section 1323.11. [NFPA 99:5.1.10.11.10.5]

1323.10.2 Documentation. Prior to any installation work, the installer of medical gas and vacuum piping shall provide and maintain documentation on the job site for the qualification of brazing procedures and individual brazers that is required under Section 1323.11. [NFPA 99:5.1.10.11.10.6]

1323.10.3 Health Care Organization Personnel. Health care organization personnel shall be permitted to install piping systems if all of the requirements of Section 1323.10 are met during the installation. [NFPA 99:5.1.10.11.10.7]

1323.11 Qualification of Brazing Procedures and Brazing. Brazing procedures and brazer performance for the installation of medical gas and vacuum piping shall be qualified in accordance with either Section IX, “Welding and
Brazing Qualifications, of the ASME Boiler and Pressure Vessel Code, or AWS B2.2, both as modified by Section 1323.11.1 through Section 1323.11.4. [NFPA 99:5.1.10.11.11.1]

1323.11.1 Examination. Brazers shall be qualified by visual examination of the test coupon followed by sectioning. [NFPA 99:5.1.10.11.11.2]

1323.11.2 Brazing Procedure Specification. The brazing procedure specification shall address cleaning, joint clearance, overlap, internal purge gas, purge gas flow rate, and filler metal. [NFPA 99:5.1.10.11.11.3]

1323.11.3 Documentation. The brazing procedure qualification record and the record of brazor performance qualification shall document filler metal used, base metals, cleaning, joint clearance, overlap, internal purge gas and flow rate during brazing of coupon, and absence of internal oxidation in the completed coupon. [NFPA 99:5.1.10.11.11.4]

1323.11.4 Procedures. Brazing procedures qualified by a technically competent group or agency shall be permitted under the following conditions:

(1) The brazing procedure specification and the procedure qualification records meet the requirements of this code.

(2) The employer obtains a copy of both the brazing procedure specification and the supporting qualification records from the group or agency and signs and dates these records, thereby accepting responsibility for the qualifications that were performed by the group or agency.

(3) The employer qualifies at least one brazer following each brazing procedure specification used. [NFPA 99:5.1.10.11.11.5]

1323.11.5 Conditions of Acceptance. An employer shall be permitted to accept brazer qualification records of a previous employer under the following conditions:

(1) The brazer has been qualified following the same or an equivalent procedure that the new employer uses.

(2) The new employer obtains a copy of the record of brazer performance qualification tests from the previous employer and signs and dates these records, thereby accepting responsibility for the qualifications performed by the previous employer. [NFPA 99:5.1.10.11.11.6]

1323.11.6 Qualifications. Performance qualifications of brazers shall remain in effect indefinitely, unless the brazer does not braze with the qualified procedure for a period exceeding 6 months or there is a specific reason to question the ability of the brazer. [NFPA 99:5.1.10.11.11.7]

1323.12 Breaching or Penetrating Medical Gas Piping. Positive pressure patient medical gas piping and medical support gas piping shall not be breached or penetrated by any means or process that will result in residual copper particles or other debris remaining in the piping or affect the oxygen-clean interior of the piping. The breaching or penetrating process shall ensure that any debris created by the process remains contained within the work area. [NFPA 99:5.1.10.11.12.1, 5.1.10.11.12.2]

1323.13 Labeling, Identification and Operating Pressure. Color and pressure requirements shall be in accordance with Table 1305.1. [NFPA 99:5.1.11]

1323.13.1 Pipe Labeling. Piping shall be labeled by stenciling or adhesive markers that identify the patient medical gas, the medical support gas, or the vacuum system and include the following:

(1) Name of the gas or vacuum system or the chemical symbol per Table 1305.1.

(2) Gas or vacuum system color code per Table 1305.1. [NFPA 99:5.1.11.1.1]

1323.13.2 Pipe Pressure Labeling. Where positive pressure gas piping systems operate at pressures other than the standard gauge pressure in Table 1305.1, the operating pressure in addition to the name of the gas shall be labeled. [NFPA 99:5.1.10.11.12.1, 5.1.10.11.12.2]

1323.13.3 Location of Pipe Labeling. Pipe labels shall be located as follows:

(1) At intervals of not more than 20 feet (6096 mm).

(2) At least once in or above every room.

(3) On both sides of walls or partitions penetrated by the piping.

(4) At least once in every story height traversed by risers. [NFPA 99:5.1.11.1.4]

1323.14 Identification of Shutoff Valves. Shutoff valves shall be identified with the following:

(1) Name or chemical symbol for the specific medical gas or vacuum system

(2) Gas or vacuum system color code in accordance with Table 1305.1.
1323.14.1 Nonstandard Operating Pressures. Where positive pressure gas piping systems operate at pressures other than the standard gauge pressure of 50 psi (345 kPa) to 55 psi (379 kPa) or a gauge pressure of 160 psi (1103 kPa) to 185 psi (1276 kPa) for nitrogen or instrument air, the valve identification shall also include the nonstandard operating pressure. [NFPA 99:5.1.11.2.2]

1323.14.2 Source Valves. Source valves shall be labeled in substance as follows:

SOURCE VALVE
FOR THE (SOURCE NAME)
[NFPA 99:5.1.11.2.4]

1323.14.3 Main Line Valves. Main line valves shall be labeled in substance as follows:

MAIN LINE VALVE FOR THE
(GAS/VACUUM NAME)
SERVING (NAME OF THE BUILDING)
[NFPA 99:5.1.11.2.5]

1323.14.4 Riser Valves. The riser valve(s) shall be labeled in substance as follows:

RISER FOR THE (GAS/VACUUM NAME)
SERVING (NAME OF THE AREA/BUILDING)
SERVED BY THE PARTICULAR RISER)
[NFPA 99:5.1.11.2.6]

1323.14.5 Service Valves. The service valve(s) shall be labeled in substance as follows:

SERVICE VALVE FOR THE
(GAS/VACUUM NAME) SERVING
(NAME OF THE AREA/BUILDING
SERVED BY THE PARTICULAR VALVE)
[NFPA 99:5.1.11.2.7]

1323.14.6 Zone Valve Box. Zone valve box assemblies shall be labeled with the rooms, areas, or spaces that they control as follows:

ZONE VALVES FOR THE
(GAS/VACUUM NAME)
SERVING (NAME OF ROOMS OR SPACES
SERVED BY THE PARTICULAR VALVE)

Labeling shall either be visible from outside the zone valve box assembly through the cover or be replicated on the outside, but not affixed to the removable cover. [NFPA 99:5.1.11.2.8]

1323.15 Identification. Station outlets and inlets shall be identified as to the name or chemical symbol for the specific medical gas or vacuum provided and shall include the following:

(1) Name of the gas or vacuum system or the chemical symbol in accordance with Table 1305.1
(2) Gas or vacuum system color code in accordance with Table 1305.1

In sleep labs, where the outlet is downstream of a flow control device, the station outlet identification shall include a warning not to use the outlet for ventilating patients.

Where medical gas systems operate at pressures other than the standard gauge pressure of 50 psi to 55 psi (345 kPa to 380 kPa) or a gauge pressure of 160 psi to 185 psi (1103 kPa to 1275 kPa) for nitrogen, the station outlet
identification shall include the nonstandard operating pressure in addition to the name of the gas. [NFPA 99:5.1.11.3.1 – 5.1.11.3.2]

1324.0 Performance Criteria and Testing Category 1 (Gases, Medical Surgical Vacuum).

1324.1 Where Required. Inspection and testing shall be performed on components, or portions thereof, of new, piped medical gas or vacuum systems, additions, renovations, temporary installations, or repaired systems in accordance with Section 1324.2 through Section 1324.5.11, and certified in accordance with Section 1306.0.

1324.2 Breached Systems. All systems that are breached and components that are subject to additions, renovations, or replacement (e.g., new gas sources: bulk, manifolds, compressors, dryers, alarms) shall be inspected and tested. Systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition. Breached portions of the systems subject to inspection and testing shall be confined to only the specific altered zone and components in the immediate zone or area that is located upstream for vacuum systems and downstream for pressure gases at the point or area of intrusion. [NFPA 99:5.1.12.1.3 – 5.1.12.1.5]

1324.2.1 Reports. The inspection and testing reports shall be submitted directly to the party that contracted for the testing, who shall submit the report through channels to the responsible facility authority and any others that are required. Reports shall contain detailed listings of all findings and results. [NFPA 99:5.1.12.1.6, 5.1.12.1.7]

1324.3 Test Gas. The test gas shall be oil-free, dry nitrogen NF. [NFPA 99:5.1.12.2.1.2]

1324.4 Initial Piping Blowdown. Piping in medical gas and vacuum distribution systems shall be blown clear by means of oil-free, dry nitrogen NF after installation of the distribution piping but before installation of station outlet/inlet rough-in assemblies and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, pressure relief valves, manifolds, source equipment). [NFPA 99:5.1.12.2.2]

1324.5 Initial Pressure Tests – Medical Gas and Vacuum Systems. Each section of the piping in medical gas and vacuum systems shall be pressure tested. Initial pressure tests shall be conducted as follows:

(1) After blowdown of the distribution piping.
(2) After installation of station outlet/inlet rough-in assemblies:
(3) Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, line pressure relief valves). [NFPA 99:5.1.12.2.3.1, 5.1.12.2.3.2]

1324.5.1 Shutoff Valve. The source shutoff valve shall remain closed during tests specified in Section 1324.5 through Section 1324.5.1.2. [NFPA 99:5.1.12.2.3.3]

1323.2.1 Exposed Piping. Piping exposed in corridors and other areas where subject to physical damage from the movement of carts, stretchers, portable equipment, or vehicles shall be protected. [NFPA 99:5.1.10.11.2.1]

1323.2 Pipe Protection. Piping shall be protected against freezing, corrosion, and physical damage. [NFPA 99:5.1.10.11.2]

1324.5.1.1 Required Test Pressure. The test pressure for pressure gases and vacuum systems shall be 1.5 times the system operating pressure but not less than a gauge pressure of 150 psi (1034 kPa). The test pressure shall be maintained until each joint has been examined for leakage by means of a leak detectant that is safe for use with oxygen and does not contain ammonia. [NFPA 99:5.1.12.2.3.4, 5.1.12.2.3.5]

1324.5.1.2 Leaks. Leaks, if any, shall be located, repaired (if permitted), replaced (if required), and retested. [NFPA 99:5.1.12.2.3.6]

1324.5.2 Initial Cross-Connection Test. It shall be determined that no cross-connections exist between the various medical gas and vacuum piping systems. [NFPA 99:5.1.12.2.4]

1324.5.2.1 Atmospheric Pressure. All piping systems shall be reduced to atmospheric pressure. [NFPA 99:5.1.12.2.4.1]

1324.5.2.2 Sources of Test Gas. Sources of test gas shall be disconnected from all piping systems, except for the one system being tested. [NFPA 99:5.1.12.2.4.2]

1324.5.2.3 System to Be Charged. The system under test shall be charged with oil-free, dry nitrogen NF to a gauge pressure of 50 psi (345 kPa). [NFPA 99:5.1.12.2.4.3]

1324.5.2.4 Check Outlets and Inlets. After the installation of the individual faceplates with appropriate adapters
matching outlet/inlet labels, each individual outlet/inlet in each installed medical gas and vacuum piping system shall be checked to determine that the test gas is being dispensed only from the piping system being tested. [NFPA 99:5.1.12.2.4.4]

1324.5.2.5 Repeat Test. The cross-connection test referenced in Section 1324.5.2 shall be repeated for each installed medical gas and vacuum piping system. [NFPA 99:5.1.12.2.4.5]

1324.5.2.6 Identification of System. The proper labeling and identification of system outlets/inlets shall be confirmed during these tests. [NFPA 99:5.1.12.2.4.6]

1324.5.3 Initial Piping Purge Tests. The outlets in each medical gas piping system shall be purged to remove any particulate matter from the distribution piping. [NFPA 99:5.1.12.2.5]

1324.5.3.1 Procedure. Using appropriate adapters, each outlet shall be purged with an intermittent high-volume flow of test gas until the purge produces no discoloration in a clean white cloth. [NFPA 99:5.1.12.2.5.1]

1324.5.3.2 Location. The purging required in Section 1324.5.3.1 shall be started at the closest outlet/inlet to the zone valve and continue to the furthest outlet/inlet within the zone. [NFPA 99:5.1.12.2.5.2]

1324.5.4 Standing Pressure Tests – for Positive Pressure Medical Gas Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, medical gas distribution piping shall be subjected to a standing pressure test. [NFPA 99:5.1.12.2.6]

1324.5.4.1 Time Frame for Testing. Tests shall be conducted after the final installation of station outlet valve bodies, faceplates, and all other distribution system components. [NFPA 99:5.1.12.2.6.1]

1324.5.4.2 Source Valve. The source valve shall be closed during this test. [NFPA 99:5.1.12.2.6.2]

1324.5.4.3 Length of Testing. The piping systems shall be subjected to a 24 hour standing pressure test using oil-free, dry nitrogen NF. [NFPA 99:5.1.12.2.6.3]

1324.5.4.4 Test Pressure. Test pressures shall be 20 percent above the normal system operating line pressure. [NFPA 99:5.1.12.2.6.4]

1324.5.4.5 Conclusion of Test. The leakage over the 24-hour test shall not exceed 0.5 percent of the starting pressure [e.g., 0.3 psi (2 kPa) starting at 60 psig (414 kPa)] except that attributed to specific changes in ambient temperature. [NFPA 99:5.1.12.2.6.5]

1324.5.4.6 Leaks. Leaks, if any, shall be located, repaired (if permitted) or replaced (if required), and retested. [NFPA 99:5.1.12.2.6.6]

1324.5.4.7 Proof of Testing. The 24 hour standing pressure test of the positive pressure system shall be witnessed by an ASSE/IAPMO/ANSI 6020 inspector, an ASSE/IAPMO/ANSI 6030 verifier, or the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. [NFPA 99:5.1.12.2.6.7]

1324.5.5 Standing Pressure Tests – Medical Vacuum Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, vacuum distribution piping shall be subjected to a standing vacuum test. [NFPA 99:5.1.12.2.7]

1324.5.5.1 Timeframe for Testing. Tests shall be conducted after installation of all components of the vacuum system. [NFPA 99:5.1.12.2.7.1]

1324.5.5.2 Length of Testing. The piping systems shall be subjected to a 24 hour standing vacuum test. [NFPA 99:5.1.12.2.7.2]

1324.5.5.3 Test Pressure. Test pressure shall be between 12 inches (305 mm) HgV and full vacuum. [NFPA 99:5.1.12.2.7.3]

1324.5.5.4 Disconnection of Testing Source. During the test, the source of test vacuum shall be disconnected from the piping system. [NFPA 99:5.1.12.2.7.4]

1324.5.5.5 Conclusion of Test. The leakage over the 24-hour test shall not exceed 0.5 percent of the starting pressure [e.g., 0.125 inch (0.3 mm) HgV starting at 25 inches (635 mm) HgV] except that attributed to specific changes in ambient temperature. [NFPA 99:5.1.12.2.7.5]

1324.5.5.6 Proof of Testing. The 24 hour standing pressure test of the vacuum system shall be witnessed by the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. [NFPA 99:5.1.12.2.7.6]
1324.5.5.7 Leaks. Leaks, if any, shall be located, repaired (if permitted) or replaced (if required), and retested. [NFPA 99:5.1.12.2.7.7]

1324.5.6 System Inspection. System inspections shall be performed prior to concealing piping distribution systems in walls, ceilings, chases, trenches, underground, or otherwise hidden from view. [NFPA 99:5.1.12.3.1.1]

1324.5.6.1 Test Gas. The test gas shall be nitrogen NF. [NFPA 99:5.1.12.3.1.2]

1324.5.6.2 Inspection Qualification. Inspections shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline inspections and testing and meeting the requirements of ASSE/IAPMO/ANSI 6020, or ASSE/IAPMO/ANSI 6030. [NFPA 99:5.1.12.3.1.3]

1324.5.6.3 Inspection Personnel. Inspections shall be performed by a party other than the installing contractor. [NFPA 99:5.1.12.3.1.4]

1324.5.6.4 Qualifications. Where systems have not been installed by inhouse personnel, inspections shall be permitted by personnel of the organization who meet the requirements of Section 1324.5.6.2. [NFPA 99:5.1.12.3.1.5]

1324.5.6.5 Inspections. The initial pressure tests performed by the installing contractor shall be witnessed by an ASSE/IAPMO/ANSI 6020 inspector, an ASSE/IAPMO/ANSI 6030 verifier, or the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. The presence and correctness of labeling and valve tagging required by this code for all concealed components and piping distribution systems shall be inspected. [NFPA 99:5.1.12.3.2 – 5.1.12.3.2.2]

1324.5.7 System Verification. Verification tests shall be performed only after all tests required in Section 1324.3 through Section 1324.5.5.7, Installer Performed Tests, have been completed. [NFPA 99:5.1.12.4.1.1]

1324.5.7.1 Test Gas. The test gas shall be oil-free, dry nitrogen NF or the system gas where permitted. [NFPA 99:5.1.12.4.1.2]

1324.5.7.2 Approved Tester. Testing shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline testing and meeting the requirements of ASSE/IAPMO/ANSI 6030, except as required by Section 1324.5.7.3. [NFPA 99:5.1.12.4.1.3]

Testing shall be performed by a party other than the installing contractor. [NFPA 99:5.1.12.4.1.5] Where systems have not been installed by inhouse personnel, testing shall be permitted by personnel of that organization who meet the requirements of Section 1324.5.7.2. [NFPA 99:5.1.12.4.1.6]

1324.5.7.3 Cryogenic Fluid Testing. Testing of the cryogenic fluid central supply system shall be conducted by a party technically competent and experienced in the field of cryogenic fluid systems and meeting the requirements of ASSE/IAPMO/ANSI 6025, in accordance with the mandatory requirements in CGA M-1. [NFPA 99:5.1.12.4.1.4]

1324.5.8 Particulate Matter. In order to remove any traces of particulate matter deposited in the pipelines as a result of construction, a heavy, intermittent purging of the pipeline shall be done. [NFPA 99:5.1.12.4.4.6]

1324.5.9 Final Tie-In Test. Each joint in the final connection between the new work and the existing system shall be leak-tested with the gas of system designation at the normal operating pressure by means of a leak detector that is safe for use with oxygen and does not contain ammonia. [NFPA 99:5.1.12.4.9.2]

1324.5.9.1 Vacuum Joints. Vacuum joints shall be tested using an ultrasonic leak detector or other means that will allow detection of leaks in an active vacuum system. [NFPA 99:5.1.12.4.9.3]

1324.5.9.2 Pressure Gases. For pressure gases, immediately after the final brazed connection is made and leak-tested, an outlet in the new piping and an outlet in the existing piping that are immediately downstream from the point or area of intrusion shall be purged in accordance with the applicable requirements of Section 1324.5.8. [NFPA 99:5.1.12.4.9.4]

1324.5.9.3 Positive Pressure Gases. Before the new work is used for patient care, positive pressure gases shall be tested for operational pressure and gas concentration in accordance with Section 1324.5.10 and Section 1324.5.11. [NFPA 99:5.1.12.4.9.5]

1324.5.9.4 Permanent Records. Permanent records of these tests shall be maintained in accordance with NFPA 99. [NFPA 99:5.1.12.4.9.6]

1324.5.10 Operational Flow Pressure Drop Test. Operational flow pressure drop tests shall be performed at each
Medical Surgical Vacuum Inlets. Medical surgical vacuum inlets shall draw 3 SCFM (85 NL/min) without reducing the vacuum pressure below 12 inch (305 mm) gauge HgV at any adjacent station inlet. [NFPA 99:5.1.12.4.10.4]

Oxygen and Medical Air Outlets. Oxygen and medical air outlets serving Category 1 space shall allow a transient flow rate of 6 SCFM (170 SLPM) for 3 seconds. [NFPA 99:5.1.12.4.10.5]

Medical Gas Concentration Test. After purging each system with the gas of system designation, the following shall be performed:

1. Each pressure gas source and outlet shall be analyzed for concentration of gas, by volume.
2. Analysis shall be conducted with instruments designed to measure the specific gas dispensed.
3. Allowable concentrations shall be as indicated in Table 1324.5.11. [NFPA 99:5.1.12.4.11]

Part III – Category 2 Piped Gas and Vacuum Systems.

Category 2 Piped Gas and Vacuum Systems.

General. Category 2 piped gas or piped vacuum system requirements shall be permitted when all of the following criteria are met:

1. Only moderate sedation (as defined in Chapter 2), minimal sedation (as defined in Chapter 2); or no sedation is performed. Deep sedation and general anesthesia shall not be permitted.
2. The loss of the piped gas or piped vacuum systems is likely to cause minor injury to patients, staff, or visitors.
3. The facility piped gas or piped vacuum systems are intended for Category 2 patient care space as defined in Chapter 2. [NFPA 99:5.2.1.2]

Nature of Hazards of Gas and Vacuum Systems. The requirement of Section 1307.2 shall apply to the nature of hazards of gas and vacuum systems. [NFPA 99:5.2.2]

Central Supply Systems. Category 2 systems shall comply with Section 1307.3 through Section 1309.13. [NFPA 99:5.2.3.4]

Category 2 Medical Air Supply Systems. Category 2 systems shall comply with Section 1310.0 through Section 1311.6, except as follows:

1. Medical air compressors, dryers, aftercoolers, filters, and regulators shall be permitted to be simplex.
2. The facility staff shall develop their emergency plan to deal with the loss of medical air. [NFPA 99:5.2.3.5]

Oxygen Concentrators. Oxygen supply systems using concentrators shall be permitted to consist of two sources, one of which shall be a cylinder header with sufficient cylinder connections for one average day’s supply. [NFPA 99:5.2.3.6]

Category 2 Medical-Surgical Vacuum. Category 2 systems shall comply with Section 1312.0 through Section 1313.5, except as follows:

1. Medical-surgical vacuum systems shall be permitted to be simplex.
2. The facility staff shall develop their emergency plan to deal with the loss of medical-surgical vacuum. [NFPA 99:5.2.3.7]

Valves. Category 2 systems shall comply with Section 1314.0 through Section 1314.12.1. [NFPA 99:5.2.4]

Station Outlets and Inlets. Category 2 systems shall comply with Section 1315.0. [NFPA 99:5.2.5]

Pressure and Vacuum Indicators. Category 2 systems shall comply with Section 1316.2. [NFPA 99:5.2.8]

Warning Systems. Warning systems associated with Category 2 systems shall provide the master, area, and local alarm functions of a Category 1 system as required in Section 1317.0, except as follows:

1. Warning systems shall be permitted to be a single alarm panel.
2. The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.
3. Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel. [NFPA 99:5.2.9]

Category 2 Distribution. Category 2 systems shall comply with Section 1318.0 through Section 1323.12. [NFPA 99:5.2.10]

Labeling and Identification. Category 2 systems shall comply with Section 1323.13 through Section 1323.15.
1326.0 Category 3 Piped Gas and Vacuum Systems.

1326.1 General. Category 3 piped gas and vacuum systems shall be permitted when all of the following criteria are met:

1. Only minimal sedation, as defined in Chapter 2; or no sedation is performed. Deep sedation, moderate sedation, and general anesthesia are not performed.
2. The loss of the piped gas and vacuum systems is not likely to cause injury to patients, staff, or visitors, but can cause discomfort.
3. The facility piped gas and vacuum systems are intended for Category 3 patient care rooms as defined in Chapter 2.

1326.2 Nature of Hazards of Gas and Vacuum Systems. The requirement of Section 1307.2 shall apply to the nature of hazards of gas and vacuum systems.

1326.3 Medical Air Supply Systems. Category 3 central supply systems shall be permitted to consist of the following:

1. Gas cylinder or cryogenic liquid container headers in accordance with NFPA 99.
2. Oxygen concentrator supply units in accordance with NFPA 99.
3. Cylinder manifolds for gas cylinders in accordance with NFPA 99.
5. Cryogenic fluid central supply systems in accordance with NFPA 99.
6. Medical air compressor systems in accordance with NFPA 99.
7. Proportioning air systems in accordance with NFPA 99.
8. Medical-surgical vacuum systems in accordance with NFPA 99.
9. Waste anesthetic gas disposal systems (WAGDs) in accordance with NFPA 99.
10. Instrument air compressor systems in accordance with NFPA 99.

1326.4 Medical–Surgical Vacuum Systems. Category 3 systems shall comply with Section 1307.3 through Section 1309.13 and Section 1312.0 through Section 1313.5, except as follows:

1. Medical–surgical vacuum systems shall be permitted to be simplex.
2. The facility staff shall develop an emergency plan to deal with the loss of medical–surgical vacuum.
3. Emergency electrical service shall conform to the requirements of Section 6.6 of NFPA 99 and NFPA 70.

1326.5 Valves. Category 3 systems shall comply with Section 1314.0.

1326.6 Station Outlets and Inlets. Category 3 systems shall comply with Section 1315.0.

1326.7 Pressure and Vacuum Indicators. Category 3 systems shall comply with Section 1316.2.

1326.8 Warning Systems. Warning systems associated with Category 3 systems shall provide the master, area, and local alarm functions of a Category 1 system as required in Section 1317.0, except as follows:

1. Warning systems shall be permitted to be a single alarm panel (i.e., a combination master/area alarm panel).
2. The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.
3. Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master-alarm panel.
4. Electrical power for warning systems shall be in accordance with Section 6.6 of NFPA 99 for Category 3 and Category 4 spaces.

1326.9 Distribution. Category 3 systems shall comply with Section 1318.0 through Section 1323.12.

1326.10 Labeling and Identification. Category 3 systems shall comply with Section 1323.13 through Section 1323.15.
Part V – Dental Gas and Vacuum Systems:

1327.0 Dental Gas and Vacuum Systems:

1327.1 General. Dental gas and vacuum systems shall comply with this code and NFPA 99.

1327.2 Emergency Shutoff Valves (Oxygen and Nitrous Oxide):

(a) All Category 2 medical gas systems shall have an emergency shutoff valve accessible from all use-point locations in an emergency.

(b) Where a central medical gas supply system supplies two treatment facilities, each facility shall be provided with an emergency shutoff valve located in that treatment facility so as to be accessible from all use-point locations in an emergency.

(c) Emergency shutoff valves shall be labeled to indicate the gas controlled by the shutoff valve and shall shut off only the gas to the treatment facility that they serve.

(d) A remotely activated shutoff valve at a gas supply manifold shall not be used for emergency shutoff. For clinical purposes, such a remote valve actuator shall not fail close in the event of loss of electric power. Where remote actuators are the type that fail-open, it shall be mandatory that cylinder shutoff valves be closed whenever the system is not in use. [NFPA 99:15.4.2.6.1 – 15.4.2.6.4.2]

1327.3 Warning Systems (Oxygen and Nitrous Oxide). Category 2 warning systems shall comply with Section 1325.10 except as follows:

(a) Warning systems shall be permitted to be a single alarm panel.

(b) The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.

(c) Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel.

(d) Warning systems for medical gas systems shall provide the following alarms:

   (a) Oxygen main line pressure low.

   (b) Oxygen main line pressure high.

   (c) Oxygen changeover to secondary bank or about to changeover (if automatic).

   (d) Nitrous oxide main line pressure low.

   (e) Nitrous oxide main line pressure high.

   (f) Nitrous oxide changeover to secondary bank or about to changeover (if automatic).

(e) Audible and noncancelable alarm visual signals shall indicate if the pressure in the main line increases or decreases 20 percent from the normal operating pressure.

(f) Visual indications shall remain until the situation that caused the alarm is resolved.

(g) Pressure switches/sensors shall be installed downstream of any emergency shutoff valves and any other shutoff valves in the system and shall cause an alarm for the medical gas if the pressure decreases or increases 20 percent from the normal operating pressure.

(h) A cancelable audible indication of each alarm condition that produces a sound at the alarm panel shall reinitiate the audible signal if another alarm condition occurs while the audible signal is silenced. [NFPA 99:15.4.2.10]

1327.4 Initial Pressure Test. Each section of the piping in positive-pressure gas systems and copper vacuum systems shall be pressure tested. Plastic vacuum and plastic scavenging piping shall not be pressure tested. [NFPA 99:15.4.7.4.4.1]

1327.4.1 Pressure Test. Initial pressure tests shall be conducted as follows:

(a) After blowdown of the distribution piping.

(b) After installation of station outlet/inlet rough-in assemblies.

(c) Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, and line pressure relief valves). [NFPA 99:15.4.7.4.4.2]

1327.4.2 Source Shutoff Valve. The source shutoff valve shall remain closed during the pressure tests. [NFPA 99:15.4.7.4.4.3]

1327.4.3 Test Pressure. The test pressure for oxygen and nitrous oxide piping shall be 1.5 times the system operating pressure but not less than a gauge pressure of 150 psi (1035 kPa). [NFPA 99:15.4.7.4.4.4]
1327.4.4 Examine for Leaks. The test pressure shall be maintained until each joint has been examined for leakage by means of a leak detector that is safe for use with oxygen and does not contain ammonia. [NFPA 99:15.4.7.4.4.5]

1327.4.5 Leaks Located. Any leaks shall be located, repaired (if permitted), or replaced (if required) by the installer, and retested. [NFPA 99:15.4.7.4.4.6]

1327.5 Maximum Copper Tube Support Spacing. The maximum support spacing for copper tube shall be in accordance with Table 1327.5. [NFPA 99:15.4.5.6.5]

1327.6 Maximum Plastic Pipe Support Spacing. The maximum support spacing for plastic pipe shall be in accordance with Table 1327.6. [NFPA 99:15.4.5.6.6]

1327.7 Standing Pressure Tests for Oxygen and Nitrous Oxide Piping. After successful completion of the initial pressure tests in Section 1327.4, the gas distribution piping shall be subject to a standing pressure test. [NFPA 99:15.4.7.4.6.1]

1327.7.1 Tests Required. Tests shall be conducted after the final installation of station outlet valve bodies, faceplates, and other distribution system components (e.g., pressure alarm devices, pressure indicators, line pressure relief valves, manufactured assemblies, and hoses). [NFPA 99:15.4.7.4.6.2]

1327.7.2 Source Valve. The source valve shall be closed during this test. [NFPA 99:15.4.7.4.6.3]

1327.7.3 Piping Systems. The piping systems shall be subjected to 24-hour standing pressure tests using oil-free, dry nitrogen NF. [NFPA 99:15.4.7.4.6.4]

1327.7.4 Test Pressure. Test pressures shall be 20 percent above the normal system operating line pressure. [NFPA 99:15.4.7.4.6.5]

1327.7.5 Change in Test Pressure. At the conclusion of the tests, there shall be no change in the test pressure except that attributed to specific changes in ambient temperature. [NFPA 99:15.4.7.4.6.6]

1327.7.6 Leaks. Any leaks shall be located, repaired (if permitted), or replaced (if required) by the installer, and retested. [NFPA 99:15.4.7.4.6.7]

1327.8 Verifier Operational Pressure Test. Operational pressure tests shall be performed at each station outlet or terminal where the user makes connections and disconnections. [NFPA 99:15.4.7.5.8.1]

1327.8.1 Test Gas. Tests shall be performed with the gas of system designation. [NFPA 99:15.4.7.5.8.2]

1327.8.2 Medical Gas Outlets. All medical gas outlets with a gauge pressure of 50 psi (345 kPa), including oxygen and nitrous oxide, shall deliver 1.8 standard cubic feet per minute (SCFM) (50 SLPM) with a pressure drop of not more than 5 psi (34 kPa) and static pressure of 50 psi (345 kPa) to 55 psi (379 kPa). [NFPA 99:15.4.7.5.8.3]

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**TABLE 1323.4.4**

MAXIMUM PIPE SUPPORT SPACING [NFPA 99: TABLE 5.1.10.11.4.6]

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>HANGER SPACING (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN8 (NPS 3/4)</td>
<td>5</td>
</tr>
<tr>
<td>DN10 (NPS 1)</td>
<td>6</td>
</tr>
<tr>
<td>DN15 (NPS 3/4)</td>
<td>6</td>
</tr>
<tr>
<td>DN20 (NPS 1 1/4)</td>
<td>7</td>
</tr>
<tr>
<td>DN25 (NPS 1 1/2)</td>
<td>8</td>
</tr>
<tr>
<td>DN32 (NPS 1 1/8)</td>
<td>9</td>
</tr>
<tr>
<td>DN40 and larger (NPS 1 3/4)</td>
<td>10</td>
</tr>
</tbody>
</table>

Vertical risers, all sizes, every floor, but not to exceed 15 feet. For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

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**TABLE 1324.5.11**

GAS CONCENTRATIONS [NFPA 99: TABLE 5.1.12.4.11]
### MEDICAL GAS

<table>
<thead>
<tr>
<th></th>
<th>CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen USP</td>
<td>≥99% oxygen</td>
</tr>
<tr>
<td>Oxygen 93 USP</td>
<td>≥90% oxygen = 96%</td>
</tr>
<tr>
<td>Nitrous oxide USP</td>
<td>≥99% nitrous oxide</td>
</tr>
<tr>
<td>Nitrogen NF</td>
<td>≤1% oxygen or ≥99% nitrogen</td>
</tr>
<tr>
<td>Medical air USP</td>
<td>19.5% - 23.5% oxygen</td>
</tr>
<tr>
<td>Other gases</td>
<td>Named gases by ±1%, or per specification</td>
</tr>
</tbody>
</table>

### TABLE 1327.5

MAXIMUM COPPER TUBE SUPPORT SPACING

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>HANGER SPACING (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN8</td>
<td>(NPS $\frac{3}{4}$)</td>
</tr>
<tr>
<td>DN10</td>
<td>(NPS $\frac{3}{8}$)</td>
</tr>
<tr>
<td>DN15</td>
<td>(NPS $\frac{5}{8}$)</td>
</tr>
<tr>
<td>DN20</td>
<td>(NPS $\frac{5}{8}$)</td>
</tr>
<tr>
<td>DN25</td>
<td>(NPS 1)</td>
</tr>
<tr>
<td>DN32</td>
<td>(NPS $1\frac{1}{4}$)</td>
</tr>
<tr>
<td>DN40 and larger</td>
<td>(NPS $1\frac{1}{4}$)</td>
</tr>
<tr>
<td>Vertical risers, all sizes, every floor, but not to exceed</td>
<td>10</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

### TABLE 1327.6

MAXIMUM PLASTIC PIPE SUPPORT SPACING

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>HANGER SPACING (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN15</td>
<td>(NPS $\frac{3}{8}$)</td>
</tr>
<tr>
<td>DN20</td>
<td>(NPS $\frac{3}{4}$)</td>
</tr>
<tr>
<td>DN25</td>
<td>(NPS 1)</td>
</tr>
<tr>
<td>DN32</td>
<td>(NPS $1\frac{1}{4}$)</td>
</tr>
<tr>
<td>DN40</td>
<td>(NPS $1\frac{1}{4}$)</td>
</tr>
<tr>
<td>DN50</td>
<td>(NPS 2)</td>
</tr>
<tr>
<td>DN65 and larger</td>
<td>(NPS $2\frac{1}{2}$)</td>
</tr>
<tr>
<td>Vertical risers, all sizes, every floor, but not to exceed</td>
<td>10</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

### TABLE 1314.5(1)

POSITIVE PRESSURE GASES

<table>
<thead>
<tr>
<th>VALVE SIZE (inch)</th>
<th>MINIMUM Cv (full open)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{2}$</td>
<td>17</td>
</tr>
</tbody>
</table>
For SI units: 1 inch = 25.4 mm

<table>
<thead>
<tr>
<th>VALVE SIZE (inch)</th>
<th>MINIMUM Cv (full open)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{3}{4} )</td>
<td>( \frac{21}{169} )</td>
</tr>
<tr>
<td>( \frac{1}{2} )</td>
<td>( \frac{60}{357} )</td>
</tr>
<tr>
<td>( \frac{1}{4} )</td>
<td>( \frac{110}{239} )</td>
</tr>
<tr>
<td>( \frac{1}{8} )</td>
<td>( \frac{232}{196} )</td>
</tr>
<tr>
<td>( \frac{1}{16} )</td>
<td>( \frac{302}{3136} )</td>
</tr>
</tbody>
</table>
Dental Chapter 15 in the 2018 edition, this limitation was removed from NFPA 99 Category 3 systems.

The deletion of the other sections and creation of the two new sections eliminates all other conflict and potential conflict both currently and in the future with NFPA 99. The two new sections are now directing the users of the code to the NFPA 99 standard. Additionally the proposal preserves the existing UPC inclusion of minimum flow rates, minimum numbers of outlets/inlets as well as the sizing and design requirements for healthcare facilities. The design, sizing and minimum quantities are not addressed in NFPA 99 and for that reason left as is in the Chapter 13.

As the Chapter is currently written all of the proposed deleted sections in this proposal are extracted from NFPA 99. However, the way the sections were extracted there are only portions of the text from NFPA 99 brought into UPC leaving gaps in the requirements as well as missing requirements. These gaps and missing requirements would put any designer, AHJ or installer in a position where they are jumping back and forth between two different standards trying to determine which code has a requirement, what is a conflict and which standard should take precedence. Many times, what ends up happening is that only one standard is used, and in the case of only the UPC being used many of the redundancy and life safety requirements and protections that are in place for patient safety and are found in NFPA 99 have been removed by not extracting those sections.

Trying to piece together different sections and different requirements from multiple standards and how they apply is very likely to result in something being missed and the added confusion and conflict creates a significant patient safety concern that will very likely lead to negative patient outcomes including death if the wrong item is missed, omitted, or misinterpreted.

As UPC has stated that The UPC shall not be interpreted to conflict with NFPA 99 it would promote increased patient safety and less risk of major injury or death to just require systems to meet the requirements of NFPA 99 as the proposed language dictates.

Additionally in many cases where UPC has been adopted, the adoption excludes chapter 13 and adopts NFPA 99 as a more stringent requirement than Chapter 13. Some of the locations that do this include but are not limited to: California Department of Health Care Access and Information (HCAI/OSHPD) (Adopts sections 1301.1&1301.2 ONLY), Minnesota, Montana, North Dakota, Clark County, NV, Maine, Maui County, and Las Vegas. This proposal would encourage states and municipalities to now adopt Chapter 13 along with the added design and sizing requirements since it would now be in harmony with NFPA 99.

Note, only the stricken language is shown above. Supporting documents showing the clean version of only the remaining text is provided.

[Supporting documentation is provided in KAVI for TC review]
1309.0 Oxygen Concentrator Supply Units.

1309.1 Oxygen Requirements. Oxygen concentrator supply units for use with medical gas pipelines shall be in accordance with NFPA 99, produce oxygen meeting the requirements of Oxygen 93 USP or Oxygen USP. [NFPA 99:5.1.3.9.1.1]

1309.2 Particulate Size. Output shall have less than or equal to $1.686 \times 10^{-6}$ pounds per cubic yard (1 mg/m$^3$) of permanent particulates sized 1 micron or larger at normal atmospheric pressure. [NFPA 99:5.1.3.9.1.2]

1309.3 Suitability. Materials of construction on the air side of the oxygen concentrator unit shall be suitable for the service as determined by the manufacturer. [NFPA 99:5.1.3.9.1.3]

1309.4 Compatible Materials. Materials of construction on the oxygen side of the oxygen concentrator unit shall comply with Section 1307.4. [NFPA 99:5.1.3.9.1.4]

1309.5 Oxygen Concentrator Components. The components that make up the oxygen concentrator unit shall be as follows:

(1) The manufacturer of the concentrator unit shall be permitted to use such components and arrangement of such components as needed to produce oxygen complying with Section 1309.1 in the quantity as required by the facility, except where otherwise specifically defined in this code.

(2) Air receivers and oxygen accumulators, where used, shall comply with Section VIII.1, “Unfired Pressure Vessels,” of the ASME Boiler and Pressure Vessels Code and be provided with overpressure relief valves. [NFPA 99:5.1.3.9.1.5]

1309.6 Supply Air Quality. The supply air to the concentrator(s) shall be of a quality to ensure the oxygen concentrator unit can produce oxygen complying with Section 1309.1 and shall not be subject to normally anticipated contamination (e.g., vehicle or other exhausts, gas leakage, discharge from vents, flooding). [NFPA 99:5.1.3.9.1.6]

1309.7 Electrical Components. The oxygen concentrator supply unit and any associated electrical equipment shall be provided with, at a minimum, the following electrical components:

(1) Either a disconnect switch for each major electrical component or a single disconnect that deactivates all electrical components in the concentrator unit.

(2) Motor starting devices with overload protection for any component with an electrical motor over 2 hp (1.5 kW). [NFPA 99:5.1.3.9.1.7]

1309.8 Vent Valve. A vent valve shall be provided as follows:
(1) Located on the source side of the concentrator outlet isolation valve to permit the operation of the oxygen concentrator unit for validation, calibration, and testing while the unit is isolated from the pipeline system.

(2) Sized to allow for at least 25 percent of the oxygen concentrator unit flow.

(3) Vented to a location compliant with Section 1309.8.1. [NFPA 99:5.1.3.9.1.8]

1309.8.1 Venting of Relief Valves. Indoor supply systems shall have all relief valves vented per Section 1308.2(4) through Section 1308.2(9). [NFPA 99:5.1.3.3.2]

1309.9 Valved Sample Port. A DN8 (NPS 1/4) valved sample port shall be provided near the oxygen concentration monitor sensor connection for sampling of the gas from the oxygen concentrator unit. [NFPA 99:5.1.3.9.1.9]

1309.10 Suitable Filter. At least one 0.1 micron filter suitable for oxygen service shall be provided at the outlet of the oxygen concentrator supply unit. [NFPA 99:5.1.3.9.1.10]

1309.11 Check Valve. A check valve shall be provided at the outlet of the oxygen concentrator supply unit to prevent backflow into the oxygen concentrator supply unit and to allow service to the unit. [NFPA 99:5.1.3.9.1.11]

1309.12 Outlet Valve. An outlet valve shall be provided to isolate all components of the oxygen concentrator from the pipeline with the following characteristics:

(1) The valve shall have both manual and automatic actuation with visual indication of open or closed.

(2) The valve shall close automatically whenever the oxygen concentrator unit is not producing oxygen of a concentration equal to that in Section 1309.1.

(3) Continuing operation of the oxygen concentrator supply unit through the vent mode shall be permitted with the isolating valve closed.

(4) The isolating valve, when automatically closed due to low concentration, shall require manual reset to ensure the oxygen concentrator supply unit is examined prior to return to service.

(5) Closing the isolating valve, whether automatically or manually, shall activate an alarm signal at the master alarms (see Section 1317.1.1) indicating that the oxygen concentrator supply unit is disconnected. [NFPA 99:5.1.3.9.1.12]

1309.13 Oxygen Concentration Monitor. The oxygen concentrator supply unit shall be provided with an oxygen concentration monitor with the following characteristics:

(1) The monitor shall be capable of monitoring 99 percent oxygen concentration with 1 percent accuracy.

(2) The monitor shall continuously display the oxygen concentration and shall activate local alarm and master alarms per NFPA 99 when a concentration lower than 91 percent is observed.

(3) The monitor shall continuously display the oxygen concentration.

(4) It shall be permitted to insert the monitor into the pipeline without a demand check. [NFPA 99:5.1.3.9.1.13]

SUBSTANTIATION:
Current UPC section 1301.3 states: "The requirements of this chapter shall not be interpreted to conflict with the requirements of NFPA 99. For requirements of portions of medical gas and vacuum systems not addressed in this chapter or medical gas and vacuum systems beyond the scope of this chapter refer to NFPA 99." [UPC 1301.3]

This section contains text that was extracted from NFPA 99. However, in the extraction only some of the paragraphs were extracted and not the complete text from NFPA 99. This leaves gaps in the requirements as well
as missing requirements in the UPC. These gaps and missing requirements would put any designer, AHJ or installer in a position where they are jumping back and forth between two different standards trying to determine which code has a requirement, what is a conflict and which standard should take precedence. Many times, what ends up happening is that only one standard is used, and in the case of only the UPC being used many of the redundancy and life safety requirements and protections that are in place for patient safety and are found in NFPA 99 have been removed by not extracting those sections.

Trying to piece together different sections and different requirements from multiple standards and how they apply is very likely to result in something being missed and the added confusion and conflict creates a significant patient safety concern that will very likely lead to negative patient outcomes including death if the wrong item is missed, omitted, or misinterpreted.

As UPC has stated in 1301.3, it shall not be interpreted to conflict with NFPA 99. This proposal promotes increased patient safety and less risk of major injury or death to extract the complete NFPA 99 text rather than only portions.
1310.0 Category 1 Medical Air Central Supply Systems.

1310.1 Quality of Medical Air Compressors. Medical air compressors shall be in accordance with NFPA 99. Medical air shall be required to have the following characteristics:

1. It shall be supplied from cylinders, bulk containers, or medical air compressor sources, or it shall be reconstituted from oxygen USP and oil-free, dry nitrogen NF.
2. It shall meet the requirements of medical air USP.
3. It shall have no detectable liquid hydrocarbons.
4. It shall have less than 25 ppm gaseous hydrocarbons.
5. It shall have equal to or less than $1.686 \times 10^{-6}$ pounds per cubic yard ($1 \text{ mg/m}^3$) of permanent particulates sized 1 micron or larger in the air at normal atmospheric pressure. [NFPA 99:5.1.3.6.1]

1310.2 Uses of Medical Air. Medical air sources shall be connected to the medical air distribution system only and shall be used only for air in the application of human respiration and calibration of medical devices for respiratory application. [NFPA 99:5.1.3.6.2]

1310.3 Medical Air Compressors. Medical air compressors shall be installed in a well-lit, ventilated, and clean location and shall be accessible. The location shall be provided with drainage facilities in accordance with this code. The medical air compressor area shall be located separately from medical gas cylinder system sources, and shall be readily accessible for maintenance.

1310.3.1 Category 1 Medical Air Compressor. Medical air compressors shall be sufficient to serve the peak calculated demand with the largest single compressor out of service. In no case shall there be fewer than two compressors. [NFPA 99:5.1.3.6.3.9(B)]

1310.3.2 Required Components. Medical air compressor systems shall consist of the following:

1. Components shall be arranged to allow service and a continuous supply of medical air in the event of a single fault failure.

   Component arrangement shall be permitted to vary as required by the technology(ies) employed, provided that an equal level of operating redundancy and medical air quality is maintained. [NFPA 99:5.1.3.6.3.9(A)(1), 5.1.3.6.3.9(A)(2)]

2. Automatic means to prevent backflow from all on-cycle compressors through all off-cycle compressors.

3. Manual shutoff valve to isolate each compressor from the centrally piped system and from other compressors for maintenance or repair without loss of pressure in the system.
(4) Intake filter muffler(s) of the dry type.

(5) Pressure relief valve(s) set at 50 percent above line pressure.

(6) Piping and components between the compressor and the source shutoff valve that do not contribute to contaminant levels.

(7) Except as defined in Section 1310.3.2(1) through Section 1310.3.2(6), materials and devices used between the medical air intake and the medical air source valve that are of any design or construction appropriate for the service as determined by the manufacturer. [NFPA 99:5.1.3.6.3.2 (2-7)]

1310.4 Medical Air Receivers. Receivers for medical air shall meet the following requirements:

(1) They shall be made of corrosion-resistant materials or otherwise be made corrosion resistant.

(2) They shall comply with Section VIII.1, "Unfired Pressure Vessels," of the ASME Boiler and Pressure Vessel Code.

(3) They shall be equipped with a pressure relief valve, automatic drain, manual drain, sight glass, and pressure indicator.

(4) They shall be of a capacity sufficient to prevent the compressors from short-cycling. [NFPA 99:5.1.3.6.3.6]

1310.5 Valves. A medical air receiver(s) shall be provided with proper valves to allow the flow of compressed air to enter and exit out of separate receiver ports during normal operation and allow the receiver to be bypassed during service without shutting down the supply of medical air. [NFPA 99:5.1.3.6.3.9(D)]

1311.0 Compressor Intake.

1311.1 Air Sources. Air sources for medical air compressors shall comply with Section 1311.2 through Section 1311.6.

1311.2 Medical Air Compressor Source. The medical air compressors shall draw their air from a source of clean air. [NFPA 99:5.1.3.6.3.11(A)]

If an air source equal to or better than outside air (e.g., air already filtered for use in operating room ventilating systems) is available, it shall be permitted to be used for the medical air compressors with the following provisions:

(1) This alternate source of supply air shall be available on a continuous 24 hours-per-day, 7 day-per-week basis.

(2) Ventilating systems having fans with motors or drive belts located in the airstream shall not be used as a source of medical air intake. [NFPA 99:5.1.3.6.3.11(E)]

1311.3 Air Intakes. Compressor intake piping shall be permitted to be made of materials and use a joining technique as permitted under Section 1319.0 and Section 1320.0. [NFPA 99:5.1.3.6.3.11(F)]

1311.4 Location. Medical air intakes shall be located as follows:

(1) The medical air intake shall be located a minimum of 25 feet (7620 mm) from ventilating system exhausts, fuel storage vents, combustion vents, plumbing vents, vacuum and WAGD discharges, or areas that can collect vehicular exhausts or other noxious fumes.

(2) The medical air intake shall be located a minimum of 20 feet (6096 mm) above ground level.

(3) The medical air intake shall be located a minimum of 10 feet (3048 mm) from any door, window, or other opening in the building. [NFPA 99:5.1.3.6.3.11(B-D)]
1311.5 Separate Compressors. Air intakes for separate compressors shall be permitted to be joined together to one common intake where the following conditions are met:

(1) The common intake is sized to minimize backpressure in accordance with the manufacturer’s recommendations.

(2) Each compressor can be isolated by manual or check valve, blind flange, or tube cap to prevent open inlet piping when the compressor(s) is removed for service from the consequent backflow of room air into the other compressor(s). [NFPA 99:5.1.3.6.3.11(G)]

1311.6 Screening. The end of the intake shall be turned down and screened or otherwise be protected against the entry of vermin, debris, or precipitation by screening fabricated or composed of a noncorroding material. [NFPA 99:5.1.3.6.3.11(H)]

**SUBSTANTIATION:**

Current UPC section 1301.3 states: “The requirements of this chapter shall not be interpreted to conflict with the requirements of NFPA 99. For requirements of portions of medical gas and vacuum systems not addressed in this chapter or medical gas and vacuum systems beyond the scope of this chapter refer to NFPA 99.” [UPC 1301.3]

This section contains text that was extracted from NFPA 99. However, in the extraction only some of the paragraphs were extracted and not the complete text from NFPA 99. This leaves gaps in the requirements as well as missing requirements in the UPC. These gaps and missing requirements would put any designer, AHJ or installer in a position where they are jumping back and forth between two different standards trying to determine which code has a requirement, what is a conflict and which standard should take precedence. Many times, what ends up happening is that only one standard is used, and in the case of only the UPC being used many of the redundancy and life safety requirements and protections that are in place for patient safety and are found in NFPA 99 have been removed by not extracting those sections.

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As UPC has stated in 1301.3, it shall not be interpreted to conflict with NFPA 99. This proposal promotes increased patient safety and less risk of major injury or death to extract the complete NFPA 99 text rather than only portions.
1312.0 Medical Surgical Vacuum Central Supply Systems.

1312.1 General. Medical surgical vacuum central supply systems shall be in accordance with NFPA 99. The vacuum plant shall be installed in a well lit, ventilated, and clean location with accessibility. The location shall be provided with drainage facilities in accordance with this code. The vacuum plant, where installed as a source, shall be located separately from other medical vacuum system sources and shall be readily accessible for maintenance.

1312.2 Medical-Surgical Vacuum Sources. Medical-surgical vacuum central supply systems shall consist of the following:

(1) Two or more vacuum pumps sufficient to serve the peak calculated demand with the largest single vacuum pump out of service.

(2) Automatic means to prevent backflow from any on-cycle vacuum pumps through any off-cycle vacuum pumps.

(3) Shutoff valve or other isolation means to isolate each vacuum pump from the centrally piped system, and other vacuum pumps for maintenance or repair without loss of vacuum in the system.

(4) Vacuum receiver.

(5) Piping between the vacuum pump(s), discharge(s), receiver(s), and vacuum source shutoff valve in accordance with Section 1319.0, except brass, galvanized, or black steel pipe, which is permitted to be used as recommended by the manufacturer.

(6) Except as defined in Section 1312.2(1) through Section 1312.2(5), materials and devices used between the medical vacuum exhaust and the medical vacuum source that are permitted to be of any design or construction appropriate for the service as determined by the manufacturer.

(7) Vacuum filtration per Section 1312.4. [NFPA 99:5.1.3.7.1.1]

1312.3 Vacuum Receivers. Receivers for vacuum shall meet the following requirements:

(1) They shall be made of materials deemed suitable by the manufacturer.

(2) They shall comply with Section VIII.1, "Unfired Pressure Vessels," of the ASME Boiler and Pressure Vessel Code.

(3) They shall be capable of withstanding a gauge pressure of 60 psi (414 kPa) and 30 inch (762 mm) gauge HgV.

(4) They shall be equipped with a manual drain.

(5) They shall be of a capacity based on the technology of the pumps. [NFPA 99:5.1.3.7.3]

1312.4 Vacuum Filtration. Central supply systems for vacuum other than liquid ring pumps shall be provided with inlet filtration with the following characteristics:
Filtration shall be at least duplex to allow one filter to be exchanged without impairing the vacuum system.

Filtration shall be located on the patient side of the vacuum producer.

Filters shall be efficient to 0.3 µ and 99.97 percent HEPA or better, per DOE-STD-3020.

Filtration shall be sized for 100 percent of the peak calculated demand while one filter or filter bundle is isolated.

It shall be permitted to group multiple filters into bundles to achieve the required capacities.

The system shall be provided with isolation valves on the source side of each filter or filter bundle and isolation valves on the patient side of each filter or filter bundle, permitting the filters to be isolated without shutting off flow to the central supply system.

A means shall be available to allow the user to observe any accumulations of liquids.

A vacuum relief petcock shall be provided to allow vacuum to be relieved in the filter canister during filter replacement.

Filter elements and canisters shall be permitted to be constructed of materials as deemed suitable by the manufacturer.

In normal operation, one filter or filter bundle shall be isolated from the system to be available for service should a blockage in the operating filter occur or rotation of the filters be desired after filter element exchange. [NFPA 99:5.1.3.7.4]

1312.5 Piping Arrangement and Redundancies. Piping arrangement shall be as follows:

1. Piping shall be arranged to allow service and a continuous supply of medical-surgical vacuum in the event of a single fault failure.

2. Piping arrangement shall be permitted to vary based on the technology(ies) employed, provided that an equal level of operating redundancy is maintained.

3. Where only one set of vacuum pumps is available for a combined medical-surgical vacuum system and an analysis, a research, or a teaching laboratory vacuum system, such laboratories shall be connected separately from the medical-surgical system directly to the receiver tank through its own isolation valve and fluid trap located at the receiver, and between the isolation valve and fluid trap, a scrubber shall be permitted to be installed. [NFPA 99:5.1.3.7.5.1]

1312.6 Piping Serviceability. The medical-surgical vacuum receiver(s) shall be serviceable without shutting down the medical-surgical vacuum system by any method to ensure continuation of service to the facility's medical-surgical pipeline distribution system. [NFPA 99:5.1.3.7.5.2]

1312.7 Shutoff Valve. Medical-surgical vacuum central supply systems shall be provided with a source shutoff valve per Section 1314.6. [NFPA 99:5.1.3.7.5.3]

1313.0 Medical-Surgical Vacuum Exhaust.

1313.1 Vacuum Source Exhausts. The medical-surgical vacuum pumps shall exhaust in a manner and location that minimizes the hazards of noise and contamination to the facility and its environment. [NFPA 99:5.1.3.7.7.1]

1313.2 Location. The exhaust shall be located as follows:
(1) Outdoors.
(2) At least 25 feet (7620 mm) from any door, window, air intake, or other openings in buildings or places of public assembly.
(3) At a level different from air intakes.
(4) Where prevailing winds, adjacent buildings, topography, or other influences will not divert the exhaust into occupied areas or prevent dispersion of the exhaust. [NFPA 99: 5.1.3.7.7.2]

1313.3 Screening. The end of the exhaust shall be turned down and screened or otherwise be protected against the entry of vermin, debris, or precipitation by screening fabricated or composed of a noncorroding material. [NFPA 99: 5.1.3.7.7.3]

1313.4 Dips and Loops. The exhaust shall be free of dips and loops that might trap condensate or oil or provided with a drip leg and valved drain at the bottom of the low point. [NFPA 99: 5.1.3.7.7.5]

1313.5 Multiple Pumps. Vacuum exhausts from multiple pumps shall be permitted to be joined together to one common exhaust where the following conditions are met:

(1) The common exhaust is sized to minimize back pressure in accordance with the pump manufacturer’s recommendations.
(2) Each pump can be isolated by manual or check valve, blind flange, or tube cap to prevent open exhaust piping when the pump(s) is removed for service from consequent flow of exhaust air into the room. [NFPA 99: 5.1.3.7.7.6]

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**SUBSTANTIATION:**

Current UPC section 1301.3 states: “The requirements of this chapter shall not be interpreted to conflict with the requirements of NFPA 99. For requirements of portions of medical gas and vacuum systems not addressed in this chapter or medical gas and vacuum systems beyond the scope of this chapter refer to NFPA 99.” [UPC 1301.3]

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As UPC has stated in 1301.3, it shall not be interpreted to conflict with NFPA 99. This proposal promotes increased patient safety and less risk of major injury or death to extract the complete NFPA 99 text rather than only portions.
Proposed Text:

1317.0 Warning Systems.

1317.1 General. Warning Systems shall be in accordance with NFPA 99.

1317.1 Category 1. All master, area, and local alarm systems used for medical gas and vacuum systems shall include the following:

(1) Separate visual indicators for each condition monitored, except as permitted in Section 1317.1.2 for local alarms that are displayed on master alarm panels.

(2) Visual indicators that remain in alarm until the situation that has caused the alarm is resolved.

(3) Cancelable audible indication of each alarm condition that produces a sound with a minimum level of 80 dBA at 3 feet (914 mm).

(4) Means to indicate a lamp or LED failure and audible failure.

(5) Visual and audible indication that the communication with an alarm initiating device is disconnected.

(6) Labeling of each indicator, indicating the condition monitored.

(7) Labeling of each alarm panel for its area of surveillance.

(8) Reinitiating of the audible signal if another alarm condition occurs while the audible alarm is silenced.

(9) Power for master alarms, area alarms, sensors, and switches from the life safety branch of the essential electrical system as described in NFPA 99.

(10) Power for local alarms, dew point sensors, and carbon monoxide sensors permitted to be from the same essential electrical branch as is used to power the air compressor system.

(11) Where used for communications, wiring from switches or sensors that is supervised or protected as required by NFPA 70 for life safety and critical branches circuits in which protection is any of the following types:

   (a) Conduit
   (b) Free air
   (c) Wire
   (d) Cable tray
   (e) Raceways

(12) Communication devices that do not use electrical wiring for signal transmission and are supervised such that failure of communication initiates an alarm.
Assurance by the responsible authority of the facility that the labeling of alarms, where room numbers or designations are used, is accurate and up to date.

Provisions for automatic restart after a power loss of 10 seconds (e.g., during generator start-up) without giving false signals or requiring manual reset.

Alarm switches/sensors installed so as to be removable and accessible for service and testing. [NFPA 99:5.1.9.1]

1317.1.1 Master Alarms. A master alarm system shall be provided to monitor the operation and condition of the source of supply, the reserve source (if any), and the pressure in the main lines of each medical gas and vacuum piping system. [NFPA 99:5.1.9.2]

1317.1.2 Master Alarm Signal. The master alarm shall include at least one signal from the source equipment to indicate a problem with the source equipment at this location. This master alarm signal shall activate when any of the required local alarm signals for this source equipment activates. [NFPA 99:5.1.9.5.2]

SUBSTANTIATION:
Current UPC section 1301.3 states: “The requirements of this chapter shall not be interpreted to conflict with the requirements of NFPA 99. For requirements of portions of medical gas and vacuum systems not addressed in this chapter or medical gas and vacuum systems beyond the scope of this chapter refer to NFPA 99.” [UPC 1301.3]

This section contains text that was extracted from NFPA 99. However, in the extraction only some of the paragraphs were extracted and not the complete text from NFPA 99. This leaves gaps in the requirements as well as missing requirements in the UPC. These gaps and missing requirements would put any designer, AHJ or installer in a position where they are jumping back and forth between two different standards trying to determine which code has a requirement, what is a conflict and which standard should take precedence. Many times, what ends up happening is that only one standard is used, and in the case of only the UPC being used many of the redundancy and life safety requirements and protections that are in place for patient safety and are found in NFPA 99 have been removed by not extracting those sections.

Trying to piece together different sections and different requirements from multiple standards and how they apply is very likely to result in something being missed and the added confusion and conflict creates a significant patient safety concern that will very likely lead to negative patient outcomes including death if the wrong item is missed, omitted, or misinterpreted.

As UPC has stated in 1301.3, it shall not be interpreted to conflict with NFPA 99. This proposal promotes increased patient safety and less risk of major injury or death to extract the complete NFPA 99 text rather than only portions.
1324.0 Performance Criteria and Testing Category 1 (Gases, Medical Surgical Vacuum).

1324.1 General. Performance criteria and testing shall be in accordance with NFPA 99.

1324.1 Where Required. Inspection and testing shall be performed on components, or portions thereof, of new, piped medical gas or vacuum systems, additions, renovations, temporary installations, or repaired systems in accordance with Section 1324.2 through Section 1324.5.11, and certified in accordance with Section 1306.0.

1324.2 Breached Systems. All systems that are breached and components that are subject to additions, renovations, or replacement (e.g., new gas sources: bulk, manifolds, compressors, dryers, alarms) shall be inspected and tested. Systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition. Breached portions of the systems subject to inspection and testing shall be confined to only the specific altered zone and components in the immediate zone or area that is located upstream for vacuum systems and downstream for pressure gases at the point or area of intrusion. [NFPA 99:5.1.12.1.3 – 5.1.12.1.5]

1324.2.1 Reports. The inspection and testing reports shall be submitted directly to the party that contracted for the testing, who shall submit the report through channels to the responsible facility authority and any others that are required. Reports shall contain detailed listings of all findings and results. [NFPA 99:5.1.12.1.6, 5.1.12.1.7]

1324.3 Test Gas. The test gas shall be oil-free, dry nitrogen NF. [NFPA 99:5.1.12.2.1.2]

1324.4 Initial Piping Blowdown. Piping in medical gas and vacuum distribution systems shall be blown clear by means of oil-free, dry nitrogen NF after installation of the distribution piping but before installation of station outlet/inlet rough-in assemblies and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, pressure relief valves, manifolds, source equipment). [NFPA 99:5.1.12.2.2]

1324.5 Initial Pressure Tests – Medical Gas and Vacuum Systems. Each section of the piping in medical gas and vacuum systems shall be pressure tested. Initial pressure tests shall be conducted as follows:

(1) After blowdown of the distribution piping.

(2) After installation of station outlet/inlet rough-in assemblies.

(3) Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, line pressure relief valves). [NFPA 99:5.1.12.2.3.1, 5.1.12.2.3.2]

1324.5.1 Shutoff Valve. The source shutoff valve shall remain closed during tests specified in Section 1324.5 through Section 1324.5.1.2. [NFPA 99:5.1.12.2.3.3]

1324.5.1.1 Required Test Pressure. The test pressure for pressure gases and vacuum systems shall be 1.5 times the system operating pressure but not less than a gauge pressure of 150 psi (1034 kPa). The test pressure shall be
maintained until each joint has been examined for leakage by means of a leak detectant that is safe for use with oxygen and does not contain ammonia. [NFPA 99:5.1.12.2.3.4, 5.1.12.2.3.5]

1324.5.1.2 Leaks. Leaks, if any, shall be located, repaired (if permitted), replaced (if required), and retested. [NFPA 99:5.1.12.2.3.6]

1324.5.2 Initial Cross-Connection Test. It shall be determined that no cross-connections exist between the various medical gas and vacuum piping systems. [NFPA 99:5.1.12.2.4]

1324.5.2.1 Atmospheric Pressure. All piping systems shall be reduced to atmospheric pressure. [NFPA 99:5.1.12.2.4.1]

1324.5.2.2 Sources of Test Gas. Sources of test gas shall be disconnected from all piping systems, except for the one system being tested. [NFPA 99:5.1.12.2.4.2]

1324.5.2.3 System to Be Charged. The system under test shall be charged with oil-free, dry nitrogen NF to a gauge pressure of 50 psi (345 kPa). [NFPA 99:5.1.12.2.4.3]

1324.5.2.4 Check Outlets and Inlets. After the installation of the individual faceplates with appropriate adapters matching outlet/inlet labels, each individual outlet/inlet in each installed medical gas and vacuum piping system shall be checked to determine that the test gas is being dispensed only from the piping system being tested. [NFPA 99:5.1.12.2.4.4]

1324.5.2.5 Repeat Test. The cross-connection test referenced in Section 1324.5.2 shall be repeated for each installed medical gas and vacuum piping system. [NFPA 99:5.1.12.2.4.5]

1324.5.2.6 Identification of System. The proper labeling and identification of system outlets/inlets shall be confirmed during these tests. [NFPA 99:5.1.12.2.4.6]

1324.5.3 Initial Piping Purge Tests. The outlets in each medical gas piping system shall be purged to remove any particulate matter from the distribution piping. [NFPA 99:5.1.12.2.5]

1324.5.3.1 Procedure. Using appropriate adapters, each outlet shall be purged with an intermittent high-volume flow of test gas until the purge produces no discoloration in a clean white cloth. [NFPA 99:5.1.12.2.5.1]

1324.5.3.2 Location. The purging required in Section 1324.5.3.1 shall be started at the closest outlet/inlet to the zone valve and continue to the furthest outlet/inlet within the zone. [NFPA 99:5.1.12.2.5.2]

1324.5.4 Standing Pressure Tests – for Positive Pressure Medical Gas Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, medical gas distribution piping shall be subjected to a standing pressure test. [NFPA 99:5.1.12.2.6]

1324.5.4.1 Time Frame for Testing. Tests shall be conducted after the final installation of station outlet valve bodies, faceplates, and all other distribution system components. [NFPA 99:5.1.12.2.6.1]

1324.5.4.2 Source Valve. The source valve shall be closed during this test. [NFPA 99:5.1.12.2.6.2]

1324.5.4.3 Length of Testing. The piping systems shall be subjected to a 24-hour standing pressure test using oil-free, dry nitrogen NF. [NFPA 99:5.1.12.2.6.3]

1324.5.4.4 Test Pressure. Test pressures shall be 20 percent above the normal system operating line pressure. [NFPA 99:5.1.12.2.6.4]

1324.5.4.5 Conclusion of Test. The leakage over the 24-hour test shall not exceed 0.5 percent of the starting pressure [e.g., 0.3 psi (2 kPa) starting at 60 psig (414 kPa)] except that attributed to specific changes in ambient conditions. [NFPA 99:5.1.12.2.6.5]
1324.5.4.6 Leaks. Leaks, if any, shall be located, repaired (if permitted) or replaced (if required), and retested. [NFPA 99:5.1.12.2.6.6]

1324.5.4.7 Proof of Testing. The 24-hour standing pressure test of the positive pressure system shall be witnessed by an ASSE/IAPMO/ANSI 6020 inspector, an ASSE/IAPMO/ANSI 6030 verifier, or the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. [NFPA 99:5.1.12.2.6.7]

1324.5.5 Standing Pressure Tests – Medical Vacuum Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, vacuum distribution piping shall be subjected to a standing vacuum test. [NFPA 99:5.1.12.2.7]

1324.5.5.1 Timeframe for Testing. Tests shall be conducted after installation of all components of the vacuum system. [NFPA 99:5.1.12.2.7.1]

1324.5.5.2 Length of Testing. The piping systems shall be subjected to a 24-hour standing vacuum test. [NFPA 99:5.1.12.2.7.2]

1324.5.5.3 Test Pressure. Test pressure shall be between 12 inches (305 mm) HgV and full vacuum. [NFPA 99:5.1.12.2.7.3]

1324.5.5.4 Disconnection of Testing Source. During the test, the source of test vacuum shall be disconnected from the piping system. [NFPA 99:5.1.12.2.7.4]

1324.5.5.5 Conclusion of Test. The leakage over the 24-hour test shall not exceed 0.5 percent of the starting pressure [e.g., 0.125 inch (0.3 mm) HgV starting at 25 inches (635 mm) HgV] except that attributed to specific changes in ambient temperature. [NFPA 99:5.1.12.2.7.5]

1324.5.5.6 Proof of Testing. The 24-hour standing pressure test of the vacuum system shall be witnessed by the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. [NFPA 99:5.1.12.2.7.6]

1324.5.5.7 Leaks. Leaks, if any, shall be located, repaired (if permitted) or replaced (if required), and retested. [NFPA 99:5.1.12.2.7.7]

1324.5.6 System Inspection. System inspections shall be performed prior to concealing piping distribution systems in walls, ceilings, chases, trenches, underground, or otherwise hidden from view. [NFPA 99:5.1.12.3.1.1]

1324.5.6.1 Test Gas. The test gas shall be nitrogen NF. [NFPA 99:5.1.12.3.1.2]

1324.5.6.2 Inspection Qualification. Inspections shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline inspections and testing and meeting the requirements of ASSE/IAPMO/ANSI 6020, or ASSE/IAPMO/ANSI 6030. [NFPA 99:5.1.12.3.1.3]

1324.5.6.3 Inspection Personnel. Inspections shall be performed by a party other than the installing contractor. [NFPA 99:5.1.12.3.1.4]

1324.5.6.4 Qualifications. Where systems have not been installed by inhouse personnel, inspections shall be permitted by personnel of the organization who meet the requirements of Section 1324.5.6.2. [NFPA 99:5.1.12.3.1.5]
1324.5.6.5 Inspections. The initial pressure tests performed by the installing contractor shall be witnessed by an ASSE/IAPMO/ANSI 6020 inspector, an ASSE/IAPMO/ANSI 6030 verifier, or the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. The presence and correctness of labeling and valve tagging required by this code for all concealed components and piping distribution systems shall be inspected. [NFPA 99:5.1.12.3.2 – 5.1.12.3.2.2]

1324.5.7 System Verification. Verification tests shall be performed only after all tests required in Section 1324.3 through Section 1324.5.5.7, Installer Performed Tests, have been completed. [NFPA 99:5.1.12.4.1.1]

1324.5.7.1 Test Gas. The test gas shall be oil-free, dry nitrogen NF or the system gas where permitted. [NFPA 99:5.1.12.4.1.2]

1324.5.7.2 Approved Tester. Testing shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline testing and meeting the requirements of ASSE/IAPMO/ANSI 6030, except as required by Section 1324.5.7.3. [NFPA 99:5.1.12.4.1.3]

Testing shall be performed by a party other than the installing contractor. [NFPA 99:5.1.12.4.1.5]

Where systems have not been installed by in-house personnel, testing shall be permitted by personnel of that organization who meet the requirements of Section 1324.5.7.2. [NFPA 99:5.1.12.4.1.6]

1324.5.7.3 Cryogenic Fluid Testing. Testing of the cryogenic fluid central supply system shall be conducted by a party technically competent and experienced in the field of cryogenic fluid systems and meeting the requirements of ASSE/IAPMO/ANSI 6025, in accordance with the mandatory requirements in CGA M-1. [NFPA 99:5.1.12.4.1.4]

1324.5.8 Particulate Matter. In order to remove any traces of particulate matter deposited in the pipelines as a result of construction, a heavy, intermittent purging of the pipeline shall be done. [NFPA 99:5.1.12.4.6]

1324.5.9 Final Tie-In Test. Each joint in the final connection between the new work and the existing system shall be leak-tested with the gas of system designation at the normal operating pressure by means of a leak detector that is safe for use with oxygen and does not contain ammonia. [NFPA 99:5.1.12.4.9.2]

1324.5.9.1 Vacuum Joints. Vacuum joints shall be tested using an ultrasonic leak detector or other means that will allow detection of leaks in an active vacuum system. [NFPA 99:5.1.12.4.9.3]

1324.5.9.2 Pressure Gases. For pressure gases, immediately after the final brazed connection is made and leak-tested, an outlet in the new piping and an outlet in the existing piping that are immediately downstream from the point or area of intrusion shall be purged in accordance with the applicable requirements of Section 1324.5.8. [NFPA 99:5.1.12.4.9.4]

1324.5.9.3 Positive Pressure Gases. Before the new work is used for patient care, positive pressure gases shall be tested for operational pressure and gas concentration in accordance with Section 1324.5.10 and Section 1324.5.11. [NFPA 99:5.1.12.4.9.5]

1324.5.9.4 Permanent Records. Permanent records of these tests shall be maintained in accordance with NFPA 99. [NFPA 99:5.1.12.4.9.6]

1324.5.10 Operational Flow Pressure Drop Test. Operational flow pressure drop tests shall be performed at each station outlet/inlet or terminal where the user makes connections and disconnections. [NFPA 99:5.1.12.4.10]

1324.5.10.1 Medical-Surgical Vacuum Inlets. Medical-surgical vacuum inlets shall draw 3 SCFM (85 Nl/min) without reducing the vacuum pressure below 12 inch (305 mm) gauge HgV at any adjacent station inlet. [NFPA 99:5.1.12.4.10.4]
1324.5.10.2 Oxygen and Medical Air Outlets. Oxygen and medical air outlets serving Category 1 space shall allow a transient flow rate of 6 SCFM (170 SLPM) for 3 seconds. [NFPA 99:5.1.12.4.10.5]

1324.5.11 Medical Gas Concentration Test. After purging each system with the gas of system designation, the following shall be performed:

(1) Each pressure gas source and outlet shall be analyzed for concentration of gas, by volume.

(2) Analysis shall be conducted with instruments designed to measure the specific gas dispensed.

(3) Allowable concentrations shall be as indicated in Table 1324.5.11. [NFPA 99:5.1.12.4.11]

<table>
<thead>
<tr>
<th>TABLE 1324.5.11</th>
</tr>
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<tbody>
<tr>
<td>GAS CONCENTRATIONS</td>
</tr>
<tr>
<td>[NFPA 99: TABLE 5.1.12.4.11]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEDICAL GAS</th>
<th>CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen USP</td>
<td>≥99% oxygen</td>
</tr>
<tr>
<td>Oxygen 93 USP</td>
<td>≥90% oxygen ≤96%</td>
</tr>
<tr>
<td>Nitrous oxide USP</td>
<td>≥99% nitrous oxide</td>
</tr>
<tr>
<td>Nitrogen NF</td>
<td>≤1% oxygen or ≥99% nitrogen</td>
</tr>
<tr>
<td>Medical air USP</td>
<td>19.5%–23.5% oxygen</td>
</tr>
<tr>
<td>Other gases</td>
<td>Named gases by ±1%, or per specification</td>
</tr>
</tbody>
</table>

SUBSTANTIATION:
Current UPC section 1301.3 states: "The requirements of this chapter shall not be interpreted to conflict with the requirements of NFPA 99. For requirements of portions of medical gas and vacuum systems not addressed in this chapter or medical gas and vacuum systems beyond the scope of this chapter refer to NFPA 99." [UPC 1301.3]

This section contains text that was extracted from NFPA 99. However, in the extraction only some of the paragraphs were extracted and not the complete text from NFPA 99. This leaves gaps in the requirements as well as missing requirements in the UPC. These gaps and missing requirements would put any designer, AHJ or installer in a position where they are jumping back and forth between two different standards trying to determine which code has a requirement, what is a conflict and which standard should take precedence. Many times, what ends up happening is that only one standard is used, and in the case of only the UPC being used many of the redundancy and life safety requirements and protections that are in place for patient safety and are found in NFPA 99 have been removed by not extracting those sections.

Trying to piece together different sections and different requirements from multiple standards and how they apply is very likely to result in something being missed and the added confusion and conflict creates a significant patient
safety concern that will very likely lead to negative patient outcomes including death if the wrong item is missed, omitted, or misinterpreted.

As UPC has stated in 1301.3, it shall not be interpreted to conflict with NFPA 99. This proposal promotes increased patient safety and less risk of major injury or death to extract the complete NFPA 99 text rather than only portions.
1327.0 Dental Gas and Vacuum Systems.

1327.1 General. Dental gas and vacuum systems shall comply with this code and be in accordance with NFPA 99.

1327.2 Emergency Shutoff Valves (Oxygen and Nitrous Oxide):

(1) All Category 2 medical gas systems shall have an emergency shutoff valve accessible from all use-point locations in an emergency.

(2) Where a central medical gas supply system supplies two treatment facilities, each facility shall be provided with an emergency shutoff valve located in that treatment facility so as to be accessible from all use-point locations in an emergency.

(3) Emergency shutoff valves shall be labeled to indicate the gas controlled by the shutoff valve and shall shut off only the gas to the treatment facility that they serve.

(4) A remotely activated shutoff valve at a gas supply manifold shall not be used for emergency shutoff. For clinical purposes, such a remote valve actuator shall not fail close in the event of loss of electric power. Where remote actuators are the type that fail-open, it shall be mandatory that cylinder shutoff valves be closed whenever the system is not in use. [NFPA 99:15.4.2.6.1–15.4.2.6.4.2]

1327.3 Warning Systems (Oxygen and Nitrous Oxide). Category 2 warning systems shall comply with Section 1325.10 except as follows:

(1) Warning systems shall be permitted to be a single alarm panel.

(2) The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.

(3) Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel.

(4) Warning systems for medical gas systems shall provide the following alarms:

(a) Oxygen main line pressure low.

(b) Oxygen main line pressure high.

(c) Oxygen changeover to secondary bank or about to changeover (if automatic).

(d) Nitrous oxide main line pressure low.

(e) Nitrous oxide main line pressure high.

(f) Nitrous oxide changeover to secondary bank or about to changeover (if automatic).
Audible and noncancelable alarm visual signals shall indicate if the pressure in the main line increases or decreases 20 percent from the normal operating pressure.

Visual indications shall remain until the situation that caused the alarm is resolved.

Pressure switches/sensors shall be installed downstream of any emergency shutoff valves and any other shutoff valves in the system and shall cause an alarm for the medical gas if the pressure decreases or increases 20 percent from the normal operating pressure.

A cancelable audible indication of each alarm condition that produces a sound at the alarm panel shall reinitiate the audible signal if another alarm condition occurs while the audible signal is silenced. [NFPA 99:15.4.2.10]

1327.4 Initial Pressure Test. Each section of the piping in positive-pressure gas systems and copper vacuum systems shall be pressure tested. Plastic vacuum and plastic scavenging piping shall not be pressure tested. [NFPA 99:15.4.7.4.4.1]

1327.4.1 Pressure Test. Initial pressure tests shall be conducted as follows:

1. After blowdown of the distribution piping
2. After installation of station outlet/inlet rough-in assemblies
3. Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, and line pressure relief valves) [NFPA 99:15.4.7.4.4.2]

1327.4.2 Source Shutoff Valve. The source shutoff valve shall remain closed during the pressure tests. [NFPA 99:15.4.7.4.4.3]

1327.4.3 Test Pressure. The test pressure for oxygen and nitrous oxide piping shall be 1.5 times the system operating pressure but not less than a gauge pressure of 150 psi (1035 kPa). [NFPA 99:15.4.7.4.4.4]

1327.4.4 Examine for Leaks. The test pressure shall be maintained until each joint has been examined for leakage by means of a leak detectant that is safe for use with oxygen and does not contain ammonia. [NFPA 99:15.4.7.4.4.5]

1327.4.5 Leaks Located. Any leaks shall be located, repaired (if permitted), or replaced (if required) by the installer, and retested. [NFPA 99:15.4.7.4.4.6]

1327.5 Maximum Copper Tube Support Spacing. The maximum support spacing for copper tube shall be in accordance with Table 1327.5. [NFPA 99:15.4.5.6.5]

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>HANGER SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(feet)</td>
</tr>
</tbody>
</table>

TABLE 1327.5

MAXIMUM COPPER TUBE SUPPORT SPACING

[NFPA-99: TABLE 15.4.5.6.5]
<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>HANGER SPACING (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN8 (NPS 1/4)</td>
<td>5</td>
</tr>
<tr>
<td>DN10 (NPS 3/8)</td>
<td>6</td>
</tr>
<tr>
<td>DN15 (NPS 1/2)</td>
<td>6</td>
</tr>
<tr>
<td>DN20 (NPS 3/4)</td>
<td>7</td>
</tr>
<tr>
<td>DN25 (NPS 1)</td>
<td>8</td>
</tr>
<tr>
<td>DN32 (11/4)</td>
<td>9</td>
</tr>
<tr>
<td>DN40 and larger (11/2)</td>
<td>10</td>
</tr>
</tbody>
</table>

Vertical risers, all sizes, every floor, but not to exceed 15 feet.

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

1327.6 Maximum Plastic Pipe Support Spacing. The maximum support spacing for plastic pipe shall be in accordance with Table 1327.6. [NFPA 99:15.4.5.6.6]

**TABLE 1327.6**

**MAXIMUM PLASTIC PIPE SUPPORT SPACING**

[NFPA-99: TABLE 15.4.5.6.6]
### 1327.7 Standing Pressure Tests for Oxygen and Nitrous Oxide Piping

After successful completion of the initial pressure tests in Section 1327.4, the gas distribution piping shall be subject to a standing pressure test. [NFPA 99:15.4.7.4.6.1]

#### 1327.7.1 Tests Required

Tests shall be conducted after the final installation of station outlet valve bodies, faceplates, and other distribution system components (e.g., pressure alarm devices, pressure indicators, line pressure relief valves, manufactured assemblies, and hoses). [NFPA 99:15.4.7.4.6.2]

#### 1327.7.2 Source Valve

The source valve shall be closed during this test. [NFPA 99:15.4.7.4.6.3]

#### 1327.7.3 Piping Systems

The piping systems shall be subjected to 24-hour standing pressure tests using oil-free, dry nitrogen NF. [NFPA 99:15.4.7.4.6.4]

#### 1327.7.4 Test Pressure

Test pressures shall be 20 percent above the normal system operating line pressure. [NFPA 99:15.4.7.4.6.5]

#### 1327.7.5 Change in Test Pressure

At the conclusion of the tests, there shall be no change in the test pressure except that attributed to specific changes in ambient temperature. [NFPA 99:15.4.7.4.6.6]

#### 1327.7.6 Leaks

Any leaks shall be located, repaired (if permitted), or replaced (if required) by the installer, and retested. [NFPA 99:15.4.7.4.6.7]

### 1327.8 Verifier Operational Pressure Test

Operational pressure tests shall be performed at each station outlet or terminal where the user makes connections and disconnections. [NFPA 99:15.4.7.5.8.1]

#### 1327.8.1 Test Gas

Tests shall be performed with the gas of system designation. [NFPA 99:15.4.7.5.8.2]

#### 1327.8.2 Medical Gas Outlets

All medical gas outlets with a gauge pressure of 50 psi (345 kPa), including oxygen and nitrous oxide, shall deliver 1.8 standard cubic feet per minute (SCFM) (50 SLPM) with a pressure drop of not more than 5 psi (34 kPa) and static pressure of 50 psi (345 kPa) to 55 psi (379 kPa). [NFPA 99:15.4.7.5.8.3]

### SUBSTANTIATION:

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Trying to piece together different sections and different requirements from multiple standards and how they apply is very likely to result in something being missed and the added confusion and conflict creates a significant patient safety concern that will very likely lead to negative patient outcomes including death if the wrong item is missed, omitted, or misinterpreted.

As UPC has stated in 1301.3, it shall not be interpreted to conflict with NFPA 99. This proposal promotes increased patient safety and less risk of major injury or death to extract the complete NFPA 99 text rather than only portions.

Additionally in the dental medical gas application there is far less regulation and oversight than typical healthcare projects like a hospital. Many times the only AHJ looking at a dental facility is the building/plumbing official. For this reason it is very benificial to include the entirety of the dental requirements from NFPA 99 in UPC to provide that soul source of code to that official. Most of the deaths related to medical gas systems in the US over the last 25 years have been in dental facilities. There is a group in Arizona who has been tracking these but the exact data was not available at the time of submission. Their numbers show that since NFPA moved dental into it's own section (chapter) in the 2018 edition there has been more focus on dental systems and the rate of deaths has actually decreased. Adding the dental requirements in their entirety will provide for an increased patient safety, as well as easier and more clear enforcement of the code.
RECOMMENDATION:
Revise text

Proposed Text:
1501.0 General.
1501.1 Applicability. The provisions of this chapter shall apply to the installation, construction, alteration, and repair of alternate water source systems for nonpotable applications.

1505.0 Reclaimed (Recycled) Water Systems.
1505.1 General Applicability. The provisions of this section shall apply to the installation, construction, alteration, and repair of reclaimed (recycled) water systems.
1505.1.1 Allowable Use of Reclaimed (Recycled) Water. Where approved or required by the Authority Having Jurisdiction, reclaimed (recycled) water intended to supply uses such as shall be permitted to be used instead of potable water for use in water closets, urinals, trap primers for floor drains and floor sinks, aboveground and subsurface irrigation, industrial or commercial cooling or air conditioning and other uses approved by the Authority Having Jurisdiction.

1506.0 On-Site Treated Nonpotable Water Systems.
1506.1 General Applicability. The provisions of this section shall apply to the installation, construction, alteration, and repair of on-site treated nonpotable water systems.
1506.1.1 Allowable Use of Onsite Treated Nonpotable Water. Where approved or required by the Authority Having Jurisdiction, onsite treated nonpotable water intended to supply uses such as shall be permitted to be used instead of potable water for use in water closets, urinals, trap primers for floor drains and floor sinks, above and belowground irrigation, and other uses approved by the Authority Having Jurisdiction.

1601.0 General.
1601.1 Applicability. (remaining text unchanged)
1601.1.1 Allowable Use of Alternate Water Nonpotable Rainwater. Where approved or required by the Authority Having Jurisdiction, nonpotable rainwater shall be permitted to be used instead of potable water for the applications identified in this chapter.

SUBSTANTIATION:
The intent of this proposal is to correlate the sections covering applicability and allowable use under Chapters 15, Alternate Water Sources for Nonpotable Applications and Chapter 16, Nonpotable Rainwater Catchment Systems (Sections 1501.1, 1505.1, 1506.1 and 1601.1).
RECOMMENDATION:
Revise text

Proposed Text:
1501.0 General.
1501.1 Applicability. (remaining text unchanged)
1501.1.1 Allowable Use of Alternate Water. Where approved or required by the Authority Having Jurisdiction, alternate water sources [reclaimed (recycled) water, gray water, and on-site treated nonpotable water] shall be permitted to be used instead in lieu of potable water for shall be in accordance with the applications identified in provisions of this chapter.
1501.2 System Design. Alternate water source systems shall be designed in accordance with this chapter by a licensed plumbing contractor, or a registered design professional, or a person who demonstrates competency to design the alternate water source system as required by the Authority Having Jurisdiction. Components, piping, and fittings used in any alternate water source system shall be listed.
Exceptions:
(1) A registered design professional is not required to design gray water systems having a maximum discharge capacity of 250 gallons per day (gal/d) (0.011 L/s) for single family and multi-family dwellings.
(2) A registered design professional is not required to design an on-site treated nonpotable water system for single family dwellings having a maximum discharge capacity of 250 gal/d (0.011 L/s).

1601.0 General.
1601.1 Applicability. (remaining text unchanged)
1601.1.1 Allowable Use of Alternate Water. Rainwater. Where approved or required by the Authority Having Jurisdiction, rainwater shall be permitted to be used instead in lieu of potable water for shall be in accordance with the applications identified in provisions of this chapter.
1601.2 System Design. Rainwater catchment systems shall be designed in accordance with this chapter by a licensed plumbing contractor, or registered design professional, or a person who demonstrates competency to design rainwater catchment systems as required by the Authority Having Jurisdiction. Components, piping, and fittings used in a rainwater catchment system shall be listed.
Exceptions:
(1) A person registered or licensed to perform plumbing design work is not required to design rainwater catchment systems used for irrigation with a maximum storage capacity of 360 to 5000 gallons (1363 to 18927 L) where the tank is supported directly upon grade and the ratio of height to width (or diameter) does not exceed 2 to 1.
(2) A person registered or licensed to perform plumbing design work is not required to design rainwater catchment systems for single family dwellings where outlets, piping, and system components are located on the exterior of the building.

SUBSTANTIATION:
The proposed change will correlate with the 2023 WeStand provisions. The substantiation provided when introduced to the WeStand is as follows: The updates clean up some text, and updates were made to clarify the persons who are allowed to design alternate water systems. The title for Section 1601.1.1 is being updated to
clarify that the section is specific for rainwater systems. Additionally, the exception for the maximum storage capacity for the allowable use of rainwater was increased to 5000 gallons to harmonize with the capacity limit indicated in the WeStand.

The specific skills needed to install most non-potable rainwater catchment systems for irrigation are predominately landscape irrigation (the irrigation system) or roofing (if gutters are altered) type of work, not plumbing work. Landscape contractors install a lot more rainwater catchment systems than do plumbing contractors. This requirement in Section 1601.2 should be general to allow for the local experts from whatever field to be able to install the systems. 360 gallons is very small, and this water would be used up in less than a week to irrigate a 1,000 square foot lawn during the summer. There is no real difference in the complexity or design of a 360-gallon system versus a 5,000 gallons system, so long as the tank is stable on a stable foundation. By using the 5,000 gallons number this code would be consistent with most existing codes for water storage- no permit is needed so long as the tank is under 5,000 gallons.
Proposed Text:

1501.0 General.

1501.3 Permit. It shall be unlawful for a person to construct, install, alter, or cause to be constructed, installed, or altered an alternate water source system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

Exception: For single family dwellings, a construction permit shall not be required for a clothes washer only system meeting the requirements of Section 1501.3.1. A written notification shall be provided to the Authority Having Jurisdiction in accordance with Section 1501.3.1.

1501.3.1 Clothes Washer System. A clothes washer system in compliance with the following shall be permitted to be installed or altered without a construction permit:

1. Where required, notification shall be provided to the Authority Having Jurisdiction regarding the proposed location and installation of a gray water irrigation or disposal system.

2. The design shall allow the user to direct the flow to the irrigation or disposal field or the building sewer. The direction control of the gray water shall be clearly labeled and readily accessible to the user.

3. The installation, change, alteration, or repair of the system shall not include a potable water connection or a pump and does not affect other building, plumbing, electrical, or mechanical components including structural features, egress, fire-life safety, sanitation, potable water supply piping, or accessibility. The pump in a clothes washer shall not be considered part of the gray water system.

4. The gray water shall be contained on the site where it is generated.

5. Gray water shall be directed to and contained within an irrigation or disposal field.

6. Ponding or runoff shall be prohibited and shall be considered a nuisance.

7. Gray water shall be permitted to be released above the ground surface provided at least 2 inches (51 mm) of mulch, rock, or soil, or a solid shield covers the release point. Other methods which provide equivalent separation shall be permitted.

8. Gray water systems shall be designed to minimize contact with humans and domestic pets.

9. Water used to wash diapers or similarly soiled or infectious garments shall not be used and shall be diverted to the building sewer.

10. Gray water shall not contain hazardous chemicals derived from activities such as cleaning car parts, washing greasy or oily rags, or disposing of waste solutions from home photo labs or similar hobbyist or home occupational activities.

11. Exemption from construction permit requirements of this code shall not be deemed to grant authorization for any gray water system to be installed in a manner that violates other provisions of this code or any other laws or ordinances of the Authority Having Jurisdiction.

12. An operation and maintenance manual shall be provided to the owner. Directions shall indicate that the manual is to remain with the building throughout the life of the system and upon change of ownership or occupancy.

13. Gray water discharge from a clothes washer system through a standpipe shall be properly trapped in accordance with this code.

SUBSTANTIATION:
These updates will correlate with the WeStand. The rationale provided at the time of this proposed change is as follows: Clothes washer only systems that do not alter the existing plumbing (and follow basic health and safety guidelines) are extremely low risk and should be allowed to be installed with no permit. There are many incentive programs across the state for the clothes washer graywater system due to its permit-exempt status.
1501.0 General.

1501.9 Commercial, Industrial, and Institutional Restroom Signs. A sign shall be installed in restrooms in commercial, industrial, and institutional occupancies using reclaimed (recycled) water and on-site treated water, for water closets, urinals, or both. Each sign shall contain 1/2 of an inch (12.7 mm) letters of a highly visible color on a contrasting background, and letters shall be at least 1/2 inch (12 mm) in height. The location of the sign(s) shall be such that the sign(s) are shall be visible to users. The location of the sign(s) shall be approved by the Authority Having Jurisdiction and shall contain the following text:
TO CONSERVE WATER, THIS BUILDING USES *____________* TO FLUSH TOILETS AND URINALS.

1501.9.1 Equipment Room Signs. Each room containing reclaimed (recycled) water and on-site treated water equipment shall have a sign posted in a location that is visible to anyone working on or near nonpotable water equipment with the following wording in not less than 1 inch (25.4 mm) in height letters:
CAUTION: NONPOTABLE *___________*, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM.
NOTICE: CONTACT BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM.
*___________*Shall indicate RECLAIMED (RECYCLED) WATER or ON-SITE TREATED WATER, accordingly.

1501.10 System Controls. Controls for pumps, valves, and other devices that contain mercury that come in contact with alternate water source water supply shall not be permitted be prohibited.

1505.0 Reclaimed (Recycled) Water Systems.

1505.10 Hose Bibbs. Hose bibbs shall not be allowed on reclaimed (recycled) water piping systems located in areas accessible to the public. Access to reclaimed (recycled) water at points in the system accessible to the public shall be through a quick-disconnect device that differs from those installed on the potable water system. Hose bibbs supplying reclaimed (recycled) water shall be indicated by posted signs marked with the words: “CAUTION: NONPOTABLE RECLAIMED WATER, DO NOT DRINK,” and the symbol in Figure 1505.10.

1603.0 Design and Installation.

1603.2 Outside Hose Bibbs. Outside hose bibbs shall be allowed on rainwater piping systems. Hose bibbs supplying rainwater shall be indicated by posted signs marked with the words: “CAUTION: NONPOTABLE RAINWATER, DO NOT DRINK” and the symbol in Figure 1603.2.

1604.0 Signs.

1604.2 Commercial, Industrial, and Institutional Restroom Signs. A sign shall be installed in restrooms in commercial, industrial, and institutional occupancies using nonpotable rainwater for water closets, urinals, or both. Each sign shall contain 1/2 of an inch (12.7 mm) letters of a highly visible color on a contrasting background. The
location of the sign(s) shall be such that the sign(s) shall be visible to users. The number and location of the sign(s) shall be approved by the Authority Having Jurisdiction and shall contain the following text:

TO CONSERVE WATER, THIS BUILDING USES RAINWATER TO FLUSH TOILETS AND URINALS.

1604.3 Equipment Room Signs. Each equipment room containing nonpotable rainwater equipment shall have a sign posted with the following wording in not less than 1 inch (25.4 mm) letters:

CAUTION NONPOTABLE RAINWATER, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM.

This sign shall be posted in a location that is visible to anyone working on or near rainwater equipment.

SUBSTANTIATION:
The proposed changes word smith the text and also harmonize with the provisions located in the 2023 WeStand.
Proposed Text:
1501.0 General.
1501.1 Applicability. (remaining text unchanged)
1501.1.1 Allowable Use of Alternate Water. Where approved or required by the Authority Having Jurisdiction, alternate water sources [reclaimed (recycled) water, stormwater, gray water, and on-site treated nonpotable water] shall be permitted to be used instead of potable water for the applications identified in this chapter.

1503.0 Stormwater Catchment Systems.
1503.1 Listed Stormwater Treatment Systems. Onsite stormwater treatment systems shall comply with ARCSA/ASPE/ANSI 78, installed in accordance with to the manufacturer's installation instructions, and commissioned in accordance with Section 1503.2.
1503.2 Commissioning. Onsite stormwater treatment systems shall be commissioned in accordance with Section 1503.2.1 through Section 1503.4.
1503.2.1 Commissioning Requirements. Commissioning for stormwater treatment systems shall be included in the design and construction processes of the project. Commissioning shall be performed by a person who demonstrates competency in commissioning stormwater treatment systems as required by the Authority Having Jurisdiction.
1503.2.2 Commissioning Plan. The construction documents shall include the commissioning plan for the stormwater treatment system. The commissioning plan shall be approved by the Authority Having Jurisdiction prior to commissioning the stormwater treatment system. The commissioning plan shall include the following:
(1) General project information.
(2) Equipment to be tested, including the test methodology.
(3) Processes to be tested.
(4) Criteria or process for testing.
(5) Criteria or process for acceptance.
(6) Commissioning team contact information.
(7) Commissioning process activities, schedules, and responsibilities.
(8) Plans for the completion of functional performance testing, post construction documentation and training, and the commissioning report.
1503.2.3 Performance Testing. Performance tests shall verify that the installation and operation of the equipment of the stormwater treatment system is in accordance with the approved plans and specifications. The performance test report shall include the equipment tested, the testing methods utilized, and proof of proper calibration of the equipment.
1503.2.4 Commissioning Report. The commissioning report shall be submitted to the Authority Having Jurisdiction.
1503.3 Operation and Maintenance Manual. An operation and maintenance manual shall be provided in accordance with Section 1501.6 and shall also include the following:
(1) Instructions on operating and maintaining the system, including treatment process operations, instrumentation and alarms, and chemicals storage and handling.
(2) Site equipment inventory and maintenance notes.
(3) Equipment/system warranty documentation and information.
(4) As-built design drawings.
(5) Details on training requirements and qualifications of personnel responsible for operating the system.
(6) Maintenance schedule.

1503.4 Inspection. Field inspections shall take place during and after construction while the contractor is on-site to verify that the stormwater treatment system components have been properly supplied and installed according to the plans and specifications used for installation. Record drawings shall be maintained with changes to the approved plans by the contractor and shall be available for periodic inspection as needed.

(shown for information purposes only)

1501.6 Operation and Maintenance Manual. An operation and maintenance manual for gray water and on-site treated water systems required to have a permit in accordance with Section 1501.3 shall be supplied to the building owner by the system designer. The operation and maintenance manual shall include the following:

(1) Detailed diagram of the entire system and the location of system components.
(2) Instructions for operating and maintaining the system.
(3) Details on maintaining the required water quality for onsite nonpotable water systems.
(4) Details on deactivating the system for maintenance, repair, or other purposes.
(5) Applicable testing, inspection, and maintenance frequencies in accordance with Table 1501.5.
(6) A method of contacting the manufacturer(s).

| TABLE 1701.1 |
| REFERENCED STANDARDS |
| STANDARD NUMBER   | STANDARD TITLE                                | APPLICATION   | REFERENCED SECTION |
| ARCSA/ASPE/ANSI 78-2023 | Stormwater Harvesting System Design for Direct End-Use Applications | Miscellaneous | 1503.1 |

Note: ARCSA/ASPE/ANSI meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The additions of this new text to brings Stormwater catchment provisions into the main code based off ARCSA/ASPE/ANSI 78.
**SUBMITTER:**
Billy Smith

**Organization Name:**
Chair, WE-Stand Technical Committee

**RECOMMENDATION:**
Revise text

**Proposed Text:**

1501.0 General.

1501.5 Maintenance and Inspection. Alternate water source systems and components shall be inspected and maintained in accordance with Section 1501.5.1 through Section 1501.5.3, the manufacturer’s installation instructions, or as required by the Authority Having Jurisdiction.

1501.5.1 Frequency. Alternate water source systems and components shall be inspected and maintained in accordance with Table 1501.5.1 unless more frequent inspection and maintenance are required by the manufacturer.

1501.5.2 Maintenance Log. A maintenance log for gray water and on-site treated nonpotable water systems is required to have a permit in accordance with Section 1501.3 and shall be maintained by the property owner and be available for inspection. The property owner or designated appointee shall ensure that a record of testing, inspection, and maintenance in accordance with Table 1501.5.1 is maintained in the log. The log will indicate the frequency of inspection and maintenance for each system.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MINIMUM FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect and clean filters and screens, and replace (where necessary).</td>
<td>In accordance with the manufacturer’s instructions or every 3 months</td>
</tr>
<tr>
<td>Inspect and maintain mulch basins for gray water irrigation systems.</td>
<td>Once per year, or as needed to maintain mulch depth and prevent ponding and runoff</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

1501.6 Operation and Maintenance Manual. An operation and maintenance manual for gray water and on-site treated water systems required to have a permit in accordance with Section 1501.3 shall be supplied to the building owner by the system designer. The operation and maintenance manual shall include the following:

(1)-(4) (remaining text unchanged)

(5) Applicable testing, inspection, and maintenance frequencies in accordance with Table 1501.5.1.

(6) (remaining text unchanged)

(7) Directions to the owner or occupant that the manual shall remain with the building throughout the life of the structure.

**SUBSTANTIATION:**
These updates will correlate with the WeStand. The rationale provided at the time of this proposed change is as follows: Filter cleaning varies based on the type of filter and usage. Therefore, the frequency should be done in accordance with the manufacturer’s instructions. Additionally, mulch basins should be checked at least once a year. Note seven (7) should be added so the system owner knows they must pass on the O&M manual to future owners.
RECOMMENDATION:
Revise text

Proposed Text:
1502.0 Inspection and Testing.
1502.1 General. Alternate water source systems shall be inspected and tested in accordance with Section 1502.2 through Section 1502.3.4.

Exception: Non-pressurized graywater or on-site nonpotable water systems without any connection to a potable water system.

SUBSTANTIATION:
These updates will correlate with the WeStand. The rationale provided at the time of this proposed change is as follows: Non-pressurized systems without any connection to a pressurized water systems would not require inspection for cross-connection nor inspection for testing potable water piping.
1502.0 Inspection and Testing.

1502.3 Annual Cross-Connection Inspection and Testing. (remaining text unchanged)

1502.3.1 Visual System Inspection. Before prior to commencing the cross-connection testing, a dual system inspection shall be conducted by the Authority Having Jurisdiction and other authorities having jurisdiction as follows:

(1)-(3) (remaining text unchanged)

1502.3.2 Cross-Connection Test. The procedure for determining cross-connection shall be followed by the applicant in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction to determine whether a cross-connection has occurred as follows:

(1) (remaining text unchanged)

(2) The potable water system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the alternate water source system is empty. The minimum period the alternate water source system is to remain depressurized shall be determined on a case-by-case basis, taking into account the size and complexity of the potable and the alternate water source distribution systems, but in no case shall that period be less than 1 hour.

(3)-(5) (remaining text unchanged)

(6) The alternate water source system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the potable water system is empty. The minimum period the potable water system is to remain depressurized shall be determined on a case-by-case basis, but in no case shall that period be less than 1 hour.

(7)-(9) (remaining text unchanged)

1505.0 Reclaimed (Recycled) Water Systems.

1505.6 Initial Cross-Connection Test. A cross-connection test is required in accordance with Section 1502.3. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

1506.0 On-Site Treated Nonpotable Water Systems.

1506.6 Initial Cross-Connection Test. A cross-connection test is required in accordance with Section 1502.3. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.
1602.0 Nonpotable Rainwater Catchment Systems.

1602.5 Initial Cross-Connection Test. Where a portion of a rainwater catchment system is installed within a building, a cross-connection test is required in accordance with Section 1605.3. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

1605.0 Inspection and Testing.

1605.3 Annual Cross-Connection Inspection and Testing.
1605.3.1 Visual System Inspection. Prior to commencing the cross-connection testing, a dual system inspection shall be conducted by the Authority Having Jurisdiction and other authorities having jurisdiction as follows:

(1) Pumps, equipment, equipment room signs, and exposed piping in an equipment room shall be checked.

1605.3.2 Cross-Connection Test. The procedure for determining cross-connection shall be followed by the applicant in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction to determine whether a cross-connection has occurred as follows:

(1)-(10) (remaining text unchanged)

SUBSTANTIATION:
The proposed updates will align with the WeStand. The phrasing "and other authorities having jurisdiction" is both unnecessary and repetitive. The definition for "Authority Having Jurisdiction," as provided in the UPC, includes federal, state, local, or regional departments; individuals such as a plumbing official, mechanical official, labor department official, health department official, building official; or others having statutory authority. Additionally, there are a few word smithing updates.
RECOMMENDATION:
Revise text

Proposed Text:

1503.0 Gray Water Systems.

1503.2 System Requirements. (remaining text unchanged)

1503.2.2 Diversion. The gray water system shall connect to the sanitary drainage system downstream of fixture traps and vent connections through a gray water diverter valve. Gray water diverter valves ranging from 2 inches (50 mm) through 4 inches (100 mm) in diameter shall comply with IAPMO PS 59 and be installed in an accessible location and clearly indicate the direction of flow. Gray water diversion valves ranging from 6 inches (150 mm) to 12 inches (300 mm) in diameter shall comply with IAPMO IGC 352. Valves shall be accessible and include a filter located upstream of the valve when required.

1506.0 On-Site Treated Nonpotable Water Systems.
1506.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of onsite treated nonpotable water systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, above and belowground irrigation, cooling towers, and other uses approved by the Authority Having Jurisdiction.

1506.10 Design and Installation. (remaining text unchanged)

1506.10.6 Diverter/Bypass Valves. On-site treated nonpotable water systems shall be provided with diversion/bypass valves for control, capture, and diversion of nonpotable water either to a capture treatment tank or to the appropriate storm or sewer drainage. To prevent system overflowing and flood damage caused by system power outage, or high rain/storm flows causing system overcapacity.

(renumber remaining sections)

1506.11 Valves. (remaining text unchanged)

1506.11.1 Diverter/Bypass Valves. Wastewater Diverter/Bypass valves ranging from 2 inches (50 mm) through 4 inches (100 mm) in diameter shall comply with IAPMO PS 59. Wastewater Diverter/Bypass valves ranging from 6 inches (150mm) to 12 inches (300mm) in diameter shall comply with IAPMO IGC 352. Diverter/Bypass valves operated by a motor, solenoid, or any other power-actuated mechanism shall have a fail-safe device that would automatically revert to directing the flow through the sanitary or storm drainage in case of power failure. Valves shall be accessible and include a debris filtering device upstream of the valve in accordance with Section 1506.10.5.

(renumber remaining sections)

(shown for information purposes only)
irrigation system.

1603.20 Rainwater Diversion Valves. Rainwater diversion valves ranging from 2 inches (50 mm) through 4 inches (100 mm) in diameter shall comply with IAPMO PS 59. Rainwater diversion valves ranging from 6 inches (150 mm) to 12 inches (300 mm) in diameter shall comply with IAPMO IGC 352. Valves shall be accessible and include a filter located upstream of the valve when required.

Note: IGC 352 and IAPMO PS 59 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The Scope of IAPMO IGC 352 is virtually the same as IAPMO PS 59 as well as the testing and compliance to adhered standards.

In addition to adding these needed valve sizes, the proposed change also includes provisions which mandates the use of a debris filter upstream of the valve as in Section n1603.20 for rainwater diversion valves.

The update to Section 1506.1 (General) adds the reference to “cooling towers” which will correlate with the requirements already mandated by the City of Los Angeles. Below is an excerpt of the mandates from the plumbing system portions for commercial buildings.

"LADBS Form GRN 18R

Plumbing System

Plumbing fixtures shall use recycled water.

9. In new buildings of 25 stories or less, the cooling towers shall comply with one of the following:
   A. Shall have a minimum of 6 cycles of concentration (blowdown): or
   B. A minimum of 50% of the makeup water supply to the cooling towers shall come from non-potable water sources, including treated backwash.

10. In new buildings over 25 stories, the cooling towers shall comply with the following:
   A. Shall have a minimum of 6 cycles of concentration (blowdown): and
   B. 100% of the makeup water supply to the cooling towers shall come from non-potable water sources, including treated backwash.

Historically, greywater was largely associated within the realm of the residential plumbing sector. With the current Cal State mandates of Title 24 and denser housing, Greywater had evolved in greater importance as another source of water for reuse such as use in cooling towers, toilets, urinals, and landscape irrigation in large scale developments. There is an unmet need for larger compliant sized diverter valves, 6”-12” in the commercial, residential, multi-unit housing, hotels, stadiums, and airports today. This code addition would cover valves specifically designed to divert and control non-potable greywater and to address the special need for valves ranging from 50 DN (NPS-2) to 300 DN (NPDS-12) for the use in large scales treatment and reuse systems."

The addition of Sections 1506.10.6 and 1506.10.11.1 would bring uniformity, more clarity, direction, and guidance to the entire Alternate Nonpotable Water Source Application category.

There has been an unmet need for direction of necessary equipment for the adoption of this growing and ever-expanding area of water sustainability., (on-site treatment). The redundancy in Chapter 15, Section 1503.2.2, should be overlooked as many AHJ's refer to specific text in specific sections of the codes regarding design and installation details. The larger sizes are required for commercial and residential development systems, where historically low rise and single-family construction was the norm.
SUBMITTER: Terry Burger
Organization Name: IAPMO

RECOMMENDATION:
Revise text

Proposed Text:
1503.0 Gray Water Systems.

1503.2 System Requirements.

1503.2.2 Diversion. The gray water system shall connect to the sanitary drainage system downstream of fixture traps and vent connections through a gray water diverter valve. The gray water diverter valve shall comply with IAPMO PS-59 [IAPMO Z1059] and be installed in an accessible location and clearly indicate the direction of flow.

1603.0 Design and Installation.

1603.20 Rainwater Diversion Valves. Rainwater diversion valves ranging from 2 inches (50 mm) through 4 inches (100 mm) in diameter shall comply with IAPMO PS-59 [IAPMO Z1059]. Rainwater diversion valves ranging from 6 inches (150 mm) to 12 inches (300 mm) in diameter shall comply with IAPMO IGC 352. Valves shall be accessible and include a filter located upstream of the valve when required.

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<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tr>
<td>IAPMO PS-59-2016a</td>
<td>Wastewater Diverter/Bypass Valves and Diversion Systems</td>
<td>Fittings</td>
<td>1503.2.2, 1603.20</td>
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<td>IAPMO Z1059-202X (Working Draft)</td>
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</table>

(portions of table not shown remain unchanged)

Note: IAPMO Z1059 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
IAPMO PS 59 is being designated as an ANSI designated National Standards (IAPMO Z1059).
**RECOMMENDATION:**
Revise text

**Proposed Text:**

TABLE 1503.4
LOCATION OF GRAY WATER SYSTEM

<table>
<thead>
<tr>
<th>MINIMUM HORIZONTAL DISTANCE REQUIRED FROM</th>
<th>SURGE TANK (feet)</th>
<th>SUBSURFACE AND SUBSOIL IRRIGATION FIELD AND MULCH BED (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building structures¹</td>
<td>5²⁻⁹⁰</td>
<td>2³⁻⁸²⁻⁷</td>
</tr>
<tr>
<td>Property line adjoining private property</td>
<td>5</td>
<td>5²⁻⁷</td>
</tr>
<tr>
<td>Water supply wells⁴³</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Streams and lakes⁴³</td>
<td>50</td>
<td>50⁴⁻⁴</td>
</tr>
<tr>
<td>Sewage pits or cesspools</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Sewage disposal field¹⁰</td>
<td>5</td>
<td>4⁶⁻⁵</td>
</tr>
<tr>
<td>Septic tank</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>On-site domestic water service line</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Pressurized public water main</td>
<td>10</td>
<td>10⁷⁻⁸</td>
</tr>
</tbody>
</table>

For SI units: 1 foot = 304.8 mm

**Notes:**

1. *Including Building structures shall not include* porches and steps, whether covered or uncovered, breezeways, roofed carports, roofed patios, carports, covered walks, covered driveways, and similar structures or appurtenances.

2. The distance shall be permitted to be reduced to 0 feet for aboveground tanks where first approved by the Authority Having Jurisdiction.

3. Reference to a 45 degree (0.79 rad) angle from the foundation.

4. Where special hazards are involved, the distance required shall be increased as directed by the Authority Having Jurisdiction.

5. These minimum clear horizontal distances shall also apply between the irrigation or disposal field and the ocean mean higher high tide line.

6. Add 2 feet (610 mm) for each additional foot of depth more than 1 foot (305 mm) below the bottom of the drain line.

7. For parallel construction or crossings, approval by the Authority Having Jurisdiction shall be required.

8. The distance shall be permitted to be reduced to 1 ¹⁄₂ feet (457 mm) for drip and mulch basin irrigation systems.

9. The distance shall be permitted to be reduced to 0 feet for surge tanks of 75 gallons (284 L) or less.
Where irrigation or disposal fields are installed in the sloping ground, the minimum horizontal distance between a part of the distribution system and the ground surface shall be 15 feet (4572 mm).

**SUBSTANTIATION:**
The minimum required horizontal distance from building structures is not consistent with the rest of the plumbing code. Sewage ejection pumps, which contain sewage, are allowed to be inside buildings and have no setbacks. Gray water tanks should be treated the same. If the plumbing is diverted in the basement or mechanical room, the surge tank would be located inside, not outside 5 feet away from the building. Note (1) is being revised since Table 602.8 is consistent with the CPC, and the CPC says that these are not considered a building structure. It doesn't make sense to have these setbacks for covered walks, breezeways, steps, etc., that are not part of the building structure. If the new distance of 0 feet is approved, Note (2) and Note (9) will not be used or referenced in the table and should therefore be removed.
Proposed Text:
1503.0 Gray Water Systems.

1503.8 Procedure for Estimating Gray Water Discharge.
1503.8.1 Single Family Dwellings and Multi-Family Dwellings. The gray water discharge for single family and multi-family dwellings shall be calculated by water use records, calculations of local daily per person interior water use, or the following procedure:

(1) The number of occupants of each dwelling unit shall be calculated as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>First bedroom</td>
<td>2 occupants</td>
</tr>
<tr>
<td>Each additional bedroom</td>
<td>1 occupant</td>
</tr>
</tbody>
</table>

(2) The estimated gray water flows of each occupant shall be calculated as follows:

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showers, bathtubs, and bathtubs lavatories</td>
<td>25 gallons (95 L) per day/occupant</td>
</tr>
<tr>
<td>Lavatories</td>
<td>4 gallons (15 L) per day/occupant</td>
</tr>
<tr>
<td>Laundry</td>
<td>10 gallons (57 L) per day/occupant</td>
</tr>
</tbody>
</table>

(3) The total number of occupants shall be multiplied by the applicable estimated gray water discharge as provided above and the type of fixtures connected to the gray water system.

SUBSTANTIATION:
The previous numbers of 25 gpcd for showers/baths/lav and 15 gpcd for washers are outdated and reflective of flow rates from the 1999 Residential End Use of Water Study (REUS). These estimates should be updated to reflect the new REUS study released in 2016.

The 2016 study found that per capita indoor use has gone down overall. New numbers are: Clothes Washer- 9.6 gpcd Shower: 11.1 gpcd Bath 1.5 gpcd Faucets 11.1 gcd (this includes all sinks, which is not representative of graywater sink flow rates which are limited to the bathroom, but the study didn't provide any other numbers for sinks. There is another report that provides accurate lavatory-only data, see below.)

Lavatory sinks should be separated from showers/bathtubs because many systems don't include the sink and there is currently no way to reduce the sizing to accommodate this. Also, if someone wanted to permit just a lavatory sink they should have an estimate that does not include showers/baths.

The new number I've provided for lavatory sinks is from page three of a report by Peter Meyer, who worked on both REUS studies. In his report he shows that lavatory sink use is 31% of total sink use. To calculate lavatory gray water production I multiplied 0.31 by 11.1 gpcd (total sink). 0.31 x 11.1= 3.4. I rounded up to 4 gpcd to have a whole number for consistency.

(As a side note: These updated numbers have been already been included in WE-Stand.)
View the study here or see it attached https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf

And the Peter Meyer report is provided for TC review.

[Supporting documentation provided in KAVI for TC review]
1503.0 Gray Water Systems. (remaining text unchanged)
1503.9 Gray Water System Components. (remaining text unchanged)
1503.9.1 Surge Tanks. Where installed, surge tanks shall be in accordance with the following:
(1)-(4) (remaining text unchanged)
(5) Where practicable, each surge tank shall have an overflow drain. The overflow drains shall have permanent connections to the building drain or building sewer, upstream of septic tanks. The overflow drain shall not be equipped with a shutoff valve.
(6)-(7) (remaining text unchanged)
(8) Where a surge tank is installed underground, the system shall be designed so that the tank overflow will gravity drain to the existing sewer line or septic tank. The tank shall be protected against sewer line backflow by a backwater valve installed in accordance with this code.
(9)-(10) (remaining text unchanged)

**SUBSTANTIATION:**
The requirements for a surge tank should be consistent with requirements for a sewage sump tank (sewage ejection tank). Sump tanks containing sewage are not required to have a gravity overflow to the sewer, so a tank merely containing gray water should also not be required to have this.

Requiring an overflow drain for a belowground gray water tank can unintentionally restrict the use of graywater, since some sites can't accommodate a gravity-flow drain.

In the UPC, section 709.1 General reads: "Where practicable, plumbing fixtures shall be drained to the public sewer or private sewage disposal system by gravity."

And section 710.2 and 710.3 allows for sewage ejector pumps to be used with no gravity drain to the sewer.

These revisions would make chapter 15 consistent with rest of the code.
SUBMITTER: Laura Allen

Organization Name: Greywater Action

RECOMMENDATION: Revise text

Proposed Text:
1503.0 Gray Water Systems.

1503.9 Gray Water System Components. (remaining text unchanged)

1503.9.2 Gray Water Pipe and Fitting Materials. Aboveground and underground building drainage and vent pipe and fittings for gray water systems shall comply with the requirements for aboveground and underground sanitary building drainage and vent pipe and fittings in this code. These materials shall extend not less than 2 feet (610 mm) outside the building.

SUBSTANTIATION:
Some gray water systems are designed to discharge gray water into a tank in the basement of the building. From this tank, gray water is pumped outside through irrigation tubing. This style of system would not use drainage piping 2 feet outside of the building.

To allow for various types and styles of gray water systems that fit into a variety of buildings, the requirement of 2 feet of drainage piping outside the building should be removed.
RECOMMENDATION:
Revise text

Proposed Text:
1503.0 Gray Water Systems.

1503.9 Gray Water System Components. (remaining text unchanged)

1503.9.4 Subsurface Irrigation Field and Mulch Basin Supply Line Materials. Materials for gray water piping outside the building for non-pressure gravity systems shall be ABS, polyethylene, or PVC, or other approved DWV pipe. Pressure systems shall be pressure rated polyethylene or PVC or other approved pressure rated pipe. Drip feeder lines shall be PVC or polyethylene tubing.

SUBSTANTIATION:
The above provisions have existed in the WE-Stand and these changes will harmonize with the 2023 WeStand. The proposed update will add additional pipe material reference for piping used for subsurface irrigation systems.
RECOMMENDATION:
Revise text

Proposed Text:
1504.0 Subsurface Irrigation System Zones.
1504.1 General. **Each zone in an irrigation or disposal fields shall be permitted to have field having** one or more valved zones. **Each zone shall be of a size to receive the gray water anticipated in that zone.**

1504.5 Subsurface and Subsoil Irrigation Field, and Mulch Basin Design and Construction. **Subsurface and subsoil irrigation field, and mulch basin** design and construction shall be in accordance with Section 1504.5.1 through Section 1504.7.3. Where a gray water irrigation system design is predicated on soil tests, the subsurface or subsoil irrigation field or mulch basin shall be installed at the same location and depth as the tested area.

SUBSTANTIATION:
The following updates will correlate with the 2023 WeStand. The text updates the provisions related to disposal fields in Section 1504.1 and makes it more clear on its intent. Furthermore, "and mulch basin" is being added to Section 1504.5 as it is also in the scope of the sections.
SUBMITTER: Laura Allen
Organization Name: Greywater Action

RECOMMENDATION:
Revise text

Proposed Text:

TABLE 1504.2
DESIGN OF SIX TYPICAL SOILS
SOIL INFILTRATION RATES

<table>
<thead>
<tr>
<th>SOIL CLASS AND TEXTURES</th>
<th>MAXIMUM ABSORPTION CAPACITY IN GALLONS PER SQUARE FOOT OF IRRIGATION/LEACHING AREA FOR A 24-HOUR PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A: Sandy Loam Textures: sand, loamy sand, sandy loam</td>
<td>11.9</td>
</tr>
<tr>
<td>Group B: Loam Textures: loam, silt loam</td>
<td>4.5</td>
</tr>
<tr>
<td>Group C: Sandy Clay Loam Textures: Sandy clay loam</td>
<td>3.0</td>
</tr>
<tr>
<td>Group D: Clay Loam Textures: clay loam, silty clay loam, sandy clay, silty clay, clay</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE OF SOIL</th>
<th>MINIMUM SQUARE FEET OF IRRIGATION AREA PER 100 GALLONS OF ESTIMATED GRAY WATER DISCHARGE PER DAY</th>
<th>MAXIMUM ABSORPTION CAPACITY IN GALLONS PER SQUARE FOOT OF IRRIGATION/LEACHING AREA FOR A 24-HOUR PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse sand or gravel</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Fine sand</td>
<td>25</td>
<td>4.0</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>40</td>
<td>2.5</td>
</tr>
<tr>
<td>Sandy clay</td>
<td>60</td>
<td>1.7</td>
</tr>
<tr>
<td>Clay with considerable sand or gravel</td>
<td>90</td>
<td>1.1</td>
</tr>
<tr>
<td>Clay with small amounts of sand or gravel</td>
<td>120</td>
<td>0.8</td>
</tr>
</tbody>
</table>

For SI units: 1 square foot = 0.0929 m², 1 gallon per day = 0.000043 L/s

SUBSTANTIATION:
The existing "Design of Six Typical Soils" does not appear to come from a referenced source and the names of the soils are not typical soils.

If someone were to send their soil into a laboratory for testing, or perform an on-site test using standard soil texture identification methods (jar test or soil ribbon test) the soil names they would get would most likely not match this chart.

I have not been able to find the original source for the information in this table. The information doesn't appear to come from septic design or irrigation system design: it appears the original creators of this table used some unknown infiltration rate and applied an unknown factor to come up with the provided coefficients for infiltration of graywater into various types of soil. I have asked people at IAPMO, HCD (State of CA that also uses this table), wastewater professionals, and done extensive online searches. No one knows where studies to back up this table come from, or if they even exist.

This new proposed table, which was adopted in WE-STAND, uses steady state infiltration rates from the Minnesota Stormwater Manual 2013. Please note that using infiltration rates for stormwater does not imply that gray water and stormwater are the same, rather these numbers are the best thing we have to a scientifically-based, referenced infiltration rates that are applicable to gray water.

This manual compiled infiltration rates and recommendations based on a review of 30 guidance manuals and other stormwater references. Other agencies, like the San Francisco Public Utilities Commission, use the same table in their stormwater system sizing manuals. The table uses steady state infiltration rates and is based on the assumption that the soil is very deeply wetted below (or at field capacity), which builds in a safety factor into the numbers. (Graywater systems are typically shut off during the rainy season so the soil would not be at field capacity during irrigation time.)

By adopting this new table the code would be using a soil infiltration table that is aligned with actual, published references that are used by stormwater, civil engineers, and landscape professionals. The proposed table includes both hydrologic groups, which a person could look up the property's hydrologic group on a GIS map or NRCS map, as well as soil textures which an on-site soil test could verify. The proposed table is more conservative.
for clay soil types then the existing table is, and so would have less potential for overloading slower draining soils than the existing table. The proposed table has higher infiltration rates for sandy and loam soils, which are soils that are verified by studies (see references for Stormwater Manual) to infiltrate much much more water than the current table permits. To create the new table we converted the units provided in the referenced table from inches/hour to gallons/day as shown in the reference material.

Please note: the existing table has 3 columns (soil type plus two infiltration rate methods). These two methods give the same information, which is unnecessary and causes confusion. The first way assumes the system discharges exactly 100 gallons per day. The second option allows the designer to plug in any number of gallons of gray water. The proposed new table has just soil type and one method to find infiltration area. It is simpler to use. No information was lost by removing one of the columns in the existing table, since it was repetitive (and confusing).

Here are the source for the steady state infiltration rates: Minnesota Stormwater Manual 2013 - thirty guidance manuals and many other stormwater references were reviewed to compile recommended infiltration rates.

All of these sources use the following studies as the basis for their recommended infiltration rates:

(1) Rawls, Brakensiek and Saxton (1982);
(2) Rawls, Gimenez and Grossman (1998);
(3) Bouwer and Rice (1984); and
(4) Urban Hydrology for Small Watersheds (NRCS).

SWWD, 2005, provides field documented data that supports the proposed infiltration rates.

(view reference list here https://stormwater.pca.state.mn.us/index.php?title=References)

The Full Minnesota Stormwater Manual is available on-line here: https://stormwater.pca.state.mn.us/index.php?title=Main_Page

Here is an example of what this would look like:

Let’s say you were designing a gray water system that produced 80 gallons per day and the site had sandy clay soil:

Old method:
First, you’d look at the chart and notice you’ll need to use the last column "Maximum absorption capacity in gallons per square foot of irrigation/leaching area for a 24-hour period," since the middle column only works if you are discharging exactly 100 gallons of greywater (Minimum square feet of irrigation area per 100 gallons of estimated gray water discharge per day).

The coefficient for sandy clay soil is 1.7.

80 gallons/1.7 = 47 square feet of irrigation/leaching area

Using the new, proposed method:
Sandy clay is a soil texture that falls into the Soil Class of Sandy Loam Class D soils, and has a coefficient of 0.9 gallons per square foot of irrigation/leaching area (for a 24 hour period).

80 gallons /0.9 = 88.89 square feet of irrigation/leaching area

As you can see, the new method is more conservative in slower draining clay soils as it requires more infiltration area compared to the old method. This helps prevent potential ponding or runoff of greywater in oversaturated soils.
RECOMMENDATION:
Revise text

Proposed Text:
1504.0 Subsurface Irrigation System Zones.

1504.5 Subsurface and Subsoil Irrigation Field Design and Construction. (remaining text unchanged)

1504.5.4 Emitter Size. Emitters shall be installed in accordance with the manufacturer's installation instructions. Emitters shall have a flow path of not less than 1200 microns (µ) (1200 µm) and shall not have a coefficient of manufacturing variation (Cv) exceeding 7 percent. Irrigation system design shall be such that emitter flow variation shall not exceed 10 percent.

SUBSTANTIATION:
Text being stricken was submitted to the WE-Stand to harmonize with the UPC. However, the WE-Stand did not update and provided the following feedback why not to include the language: “the emitter size varies based on the type of irrigation system installed. Since sizing is not consistent across varying emitter types, the provided flow path requirement would be overly restrictive and would disallow the use of appropriate emitters.”

For this reason, the text is being stricken from the UPC as it is considered overly restrictive and will match what is currently in the 2023 WE-Stand.
RECOMMENDATION:
Revise text

Proposed Text:
1504.0 Subsurface Irrigation System Zones.

1504.5 Subsurface and Subsoil Irrigation Field Design and Construction. (remaining text unchanged)

1504.5.7 Maximum Pressure. Where pressure at the discharge side of the pump exceeds 20 pounds-force per square inch (psi) (138 kPa), a pressure-reducing valve able to maintain downstream pressure not exceeding 20 psi (138 kPa) the maximum operating pressure of the installed tubing, emitters, or other components shall be installed downstream from the pump and before an emission device.

SUBSTANTIATION:
The proposed change will correlate with the provisions in the 2023 WE-Stand. The codes should not be so specific and should allow for a range of graywater system components so long as they function as designed. The edit will ensure the pressure is not greater than what the tubing, emitters, or other components can handle, which is the intent of this section, without being unnecessarily prescriptive.
RECOMMENDATION:
Revise text

Proposed Text:
1505.0 Reclaimed (Recycled) Water Systems.
1505.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of reclaimed (recycled) water and stormwater systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, aboveground and subsurface irrigation, industrial or commercial cooling or air conditioning and other uses approved by the Authority Having Jurisdiction.

SUBSTANTIATION:
This section applies to offsite produced recycled water and treated stormwater. This update will clarify the intent of the section and will harmonize with the text in the 2023 WeStand.
RECOMMENDATION:
Revise text

Proposed Text:
1506.0 On-Site Treated Nonpotable Water Systems.

1506.10 Design and Installation. (remaining text unchanged)

1506.10.2 Minimum Water Quality. On-site treated nonpotable water supplied to toilets or urinals or for other uses in which it is sprayed or exposed shall be disinfected. Acceptable disinfection methods shall include chlorination, ultraviolet sterilization, ozone disinfection, ozonation, or other methods as approved by the Authority Having Jurisdiction. The minimum water quality for on-site treated nonpotable water systems shall meet the applicable water quality requirements for the intended applications as determined by the public health Authority Having Jurisdiction. Potable water shall be supplied to personal hygiene devices (bidet and bidet seats).

K 104.0 Design and Installation.

K 104.4 Water Quality Devices and Equipment. (remaining text unchanged)

K 104.4.2 Disinfection Devices. Chlorination, ozone ozonation, and ultraviolet disinfection, or other disinfection methods shall be approved by the Authority Having Jurisdiction, or the product is shall be listed and certified according to a microbiological reduction performance standard for drinking water, shall be used to treat harvested rainwater to meet the required water quality permitted. The disinfection devices and systems shall be installed in accordance with the manufacturer’s installation instructions and the conditions of listing. Disinfection devices and systems shall be located downstream of the water storage tank.

K 104.4.3 Filtration and Disinfection Systems. Filtration and disinfection systems shall be located after the water storage tank. Where a chlorination system is installed, it shall be installed upstream of filtration systems. Where an ultraviolet disinfection system is installed, a filter not more than minimum of 2 inline filters, one 5 microns (5 µm) filter followed by one 0.5-1 micron (0.5-1 µm) filter, shall be installed upstream of prior to the disinfection system.

217.0  O  –
Ozonation. The process of treating water with ozone.
Ozone (Activated Oxygen, O₃). A gaseous disinfectant oxidant (generated on-site) which produces a broad spectrum biocide used to kill bacteria, viruses, and cysts.

SUBSTANTIATION:
The proposed changes will align with the WeStand. The substantiation provided when introduced to the WeStand is as follows: Ozonation is listed as one of the approved disinfection methods and should be supported by appropriate terminology within Chapter 2 (Definitions). Many wastewater treatment systems utilize this method of disinfection, and the process is not widely understood. The provided definition, in conjunction with the definition for “ozone,” clarifies that ozone is a gaseous disinfectant-oxidant used in the treatment process called “ozonation.” Revisions to Section 1506.10.2 (Minimum Water Quality) and Section K 104.3.2 (Disinfection Devices) are needed.
to correctly reference this treatment process. Additionally, the term "UV sterilization" is being updated to "UV disinfection" since sterilization is a process of complete elimination or destruction of all forms of microbial life, and both sections provide requirements for “disinfection.”
1601.0 General.
1601.1 Applicability. The provisions of this chapter shall apply to the installation, construction, alteration, and repair of nonpotable rainwater catchment systems.

1601.2 System Design. Nonpotable rainwater catchment systems shall comply with ARCSA/ASPE/ANSI 63. Rainwater catchment systems shall be designed, installed, and inspected in accordance with this chapter by personnel certified in accordance with ASSE/ARCSA/IAPMO Series 21000, a licensed plumbing contractor or registered design professional. Components, piping, and fittings used in a rainwater catchment system shall be listed.

Exceptions:
(1) A person registered or licensed to perform plumbing design work is not required to design rainwater catchment systems used for irrigation with a maximum storage capacity of 360 gallons (1363 L).
(2) A person registered or licensed to perform plumbing design work is not required to design rainwater catchment systems for single family dwellings where no rainwater is brought back into the house and outlets, piping, and system components are located on the exterior of the building.

1603.0 Design and Installation.

1603.3 Rainwater Catchment Collection Surfaces. Rainwater shall be collected from roof surfaces or other manmade, aboveground collection surfaces which have limited access to people, animals, or other possible contaminants.

1603.5 Pre-Tank Filtration. By way of a debris excluder, first flush device or a rainwater pre-tank filter unit, all harvested rainwater entering a rainwater storage tank shall be filtered to a level not less than 400-microns ($\mu$m). The filtration device or method shall be accessible, and shall be sized and installed in accordance with manufacturer's installation instructions. Such units shall be designed to have the capacity to handle the maximum flow rate of the inlet pipe size. Unit shall allow for access to the filtration system for routine maintenance.

(renumber remaining sections)

1603.7 Above Grade. Above grade, storage tanks shall be of an opaque material, approved for aboveground use in direct sunlight or shall be shielded from direct sunlight. Tanks shall be installed in an accessible location to allow for inspection and cleaning. The tank shall be installed on a foundation or platform that is constructed to accommodate loads in accordance with the building code. The tank shall have a manway and lid with a minimum diameter of 24 inches (610 mm).

1603.8 Below Grade. Rainwater storage tanks installed below grade shall be structurally designed to withstand anticipated earth or other loads. Holding tank covers shall be capable of supporting an earth load of not less than
300 pounds per square foot (lb/ft$^2$) (1465 kg/m$^2$) where the tank is designed for underground installation. Below grade rainwater tanks installed underground shall be provided with manholes. The manhole opening shall be not less than 20 in (508 mm) in diameter and located not less than 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground where empty. The combined weight of the tank and hold down system shall meet or exceed the buoyancy force of the tank.

1603.12 Storage Tank Venting. Where venting using drainage or overflow piping is not provided or is considered insufficient, a vent shall be installed on each tank. The vent shall extend from the top of the tank and terminate not less than 6 inches (152 mm) above grade and shall be not less than 1½ inches (40 mm) in diameter. The vent terminal shall be directed downward and covered with a $\frac{3}{32}$ of an inch (2.4 mm) mesh screen to prevent the entry of vermin and insects. Where the tank overflow is equipped with a backwater valve in accordance with Section 1603.9, the storage tank vent shall be sized in the same way as described in Section 1603.9.1.

1603.13 Pumps. Pumps serving rainwater catchment systems shall be listed. Pumps supplying water to water closets, urinals, and trap primers shall be capable of delivering not less than 15 pounds-force per square inch (psi) (103 kPa) residual pressure at the highest and most remote outlet served. Where the water pressure in the rainwater supply system within the building exceeds 80 psi (552 kPa), a pressure reducing valve reducing the pressure to 80 psi (552 kPa) or less to water outlets in the building shall be installed in accordance with this code. Pump inlets located in rainwater storage tanks shall be located not less than 6 inches (152 mm) above the floor of the tank or other means shall be used to ensure that the pump does not pull debris from the bottom 6 inches (152 mm) of the tank.

1603.15 Water Quality Devices and Equipment. Devices and equipment used to treat rainwater to maintain the minimum water quality requirements determined by the Authority Having Jurisdiction shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body) and approved for the intended application designed for their intended use.

1603.17 Debris Removal. The rainwater catchment conveyance system shall be equipped with a debris excluder or other approved means to prevent the accumulation of leaves, needles, other debris and sediment from entering the storage tank. Devices or methods used to remove debris or sediment shall be accessible and sized and installed in accordance with manufacturer’s installation instructions.

(Shown for information purposes only)

1603.9 Drainage and Overflow. Rainwater storage tanks shall be provided with a means of draining and cleaning. The overflow drain shall not be equipped with a shutoff valve. The overflow outlet shall discharge in accordance with this code for storm drainage systems. Where discharging to the storm drainage system, the overflow drain shall be protected from backflow of the storm drainage system by a backwater valve or other approved method.

1603.9.1 Overflow Outlet Size. The overflow outlet shall be sized to accommodate the flow of the rainwater entering the tank and not less than the aggregate crosssectional area of inflow pipes.

### TABLE 1701.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCSA/ASPE/ANSI 78-2023</td>
<td>Stormwater Harvesting System Design for Direct End-Use Applications</td>
<td>Miscellaneous</td>
<td>1601.2</td>
</tr>
</tbody>
</table>

(Shown for information purposes only)
TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCSA/ASPE 78-2015</td>
<td>Stormwater Harvesting System Design for Direct End-Use Applications</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>ASSE/ARCSA/IAPMO/ ANSI Series 21000-2017</td>
<td>Rainwater Catchment Systems Personnel Professional Qualifications</td>
<td>Professional Qualifications</td>
</tr>
</tbody>
</table>

Note: ARCSA/ASPE/ANSI and ASSE/ARCSA/IAPMO/ANSI Series 2100 meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Chapter 16 is being updated to coincide with the industry changes and the ARCSA/ASPE/ANSI 62-2023 updates as well as the now available professional standards.

The new Section 1303.5 (Pre-Tank Filtration) is being added in place of roof washers. Roof washers are substandard equipment and are now out of date; no one is using them. The 400-micron level is needed to keep trash and debris out of rainwater systems. All established pre-filters are at this micron level. European standards are at this level. Keeps particles small so biofilms can break them down.

Section 1603.7 (Above Grade) is being updated to add provisions for manway and lid minimum openings. Some tanks are designed with 20-inch entries which are too small, 24 inch is better and for those like the below grade entries that may have ladders a 28-inch entry should be used. Additionally, Section 1603.8 (Below Grade) is being updated with respect to manhole openings. Some tanks are designed with 20-inch entries which are too small, 24 inch is better and for those like the below grade entries that may have ladders a 28 inch entry should be used.

Section 1603.12 (Storage Tank Venting) refers to similar requirements in Section 1603.9 and Section 1603.9.1.

For Section 1603.13 (Pumps), the six inches from the floor will correlate with the latest edition of the 2023 ARSCA/ASPE/ANSI 63 draft standard. The 6 inches will ensure that sediment and debris is not pulled into the pump inlet and is also an industry standard. If the minimum distance is not achievable, then a means of preventing debris vacuuming shall be used.

Section 1603.15 is being updated to remove the listing and labeling requirement for devices and equipment used to treat non-potable rainwater as there is no standard for equipment used for non-potable rainwater harvesting. Therefore, it cannot be third party certified.

Section 1603.17 is no longer needed as it is being replaced with provisions for pre-tank filtration.
RECOMMENDATION:
Revise text

Proposed Text:
1602.0 Nonpotable Rainwater Catchment Systems.

1602.9 Deactivation and Drainage for Cross-Connection Test. Where any portion of a rainwater catchment system is installed within a building, the rainwater catchment system and the potable water system within the building shall be provided with the required appurtenances (e.g., valves, air or vacuum relief valves, etc.) to allow for deactivation or drainage as required for a cross-connection test in accordance with Section 1605.3.

SUBSTANTIATION:
The proposed updates will align with the 2023 WE-Stand. The substantiation provided for these changes is as follows: Including this qualifier makes it more clear when a cross-connection test is required. Without it the section could be interpreted as all systems require testing.
RECOMMENDATION:
Revise text

Proposed Text:
1605.0 Inspection and Testing.
1605.1 General. Rainwater catchment systems shall be inspected and tested in accordance with Section 1605.2 and Section 1605.3. Irrigation systems not connected to a potable water system shall be exempt from testing requirements in Section 1605.3.

(shown for information purposes only)

1605.3 Annual Cross-Connection Inspection and Testing. An initial and subsequent annual inspection and test in accordance with Section 1602.5 shall be performed on both the potable and rainwater catchment water systems. The potable and rainwater catchment water systems shall be isolated from each other and independently inspected and tested to ensure there is no cross-connection in accordance with Section 1605.3.1 through Section 1605.3.4.

SUBSTANTIATION:
The proposed change will align with WeStand. The rationale provided when the change was proposed is as follows:
The proposed change in Section 1605.1 (General) clarifies when an irrigation system is exempt from the testing requirements.
1601.0 General.  
1601.3 Permit. It shall be unlawful for a person to construct, install, alter, or cause to be constructed, installed, or altered a rainwater catchment system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.  
Exceptions:  
(1) A permit is not required for exterior rainwater catchment systems used for outdoor drip and subsurface irrigation with a maximum storage capacity of **360 gallons (1363 L)**, **5000 gallons (18927 L)** where the tank is supported directly upon grade and the ratio of height to width (or diameter) does not exceed 2 to 1 and the system does not require electrical power or a make-up water supply connection.  
(2) A plumbing permit is not required for rainwater catchment systems for single family dwellings where outlets, piping, and system components are located on the exterior of the building. This does not exempt the need for permits where required for electrical connections, tank supports, or enclosures.  

1601.7 Minimum Water Quality Requirements. The minimum water quality for rainwater catchment systems shall comply with the applicable water quality requirements for the intended application as determined by the Authority Having Jurisdiction. Water quality for nonpotable rainwater catchment systems shall comply with Section 1603.4.  
Exceptions:  
(1) Water treatment is not required for rainwater catchment systems used for aboveground irrigation with a maximum storage capacity of **360 gallons (1363 L)**.  
(2) Water treatment is not required for rainwater catchment systems used for subsurface or drip nonspray irrigation.  

1602.0 Nonpotable Rainwater Catchment Systems.  
1602.9 Deactivation and Drainage for Cross-Connection Test. Where any portion of a rainwater catchment system is installed within a building, the rainwater catchment system and the potable water system within the building shall be provided with the required appurtenances (e.g., valves, air or vacuum relief valves, etc.) to allow for deactivation or drainage as required for a cross-connection test in accordance with Section 1605.3.  

1605.0 Inspection and Testing.  
1605.3 Annual Cross-Connection Inspection and Testing. An initial and subsequent annual inspection and test in accordance with Section 1602.5 shall be performed on both the potable and rainwater catchment water systems. The potable and rainwater catchment water systems shall be isolated from each other and independently inspected and tested to ensure there is no cross-connection in accordance with Section 1605.3.1 through Section 1605.3.4.  
1605.3.1 Visual System Inspection. Prior to commencing the cross-connection testing, a dual system inspection shall be conducted by the Authority Having Jurisdiction and other authorities having jurisdiction as follows:  
(1) **Meter locations of the rainwater and potable water lines shall be checked to verify that no modifications were made and that no cross-connections are visible.**
(2) Pumps, and equipment, equipment room signs, and exposed piping in an equipment room shall be checked.

(3) Valves shall be checked to ensure that valve lock seals are still in place and intact. Valve control door signs shall be checked to verify that no signs have been removed.

1605.3.2 Cross-Connection Test. The procedure for determining cross-connection shall be followed by the applicant in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction to determine whether a cross-connection has occurred as follows:

(1) The potable water system shall be activated and pressurized. The rainwater catchment water system shall be shut down, depressurized and completely drained.

(2) The potable water system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the rainwater catchment water system is empty. The minimum period the rainwater catchment water system is to remain depressurized shall be determined on a case-by-case basis, taking into account the size and complexity of the potable and the rainwater catchment water distribution systems, but in no case shall that period be less than 1 hour.

(3) The drain on the rainwater catchment system shall be checked for flow during the test and all fixtures, potable, and rainwater alternate water source, shall be tested and inspected for flow. Flow from a rainwater catchment water system outlet shall indicate a cross-connection. No flow from a potable water outlet shall indicate that it is connected to the rainwater catchment system.

(4) The drain on the rainwater catchment water system shall be checked for flow during the test and at the end of the period.

(5) The potable water system shall then be completely depressurized and drained.

(6) The rainwater catchment water system shall then be activated and pressurized.

(7) The rainwater catchment water system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the potable water system is empty. The minimum period the potable water system is to remain depressurized shall be determined on a case-by-case basis, but in no case shall that period be less than 1 hour.

(8) Fixtures, potable and rainwater catchment, shall be tested and inspected for flow. Flow from a potable water system outlet shall indicate a cross-connection. No flow from a rainwater catchment water outlet shall indicate that it is connected to the potable water system.

(9) The drain on the potable water system shall be checked for flow during the test and at the end of the period test.

(10) Where there is no flow detected in the fixtures which would indicate a cross-connection, the potable water system shall be repressurized.

1605.3.3 Discovery of Cross-Connection. In the event that a cross-connection is discovered, the following procedure, in the presence of the Authority Having Jurisdiction, shall be activated immediately:

(1) The rainwater catchment piping to the building shall be shutdown at the meter, and the rainwater riser shall be drained.

(2)- (6) (remaining text unchanged)

1605.3.4 Annual Inspection. An annual inspection of the rainwater catchment water system, following the procedures listed in Section 1605.3.1 shall be required. Annual cross-connection testing, following the procedures listed in Section 1605.3.2 shall be required by the Authority Having Jurisdiction, unless site conditions do not require it. In no event shall the test occur less than once in 4 years.

Alternate testing requirements shall be permitted by the Authority Having Jurisdiction.

SUBSTANTIATION:
The proposed updates will align with the latest WeStand.

Section 1601.3 (Permit): The proposed update will correlate with storage capacity (gallons) from the WeStand. The rational provided for this change from the WeStand is as follows: Exempting permits from systems with tanks smaller than 5,000 gallons would be consistent with most codes for water storage tanks as well as California's
rainwater code. If the tank is stable, upon grade, and doesn't require power or make-up water it is a very safe and low-risk system and thus should not require permits.

Section 1601.7: The rational submitted to the use of “nonspray” is as follows: This should specify spray irrigation to avoid confusion from regulators that may interpret drip irrigation as requiring treatment, even though it says below that drip does not require treatment- it is a form of above ground irrigation.

Section 1602.9: The substantiation provided for these changes is as follows: Including this qualifier makes it more clear when a cross-connection test is required. Without it the section could be interpreted as all systems require testing.

Section 1605.3 removes the term “water” as it is not needed since rainwater is already water. Updates to Section 1605.3.1 adds additional guidance for visual inspections including meter locations, and valves. Section 1605.3.2 cleans up the language for clarity and intent.
RECOMMENDATION:
Revise text

Proposed Text:

TABLE A 103.1
WATER SUPPLY FIXTURE UNITS (WSFU) AND MINIMUM FIXTURE BRANCH PIPE SIZES

| APPLIANCES, APPURtenances, OR FIXTURES | MINIMUM FIXTURE BRANCH PIPE SIZE | PRIVATE | PUBLIC | ASSEMBLY
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bidet</td>
<td>1/2</td>
<td>1.0</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Dishwasher, domestic</td>
<td>1/2</td>
<td>1.5</td>
<td>1.5</td>
<td>–</td>
</tr>
<tr>
<td>Lavatory</td>
<td>1/2</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Bar</td>
<td>1/2</td>
<td>1.0</td>
<td>2.0</td>
<td>–</td>
</tr>
<tr>
<td>Kitchen, domestic with or without dishwasher</td>
<td>1/2</td>
<td>1.5</td>
<td>1.5</td>
<td>–</td>
</tr>
<tr>
<td>Washup, each set of faucets</td>
<td>1/2</td>
<td>–</td>
<td>2.0</td>
<td>–</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm

Notes:
1-7 (remaining text unchanged)

8 Nominal tubing size 3/8 inch (10 mm) shall be permitted to be used where pressure loss (i.e., hydraulic) calculations such as those described in this code support the use of this size.

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Recent research has been published by multiple organizations including IAPMO regarding the oversizing of water distribution pipes when following Hunter’s Curve and historical pipe sizing tables. New information such as that found within Appendix M “Peak Water Demand Calculator” of the Code indicates that water distribution pipes are often oversized for the flow rates allowed by many current fixtures. Oversized distribution pipes can lead to stagnant water and the potential health risk of Legionella growth. Oversized distribution pipes can also cause greater water usage when users flush water lines to access hot water, wasting both water and energy.

Many of the Appliances, Appurtenances or Fixtures which are currently approved for use are subject to water conservation regulations which reduce their WSFU demand, and therefore their required supply pipe sizing. The six (6) specific Appliances, Appurtenances or Fixtures to which footnote 8 is proposed to be added meet this description.

Plumbing system designers should have the option to supply these Appliances, Appurtenances or Fixtures with NTS 3/8 tubing where supported by pressure loss calculations which demonstrate sufficient flow and pressure...
supply. This will assist with conservation of water, because 3/8 tubing has approximately half the volume of 1/2 tubing, so hot-water fixtures will require less flushing of water before hot water arrives. The addition of Footnote 8 applies to all approved piping materials.

**Example:** 20 ft. of NTS ½ tubing has a volume of 0.24 US Gallons whereas 20 ft. of NTS 3/8 tubing has a volume of 0.15 US gallons, a reduction of 38%, translating to approximately 38% water savings when opening a faucet or fixture to get hot water.

This proposal recognizes that Section 610.5 allows that “Except as provided in Section 610.4, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A.” Therefore, the method for sizing pipes correctly based on required flow and pressure are already established in the Code.
RECOMMENDATION:
Revise text

Proposed Text:
C 401.0 Vent System Sizing.

C 401.2 Vent Stack. A vent stack shall be required for a drainage stack that extends five or more branch intervals above the building drain or horizontal branch. The developed length of the vent stack shall be measured from the lowest connection of a branch vent to the termination outdoors.

Exception: No vent stack shall be required except where air admittance valves conforming to ASSE 1050 and positive pressure reduction devices conforming to ASSE 1030 are installed in accordance with the manufacturer's instructions as part of an engineered system.

C 401.4 Venting Horizontal Offsets. Drainage stacks with horizontal offsets shall be vented where five or more branch intervals are located above the offset. The upper and lower section of the horizontal offset shall be vented in accordance with Section C 401.4.1 and Section C 401.4.2.

Exception: Except where air admittance valves conforming to ASSE 1050 or 1051 and positive pressure reduction devices conforming to ASSE 1030 are installed in accordance with the manufacturer's instructions as part of an engineered system and Section C 401.4.1 and Section C 401.4.2.

C 401.4.1 Venting Upper Section. The vent for the upper section of the stack shall be vented as a separate stack with a vent stack connection installed at the base of the drainage stack. Such vent stack shall connect below the lowest horizontal branch or building drain. Where vent stack connects to the building drain, the connection shall be located downstream of the drainage stack and within a distance of 10 times the diameter of the drainage stack.

Exception: Except where air admittance valves conforming to ASSE 1050 or 1051 and positive pressure reduction devices conforming to ASSE 1030 are installed in accordance with the manufacturer's instructions as part of an engineered system.

C 401.4.2 Venting Lower Section. The vent for the lower section of the stack shall be vented by a yoke vent connecting between the offset and the next lower horizontal branch using a wye-branch fitting. The size of the yoke vent and connection shall be not less in diameter than the required size for the vent serving the drainage stack. The yoke vent connection shall be permitted to be a vertical extension of the drainage stack.

Exception: Except where air admittance valves conforming to ASSE 1050 or 1051 and positive pressure reduction devices conforming to ASSE 1030 are installed in accordance with the manufacturer's instructions as part of an engineered system.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1050-2021</td>
<td>Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>
(portions of the table not shown remain unchanged)

**SUBSTANTIATION:**
Air admittance valves and positive pressure reduction devices work well in an engineered single stack drainage system without a vent stack when installed in accordance with the manufacturer's instructions.

*[Supporting documentation provided in KAVI for TC review]*
Revised text:

C 501.0 Vacuum Drainage Systems.

C 501.1 General. This section regulates the design and installation provisions for vacuum waste drainage systems. Plans for vacuum waste drainage systems shall be submitted to the Authority Having Jurisdiction for approval and shall be considered an engineered designed system. Such plans shall be prepared by a registered design professional to perform plumbing design work. Details are necessary to ensure compliance with the requirements of this section, together with a full description of the complete installation including quality, grade of materials, equipment, construction, and methods of assembly and installation. Components, materials, and equipment shall comply with standards and specifications listed in Chapter 17 of this code, including CSA B45.13/IAPMO Z1700, or approved by the Authority Having Jurisdiction and other national consensus standards applicable to plumbing systems and materials. Where such standards and specifications are not available, alternate materials and equipment shall be approved in accordance with Section 301.3.

C 501.2 System Design. Vacuum waste drainage systems shall be designed and installed in accordance with CSA B45.13/IAPMO Z1700 and with the manufacturer’s installation instructions. A vacuum waste drainage system shall include a vacuum generating system, waste collection center, piping network, vacuum valve, and control components used to isolate the vacuum piping network from atmospheric pressure and to collect waste at its point of origin. Where a vacuum system provides the only means of sanitation, the duplicate vacuum generating equipment set to operate automatically shall be installed to allow the system to continue in operation during periods of maintenance.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Adding a reference to CSA B45.13/IAPMO Z1700—a consensus standard that specifies requirements for materials, construction, performance testing, and markings—in the general and system design sections of the UPC will standardize vacuum waste-collection systems. Mandating that such systems comply only with the manufacturer’s instructions allows installation of substandard systems that do not benefit users or regulators.

This is a joint proposal submitted together with Jets Vacuum AS, Norway.
C 501.2 System Design. Vacuum waste drainage systems shall be designed and installed in accordance with the manufacturer's installation instructions. A vacuum waste drainage system shall include a vacuum generating system, waste collection center, piping network, vacuum valve, and control components used to isolate the vacuum piping network from atmospheric pressure and to collect waste at its point of origin. Where a vacuum system provides the only means of sanitation, equipment redundancy should be designed according to essential services and evaluations according to the intent of the manufacturer's specification. If required, the duplicate vacuum generating equipment set to operate automatically shall be installed to allow the system to continue in operation during periods of maintenance.

SUBSTANTIATION:
Adding the text "equipment redundancy should be designed according to essential services and evaluations according to the intent of the manufacturer's specification. If required" to Section C 501.2 allows more flexibility to the design and installation of vacuum systems and clarifies that duplicate vacuum-generating equipment (i.e., redundancy) shall only be required when the system design requires it. There are non-critical applications that do not need redundant systems.

This is a joint proposal submitted together with Jets Vacuum AS, Norway.
Proposed Text:
C 501.0 Vacuum Drainage Systems.

C 501.2 System Design.
C 501.2.1 Vacuum Generating System. The vacuum generating station shall include a vacuum pump(s) to create a constant vacuum pressure within the piping network and storage tanks, where installed. The operation of pumps, valves, collection tanks, and alarms shall be automated by controls. The vacuum pumps shall be activated on demand and accessible for repair or replacement. The vent from the vacuum pump, when required as part of the manufacturer’s operational requirements, shall be provided for vacuum pump air exhaust and shall be of a size capable of handling the total air volume of the vacuum pump.

SUBSTANTIATION:
The changes to Section C 501.2.1 allow more flexibility to the design and installation of vacuum systems and clarify that
· a vacuum system can safely operate on one single pump, especially in non-critical applications;
· storage tanks are optional, depending on the system design; and
· a vent is necessary when required as part of the manufacturer’s operational requirements.
This is a joint proposal submitted together with Jets Vacuum AS, Norway.
C 501.0 Vacuum Drainage Systems.

C 501.6 Materials. Materials used for water distribution pipe and fittings shall be in accordance with Table 604.1. Materials used for aboveground drainage shall be in accordance with Table 701.2 and shall have a smooth bore, and be constructed of non-porous material. Materials used in vacuum drainage pipe and fittings shall be in accordance with Table C 501.6.

**TABLE C 501.6**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNDERGROUND VACUUM DRAINAGE PIPE AND FITTINGS</th>
<th>ABOVEGROUND VACUUM DRAINAGE PIPE AND FITTINGS</th>
<th>REFERENCED STANDARDS FOR PIPE</th>
<th>REFERENCED STANDARDS FOR FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorinated Polyvinylchloride (CPVC)</td>
<td>80, X</td>
<td>X</td>
<td>ASTM F441, CSA B181.2</td>
<td>ASTM F439, CSA B181.2</td>
</tr>
<tr>
<td>Polyolefin</td>
<td>40, 80, X</td>
<td>X</td>
<td>ASTM F1412, ASTM F3371, CSA B181.3</td>
<td>ASTM F1412, ASTM F3371, CSA B181.3</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>40, 80, X</td>
<td>X</td>
<td>ASTM F1412, ASTM F3371, CSA B181.3, IAPMO IGC 345</td>
<td>ASTM F1412, ASTM F3371, ASTM F3371, IAPMO IGC 345</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**TABLE 1701.2**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B181.2-2021</td>
<td>Polyvinylchloride (PVC) and chlorinated polyvinylchloride (CPVC) drain, waste, and vent pipe and pipe fittings</td>
<td>Piping, Fittings</td>
</tr>
<tr>
<td>IAPMO IGC 345-2020a</td>
<td>Industry Standard for Polypropylene (PP) DWV Pipe with a Mineral Filled Core and PP Fittings</td>
<td>Piping, Fittings</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
Drainage piping for vacuum waste-collection systems must withstand negative pressures; therefore, not all types of pipe and fittings are adequate for vacuum applications. Adding this table in the vacuum drainage systems section of the UPC educates the users on the adequate materials and regulates the types of pipe and fittings that can be used in such systems.

This is a joint proposal submitted together with Jets Vacuum AS, Norway.
C 601.0 Single-Stack Vent System.

C 601.7 Stack Offsets. Where there are no fixture drain connections below a horizontal offset in a stack, the offset does not need to be vented. Where there are fixture drain connections below a horizontal offset in a stack, the offset shall be vented. There shall be no fixture connections to a stack within 2 feet (610 mm) above and below a horizontal offset.

Exception: Branch of fixture connection does not occur within any of the follow locations:
(1) Three feet (914 mm) below the horizontal offset of the lower stack
(2) Eight feet (2438 mm) upstream or downstream of the stack base at the stack offset or at the stack base of the lower stack
(3) Three feet (914 mm) upstream of the horizontal-to-vertical transition of the lower stack

SUBSTANTIATION:
Offsets have been shown to successfully operate within the allowable ±1 inch water column (250 Pa) pressure differentials in various drainage standards used internationally. A diagram of the connection clearance zones is shown in Figure A1.2 of the attached document and discussed in each of the “Stack offsets” subsections of the paper.
SUBMITTER:
John Lansing

Organization Name:
PAE Consulting Engineers

Organization Representation:
PAE Consulting Engineers

RECOMMENDATION:
Revise text

Proposed Text:
C 601.0 Single-Stack Vent System.

C 601.8 Prohibited Connections Near Base of Stack. (remaining text unchanged)
C 601.8.1 Conditional Bypass Vent. Venting of fixtures on the lowest floor shall be in accordance with Section 908.0 through Section 911.5 and may connect into the single-stack as a conditional bypass vent. The conditional bypass vent connects into the stack by means of a wye-fitting to prevent ingress of drainage into the vent. No more than 12 drainage fixture units (DFU) may be connected into the conditional bypass vent and shall connect not less than 8 feet (2438 mm) above the stack base.

SUBSTANTIATION:
The term "bypass" vent has replaced the term "conditional", in support of current terminology.

[Supporting documentation provided in KAVI for TC review]
C 601.0 Single-Stack Vent System.

C 601.8.1 Conditional Vent. Venting of fixtures on the lowest floor shall be in accordance with Section 908.0 through Section 911.5 and may connect into the single-stack as a conditional vent. The conditional vent connects into the stack by means of a wye-fitting to prevent ingress of drainage into the vent. No more than 12 drainage fixture units (DFU) may be connected into the conditional vent and shall connect not less than 8 feet (2438 mm) above the stack base. Where a separate stack is required to serve fixtures on the lower two floors in accordance with Section C 601.8, the stack vent shall be permitted to terminate into the drainage stack at a conditional vent, provided the connection is made at least two levels above the stack base.

(shown for information purposes only)

C 601.8 Prohibited Connections Near Base of Stack. Where stacks are more than 75 feet (22 860 mm) high, a separate stack shall be provided for the fixtures on the lower two stories. The stack for the lower two stories shall be permitted to be connected to the branch of the building drain that serves the stack for the upper stories at a point that is not less than 8 feet (2438 mm) downstream from the base of the upper stack. Where stacks are less than 75 feet (22 860 mm) high but more than two stories high, the lowest story shall not connect within 8 feet (2438 mm) downstream from the base of the stack. Venting for the lowest story shall be provided in accordance with Section C 601.8.1 and Section C 601.8.2.

SUBSTANTIATION:
The recommendation described above is supported by international design recommendations for the single stack. Supporting information may be found in the provided paper.

[Supporting documentation provided in KAVI for TC review]
RECOMMENDATION:
Add new text

Proposed Text:
C 601.0 Single-Stack Vent System.

C 601.10 Parallel Vent Stacks. Drainage stacks extending more than 75 feet (22 860 mm) shall be provided with a parallel vent stack and shall meet the requirements of Section 907.0.

Exception: Where the stack base transition from vertical to horizontal is made with two 45 degree (0.79 rad) bends separated by 9 inches (229 mm) of diagonal piping or a combination wye, a parallel vent stack shall not be required.

SUBSTANTIATION:
The airflow resistances associated with the water curtain along the inner radius of stack base transition are significantly influenced by the characteristics of the transition. A standard sweep bend will create large pressure disturbances whereas two separate 45° bends will be less impactful, even in comparison to a long radius (radius equal to at least twice the diameter) bend according to some sources. The DS 432 Plumbing Code for Drainage used in Denmark requires (2) 45° separated by a 1 ft diagonal segment between for the stack base for single stacks extending more than 8 floors in height. Similarly, the stack base transition in the DIN 1986-100 standard requires (2) 45° bends separated by a 10 inch diagonal length of piping. The parallel vent stack is not typically used in Philadelphia when using the single stack configuration. These findings come from a recently published paper from the CIB W062 proceedings, which conducted a study of the design requirements and common practices for the single stack drainage configuration in 12 different regions of the world.

[Supporting documentation provided in KAVI for TC review]
RECOMMENDATION:
Add new text

Proposed Text:
C 601.0 Single-Stack Vent System.

C 601.11 Alternate Maximum Stack Heights. Table 601.2 is not required where testing can demonstrate a stack height for a given drainage flow complies with 901.3

SUBSTANTIATION:
The introduction of drainage simulation software, such as AIRNET developed at Heriot-Watt University, allows for the implementation of the single stack under many special design conditions. Additionally, international guidance, such as SHASE S218-2021, provides design methods and equations based on testing towers.
H 101.0 General.
H 101.1 Applicability. This appendix provides general guidelines for the materials, design, and installation of private sewage dispersal systems.

H 101.2 General Requirements. Where permitted by Section 713.0, the building sewer shall be permitted to be connected to a private sewage dispersal system in accordance with the provisions of this appendix. The type of system shall be determined on the basis of location, soil porosity, and groundwater level, and shall be designed to receive all sewage from the property. The system, except as otherwise approved, shall consist of a septic tank with effluent discharging into a subsurface dispersal field, into one or more seepage pits, or into a combination of subsurface dispersal field and seepage pits. The Authority Having Jurisdiction shall be permitted to grant exceptions to the provisions of this appendix for permitted structures that have been destroyed due to fire or natural disaster, and that cannot be reconstructed in compliance with these provisions provided that such exceptions are the minimum necessary.

H 101.3 Quantity and Quality. Where the quantity or quality of the sewage is such that the above system cannot be expected to function satisfactorily for commercial, agricultural, and industrial plumbing systems; for installations where appreciable amounts of industrial or indigestible wastes are produced; for occupancies producing abnormal quantities of sewage or liquid waste; or where grease interceptors are required by other parts of this code, the method of sewage treatment and dispersal shall be first approved by the Authority Having Jurisdiction. Special sewage dispersal systems for minor, limited, or temporary uses shall be first approved by the Authority Having Jurisdiction.

H 101.4 Septic Tank and Disposal Field Systems. Disposal field systems shall be designed to utilize the most porous or absorptive portions of the soil formation. Where the groundwater level extends to within 12 feet (3658 mm) or less of the ground surface or where the upper soil is porous, and the underlying stratum is rock or impervious soil, a septic tank and dispersal field system shall be installed.

H 101.5 Flood Hazard Areas. Disposal dispersal systems shall be located outside of flood hazard areas. Exception: Where suitable sites outside of flood hazard areas are not available, dispersal systems shall be permitted to be located in flood hazard areas on sites where the effects of inundation under conditions of the design flood are minimized.

H 101.6 Design. Private sewage dispersal systems shall be so designed that additional seepage pits or subsurface drain fields, equivalent to not less than 100 percent of the required original system, shall be permitted to be installed where the original system cannot absorb all the sewage. No division of the lot or erection of structures on the lot shall be made where such division or structure impairs the usefulness of the 100 percent expansion area.

H 101.7 Capacity. No property shall be improved more than its capacity to absorb sewage effluent properly by the means provided in this code. Exception: The Authority Having Jurisdiction shall be permitted to, at its discretion, approve an alternate system.

H 101.8 Location. No private sewage dispersal system, or part thereof, shall be located in any lot other than the lot that is the site of the building or structure served by such private sewage dispersal system, nor
shall any private sewage disposal system or part thereof be located at any point having less than the minimum distances indicated in Table H 101.8.

Nothing contained in this code shall be construed to prohibit the use of all or part of an abutting lot to provide additional space for a private sewage disposal system or part thereof where proper cause, transfer of ownership, or change of boundary not in violation of other requirements has been first established to the satisfaction of the Authority Having Jurisdiction. The instrument recording such action shall constitute an agreement with the Authority Having Jurisdiction, which shall clearly state and show that the areas so joined or used shall be maintained as a unit during the time they are so used. Such agreement shall be recorded in the office of the County Recorder as part of the conditions of ownership of said properties and shall be binding on heirs, successors, and assigns to such properties. A copy of the instrument recording such proceedings shall be filed with the Authority Having Jurisdiction.

**H 101.9 Building Permit.** Where there is insufficient lot area or improper soil conditions for sewage disposal, for the building or land use proposed, and the Authority Having Jurisdiction so finds, no building permit shall be issued, and no private sewage disposal shall be permitted. Where space or soil conditions are critical, no building permit shall be issued until engineering data, and test reports satisfactory to the Authority Having Jurisdiction have been submitted and approved.

### Table H 101.8

**LOCATION OF SEWAGE DISPOSAL DISPERsal SYSTEM**

<table>
<thead>
<tr>
<th>MINIMUM HORIZONTAL DISTANCE</th>
<th>BUILDING SEWER</th>
<th>SEPTIC TANK</th>
<th>DISPOSAL DISPERsal FIELD</th>
<th>SEEPAGE PIT OR CESSPOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streams and other bodies of water</td>
<td>50 feet</td>
<td>50 feet</td>
<td>100 feet&lt;sup&gt;7&lt;/sup&gt;</td>
<td>150 feet&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>Seepage pits or cesspools&lt;sup&gt;8&lt;/sup&gt;</td>
<td>-</td>
<td>5 feet</td>
<td>5 feet</td>
<td>12 feet</td>
</tr>
<tr>
<td>Disposal Dispersal field&lt;sup&gt;8&lt;/sup&gt;</td>
<td>-</td>
<td>5 feet</td>
<td>4 feet&lt;sup&gt;4&lt;/sup&gt;</td>
<td>5 feet</td>
</tr>
</tbody>
</table>

**Notes:**
1-6 (remaining text unchanged)

<sup>7</sup> These minimum clear horizontal distances shall also apply to disposal fields, seepage pits, and the mean high-tide line.

<sup>8</sup> Where disposal fields, seepage pits, or both are installed in sloping ground, the minimum horizontal distance between any part of the leaching system and ground surface shall be 15 feet (4572 mm).

(portions of table not shown remain unchanged)

### Table H 201.1(4)

**ESTIMATED WASTE/SEWAGE FLOW RATES<sup>1, 2, 3</sup>**

**Notes:**

1 Sewage disposal systems sized using the estimated waste/sewage flow rates shall be calculated as follows:

(a) Waste/sewage flow, up to 1500 gallons per day (5678 L/day)
Flow x 1.5 = septic tank size
(b) Waste/sewage flow, over 1500 gallons per day (5678 L/day)
Flow x 0.75 + 1125 = septic tank size
(c) Secondary system shall be sized for total flow per 24 hours.

(portion of table not shown remain unchanged)

H 301.0 Area of Disposal Dispersal Fields and Seepage Pits.
H 301.1 General. The minimum effective absorption area in disposal dispersal fields in square feet (m²), and in seepage pits in square feet (m²) of sidewall, shall be predicated on the required septic tank capacity of gallons (liters), estimated waste/sewage flow rate, or whichever is greater, and shall be in accordance with Table H 201.1(2) as determined by the type of soil found in the excavation, and shall be as follows:

(1) Where disposal dispersal fields are installed, not less than 150 square feet (13.9 m²) of trench bottom shall be provided for each system exclusive of any hard pan, rock, clay, or other impervious formations. Sidewall area more than the required 12 inches (305 mm) and not exceeding 36 inches (914 mm) below the leach line shall be permitted to be added to the trench bottom area where computing absorption areas.

(2)-(5) (remaining text unchanged)

(6) Systems that combine treatment and disposal dispersal of sewage within a single footprint and comply with NSF 40 Class 1 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2) for both leach lines and leach beds. No system component for a combined treatment and disposal leach line or leach bed shall be located within 2 feet (610 mm) of the water table nor to a depth where sewage is capable of contaminating the underground water stratum that is usable for domestic purposes. Combined treatment and disposal system operation and maintenance shall be in accordance with the manufacturer's instructions.

Exception: Combined treatment and disposal dispersal systems tested and certified in a bed configuration in accordance with NSF 40 Class 1 are exempted from the requirements of Section H 301.1(2).

H 401.0 Percolation Test.
H 401.1 Pit Sizes. Where practicable, disposal dispersal field and seepage pit sizes shall be computed from Table H 201.1(2). Seepage pit sizes shall be computed by percolation tests unless use of Table H 201.1(2) is approved by the Authority Having Jurisdiction.

H 401.2 Absorption Qualities. The absorption qualities of seepage pits and questionable soils other than those listed in Table H 201.1(2), the proposed site, shall be subjected to percolation tests acceptable to the Authority Having Jurisdiction.

H 401.3 Absorption Rates. Where a percolation test is required, no private disposal dispersal system shall be permitted to serve a building where that test shows the absorption capacity of the soil is less than 0.83 gallons per square foot (gal/ft²) (33.8 L/m²) or more than 5.12 gal/ft² (208.6 L/m²) of leaching area per 24 hours. Where the percolation test shows an absorption rate greater than 5.12 gal/ft² (208.6 L/m²) per 24 hours, a private disposal dispersal system shall be permitted where the site does not overlie groundwaters protected for drinking water supplies, a minimum thickness of 2 feet (610 mm) of the native soil below the entire proposed system is replaced by loamy sand, and the system design is based on percolation tests made in the loamy sand.

H 501.8 Free Vent Area. Inlet and outlet pipe fittings or baffles and compartment partitions shall have a free vent area equal to the required cross-sectional area of the house sewer or private sewer discharging therein to provide free ventilation above the water surface from the disposal dispersal field or seepage pit through the septic tank, house sewer, and stack to the outer air.

H 601.0 Disposal Dispersal Fields.
H 601.2 Filter Material. Exception: Listed or approved plastic leaching chambers, bundled expanded polystyrene synthetic aggregate units, and systems that treat and dispose of sewage within a single footprint, as described in Section H 301.1(5) and Section H 301.1(6), shall be permitted to be used in lieu of pipe and filter material. Chamber, bundled expanded polystyrene synthetic aggregate unit, and systems that treat and dispose of sewage within a single footprint, installations shall follow the rules for dispersal fields, where applicable, and shall be in accordance with the manufacturer’s instructions.

H 601.4 Seepage Pits. Where seepage pits are used in combination with dispersal fields, the filter material in the trenches shall terminate not less than 5 feet (1524 mm) from the pit excavation, and the line extending from such points to the seepage pit shall be approved pipe with watertight joints.

H 601.5 Distribution Boxes. Where two or more drain lines are installed, an approved distribution box of sufficient size to receive lateral lines shall be installed at the head of each dispersal field. The invert of outlets shall be level, and the invert of the inlet shall be not less than 1 inch (25.4 mm) above the outlets. Distribution boxes shall be designed to ensure equal flow and shall be installed on a level concrete slab in natural or compacted soil.

H 601.6 Laterals. Laterals from a distribution box to the dispersal field shall be approved pipe with watertight joints. Multiple dispersal field laterals, where practicable, shall be of uniform length.

H 601.9 Construction. Dispersal fields shall be constructed in accordance with Table H 601.9. Minimum spacing between trenches or leaching beds shall be not less than 4 feet (1219 mm) plus 2 feet (610 mm) for each additional foot (305 mm) of depth more than 1 foot (305 mm) below the bottom of the drain line. Distribution drain lines in leaching beds shall be not more than 6 feet (1829 mm) apart on centers, and no part of the perimeter of the leaching bed shall exceed 3 feet (914 mm) from a distribution drain line. Dispersal fields, trenches, and leaching beds shall not be paved over or covered by concrete or a material that is capable of reducing or inhibiting a possible evaporation of sewer effluent.

TABLE H 601.9
GENERAL DISPOSAL DISPERSAL FIELD REQUIREMENTS
(portions of table not shown remain unchanged)

H 801.0 Cesspools. H 801.1 Limitations. A cesspool shall be considered as a temporary expedient pending the construction of a public sewer; as an overflow facility where installed in conjunction with an existing cesspool; or as a means of sewage dispersal for limited, minor, or temporary uses, where first approved by the Authority Having Jurisdiction.

H 801.2 Septic Tanks. Where it is established that a public sewer system will be available in less than 2 years, and soil and groundwater conditions are favorable to cesspool dispersal, cesspools without septic tanks shall be permitted to be installed for single-family dwellings or for other limited uses where first approved by the Authority Having Jurisdiction.

H 901.0 Commercial or Industrial Special Liquid-Waste Disposal. H 901.1 Interceptor. Where liquid wastes contain excessive amounts of grease, garbage, flammable wastes, sand, or other ingredients that affect the operation of a private sewage dispersal system, an interceptor for such wastes shall be installed.

H 901.6 Waste Discharge. Waste discharge from interceptors shall be permitted to be connected to a septic tank or other primary system or be disposed into a separate dispersal system.
H 1001.2 Testing. Testing requirements shall comply with the following:
(1) Septic tanks or other primary components shall be filled with water to flow line before requesting an inspection. Seams or joints shall be left exposed (except the bottom), and the tank shall remain watertight.
(2) A flow test shall be performed through the system to the point of effluent dispersal. All lines and components shall be watertight. Capacities required air space, and fittings shall comply with the provisions outlined in this appendix.

1101.0 Abandoned Sewers and Sewage Disposal Dispersal Facilities.

H 1101.5 Permittee. Where disposal dispersal facilities are abandoned consequent to connecting any premises with the public sewer, the permittee making the connection shall fill all abandoned facilities in accordance with the Authority Having Jurisdiction within 30 days from the time of connecting to the public sewer.

H 1201.0 Drawings and Specifications.
H 1201.1 General. The Authority Having Jurisdiction, Health Officer, or other department having jurisdiction shall be permitted to require the following information before a permit is issued for a private sewage dispersal system or at a time during the construction thereof:
(1) Plot plan drawn to scale, completely dimensioned, showing direction and approximate slope of surface, location of present or proposed retaining walls, drainage channels, water supply lines or wells, paved areas and structures on the plot, number of bedrooms or plumbing fixtures in each structure, and location of the private sewage dispersal system with relation to lot lines and structures.
(2) (remaining text unchanged)
(3) A log of soil formations and groundwater levels as determined by test holes dug in close proximity to a proposed seepage pit or dispersal dispersal field, together with a statement of water absorption characteristics of the soil at the proposed site, as determined by approved percolation tests.

SUBSTANTIATION:
Remove the use of the word "disposal" and replace with "dispersal" throughout Appendix H. There are 58 references to disposal. Change all references to dispersal to reflect the effluent is going back into the environment and back into the water cycle.
SUBMITTER: David Lentz

Organization Name: Infiltrator Water Technologies

RECOMMENDATION:
Add new text

Proposed Text:

H 1001.0 Effluent Treatment:

H 1001.1 Devices and Systems. The effluent water quality for private sewage disposal systems shall comply with the applicable water quality requirements as determined by the Authority Having Jurisdiction. Effluent treatment devices or equipment shall be listed and labeled (third party certified) by a listing agency (accredited conformity assessment body) and shall be approved by the Authority Having Jurisdiction. When the Authority Having Jurisdiction requires the treatment of effluent:

(1) To achieve secondary treatment standards, devices or equipment shall comply with NSF/ANSI 40.
(2) To reduce total nitrogen concentration, devices or equipment shall comply with NSF/ANSI 245.
(3) For use in the water closet and urinal flushing, surface irrigation, and similar applications, devices or equipment shall comply with the requirements of Section 1506.8.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF/ANSI 245-2023</td>
<td>Residential Wastewater Treatment Systems - Nitrogen Reduction</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

(shown for information purposes only)

1506.8 On-Site Treated Nonpotable Water Devices and Systems. Devices or equipment used to treat on-site treated nonpotable water to maintain the minimum water quality requirements determined by the Authority Having Jurisdiction shall be listed and labeled (third-party certified) by a listing agency (accredited conformity assessment body) or approved for the intended application. Devices or equipment used to treat on-site treated nonpotable water for use in the water closet and urinal flushing, surface irrigation, and similar applications shall comply with IAPMO IGC 324, NSF/ANSI 350 or approved by the Authority Having Jurisdiction.

SUBSTANTIATION:
This proposal adds internationally recognized wastewater treatment standards to Appendix H for AHJs requiring effluent treatment to meet water quality standards. AHJs are increasingly applying more stringent water quality standards through effluent treatment for a range of intended applications. Appendix H currently includes a single effluent treatment alternative, cited in Section H 301.1(6), for systems that combine treatment and disposal.

This proposal addresses:
1) USEPA secondary treatment (NSF/ANSI 40);
2) reduction of nitrogen, a nutrient that can cause surface-water-body algae blooms (NSF/ANSI 245); and
3) indoor and outdoor water reuse (several reuse standards cited in Section 1506.8).

Application of the proposed standards only occurs where the AHJ has established a corresponding intended use that requires effluent treatment. Adding the proposed information can support AHJs citing effluent treatment requirements in their regulations or local area management programs. This proposal is modeled from Sections 501.13(3), 1501.7, and 1506.8.

If approved, existing Sections H 1001, H 1101, and H 1201 should be renumbered accordingly.
Proposed Text:
H 101.0 General.
H 101.1 Applicability. This appendix provides general guidelines for the materials, design, and installation of private sewage disposal systems.

H 101.2 General Requirements. Where permitted by Section 713.0, the building sewer shall be permitted to be connected to a private sewage disposal system in accordance with the provisions of this appendix. The type of system shall be determined on the basis of location, soil porosity, and groundwater level, and shall be designed to receive all sewage from the property. The system, except as otherwise approved, shall consist of a septic tank with effluent discharging into a subsurface disposal field, into one or more seepage pits, or into a combination of subsurface disposal field and seepage pits. The Authority Having Jurisdiction shall be permitted to grant exceptions to the provisions of this appendix for permitted structures that have been destroyed due to fire or natural disaster, and that cannot be reconstructed in compliance with these provisions provided that such exceptions are the minimum necessary.

H 101.3 Quantity and Quality. Where the quantity or quality of the sewage is such that the above system cannot be expected to function satisfactorily for commercial, agricultural, and industrial plumbing systems; for installations where appreciable amounts of industrial or indigestible wastes are produced; for occupancies producing abnormal quantities of sewage or liquid waste; or where grease interceptors are required by other parts of this code, the method of sewage treatment and disposal shall be first approved by the Authority Having Jurisdiction. Special sewage disposal systems for minor, limited, or temporary uses shall be first approved by the Authority Having Jurisdiction.

H 101.4 Septic Tank and Disposal Field Systems. Disposal systems shall be designed to utilize the most porous or absorptive portions of the soil formation. Where the groundwater level extends to within 12 feet (3658 mm) or less of the ground surface or where the upper soil is porous, and the underlying stratum is rock or impervious soil, a septic tank and disposal field system shall be installed.

H 101.5 Flood Hazard Areas. Disposal systems shall be located outside of flood hazard areas.

Exception: Where suitable sites outside of flood hazard areas are not available, disposal systems shall be permitted to be located in flood hazard areas on sites where the effects of inundation under conditions of the design flood are minimized.

H 101.6 Design. Private sewage disposal systems shall be so designed that additional seepage pits or subsurface drain fields, equivalent to not less than 100 percent of the required original system, shall be permitted to be installed where the original system cannot absorb all the sewage. No division of the lot or erection of structures on the lot shall be made where such division or structure impairs the usefulness of the 100 percent expansion area. No property shall be improved more than its capacity to absorb sewage effluent properly by the means provided in this code.

Exception: The Authority Having Jurisdiction shall be permitted to, at its discretion, approve an alternate system.

H 101.7 Capacity. No property shall be improved more than its capacity to absorb sewage effluent properly by the means provided in this code.

Exception: The Authority Having Jurisdiction shall be permitted to, at its discretion, approve an alternate system.

H 101.8 Location. No private sewage disposal system, or part thereof, shall be located in any lot other than the lot that is the site of the building or structure served by such private sewage disposal system, nor shall any private sewage disposal system or part thereof be located at any point having less than the minimum distances indicated in Table H 101.8.

Nothing contained in this code shall be construed to prohibit the use of all or part of an abutting lot to provide...
additional space for a private sewage disposal system or part thereof where proper cause, transfer of ownership, or change of boundary not in violation of other requirements has been first established to the satisfaction of the Authority Having Jurisdiction. The instrument recording such action shall constitute an agreement with the Authority Having Jurisdiction, which shall clearly state and show that the areas so joined or used shall be maintained as a unit during the time they are so used. Such agreement shall be recorded in the office of the County Recorder as part of the conditions of ownership of said properties and shall be binding on heirs, successors, and assigns to such properties. A copy of the instrument recording such proceedings shall be filed with the Authority Having Jurisdiction.

H 101.9 Building Permit. Where there is insufficient lot area or improper soil conditions for sewage disposal for the building or land use proposed, and the Authority Having Jurisdiction so finds, no building permit shall be issued, and no private sewage disposal shall be permitted. Where space or soil conditions are critical, no building permit shall be issued until engineering data, and test reports satisfactory to the Authority Having Jurisdiction have been submitted and approved.

H 101.10 Additional Requirements. Nothing contained in this appendix shall be construed to prevent the Authority Having Jurisdiction from requiring compliance with additional requirements than those contained herein, where such additional requirements are essential to maintaining a safe and sanitary condition.

H 101.11 Alternate Systems. Alternate systems, including pressurized in-ground, pressurized at-grade, and pressurized mounds, shall be permitted to be used by special permission of the Authority Having Jurisdiction after being satisfied with their adequacy. This authorization is based on extensive field and test data from conditions similar to those at the proposed site or requires such additional data as necessary to assure that the alternate system will produce continuous and long-range results at the proposed site, not less than equivalent to systems which are specifically authorized.

Where demonstration systems are to be considered for installation, conditions for installation, maintenance, and monitoring at each such site shall first be established by the Authority Having Jurisdiction.

Approved aerobic systems shall be permitted to be substituted for conventional septic tanks provided the Authority Having Jurisdiction is satisfied that such systems will produce results not less than equivalent to septic tanks, whether their aeration systems are operating or not.

### TABLE H 101.8
LOCATION OF SEWAGE DISPOSAL SYSTEM

<table>
<thead>
<tr>
<th>MINIMUM HORIZONTAL DISTANCE</th>
<th>BUILDING SEWER</th>
<th>SEPTIC TANK</th>
<th>DISPOSAL FIELD</th>
<th>SEEPAGE PIT OR CESSPOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building or structures$^1$</td>
<td>2 feet</td>
<td>5 feet</td>
<td>8 feet</td>
<td>8 feet</td>
</tr>
<tr>
<td>Property line adjoining private property</td>
<td>Clear$^2$</td>
<td>5 feet</td>
<td>5 feet</td>
<td>8 feet</td>
</tr>
<tr>
<td>Water supply wells</td>
<td>50 feet$^3$</td>
<td>50 feet</td>
<td>100 feet</td>
<td>150 feet</td>
</tr>
<tr>
<td>Streams and other bodies of water</td>
<td>50 feet</td>
<td>50 feet</td>
<td>100 feet$^7$</td>
<td>150 feet$^7$</td>
</tr>
<tr>
<td>Trees</td>
<td>–</td>
<td>10 feet</td>
<td>–</td>
<td>10 feet</td>
</tr>
<tr>
<td>Seepage pits or cesspools$^8$</td>
<td>–</td>
<td>5 feet</td>
<td>5 feet</td>
<td>12 feet</td>
</tr>
<tr>
<td>Disposal field$^8$</td>
<td>–</td>
<td>5 feet</td>
<td>4 feet$^4$</td>
<td>4 feet$^4$</td>
</tr>
<tr>
<td>On-site domestic water service line</td>
<td>1 foot$^5$</td>
<td>5 feet</td>
<td>5 feet</td>
<td>5 feet</td>
</tr>
<tr>
<td>Distribution box</td>
<td>–</td>
<td>–</td>
<td>5 feet</td>
<td>5 feet</td>
</tr>
<tr>
<td>Pressure public water main</td>
<td>10 feet$^6$</td>
<td>10 feet</td>
<td>10 feet</td>
<td>10 feet</td>
</tr>
</tbody>
</table>

For SI units: 1 foot = 304.8 mm

Notes:
Including porches and steps, whether covered or uncovered, breezeways, roofed porte cocheres, roofed patios, carports, covered walks, covered driveways, and similar structures or appurtenances.

2 See Section 312.3.

3 Drainage piping shall clear domestic water supply wells by not less than 50 feet (15 240 mm). This distance shall be permitted to be reduced to not less than 25 feet (7620 mm) where the drainage piping is constructed of materials approved for use within a building.

4 Plus 2 feet (610 mm) for each additional 1 foot (305 mm) of depth more than 1 foot (305 mm) below the bottom of the drain line. (See Section H 601.0)

5 See Section 720.0.

6 For parallel construction – For crossings, approval by the Health Department shall be required.

7 These minimum clear horizontal distances shall also apply to disposal fields, seepage pits, and the mean high-tide line.

8 Where disposal fields, seepage pits, or both are installed in sloping ground, the minimum horizontal distance between any part of the leaching system and ground surface shall be 15 feet (4572 mm).

H 201.0 Capacity of Septic Tanks.

H 201.1 General. The liquid capacity of septic tanks shall comply with Table H 201.1(1) and Table H 201.1(4), or in accordance with an approved maintenance schedule as determined by the number of bedrooms or apartment units in dwelling occupancies and the estimated waste/sewage design flow rate or the number of plumbing fixture units as determined from Table 702.1 of this code, whichever is greater in other building occupancies. The capacity of any one septic tank and its drainage system shall be limited to the soil structure classification in Table H 201.1(2), and as specified in Table H 201.1(3).

<table>
<thead>
<tr>
<th>TABLE H 201.1(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPACITY OF SEPTIC TANKS 1, 2, 3, 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SINGLE-FAMILY DWELLINGS - NUMBER OF BEDROOMS</th>
<th>MULTIPLE DWELLING UNITS OR APARTMENTS - ONE BEDROOM EACH</th>
<th>OTHER USES: MAXIMUM FIXTURE UNITS SERVED PER TABLE 702.1</th>
<th>MINIMUM SEPTIC TANK CAPACITY (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2</td>
<td>–</td>
<td>15</td>
<td>750</td>
</tr>
<tr>
<td>3</td>
<td>–</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>2 units</td>
<td>25</td>
<td>1200</td>
</tr>
<tr>
<td>5 or 6</td>
<td>3</td>
<td>33</td>
<td>1500</td>
</tr>
<tr>
<td>–</td>
<td>4</td>
<td>45</td>
<td>2000</td>
</tr>
<tr>
<td>–</td>
<td>5</td>
<td>55</td>
<td>2250</td>
</tr>
<tr>
<td>–</td>
<td>6</td>
<td>60</td>
<td>2500</td>
</tr>
<tr>
<td>–</td>
<td>7</td>
<td>70</td>
<td>2750</td>
</tr>
<tr>
<td>–</td>
<td>8</td>
<td>80</td>
<td>3000</td>
</tr>
<tr>
<td>–</td>
<td>9</td>
<td>90</td>
<td>3250</td>
</tr>
<tr>
<td>–</td>
<td>10</td>
<td>100</td>
<td>3500</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon = 3.785 L

Notes:
1 Extra bedroom, 150 gallons (568 L) each.
2 Extra dwelling units over 10: 250 gallons (946 L) each.
3 Extra fixture units over 100: 25 gallons (94.6 L) per fixture unit.
4 Septic tank sizes in this table include sludge storage capacity and the connection of domestic food waste disposers without further volume increase.

### TABLE H 201.1(2)
**DESIGN CRITERIA OF FIVE TYPICAL SOILS**

<table>
<thead>
<tr>
<th>TYPE OF SOIL</th>
<th>REQUIRED SQUARE FEET OF LEACHING AREA PER 100 GALLONS</th>
<th>MAXIMUM ABSORPTION CAPACITY IN GALLONS PER SQUARE FEET OF LEACHING AREA FOR A 24-HOUR PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse sand or gravel</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Fine sand</td>
<td>25</td>
<td>4.0</td>
</tr>
<tr>
<td>Sandy loam or sandy clay</td>
<td>40</td>
<td>2.5</td>
</tr>
<tr>
<td>Clay with considerable sand or gravel</td>
<td>90</td>
<td>1.1</td>
</tr>
<tr>
<td>Clay with small amount of sand or gravel</td>
<td>120</td>
<td>0.8</td>
</tr>
</tbody>
</table>

For SI units: 1 square foot = 0.0929 m², 1 gallon = 3.785 L, 1 gallon per square foot = 40.7 L/m²

### TABLE H 201.1(3)
**LEACHING AREA SIZE BASED ON SEPTIC TANK CAPACITY**

<table>
<thead>
<tr>
<th>REQUIRED SQUARE FEET OF LEACHING AREA PER 100 GALLONS SEPTIC TANK CAPACITY (square feet per 100 gallons)</th>
<th>MAXIMUM SEPTIC TANK SIZE ALLOWABLE (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–25</td>
<td>7500</td>
</tr>
<tr>
<td>40</td>
<td>5000</td>
</tr>
<tr>
<td>90</td>
<td>3500</td>
</tr>
<tr>
<td>120</td>
<td>3000</td>
</tr>
</tbody>
</table>

For SI units: 1 square foot per 100 gallons = 0.000245 m²/L, 1 gallon = 3.785 L

### TABLE H 201.1(4)
**ESTIMATED WASTE/SEWAGE FLOW RATES**

<table>
<thead>
<tr>
<th>TYPE OF OCCUPANCY</th>
<th>GALLONS PER DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airports (per employee)</td>
<td>15</td>
</tr>
<tr>
<td>Airports (per passenger)</td>
<td>5</td>
</tr>
<tr>
<td>Auto washers – check with equipment manufacturer</td>
<td>–</td>
</tr>
<tr>
<td>Bowling alleys – with snack bar only (per lane)</td>
<td>75</td>
</tr>
<tr>
<td>Campground – with central comfort station (per person)</td>
<td>35</td>
</tr>
<tr>
<td>Campground – with flush toilets - no showers (per person)</td>
<td>25</td>
</tr>
<tr>
<td>Service</td>
<td>Rate (per unit)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Camps (day) – no meals served (per person)</td>
<td>15</td>
</tr>
<tr>
<td>Camps (summer and seasonal camps) – (per person)</td>
<td>50</td>
</tr>
<tr>
<td>Churches – sanctuary (per seat)</td>
<td>5</td>
</tr>
<tr>
<td>Churches – with kitchen waste (per seat)</td>
<td>7</td>
</tr>
<tr>
<td>Dance halls – (per person)</td>
<td>5</td>
</tr>
<tr>
<td>Factories – no showers (per employee)</td>
<td>25</td>
</tr>
<tr>
<td>Factories – with showers (per employee)</td>
<td>35</td>
</tr>
<tr>
<td>Factories – with cafeteria (per employee)</td>
<td>5</td>
</tr>
<tr>
<td>Hospitals – (per bed)</td>
<td>250</td>
</tr>
<tr>
<td>Hospitals – kitchen waste only (per bed)</td>
<td>25</td>
</tr>
<tr>
<td>Hospitals – laundry waste only (per bed)</td>
<td>40</td>
</tr>
<tr>
<td>Hotels – no kitchen waste (per bed)</td>
<td>60</td>
</tr>
<tr>
<td>Institutions – resident (per person)</td>
<td>75</td>
</tr>
<tr>
<td>Nursing home – (per person)</td>
<td>125</td>
</tr>
<tr>
<td>Rest home – (per person)</td>
<td>125</td>
</tr>
<tr>
<td>Laundries – self-service with minimum 10 hours per day (per wash cycle)</td>
<td>50</td>
</tr>
<tr>
<td>Laundries – commercial check with manufacturer’s specification</td>
<td>–</td>
</tr>
<tr>
<td>Motel (per bed space)</td>
<td>50</td>
</tr>
<tr>
<td>Motel – with kitchen (per bed space)</td>
<td>60</td>
</tr>
<tr>
<td>Offices – (per employee)</td>
<td>20</td>
</tr>
<tr>
<td>Parks – mobile homes (per space)</td>
<td>250</td>
</tr>
<tr>
<td>Parks (picnic) – with toilets only (per parking space)</td>
<td>20</td>
</tr>
<tr>
<td>Parks (recreational vehicles) – without water hook-up (per space)</td>
<td>75</td>
</tr>
<tr>
<td>Parks (recreational vehicles) – with water and sewer hook-up (per space)</td>
<td>100</td>
</tr>
<tr>
<td>Restaurants – cafeteria (per employee)</td>
<td>20</td>
</tr>
<tr>
<td>Restaurants – with toilet waste (per customer)</td>
<td>7</td>
</tr>
<tr>
<td>Restaurants – with kitchen waste (per meal)</td>
<td>6</td>
</tr>
<tr>
<td>Restaurants – with kitchen waste disposable service (per meal)</td>
<td>2</td>
</tr>
<tr>
<td>Restaurants – with garbage disposal (per meal)</td>
<td>1</td>
</tr>
<tr>
<td>Restaurants – with cocktail lounge (per customer)</td>
<td>2</td>
</tr>
<tr>
<td>Schools staff and office (per person)</td>
<td>20</td>
</tr>
<tr>
<td>Schools – elementary (per student)</td>
<td>15</td>
</tr>
<tr>
<td>Schools – intermediate and high (per student)</td>
<td>20</td>
</tr>
<tr>
<td>Schools – with gym and showers (per student)</td>
<td>5</td>
</tr>
<tr>
<td>Schools – with cafeteria (per student)</td>
<td>3</td>
</tr>
<tr>
<td>Schools (boarding) – total waste (per person)</td>
<td>100</td>
</tr>
<tr>
<td>Service station – with toilets for 1st bay</td>
<td>1000</td>
</tr>
<tr>
<td>Service station – with toilets for each additional bay</td>
<td>500</td>
</tr>
<tr>
<td>Stores – (per employee)</td>
<td>20</td>
</tr>
<tr>
<td>Stores – with public restrooms (per 10 square feet of floor space)</td>
<td>1</td>
</tr>
<tr>
<td>Swimming pools – public (per person)</td>
<td>10</td>
</tr>
<tr>
<td>Theaters – auditoriums (per seat)</td>
<td>5</td>
</tr>
<tr>
<td>Theaters – with drive-in (per space)</td>
<td>10</td>
</tr>
</tbody>
</table>

For SI units: 1 square foot = 0.0929 m², 1 gallon per day = 3.785 L/day

**Notes:**

1 Sewage disposal systems sized using the estimated waste/sewage flow rates shall be calculated as follows:
(a) Waste/sewage flow, up to 1500 gallons per day (5678 L/day)
Flow x 1.5 = septic tank size
(b) Waste/sewage flow, over 1500 gallons per day (5678 L/day)
Flow x 0.75 + 1125 = septic tank size
(c) Secondary system shall be sized for total flow per 24 hours.

2 See Section H 201.1.

3 Because of the many variables encountered, it is not possible to set absolute values for waste/sewage flow rates for all situations. The designer should evaluate each situation and, where figures in this table need modification; they should be made with the concurrence of the Authority Having Jurisdiction.

H 301.0 Area of Disposal Fields and Seepage Pits.

H 301.1 General. The minimum effective absorption area in disposal fields in square feet (m²), and in seepage pits in square feet (m²) of sidewall, shall be predicated based on the estimated waste/sewage flow rates and morphological soil conditions. Some examples of soil conditions are in Table H 201.1(2), on the required septic tank capacity of gallons (liters), estimated waste/sewage flow rate, or whichever is greater, and shall be in accordance with Table H 201.1(2) as determined by the type of soil found in the excavation, and shall be as follows: The following are minimal considerations for determining the area of a disposal field:

1. Where disposal fields are installed, not less than 150 square feet (13.9 m²) of trench bottom shall be provided for each system exclusive of any hard pan, rock, clay, or other impervious formations. Sidewall area more than the required 12 inches (305 mm) and not exceeding 36 inches (914 mm) below the leach line shall be permitted to be added to the trench bottom area where computing absorption areas.
2. Where leaching beds are permitted instead of trenches, the area of each such bed shall be not less than 50 percent greater than the tabular requirements for trenches. Perimeter sidewall area more than the required 12 inches (305 mm) and not exceeding 36 inches (914 mm) below the leach line shall be permitted to be added to the trench bottom area where computing absorption areas.
3. No excavation for a leach line or leach bed shall be located within 5 feet (1524 mm) of the water table nor to a depth where sewage is capable of contaminating the underground water stratum that is usable for domestic purposes.

Exception: In areas where the records or data indicate that the groundwaters are grossly degraded, the 5 foot (1524 mm) separation requirement shall be permitted to be reduced by the Authority Having Jurisdiction. The applicant shall supply evidence of groundwater depth to the satisfaction of the Authority Having Jurisdiction.

4. The minimum effective absorption area in any seepage pit shall be calculated as the excavated sidewall area below the inlet exclusive of any hardpan, rock, clay, or other impervious formations. The minimum required area of porous formation shall be provided in one or more seepage pits. No excavation shall extend within 10 feet (3048 mm) of the water table nor to a depth where sewage is capable of contaminating underground water stratum that is usable for domestic purposes.

Exception: In areas where the records or data indicate that the groundwaters are grossly degraded, the 10 foot (3048 mm) separation requirement shall be permitted to be reduced by the Authority Having Jurisdiction. The applicant shall supply evidence of groundwater depth to the satisfaction of the Authority Having Jurisdiction.

5. Leaching chambers that comply with IAPMO PS 63 and bundled expanded polystyrene synthetic aggregate units that comply with IAPMO IGC 276 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2).

6. Systems that combine treatment and disposal of sewage within a single footprint and comply with NSF 40 Class 1 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2) for both leach lines and leach beds. No system component for a combined treatment and disposal leach line or leach bed shall be located within 23 feet (6.914 mm) of the water table nor to a depth where sewage is capable of contaminating the underground water stratum that is usable for domestic purposes. Combined treatment and disposal system
operation and maintenance shall be in accordance with the manufacturer's instructions.

Exceptions:

(1) Combined treatment and disposal systems tested and certified in a bed configuration in accordance with NSF 40 Class 1 are exempted from the requirements of Section H 301.1(2).

(2) System component for a combined treatment and disposal leach line or leach bed shall may be permitted to be located less than 3 feet (914 mm) where the effluent quality permits and first approved by the Authority Having Jurisdiction.

H 401.0 Percollation Test. Soil Verification.

H 401.1 Pit Sizes. General. Where practicable, disposal field and seepage pit sizes shall be computed from Table H 201.1(2). Seepage pit sizes shall be computed by percolation tests unless use of Table H 201.1(2) is approved by the Authority Having Jurisdiction. Where required by the Authority Having Jurisdiction (AHJ), depth to soil mottles, depth to high ground water, soil textures, depth to bedrock and land slope shall be verified. The AHJ shall be permitted to require backhoe pits to be provided for verification of soil boring data. Where required, the results of percolation tests or permeability evaluations shall be verified. Where required, the percolation tests shall be conducted under supervision. Where the natural soil condition has been altered to improve wet areas, the AHJ shall be permitted to request an observation of high ground water levels under saturated soil conditions. Detailed soil maps, or other permissible data, shall be used for determining estimated percolation rates and other soil characteristics.

H 401.2 Absorption Qualities. The absorption qualities of seepage pits and questionable soils other than those listed in Table H 201.1(2), the proposed site, shall be subjected to percolation tests acceptable to the Authority Having Jurisdiction.

H 401.3 Absorption Rates. Where a percolation test is required, no private disposal system shall be permitted to serve a building where that test shows the absorption capacity of the soil is less than 0.83 gallons per square foot (gal/ft²) (33.8 L/m²) or more than 5.12 gal/ft² (208.6 L/m²) of leaching area per 24 hours. Where the percolation test shows an absorption rate greater than 5.12 gal/ft² (208.6 L/m²) per 24 hours, a private disposal system shall be permitted where the site does not overlie groundwaters protected for drinking water supplies, a minimum thickness of 23 feet (610 mm) of the native soil below the entire proposed system is replaced by loamy sand, and the system design is based on percolation tests made in the loamy sand. Exception: System component for a combined treatment and disposal leach line or leach bed shall may be permitted to be located less than 3 ft where the effluent quality permits and first approved by the Authority Having Jurisdiction.

H 501.0 Septic Tank Construction.

H 501.1 Plans. Plans for septic tanks shall be submitted to the Authority Having Jurisdiction for approval. Such plans shall show dimensions, reinforcing, structural calculations, and such other pertinent data as required.

H 501.2 Design. Septic tank design shall be such as to produce a clarified effluent consistent with accepted standards and shall provide adequate space for sludge and scum accumulations.

H 501.3 Construction. Septic tanks shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight.

H 501.4 Compartments. Unless otherwise approved by the Authority Having Jurisdiction, septic tanks shall have not less than two compartments unless otherwise approved by the Authority Having Jurisdiction. The inlet compartment of any septic tank shall be not less than two-thirds of the total capacity of the tank, nor less than 500 gallons (1892 L) liquid capacity, and shall be not less than 3 feet (914 mm) in width and 5 feet (1524 mm) in length. Liquid depth shall be not less than 21/2 feet (762 mm) nor more than 6 feet (1829 mm). The secondary compartment of a septic tank shall have a capacity of not less than 250 gallons (946 L) and a capacity not exceeding one-third of the total capacity of such tank. In septic tanks having a 1500 gallon (5678 L) capacity, the secondary compartment shall be not less than 5 feet (1524 mm) in length. The septic tank outlet shall include a
filter prior to effluent discharge. The filter shall be maintained in accordance with the manufacturer’s instructions.

H 501.5 Access. Access to each septic tank shall be provided by not less than two manholes 20 inches (508 mm) in minimum dimension or by an equivalent removable cover slab. One access manhole shall be located over the inlet, and one access manhole shall be located over the outlet. Where a first compartment exceeds 12 feet (3658 mm) in length, an additional manhole shall be provided over the baffle wall.

H 501.6 Pipe Opening Sizes. The inlet and outlet pipe openings shall not be larger in size than the connecting sewer pipe. The vertical leg of round inlet and outlet fittings shall not be less in size than the connecting sewer pipe nor less than 43 inches (1090 mm) in diameter. A baffle-type fitting shall have the equivalent cross-sectional area of the connecting sewer pipe and not less than a 4 inch (102 mm) horizontal dimension where measured at the inlet and outlet pipe inverts.

H 501.7 Pipe Extension. The inlet and outlet pipe or baffle shall extend 4 inches (102 mm) above and not less than 12 inches (305 mm) below the water surface. The invert of the inlet pipe shall be at a level not less than 2 inches (51 mm) above the invert of the outlet pipe.

H 501.8 Free Vent Area. Inlet and outlet pipe fittings or baffles and compartment partitions shall have a free vent area equal to the required cross-sectional area of the house sewer or private sewer discharging therein to provide free ventilation above the water surface from the disposal field or seepage pit through the septic tank, house sewer, and stack to the outer air.

H 501.9 Sidewalls. The sidewalls shall extend not less than 9 inches (229 mm) above the liquid depth. The cover of the septic tank shall be not less than 2 inches (51 mm) above the back vent openings.

H 501.10 Partitions and Baffles. Partitions or baffles between compartments shall be of solid, durable material and shall extend not less than 4 inches (102 mm) above the liquid level. The transfer port between compartments shall be a minimum size equivalent to the tank inlet, but in no case less than 4 inches (102 mm) in size, shall be installed in the inlet compartment side of the baffle so that the entry into the port is placed 65 percent to 75 percent in the depth of the liquid. Wooden baffles are prohibited.

H 501.11 Structural Design. The structural design of septic tanks shall comply with the following requirements:
(1) Each such tank shall be structurally designed to withstand all anticipated earth or other loads. Septic tank covers shall be capable of supporting an earth load of not less than 500 pounds per square foot (lb/ft²) (2441 kg/m²) where the maximum coverage does not exceed 3 feet (914 mm).
(2) In flood hazard areas, tanks shall be anchored to counter buoyant forces during conditions of the design flood. The vent termination and service manhole of the tank shall be not less than 2 feet (610 mm) above the design flood elevation or fitted with covers designed to prevent the inflow of floodwater or the outflow of the contents of the tanks during conditions of the design flood.

H 501.12 Manholes. Septic tanks installed under concrete or blacktop paving shall have the required manholes accessible by extending the manhole openings to grade in a manner acceptable to the Authority Having Jurisdiction.

H 501.13 Materials. The materials used for constructing a septic tank shall be in accordance with the following:
(1) Materials used in constructing a concrete septic tank shall be in accordance with applicable standards in Chapter 17.
(2) The minimum wall thickness of a steel septic tank shall be number 12 U.S. gauge (0.109 of an inch) (2.77 mm), and each such tank shall be protected from corrosion both externally and internally by an approved bituminous coating or by other acceptable means.
(3) Septic tanks constructed of alternate materials shall be permitted to be approved by the Authority Having Jurisdiction where in accordance with approved applicable standards. Wooden septic tanks shall be prohibited.

H 501.14 Prefabricated Septic Tanks. Prefabricated septic tanks shall comply with the following requirements:
(1) Manufactured or prefabricated septic tanks shall comply with IAPMO/ANSI Z1000, IAPMO IGC 262, or CSA B66 and be approved by the Authority Having Jurisdiction. Prefabricated bituminous coated septic tanks shall comply with UL 70.
(2) Independent laboratory tests and engineering calculations certifying the tank capacity and structural stability
H 601.0 Disposal Fields.
H 601.1 Distribution Lines. Distribution lines shall be constructed of clay tile laid with open joints, perforated clay pipe, perforated bituminous fiber pipe, perforated high-density polyethylene pipe, perforated ABS pipe, perforated PVC pipe, or other approved materials, provided that approved openings are available for distribution of the effluent into the trench area.

H 601.1.1 Bundled Expanded Polystyrene Synthetic Aggregate Units. Bundled expanded polystyrene synthetic aggregate units with an integrated distribution line consisting of perforated, corrugated high-density polyethylene pipe that complies with IAPMO IGC 276 shall be permitted.

H 601.2 Filter Material. Before placing filter material or drain lines in a prepared excavation, smeared or compacted surfaces shall be removed from trenches by raking to a depth of 1 inch (25.4 mm) and the loose material removed. Clean stone, gravel, slag, or similar filter material acceptable to the Authority Having Jurisdiction, varying in size from $\frac{3}{4}$ of an inch to $2\frac{1}{2}$ inches (19.1 mm to 64 mm), shall be placed in the trench to the depth and grade required by this section. Drainpipe shall be placed on filter material in an approved manner. The drain lines shall then be covered with filter material to the minimum depth required by this section, and this material covered with untreated building paper, straw, or similar porous material to prevent the closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.

Exception: Listed or approved plastic leaching chambers, bundled expanded polystyrene synthetic aggregate units, and systems that treat and dispose of sewage within a single footprint, as described in Section H 301.1(5) and Section H 301.1(6), shall be permitted to be used in lieu of pipe and filter material. Chamber, bundled expanded polystyrene synthetic aggregate unit, and systems that treat and dispose of sewage within a single footprint, installations shall follow the rules for disposal fields, where applicable, and shall be in accordance with the manufacturer’s instructions.

H 601.3 Grade Board. A grade board staked in the trench to the depth of filter material shall be utilized where the distribution line is constructed with drain tile or a flexible pipe material that will not maintain alignment without continuous support.

H 601.4 Seepage Pits. Where seepage pits are used in combination with disposal fields, the filter material in the trenches shall terminate not less than 5 feet (1524 mm) from the pit excavation, and the line extending from such points to the seepage pit shall be approved pipe with watertight joints.

(renumber remaining text)

H 601.5 Distribution Boxes. Where two or more drain lines are installed, an approved distribution box of sufficient size to receive lateral lines shall be installed at the head of each disposal field. The invert of outlets shall be level, and the invert of the inlet shall be not less than 1 inch (25.4 mm) above the outlets. Where permitted, an approved manifold shall be permitted. Field manufactured manifold shall comply with the DWV piping in the plumbing code. Distribution and manifolds boxes shall be designed and installed level to ensure equal flow and shall be installed on a level concrete slab in natural or compacted soil.

H 601.6 Laterals. Laterals from a distribution box or manifold to the disposal field shall be approved pipe with watertight joints. Multiple disposal field laterals, where practicable, shall be of uniform length.

H 601.7 Connections. Connections between a septic tank and a distribution box shall be laid with approved pipe with watertight joints on natural ground or compacted fill.

H 601.8 Dosing Tanks. Unless otherwise required by the Authority Having Jurisdiction. Where the quantity of sewage exceeds the amount that is permitted to be disposed of in 500 lineal feet (152.4 m) of leach line, a dosing tank shall be used. Dosing tanks shall be equipped with an automatic siphon or pump that discharges the tank once every 3 or 4 hours. The tank shall have a capacity equal to 60 to 75 percent of the interior capacity of the pipe to be dosed at one time. Where the total length of pipe exceeds 1000 lineal feet (305 m), the dosing tank shall be
provided with two siphons or pumps dosing alternately and each serving one-half of the leach field.

H 601.9 Construction. Unless otherwise required by the Authority Having Jurisdiction, disposal fields shall be constructed in accordance with Table H 601.9. Minimum spacing between trenches or leaching beds shall be not less than 4 feet (1219 mm) plus 2 feet (610 mm) for each additional foot (305 mm) of depth more than 1 foot (305 mm) below the bottom of the drain line. Distribution drain lines in leaching beds shall be not more than 6 feet (1829 mm) apart on centers, and no part of the perimeter of the leaching bed shall exceed 3 feet (914 mm) from a distribution drain line. Disposal fields, trenches, and leaching beds shall not be paved over or covered by concrete or a material that is capable of reducing or inhibiting a possible evaporation of sewer effluent.

<table>
<thead>
<tr>
<th>TABLE H 601.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL DISPOSAL FIELD REQUIREMENTS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of drain lines per field</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Length of each line</td>
<td>-</td>
<td>100 feet</td>
</tr>
<tr>
<td>Bottom width of trench</td>
<td>18 inches</td>
<td>36 inches</td>
</tr>
<tr>
<td>Spacing of lines, centerto-center</td>
<td>6 feet</td>
<td>-</td>
</tr>
<tr>
<td>Depth of earth cover of lines (preferred 18 inches)</td>
<td>12 inches</td>
<td>-</td>
</tr>
<tr>
<td>Grade of lines</td>
<td>level</td>
<td>3 inches per 100 feet</td>
</tr>
<tr>
<td>Filter material under drain lines</td>
<td>6 inches</td>
<td>-</td>
</tr>
<tr>
<td>Filter material over drain lines</td>
<td>2 inches</td>
<td>-</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.3 mm/m

H 601.10 Joints. Where necessary on sloping ground to prevent excessive line slope, leach lines or leach beds shall be stepped. The lines between each horizontal section shall be made with watertight joints and shall be designed, so each horizontal leaching trench or bed shall be utilized to the maximum capacity before the effluent shall pass to the next lower leach line or bed. The lines between each horizontal leaching section shall be made with approved watertight joints and installed on the natural or unfilled ground.

H 701.0 Seepage Pits:

H 701.1 Capacity. The capacity of seepage pits shall be based on the quantity of liquid waste discharging thereinto and on the character and porosity of the surrounding soil, and shall be in accordance with Section H 301.0 of this appendix.

H 701.2 Multiple Installations. Multiple seepage pit installations shall be served through an approved distribution box or be connected in series using a watertight connection laid on undistributed or compacted soil. The outlet from the pit shall have an approved vented leg fitting extending not less than 12 inches (305 mm) below the inlet fitting.

H 701.3 Construction. A seepage pit shall be circular in shape and shall have an excavated diameter of not less than 4 feet (1219 mm). Each such pit shall be lined with approved type whole new hard-burned clay brick, concrete brick, concrete circular-type cesspool blocks, or other approved materials. Approval shall be obtained before construction for any pit having an excavated diameter greater than 6 feet (1829 mm).

H 701.4 Lining. The lining in a seepage pit shall be laid on a firm foundation. Lining materials shall be placed tight together and laid with joints staggered. Except in the case of approved type precast concrete circular sections, no brick or block shall be greater in height than its width and shall be laid flat to form not less than a 4 inch (102 mm) wall. Brick or block greater than 12 inches (305 mm) in length shall have chamfered matching ends and be scored to provide for seepage. Excavation voids behind the brick, block, or concrete liner shall have not less than 6 inches (152 mm) of clean \(\frac{3}{4}\) of an inch (19.1 mm) gravel or rock.
H 701.5 Brick and Block. Brick or block used in seepage pit construction shall have a compressive strength of not less than 2500 pounds per square inch (lb/in²) (1 757 674 kg/m²).

H 701.6 Sidewall. A seepage pit shall have a minimum sidewall (not including the arch) of 10 feet (3048 mm) below the inlet.

H 701.7 Arch and Dome. The arch or dome of a seepage pit shall be permitted to be constructed in one of three ways:
(1) Approved-type hard-burned clay brick or solid concrete brick or block laid in cement mortar.
(2) Approved brick or block laid dry. In both of the above methods, an approved cement mortar covering of not less than 2 inches (51 mm) in thickness shall be applied, said covering to extend not less than 6 inches (152 mm) beyond the sidewalls of the pit.
(3) Approved-type one or two-piece reinforced concrete slabs of not less than 2500 lb/in² (1 757 674 kg/m²) minimum compressive strength, not less than 5 inches (127 mm) thick, and designed to support an earth load of not less than 400 pounds per square foot (lb/ft²) (1953 kg/m²). Each such cover shall be provided with a 9 inch (229 mm) minimum inspection hole with plug or cover and shall be coated on the underside with an approved bituminous or other nonpermeable protective compound.

H 701.8 Location. The top of the arch or cover shall be not less than 18 inches (457 mm) but not exceed 4 feet (1219 mm) below the surface of the ground.

H 701.9 Inlet Fitting. An approved vented inlet fitting shall be provided in the seepage pit so arranged as to prevent the inflow from damaging the sidewall.

Exception: Where using a one- or two-piece concrete slab cover inlet, fitting shall be permitted to be a one-fourth bend fitting discharging through an opening in the top of the slab cover. On multiple seepage pit installations, the outlet fittings shall comply with Section H 701.2 of this appendix.

H 801.0 Cesspools.

H 801.1 General. Where required a Cesspools shall be permitted to be installed. A cesspool shall only be a temporary installation for the following conditions:
(1) Pending the final construction of a public sewer,
(2) As an overflow facility where installed as part of an existing cesspool, or
(3) As a means of sewage disposal for limited, minor or temporary applications.

H 801.1 Limitations. A cesspool shall be considered as a temporary expedient pending the construction of a public sewer; as an overflow facility where installed in conjunction with an existing cesspool; or as a means of sewage disposal for limited, minor, or temporary uses, where first approved by the Authority Having Jurisdiction.

H 801.2 Septic Tanks. Where it is established that a public sewer system will be available in less than 2 years, and soil and groundwater conditions are favorable to cesspool disposal, cesspools without septic tanks shall be permitted to be installed for single-family dwellings or for other limited uses where first approved by the Authority Having Jurisdiction.

H 801.3 Construction. Each cesspool, where permitted, shall be in accordance with the construction requirements set forth in Section H 701.0 of this appendix for seepage pits and shall have a sidewall (not including arch) of not less than 20 feet (6096 mm) below the inlet, provided, however, that where a strata of gravel or equally pervious material of 4 feet (1219 mm) in thickness is found, the depth of such sidewall shall not exceed 10 feet (3048 mm) below the inlet.

H 801.4 Existing Installations. Where overflow cesspools or seepage pits are added to existing installations, the effluent shall leave the existing pit through an approved vented leg extending not less than 12 inches (305 mm) downward into such existing pit and having its outlet flow line not less than 6 inches (152 mm) below the inlet. The pipe between pits shall be laid with approved watertight joints.
H 901.0 Commercial or Industrial Special Liquid-Waste Disposal.

H 901.1 Interceptor. Where liquid wastes contain excessive amounts of grease, garbage, flammable wastes, sand, or other ingredients that affect the operation of a private sewage disposal system, an interceptor for such wastes shall be installed.

H 901.2 Installation. Installation of such interceptors shall comply with Section 1009.0 of this code, and their location shall comply with Table H 101.8 of this appendix.

H 901.3 Sampling Box. A sampling box shall be installed where required by the Authority Having Jurisdiction.

H 901.4 Design and Structural Requirement. Interceptors shall be of approved design and be not less than two compartments. Structural requirements shall comply with Section H 501.0 of this appendix.

H 901.5 Location. Interceptors shall be located as close to the source as possible and be accessible for servicing. Necessary manholes for servicing shall be at grade level and be gastight.

H 901.6 Waste Discharge. Waste discharge from interceptors shall be permitted to be connected to a septic tank or other primary system or be disposed into a separate disposal system.

H 901.7 Design Criteria. A formula shall be permitted to be adapted to other types of occupancies with similar wastes. (See Chart H 901.7)

H 1001.0 Inspection and Testing.

H 1001.1 Inspection. Inspection requirements shall comply with the following:
(1) Applicable provisions of Section 105.0 of this code and this appendix shall be required. Plans shall be required in accordance with Section 103.3 of this code.
(2) System components shall be properly identified as to manufacturer. Septic tanks or other primary systems shall have the rated capacity permanently marked on the unit.
(3) Septic tanks or other primary systems shall be installed on dry, level, well-compacted soil.
(4) Where design is predicated on soil tests, the system shall be installed at the same location and depth as the tested area.

H 1001.2 Testing. Testing requirements shall comply with the following:
(1) Septic tanks or other primary components shall be filled with water to flow line before requesting an inspection. Seams or joints shall be left exposed (except the bottom), and the tank shall remain watertight.
(2) A flow test shall be performed through the system to the point of effluent disposal. All lines and components shall be watertight. Capacities required air space, and fittings shall comply with the provisions outlined in this appendix.

### Table H 901.7

<table>
<thead>
<tr>
<th>RECOMMENDED DESIGN CRITERIA</th>
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<tbody>
<tr>
<td><strong>GREASE AND GARBAGE, COMMERCIAL KITCHENS</strong></td>
</tr>
<tr>
<td>Number of meals per peak hour x</td>
</tr>
<tr>
<td><strong>SAND-SILT OIL, AUTO WASHERS</strong></td>
</tr>
<tr>
<td>Number of meals per peak hour x</td>
</tr>
<tr>
<td><strong>SILT-LINT GREASE, LAUNDRIES, LAUNDROMATS</strong></td>
</tr>
<tr>
<td>Number of machines x</td>
</tr>
</tbody>
</table>

Notes:
1 For waste flow rate see Table H 201.1(4).
2 Retention Times:
(a) Kitchen (commercial) – with dishwasher, garbage disposal, or both = 2.5 hours
(b) Kitchen (single service) – with garbage disposal = 1.5 hours
(c) Auto Washers (sand-silt oil) = 2.0 hours
(d) Laundries/Laundromats = 2.0 hours

3 Storage Factors:
(a) Kitchen (commercial) – with 8 hours operation = 1
(b) Kitchen (commercial) – with 16 hours operation = 2
(c) Kitchen (commercial) – with 24 hours operation = 3
(d) Kitchen (single service) = 1.5
(e) Auto Washers (sand-silt oil) – with self service = 1.5
(f) Auto Washers (sand-silt oil) – with employee operated = 2
(g) Laundries/Laundromats – with rock filter = 1.5 hours

H 1101.0 Abandoned Sewers and Sewage Disposal Facilities.
H 1101.1 Plugged and Capped. An abandoned building (house) sewer, or part thereof, shall be plugged or capped in an approved manner within 5 feet (1524 mm) of the property line.
H 1101.2 Fill Material. A cesspool, or septic tank, or seepage pit that has been abandoned or has been discontinued otherwise from further use, or to which no waste or soil pipe from a plumbing fixture is connected, shall have the sewage removed therefrom and be completely filled with the earth, sand, gravel, concrete, or other approved material.
H 1101.3 Filling Requirements. The top cover or arch over the cesspool, or septic tank, or seepage pit shall be removed before filling, and the filling shall not extend above the top of the vertical portions of the sidewalls or above the level of any outlet pipe until inspection has been called and the cesspool, septic tank, or seepage pit has been inspected. After such inspection, the cesspool, or septic tank, or seepage pit shall be filled to the level of the top of the ground.
H 1101.4 Owner. No person owning or controlling a cesspool, or septic tank, or seepage pit on the premises of such person or in that portion of any public street, alley, or other public property abutting such premises shall fail, refuse, or neglect to be in accordance with the provisions of this section or upon receipt of notice so to be in accordance with the Authority Having Jurisdiction.
H 1101.5 Permittee. Where disposal facilities are abandoned consequent to connecting any premises with the public sewer, the permittee making the connection shall fill all abandoned facilities in accordance with the Authority Having Jurisdiction within 30 days from the time of connecting to the public sewer.

H 1201.0 Drawings and Specifications.
H 1201.1 General. The Authority Having Jurisdiction, Health Officer, or other department having jurisdiction shall be permitted to require the following information before a permit is issued for a private sewage disposal system or at a time during the construction thereof:
(1) Plot plan drawn to scale, completely dimensioned, showing direction and approximate slope of surface, location of present or proposed retaining walls, drainage channels, water supply lines or wells, paved areas and structures on the plot, number of bedrooms or plumbing fixtures in each structure, and location of the private sewage disposal system with relation to lot lines and structures.
(2) Details of construction necessary to ensure compliance with the requirements of this appendix together with a full description of the complete installation including quality, kind, and grade of materials, equipment, construction, workmanship, and methods of assembly and installation.
(3) A log of soil formations and groundwater levels as determined by test holes dug in close proximity to a proposed seepage pit or disposal field, together with a statement of water absorption characteristics of the soil at the proposed site, as determined by approved percolation tests.

SUBSTANTIATION:
Section H 101.11 is being updated to clarify that Appendix H (Private Sewage Disposal Systems) recognizes pressure systems which are used throughout the nation. These types of systems are similar in fashion and design,
however, unique in how they are implemented.

Section H 201.1: The last sentence in Section H 201.1 is being stricken as it is not relevant to this section. Table H 201.1(2) is specific to drain field sizing which is covered in H 301.0. Table H and H 401. (3) is being stricken as it is not a valid parameter used in sizing drainage fields.

Section H 401.1 (Pit Sizes): This section is being rewritten as it does not have any provisions related to soil conditions, wastewater flow, water quality, or soil verifications. These soil conditions are now addressed in the new replacement of Section H 401.1 (General).

Section H 501.4: Adds provision for filters on the outlet side of septic tanks. This will increase the longevity of the disposal of the drain field.

Section 501.6: This updates the minimum inlet and outlet pipe diameter minimum to 3 inches as the UPC permits a building sewer size of 3 inches.

Section H 601.4 (Seepage Pits) and H 701.0 (Seepage Pits): These sections on seepage pits are being removed as there is a concern about their design and these systems may endanger ground water quality. The reference to seepage pits is being stricken throughout Appendix H. See the following EPA article for more information: https://www.epa.gov/sites/default/files/2015-06/documents/seepagepits.pdf

Section H 601.6: Field fabricated manifolds are a common practice in the field. This update will ensure that the proper fittings and piping are used when field-fabricating such manifolds. Additionally, the update clarifies that manifolds and distribution boxes should be supported and placed level to allow for even flow of the effluent.

Section H 601.8 (Dosing Tanks); H 501.4, and 601.9 (Construction) adds the phrase "Unless otherwise required by the AHJ to acknowledges that the existing text is providing guidance and provisions for such systems, but recognized that jurisdictions may already have local provisions.

Table H 601.9 is updating the minimum filter depth filter material from 12 to 6 inches. 12 inches is overly stringent as the industry standard is 6 inches. The local jurisdiction can always require more.

Section 801.1: This section is being replaced by a new general section which better addresses cesspools as a temporary system and not to be considered a permanent system. The EPA does not regulate residential cesspools, but they do regulate (aka have banned) large-capacity cesspools.

A cesspool connected solely to a single-family residence which does not serve any other structure and does not receive any waste other than residential sanitary waste is considered a small-capacity cesspool and is not federally regulated. Small-capacity cesspools may be regulated by state and local governmental agencies (e.g., departments of health). Cesspools that serve multiple residential units, including townhouse complexes or apartments, are large-capacity cesspools.

In 2000, EPA banned the construction of new large-capacity cesspools (LCCs) and required all existing large-capacity cesspools to be closed by April 5, 2005. Any cesspools that treat waste other than sanitary waste (e.g., from commercial or industrial processes) are subject to Safe Drinking Water Act's Underground Injection Control (UIC) regulations. https://www.epa.gov/uic/large-capacity-cesspools#what_not

Hawaii is the only state to create a mandate to convert all cesspools by 2050. Specifically, the Hawaii Department of Health Wastewater Branch oversees and permits all onsite wastewater systems, including cesspools, and require that cesspools of any size be upgraded, converted, or closed by January 1, 2050. (https://www.epa.gov/uic/cesspools-hawaii | US EPA) This page will help you provide general information about
large-capacity cesspools, why large-capacity cesspools are banned, how to properly close them when no longer in use.
H 101.2 General Requirements. Where permitted by Section 713.0, the building sewer shall be permitted to be connected to a private sewage disposal system in accordance with the provisions of this appendix. The type of system shall be determined on the basis of location, soil porosity, and groundwater level, and shall be designed to receive all sewage from the property. The system, except as otherwise approved, shall consist of a septic tank with effluent discharging into a subsurface disposal field, into one or more seepage pits, or into a combination of subsurface disposal field and seepage pits. The Authority Having Jurisdiction shall be permitted to grant exceptions to the provisions of this appendix for permitted structures that have been destroyed due to fire or natural disaster, and that cannot be reconstructed in compliance with these provisions provided that such exceptions are the minimum necessary.

H 101.4 Septic Tank and Disposal Dispersal Field Systems. Disposal systems shall be designed to utilize the most porous or absorptive portions of the soil formation. Where the groundwater level extends to within 12 feet (3658 mm) or less of the ground surface or where the upper soil is porous, and the underlying stratum is rock or impervious soil, a septic tank and disposal dispersal field system shall be installed.

H 101.9 Building Permit. Where there is insufficient lot area or improper soil conditions for sewage disposal for the building or land use proposed, and the Authority Having Jurisdiction so finds, no building permit shall be issued, and no private sewage disposal shall be permitted. Where space or soil conditions are critical, no building permit shall be issued until engineering data, and test reports satisfactory to the Authority Having Jurisdiction have been submitted and approved.

| LOCATION OF SEWAGE DISPOSAL DISPER
SAL SYSTEM | MINIMUM HORIZONTAL DISTANCE | BUILDING SEWER SEPTIC TANK DISPOSAL FIELD SEEPAGE PIT OR CESSPOOL |
<table>
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<tr>
<td>Streams and other bodies of water</td>
<td>50 feet</td>
<td>50 feet</td>
<td>100 feet</td>
<td>150 feet</td>
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<tr>
<td>Trees</td>
<td>–</td>
<td>10 feet</td>
<td>–</td>
<td>10 feet</td>
</tr>
<tr>
<td>Seepage pits or cesspools</td>
<td>–</td>
<td>5 feet</td>
<td>5 feet</td>
<td>12 feet</td>
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<tr>
<td>Disposal dispersal field</td>
<td>–</td>
<td>5 feet</td>
<td>4 feet</td>
<td>4 feet</td>
</tr>
</tbody>
</table>

Notes:
1-6 (remaining text unchanged)
7 These minimum clear horizontal distances shall also apply to disposal dispersal fields, seepage pits, and the mean high-tide line.
Where disposal dispersal fields, seepage pits, or both are installed in sloping ground, the minimum horizontal distance between any part of the leaching system and ground surface shall be 15 feet (4572 mm).

(portions of table not shown remain unchanged)

H 301.0 Area of Disposal Dispersal Fields and Seepage Pits.

H 301.1 General. The minimum effective absorption area in disposal dispersal fields in square feet (m$^2$), and in seepage pits in square feet (m$^2$) of sidewall, shall be predicated on the required septic tank capacity of gallons (liters), estimated waste/sewage flow rate, or whichever is greater, and shall be in accordance with Table H 201.1(2) as determined by the type of soil found in the excavation, and shall be as follows:

(1) Where disposal dispersal fields are installed, not less than 150 square feet (13.9 m$^2$) of trench bottom shall be provided for each system exclusive of any hard pan, rock, clay, or other impervious formations. Sidewall area more than the required 12 inches (305 mm) and not exceeding 36 inches (914 mm) below the leach line shall be permitted to be added to the trench bottom area where computing absorption areas.

(2)-(5) (remaining text unchanged)

(6) Systems that combine treatment and disposal dispersal of sewage within a single footprint and comply with NSF 40 Class 1 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2) for both leach lines and leach beds. No system component for a combined treatment and disposal dispersal leach line or leach bed shall be located within 2 feet (610 mm) of the water table nor to a depth where sewage is capable of contaminating the underground water stratum that is usable for domestic purposes. Combined treatment and disposal dispersal system operation and maintenance shall be in accordance with the manufacturer’s instructions.

Exception: Combined treatment and disposal dispersal systems tested and certified in a bed configuration in accordance with NSF 40 Class 1 are exempted from the requirements of Section H 301.1(2).

H 401.0 Percolation Test.

H 401.1 Pit Sizes. Where practicable, disposal dispersal field and seepage pit sizes shall be computed from Table H 201.1(2). Seepage pit sizes shall be computed by percolation tests unless use of Table H 201.1(2) is approved by the Authority Having Jurisdiction.

H 501.0 Septic Tank Construction.

H 501.8 Free Vent Area. Inlet and outlet pipe fittings or baffles and compartment partitions shall have a free vent area equal to the required cross-sectional area of the house sewer or private sewer discharging therein to provide free ventilation above the water surface from the disposal dispersal field or seepage pit through the septic tank, house sewer, and stack to the outer air.

H 601.0 Disposal Dispersal Fields.

H 601.2 Filter Material. Before placing filter material or drain lines in a prepared excavation, smeared or compacted surfaces shall be removed from trenches by raking to a depth of 1 inch (25.4 mm) and the loose material removed. Clean stone, gravel, slag, or similar filter material acceptable to the Authority Having Jurisdiction, varying in size from $\frac{3}{4}$ of an inch to $2\frac{1}{2}$ inches (19.1 mm to 64 mm), shall be placed in the trench to the depth and grade required by this section. Drainpipe shall be placed on filter material in an approved manner. The drain lines shall then be covered with filter material to the minimum depth required by this section, and this material covered with untreated building paper, straw, or similar porous material to prevent the closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.
**Exception:** Listed or approved plastic leaching chambers, bundled expanded polystyrene synthetic aggregate units, and systems that treat and dispose of sewage within a single footprint, as described in Section H 301.1(5) and Section H 301.1(6), shall be permitted to be used in lieu of pipe and filter material. Chamber, bundled expanded polystyrene synthetic aggregate unit, and systems that treat and dispose of sewage within a single footprint, installations shall follow the rules for disposal fields, where applicable, and shall be in accordance with the manufacturer’s instructions.

**H 601.4 Seepage Pits.** Where seepage pits are used in combination with disposal fields, the filter material in the trenches shall terminate not less than 5 feet (1524 mm) from the pit excavation, and the line extending from such points to the seepage pit shall be approved pipe with watertight joints.

**H 601.5 Distribution Boxes.** Where two or more drain lines are installed, an approved distribution box of sufficient size to receive lateral lines shall be installed at the head of each disposal field. The invert of outlets shall be level, and the invert of the inlet shall be not less than 1 inch (25.4 mm) above the outlets. Distribution boxes shall be designed to ensure equal flow and shall be installed on a level concrete slab in natural or compacted soil.

**H 601.6 Laterals.** Laterals from a distribution box to the disposal field shall be approved pipe with watertight joints. Multiple disposal field laterals, where practicable, shall be of uniform length.

**H 601.9 Construction.** Disposal fields shall be constructed in accordance with Table H 601.9. Minimum spacing between trenches or leaching beds shall be not less than 4 feet (1219 mm) plus 2 feet (610 mm) for each additional foot (305 mm) of depth more than 1 foot (305 mm) below the bottom of the drain line. Distribution drain lines in leaching beds shall be not more than 6 feet (1829 mm) apart on centers, and no part of the perimeter of the leaching bed shall exceed 3 feet (914 mm) from a distribution drain line. Disposal fields, trenches, and leaching beds shall not be paved over or covered by concrete or a material that is capable of reducing or inhibiting a possible evaporation of sewer effluent.

<table>
<thead>
<tr>
<th>TABLE H 601.9</th>
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<tbody>
<tr>
<td>GENERAL DISPOSAL DISPERSAL FIELD REQUIREMENTS</td>
</tr>
<tr>
<td>(portions of table not shown remain unchanged)</td>
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</table>

**H 1201.0 Drawings and Specifications.**

**H 1201.1 General.** The Authority Having Jurisdiction, Health Officer, or other department having jurisdiction shall be permitted to require the following information before a permit is issued for a private sewage disposal system or at a time during the construction thereof:

(1)-(2) (remaining text unchanged)

(3) A log of soil formations and groundwater levels as determined by test holes dug in close proximity to a proposed seepage pit or disposal field, together with a statement of water absorption characteristics of the soil at the proposed site, as determined by approved percolation tests.

**SUBSTANTIATION:**

This proposal is to change the term “disposal” to “dispersal” within Appendix H when the term “disposal” refers to a mechanism that distributes wastewater within the subsurface environment. This proposed context change pertains to aligning the spirit of the UPC with contemporary environmental concerns and does not change technical requirements.

At a time of increasing environmental consciousness and elevated need for groundwater resource protection, differentiating between a wastewater “disposal” system and the portion of the wastewater system that responsibly “disperses” effluent is important. The USEPA Onsite Wastewater Treatment Systems Manual differentiates sewage “disposal” systems from effluent “dispersal” systems, where “dispersal” is the process of distributing effluent to the
subsurface environment. According to USEPA, subsurface wastewater infiltration systems provide wastewater treatment and dispersal through soil purification processes.

Therefore, “dispersal” is the responsible and protective end-stage process provided by the sewage “disposal” system. This change will align the UPC with the USEPA Onsite Wastewater Treatment Systems Manual as well as numerous regulatory agency regulatory documents being used across the nation.
H 1101.0 Interceptors and Separators.

H 1101.1 Devices and Systems. Interceptors (clarifiers) and separators shall be required where necessary for the proper handling of sewage and liquid wastes containing fats, oil, and grease, detrimental to the building drainage system or sewage disposal system. Interceptor and separator devices and systems shall be in accordance with the referenced standards for fats, oil, and grease (FOG) in Table 1009.1.

(renumber remaining sections)

(shown for information purposes only)

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>STANDARD</th>
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<tbody>
<tr>
<td>Solid Waste</td>
<td>IAPMO IGC 167</td>
</tr>
<tr>
<td>Non-petroleum Oil</td>
<td>ASME A112.14.6, IAPMO PS 80, PDI G-102</td>
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<td>Petroleum Oil</td>
<td>ASTM D6104, IAPMO IGC 183, IAPMO IGC 325</td>
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</table>

SUBSTANTIATION:
This proposal is modeled from the requirements set forth in Section 1009.1. It provides a means of referencing grease interceptors incorporated into private sewage disposal systems, which is common practice for establishments not connected to a centralized sewer system. Interceptors are described in Chapter 10. This proposal requires that interceptors in private sewage disposal systems conform with the standards in Table 1009.1 where required by the AHJ.

If approved, existing Sections H 1001, H 1101, and H 1201 should be renumbered accordingly.
H 301.0 Area of Disposal Fields and Seepage Pits.

H 301.1 General. The minimum effective absorption area in disposal fields in square feet (m²), and in seepage pits in square feet (m²) of sidewall, shall be predicated on the required septic tank capacity of gallons (liters), estimated waste/sewage flow rate, or whichever is greater, and shall be in accordance with Table H 201.1(2) as determined by the type of soil found in the excavation, and shall be as follows:

(1)-(4) (remaining text unchanged)

(5) Gravelless effluent dispersal systems, such as leaching chambers that comply with IAPMO PS 63 and bundled expanded polystyrene synthetic aggregate units that comply with IAPMO IGC 276 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2).

(6) (remaining text unchanged)

SUBSTANTIATION:

This proposal assigns industry terminology and clarifies the intent of gravelless effluent dispersal systems, which are designed and manufactured to be installed without filter material (stone, gravel, or slag per Appendix H 601.2), thus the broadly used term "gravelless" technologies.

Some regulators are unclear about the proper usage of gravelless systems, resulting in requirements to include filter material around gravelless systems in a trench or bed, which is not the intent.

Since 2002, the USEPA Onsite Wastewater Treatment Systems Manual has referred to this class of effluent dispersal media as “gravelless wastewater dispersal systems”. According to USEPA, gravelless systems “take many forms, including open-bottomed chambers, fabric-wrapped pipe, and synthetic materials such as expanded polystyrene foam chips”.

Numerous state regulatory agencies having oversight over private sewage disposal systems also use the term “gravelless wastewater dispersal systems”. The proposed addition identifies these media using the most modern, contemporary terminology.

Reformatting of the 2024 UPC included adding “/ANSI” to NSF International standard references. The “NSF 40” reference in Appendix H 301.1(6). The proposed change makes Appendix H consistent with other Code text.
Proposed Text:

H 301.0 Area of Disposal Fields and Seepage Pits.

H 301.1 General. The minimum effective absorption area in disposal fields in square feet (m²), and in seepage pits in square feet (m²) of sidewall, shall be predicated on the required septic tank capacity of gallons (liters), estimated waste/sewage flow rate, or whichever is greater, and shall be in accordance with Table H 201.1(2) as determined by the type of soil found in the excavation, and shall be as follows:

1) (renumber remaining sections)

5) Leaching chambers that comply with IAPMO PS 63 and bundled expanded polystyrene synthetic aggregate units that comply with IAPMO IGC 276 shall be sized using a 0.70 equivalency multiplier applied to the required area in Table H 201.1(2).

6) Systems that combine treatment and disposal of sewage within a single footprint and comply with NSF 40 Class 1 shall be sized using a 0.70 equivalency multiplier applied to the required area in Table H 201.1(2) for both leach lines and leach beds. No system component for a combined treatment and disposal leach line or leach bed shall be located within 2 feet (610 mm) of the water table nor to a depth where sewage is capable of contaminating the underground water stratum that is usable for domestic purposes. Combined treatment and disposal system operation and maintenance shall be in accordance with the manufacturer's instructions.

Exception: Combined treatment and disposal systems tested and certified in a bed configuration in accordance with NSF 40 Class 1 are exempted from the requirements of Section H 301.1(2).

SUBSTANTIATION:

This proposal clarifies the purpose of the 0.70 multiplier, which is to size the disposal system receiving treated effluent such that it is hydraulically equivalent to a disposal field receiving septic tank effluent that does not meet NSF/ANSI 40 Class I water quality standards. The dispersal of treated effluent does not require as much area as the dispersal of septic tank effluent due to the reduced organic materials in the treated effluent. Some users and regulators are unclear about the rationale for using a 0.70 multiplier for treated effluent, and this change will improve user comprehension.
RECOMMENDATION:
Revise text

Proposed Text:
H 301.0 Area of Disposal Fields and Seepage Pits.

H 301.1 General. The minimum effective absorption area in disposal fields in square feet ($m^2$), and in seepage pits in square feet ($m^2$) of sidewall, shall be predicated on the required septic tank capacity of gallons (liters), estimated waste/sewage flow rate, or whichever is greater, and shall be in accordance with Table H 201.1(2) as determined by the type of soil found in the excavation, and shall be as follows:
(1) - (4) (remaining text unchanged)
(5) Leaching chambers that comply with IAPMO PS 63 and bundled expanded polystyrene synthetic aggregate units that comply with IAPMO IGC 276 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2).
(6) (remaining text unchanged)

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<td>IAPMO PS 63-2019</td>
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<td>DWV Components</td>
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<tr>
<td>IAPMO Z1386-202X (Working Draft)</td>
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</table>

(portions of the table not shown remain unchanged)

Note: IAPMO Z1386 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
The IAPMO PS 63 standard is being updated as an ANSI designated National Standards (IAPMO Z1386).
Proposed Text:
H 501.0 Septic Tank Construction.

H 501.14 Prefabricated Septic Tanks. Prefabricated septic tanks shall comply with the following requirements:
(1) Manufactured or prefabricated septic tanks shall comply with IAPMO/ANSI Z1000, IAPMO IGC 262, or CSA B66 and be approved by the Authority Having Jurisdiction. Prefabricated bituminous coated septic tanks shall comply with UL 70.
(2) Independent laboratory tests and engineering calculations certifying the tank capacity and structural stability shall be provided as required by the Authority Having Jurisdiction.
(3) All manholes that can be removed and in which pose a risk of accidental entry shall have a secondary safety device that can withstand a 200 lb (91 kg) dead load.

SUBSTANTIATION:
This proposal is intended to increase the safety of septic tanks by reducing the risk that people inadvertently fall into an open manhole. On a regular basis, people accidentally fall into septic tanks for which the manhole lid was not secured. If the tank has been pumped, this often results in injury. If the tank contains sewage, this often results in drowning death, with children being disproportionally affected by this type of accident. This proposal is to add a requirement for a secondary lid or device below the manhole lid on the ground surface. The secondary lid or device would provide a safety barrier for a person who steps on an unsecured lid or who steps across an open manhole without a lid.
**Item #:** 271  
**Code Number:** 2024 UPC  
**Section Number:** H 501.14

**SUBMITTER:** Peter Gavin  
**Organization Name:** Polylok, Inc.  
**Organization Representation:** Peter Gavin

**RECOMMENDATION:**  
Add new text

**Proposed Text:**

**H 501.14 Prefabricated Septic Tanks.** Prefabricated septic tanks shall comply with the following requirements:

1. Manufactured or prefabricated septic tanks shall comply with IAPMO/ANSI Z1000, IAPMO IGC 262, or CSA B66 and be approved by the Authority Having Jurisdiction. Prefabricated bituminous coated septic tanks shall comply with UL 70.
2. Independent laboratory tests and engineering calculations certifying the tank capacity and structural stability shall be provided as required by the Authority Having Jurisdiction.
3. All manholes that can be removed and in which there is a risk of accidental entry shall have a secondary safety device that can withstand a 200 lb (91 kg) dead load.

**SUBSTANTIATION:**

This proposal is intended to increase the safety of septic tanks by reducing the risk that people inadvertently fall into an open manhole. On a regular basis, people accidentally fall into septic tanks for which the manhole lid was not secured. If the tank has been pumped, this often results in injury. If the tank contains sewage, this often results in drowning death, with children being disproportionally affected by this type of accident. This proposal is to add a requirement for a secondary lid or device below the manhole lid on the ground surface. The secondary lid or device would provide a safety barrier for a person who steps on an unsecured lid or who steps across an open manhole without a lid.
H 501.14 Prefabricated Septic Tanks. Prefabricated septic tanks shall comply with the following requirements:

1. Manufactured or prefabricated septic tanks shall comply with IAPMO/ANSI Z1000, IAPMO IGC 262, or CSA B66 and be approved by the Authority Having Jurisdiction. Prefabricated bituminous coated septic tanks shall comply with UL 70.

2. Independent laboratory tests and engineering calculations certifying the tank capacity and structural stability shall be provided as required by the Authority Having Jurisdiction.

3. Manholes with a diameter greater than 8 inches (200 mm), that extend to grade, have a cover that can be removed, and in which there is a risk of accidental entry into the septic tank, shall have a secondary safety device that can withstand a 200 pounds (91 kg) dead load.

SUBSTANTIATION:
This proposal is intended to increase the safety of septic tanks by reducing the risk that people inadvertently fall into an open manhole. On a regular basis, people accidentally fall into septic tanks for which the manhole lid was not secured. If the tank has been pumped, this often results in injury. If the tank contains sewage, this often results in drowning death, with children being disproportionately affected by this type of accident. This proposal is to add a requirement for a secondary lid or device below the manhole lid on the ground surface. The secondary lid or device would provide a safety barrier for a person who steps on an unsecured lid or who steps across an open manhole without a lid.
RECOMMENDATION:
Revise text

Proposed Text:
H 501.0 Septic Tank Construction.

H 501.5 Access. Access to each septic tank shall be provided by not less than two manholes 20 inches (508 mm) in minimum dimension or by an equivalent removable cover slab. One access manhole shall be located over the inlet, and one access manhole shall be located over the outlet. Where a first compartment exceeds 12 feet (3658 mm) in length, an additional manhole shall be provided over the baffle wall. Manholes that can be removed and in which pose a risk of accidental entry shall have a secondary safety device that can withstand a 200 lb (91 kg) dead load.

SUBSTANTIATION:
This proposal is intended to increase the safety of septic tanks by reducing the risk that people inadvertently fall into an open manhole. On a regular basis, people accidentally fall into septic tanks for which the manhole lid was not secured. If the tank has been pumped, this often results in injury. If the tank contains sewage, this often results in drowning death, with children being disproportionally affected by this type of accident. This proposal is to add a requirement for a secondary lid or device below the manhole lid on the ground surface. The secondary lid or device would provide a safety barrier for a person who steps on an unsecured lid or or who steps across an open manhole without a lid.
RECOMMENDATION:
Add new text

Proposed Text:
H 501.5 Access. Access to each septic tank shall be provided by not less than two manholes 20 inches (508 mm) in minimum dimension or by an equivalent removable cover slab. One access manhole shall be located over the inlet, and one access manhole shall be located over the outlet. Where a first compartment exceeds 12 feet (3658 mm) in length, an additional manhole shall be provided over the baffle wall.

All manholes that can be removed and in which there is a risk of accidental entry shall have a secondary safety device that can withstand a 200 lb (91 kg) dead load.

SUBSTANTIATION:
This proposal is intended to increase the safety of septic tanks by reducing the risk that people inadvertently fall into an open manhole. On a regular basis, people accidentally fall into septic tanks for which the manhole lid was not secured. If the tank has been pumped, this often results in injury. If the tank contains sewage, this often results in drowning death, with children being disproportionally affected by this type of accident. This proposal is to add a requirement for a secondary lid or device below the manhole lid on the ground surface. The secondary lid or device would provide a safety barrier for a person who steps on an unsecured lid or who steps across an open manhole without a lid.
RECOMMENDATION:
Revise text

Proposed Text:
H 501.0 Septic Tank Construction.

H 501.5 Access. Access to each septic tank shall be provided by not less than two manholes 20 inches (508 mm) in minimum dimension or by an equivalent removable cover slab. One access manhole shall be located over the inlet, and one access manhole shall be located over the outlet. Where a first compartment exceeds 12 feet (3658 mm) in length, an additional manhole shall be provided over the baffle wall. Manholes with a diameter greater than 8 inches (200 mm), that extend to grade, have a cover that can be removed, and in which pose a risk of accidental entry into the septic tank, shall have a secondary safety device that can withstand a 200 pound (91 kg) dead load.

SUBSTANTIATION:
This proposal is intended to increase the safety of septic tanks by reducing the risk that people inadvertently fall into an open manhole. On a regular basis, people accidentally fall into septic tanks for which the manhole lid was not secured. If the tank has been pumped, this often results in injury. If the tank contains sewage, this often results in drowning death, with children being disproportionally affected by this type of accident. This proposal is to add a requirement for a secondary lid or device below the manhole lid on the ground surface. The secondary lid or device would provide a safety barrier for a person who steps on an unsecured lid or who steps across an open manhole without a lid.

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H 601.2 Filter Material. Before placing filter material or drain lines in a prepared excavation, smeared or compacted surfaces shall be removed from trenches by raking to a depth of 1 inch (25.4 mm) and the loose material removed. Clean stone, gravel, slag, or similar filter material acceptable to the Authority Having Jurisdiction, varying in size from $\frac{3}{4}$ of an inch to $2\frac{1}{2}$ inches (19.1 mm to 64 mm), shall be placed in the trench to the depth and grade required by this section. Drainpipe shall be placed on filter material in an approved manner. The drain lines shall then be covered with filter material to the minimum depth required by this section, and this material covered with untreated building paper, straw, or similar porous material to prevent the closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.

Exception: Listed or approved plastic leaching chambers, bundled expanded polystyrene synthetic aggregate units, and systems that treat and dispose of sewage within a single footprint, as described in Section H 301.1(5) and Section H 301.1(6), shall be permitted to be used in lieu of pipe and filter material. ChamberInstallation of chambers, bundled expanded polystyrene synthetic aggregate units, and systems that treat and dispose of sewage within a single footprint, installations shall follow the rules for disposal fields, where applicable, shall be permitted to be installed without filter material, and shall be in accordance with the manufacturer’s instructions.

SUBSTANTIATION:
This proposal clarifies the intent of plastic leaching chambers, bundled expanded polystyrene synthetic aggregate units, and systems that treat and dispose of sewage, which are designed and manufactured to be installed without filter material (stone, gravel, or slag per Appendix H 601.2). Some AHJs require the use of filter material in addition to the gravelless effluent dispersal system, which is a costly, duplicative requirement that serves no useful purpose.
K 101.2 System Design. Potable rainwater catchment systems shall comply with ARCSA/ASPE/ANSI 63. Potable rainwater catchment systems shall be designed, installed, and inspected in accordance with this appendix. They shall be designed by a registered design professional or person deemed competent by personnel qualified in accordance with ASSE 21000 or as required by the Authority Having Jurisdiction to perform potable rainwater catchment system design work. Where required, rainwater catchment systems shall be seismically restrained against earthquakes in accordance with the building code.

K 104.0 Design and Installation.

K 104.3 Pre-Tank Filtration. By way of a debris excluder, first flush device or a rainwater pre-tank filter unit, all harvested rainwater entering a rainwater storage tank shall be filtered to a level not less than 400 microns (μm). The filtration device or method shall be accessible, sized and installed in accordance with manufacturer’s installation instructions. Such units shall be designed to have the capacity to handle the maximum flow rate of the inlet pipe size. Unit shall allow for access to the filtration system for routine maintenance.

K 105.0 Rainwater Storage Tanks.

K 105.3 Location. (remaining text unchanged)

K 105.3.1 Above Grade. Above grade, storage tanks shall be of an opaque material, approved for aboveground use in direct sunlight, or shall be shielded from direct sunlight. Tanks shall be installed in an accessible location to allow for inspection and cleaning. The tank shall be installed on a foundation or platform that is constructed to accommodate the weight and loads when filled to maximum capacity in accordance with the building code. The tank shall have a manhole and lid with a minimum diameter of 24 inches (610 mm).

K 105.3.2 Below Grade. Rainwater storage tanks installed below grade shall be structurally designed to withstand anticipated earth or other loads. Holding tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft²) (1465 kg/m²) where the tank is designed for underground installation. Below grade rainwater tanks installed underground shall be provided with manholes. The manhole opening shall be not less than 28 inches (711 mm) in diameter and located not less than 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground where empty. The combined weight of the tank and hold down system shall meet or exceed the buoyancy force of the tank.

K 105.10 Storage Tank Venting. Where venting using drainage or overflow piping is not provided or is considered
insufficient, a vent shall be installed on each tank. The vent shall extend from the top of the tank and terminate not less than 6 inches (152 mm) above grade and shall be not less than $1\frac{1}{2}$ inches (40 mm) in diameter. The vent terminal shall be directed downward and covered with a $\frac{3}{32}$ of an inch (2.4 mm) mesh screen to prevent the entry of vermin and insect. **When the tank overflow is equipped with a backwater valve in accordance with Section 1603.9, the Storage Tank Vent shall be sized in accordance with Section 1603.9.1.**

**K 105.11 Pumps.** Pumps serving rainwater catchment systems shall be listed for potable water use. Pumps supplying water to water closets, urinals, and trap primers shall be capable of delivering not less than the minimum residual pressure required by the highest and most remote outlet served. Where the water pressure in the rainwater supply system within the building exceeds 80 psi (552 kPa), a pressure reducing valve reducing the pressure to 80 psi (552 kPa) or less to water outlets in the building shall be installed in accordance with this code. **Pump inlets located in rainwater storage tanks shall be located not less than 6 inches (152 mm) off of the floor of the tank or other means shall be used to ensure that the pump does not pull debris from the bottom 6 inches (152 mm) of the tank.**

**SUBSTANTIATION:**
Appendix K is being updated to match similar changes recommended to Chapter 16 in a separate proposal. The appendix is being updated to coincide with the industry changes and the ARCSA/ASPE/ANSI 62-2023 updates as well as the now available professional standards.

The new Section K 104.2 (Pre-Tank Filtration) is being added in place of roof washers. Roof washers are substandard equipment and are now out of date; no one is using them. The 400-micron level is needed to keep trash and debris out of rainwater systems. All established pre-filters are at this micron level. European standards are at this level. Keeps particles small so biofilms can break them down.

Section K 105.3.1 (Above Grade) is being updated to add provisions for manway and lid minimum openings. Some tanks are designed with 20-inch entries which are too small, 24 inch is better and for those like the below grade entries that may have ladders a 28-inch entry should be used. Additionally, Section K 105.3.2 (Below Grade) is being updated with respect to manhole openings. Some tanks are designed with 20-inch entries which are too small, 24 inch is better and for those like the below grade entries that may have ladders a 28-inch entry should be used.

Section K 105.10 (Storage Tank Venting) refers to similar requirements in Section 1603.9 and Section 1603.9.1.

For Section K 105.11 (Pumps), the six inches from the floor will correlate with the latest edition of the 2023 ARSCA/ASPE/ANSI 63 draft standard. The 6 inches will ensure that sediment and debris is not pulled into the pump inlet and is also an industry standard. If the minimum distance is not achievable, then a means of preventing debris vacuuming shall be used.
Proposed Text:

K 101.0 General.

K 101.7 Minimum Water Quality Requirements. The minimum water quality for potable rainwater catchment systems shall comply with be in accordance with ARCSA/ASPE/ANSI 63 or shall meet the applicable water quality requirements as determined by the Authority Having Jurisdiction for private wells. In the absence of water quality requirements, the guidelines EPA/600/R 12/618 contains recommended water reuse guidelines to assist regulatory agencies develop, revise, or expand alternate water source water quality standards.

K 101.6 Operation and Maintenance Manual. (remaining text unchanged)

K 106.2.1 Size. The roof washer shall be sized to direct a sufficient volume of rainwater containing debris that has accumulated on the collection surface away from the storage tank. ARCSA/ASPE/ANSI 63 contains additional guidance on acceptable methods of sizing roof washers.

Note: See ARCSA/ASPE/ANSI 63 for additional guidance on acceptable methods of sizing roof washers.

SUBSTANTIATION:

The proposed updates will align with the 2023 WeStand. The substantiation provided for these changes is as follows: Reference has been made to ARCSA/ASPE/ANSI 63 (Rainwater Catchment Systems) as this standard establishes the minimum potable water quality parameters required at the point of use (POU) for harvested rainwater which are consistent with the potable water standards established by the U.S. EPA for drinking water. Additionally, the parameters dictated by ARCSA/ASPE/ANSI 63 are consistent with those found in Table K 104.3.3 (Minimum System Maintenance Requirements) and therefore presents no conflict if referenced in Section K 101.7 (Minimum Water Quality Requirements). The revision to Section K 106.2.1 (Size) is necessary as it identifies informative language as a "note" to the section and more appropriately directs the users to ARCSA/ASPE/ANSI 63 for additional guidance on acceptable methods of sizing roof washers.
**RECOMMENDATION:**

Revise text

**Proposed Text:**

K 103.0 Potable Rainfall Catchment System Materials.

K 103.1 Collections Surfaces. The collection surface for potable applications shall be constructed of a hard, impervious material and Roof materials containing lead, arsenic, or biocides shall not be approved for potable water use permitted. Roof coatings, paints, and liners shall comply with NSF Protocol P151.

K 103.2 Rainwater Catchment System Drainage Materials. Materials Gutters and downspouts used in rainwater catchment drainage systems, including gutters, downspouts, conductors, and leaders shall be in accordance with shall be made from metal or plastic pipe that meets the requirements of this code for storm drainage NSF/ANSI 14 and NSF/ANSI/CAN 61.

K 105.0 Rainwater Storage Tanks.

K 105.2 Construction. Rainwater storage tanks shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight. Storage tanks shall be listed to NSF/ANSI/CAN 61 and approved by the Authority Having Jurisdiction for potable water applications, provided such tanks comply with approved applicable standards.

**SUBSTANTIATION:**

The proposed updates will align with the 2023 WeStand.
RECOMMENDATION:
Revise text

Proposed Text:

TABLE K 104.3.1
MINIMUM WATER QUALITY

<table>
<thead>
<tr>
<th>TOTAL COLIFORM</th>
<th>NON-DETECTABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli (fecal coliform)</td>
<td>Non-detectable</td>
</tr>
<tr>
<td>Protozoan Cysts</td>
<td>Non-detectable</td>
</tr>
<tr>
<td>Viruses</td>
<td>Non-detectable</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&lt;0.3 NTU</td>
</tr>
</tbody>
</table>

K 104.0 Design and Installation.

K 104.3 Minimum Water Quality.

K 104.3.3 Maintenance. Normal system maintenance shall require system testing for total coliform. If a total coliform test is positive, the system shall be tested for Escherichia coli (fecal coliform). Total coliform and turbidity shall be tested every 3 months in accordance with Table K 104.3.3. Upon failure of the fecal coliform test, the system shall be re-commissioned involving cleaning, and retesting in accordance with Section K 104.3. Testing for viruses and cysts shall occur once after 3 months of initial operation and once every 12 months thereafter. Exception: Upon failure of the virus or cyst test, the tests will be repeated every 3 months until the tests results are negative for two consecutive tests.

TABLE K 104.3.3
MINIMUM SYSTEM MAINTENANCE REQUIREMENTS

<table>
<thead>
<tr>
<th>TOTAL COLIFORM</th>
<th>NON-DETECTABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli (fecal coliform)</td>
<td>Non-detectable</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&lt;0.3 NTU</td>
</tr>
</tbody>
</table>

SUBSTANTIATION:
The proposed updates will align with the 2023 WeStand. The substantiation provided for these changes is as follows: The additional parameters (shown as stricken) within Table K104.3.1 were reviewed during previous cycles for the WeStand, and it was determined that the inclusion of protozoan cysts and viruses is overly restrictive, costly, and impractical. Such testing is not required at this level unless serving over 100,000 people. For these reasons, the proposed parameters are being stricken. Additionally, Section K 104.3.3 is being updated to remove reference to testing of viruses.
RECOMMENDATION:
Revise text

Proposed Text:
K 104.0 Design and Installation.

K 104.4 Water Quality Devices and Equipment. (remaining text unchanged)

K 104.4.3 Filtration and Disinfection Systems. Filtration and disinfection systems shall be located after the water storage tank. Where a chlorination system is installed, it shall be installed upstream of filtration systems. Where an ultraviolet disinfection system is installed, a filter not more than minimum of 2 inline filters, one 5 microns (5 µm) filter followed by one 0.5-1 micron (0.5-1µm) filter, shall be installed upstream prior to the disinfection system.

SUBSTANTIATION:
The proposed update will correlate with the 2023 WeStand. The substantiation provided when introduced in the WeStand is as follows: Current literature on potable rainwater systems recommends two filters prior to a UV system to prevent the potential shading of a pathogen from the UV light. This will ensure the UV disinfection system renders all potential pathogens harmless. (Sources: Rainwater Harvesting: System Planning Manual by Texas A&M and ARCSA, and the book, Design for Water by Heather Kinkade-Levario).
SUBMITTER: Chris Quillen

Organization Name: ARCSA

RECOMMENDATION:
Revise text

Proposed Text:
K 105.0 Rainwater Storage Tanks and Components.
K 105.1 General. Rainwater storage tanks and components shall be installed in accordance with Section K 105.2 through Section K 105.10.

K 105.13 Roof Gutters. Gutters shall maintain a minimum slope and be sized in accordance with this code.
K 105.14 Drains, Conductors, and Leaders. The design and size of rainwater drains, conductors, and leaders shall comply with this code.
K 105.15 Size of Potable Water Piping. Potable rainwater system distribution piping shall be sized in accordance with this code for sizing potable water piping.

SUBSTANTIATION:
Sections K 106.3 through Section K 106.5 do not have anything to do with the leading section header K 106.0 (Freeze Protection) and are being relocated under Section K 105.0 (Rainwater Storage Tanks). The reference sections in Section K 105.1 are being updated to include the relocated sections. Additionally, the phrase “and components” is being added to indicate that Section K 105.0 covers more than just the tanks, as it also includes provisions on pumps and roof drains related to rainwater systems. Therefore, it is appropriate to relocate roof gutters, drains, conductors, leaders, and the piping related to the rainwater storage tanks under this section.
RECOMMENDATION:
Delete text without substitution

Proposed Text:

K 106.0 Freeze Protection.

K 106.2 Roof Washer or Pre-Filtration System. Collected rainwater shall pass through a roof washer or pre-filtration system before the water enters the rainwater storage tank. Roof washer systems shall comply with Section K 106.2.1 through Section K 106.2.4.

K 106.2.1 Size. The roof washer shall be sized to direct rainwater containing debris that has accumulated on the collection surface away from the storage tank. ARCSA/ASPE/ANSI 63 contains additional guidance on acceptable methods of sizing roof washers.

K 106.2.2 Debris Screen. The inlet to the roof washer shall be provided with a debris screen or other approved means that protects the roof washer from the intrusion of debris and vermin. Where the debris screen is installed, the debris screen shall be corrosion resistant and shall have openings not larger than \( \frac{3}{8} \) of an inch (12.7 mm).

K 106.2.3 Drain Discharge. Water drained from the roof washer, or pre-filter shall be diverted away from the storage tank and discharged to a disposal area that does not cause property damage or erosion. Roof washer drainage shall not drain over a public way.

K 106.2.4 Automatic Drain. Roof washing systems shall be provided with an automatic means of self-draining between rain events.

(renumber remaining sections)

SUBSTANTIATION:
The deletions of Section K 106.2 through K 106.2.4 for "Roof Washer or Pre-Filtration Systems" is to match a similar proposed change to Chapter 16 to remove roof washer references as they are old technology and no longer used in the industry. Additionally, these provisions have nothing to do with the leading section of K 106.0 for "freeze protection." For these reasons the sections are being removed.
TABLE K 101.5.1
MINIMUM POTABLE RAINWATER CATCHMENT SYSTEM TESTING, INSPECTION, AND MAINTENANCE

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MINIMUM FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform applicable water quality tests to verify compliance with Section K 104.3.</td>
<td>Every 3 months</td>
</tr>
<tr>
<td>Perform a water quality test for E. Coli, Total Coliform, and Heterotrophic bacteria. If total coliform test is positive, perform test for E. coli. For a system where 25 different people consume water from the system over a 60 day period, a water quality test for cryptosporidium shall also be performed.</td>
<td>After initial installation and every 12 months thereafter, or as directed by the Authority Having Jurisdiction.</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The proposed updates will align with the 2023 WeStand. The substantiation provided for these changes is as follows: This table has multiple requirements for maintaining water quality. The proposal requests to remove the one line of the table that points to another table with unobtainable testing requirements. With my revision the table requires water quality to be protected in three ways. 1) By complying with "inspect and verify that disinfection, filters and water quality treatment devices and systems are operational" the water will be safe to drink because these treatment devices are certified to remove pathogens and contaminants and to create potable water. 2) To "Perform any water quality tests as required by the Authority Having Jurisdiction" will allow the local AHJ to require testing for any known pollutants or contaminants in that area. 3) To "Perform a water quality test for E. coli, total coliform, and heterotrophic bacteria. If total coliform test is positive perform a test for E. coli" also requires water quality testing to ensure the system is safe for drinking. This is in line with EPA requirements for bacterial testing for public water systems (if their total coliform test if positive, then they test for E. coli.)
SUBMITTER: Emily Toto
Organization Name: ASHRAE

RECOMMENDATION:
Revise text

Proposed Text:
L 201.0 Definitions.
L 201.1 General. For the purpose of this appendix, the following definitions shall apply:
On-Site Renewable Energy. Energy generated from renewable resources produced at the building site. [ASHRAE 90.1:3.2]

SUBSTANTIATION:
This code change proposal is for alignment with Section 3.2 (Definitions) of ASHRAE 90.1-2022.
Proposed Text:
L 201.0 Definitions.
L 201.1 General. For the purpose of this appendix, the following definitions shall apply:
On-Site Renewable Energy. Energy generated from renewable resources produced at the building site. [ASHRAE 90.1:3.2]

SUBSTANTIATION:
This code change proposal is for alignment with Section 3.2 (Definitions) of ASHRAE 90.1-2022.
L 201.0 Definitions.
L 201.1 General. For the purpose of this appendix, the following definitions shall apply:

ET<sub>c</sub>. Evapotranspiration rate (in/hr) of the plants derived by multiplying ETo by the appropriate plant factor or coefficient.

ET<sub:o</sub>. Reference evapotranspiration rate (in/hr) for a cool-season grass as calculated by the standardized Penman-Monteith equation based on weather-station data.

Evapotranspiration (ET). The water transpired from vegetation, evaporated from the soil, water, and plant surfaces. Evapotranspiration rates are values expressed in inches (mm) per unit of time (day, week, month, or year). Evapotranspiration rates vary by components of weather conditions, including insolation, humidity, temperatures and wind, and time of year.

Common sources for obtaining local reference evapotranspiration rates are local agriculture extension services, state departments of agriculture, water agencies, irrigation professionals, the United States Geological Survey, and internet websites.

Reference Evapotranspiration (ET<sub:o</sub>). Numeric value, expressed in inches/hour (in/h), calculated as the water necessary to produce maximum biomass based upon a cool-season turf grass 4 inches to 6 inches (102 mm to 152 mm) tall. Common sources for obtaining local reference evapotranspiration rates are local agriculture extension services, state departments of agriculture, water agencies, irrigation professionals, the United States Geological Survey, and internet websites.

SUBSTANTIATION:
There currently exists two varying definitions for “reference evapotranspiration (ET<sub:o</sub>)” in Chapter 2 (Definitions). To mitigate this, the provided terminology for “ET<sub:o</sub>” offers a combination of the two and removes the duplicate definition found in Appendix L. The key difference between the two definitions is the language referencing the method of calculation.

The Food and Agriculture Organization uses the Penman-Monteith equation as the sole method for determining reference evapotranspiration rates as it has a strong likelihood for correct predictions over a wide range of locations and climates and has provisions for application in data-short situations. For this reason, the language referencing this calculation method was kept. Additionally, both ET<sub>c</sub> and ET<sub:o</sub> have been relocated and indented under the main description for ET.
### TABLE L 402.1

MAXIMUM FIXTURE AND FIXTURE FITTINGS FLOW RATES

<table>
<thead>
<tr>
<th>FIXTURE TYPE</th>
<th>FLOW RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showerheads</td>
<td>2.0 gpm at 80 psi</td>
</tr>
<tr>
<td>Kitchen faucets residential</td>
<td>1.8 gpm at 60 psi</td>
</tr>
<tr>
<td>Lavatory faucets residential</td>
<td>1.5 gpm at 60 psi</td>
</tr>
<tr>
<td>Lavatory faucets other than residential</td>
<td>0.5 gpm at 60 psi</td>
</tr>
<tr>
<td>Metering faucets</td>
<td>0.25 gallons/cycle</td>
</tr>
<tr>
<td>Metering faucets for wash fountains</td>
<td>One 0.25 gallons/cycle fixture fitting for each 20 inches rim space</td>
</tr>
<tr>
<td>Wash fountains</td>
<td>One 2.2 gpm at 60 psi fixture fitting for each 20 inches rim space</td>
</tr>
<tr>
<td>Water Closets</td>
<td>1.28 gallons/flush</td>
</tr>
<tr>
<td>Urinals</td>
<td>0.5 gallons/flush</td>
</tr>
<tr>
<td>Commercial Pre-Rinse Spray Valves</td>
<td>See Section L 402.9</td>
</tr>
</tbody>
</table>

#### RESIDENTIAL

- Kitchen faucets: 1.8 gpm at 60 psi
- Lavatory faucets: 1.5 gpm at 60 psi

#### NON-RESIDENTIAL

- Lavatory faucets (metering): 0.25 gallon/cycle
- Lavatory faucets (non-metering): 0.5 gpm at 60 psi
- Pre-rinse spray valves: 1.0 gpm for Product Class 1 (\(\leq 5.0\) ozf), 1.2 gpm for Product Class 2 (\(> 5.0\) ozf and \(\leq 8.0\) ozf), 1.28 gpm for Product Class 3 (\(> 8.0\) ozf)
- Wash fountains (metering): 0.25 gallon/cycle
- Wash fountains (non-metering): 2.2 gpm at 60 psi

#### BOTH RESIDENTIAL AND NON-RESIDENTIAL

- Showerheads: 2.0 gpm at 80 psi
- Water closets: 1.28 gpf

---

**SUBMITTER:** Billy Smith  
**Organization Name:** Chair, WE-Stand Technical Committee

**RECOMMENDATION:** 
Revise text

**Proposed Text:**
<table>
<thead>
<tr>
<th>FIXTURE TYPE</th>
<th>FLOW RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinals</td>
<td>0.5 gpf</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 inch = 25.4 mm, 1 gallon = 3.785 L, 1 ounce-force = 0.278 N, 1 ounce-force = 28.3495 grams-force

Notes:

1. **Maximum flow rate per fixture fitting.**
2. For temporary increased flow above the maximum rate, see Section L 402.4.
3. For lavatory faucets installed in residences, apartments, and private bathrooms in lodging, hospitals, and patient care facilities (including skilled nursing and long-term care facilities).
4. For occupancies other than those specified in Note (3).
5. Where pre-rinse spray valves with maximum flow rates of 1.0 gpm (3.8 L/m) or less are installed, the static pressure shall be listed to EPA WaterSense Specification for Showerheads not less than 30 psi (207 kPa).
6. For multiple showerheads serving one single shower compartment, the total allowable flow rate shall be in accordance with Section L 402.6.1.

L 402.0 Water-Conserving Plumbing Fixtures and Fittings.

L 402.2 Water Closets. No water closets shall have an effective flush volume exceeding 1.28 gallons per flush (gpf) (4.8 Lpf) be in accordance with Section 402.2.1 and Section 402.2.2.

L 402.2.1 Gravity, Pressure Assisted, and Electro-Hydraulic Tank Type Water Closets. Gravity, pressure assisted, and electro-hydraulic tank-type water closets shall have a maximum effective flush volume of not more than 1.28 gallons (4.8 Lpf) of water per flush in accordance comply with ASME A112.19.2/CSA B45.1 or ASME A112.19.14 and shall also be listed to the EPA WaterSense Specification for Tank-Type Toilets. The effective flush volume for dual flush toilets is defined as the composite, average flush volume of two reduced flushes and one full flush.

L 402.2.2 Flushometer-Valve Activated Water Closets. Flushometer-valve activated water closets shall have a maximum flush volume of not more than 1.28 gallons (4.8 Lpf) of water per flush in accordance comply with ASME A112.19.2/CSA B45.1 and shall be listed to the EPA WaterSense Specification for Flushometer-Valve Water Closets.

L 402.3 Urinals. Urinals shall have a maximum flush volume of not more than 0.5 gallon (1.9 Lpf) of water per flush in accordance comply with ASME A112.19.2/CSA B45.1 or CSA B45.5/IAPMO Z124. Flushing urinals shall be listed to the EPA WaterSense Flushing Urinal Specification for Flushing Urinals.

L 402.3.1 Nonwater Urinals. Nonwater urinals shall comply with ASME A112.19.3/CSA B45.4, ASME A112.19.19, or CSA B45.5/IAPMO Z124. Nonwater urinals shall be cleaned and maintained in accordance with the manufacturer’s instructions after installation. Where nonwater urinals are installed, they shall have a water distribution line roughed-in to the urinal location at a height not less than 56 inches (1422 mm) above finished floor to allow for the installation of an approved backflow prevention device in the event of a retrofit. Such water distribution lines shall be installed with shutoff valves located as close as possible to the distributing main to prevent the creation of dead ends. Where nonwater urinals are installed, not less than one water supplied fixture rated at not less than 1 drainage fixture unit (DFU) shall be installed upstream on the same drain line to facilitate drain line flow and rinsing.
Exception: Nonwater urinals used as part of a composting toilet system.

L 402.4 Residential Kitchen Faucets. The maximum flow rate of residential kitchen faucets shall not exceed 1.8 gallons per minute (gpm) (6.8 L/m) at 60 pounds force per square inch (psi) (414 kPa). Kitchen faucets are permitted to temporarily increase the flow above the maximum rate, but not to exceed 2.2 gpm (8.3 L/m) at 60 psi (414 kPa), and shall revert to a maximum flow rate of 1.8 gpm (6.8 L/m) at 60 psi (414 kPa) in accordance with Table L 402.1 upon valve closure.

L 402.5 Lavatory Faucets. The maximum water flow rate of lavatory faucets shall comply be in accordance with Section L 402.5.1 and Section L 402.5.2.

L 402.5.1 Lavatory Faucets in Residences, Apartments, and Private Bathrooms in Lodging Facilities, Hospitals, and Patient Care Facilities. The flow rate for lavatory faucets installed in residences, apartments, and private bathrooms in lodging, hospitals, and patient care facilities (including skilled nursing and long-term care facilities) shall not exceed 1.5 gpm (5.7 L/m) at 60 psi (414 kPa) in accordance with ASME A112.18.1/CSA B125.1 and shall be listed to the EPA WaterSense High Efficiency Lavatory Faucet Specification.

L 402.5.2 Lavatory Faucets in Other Than Residences, Apartments, and Private Bathrooms in Lodging Facilities. Lavatory faucets installed in bathrooms of buildings or occupancies other than those specified in Section L 402.5.1 shall be in accordance with Section L 402.5.2(1) or Section L 402.5.2(2).

(1) The flow rate shall not exceed 0.5 gpm (1.9 L/m) at 60 psi (414 kPa) in accordance with ASME A112.18.1/CSA B125.1.

(2) Metering faucets shall deliver not more than 0.25 gallons (0.95 L) of water per cycle.

L 402.6 Showerheads. Showerheads shall not exceed 2.0 gpm (7.6 L/m) at 80 psi (552 kPa), and shall be listed to comply with ASME A112.18.1/CSA B125.1 and shall be listed to the EPA WaterSense Specification for Showerheads.

L 402.6.1 Multiple Showerheads Serving One Shower Compartment. The total allowable flow rate of water from multiple showerheads flowing at a given time, with or without a diverter, including rain systems, waterfalls, bodysprays, and jets, shall not exceed 2.0 gpm (7.6 L/m) per shower compartment, where the floor area of the shower compartment is less than 1800 square inches (1.161 m\(^2\)). For each increment of 1800 square inches (1.161 m\(^2\)) of floor area after that or part thereof, additional showerheads are allowed, provided the total flow rate of water from flowing devices shall not exceed 2.0 gpm (7.6 L/m) for each such increment.

Exceptions:

(1) For gang showers in nonresidential occupancies, singular showerheads or multiple shower outlets serving one showering position in gang showers shall not have more than exceed 2.0 gpm (7.6 L/m) in total flow.

(2) Where provided, shower compartments required for persons with disabilities in accordance with Chapter 17 CSA B651 or ICC A117.1 shall not have more than exceed 4.0 gpm (15.0 L/m) in total flow, where one outlet is the hand shower.

L 402.6.2 Bath and Shower Diverters. Tub spout bath and shower diverters, while operating in the shower mode, shall not exceed 0.1 gpm (0.4 L/m) rate of leakage in accordance with ASME A112.18.1/CSA B125.1 perform with zero leakage.

L 402.6.3.1 Marking. Control valves for showers and tub/shower combinations shall be tagged, labeled, or marked in accordance with the applicable standards manufacturer’s minimum rated flow and such marking shall be visible after installation.

L 402.9 Commercial Pre-Rinse Spray Valves. The flow rate for a pre-rinse spray valve installed in a commercial kitchen to remove food waste from cookware and dishes before cleaning shall not be more than the maximum flow rate, as specified in Table L 402.9 L 402.1. Where pre-rinse spray valves with maximum flow rates of 1.0 gpm (3.8 L/m) or less are installed, the static pressure shall be not less than 30 psi (207 kPa). Commercial kitchen pre-rinse spray valves shall be equipped with an integral automatic shutoff.
TABLE L 402.9
COMMERCIAL PRE-RINSE SPRAY VALVE
MAXIMUM FLOW RATE

<table>
<thead>
<tr>
<th>PRODUCT CLASS BY SPRAY FORCE</th>
<th>MAXIMUM FLOW RATE (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Class 1 (≤ 5.0 ounces-force)</td>
<td>1.00</td>
</tr>
<tr>
<td>Product Class 2 (&gt; 5.0 ounces-force and ≤ 8.0 ounces-force)</td>
<td>1.20</td>
</tr>
<tr>
<td>Product Class 3 (&gt; 8.0 ounces-force)</td>
<td>1.28</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 3.785 L/min, 1 ounce-force = 0.278 N.

L 402.12 Wash Fountains. Wash fountains shall be installed with not less than one fixture fitting per 20 inches (508 mm) of rim space.

L 402.13 Installation. Water-conserving fixtures and fixture fittings shall be installed in accordance with the manufacturers’ instructions to maintain their rated performance.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B651-2018</td>
<td>Accessible Design for the Built Environment</td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The above proposed change will correlate with the updates taken on the 2023 WE•Stand. Table L 402.1 can serve as the sole location for listing maximum flow rates of fixtures and fixture fittings. This prevents potential conflicts as later editions of the standard are published and new information is incorporated. This table should also be categorized based on application (residential, non-residential, or both). The notes accompanying the table should not include listing requirements, but rather specific information needed to interpret and apply requirements presented. Such listing requirements should remain only in the specific section that addresses the fixture or fitting type. In line with this approach, Section L 402.12 (Wash Fountains) is being added to relocate existing requirements from Table L 402.1 which address the required number of fixture fittings per length of rim space as this pertains to installation and not flow rates. This is needed since note (1) of Table L 402.1 states that the maximum flow rates prescribed are “per fixture fitting.” This option also includes the maximum flow rates for pre-rinse spray valves that were accepted during the proposal stage. The proposed change also addresses needed wordsmithing and improves the code language.
RECOMMENDATION:
Revise text

Proposed Text:
L 404.0 Occupancy Specific Water Efficiency Requirements.

L 404.10 Steam Sterilizers. Controls shall be installed to limit the discharge temperature of condensate or water from steam sterilizers to 140°F (60°C) or less. The discharge waste from steam sterilizers shall not be tempered with potable water. A venturi-type vacuum system shall not be utilized with vacuum sterilizers.

SUBSTANTIATION:
Not only should venti-type vacuum systems be prohibited based on their method of operation or function, but language should also be added to prohibit tempering water that is discharged from the steam sterilizer. Both of these requirements offer needed water efficiency benefits and belong in the plumbing code.
SUBMITTER: 
Billy Smith

Organization Name: 
Chair, WE-Stand Technical Committee

RECOMMENDATION:
Revise text

Proposed Text:
L 404.0 Occupancy Specific Water Efficiency Requirements.

L 404.4 Combination Ovens. Combination ovens shall not use water in the convection mode except when utilizing a moisture nozzle for food products in the oven. The total amount of water used by the moisture nozzle consumption rate shall not exceed 0.4 gallons (1.5 L) per pan when in the convection mode and shall not exceed a half a gallon per hour (0.5 gallons (1.9 L) per oven cavity. When operating in the steamer mode, combination ovens shall not consume more than 1.5 gallons per hour (gph) (5.7 L/h) per pan. The pan capacity shall be in accordance with ASTM F1495.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F1495-2020</td>
<td>Standard Specification for Combination Oven Electric or Gas Fired</td>
<td>Combination Oven</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The proposed change will correlate with updates made to the 2023 WE-Stand. ENERGY STAR incorporated water efficiency criteria for combination ovens within Version 3.0 of the ENERGY STAR Product Specification for Commercial Ovens, published in April 2022. Prior versions of the specification did not address water efficiency. Within Version 3.0, ENERGY STAR developed the water efficiency criteria in coordination with EPA's WaterSense program. The specification takes effect on January 12, 2023, although products are able to pursue early certification prior to that date. 69 The specification requires that combination ovens have a maximum water consumption of 0.5 gallons per pan (gal/pan) when in steamer mode and 0.4 gallons per pan (gal/pan) when in convection mode. To determine these thresholds, ENERGY STAR and WaterSense reviewed the existing marketplace for combination ovens, including qualified product listings from ENERGY STAR and the California Foodservice Instant Rebates. The criteria selected would reduce allowable water consumption within the steamer mode currently included by the plumbing code by 67%, while also aligning with a well-known and prominent EPA labeling program. According to the 2021 ENERGY STAR Unit Shipment and Market Penetration Report, ENERGY STAR certified models of commercial ovens represented 53% of the marketplace. Therefore, there is availability of many models from a variety of manufacturers meeting the Version 3.0 specification. The gallons per pan (gal/pan) metric for evaluating water consumption within the ENERGY STAR specification is different from the gallons per hour per pan (gal/hr/pan) metric currently used in plumbing code. During the specification revision process, some manufacturers expressed that establishing a gallon per hour per pan (gal/hr/pan) criteria would inadvertently...
disadvantage ovens with higher production rates that have shorter cook times. Expressing the water consumption value in gallons per hour per pan (gal/hr/pan) during cooking periods could therefore potentially be misleading for some models and may reflect negatively on some high energy and water efficient ovens with high throughput. Multiple stakeholders suggested that EPA instead use gallons per pan (gal/pan) as an alternative to express the water consumption value during combination oven cooking periods for both steam and convection modes to avoid any displacement of high energy and water efficient combination ovens with high production capacities. The plumbing code has historically included reference to EPA's labeling programs, including WaterSense and ENERGY STAR, when establishing water efficiency criteria for applicable product categories. For combination ovens, now that ENERGY STAR adequately addresses water efficiency in addition to energy efficiency, EPA similarly suggests aligning to the criteria within the new ENERGY STAR specification.
RECOMMENDATION:
Revise text

Proposed Text:
L 405.0 Leak Detection and Control.
L 405.1 General. Where installed, leak detection and control devices shall comply with IAPMO IGC 115, IAPMO IGC 349, or ANSI/CAN/IAPMO Z1349. Leak detection with control devices shall not be installed where they isolate restrict fire sprinkler suppression systems.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 115-2013</td>
<td>Automatic Water Leak Detection and Control Devices</td>
<td>Leak Detection</td>
</tr>
<tr>
<td>IAPMO IGC 349-2018</td>
<td>Electronic Plumbing Supply System Integrity Protection Devices</td>
<td>Leak Detection</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

SUBSTANTIATION:
The proposed change will correlate with the 2023 WE•Stand. It can take several years for manufacturers and third-party certifiers to shift the listing of products to a newer standard like IAPMO Z1349. The proposed change adds all the applicable standards in this proposal with provides the most viable option for this situation type. The proposal is being revised to keep reference to IAPMO IGC 349 and IAPMO IGC 115. Additionally, the term "sprinkler" is being modified to "suppression" for clarity and use of common industry terms.
Proposed Text:

L 405.0 Leak Detection and Control.
L 405.1 General. (remaining text unchanged)

**L 405.2 Water Flow Shut Off Devices.** Where installed on bath tubs or lavatories/basins, water flow shut off devices shall comply with IAPMO IGC 241.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 241-2019</td>
<td>Water Flow Shut-Off Devices</td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**

Water waste and water damage from overflowing bath tubs and basins is a common problem when faucets are left unattended. An overflow drain is normally installed to deal with incoming water to stop the tub or basin from overflowing but the water flowing down the overflow goes to waste as does the energy used to heat the water. The overflow can run for hours or even days with considerable volumes of water. A worse scenario occurs when the overflow is not capable of dealing with the high rate of inflowing water, especially in large jet tubs, and the overflow from the tub or basin can cause considerable damage and put accommodation or retail outlets below the bath tub out of action for days or weeks.

IGC 241-2019 is focused on devices to stop this damage and waste occurring.

See also the video on www.flowban.com for an example of such a device.
RECOMMENDATION:
Revise text

Proposed Text:
L 406.0 Fountains and Other Water Features.
L 406.1 Use of Alternate Water Source for Special Water Features. Special Water features such as ponds and water fountains shall be provided with reclaimed (recycled) water, rainwater, or on-site treated nonpotable water where the source and capacity are available on the premises and approved by the Authority Having Jurisdiction.

SUBSTANTIATION:
The proposed change will correlate with the 2023 WE•Stand. The term “special” is being stricken from the title and the section as section pertains to water features in general. The term “special” is not needed and therefore being removed.
Proposed Text:

L 407.0 Meters.
L 407.1 Required. A water meter shall be required for each building site connected to a public water system, including municipally supplied reclaimed (recycled) water. In other than single-family houses, a dedicated meter shall be installed in accordance with Table L 407.1.

L 407.1.1 Meter Performance Specifications. Consumption data shall be capable of being reported within 0.35 ft³ (0.01 m³) resolution at each 15-minute interval. Flow rate data shall be capable of being reported at each 0.25 gallon per minute (gpm) (1.0 L/min) change in flow rate.

L 407.1.2 Unusual Flow. Data shall be capable of being analyzed when one or more of the following unusual flow conditions are met:

1. Consumption measured is greater than 0.25 gallon per minute (gpm) (1.0 L/min) for more than 6 consecutive hours at a consistent (+/- 0.5 gpm) (+/- 2 L/min) measurement at each interval.
2. Flow rate exceeds 0.25 gallon per minute (gpm) (1.0 L/min) more than 4 times within a 15-minute interval, where each peak is within 0.5 gpm (2.0 L/min) of each other during low water demand period(s).
3. Average water consumption for a 15-minute interval exceeds the average water consumption by greater than 50 percent when compared to the average usage calculated in the previous measured intervals.

TABLE L 407.1
DEDICATED WATER METERING REQUIREMENTS

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
</table>
| Landscape Irrigation         | Landscape irrigation water where either of the following conditions exist:
(1) **Single-family residential projects:** Total accumulated landscape area with in-ground irrigation system exceeds 2500 square feet (ft²), or
(2) **Other than single-family residential projects:** Total accumulated landscape area using an automatic irrigation controller **served by in-ground irrigation system** exceeds 4500-1000 square feet (ft²)
Exception: Where the water purveyor provides a separate water supply meter that serves only the irrigation system, an additional dedicated meter is not required.|

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The proposed change will correlate with the 2023 WE•Stand. Section L 407.1 (Required) is being revised to appropriately reflect the applicability of Table L 407.1. In particular, the metering requirements for landscape irrigation are split into either single-family residential projects and other than single-family. The table has also been updated for clarity and further supports the changes made to Section L 407.1.
Section L 407.1.1 (Meter Performance Specifications) is needed in order to properly collect consumption and flow rate data at a resolution level which allows for the detection of abnormalities or unusual ow conditions. This language provides the necessary baseline for meter data resolution and reporting performance.

Section L 407.1.2 (Unusual Flow) has been added as a baseline for data analysis results to indicate an unusual ow condition. It is necessary to analyze consumption and ow rate data in a continuous and comparative process to detect changes that indicate fixture failure. For these reasons, the additional proposed language is needed.
L 410.3 Point-of-Use Reverse Osmosis Water Treatment Systems. Reverse osmosis (RO) water treatment systems shall comply with NSF/ANSI 58 and shall be equipped with automatic shutoff valves to prevent discharge when there is no call for producing treated water. Residential RO systems shall also comply with NSF/ANSI 58 and ASSE 1086.

SUBSTANTIATION:
The proposed change will correlate with the 2023 WE•Stand. Section L 410.3 (Point-of-Use Reverse Osmosis Water Treatment Systems) is being modified to avoid limitations on provisions for reverse osmosis water treatment systems. ASSE 1086 only applies to residential RO systems, and this modified language includes that distinction.

Additionally, NSF/ANSI 58 and ASSE 1086 do not overlap. As noted in the substantiation provided with the proposal, NSF/ANSI 58 focuses on the testing protocols associated with the reduction of chemicals through RO technology, and ASSE 1086 focuses on the treatment technology and ensuring that efficiency does not compromise membrane life. It is not redundant to require compliance with both standards as they complement one another. ASSE 1086 aligns with sustainable practices in that it reduces the volume of water being wasted by improving membrane efficiency. Therefore, it is still appropriate to include both standards within this section.

ASSE 1086 (Scope): This standard covers water efficiency, automatic shut-off valves, and flow restrictor requirements for residential RO systems and performance testing to address the membrane life concerns of high efficiency RO membranes. This standard includes test requirements for complete systems or components (RO membrane, automatic shut off valve, flow restrictor).

NSF/ANSI 58 (Scope): The purpose of this standard is to establish minimum requirements for materials, design and construction, and performance of reverse osmosis (RO) drinking water treatment systems. This standard also specifies the minimum product literature that manufacturers shall supply to authorized representatives and owners, as well as the minimum service-related obligations that manufacturers shall extend to system owners. The point-of-use (POU) RO drinking water treatment systems addressed by this standard are designed to be used for the reduction of specific substances that may be present in drinking water (public or private) considered to be microbiologically safe and of known quality.
L 410.0 Water Softeners and Treatment Devices.

L 410.3 Point-of-Use Reverse Osmosis Water Treatment Systems. Reverse osmosis water treatment systems shall be equipped with automatic shutoff valves to prevent discharge when there is no call for producing treated water. Reverse osmosis water treatment systems shall comply with NSF/ANSI 58, and high efficiency reverse osmosis water systems shall also comply with ASSE 1086.

SUBSTANTIATION:
The above proposed change will clarify that the ASSE 1086 standard applies to high efficiency reverse osmosis systems. ASSE 1086 covers water efficiency for residential RO systems and performance testing to address the membrane life concerns of high efficiency RO systems and membranes. The standard includes test requirements for complete systems or components, including system manifolds, RO membranes, pre- and post-filtration assemblies, supply and drain connections, and more.
RECOMMENDATION:
Revise text

Proposed Text:
L 201.0 Definitions.
L 201.1 General. For the purpose of this appendix, the following definitions shall apply:

**Landscape.** That portion of a lot not covered by the footprint of a building or any hardscape including driveways, sidewalks, decks, patios, swimming pools, or spas.

**Landscape, Vegetated.** That portion of a landscape in which living plant material and porous landscape elements are installed or maintained, or is prepared for the installation of such material, not including vegetated roofs or undisturbed native vegetation maintained without supplemental irrigation.

L 411.0 Landscape Irrigation Systems Design and Installation.
L 411.1 General. Where landscape irrigation systems are installed, they shall comply with Section L 411.2 through Section L 411.19. Vegetated roofs shall be in accordance with Section L 411.20 L 411.1.1 through Section L 411.17.

L 411.2 Required Documentation. The following documents shall be provided to the owner and shall be readily accessible onsite to the Authority Having Jurisdiction at the time of inspection:

1. The landscape plan and irrigation design as approved.
2. Drawings and records showing any changes during installation.
3. The report of the irrigation audit required by Section L 411.13.
4. Irrigation controller information required by Section L 411.7.1.

L 411.3 Qualifications. 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 irrigation contractor, installer, or service technician shall be approved to perform such work.

L 411.1.1 Irrigation Design and Installation. The Authority Having Jurisdiction shall have the authority to require landscape irrigation contractors, installers, or designers to demonstrate competency. The system shall be designed and record drawings showing changes during installation shall be made available for the owner and for any required inspections. Where required by the Authority Having Jurisdiction, the contractor, installer, or designer shall be licensed, certified, or both to perform such work.

L 411.2 Plant and Irrigation System Limitations. Nuisance, invasive and noxious plants as defined by the Authority Having Jurisdiction shall not be used in the landscape. Plants not requiring supplemental irrigation and not principally used as an athletic field or public recreation shall be used in no less than 60 percent of the vegetated landscape that is not principally used as an athletic field or public recreation. Inground site. An irrigation system shall not be installed to serve more than 40 percent of the landscaped area vegetated landscape.

Exceptions:
(1) Where average annual rainfall is less than 12 inches (305 mm) and in climate zones where the
plant materials have an annual ETc of not exceeding 15 inches (381 mm), an in-ground irrigation system shall be allowed to be installed in 80 percent of the vegetated landscape.

(2) Where neither potable or reclaimed (recycled) only onsite alternate water is sources in accordance with Chapter 15 or Chapter 16 are used in the for irrigation system, an in-ground irrigation system shall be allowed in 100 percent of the landscaped area and vegetative roofs.

L 411.4.1 Noxious Plants. Nuisance, invasive and noxious plants as defined by the Authority Having Jurisdiction shall not be installed in the landscape.

L 411.4.2 Athletic Fields. Athletic fields shall be irrigated with either reclaimed (recycled) or onsite alternate water sources provided in accordance with Chapter 15 or Chapter 16. Golf courses shall be planted in landscaping which does not require supplemental irrigation except for tees, fairways, and greens. The use of potable water on newly installed athletic fields shall be permitted for a period of not more than 18 months after installation or as approved by the Authority Having Jurisdiction.

L 411.4.3 Plant Grouping. Plants shall be grouped into hydrozones based on water use classifications. Irrigation systems shall be designed to provide water requirements to hydrozones as specified by the water use classification of the plant species. Minimum plant water demands shall be determined in accordance with ANSI/ASABE S623.1.

L 411.4.4 Narrow or Irregularly Shaped Landscape Areas. Narrow or irregularly shaped landscape areas, less than 4 feet (1219 mm) in any direction across opposing boundaries, shall not be irrigated by an irrigation emission device except low flow emitters with flow rates not to exceed 6.3 gallons (24 L) per hour.

L 411.20 Vegetative Roofs and Walls. Irrigation systems using potable water for vegetative roofs and walls are prohibited.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI/ASABE S623.1-2017 (R2022)</td>
<td>Determining Landscape Plant Water Demands</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ANSI/ASABE S623.1 meets the requirements for a mandatory reference standard in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

Section L 411.4 (Plant and Irrigation System Limitations) is being revised to include additional relevant subsections pertaining to noxious plants, athletic fields, and plant grouping. All of these topics should be addressed within the specified plant and irrigation system limitations.

Although noxious plant provisions are more aligned with environmental site benefits, such language is necessary for designing landscapes and complying with local jurisdictions as these plants may be invasive and toxic. In some cases, noxious plants may crowd out native vegetation. In any case, the requirements vary by geographical setting.

Section L 411.4.2 (Athletic Fields) is being added to ensure that irrigation is focused on actual playing surfaces. The language pertaining to newly installed athletic fields and the landscape establishment phase is needed as potable water may be required to flush out salts within the soil.
Section L 411.4.3 (Plant Grouping) is needed for grouping of plants into hydrozones based on water classifications. Such plant grouping conserves water used for irrigation and promotes healthier vegetation. In support of this, ANSI/ASABE S623.1 is referenced as it provides the methodology for determining the minimum plant water demands used for such grouping.
RECOMMENDATION:
Add new text

Proposed Text:
L 411.0 Landscape Irrigation Systems.

L 411.12 Sloped Areas. Where soil surface rises more than 1 foot (305 mm) per 4 feet (1219 mm) of length, the irrigation zone system average precipitation rate shall not exceed 0.75 inches per hour (in/h) (19.1 mm/h) per hour as verified through one of the following methods:

(1) Manufacturer's documentation that the precipitation rate for the installed sprinkler head does not exceed 0.75 inches per hour (in/h) (19.1 mm/h) per hour where the sprinkler heads are installed not closer than the specified radius and where the water pressure of the irrigation system is not more than the manufacturer's recommendations.

(2) Catch can test in accordance with the requirements of the Authority Having Jurisdiction and where emitted water volume is measured with a minimum of six catchment containers at random places within the irrigation zone for a minimum of 15 minutes to determine the average precipitation rate, expressed as inches per hour (in/h) (mm/h).

(renumber remaining sections)

SUBSTANTIATION:
Section L 411.12 (Sloped Areas) identifies requirements which prevent substantial water waste caused by run-off. Such language also correlates with the latest edition of the WEStand.
SUBMITTER: Billy Smith
Organization Name: Chair, WE-Stand Technical Committee

RECOMMENDATION:
Revise text

Proposed Text:
L 411.0 Landscape Irrigation Systems.

L 411.13 Irrigation System Inspection and Performance Check Audit. The Prior to final inspection, the irrigation system shall be inspected audited to verify compliance with the approved irrigation design and the provisions of this chapter in accordance with the following:
(1) Inspection and performance check The audit shall be performed by an independent third party having credentials in accordance with the US EPA WaterSense program or the Authority Having Jurisdiction. Irrigation audits shall not be performed by any person participating in the design or installation of the landscape.
(2a) Plants are grouped into hydrozones in accordance with Section L 411.4.3.
(b) Sprinklers shall be installed as specified with proper spacing and required nozzle.
(3c) Sprinklers shall be activated and visually inspected for covering areas without causing overspray or runoff.
(4d) Valves shall be installed as specified.
(5e) Drip irrigation systems shall be inspected to verify include the proper valve, pressure regulation, filtering device, location of flush valves, and that the installed emitters comply with the irrigation plan.
(6f) Control system(s) shall be installed as specified and listed as a US EPA WaterSense labeled controller, and all sensors shall be installed and verified for proper installation and operation.
(7g) The peak demand irrigation schedule(s) shall be posted near the controller, or the scheduling parameters for the controller shall be listed for each station including cycle and soak times.
(8h) Record drawings of the irrigation system shall be completed and provided for the irrigation inspection.
(9)(2) An inspection The audit report shall be provided to the property owner or management company identifying problems. The audit report shall identify deficiencies and what corresponding corrective actions are required.

SUBSTANTIATION:
Modifications made to this section are needed to verify compliance of the installed irrigation system. The current list has been reorganized to clarify the intent and purpose of the audit while also correlating with the other updates to the latest edition of the WEStand. For these reasons, the modifications are required.
RECOMMENDATION:
Revise text

Proposed Text:
L 411.0 Landscape Irrigation Systems.

L 411.14 Sprinklers. Sprinklers shall not be installed within 24 inches (610 mm) of any non-permeable surface. Extenders over paved areas shall not be used to irrigate shrubs.

Exception: Adjacent non-permeable surfaces which are designed and constructed to drain entirely to landscaping.

L 411.14 L 411.14.1 Sprinkler Head Installations. All installed sprinkler heads shall comply with ASABE/ICC 802 or other approved standard(s).

L 411.14.1 L 411.14.1.1 Sprinkler Heads in Common Irrigation Zones. Sprinkler heads installed in irrigation zones served by a common valve shall be limited to applying water to plants with similar irrigation needs, and shall have matched precipitation rates (identical inches of water application per hour as rated or tested plus or minus 75 percent as labeled or declared in manufacturer’s published performance data).

L 411.14.2 L 411.14.1.2 Sprinkler Head Pressure Regulation. Sprinkler heads shall utilize pressure regulating devices (as part of an irrigation system or integral to the sprinkler body) to maintain manufacturer’s recommended operating pressure for each sprinkler and nozzle type. Spray sprinkler bodies with integral pressure regulation shall be listed to the EPA WaterSense Specification for Spray Sprinkler Bodies.

L 411.14.3 L 411.14.1.3 Pop-up Type Sprinkler Heads. Where pop-up type sprinkler heads are installed, the sprinkler heads shall rise to a height above vegetation level and of not less than 4 inches (102 mm) above the soil level where emitting water.

L 411.14.4 L 411.14.1.4 Sprinkler Head Maximum Precipitation Rate. Where the slope of the landscape exceeds 25 percent, the precipitation rate of sprinkler heads shall not exceed 1.75 inches (44 mm) per hour when tested to ASABE/ICC 802.

SUBSTANTIATION:
The proposed revisions comply with state and local ordinances and prevent overspray onto non-permeable surfaces from closely installed spray heads. Additionally, the required distance from non-permeable surfaces also assists with avoiding damage to sprinkler heads. For these reasons, the proposed modifications are necessary and improve Appendix L.
**RECOMMENDATION:**
Add new text

**Proposed Text:**

L 411.0 Landscape Irrigation Systems.

L 411.16 Irrigation Zone Performance Criteria. Irrigation zones shall be designed and installed to ensure the average precipitation rate of the sprinkler heads over the irrigated area does not exceed 1 inch per hour (in/h) (25.4 mm/h) as verified through either of the following methods:

1. Manufacturer's documentation that the precipitation rate for the installed sprinkler head does not exceed 1 inch per hour (in/h) (25.4 mm/h) where the sprinkler heads are installed not closer than the specified radius and where the water pressure of the irrigation system is not more than the manufacturer's recommendations.

2. Catch can test where emitted water volume is measured with a minimum of six catchment containers at random places within the irrigation zone for a minimum of 15 minutes to determine the average precipitation rate, expressed as inches per hour (in/h) (mm/h).

(renumber remaining sections)

**SUBSTANTIATION:**
The proposed language correlates with the provisions of the WESstand. The requirements for manufacturer's documentation and catch can testing are similar to the layout of provisions for sloped areas. Such language strengthens the UPC and ensures verification of established criteria for irrigation zone performance.
SUBMITTER:
Billy Smith

Organization Name: Chair, WE-Stand Technical Committee

RECOMMENDATION:
Revise text

Proposed Text:
L 411.0 Landscape Irrigation Systems.

L 411.16 Depth of Irrigation Pipe. Irrigation pipe downstream from the backflow preventer shall be buried at a minimum depth according to Section L 411.16.1 and Section L 411.16.2. Irrigation piping shall not be installed below sewage piping.

L 411.16.1 Landscape Irrigated Areas. Irrigated landscaped areas not exceeding 10 000 square feet (929 m$^2$) shall have irrigation main lines buried a minimum of 12 inches (305 mm) and irrigation lateral lines buried a minimum of 8 inches (203 mm). Irrigated landscaped areas greater than 10 000 square feet (929 m$^2$) shall have irrigation main lines buried a minimum of 18 inches (457 mm) and irrigation lateral lines buried a minimum of 12 inches (305 mm).

SUBSTANTIATION:
Section L 411.16 is being revised to clarify that irrigation piping should not be installed below sewage piping. Additionally, the phrase “landscape areas” is being changed to “irrigated areas” as the provisions of the main section are applicable to irrigation piping.

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RECOMMENDATION:
Add new text

Proposed Text:
L 411.0 Landscape Irrigation Systems.

L 411.17 Stormwater Management and Rainwater Retention. Landscapes and structures shall be designed to include rainwater capture and stormwater infiltration capacity sufficient to prevent stormwater from either the 1 inch (25.4 mm) 24-hour rain event or the 85th percentile, 24-hour rain event from leaving the landscape. The location, installation details, and 24-hour retention or infiltration capacity of any stormwater management feature shall be included in the landscape plan and shall be readily accessible onsite to the Authority Having Jurisdiction at the time of inspection.

(renumber remaining sections)

SUBSTANTIATION:
Preventing excessive stormwater runoff is a major objective for both land use agencies and water management officials. Rainwater retention and stormwater treatment systems are alternate water sources that can support non-potable uses of water without further burdening public water supplies. Stormwater management features can also assist in recharging groundwater to help stabilize water tables and build supplies for potential withdrawal and reuse, as well as protecting water quality and natural watercourses. This proposal would establish a minimum standard for on-site retention of stormwater. Local or regional regulations may supplement this minimum standard with more stringent requirements if necessary to achieve water quality standards or other regulatory objectives. Furthermore, the proposed language correlates with the provisions of the WEStand.
L 411.5 Backflow Protection. Potable water and reclaimed water supplies to landscape irrigation systems shall be protected from backflow in accordance with this code and the Authority Having Jurisdiction.

L 411.6 Use of Alternate Water Sources for Landscape Irrigation. Where available by pre-existing treatment, storage, or distribution network, and where approved by the Authority Having Jurisdiction, alternate water source(s) complying with Chapter 15 shall be utilized for landscape irrigation. Where adequate capacity and volumes of pre-existing alternative water sources are available, the irrigation system shall be designed to use a minimum of 75 percent of alternative water for to meet the annual irrigation demand before supplemental potable water is used.

Exception: Plants grown for food production for direct human consumption.

L 411.6.1 Master Valve. Where continuously pressurized alternate water sources supply an existing irrigation system, a master valve shall be installed at the point where the alternate water sources supply piping connects to the existing irrigation system downstream of the backflow preventer where required.

L 411.6.2 Identification. Where alternate water sources supply an existing irrigation system, the existing sprinkler heads, valve boxes, the continuously pressurized line supplying the irrigation master valve, or any other components required by the Authority Having Jurisdiction, shall be colored purple. The piping supplying the irrigation master valve shall be identified in accordance with Chapter 15 of this code.

L 411.11 System Performance Requirements. The landscape irrigation system shall be designed and installed to:

(1) Prevent irrigation water from runoff out of the irrigation zone.
(2) Prevent water in the supply line drainage from draining out between irrigation events.
(3) Not allow irrigation water to be applied onto or enter nontargeted areas including adjacent property and vegetation areas, adjacent hydrozones not requiring the irrigation water to meet its irrigation demand, non-vegetative areas, impermeable surfaces, roadways, and structures.

Exception: Landscape features outside of the public right of way such as paved walkways, jogging paths, and golf cart paths, are exempted from this requirement where run off drains into the same hydrozone without puddling.

SUBSTANTIATION:
The proposed changes to Section L 411.5, Section L 411.6, and Section L 411.11 provide clarity and remove unnecessary language. The reclaimed water supply to an irrigation system does not require backflow prevention, and the type of irrigation is already specified under Section L 411.1. Additionally, Section L 411.6.1 and Section L 411.6.2 are being revised to remove the word “existing” as the provisions apply to both new and existing irrigation systems subject to this standard.
Proposed Text:

L 411.0 Landscape Irrigation Systems.

L 411.7 Irrigation Control Systems. Where installed as part of an irrigation system, irrigation control systems shall:

1. Automatically adjust the irrigation schedule to respond to plant water needs determined by weather or soil moisture conditions. Shall be listed to be listed to either the EPA WaterSense Specification for Weather-Based Irrigation Controllers or the EPA WaterSense Specification for Soil Moisture-Based Irrigation Controllers.

2. Utilize on-site sensors, either integral or remote weather auxiliary, data to inhibit or suspend irrigation when adequate soil moisture is present or during a rainfall or freezing conditions.

3. Utilize either one or more on-site sensors or a weather based irrigation controller listed to the US EPA WaterSense Weather Based Irrigation Controllers Specification to suspend irrigation where adequate soil moisture is present for plant growth.

4. Have the capability to program multiple and different run times for each irrigation zone to enable cycling of water applications and durations to mitigate water flowing off of the intended irrigation zone.

5. Be capable of indicating to the user when it is not receiving a signal or local sensor input.

6. Be capable of allowing for a manual operation troubleshooting test cycle and shall automatically return to sensor input mode within some period of time as designated by the manufacturer, even when the switch is still positioned for manual operation.

7. L 411.7.1 Posting of Settings. The site-specific settings of the irrigation control system shall be posted at the control system location and be visible at the time of inspection. The posted data, where applicable to the settings of the controller, shall include:

   a. Precipitation rate for each zone.
   b. Plant evapotranspiration coefficients for each zone.
   c. Soil absorption rate for each zone.
   d. Rain sensor settings.
   e. Soil moisture setting.
   f. Peak demand schedule including run times for each zone and the number of cycles to mitigate runoff and monthly adjustments or percentage change from peak demand schedule.

SUBSTANTIATION:

Section L 411.7 (Irrigation Control Systems) is being revised and separated for additional clarity on the application of provisions. The EPA WaterSense Specification for Weather-Based Irrigation Controllers establishes the performance and capability criteria and applies to standalone controllers, add-on devices, and plug-in devices that use current weather data as a basis for scheduling irrigation.

that inhibit or allow an irrigation event based on reading from a soil moisture sensor mechanism. For these reasons, the proposed modifications are beneficial to the UPC.
RECOMMENDATION:
Revise text

Proposed Text:
L 201.0 Definitions.
L 201.1 General. For the purpose of this appendix, the following definitions shall apply:
Low Flow Emitter. Low-flow irrigation emission device designed to dissipate water pressure and discharge a small uniform flow or trickle of water at a constant flow rate not exceeding 6.3 gallons (24 L) per hour when operating at 30 psi (207 kPa)

L 411.0 Landscape Irrigation Systems.
L 411.9 Low Flow Irrigation. Irrigation zones using low flow irrigation emitters shall comply with ASABE/ICC 802 Landscape Irrigation Sprinkler and Emitter Standard and shall be equipped with filters sized according to the manufacturer’s recommendation for the specific low flow emitter, and with a pressure regulator installed upstream of the irrigation emission devices as necessary to reduce the operating water pressure in accordance with the manufacturers’ equipment requirements.

L 411.10 Mulched Planting Areas. Only low flow emitters are allowed to be installed in mulched planting areas with vegetation taller than 12 inches (305 mm).

L 411.12 Narrow or Irregularly Shaped Landscape Areas. Narrow or irregularly shaped landscape areas, Vegetated landscapes less than 410 feet (12193048 mm) in any direction across any opposing boundaries, shall not be irrigated by an irrigation emission device except sub-surface or low flow emitters with flow rates not to exceed 6.3 gallons (24 L) per hour.

SUBSTANTIATION:
The above sections are being modified to remove the phrase “with flow rates not to exceed 6.3 gallons (24 L) per hour” as this language belongs better within the definition for “low flow emitter.” Since this flow rate is established in industry standards as the maximum value, it does not need to be repeated wherever “low flow emitter” is mentioned within the Appendix L. Furthermore, applying the limitations on irregularly shaped areas of larger size is more protective against overspray and runoff and is consistent with California’s statewide landscape regulations. All other revisions are for clarity and allow for continuity with the updates to the latest edition of the WEStand.
RECOMMENDATION:
Revise text

Proposed Text:
L 501.0 Water Heating Design, Equipment, and Installation.

L 501.2 Insulation. Hot water supply and return piping shall be thermally insulated. The wall thickness of the insulation shall be equal to the nominal diameter of the pipe up to 2 inches (50 mm). The wall thickness shall be not less than 2 inches (51 mm) for nominal pipe diameters exceeding 2 inches (50 mm). The conductivity of the insulation [k-factor (Btu•in/(h•ft²•°F))], measured radially, shall not be more less than or equal to 0.28 [Btu•in/(h•ft²•°F)] [0.04 W/(m•K)]. Hot water piping to be insulated shall be installed such that insulation is continuous. Pipe insulation shall be installed to within ¹⁄₁₆ of an inch (6.4 mm) of appliances, appurtenances, fixtures, structural members, or a wall where the pipe passes through to connect to a fixture within 24 inches (610 mm).

Exceptions:
(1) Where the hot water pipe is installed in a wall that is not of sufficient width to accommodate the pipe and insulation, the insulation thickness shall be permitted to have the maximum thickness that the wall is capable of accommodating and not less than ¹⁄₄ of an inch (12.7 mm) thick.
(2) Hot water supply piping exposed under sinks, lavatories, and similar fixtures.
(3) Where hot water distribution piping is installed within attic, crawlspace, or wall insulation.

SUBSTANTIATION:
The proposed change will correlate with the provisions in the 2023 WE-Stand. The proposed change adds an exception for hot water piping installed in attics, crawlspaces or within wall insulation. The addition of the exception recognizes that the pipe installed within the insulation within these spaces are already meeting the intent of insulation.
SUBMITTER: Billy Smith
Organization Name: Chair, WE-Stand Technical Committee

RECOMMENDATION:
Revise text

Proposed Text:
L 201.0 Definitions.
L 201.1 General. For the purpose of this appendix, the following definitions shall apply:
**Dwelling Unit Footprint.** The area within the inside perimeter of the exterior walls of a dwelling unit.
**Hot Water System Ratio.** The ratio of the hot water system rectangle to the floor area of a dwelling unit.
**Hot Water System Rectangle.** The region of a dwelling that bounds the water heater, plumbing fixture fittings that supply hot water, and appliances that use hot water.

L 502.0 Service Hot Water – Low-Rise Residential Buildings.

**L 502.7 Maximum Hot Water System Ratio.** The ratio of the hot water system rectangle to the dwelling unit footprint shall not exceed 60 percent.

(renumber remaining sections)

SUBSTANTIATION:
This "maximum hot water system ratio" is intended to promote efficient floor plan layouts to limit heating energy and water-use. Inefficient fixture locations will have long hot water wait times, resulting in greater water use and heating energy with no benefit to the user. The value of 60% is achievable in common fixture arrangements in most dwellings, while prohibiting the most inefficient layouts. While the hot water system rectangle accounts for fixtures on all floors, the 60% area is only counted once and does not tally for each additional floor of the unit.

Additionally, the definitions for "hot water system ratio" and "hot water system rectangle" have been added to further support the new section. Since the intent of these provisions pertains to only hot-water distribution and improved efficiency, the phrase "plumbing fixture fittings that supply hot water" is being proposed within the terminology for "hot water system rectangle."

It was also necessary to specify that the ratio calculations are to be determined using the hot water system rectangle and the "dwelling unit footprint." This prevents misinterpretations and miscalculations when determining the prescribed ratio. Further clarification has also been provided via the proposed definition for "dwelling unit footprint."

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REVISED CODE PROPOSAL

L 503.0 Service Hot Water - Other Than Low-Rise Residential Buildings.
L 503.1 General.
L 503.1.1 New Buildings. Service water-heating systems and equipment shall comply with the requirements of this section as described in Section L 503.2. [ASHRAE 90.1:7.1.1, 7.1.2]

L 503.3 Mandatory Provisions.
L 503.3.5 Service Water Heating System Controls. Service water heating system controls shall comply with Section L 503.3.5(1) L 503.3.5.1 and Section L 503.3.5(2) L 503.3.5.2.
(1) L 503.3.5.1 Temperature Controls. Temperature controls shall be provided that allow for storage temperature adjustment from 120°F (49°C) or lower to a maximum temperature compatible with the intended use. Exception: When the manufacturer's installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion. [ASHRAE 90.1:7.4.4.1]
(2) L 503.3.5.2 Outlet Temperature Controls. Temperature controlling means shall be provided to limit the maximum temperature of water delivered from lavatory faucets in public facility restrooms to 110°F (43°C). [ASHRAE 90.1:7.4.4.3]

L 503.3.6 Pools. Pool heating systems shall comply with Section L 503.3.6(1) L 503.3.6.1 through Section L 503.3.6(3) L 503.3.6.3.
(1) L 503.3.6.1 Pool Heaters. Pool heaters shall be equipped with a readily accessible ON/OFF switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights. [ASHRAE 90.1:7.4.5.1]
(2) L 503.3.6.2 Pool Covers. Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12. Exception: Pools that are deriving over 60 percent of the energy for heating from site-recovered energy or on-site renewable energy. [ASHRAE 90.1:7.4.5.2]
(3) L 503.3.6.3 Time Switches. Time switches shall be installed on swimming pool heaters and pumps. Exceptions:
(1) Where public health standards require 24-hour pump operation.
(2) Where pumps are required to operate solar and waste heat recovery pool heating systems. [ASHRAE 90.1:7.4.5.3]

SUBSTANTIATION:
This code change proposal is for alignment with Section 7.1 (Service Water Heating-General) and Section 7.4 (Mandatory Provisions) of ASHRAE 90.1-2022.
L 503.0 Service Hot Water – Other Than Low-Rise Residential Buildings.

L 503.1 General. The service hot water, other than singlefamily houses, multifamily structures of three stories or fewer above grade, and modular houses shall comply with this section.

L 503.1.1 New Buildings. Service water-heating systems and equipment shall comply with the requirements of this section as described in Section L 503.2. [ASHRAE 90.1:7.1.1.1, 7.1.2]

L 503.3 Mandatory Provisions. The mandatory provisions of Section L 503.3.1 through Section L 503.3.7 shall be followed.

L 503.3.5 Service Water Heating System Controls. Service water heating system controls shall comply with Section L 503.3.5(1) L 503.3.5.1 and Section L 503.3.5(2) L 503.3.5.2.

(1) L 503.3.5.1 Temperature Controls. Temperature controls shall be provided that allow for storage temperature adjustment from 120°F (49°C) or lower to a maximum temperature compatible with the intended use. Exception: Where the manufacturer’s installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion. [ASHRAE 90.1:7.4.4.1]

(2) L 503.3.5.2 Outlet Temperature Controls. Temperature controlling means shall be provided to limit the maximum temperature of water delivered from lavatory faucets in public facility restrooms to 110°F (43°C). [ASHRAE 90.1:7.4.4.3]

L 503.3.6 Pools. Pool heating systems shall comply with Section L 503.3.6(1) L 503.3.6.1 through Section L 503.3.6(3) L 503.3.6.3.

(1) L 503.3.6.1 Pool Heaters. Pool heaters shall be equipped with a readily accessible ON/OFF switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights. [ASHRAE 90.1:7.4.5.1]

(2) L 503.3.6.2 Pool Covers. Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12. Exception: Pools that are deriving over 60 percent of the energy for heating from site-recovered energy or on-site renewable energy. [ASHRAE 90.1:7.4.5.2]

(3) L 503.3.6.3 Time Switches. Time switches shall be installed on swimming pool heaters and pumps. Exception:

(1) Where public health standards require 24-hour pump operation.

(2) Where pumps are required to operate solar and waste heat recovery pool heating systems. [ASHRAE 90.1:7.4.5.3]

SUBSTANTIATION:
This code change proposal is for alignment with Section 7.1 (Service Water Heating-General) and Section 7.4 (Mandatory Provisions) of ASHRAE 90.1-2022.
### RECOMMENDATION:
Revise text

### Proposed Text:

**TABLE L 503.3.2**

PERFORMANCE REQUIREMENTS FOR WATER-HEATING EQUIPMENT MINIMUM EFFICIENCY REQUIREMENTS  
[ASHRAE 90.1: TABLE 7.8]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>PERFORMANCE REQUIRED¹</th>
<th>TEST PROCEDURE²,³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil instantaneous water heaters</td>
<td>≤210 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal &lt;2 gal</td>
<td>80 % $E_t \ EF \geq 0.59 - 0.0005 \times V$</td>
<td>Appendix E of 10 CFR 430 as it appeared as of 1/1/2014</td>
</tr>
<tr>
<td></td>
<td>&gt;210 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal &lt;10 gal</td>
<td>80% $E_t$</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td></td>
<td>&gt;210 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal ≥10 gal</td>
<td>78% $E_t \ SL \leq (Q/800 + 110\sqrt{V})$, Btu/h</td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remains unchanged)

### SUBSTANTIATION:
This code change proposal is for alignment with Table 7.8 of ASHRAE 90.1-2022.
**TABLE L 503.3.2**  
PERFORMANCE REQUIREMENTS FOR WATER-HEATING EQUIPMENT MINIMUM EFFICIENCY REQUIREMENTS  
[ASHRAE 90.1: TABLE 7.8]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>PERFORMANCE REQUIRED¹</th>
<th>TEST PROCEDURE²³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric table-top water heaters</td>
<td>≤12 kW</td>
<td>&lt;4000 (Btu/h)/gal ≥20 gal and ≤120 gal</td>
<td>For applications outside U.S., see footnote (h). For U.S. applications, see footnote (7).</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td>Electric storage water heaters</td>
<td>≤12 kW</td>
<td>&lt;4000 (Btu/h)/gal ≥20 gal and ≤55 gal</td>
<td>For applications outside U.S., see footnote (8). For U.S. applications, see footnote (7).</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td>&gt;12 kW</td>
<td>&lt;4000 (Btu/h)/gal</td>
<td>SL ≤ 0.3 + 27/Vₚₘ%/h</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td>Electric instantaneous water heaters</td>
<td>≤12 kW</td>
<td>≥4000 (Btu/h)/gal &lt;2 gal</td>
<td>For applications outside U.S., see footnote (8). For U.S. applications, see footnote (7).</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td>&gt;12 kW and ≤58.6 kW³</td>
<td>≥4000 (Btu/h)/gal ≤2 gal ≤180°F</td>
<td>Very Small DP: UEF = 0.80 Low DP: UEF = 0.80 Medium DP: UEF = 0.80 High DP: UEF = 0.80</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td>≤58.6 kW³</td>
<td>≥4000 (Btu/h)/gal &lt;10 gal</td>
<td>No requirement</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥4000 (Btu/h)/gal ≥10 gal</td>
<td>No requirement</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td>Gas storage water heaters</td>
<td>≤75 000 Btu/h</td>
<td>&lt;4000 (Btu/h)/gal ≥20 gal and ≤55 gal</td>
<td>For applications outside U.S., see footnote (8). For U.S. applications, see footnote (7).</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;4000 (Btu/h)/gal &gt;55 gal and ≤100 gal</td>
<td>For applications outside U.S., see footnote (8). For U.S. applications, see footnote (7).</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td>&gt;75 000 Btu/h and ≤105 000</td>
<td>&lt;4000 (Btu/h)/gal ≤120 gal ≤180°F</td>
<td>Very Small DP: UEF = 0.2674 − (0.0009 × Vₚ) Low DP: UEF = 0.5362 −</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
</tbody>
</table>

¹ Performance required varies based on size and input.  
² Test procedure numbers refer to appropriate codes and regulations.  
³ Very Small and Low DP scenarios apply to certain conditions.
<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>PERFORMANCE REQUIRED(^1)</th>
<th>TEST PROCEDURE(^{2,3})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas instantaneous water heaters</td>
<td>≥105 000 Btu/h(^4)</td>
<td>&lt;4000 (Btu/h)/gal</td>
<td>80% (E_t) SL ≤ ((Q/800 + 110\sqrt{V})), Btu/h</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td></td>
<td>&gt;50 000 Btu/h and ≤200 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal &lt;2 gal</td>
<td>For applications outside U.S., see footnote (8). For U.S. applications, see footnote (7).</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td>≥200 000 Btu/h(^4,6)</td>
<td>≥4000 (Btu/h)/gal &lt;10 gal</td>
<td>80% (E_t)</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td></td>
<td>≥200 000 Btu/h(^6)</td>
<td>≥4000 (Btu/h)/gal ≥10 gal</td>
<td>80% (E_t) SL ≤ ((Q/800 + \sqrt{V})), Btu/h</td>
<td></td>
</tr>
<tr>
<td>Oil storage water heaters</td>
<td>≤105 000 Btu/h</td>
<td>&lt;4000 (Btu/h)/gal ≤50 gal</td>
<td>For applications outside U.S., see footnote (8). For U.S. applications, see footnote (7).</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td>≥105 000 Btu/h and ≤140 000 Btu/h</td>
<td>≤120 gal &lt;4000 (Btu/h)/gal ≤180°F</td>
<td>Very Small DP: UEF = 0.2932 – (0.0015 × (V)) Low DP: UEF = 0.5596 – (0.0018 × (V)) Medium DP: UEF = 0.6194 – (0.0016 × (V)) High DP: UEF = 0.6740 – (0.0013 × (V))</td>
<td>Appendix E of 10 CFR 430</td>
</tr>
<tr>
<td></td>
<td>&gt;140 000 Btu/h</td>
<td>&lt;4000 (Btu/h)/gal</td>
<td>80% (E_t) SL ≤ ((Q/800 + 110\sqrt{V})), Btu/h</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td>Oil instantaneous water heaters</td>
<td>≤210 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal &lt;2 gal</td>
<td>80% (E_t) EF ≥ 0.59 – 0.0005 × (V)</td>
<td>Appendix E of 10 CFR 430 as it appeared as of 1/1/2014</td>
</tr>
<tr>
<td></td>
<td>&gt;210 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal &lt;10 gal</td>
<td>80% (E_t)</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td></td>
<td>&gt;210 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal ≥10 gal</td>
<td>78% (E_t) SL ≤ ((Q/800 + 110\sqrt{V})), Btu/h</td>
<td></td>
</tr>
<tr>
<td>Hot-water supply boilers, gas and</td>
<td>≥300 000 Btu/h and &lt;12 500 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal &lt;10 gal</td>
<td>80% (E_t)</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td>oil(^6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot-water supply boilers, gas(^6)</td>
<td>≥300 000 Btu/h and &lt;12 500 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal ≥10 gal</td>
<td>80% (E_t) SL ≤ ((Q/800 + 110\sqrt{V})), Btu/h</td>
<td>10 CFR 431.106</td>
</tr>
<tr>
<td>Hot-water supply boilers, oil</td>
<td>≥300 000 Btu/h and &lt;12 500 000 Btu/h</td>
<td>≥4000 (Btu/h)/gal ≥10 gal</td>
<td>78% (E_t) SL ≤ ((Q/800 + 110\sqrt{V})), Btu/h</td>
<td></td>
</tr>
<tr>
<td>Pool heaters, gas</td>
<td>All</td>
<td>–</td>
<td>82% (E_t) for commercial pool heaters and for applications outside U.S. For U.S. applications, see footnote (7).</td>
<td>Appendix P of 10 CFR 430</td>
</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY (INPUT)</td>
<td>SUBCATEGORY OR RATING CONDITION</td>
<td>PERFORMANCE REQUIRED</td>
<td>TEST PROCEDURE</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Heat pump pool heaters</td>
<td>All</td>
<td>50°F db 44.2°F wb Outdoor air 80.0°F entering water</td>
<td>4.0 COP</td>
<td>Appendix P of 10 CFR 430</td>
</tr>
<tr>
<td>Unfired storage tanks</td>
<td>All</td>
<td>—</td>
<td>R-12.5</td>
<td>(none)</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon = 3.785 L, 1000 British thermal units per hour = 0.293 kW, °C = (°F-32)/1.8

Notes:

1. Thermal efficiency (Et) is a minimum requirement, while standby loss (SL) is a maximum requirement. In the SL equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h (kW). Vm is the measured volume in the tank in gallons. Standby loss for electric water heaters is in terms of %/h and denoted by the term "S," and standby loss for gas and oil water heaters is in terms of Btu/h and denoted by the term "SL." Draw pattern (DP) refers to the water draw profile in the Uniform Energy Factor (UEF) test. UEF and Energy Factor (EF) are minimum requirements. In the UEF standard equations, V_r refers to the rated volume in gallons.

2. ASHRAE 90.1 contains a complete specification, including the year version, of the referenced test procedure.

3. Electric instantaneous water heaters with input capacity >40 946 Btu/h (12 kW) and ≤200 000 Btu/h (58.6 kW) must comply with the requirements for the 200 000 Btu/h (58.6 kW) if the water heater either:
   (a) has a storage volume >2 gallons (7.6 L);
   (b) is designed to provide outlet hot water at temperatures greater than 180°F (82°C); or
   (c) uses three phase power.

4. Gas storage water heaters with input capacity >75 000 Btu/h (22 kW) and ≤105 000 Btu/h (30.8 kW) must comply with the requirements for the >105 000 Btu/h (30.8 kW) if the water heater either:
   (a) has a storage volume >120 gallons (454 L);
   (b) is designed to provide outlet hot water at temperatures greater than 180°F (82.2°C); or
   (c) uses three-phase power.

5. Oil storage water heaters with input capacity >105 000 Btu/h (30.8 kW) and ≤140 000 Btu/h (41.0 kW) must comply with the requirements for the >140 000 Btu/h (41.0 kW) if the water heater either:
   (a) has a storage volume >120 gallons (454 L);
   (b) is designed to provide outlet hot water at temperatures greater than 180°F (82.2°C); or
   (c) uses three-phase power.

6. Refer to Section L 503.4.3 for additional requirements for gas storage and instantaneous water heaters and gas hot-water supply boilers.

7. Water heaters or gas pool heaters in this category or subcategory are regulated as consumer products by the USDOE as defined in 10 CFR 430.

8. Where this standard is being applied to a building outside the U.S. and Canada and water heaters in this subcategory are being installed in that building, those water heaters shall meet the local efficiency requirements. If there are no local efficiency standards for residential water heaters, consideration should be given to using the USDOE efficiency requirements shown in Appendix F, Table F-2 of ASHRAE 90.1.

**SUBSTANTIATION:**

This code change proposal is for alignment with Table 7.8 of ASHRAE 90.1-2022.
L 503.3 Mandatory Provisions. (remaining text unchanged)

L 503.3.5 Service Water Heating System Controls. Service water heating system controls shall comply with Section L 503.3.5(1) and Section L 503.3.5(2).

(1) Temperature controls shall be provided that allow for storage temperature adjustment from 120°F (49°C) or lower to a maximum temperature compatible with the intended use.
Exception: Where the manufacturer’s installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion.

(2) Temperature controlling means shall be provided to limit the maximum temperature of water delivered from lavatory faucets in public facility restrooms to 110°F (43°C).

(3) Hot water distribution main temperature shall be controlled by a device that complies with IAPMO IGC 384.

L 102.0 Definitions.
L 102.1 General. (remaining text unchanged)

Adiabatic Mixing. The mixing of two (or more) streams of fluid of differing temperatures to achieve a new mixed temperature.

Master Mixing Valve. Temperature actuated mixing valves for hot water distribution systems are used for controlling water temperature in hot water systems. They are not intended for point-of-use temperature limiting, control, or end use applications including emergency eyewash and shower equipment. These devices consist of a hot water inlet connection, a cold water inlet connection, a mixed water outlet connection, a thermal element or thermostatic sensor and a means for adjusting the mixed water outlet temperature. These devices can be either a mechanical master mixing valve which is mechanically actuated or a digital master mixing valve which is electronically controlled device.

Mechanical Master Mixing Valve. Master Mixing Valve that utilizes mechanical means such as a thermostatic element to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

Digital Master Mixing Valve. Master mixing valves that utilize electronic means such as digital controls to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>533</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Note: ASSE/IAPMO IGC 384 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Hotels after healthcare facilities have the highest incidence rate of Legionnaires’ disease and thus need to be included in this list. The IECC 2015, 2018, and 2021 requires an aquastat and timer on ALL hot water recirculation pumps. The 2024 UPC added the allowance to operate recirculation pumps continuously; however, other hot water recirculation control devices may still end up adding an aquastat that turns off the recirculation pump thereby negating the positive impact of operating the recirculation pump continuously. An aquastat and timer can cause temperature stagnation of hot water distribution systems which can lead to proliferation of waterborne pathogens and directly conflicts with NASEM Management of Legionella in Buildings, OSHA Technical Manual, ASHRAE 188, ASHRAE 12, ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems, VA-1061, among others. A critical device that may end up inadvertently requiring the use of an aquastat is a water distribution system master mixing valve.

Water distribution system master mechanical mixing valves were not intended for continuous recirculation. An aquastat was needed on the recirculation pump in part due to the potential for an over-temperature safety related to the master mixing valve, also known as "temperature creep," by the industry. Temperature creep occurs during zero demand on the system, when no cold water enters the system. The amount of heat being dissipated by the hot water supply and return piping system (total heat loss: radiant, conduction, convection) is less than the minimum heat being added to the system by all combined heat sources. Or, to put it another way, all mixing valves have a minimum inlet to outlet temperature, and temperature creep happens when the heat added to the piping system by the minimum hot water supply flow through the master mixing valve exceeds the piping system total heat loss. Because the mechanical mixing valve on its own couldn't control a throttling valve was also required back to the heater to limit the amount of hot water entering the mixture of water flows at the water heater and mixing valve, minimizing temperature creep. Worth noting is that some Digital Master Mixing Valves also require an aquastat as they are subject to temperature creep. This is in part what IGC-384 attempts to solve by testing (digital) master mixing valves to verify that they can avoid temperature creep. ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems indicates that Digital Master Mixing Valves should be utilized over Mechanical Master Mixing Valves for buildings water distribution systems such as healthcare and hospitality facilities.

By matching the requirement of master mixing valves ability to operate in such a way that allows continuous recirculation engineers, installers, and owners have the option to design, install, and operate hot water return systems in a manner that minimizes the risk of waterborne pathogen outbreaks, thus positively impacting public health and safety. By adding this exception language to the code, jurisdictions can better work with engineers, installers, and owners and become more aligned to the latest science in regard to hot water safety.

Substantiation provided by:
- Jeremiah Mastery, Institutional Product Mgr. – Hot Water Group, Armstrong International
- Paul Knight, Global Business Development, Armstrong International
- David D. Dexter, Master Plumber, CPI/CPE ret., PE, F.ASPE, F.NSPE, LEED AP BC+D. Sr. Engineer, 3D Engineering Consultants, LLC
- Jose Garcia, PE, Sr. Research Engineer, TRC Companies
TRC Companies have performed limited preliminary research and tested this in a specialized laboratory on this subject, and have provided the following items for consideration:

Both mechanical and digital master mixing valves (MMV) are types of thermostatic mixing valves defined by the capability to sense the water heater or storage tank outlet temperature and actively mix the right ratio of incoming hot and cold water to maintain the desired output temperature. The MMV must be installed on the hot water supply outlet of a central heater or storage tank before the hot water distribution supply piping. The MMV ensures most of the hot water returns to the cold side of the MMV and bypasses the storage tank, which promotes water temperature stratification in gas-fired or heat pump-based indirect storage tank systems or integrated water heaters, leading to higher efficiency operation. MMV can also provide distribution loop pipe heat loss savings by better controlling the outlet temperature from the water heater.

MMV’s are essentially required for heat pump water heaters serving commercial applications because single pass HPWH heat water to temperatures of 140°F or greater. Manufacturers and organizations such as NEEA (publisher of the Advanced Water Heating Specification 8.0), Sanden, and Mitsubishi recognize that commercial HPWH require MMV to operate. MMV also supports load flexibility for HPWH because it allows for increased stored energy capacity (e.g., 140-180°F), which supports load flexibility strategies such as load shifting to be incorporated, or allows smaller sizing of the storage tank improving feasibility especially for retrofit applications.

Compared to mechanical MMV, digital MMV (DMMV) more accurately maintain their setpoint temperature to ±1-3°F with fast response, which is more accurate that a tank thermostat sensor (±5°F of setpoint), thus resulting in the potential to lower the distribution supply setpoint and reduce distribution system pipe heat loss. DMMV are also designed to operate with modern domestic hot water systems with recirculation and wide variation in water draws. Limited and preliminary lab testing results show that one High-Low dual mechanical MMV assembly with built in pressure regulator was able to approach but not match the performance of DMMV with proper commissioning, whereas one single mechanical MMV could not maintain its setpoint temperatures when subject to medium to high flow hot water draws in multifamily buildings. DMMV can direct up to 100 percent of the return flow back to the distribution system by fully closing the hot inlet port to prevent temperature creep, thus eliminating pipe energy loss associated with temperature creep and improving tank water temperature stratification. The impact on stratification may provide additional energy savings at the water heater plant by leading to higher efficiency operation. DMMV also offer energy savings for the systems’ pumps due to reduced pressure drops, reduced temperature fluctuation between low and high demand periods, and increased ability to maintain loop temperatures during minimum demand periods (Ali Rahmatmand et al. 2020)[1]. Compared to mechanical MMVs, they minimize energy waste by limiting cold water intrusion into the distribution loop during draws (Ali Rahmatmand et al. 2019)[2]. To date, lab testing results show a savings range of 6% to 18% with an average of 10.5% savings when DMMV is added to a heat pump based heating plant that previously did not have a MMV and relied on tempering at the apartment level. Gas systems are expected to have a savings of 3% to 6% depending on the system type, with condensing gas systems having higher savings due to the impact of increased stratification on condensation. Field testing is underway to further understand the energy savings for gas and heat pump systems.


RECOMMENDATION:
Revise text

Proposed Text:
L 504.0 Solar Water Heating Systems.
L 504.1 General. The erection, installation, alteration, addition to, use or maintenance of solar water heating systems shall be in accordance with this section and the Uniform Solar, Energy and Hydronics and Geothermal Code.

SUBSTANTIATION:
The proposed change updates the title to the solar, hydronic, and geothermal code.
M 101.0 General.

M 101.1 Applicability. The provisions of this appendix shall establish the method for estimating the supply demand load for the building water supply and principal branches and risers for new construction of single- and multi-family dwellings with water-conserving plumbing fixtures, fixture fittings, and appliances. Chapter 6 shall be used for all other occupancies.

Note: The requirements listed in this chapter are based on the technical paper entitled “Peak Water Demand Study.” Both the Water Demand Calculator and a copy of this technical paper are available for download at: https://www.iapmo.org/water-demand-calculator/.

M 102.0 Demand Load.

M 102.1 Water Demand Calculator. The estimated design supply demand flow rate for the building supply and principal branches and risers shall be determined by the IAPMO Water Demand Calculator available for download at http://www.iapmo.org/WESTand/Pages/WaterDemandCalculator.aspx.

M 102.1.1 Water-Conserving Fixtures. The flow rates for plumbing fixtures, fixture fittings, and appliances shall not exceed the design flow rates in Table M 102.1.1.

M 102.1.2 Other Fixtures. Indoor fixtures, fixture fittings, and appliances not included in Table M 102.1 shall be added in Rows 12 through 14 in the Water Demand Calculator as “Other Fixtures.” The probability of use and flow rate for “Other Fixtures” shall be added by selecting a comparable probability of use and design flow rate from Columns [C] and [E] the Water Demand Calculator.

TABLE M 102.1.1

<table>
<thead>
<tr>
<th>FIXTURE AND APPLIANCE</th>
<th>MAXIMUM DESIGN FLOW RATE (gallons per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td>1.5</td>
</tr>
<tr>
<td>Bathtub</td>
<td>5.5</td>
</tr>
<tr>
<td>Bidet</td>
<td>2.0</td>
</tr>
<tr>
<td>Clothes Washer*</td>
<td>3.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>5.5</td>
</tr>
<tr>
<td>Dishwasher*</td>
<td>1.3</td>
</tr>
<tr>
<td>Kitchen Faucet</td>
<td>2.2</td>
</tr>
<tr>
<td>Laundry Faucet (with aerator)</td>
<td>2.0</td>
</tr>
<tr>
<td>Lavatory Faucet</td>
<td>1.5</td>
</tr>
<tr>
<td>Shower, per head</td>
<td>2.0</td>
</tr>
<tr>
<td>Water Closet, 1.28 GPF Gravity Tank</td>
<td>3.0</td>
</tr>
<tr>
<td>Other fixtures</td>
<td>6.0</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 0.06 L/s
Notes:

Clothes washers and dishwashers shall have an Energy Star label.

Including whirlpools and similar fixtures.

M 102.2 Supply Demand. The supply demand flow rate shall be determined in accordance with Section M 102.2.1 and Section M 102.2.2.

M 102.2.1 Meter and Building Supply. To determine the design supply demand flow rate for the water meter and building supply, enter the total number of each indoor plumbing fixtures and appliances for the building in Column [B] of into the Water Demand Calculator and run the Calculator. (See Table M 102.3 for an example Figure M 102.2.1.)

M 102.2.2 Fixture Branches and Fixture Supplies Risers. To determine the design supply demand flow rate for fixture branches and risers, enter the total number of each plumbing fixtures and appliances for the fixture appliance on each branch or riser in Column [B] of into the Water Demand Calculator and run the Calculator. The flow rate for one fixture branch and one fixture supply shall be the design flow rate of the fixture according to Table M 102.3.

M 102.3 Continuous Supply Demand. The continuous supply demand in gallons per minute (gpm) for lawn sprinklers, air conditioners, hose bibbs, etc., shall be added to the total estimated demand determined for the building supply as determined by Section M 102.3 branches, and risers in accordance with Chapter 6.

Exceptions:

(1) Where there is more than one hose bibb installed on the plumbing system, the demand for only one hose bibb shall be added to the total estimated demand for the building supply.

(2) Where a hose bibb is installed on a principal branch, riser, or fixture branch, the demand of the hose bibb shall be added to the design flow rate for the principal branch, riser, or fixture branch as determined by Section M 102.4 applicable.

### TABLE M 102.3

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td>0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Bathtub</td>
<td>0</td>
<td>1.0</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Bidet</td>
<td>0</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>1</td>
<td>5.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>1</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>1</td>
<td>0.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Kitchen Faucet</td>
<td>1</td>
<td>2.0</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Laundry Faucet</td>
<td>0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Lavatory Faucet</td>
<td>1</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Shower, per head</td>
<td>0</td>
<td>4.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Water Closet, 1.28 GPF Gravity Tank</td>
<td>1</td>
<td>1.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Other Fixture 1</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Fixture 2</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Fixture 3</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total Number of Fixtures</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>99th Percentile Demand Flow = 8.5-GPM</td>
<td>8.5-GPM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 0.66 L/s; 1 gallon = 3.785 L
M 102.7 Size of Water Piping per Appendix A.

M 102.7.1 Minimum Fixture Branch Size. The minimum fixture branch size shall be \(\frac{1}{2}\) inch (15 mm) in diameter.

M 104.0 Peak Water Demand Calculator Examples.

M 104.1 General. This section provides examples illustrating the use of the Water Demand Calculator to estimate the supply demand load for the building water supply and principal branches and risers for single- and multi-family dwellings. See Chart M 103.3(1) through Chart M 103.3(9) for determining pipe size based on friction loss and maximum allowable pipe velocity.

M 102.8 Examples Illustrating Use of Water Demand Calculator with Appendix A.

Example 1: Indoor Water Use Only. — Use the information given below to find the pipe size for the building supply to a residential building with six indoor fixtures as shown in Figure M 104.2(1) [Pipe Section 4].

Given Information:

Type of construction: Residential, one-bathroom  
Friction loss per 100 ft (30 480 mm): 15 psi (103 kPa)
Type of pipe material: L-copper  
Maximum velocity: \(\frac{108}{20} = 5.4 \text{ ft/s (1.6 m/s)}\)
Fixture number/type: 1 combination bath/shower 1 kitchen faucet 1 washbasin 1 washing machine 1 clothes washer 1 toilet 1 lavatory faucet
Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The Water Demand Calculator [WDC] in Figure M 104.2(2) is used to determine the demand load expected from indoor water use. The WDC has white-shaded cells and light-gray-shaded cells. The values in the light-gray cells are derived from a national survey of indoor water use at homes with efficient fixtures and cannot be changed.

The white-shaded cells accept input from the designer. For instance, fixture counts from the given information are entered in Column [B], the column designated as total number of fixtures; the corresponding recommended fixture flow rates are already provided in Column [D], the flow rate column. The flow rates in Column [D], the white cells, may be reduced only if the manufacturer specifies a lower flow rate for the fixture. Column [E], The last column showing maximum fixture flow rates, establishes the upper limits for the flow rates entered into Column [D], the fixture flow rate column. Clicking the "Run Water Demand Calculator WDC" button gives 8.59 gpm (0.540.57 L/s) as the estimated indoor water demand for the whole building. This result appears in the dark-gray output box on the right-hand side of the WDC in Figure M 104.2(2).
For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

FIGURE 2M 104.2(2)
WATER DEMAND CALCULATOR FOR INDOOR USE AT HOME WITH SIX EFFICIENT FIXTURES (EXAMPLE 1)

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Chart A 105.1(1) for copper piping systems (from Appendix A of the UPC, shown in Figure 3) Figure M 104.2(3) is used to determine the pipe size, based on given friction loss, given maximum allowable pipe velocity, given pipe material and the demand load computed in Step 1. In Figure 3M 104.2(3), the intersection of the given friction loss (15 psi) (103.4 kPa) and the maximum allowable pipe velocity (10.8 ft/s) (3.052.4 m/s) is labeled point A. The vertical line that descends from point A to the base of the chart intersects four nominal sizes for L-copper pipe. These intersection points are labeled B, C, D, E and correspond to pipe sizes of 1 inch (25 mm), 3/4 inch (20 mm), 1/2 inch (15 mm) and 3/8 inch (10 mm), respectively. A horizontal line from points B, C, D, E
to the right-hand side of the chart gives maximum flow rates of 24 gpm (0.88 L/s), 12 gpm (0.75 L/s), 4.5 gpm (0.28 L/s), and 2.3 gpm (0.14 L/s), respectively. These results are summarized in Table 1 which shows that a 3/4 inch (20 mm) type L copper line is the minimum size that can convey the peak water demand of 8.5 gpm (0.54 L/s).

### TABLE 1

<table>
<thead>
<tr>
<th>PIPE SIZE OPTIONS FOR BUILDING SUPPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIPE DIAMETER (INCH)</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>E 3/8</td>
</tr>
<tr>
<td>D 1/2</td>
</tr>
<tr>
<td>C 3/4</td>
</tr>
<tr>
<td>B 1</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s

* For Building in Examples 1, 2, 3, and 4.
Example 2: Indoor and Outdoor Water Use – Find the pipe size for the building supply [Figure 3M 104.2(1), Pipe Section 4] if the building in Example 1 adds two outdoor fixtures (hose bibb s, each with a fixture flow of 2.0 gpm) (0.13 L/s).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The WDC has been developed exclusively for peak indoor water use which can be viewed as a highfrequency short duration process. Because fixtures for outdoor water use may operate continuously for very long periods, they are not included in the...
WDC. To account for water use from one or more outdoor fixtures, add the demand of the single outdoor fixture with the highest flowrate to the calculated demand for indoor water use. With two hose bibbs, the demand of only one hose bibb is included. Hence, in this example, the total demand for the whole house is 8.5 gpm (0.54 L/s) + 2.0 gpm (0.13 L/s) = 10.5 gpm (0.66 L/s). 

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Table M 104.2 shows that at 10.5 gpm (0.66 L/s) the building supply shall be 3/4 inch (20 mm) in diameter.

M 104.4 Example 3: Indoor, Outdoor and Other Fixture Water Use – Find the pipe size for the water supply [Figure M 104.2(1), Pipe Section 4] if the building in Example 2 adds a kitchen pot filler and a dog bath each with a faucet flow rate of 5.5 gpm (0.35 L/s).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The kitchen pot filler and dog bath are not listed in Column [A] the fixture list column of the WDC. To accommodate cases such as this, the WDC provides up to three additional rows for “Other Fixtures”. Enter the kitchen pot filler and dog bath in Column [A] the fixture list column of the WDC and enter the fixture count for each in Column [B] the next column. Find an indoor fixture that has a similar probability of use in Column [C] the probability column and add that to the column. Finally, enter the flow rate of the kitchen pot filler and dog bath in Column [D] the flow rate column. The estimated indoor water demand for the whole building is 11.0 gpm (0.70 L/s), as shown in the WDC in Figure 4 M 104.4. As illustrated in Example 2, the hose bibb will increase the total demand for the whole house to 13.0 gpm (0.820 L/s).

Note that a reset button is provided to clear any numbers in Column [B] from a previous calculation.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Table M 104.2 shows that at 13.0 gpm (0.820 L/s) the building supply shall be 1 inch (25 mm) in diameter.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td>0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Bathtub</td>
<td>0</td>
<td>1.0</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Bidet</td>
<td>0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>1</td>
<td>5.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>1</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>1</td>
<td>0.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Kitchen Faucet</td>
<td>1</td>
<td>2.0</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Laundry Faucet</td>
<td>0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Lavatory Faucet</td>
<td>1</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Shower, per head</td>
<td>0</td>
<td>4.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Water Closet, 1.28 gpf Gravity Tank</td>
<td>1</td>
<td>1.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Pot Filler</td>
<td>1</td>
<td>2.0</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Dog Bath</td>
<td>1</td>
<td>1.0</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Other Fixture 3</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Total Number of Fixtures</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>99th Percentile Demand Flow =</td>
<td>11.0 GPM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L
M 104.4 Example 4: Sizing Branches and Risers

For individual hot and cold branches, repeat Steps 1 and 2. For example, for the hot water branch at the water heater [Figure 1M 104.2(1), Pipe Section 3], enter all the fixtures and appliances that use hot water into the Water Demand Calculator (toilets will be excluded) as seen in Figure 5M 104.5. Use the calculated demand load to find the pipe size in Step 2. Table 5M 104.2 shows that at 7.7 gpm (0.49 L/s) gpm, the hot water branch shall be 3/4 inch (20 mm) in diameter.

For each additional hot and cold branch [Figure 1M 104.2(1), Pipe Sections 1 and 2], enter the number of fixtures and appliances served by that branch into the WDC and use that demand in Step 2 to determine the branch size. If the branch serves a hose bibb, add the demand of the hose bibb to the calculated demand flow for the branch. As discussed in Example 2, the hose bibb is not to be entered into WDC, since the Calculator is for indoor uses only.

When there is only one fixture or appliance served by a fixture branch, the demand flow shall not exceed the fixture flow rate in Column [E] the last column of the Water Demand Calculator. The fixture flow rate would be used in Step 2 to determine the size of the fixture branch and supply.
For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

**FIGURE M 104.5**

**WATER DEMAND CALCULATOR FOR THE HOT WATER BRANCH (EXAMPLE 4)**

**M 104.6 Example 5: Multi-Family Application.** When using the WDC for multi-family dwellings, use the drop-down menu on the top left corner that allows you to select either single-family residence or a multi-family building. Choosing the multi-family option opens two more boxes to fill in information. (See Figure M 104.6.) When estimating for a multi-family building, enter the total number of dwelling units in the building. The example shows a total of 100 dwelling units in the building. The box below it will be for the number of units you are calculating for. If you are calculating for the whole building, enter the same number of 100. If you are calculating for half the dwelling units, enter 50. If you are estimating for only one unit, then enter the number one. The total number of units in the first box will not change in any of your calculations. Then use the WDC, as has been explained earlier, for sizing branches and risers.
### FIGURE M 104.6

**WATER DEMAND CALCULATOR FOR MULTI-FAMILY DWELLINGS (EXAMPLE 5)**

#### CHART M 103.3(1)
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART M 103.3(2)
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART M 103.3(7)
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART M 103.3(8)

PRESSURE LOSS OF PEX TUBING AT 60°F
For SI units: °C = (°F-32)/1.8, 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART M 103.3(9)

PRESSURE LOSS OF PEX TUBING AT 120°F
SUBSTANTIATION:
This proposal correlates the UPC Appendix M, Water Demand Calculator (WDC) to the latest approved version of the WeStand updates to the WDC. The proposal is to update requirements pertaining to the Water Demand Calculator (WDC) and clarify use of the WDC when estimating the demand load for the building water supply and principal branches for single- and multi-family dwellings. The existing examples were also updated, and a new example for multi-family applications has been added.
Chart M 103.3(1) through Chart M 103.3(7) were gathered from Appendix A (Recommended Rules for Sizing the Water Supply System) of the UPC, and Chart M 103.3(8) and Chart M 103.3(9) were gathered from IAPMO IS 31 (Installation Standard for PEX Tubing Systems for Hot- and Cold-Water Distribution).

The charts listed above, used for determining diameters of building supply pipe, branches, and risers, have been relocated to Appendix M as this offers applicable tools and provides additional guidance when implementing the Water Demand Calculator (WDC).

This code change proposal is for alignment with similar updates to the WEStand. As presented in the proposal, requirements for the WDC were moved to the normative body of the code and Appendix M was updated to only include WDC examples. As alternative to the proposal to “only” correlate with the WeStand, this proposal offers the same technical revisions without the relocation of requirements into the normative body.

These technical updates were generated by the WE•Stand Premise Water System Design Task Group and submitted to the WEStand during the recent code cycle. Such updates were endorsed by the Task Group based on the significant theoretical work conducted in the development of the Water Demand Calculator followed by the validation of the theory through the comparison of the Water Demand Calculator to actual field peak flow rates.

Additional information on the Water Demand Calculator may be found via the following link: https://www.iapmo.org/water-demand-calculator/
CHAPTER 17
PEAK WATER DEMAND CALCULATOR

M 101.0 1701.0 General.

M 101.1 1701.1 Applicability. The provisions of this chapter shall establish the method for estimating the supply demand load for the building water supply and principal branches for and risers for new construction of single- and multi-family dwellings with water-conserving plumbing fixtures, fixture fittings, and appliances. Chapter 6 shall be used for all other occupancies.

Note: The requirements listed in this chapter are based on the technical paper entitled "Peak Water Demand Study." Both the Water Demand Calculator and a copy of this technical paper are available for download at: https://www.iapmo.org/water-demand-calculator/.

M 102.0 1702.0 Demand Load.

M 102.1 1702.1 Water Demand Calculator. The estimated design supply demand flow rate for the building supply and principal branches and risers shall be determined by the IAPMO Water Demand Calculator available for download at http://www.iapmo.org/WEStand/Pages/WaterDemandCalculator.aspx.

M 102.1.1 Water-Conserving Fixtures. The flow rates for plumbing fixtures, fixture fittings, and appliances shall not exceed the design flow rate in Table M 102.1.1.1.

M 102.2 1702.2 Other Fixtures. Indoor fixtures, fixture fittings, and appliances not specified in Table M 102.1.1 shall be added in Rows 12 through 14 in the Water Demand Calculator as "Other Fixtures." The probability of use and flow rate for "Other Fixtures" shall be added by selecting a comparable probability of use and design flow rate from Columns [C] and [E] the Water Demand Calculator.

### TABLE M 102.1.1.1
MAXIMUM DESIGN FLOW RATE FOR WATER-CONSERVING PLUMBING FIXTURES, FIXTURE FITTINGS, AND APPLIANCES IN RESIDENTIAL OCCUPANCIES

<table>
<thead>
<tr>
<th>FIXTURE AND APPLIANCE</th>
<th>MAXIMUM DESIGN FLOW RATE (gallons per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td>1.5</td>
</tr>
<tr>
<td>Bathtub</td>
<td>5.5</td>
</tr>
<tr>
<td>Bidet</td>
<td>2.0</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>3.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>5.5</td>
</tr>
<tr>
<td>Dishwashers</td>
<td>1.3</td>
</tr>
<tr>
<td>Kitchen Faucet</td>
<td>2.2</td>
</tr>
<tr>
<td>Laundry Faucet (with aerator)</td>
<td>2.0</td>
</tr>
<tr>
<td>Lavatory Faucet</td>
<td>1.5</td>
</tr>
<tr>
<td>Shower, per head</td>
<td>2.0</td>
</tr>
</tbody>
</table>
### Fixture and Appliance Maximum Design Flow Rate (gallons per minute)

<table>
<thead>
<tr>
<th>Fixture and Appliance</th>
<th>Maximum Design Flow Rate (gallons per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Closet, 1.28 GPF Gravity Tank</td>
<td>3.0</td>
</tr>
<tr>
<td>Other fixtures</td>
<td>6.0</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 0.06 L/s

**Notes:**

1. Clothes washers and dishwashers shall have an Energy Star label.
2. Including whirlpools and similar fixtures.

**1702.2 Supply Demand.** The supply demand flow rate shall be determined in accordance with Section 1702.2.1 and Section 1702.2.2.

**M 102.2.1** Meter and Building Supply. To determine the design supply demand flow rate for the water meter and building supply, enter the total number of each indoor plumbing fixtures and appliances for the building in Column [B] of Table M 102.3 into the Water Demand Calculator and run the Calculator. (See Table M 102.3 for an example Figure 1702.2.1).

**M 102.2.2** Fixture Branches and Fixture Supplies Risers. To determine the design supply demand flow rate for fixture branches and risers, enter the total number of each plumbing fixtures and appliances for the fixture appliance on each branch or riser in Column [B] of Table M 102.3 into the Water Demand Calculator and run the Calculator. The flow rate for one fixture branch and one fixture supply shall be the design flow rate of the fixture according to Table M 102.2.1.

**M 102.2.3** Continuous Supply Demand. The continuous supply demands in gallons per minute (gpm) for lawn sprinklers, air conditioners, hose bibbs, etc., shall be added to the total estimated demand determined for the building supply as determined by Section M 102.3, branches, and risers in accordance with Chapter 6.

**Exceptions:**

1. Where there is more than one hose bibb installed on the plumbing system, the demand for only one hose bibb shall be added to the total estimated demand for the building supply.
2. Where a hose bibb is installed on a principal branch, riser, or fixture branch, the demand of the hose bibb shall be added to the design flow rate for the principal branch, riser, or fixture branch as determined by Section M 102.2.4 applicable.

**Table M 102.3**

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Enter Number of Fixtures</th>
<th>Probability of Use (%)</th>
<th>Enter Fixture Flow Rate (GPM)</th>
<th>Maximum Recommended Fixture Flow Rate (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar-Sink</td>
<td>0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Bathtub</td>
<td>0</td>
<td>1.0</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Bidet</td>
<td>0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>1</td>
<td>5.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>1</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>1</td>
<td>0.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Kitchen Faucet</td>
<td>1</td>
<td>2.0</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Laundry Faucet</td>
<td>0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Lavatory Faucet</td>
<td>1</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Shower, per head</td>
<td>0</td>
<td>4.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Water Closet, 1.28 GPF Gravity Tank</td>
<td>1</td>
<td>1.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>
FIGURE 1702.2.1
WATER DEMAND CALCULATOR

M 102.7.1703.0 Size of Water Piping per Appendix A.

1703.1 General. Except as provided in Section M 102.9 this section, the procedure for estimating the demand load for single- and multi-family dwellings, sizing the size of each water piping supply system shall be determined in accordance with the procedure set forth in Appendix A Chapter 6.

1703.2 Total Demand Load. The total demand load shall be the sum of the supply demand load calculated in accordance with Section 1702.2 and the continuous demand load calculated in accordance with Section 1702.3 for the building supply, branches, risers, and fixture branches as applicable.

1703.3 Determining Pipe Diameters. After determining the permissible friction loss per 100 feet (30480 mm) of pipe and the total demand loads in accordance with Section A 104.0 and the demand flow in accordance with the Water Demand Calculator 1703.2 the diameter of the building supply pipe, branches and risers shall be obtained from determined in accordance with Chart A 105.1(1) 1703.3(1) through Chart A 105.1(7) 1703.3(9), whichever is applicable, in accordance with Section A 105.0 and Section A 106.0. Velocities shall be in accordance with Section A 107.0. Appendix I (IS 31), Figure 3 and Figure 4 shall be permitted when sizing PEX systems.

M 102.7.1 Minimum Fixture Branch Size. The minimum fixture branch size shall be $\frac{3}{4}$ inch (15 mm) in diameter.

CHART 1703.3(1)
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART 1703.3(4)
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART 1703.3(5)
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART 1703.3(7)
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART 1703.3(8)
PRESSURE LOSS OF PEX TUBING AT 60°F
For SI units: °C = (°F-32)/1.8, 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

**CHART 1703.3(9)**

**PRESSURE LOSS OF PEX TUBING AT 120°F**
For SI units: °C = (°F-32)/1.8, 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s
This proposal is to move the use of the Water Demand Calculator (WDC), currently in the informative Appendix M of the UPC, into normative Chapter 17. As noted in the proposal, the new mandated requirements are to use the WDC for estimating the demand load for the building water supply and principal branches for single- and multi-family dwellings.

The development of the WDC is documented in the study, Peak Water Demand Study (Buchberger, et.al. 2017. https://www.iapmo.org/water-demand-calculator/). The Study concluded, "The computational methods for estimating water supply demand for single and multi-family dwellings identified in this report and coded into the Water Demand Calculator are offered as an improved method to avoid over-design resulting from Hunter's Curve as the current method used in the U.S. plumbing codes." The study also concludes that "A key advantage of the Wistort approach is that it does not rely on mysterious fixture units and it is not calibrated to any particular fixture type. Hence, the dimensionless formulation will remain valid even as water use habits change and fixture types evolve in the future."

Since the publication of the Study and the inclusion of the WDC in an informative appendix, a number of states and local jurisdictions have taken the lead in adopting the use of the Water Demand Calculator including: Nevada (2018), North Dakota (2020), Oregon (2021), and the city of Seattle along with King County in Washington (2021).

In November 2021 Gary Klein and Associates, Inc., on behalf of 20 organizations, submitted a Petition to the California Building Standards Commission to adopt the use of the Water Demand Calculator (Petition) in determining the estimated design flow rate.

The following benefits were cited in the Petition:
- Construction cost savings due to:
  - Smaller diameter pipes and fittings, valves, pumps, and other equipment,
  - Smaller inside diameter pipe insulation, and
  - Smaller water service entrance size, resulting in smaller water meter size with lower connection fees.
- Ongoing cost savings due to:
  - Water savings from faster hot water delivery times, resulting in smaller monthly water service charges and lower associated volumetric sewer charges,
  - Energy savings due to decreased heat loss in hot water distribution system, particularly in multifamily buildings with a recirculation system, and
  - Embedded energy savings for the water and wastewater utilities due to customer indoor water savings.
- Reduced public health and safety risks and improved water quality due to shorter water dwell times within plumbing systems.
- Each floor plan determines the distance between the mechanical room and the fixtures. UPC Appendix M does not change the length of the pipe, only the diameter. With the pipe diameter on each segment reduced, the pipe volume will be reduced.
- Reduced carbon emissions due to material savings and energy reductions.

Figure 1 from the Petition provides a comparison of Actual Peak Flow Rates to calculated rates using the Hunter's Curve. The figure underscores that the standard practice – based on the Hunter's curve – overestimates the peak flow rates when compared to use with plumbing fixtures and appliances that have been in buildings since the Energy Policy Act of 1992 went into effect the mid-1990s.
Figure 1: Comparing UPC Appendix A (Hunter’s Curve) to Actual Peak Flow Rates (99th Percentile of non-zero flows for all sampling intervals over the entire monitoring period) in Multifamily Buildings (ranging in size from 8 to 384 apartments). The top graph in Figure 1 shows data for all buildings analyzed to date. The bottom graph in Figure 1 zooms in on the cluster of buildings with fewer than 300 Water Supply Fixture Units (WSFU).

Figure 2 from the Petition compares the monitored data from the 16 multifamily buildings to the peak water demand estimates based on UPC Appendix M. The comparison shows that Water Demand Calculator provides a conservative approach to estimate peak water flow rates, providing a margin of safety at least 1.8 times the measured data in multifamily buildings.
Chart 1703.3(1) through Chart 1703.3(7) were gathered from Appendix A (Recommended Rules for Sizing the Water Supply System) of the UPC, and Chart 1703.3(8) and Chart 1703.3(9) were gathered from IAPMO IS 31 (Installation Standard for PEX Tubing Systems for Hot- and Cold-Water Distribution).

The charts listed above, used for determining diameters of building supply pipe, branches, and risers, have been relocated to Chapter 17 as this offers applicable tools and provides additional guidance when implementing the Water Demand Calculator (WDC).

This code change proposal is for correlation with the WEStand. These updates were generated by the WE•Stand Premise Water System Design Task Group and submitted to the WEStand during the recent code cycle. Such updates were endorsed by the Task Group based on the significant theoretical work conducted in the development of the Water Demand Calculator followed by the validation of the theory through the comparison of the Water Demand Calculator to actual field peak flow rates.

Additional information on the Water Demand Calculator may be found via the following link:
https://www.iapmo.org/water-demand-calculator/

(See Item # XXX for the related proposal to Appendix M which updates the existing WDC examples and provides an additional for multi-family applications.)
APPENDIX M

PEAK WATER DEMAND CALCULATOR – EXAMPLES

M 101.0 General

M 101.1 Applicability. This appendix provides examples illustrating the use of the Water Demand Calculator to estimate the supply demand load for the building water supply and principal branches and risers for single- and multi-family dwellings. See Chart 1703.3(1) through Chart 1703.3(9) for determining pipe size based on friction loss and maximum allowable pipe velocity.

M 102.0 Examples Illustrating Use of Water Demand Calculator with Appendix A.

Example 1: Indoor Water Use Only. Use the information given below to find the pipe size for the building supply to a residential building with six indoor fixtures as shown in Figure 1.

Given Information:

Type of construction: Residential, one-bathroom
Friction loss per 100 ft (30 480 mm): 15 psi (103 kPa)
Type of pipe material: L-copper
Maximum velocity: 10.8 ft/s (3.05 m/s)

Fixture number/type: 1 combination bath/shower
1 dishwasher
1 kitchen faucet
1 WC
1 lavatory faucet
1 clothes washer

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The Water Demand Calculator (WDC) in Figure 2 is used to determine the demand load expected from indoor water use. The WDC has white-shaded cells and light-gray-shaded cells. The values in the light-gray cells are derived from a national survey of indoor water use at homes with efficient fixtures and cannot be changed.

Column [B] the column designated as total number of fixtures; the corresponding recommended fixture flow rates are already provided in Column [D] the flow rate column. The flow rates in Column [D] the white cells may be reduced only if the manufacturer specifies a lower flow rate for the fixture.

Column [E] The last column showing maximum fixture flow rates establishes the upper limits for the flow rates entered into Column [D] the fixture flow rate column. Clicking the “Run Water Demand Calculator WDC” button gives 8.5 gpm (6.5 L/s) as the estimated indoor water demand for the whole building. This result appears in the dark-gray output box on the right-hand side of the WDC in Figure 2.
For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

**FIGURE 2**

**WATER DEMAND CALCULATOR FOR INDOOR USE AT HOME WITH SIX EFFICIENT FIXTURES (EXAMPLE 1)**

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Chart A 105.1(1) for copper piping systems (from Appendix A of the UPC, shown in Figure 3) Figure M 102.1(3) is used to determine the pipe size, based on given friction loss, given maximum allowable pipe velocity, given pipe material and the demand load computed in Step 1. In Figure M 102.1(2), the intersection of the given friction loss (15 psi) (103.4 kPa) and the maximum allowable pipe velocity (10.8 ft/s) (3.3 m/s) is labeled point A. The vertical line that descends from point A to the base of the chart intersects four nominal sizes for L-copper pipe. These intersection points are labeled B, C, D, E and correspond to pipe sizes of 1 inch (25 mm), 3/4 inch (20 mm), 1/2 inch (15 mm) and 3/8 inch (10 mm), respectively. A horizontal line from points B, C, D, E to the right-hand side of the chart gives maximum flow rates of 24.0 gpm (90.5 L/s), 12 gpm (45.7 L/s), 4.5 gpm (0.28 L/s), and 2.3 gpm (0.145 L/s), respectively. These results are summarized in Table M 104.2 which shows that a 3/4 inch (20 mm) type L-copper line is the minimum size that can convey the peak water demand of 8.5 gpm (30.7 L/s).

**TABLE M 102.1**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td>0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Bathtub</td>
<td>0</td>
<td>1.0</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Bidet</td>
<td>0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>1</td>
<td>5.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>1</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>1</td>
<td>0.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Kitchen Faucet</td>
<td>1</td>
<td>2.0</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Laundry Faucet</td>
<td>0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Lavatory Faucet</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Shower, per head</td>
<td>0</td>
<td>4.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Water Closet, 1.28 GPF Gravity Tank</td>
<td>1</td>
<td>1.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Other Fixture 1</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Fixture 2</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Fixture 3</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total Number of Fixtures</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>99th Percentile Demand Flow =</td>
<td>8.5 GPM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Saturday, January 21, 2022 11:21 AM**

- **Total No. of Fixtures in Calculation**: n = 6
- **99th Percentile Demand Flow**: Q = 9.0 GPM
- **Hydraulics**: H(p,r) = 0.17
- **Stagnation Probability**: Pr(Zero Demand) = 84%

**TABLE M 102.1**

- **Fixture Groups**
  - **Bathroom Fixtures**
    - 1. Bath (no Shower)
    - 2. Bidet
    - 3. Combination Bath/Shower
    - 4. Faucet, Lavatory
    - 5. Shower, per head (no Bathtub)
    - 6. Water Closet, 1.28 GPF Gravity Tank
  - **Kitchen Fixtures**
    - 7. Dishwasher
    - 8. Faucet, Kitchen Sink
  - **Laundry Room Fixtures**
    - 9. Clothes Washer
    - 10. Faucet, Laundry
  - **Day/Prep Fixtures**
    - 11. Faucet, Bar Sink
    - 12. Fixture 1
    - 13. Fixture 2
    - 14. Fixture 3

- **Select Units for Water Demand**
  - **Download Result**
  - **Reset WDC**
  - **GPM**
  - **LPM**
  - **LPS**
  - **Run WDC**

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## PIPE SIZE OPTIONS FOR BUILDING SUPPLY

<table>
<thead>
<tr>
<th>POINT IN FIGURE 3M 104.2(3)</th>
<th>PIPE DIAMETER (INCH)</th>
<th>MAXIMUM FLOW (GPM)</th>
<th>OK FOR BUILDING SUPPLY*</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>$\frac{3}{8}$</td>
<td>2.3</td>
<td>No</td>
</tr>
<tr>
<td>D</td>
<td>$\frac{1}{2}$</td>
<td>4.5</td>
<td>No</td>
</tr>
<tr>
<td>C</td>
<td>$\frac{3}{4}$</td>
<td>12</td>
<td>Yes</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>24</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s

* For Building in Examples 1, 2, 3, and 4.
FIGURE 3M 102.1(3)
CHART A 105.1(1) 1703.3(1) FOR FINDING PIPE SIZE
Example 2: Indoor and Outdoor Water Use

Find the pipe size for the building supply [Figure M 102.1(1), Pipe Section 4] if the building in Example 1 adds two outdoor fixtures [hose bibbs, each with a fixture flow of 2.0 gpm] (0.13 L/s)].

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The WDC has been developed exclusively for peak indoor water use which can be viewed as a highfrequency short duration process. Because fixtures for outdoor water use may operate continuously for very long periods, they are not included in the WDC. To account for water use from one or more outdoor fixtures, add the demand of the single outdoor fixture with the highest flowrate to the calculated demand for indoor water use. With two hose bibbs, the demand of only one hose bibb is included. Hence, in this example, the total demand for the whole house is $9.0 \text{ gpm } (0.54 \text{ L/s}) + 2.0 \text{ gpm } (0.13 \text{ L/s}) = 11.0 \text{ gpm } (0.66 \text{ L/s})$.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Table M 102.1 shows that at 11.0 gpm (0.66 L/s) the building supply shall be 3/4 inch (20 mm) in diameter.

Example 3: Indoor, Outdoor and Other Fixture Water Use

Find the pipe size for the water supply [Figure M 102.1(1), Pipe Section 4] if the building in Example 2 adds a kitchen pot filler and a dog bath each with a faucet flow rate of 5.5 gpm (0.35 L/s).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The kitchen pot filler and dog bath are not listed in Column [A] the fixture list column of the WDC. To accommodate cases such as this, the WDC provides up to three additional rows for "Other Fixtures." Enter the kitchen pot filler and dog bath in Column [A] the fixture list column of the WDC and enter the fixture count for each in Column [B] the next column. Find an indoor fixture that has a similar probability of use in Column [C] the probability column and add that to the column. Finally, enter the flow rate of the kitchen pot filler and dog bath in Column [D] the flow rate column. The estimated indoor water demand for the whole building is 11.0 gpm (0.70 L/s), as shown in the WDC in Figure M 102.3.

As illustrated in Example 2, the hose bibb will increase the total demand for the whole house to 13.0 gpm (0.82 L/s).

Note that a reset button is provided to clear any numbers in Column [B] from a previous calculation.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Table M 102.1 shows that at 13.0 gpm (0.82 L/s) the building supply shall be 1 inch (25 mm) in diameter.
FIGURE 4M.102.3
WATER DEMAND CALCULATOR TO ACCOMMODATE OTHER FIXTURES (EXAMPLE 3)

M.102.4 Example 4: Sizing Branches and Risers - For individual hot and cold branches, repeat Steps 1 and 2. For example, for the hot water branch at the water heater [Figure 4M.102.1(1), Pipe Section 3], enter all the fixtures and appliances that use hot water into the Water Demand Calculator (toilets will be excluded) as seen in Figure 5M.102.4. Use the calculated demand load to find the pipe size in Step 2. Table 4M.102.1 shows that at 7.7-9.0 gpm (0.49-0.57 L/s), the hot water branch shall be 3/4 inch (20 mm) in diameter.

For each additional hot and cold branch [Figure 4M.102.1(1), Pipe Sections 1 and 2], enter the number of fixtures and appliances served by that branch into the WDC and use that demand in Step 2 to determine the branch size. If the branch serves a hose bibb, add the demand of the hose bibb to the calculated demand flow for the branch. As discussed in Example 2, the hose bibb is not to be entered into WDC, since the Calculator is for indoor uses only.

When there is only one fixture or appliance served by a fixture branch, the demand flow shall not exceed the fixture flow rate in Column (C), the last column of the Water Demand Calculator. The fixture flow rate would be used in Step 2 to determine the size of the fixture branch and supply.

For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L.
### Water Demand Calculator for the Hot Water Branch (Example 4)

**M 102.5 Example 5: Multi-Family Application.** When using the WDC for multi-family dwellings, use the drop-down menu on the top left corner that allows you to select either single-family residence or a multi-family building. Choosing the multi-family option opens two more boxes to fill in information. (See Figure M 102.5.) When estimating for a multi-family building, enter the total number of dwelling units in the building. The example shows a total of 100 dwelling units in the building. The box below it will be for the number of units you are calculating for. If you are calculating for the whole building, enter the same number of 100. If you are calculating for half the dwelling units, enter 50. If you are estimating for only one unit, then enter the number one. The total number of units in the first box will not change in any of your calculations. Then use the WDC, as has been explained earlier, for sizing branches and risers.

### Water Demand Calculator for Multi-Family Dwellings (Example 5)

![WDC for Multi-Family Dwellings](image)

**Figure M 102.5**

**Water Demand Calculator (WDC v2.1)**

#### Table: Water Demand Calculator for Multi-Family Dwellings

<table>
<thead>
<tr>
<th>Fixture Groups</th>
<th>Fixture</th>
<th>Enter Total Number of Fixtures</th>
<th>Probability of Use (%)</th>
<th>Enter Fixture Flow Rate (gpm)</th>
<th>Maximum Recommended Fixture Flow Rate (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bathroom Fixtures</strong></td>
<td><strong>Bathtub (no Shower)</strong></td>
<td>0</td>
<td>1.00</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td><strong>Shower</strong></td>
<td>0</td>
<td>1.00</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td><strong>Combination Bath/Shower</strong></td>
<td>1</td>
<td>3.50</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td><strong>Faucet, Lavatory</strong></td>
<td>1</td>
<td>0.00</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td><strong>Shower, per head (no Bathtub)</strong></td>
<td>0</td>
<td>4.50</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td><strong>Water Closet, 1.28 GPF Gravity Tank</strong></td>
<td>0</td>
<td>1.00</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Kitchen Fixtures</strong></td>
<td><strong>Dishwasher</strong></td>
<td>1</td>
<td>0.50</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td><strong>Faucet, Kitchen Sink</strong></td>
<td>1</td>
<td>2.00</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Laundry Room Fixtures</strong></td>
<td><strong>Clothes Washer</strong></td>
<td>1</td>
<td>3.50</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td><strong>Faucet, Laundry</strong></td>
<td>0</td>
<td>2.00</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Bar/Prep Fixtures</strong></td>
<td><strong>Faucet, Bar Sink</strong></td>
<td>0</td>
<td>2.00</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td><strong>Other Fixtures</strong></td>
<td><strong>Fixture 1</strong></td>
<td>0</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Fixture 2</strong></td>
<td>0</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Fixture 3</strong></td>
<td>0</td>
<td>0.00</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Computed Results for Peak Period Conditions**

- Total No. of Fixtures in Calculations: 100
- 99th Percentile Demand Flow: 10.6 gpm
- Hunter Number: 0.36
- Stagnation Probability: 7.0%
In support of the other recommendation in a separate proposal, Appendix M has been revised to include updated examples for the Water Demand Calculator. As depicted within the applicability, the provided examples illustrate the use of the WDC to estimate the supply demand load for the building water supply and principal branches and risers for single- and multi-family dwellings.

To provide users of this appendix with figures that more closely resemble the WDC program, the previous tables used for data inputs were replaced with screen captures of the WDC software. This also allowed for the removal of references to specific columns throughout the text. Additionally, the values provided were revised for consistency with the updated examples as shown in the WDC program figures.

Previously, this appendix did not offer an example of a multi-family application, nor did it include the necessary charts for determining pipe size based on friction loss and maximum allowable pipe velocity.

In summary, the updates made to Appendix M are necessary to provide users of the UPC with the appropriate tools for correctly using the Water Demand Calculator.

This code change proposal is for correlation with the WEStand. These updates were generated by the WE-Stand Premise Water System Design Task Group and submitted to the WEStand during the recent code cycle. Such updates were endorsed by the Task Group based on the significant theoretical work conducted in the development of the Water Demand Calculator followed by the validation of the theory through the comparison of the Water Demand Calculator to actual field peak flow rates.

Additional information on the Water Demand Calculator may be found via the following link:
https://www.iapmo.org/water-demand-calculator/

(See related proposal to a new Chapter 17 which relocates WDC requirements to the normative body of the code.)
Proposed Text:

APPENDIX M

PEAK WATER DEMAND CALCULATOR

M 101.0 General.
M 101.1 Applicability. The provisions of this appendix shall establish the method for estimating the supply demand load for the building water supply and principal branches and risers for new construction of single- and multi-family dwellings, and commercial buildings. The plumbing code shall be used for all other occupancies with water-conserving plumbing fixtures, fixture fittings, and appliances.

M 102.0 Demand Load.
M 102.1 Water-Conserving Fixtures. The flow rates for plumbing fixtures, fixture fittings, and appliances shall not exceed the design flow rates in Table M 102.1(1) and Table M 102.1(2).

**TABLE M 102.1(1)**

MAXIMUM DESIGN FLOW RATE FOR WATER-CONSERVING PLUMBING FIXTURES, FIXTURE FITTINGS, AND APPLIANCES IN RESIDENTIAL OCCUPANCIES

<table>
<thead>
<tr>
<th>Fixture and Appliance</th>
<th>Maximum Design Flow Rate (gallons per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td>1.5</td>
</tr>
<tr>
<td>Bathtub²</td>
<td>5.5</td>
</tr>
<tr>
<td>Bidet</td>
<td>2.0</td>
</tr>
<tr>
<td>Clothes Washer¹</td>
<td>3.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>5.5</td>
</tr>
<tr>
<td>Dishwasher¹</td>
<td>1.3</td>
</tr>
<tr>
<td>Kitchen Faucet</td>
<td>2.2</td>
</tr>
<tr>
<td>Laundry Faucet (with aerator)</td>
<td>2.0</td>
</tr>
<tr>
<td>Lavatory Faucet</td>
<td>1.5</td>
</tr>
<tr>
<td>Shower, per head</td>
<td>2.0</td>
</tr>
<tr>
<td>Water Closet, 1.28 GPF Gravity Tank</td>
<td>3.0</td>
</tr>
<tr>
<td>Other fixtures</td>
<td>10.0</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon per minute = 0.06 L/s

¹ Clothes washers and dishwashers shall have an energy star label.

² Including whirlpools and similar fixtures.

**TABLE M 102.1(2)**

MAXIMUM DESIGN FLOW RATE FOR PLUMBING FIXTURES, FIXTURE FITTINGS, AND APPLIANCES IN COMMERCIAL BUILDINGS

<table>
<thead>
<tr>
<th>Fixture and Appliance</th>
<th>Maximum Design Flow Rate (gallons per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td>1.6</td>
</tr>
<tr>
<td>Bathtub only</td>
<td>8</td>
</tr>
<tr>
<td>Bidet</td>
<td>2.0</td>
</tr>
<tr>
<td>Commercial Clothes Washer</td>
<td>4</td>
</tr>
<tr>
<td>Commercial Dishwasher</td>
<td>1.5</td>
</tr>
<tr>
<td>Combination Bath/Shower</td>
<td>5.5</td>
</tr>
<tr>
<td>Drinking Fountain</td>
<td>1.0</td>
</tr>
<tr>
<td>Ice maker</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Jacuzzi & 10.0  
Kitchen Faucet & 2.2  
Laundry Faucet (with aerator) & 2.0  
Lavatory Faucet, private & 1.5  
Lavatory Faucet, public-metered & 0.5  
Lavatory Faucet, public-non-metered & 1.5  
Shower, per head & 2.0  
Service sink & 3.5  
Urinal, flushometer valve & 8  
Water Closet, 1.28 GPF flushometer valve & 2.5  
Water Closet, 1.28 GPF Gravity Tank & 3.0  
Other fixtures & 10.0  

For SI units: 1 gallon per minute = 0.06 L/s.

M 102.2 Water Demand Calculator. The estimated design flow rate for the building supply and principal branches and risers shall be determined by the IAPMO Water Demand Calculator available for download at http://www.iapmo.org/WESTand/Pages/WaterDemandCalculator.aspx.

M 102.3 Meter and Building Supply. To determine the design flow rate for the water meter and building supply, enter the total number of indoor plumbing fixtures and appliances for the building in Column [B] of Table M 102.3 into the Water Demand Calculator and run Calculator. See Table Figure M 102.3 for an example.

M 102.4 Fixture Branches and Fixture Supplies. To determine the design flow rate for fixture branches and risers, enter the total number of plumbing fixtures and appliances for the fixture branch or riser in Column [B] of Table M 102.3 into the Water Demand Calculator and run Calculator. The flow rate for one fixture branch and one fixture supply shall be the design flow rate of the fixture according to Table M 102.4(1) and Table M 102.4(2).

M 102.5 Continuous Supply Demand. Continuous supply demands in gallons per minute (gpm) for lawn sprinklers, air conditioners, hose bibs, etc., shall be added to the total estimated demand for the building supply as determined by Section M 102.3. Where there is more than one hose bibb installed on the plumbing system, the demand for only one hose bibb shall be added to the total estimated demand for the building supply. Where a hose bibb is installed on a fixture branch, the demand of the hose bibb shall be added to the design flow rate for the fixture branch as determined by Section M 102.4.

M 102.6 Other Fixtures. Fixtures not included in Table M 102.1(1) and Table M 102.1(2) shall be added in Rows 12 through 14 in the Water Demand Calculator as Other Fixture. The probability of use and flow rate for Other Fixtures shall be added by selecting the comparable probability of use and flow rate from Columns [C] and [E] from the Water Demand Calculator.

M 102.7 Size of Water Piping per Appendix A. Except as provided in Section M 102.0 for estimating the demand load for single- and multi-family dwellings, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A. After determining the permissible friction loss per 100 feet (30.480 mm) of pipe in accordance with Section A 104.0 and the demand flow in accordance with the Water Demand Calculator, the diameter of the building supply pipe, branches and risers shall be obtained from Chart A 105.1(1) through Chart A 105.1(7), whichever is applicable, in accordance with Section A 105.0 and Section A 106.0. Velocities shall be in accordance with Section A 107.0. Appendix I (IS 31), Figure 3 and Figure 4 shall be permitted when sizing PEX systems.

M 102.7.1 Minimum Fixture Branch Size. The minimum fixture branch size shall be 1/2 inch (15 mm) in diameter.

**TABLE FIGURE M 102.3**

**WATER DEMAND CALCULATOR EXAMPLE**

<table>
<thead>
<tr>
<th>[A] Fixture</th>
<th>[B] Enter Number of Fixtures</th>
<th>[C] Probability of Use (%)</th>
<th>[D] Enter Fixture Flow Rate (GPM)</th>
<th>[E] Maximum Recommended Fixture Flow Rate (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bar-Sink</td>
<td>0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2 Bathtub</td>
<td>0</td>
<td>1.0</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>3 Bidet</td>
<td>0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>4 Clothes-Washer</td>
<td>1</td>
<td>5.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>5 Combination-Bath/Shower</td>
<td>1</td>
<td>5.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>6 Dishwasher</td>
<td>1</td>
<td>5.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>7 Kitchen Faucet</td>
<td>1</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>8 Laundry Faucet</td>
<td>1</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>9 Lavatory Faucet</td>
<td>1</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Example 1: Indoor Water Use Only – Use the information given below to find the pipe size for the building supply to a residential building with six indoor fixtures as shown in Figure 1 [Pipe Section 4].

Given Information:

<table>
<thead>
<tr>
<th>Fixture number/type</th>
<th>Type of construction: Residential, one-bathroom</th>
<th>Friction loss per 100 ft (30 480 mm): 15 psi (103 kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type of pipe material: L-copper</td>
<td>Maximum velocity: 10 ft/s (3.05 m/s)</td>
</tr>
<tr>
<td></td>
<td>Fixture number/type: 1 combination bath/shower</td>
<td>1 kitchen faucet 1 lavatory faucet 1 dishwasher 1 WC 1 clothes washer</td>
</tr>
</tbody>
</table>
The Water Demand Calculator (WDC) in Figure 2 is used to determine the demand load expected from indoor water use. The WDC has white-shaded cells and light gray-shaded cells. The values in the light gray cells are derived from a national survey of indoor water use at homes with efficient fixtures and cannot be changed. The white-shaded cells accept input from the designer. For instance, fixture counts from the given information are entered in column B designated as total number of fixtures, the corresponding recommended fixture flow rates are already provided in column D. The flow rates in the white cells column D may be reduced only if the manufacturer specifies a lower flow rate for the fixture. The last column E showing maximum fixture flow rates establishes the upper limits for the flow rates entered into the fixture flow rate column D. Clicking the Run Water Demand Calculator button gives 8.5 gpm (0.54 L/s) as the estimated indoor water demand for the whole building. This result appears in the dark gray output box on the right-hand side of the WDC in Figure 2.
For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

FIGURE 2
WATER DEMAND CALCULATOR FOR INDOOR USE AT HOME WITH SIX EFFICIENT FIXTURES (EXAMPLE 1)

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Chart A 105.1(1) for copper piping systems (from Appendix A of the UPC, shown in Figure 3) is used to determine the pipe size, based on given friction loss, given maximum allowable pipe velocity, given pipe material and the demand load computed in Step 1. In Figure 3, the intersection of the given friction loss (15 psi) (103 kPa) and the maximum allowable pipe velocity (16.8 ft/s) (5.1 m/s) is labeled point A. The vertical line that descends from point A to the base of the chart intersects four nominal sizes for L-copper pipe. These intersection points are labeled B, C, D, E and correspond to pipe sizes of 1 inch (25 mm), 3/4 inch (20 mm), 1/2 inch (15 mm) and 3/8 inch (10 mm), respectively. A horizontal line from points B, C, D, E to the right-hand side of the chart gives maximum flow rates of 24 gpm (1.5 L/s), 12 gpm (0.757 L/s), 4.5 gpm (0.28 L/s), and 2.3 gpm (0.145 L/s), respectively. These results are summarized in Table 1 which shows that a 3/4 inch (20 mm) type L copper line is the minimum size that can convey the peak water demand of 8.5 gpm (0.57 L/s).

TABLE 1
PIPE SIZE OPTIONS FOR BUILDING SUPPLY

<table>
<thead>
<tr>
<th>POINT IN FIGURE 3</th>
<th>PIPE DIAMETER (INCH)</th>
<th>MAXIMUM FLOW (GPM)</th>
<th>OK FOR BUILDING SUPPLY*</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>3/8</td>
<td>2.3</td>
<td>No</td>
</tr>
<tr>
<td>D</td>
<td>1/2</td>
<td>4.5</td>
<td>No</td>
</tr>
<tr>
<td>C</td>
<td>3/4</td>
<td>12</td>
<td>Yes</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>20</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s
* For Building in Examples 1, 2, 3, and 4.
FIGURE 3
CHART A 105.1(1) FOR FINDING PIPE SIZE

For SI units: 1 foot = 304.8 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa
Example 2: Indoor and Outdoor Water Use – Find the pipe size for the building supply [Figure 1, Pipe Section 4] if the building in Example 1 adds two outdoor fixtures (hose bibb, each with a fixture flow rate of 2.0 gpm) (0.13 L/s).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.
The WDC has been developed exclusively for peak indoor water use which can be viewed as a high-frequency short duration process. Because fixtures for outdoor water use may operate continuously for very long periods, they are not included in the WDC. To account for water use from one or more outdoor fixtures, add the demand of the single outdoor fixture with the highest flowrate to the calculated demand for indoor water use. With two hose bibbs, the demand of only one hose bibb is included. Hence, in this example, the total demand for the whole house is 2.0 gpm (0.13 L/s) + 2.0 gpm (0.13 L/s) = 4.0 gpm (0.26 L/s) + 2.0 gpm (0.13 L/s) = 6.0 gpm (0.38 L/s).

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.
Table 1 shows that at 6.0 gpm (0.38 L/s) the building supply shall be 3/4 inch (20 mm) in diameter.

Example 3: Indoor, Outdoor and Other Fixture Water Use – Find the pipe size for the water supply [Figure 1, Pipe Section 4] if the building in Example 2 adds a kitchen pot filler and a dog bath each with a faucet flow rate of 5.5 gpm (0.35 L/s).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.
The kitchen pot filler and dog bath are not listed in the fixture list column A of the WDC. To accommodate cases such as this, the WDC provides up to three additional rows for "Other Fixtures”. Enter the kitchen pot filler and dog bath in the fixture list column A of the WDC and enter the fixture count for each in the next column B. Find an indoor fixture that has a similar probability of use in the probability column C and add that to the column. Finally, enter the flow rate of the kitchen pot filler and dog bath in the flow rate column D. The estimated indoor water demand for the whole building is 11.0 gpm, as shown in the WDC in Figure 4. As illustrated in Example 2, the hose bibb will increase the total demand for the whole house to 13.0 gpm (0.820 L/s).

Note that a reset button is provided to clear any numbers in Column B from a previous calculation.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.
Table 1 shows that at 13.0 gpm (0.820 L/s) the building supply shall be 1 inch (25 mm) in diameter.

Example 4: Sizing Branches and Risers – For individual hot and cold branches, repeat Steps 1 and 2. For example, for the hot water branch at the water heater [Figure 1, Pipe Section 3], enter all the fixtures and appliances that use hot water into the Water Demand Calculator (toilets will be excluded) as seen in Figure 5. Use the calculated demand load to find the pipe size in Step 2. Table 1 shows that at 7.7 gpm (0.490 L/s) gpm, the hot water branch shall be 3/4 inch (20 mm) in diameter.

For each additional hot and cold branch [Figure 1, Pipe Sections 1 and 2], enter the number of fixtures and appliances served by that branch into the WDC and use that demand in Step 2 to determine the branch size. If the branch serves a hose bibb, add the demand of the hose bibb to the calculated demand flow for the branch. As discussed in Example 2, the hose bibb is not to be entered into WDC, since the Calculator is for indoor uses only.

When there is only one fixture or appliance served by a fixture branch, the demand flow shall not exceed the fixture flow rate in the last column E of the Water Demand Calculator. The fixture flow rate would be used in Step 2 to determine the size of the fixture branch and supply.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bar-Sink</td>
<td>0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2 Bathtub</td>
<td>0</td>
<td>1.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>3 Bidet</td>
<td>0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>4 Clothes-Washer</td>
<td>1</td>
<td>5.5</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>5 Combination-Bath/Shower</td>
<td>1</td>
<td>6.6</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>6 Dishwasher</td>
<td>1</td>
<td>0.5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>7 Kitchen Faucet</td>
<td>1</td>
<td>2.0</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>8 Laundry Faucet</td>
<td>0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>9 Lavatory Faucet</td>
<td>1</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>10 Shower per head</td>
<td>0</td>
<td>4.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>11 Water Closet, 1.25 GPF Gravity Tank</td>
<td>1</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>12 Pot Filler</td>
<td>1</td>
<td>2.0</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>13 Dog Bath</td>
<td>1</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>14 Other Fixture</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total Number of Fixtures</td>
<td>8</td>
<td>RESET</td>
<td>RUN WATER DEMAND CALCULATOR</td>
<td></td>
</tr>
</tbody>
</table>
For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

**FIGURE 4**
WATER DEMAND CALCULATOR TO ACCOMMODATE OTHER FIXTURES (EXAMPLE 3)

<table>
<thead>
<tr>
<th>A) FIXTURE</th>
<th>B) ENTER NUMBER OF FIXTURES</th>
<th>C) PROBABILITY OF USE (%)</th>
<th>D) ENTER FIXTURE FLOW RATE (GPM)</th>
<th>E) MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bar-Sink</td>
<td>0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2 Bathtub</td>
<td></td>
<td>1.0</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>3 Bidet</td>
<td>0</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>4 Clothes-Washer</td>
<td>3</td>
<td>6.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>5 Combination Bath/Shower</td>
<td>3</td>
<td>6.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>6 Dishwasher</td>
<td>3</td>
<td>0.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>7 Kitchen Fauceet</td>
<td>3</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>8 Laundry-Faucet</td>
<td>0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>9 Lavatory-Faucet</td>
<td>3</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>10 Shower, per head</td>
<td>0</td>
<td>4.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>11 Water Closet, 1.28 GPF Gravity Tank</td>
<td>0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>12 Other Fixture 1</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>13 Other Fixture 2</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>14 Other Fixture 3</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Total Number of Fixtures</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMPUTED RESULTS FOR PEAK PERIOD CONDITIONS**
- Total No. of Fixtures in Calculation: N = 8
- 99th Percentile Demand Flow: Q = 11.0 GPM
- Hunter Number: H[9.9] = 0.20
- Stagnation Probability: Pr[Zero Demand] = 82%
- Method of Computation: Convolution

**Download Result**
**Reset**
**Run WDC**
For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

FIGURE 5
WATER DEMAND CALCULATOR FOR THE HOT WATER BRANCH (EXAMPLE 4)

Example 5: Multi-family Application. When using the WDC for multi-family dwellings, use the drop-down menu on the top left corner that allows you to select either single-family residence or a multi-family building. Choosing the multi-family option opens two more boxes to fill in information (See Figure 6). When estimating for a multi-family building, enter the total number of dwelling units in the building. The example shows a total of 100 dwelling units in the building. The box below will be for the number of units you are calculating for. If you are calculating for the whole building, enter the same number of 100. If you are calculating for half the dwelling units, enter 50. If you are estimating for only one unit, then enter the number one. The total number of units in the first box will not change in any of your calculations. Then use the WDC, as was explained earlier, for sizing branches and risers.

Example 6: Office Building and Hotel Application. When using the WDC for an Office Building or Hotel, use the drop-down menu on the top left corner that allows you to select the type of building. Choosing the office building or hotel option opens a utilization factor box (See Figures 7 and 8). When estimating for an office building or hotel, enter the expected utilization factor within the range shown. The example shows a utilization factor of 0.150 for the Office Building and 0.160 for
the Hotel. Then use the WDC, as was explained earlier, for sizing branches and risers.

**Figure 7**

*Water Demand Calculator for Office Building (Example 6)*
SUBSTANTIATION:
The Water Demand Calculator® version 3.0 is expanded to include commercial buildings. The drop-down menu in the upper left corner allows the selection of the building type both residential and commercial. The algorithms in the WDC are still the same as in version 2.2 and are identified in the solution box labelled Method of Computation. There are two new features in version 3.0.

The first new feature is the fixture list. The fixture list will be populated based on the type of building selected. Residential type buildings will only have residential type fixtures and commercial type buildings will have commercial type fixtures applicable to the building type. Therefore, the fixture list will change accordingly.

The second new feature is the "utilization factor" when selecting commercial type buildings. When selecting a commercial building, a utilization box will appear as seen in the upper right-hand side of the WDC. Selecting the value within the utilization range provided will affect the values in the probability of use column. Different commercial building types have different fixture probability of use. The suggested utilization factor range is based on monitored field data.

A published NIST report is forthcoming as well as a report on the analysis of the monitored data.

This proposal also replaces the older versions of the WDC templates with the new version and revises the language to correspond to the new template. Three new examples are provided for multi-family dwellings and commercial buildings.
APPENDIX N

IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR MINIMUM REQUIREMENTS TO ADDRESS SCALDING POTENTIAL AND LEGIONELLA GROWTH IN PLUMBING SYSTEMS

N 101.0 General.

N 101.1 Applicability. This appendix provides guidelines on the impact of water temperature in minimizing minimum requirements to address both scalding and Legionella growth in plumbing systems and shall apply to potential associated with occupiable commercial, institutional, multi-unit residential, and industrial buildings. This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella. Where required by the Authority Having Jurisdiction, Legionella risk management shall be in accordance with ASHRAE 188 and ASHRAE Guideline 12.

Note: See ASHRAE 188 and ASHRAE Guideline 12 for additional factors associated with the potential for Legionella growth other than temperature. There are additional factors associated with the potential for scalding and Legionella growth other than temperature.

For scalding potential, other factors include, but are not limited to, user age, health, body part, length of contact time, and water source.

For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

N 101.2 Minimum Requirements to Address Legionella Growth in Plumbing Systems. Plumbing systems that are a part of a building water system shall comply with ASHRAE 188, ASHRAE Guideline 12, and the requirements of the Authority Having Jurisdiction.

N 102.0 Definitions.

N 102.1 General. For the purpose of this appendix, the following definitions shall apply:

Disinfection. The process of killing or inactivating microorganism. [ASHRAE 188:3]

Halogenation. A chemical reaction that involves the addition of one or more halogens, including, but not limited to, chlorine, bromine, or iodine, commonly used to disinfect water systems.

Hazard. See Risk.

Nutrient. Any element or compound essential as a raw material for an organism's growth and development.

Potable Water System. A building distribution water system that provides water satisfactory for drinking, culinary, and domestic purposes and that meets the requirements of the Health Authority Having Jurisdiction.

Risk. The potential for harm to humans resulting from exposure to Legionella. [ASHRAE 188:3]

Test. The measurement of the physical, chemical, or microbial characteristics or quality of water.
N 103.0 Building Water Systems and System Equipment Design Documentation.

N 103.1 Design Construction Documentation. Construction documents shall be required for new construction, renovation, refurbishment, replacement, or repurposing of an occupiable building water system, including a water management plan, and shall be submitted to the Authority Having Jurisdiction. The construction documents shall include, but not be limited to, the following information:

1. Point of use location(s) of potable and nonpotable water systems.
2. Location(s) of water processing equipment and components.
3. Means by which water is received and processed, including but not limited to, storage, recirculation, and delivery to point of use.
4. Location(s) within the building water system where design water temperatures are associated with Legionella growth potential, as specified in Figure N 103.3.

N 103.2 System Component Maintenance and Inspection. Documentation shall be provided for potable water system point of use maintenance, procedures, and inspection requirements to control Legionella growth in accordance with ASHRAE 188.

N 104.0 Potential Exposure.

N 104.1 Legionella Growth Potential. The Authority Having Jurisdiction shall have the authority to require documentation, including a water management plan in accordance with Section N 104.0, to address Legionella growth potential, where water temperatures in the municipal or building water supply or a building water distribution system are within ranges shown specified in Figure N 104.1 that pose a Legionella growth potential.

N 104.2 Scald Potential. Where the water distribution system's water temperature(s) range poses a scald potential in accordance with Table N 104.2, protection shall be provided in accordance with Chapter 4.

N 103.5 Onsite Documentation. Documentation shall be maintained onsite and shall be readily accessible to the Authority Having Jurisdiction.

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**FIGURE N 104.1**

**WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL**

- Legionella growth: 77 – 85°F (25 – 30°C)
- Ideal growth range: 85 – 110°F (30 – 43°C)
- Legionella growth slows and some die: 110 – 130°F (43 – 54°C)
- Legionella growth range: 68 – 120°F (20 – 49°C)
- Legionella feels free and do not grow: above 160°F (71°C)
- **Slow growth range:** 68 – 77°F (20 – 25°C)
- **Rapid Legionella death:** above 160°F (71°C)

*The following temperatures have been shown to kill Legionella in laboratory conditions:
- 131°F (55°C), 5 – 6 hours
- 140°F (60°C), 32 minutes
- 151°F (66°C), 2 minutes

For SI units: °C = (°F - 32) x 1.8

*Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.
FIGURE N 103.3
TEMPERATURE EFFECTS ON SURVIVAL AND GROWTH OF LEGIONELLA IN LABORATORY CONDITIONS1,2
[ASHRAE GUIDELINE 12: FIGURE 1]

Notes:
1 In building water systems, the temperature below which Legionella bacteria are dormant, the temperatures and speed at which Legionella grow, and the elevated temperatures and speed at which Legionella die are affected by numerous environmental variables, such as pH, salts and minerals, Legionella species, Legionella growth phase, and association with biofilms.
2 Legionella pneumophila, the species of Legionella responsible for most Legionnaire's disease, generally grow in laboratory conditions between 95°F (35°C) and 99°F (37°C), the peak of their growth range. Other Legionella species may have different optimal growth range peak temperatures.

TABLE N 104.2
WATER TEMPERATURE RANGES AND SCALD POTENTIAL

(portions of table not shown remain unchanged)

N 104.0 Water Management Plan.
N 104.1 General. Where required by the Authority Having Jurisdiction, a water management plan shall be established. The water management plan shall include, but not be limited to, the following information:
(1) Person(s) responsible for developing and implementing the water management plan (i.e., the water management program team).
(2) Building water system schematics, including the following:
(a) A description of potable and nonpotable water systems within the building and on the building site.
(b) Construction documents in accordance with Section N 103.1.
(3) Location(s) within the building water system where conditions, including water temperatures, are associated with Legionella growth potential, as specified in Figure N 103.3.
(4) Location(s) where control measures for Legionella growth are to be applied and maintained.
(5) Procedures for each of the following:
   (a) Monitoring and maintaining control measures.
   (b) Verifying correct implementation of the water management plan.
   (c) Validating the water management plan's control of Legionella growth throughout the building water system.
   (d) Documenting and communicating actions taken and data collected which are associated with the water management plan.
(6) Provisions for responding to water service disruptions.

Notes:
1 As derived from ASHRAE 188, Figure 1 (Elements of a Water Management Plan).
2 At a minimum, the following risk factors should be considered when developing a water management plan:
   (a) Stagnant water due to dead legs, intermittent operation, or seasonal usage.
   (b) The presence of nutrients or biofilm.
   (c) Water temperature within a range that supports microbial growth as specified in Figure N 103.3.
   (d) Water quality
   (e) System size
   (f) Physical condition of system
   (g) Aerosol generation and dispersion
   (h) System site location

N 105.0 Disinfection:
N 105.1 Disinfection Documentation. Where required by the Authority Having Jurisdiction, documentation for disinfection of all building water systems shall be provided by the registered design professional in the construction documents.
N 105.1.1 Copper-Silver Ionization. Copper-silver ionization methods and procedures, shall include the following documentation:
   (1) Copper and silver ionization concentrations.
   (2) Methods and documentation for monitoring ion levels.
   (3) Electrode cleaning cycles and methods.
N 105.1.2 Ultraviolet Light. Ultraviolet light methods shall include the following documentation:
   (1) Locations of ultraviolet light units.
   (2) Cleaning cycles and methods of the quartz sleeves and housing.
N 105.2 Chemical Disinfection. Chemical biocide treatment shall be permitted to be used in accordance with the following:
   (1) Oxidizing biocides in accordance with manufacturer’s guidelines, or as required by the Authority Having Jurisdiction.
   (2) Non-oxidizing biocides in accordance with manufacturer’s guidelines.
   (3) Alternating the use of different types of biocides, dose, and frequency is recommended.
   (4) These treatment methods can be used for continuous, online disinfection or shock treatment online or offline.
   (5) Biocides intended for potable water applications shall listed in accordance with NSF/ANSI/CAN 60 and approved by the Authority Having Jurisdiction.
N 105.3 Non-Chemical Treatment. Non-chemical treatment devices shall be permitted to be used in accordance with manufacturer’s guidelines.
N 105.3.1 Thermal Shock. Thermal treatment using heat shock at 158°F (70°C) for 30 minutes shall be permitted in accordance with applicable guidelines.
N 105.4 Frequency of Cleaning and Disinfection. Where a water management plan is implemented, the frequency of cleaning and disinfection logs shall be readily accessible to the water management team and the Authority Having Jurisdiction.
SUBSTANTIATION:
A UMC Legionella Task Group was established to address concerns pertaining to the control and intervention of Legionella associated with mechanical systems and equipment. Based on their recommendations to the UMC, this code change proposal intends to correlate such requirements with UPC Appendix N for consistency between the Uniform Codes.

Ultimately, the Task Group determined that providing a prescriptive path for the AHJs to follow, regarding water management plans and required documentation, was the optimal path towards developing a recommendation. This decision led to the removal of any requirements addressing test procedures, water sample analysis, remediation actions, and disinfection/treatment methods. Removal of such provisions achieves the following goals:

1. Clarifies that determination of appropriate control measures is the responsibility of the water management team as such measures vary based on building and system design parameters.
2. Improves the enforceability of the appendix since building operation and maintenance following inspection are outside the scope of the code.
3. Prevents misinterpretations regarding the intent of the appendix versus risk management practices.

For legionellosis risk management requirements applicable to mechanical systems that are a part of a building water system, the appendix directs users to the available and appropriate industry standards, ASHRAE 188 and ASHRAE Guideline 12. Furthermore, an informative note is provided under Section N 101.1 (Applicability) which identifies these standards as sources for additional factors associated with the potential for Legionella growth other than temperature. The appendix now includes minor extracts from these standards pertaining to requirements for documentation as well as a figure representing the effects of temperature on Legionella growth and survival. The Task Group also reviewed and compared the minimum details to be included in water management plans and updated requirements for consistency. For reference, the scope of each of these standards is as follows:

ASHRAE 188 (Legionellosis: Risk Management for Building Water Systems): “This standard provides minimum legionellosis risk management requirements for the design, construction, commissioning, operation, maintenance, repair, replacement, and expansion of new and existing buildings and their associated (potable and nonpotable) water systems and components. This standard applies to human-occupied commercial, institutional, multiunit residential, and industrial buildings. This standard does not include single-family residential buildings. Only where specifically noted in this standard shall certain building water systems or parts of building water systems be exempt. This standard is intended for use by owners and managers of human-occupied buildings, excluding single-family residential buildings. This standard is also intended for those involved in the design, construction, installation, commissioning, operation, maintenance, and service of centralized building water systems and components.”

ASHRAE Guideline 12 (Managing the Risk of Legionellosis Associated with Building Water Systems): “This guideline applies to new and existing centralized hot and cold potable building water systems and to nonpotable building water systems in human-occupied commercial, institutional, multiunit-residential, and industrial buildings, including hotels, office buildings, hospitals and other health care facilities, assisted living facilities, schools, universities, commercial buildings, industrial buildings, and centralized systems in multifamily residential buildings. While buildings with noncentralized building water systems and single-family residential buildings are not included, some of the information may be useful for such building water systems. This guideline is intended for use by building owners and those involved in the design, construction, installation, commissioning, management, operation, maintenance, and service of centralized building water systems, and by manufacturers of associated equipment. This guideline is also intended for use in the implementation of ANSI/ASHRAE Standard 188, Legionellosis: Risk Management for Building Water Systems.”
During their last two meetings, the Task Group heavily discussed whether a statement within Section H 101.1 (Applicability) was needed to specify that this appendix is not to be considered a risk management document.
N 101.0 General.

N 101.1 Applicability. This appendix provides guidelines on the impact of water temperature in minimizing both scalding and Legionella growth potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building plumbing systems.

This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella. Where required by the Authority Having Jurisdiction, Legionella risk management shall be in accordance with ASHRAE 188 and ASHRAE Guideline 12. Where required, the water supply and distribution system(s) shall be designed to manage the risk from Legionella and other microbial hazards in accordance with ASHRAE 188 and ASHRAE 514.

Note: There are additional factors associated with the potential for scalding and Legionella growth other than temperature. For scalding potential, other factors include, but are not limited to, user age, health, body part, length of contact time, and water source.

For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

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Note: ASHRAE 514 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This change will add the reference to the new ASHRAE Standard 514. This standard was developed by a group of experts and relates to contaminant that can cause harm through physical, chemical and microbial hazards. ASHRAE 514 is consistent with ASHRAE 188. As such, it should be referenced in association with ASHRAE 188.
<table>
<thead>
<tr>
<th>Item #:</th>
<th>Code Number:</th>
<th>Section Number:</th>
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<tbody>
<tr>
<td>321</td>
<td>2024 UPC</td>
<td>N 102.1</td>
</tr>
</tbody>
</table>

**SUBMITTER:** Bruce Meiners  
**Organization Name:** Wisconsin DPH  
**Organization Representation:** Myself

**RECOMMENDATION:**  
Add new text

**Proposed Text:**  
N 102.0 Definitions.  
N 102.1 General. For the purpose of this appendix, the following definitions shall apply:  
Community-Based Residential Facility (CBRF). A place where 5 or more adults who are not related to the operator or administrator and who do not require care above intermediate level nursing care reside and receive care, treatment or services that are above the level of room and board but that include no more than 3 hours of nursing care per week per resident.

**SUBSTANTIATION:**  
Definition required for proposed code change to Appendix N 102.1. Definition is from the Wisconsin Department of Health.
RECOMMENDATION:
Add new text

Proposed Text:
N 103.0 Building Water System Design Documentation.

N 103.3 Healthcare Facilities. In health care facilities hot water shall be initiated and stored at not less than 140°F (60°C) in health care facilities.

SUBSTANTIATION:
Keeping water heater storage tanks at a minimum of a 140° will minimize the potential for those tanks of becoming ampliphyers for *Legionella*. This reduces the risk of a *Legionella* outbreak in a health care facility. Current plumbing code in Wisconsin contains these provisions. This should be common language for provisions related to health care facilities.
RECOMMENDATION:
Add new text

Proposed Text:
N 103.0 Building Water System Design Documentation.

N 103.4 Healthcare Water Distribution. A water distribution system in health care facilities shall be provided with a fail-safe normally closed selenoid located immediately downstream of the water heater. Where a master mixing valve is installed the fail-safe selenoid shall be installed immediately after the mixing valve.

SUBSTANTIATION:
Reduce scalding potential in healthcare. Water heaters can fail and provide overheated water to the patients. These fail-safe valves will protect the end users. This has been a requirement in Wisconsin since 2003.
RECOMMENDATION:
Add new text

Proposed Text:
N 103.0 Building Water System Design Documentation.

N 103.5 Water Heaters in Health Care Facilities. Where hot water is stored at a temperature of not less than 140°; a master mixer valve in accordance with ASSE 1017 shall be installed immediately downstream of the water heater(s).

SUBSTANTIATION:
To help prevent scalding to patients in health care facilities.
SUBMITTER:
Janet Stout

Organization Name:
Special Pathogens Laboratory

RECOMMENDATION:
Revise text

Proposed Text:
N 105.0 Disinfection.

N 105.1 Disinfection Documentation. Where required by the Authority Having Jurisdiction, documentation for disinfection of all building water systems shall be provided by the registered design professional in the construction documents.

Disinfection shall be permitted to be used either continuously, in emergency situations, or both.

SUBSTANTIATION:
This addition is to be added to the end of the section N 105.1 Disinfection Documentation. This addition clarifies that disinfection can be applied in various ways (continuous or intermittent) and different circumstances - proactive prevention (continuously) or if Legionnaires' disease is suspected (emergency).

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N 105.3 Non-Chemical Treatment. (remaining text unchanged)

**N 105.3.2 Point-of-Use (POU) Filters for Legionella.** Where point-of-use (POU) filters for legionella control are used, such filters shall be listed to ASSE LEC 2011.

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**SUBSTANTIATION:**

Per the scope of ASSE LEC 2011 Listing Evaluation Criteria for Legionella Reduction and Treatment Devices 2022: "Legionella reduction and treatment devices are designed to reduce the microorganisms in the genus Legionella (e.g., Legionella pneumophila) typically found in potable water systems. The devices reduce the number of the bacteria through inactivation and/or filtration. They can reduce or prevent the downstream bacterial colonization of a water system and thus ultimately the release of the bacteria into the product water. Devices are intended to be used at Point of Entry (POE) or Point-Of-Use (POU) in applications for hot or cold-water or both for drinking water, washing hands or showering."

APPENDIX N

IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR SCALDING AND LEGIONELLA GROWTH

N 102.0 Definitions.

224.0 Valve, Balancing. A valve that regulates and controls the return of water to the water heater in a recirculating hot water piping system.

Automatic Balancing Valve. A valve that, once set, automatically controls flow or temperature drop in the recirculation system.

Electronic Balancing Valve. A valve that uses electronic sensors and actuators to automatically adjust the return water flow rate or pressure drop across the valve based on water temperature or design flow rate.

Pressure Independent Balancing Valve. A valve that automatically adjusts the pressure drop across the valve to maintain the design water flow rate which impacts the return temperature in the system. Valve can be fixed cartridge or adjustable.

Thermostatic Balancing Valve. A valve that automatically adjusts the return water flow to maintain design water temperatures which impacts the pressure drop across the valve. Valve can be fixed cartridge or adjustable.

Manual Balancing Valve. A valve with a handle or knob that varies the pressure drop across the valve to control the flow and return temperature in the recirculation system.

N 106.0 Hot Water Return System Balancing.

N 106.1 Hot Water Balancing Valves. Automatic or manual balancing valves are required on each branch of a hot water return system with two or more parallel branches. Hot water balancing valves shall be installed downstream of the last plumbing fixture branch.

N 106.1.1 Automatic Balancing Valves. Automatic balancing valves shall be permitted provided that a constant flow or temperature can be maintained across the valve under changing hydraulic and/or thermal conditions.

(1) Electronic Balancing Valves. Electronic balancing valves shall be permitted provided that they can meet the requirements of either/both thermostatic balancing valves or pressure independent balancing valves, pending on their operation.

(2) Pressure Independent Balancing Valves. Pressure independent balancing valves shall be permitted provided that a constant flow can be maintained across the valve under changing hydraulic conditions.

(3) Thermostatic Balancing Valves. Thermostatic Balancing Valves shall be listed to IGC 368.

N 106.1.2 Manual Balancing Valves. Manual balancing valves with integral or external pressure gauge ports are permitted provided that a constant pressure drop can be maintained across the valve under steady flow conditions. Manual balancing valves are unable to maintain a constant flow or constant valve outlet temperature across the valve under changing hydraulic conditions and shall follow testing and balancing provisions as indicated in N106.2.1.
N 106.1.3 Prohibited Valves. Ball valves, gate valves, and butterfly valves, shall not be utilized for balancing domestic hot water return systems.

N106.2 Testing, Balancing, and Commissioning of Hot Water Return System.

N 106.2.1 Testing and Balancing. All manual balancing valves shall be tested and balanced by a test and balance agent. Testing and balancing of manual balancing valves shall be completed in accordance with the manufacturer's instructions. Refer to Table N1 for sample test and balance report to be supplied to AHJ or AHJ designee upon completion of testing and balancing prior to commissioning.

N 106.2.2 Commissioning. All manual balancing valves and automatic balancing valves shall be commissioned. Commissioning provider shall set valve flow or temperature of automatic, adjustable balancing valve to design flow or temperature, respectively. Commissioning shall include time-to-tap or fixed volume validations, as required by the AHJ. If AHJ has no requirement, then time-to-tap shall be followed. Refer to Table N2 for sample commissioning report to be supplied to AHJ or AHJ designee.

Table N1: Sample Test & Balance Report

Facility (Project) Name:
Facility Address:
Facility Description:
Facility History:
Facility/Site Contact Information:
Balancing & Testing Agent: (example; P&M Plbg & Mech, person's name, contact info)

Systems to be Tested and Balanced:
Recirculating Domestic Hot Water Distribution System

System Description:
(example: ____ DHW circulating circuits per east/west wings, or per ____ story pressure regulated zones)

System's Original Design Intent:
To Deliver _____°F DHW temperature(s) at the last Kitchen or Lavatory Fixture in each Circulating Circuit within _____ seconds (Time to Tap)

1. ASSE 1016, ASSE 1069 TMV supplied fixture HW temperatures should not vary more than ± 3.6°F
2. ASSE 1070 TMV supplied fixture HW temperatures should not vary more than ± 7°F
3. Public Lavatories shall be Limited to 110°F. (CEC 110.3.3)
4. Maximum mixed water temperature of 120°F for bathing fixtures, and 110°F at bidets to prevent scalding. (UPC 408.3, 409.4, 410.3)

Pre-Testing Checklist:
1. DHW circulating system isolation valves should be open
2. Pre-check and start-up of the DHW heater per the project commissioning guidelines and the manufacturer's start-up instructions.
3. Allow DHW heater circulating system to run until system temperatures stop rising.
4. Check and record the DHW heater temperature adjustment is set at the project specified temperature.
5. Check and record the DHW heater outgoing water temperature, and the recirculating DHW return water temperature(s).

Water Heater Setting | Outgoing HW Temperature | HW Return Temperature | Zones
---|---|---|---


Functional Circulating DHW System Circuit Testing & Balancing:

1. Manually adjusted balancing valve flow rates must be individually adjusted to ensure balanced circulating DHW systems delivering specified hot water temperatures to fixtures within the project specified time frames and/or volumes, (Time to Tap).
2. Adjust and balance, and record the setting of each balancing valve in each recirculating DHW circuit.
3. Test and record the DHW system temperature at the location of the balancing valve in each recirculating DHW circuit.

Table N2: Sample Commissioning Report

Facility (Project) Name:
Facility Address:
Facility Description:
Facility History:
Facility/Site Contact Information:
Commissioning Provider: (example; LA Commissioning, person's name, contact info)

Systems to be Commissioned: Recirculating Domestic Hot Water Distribution System

System Description: (example: ____ DHW circulating circuits per east/west wings, or per ____ story pressure regulated zones)

System’s Original Design Intent: To Deliver ______°F DHW temperature(s) at the last Kitchen or Lavatory Fixture in each Circulating Circuit within _____ seconds (Time to Tap)

1. ASSE 1016, ASSE 1069 TMV supplied fixture HW temperatures should not vary more than ± 3.6°F
2. ASSE 1070 TMV supplied fixture HW temperatures should not vary more than ± 7°F
3. Public Lavatories shall be Limited to 110°F. (CEC 110.3.3)
4. Maximum mixed water temperature of 120°F for bathing fixtures, and 110°F at bidets to prevent scalding. (UPC 408.3, 409.4, 410.3)

Commissioning of Manually Adjusted Balancing Valves

1. Check manual adjusted balancing valves controlled circulating DHW systems are delivering project specified hot water temperatures to fixtures within the project specified time frames and/or volumes, (Time to Tap).
2. Test and record the DHW system temperature at the location of the balancing valve in each recirculating DHW circuit.
3. Test and record the time required for specified hot water temperatures being delivered to the last fixture in each recirculating DHW circuit.
4. Test and record the hot water temperatures being delivered to the last fixture in each recirculating DHW circuit.

Commissioning of Thermostatically Self-Adjusting and Electronic Temperature Controlled Balancing Valves

1. Check thermostatically self-adjusting and electronic temperature controlled circulating DHW systems are delivering project specified hot water temperatures to fixtures within the project specified time frames and/or volumes, (Time to Tap).
2. Test and record the DHW system temperature at the location of the balancing valve in each recirculating DHW circuit.
3. Test and record the time required for specified hot water temperatures being delivered to the last fixture in each recirculating DHW circuit.
4. Test and record the hot water temperatures being delivered to the last fixture in each recirculating DHW circuit.

Commissioning of Pressure Independent and Electronic Pressure Independent Balancing Valves
1. Check pressure independent self-adjusting and electronic pressure independent circulating DHW systems are delivering project specified hot water temperatures to fixtures within the project specified time frames and/or volumes, (Time to Tap).
2. Test and record the DHW system temperature at the location of the balancing valve in each recirculating DHW circuit.
3. Test and record the time required for specified hot water temperatures being delivered to the last fixture in each recirculating DHW circuit.
4. Test and record the hot water temperatures being delivered to the last fixture in each recirculating DHW circuit.
5. Test and record the hot water temperatures being delivered to the last fixture in each recirculating DHW circuit.

Circulating DHW system Circuit Balancing and Testing Recording:
Commissioning/Balancing/Testing Provider: (example; P&M Plbg & Mech, testing person's name, contact info)

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TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

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<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>ASSE/IAPMO IGC 368-2023</td>
<td>Industry Standard for Mechanical Thermostatic Balancing Valves for Domestic Hot Water Recirculating Systems</td>
<td>??????</td>
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</tbody>
</table>

(portions of the table not shown remain unchanged)

SUBSTANTIATION:
There is currently no code language that addresses balancing domestic hot water systems. This code will help create guidance for designers & installers to select the proper balancing valve, instructions on how to test and balance, and develop a procedure for commissioning DHW circulation systems. This code addresses longstanding Testing and Balancing issues, and can help improve Energy efficiency.
RECOMMENDATION:
Add new text

**Proposed Text:**

**N 203.0 Hot Water Systems Components**

**N 203.1 Hot Water Recirculating Pumps.** For healthcare facilities, long term care facilities, hotels, or motels devices that automatically turn off the recirculation pump(s) shall not be required.

**N 203.2 Master Mixing Valves.** Where master mixing valves are installed, they shall be listed to IGC 384. Master mixing valves shall be capable of being operated continuously when the recirculation pump is also operated continuously for the following building types: healthcare facilities, long term care facilities, hotels, or motels.

**N 102.0 Definitions.**

**N 102.1 General.** For the purpose of this appendix, the following definitions shall apply.

**Adiabatic Mixing.** The mixing of two (or more) streams of fluid of differing temperatures to achieve a new mixed temperature.

**Digital Master Mixing Valve.** Master mixing valves that utilize electronic means such as digital controls to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

**Master Mixing Valve.** Temperature actuated mixing valves for hot water distribution systems are used for controlling water temperature in hot water systems. They are not intended for point-of-use temperature limiting, control, or end use applications including emergency eyewash and shower equipment. These devices consist of a hot water inlet connection, a cold water inlet connection, a mixed water outlet connection, a thermal element or thermostatic sensor and a means for adjusting the mixed water outlet temperature. These devices can be either a mechanical master mixing valve which is mechanically actuated or a digital master mixing valve which is electronically controlled device.

**Mechanical Master Mixing Valve.** Master Mixing Valve that utilizes mechanical means such as a thermostatic element to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

**TABLE 1701.2**

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<th>DOCUMENT NUMBER</th>
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<tbody>
<tr>
<td>ASSE/IAPMO IGC 384-2023</td>
<td>Industry Standard for Digital Mixing Valves for Recirculating Hot Water Systems</td>
<td>DWV Components</td>
</tr>
</tbody>
</table>

(portions of the table not shown remain unchanged)

Note: ASSE/IAPMO IGC 384 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
Substantiation: Hotels after healthcare facilities has the highest incidence rate of Legionnaires’ disease and thus need to be included in this list. The IECC 2015, 2018, and 2021 requires an aquastat and timer on ALL hot water recirculation pumps. The 2024 UPC added the allowance to operate recirculation pumps continuously; however, other hot water recirculation control devices may still end up adding an aquastat that turns off the recirculation pump thereby negating the positive impact of operating the recirculation pump continuously. An aquastat and timer can cause temperature stagnation of hot water systems which can lead to proliferation of waterborne pathogens and directly conflicts with NASEM Management of Legionella in Buildings, OSHA Technical Manual, ASHRAE 188, ASHRAE 12, ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems, VA-1061, among others. A critical device that may end up inadvertently requiring the use of an aquastat is a master mixing valve.

Master mechanical mixing valves were not intended for continuous recirculation. An aquastat was needed on the recirculation pump in part due to the potential for an over-temperature safety for the master mixing valve, also known as “temperature creep,” by the industry. Temperature creep occurs during zero demand on the system, when no cold water enters the system. The amount of heat being dissipated by the hot water supply and return piping system (total heat loss: radiant, conduction, convection) is less than the minimum heat being added to the system by all combined heat sources. Or, to put it another way, all mixing valves have a minimum inlet to outlet temperature, and temperature creep happens when the heat added to the piping system by the minimum hot water supply flow through the master mixing valve exceeds the piping system total heat loss. Because the mechanical mixing valve on its own couldn’t control a throttling valve was also required back to the heater to limit the amount of hot water entering the mixture of water flows at the water heater and mixing valve, minimizing temperature creep. Worth noting is that some Digital Master Mixing Valves also require an aquastat as they are subject to temperature creep. ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems indicates that Digital Master Mixing Valves should be utilized over Mechanical Master Mixing Valves for buildings such as healthcare and hospitality facilities.

By matching the requirement of master mixing valves being able to operate in such a way that allows continuous recirculation engineers, installers, and owners have the option to design, install, and operate hot water return systems in a manner that minimizes the risk of waterborne pathogen outbreaks, thus positively impacting public health and safety. By adding this exception language to the code, jurisdictions can better work with engineers, installers, and owners and become more aligned to the latest science in regard to hot water safety.

Substantiation provided by:

- Jeremiah Mastery, Institutional Product Mgr. – Hot Water Group, Armstrong International
- Paul Knight, Global Business Development, Armstrong International
- David D. Dexter, Master Plumber, CPI/CPE_ret., PE, F.ASPE, F.NSPE, LEED AP BC+D. Sr. Engineer, 3D Engineering Consultants, LLC

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RECOMMENDATION:
Revise text

Proposed Text:
P 102.0 Qualifications.

P 102.8 Rainwater Catchment System Personnel. Professional qualification for designers and installers of rainwater catchment systems, and inspectors of rainwater/stormwater catchment systems shall be in accordance with ASSE/ARCSA/IAPMO/ANSI Series 21000.

P 102.8.1 Qualification for Installer. Professional qualification for rainwater catchment systems installers shall be in accordance with ASSE/ARCSA/IAPMO/ANSI 21110.

P 102.8.2 Qualification for Designer. Professional qualification for rainwater catchment system designers shall be in accordance with ASSE/ARCSA/IAPMO/ANSI 21120.

P 102.8.3 Qualification for Inspectors. Professional qualification for rainwater and stormwater catchment systems inspectors shall be in accordance with ASSE/ARCSA/IAPMO/ANSI 21130.

SUBSTANTIATION:
The proposed change updates the harmonized standards for the ASSE/ARCSA/IAPMO/ANSI 21000 standard.
RECOMMENDATION:
Add new text

Proposed Text:
P 102.0 Qualifications.

**P 102.9 Qualifications Standard for Water Treatment Equipment Personnel.** Professional qualification for water treatment personnel shall be in accordance with ASSE/IAPMO Series 22000.

**P 102.9.1 Water Treatment Equipment Installers.** Professional qualification for water treatment equipment installers shall be in accordance with ASSE/IAPMO Series 22010.

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<th>DOCUMENT NUMBER</th>
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<tbody>
<tr>
<td>ASSE/IAPMO Series 22000:</td>
<td>Professional Qualifications Standard for Water</td>
<td>Professional</td>
</tr>
<tr>
<td>202X</td>
<td>Treatment Equipment Personnel</td>
<td>Qualifications</td>
</tr>
<tr>
<td>ASSE/IAPMO Series 22010:</td>
<td>Professional Qualifications Standard for Water</td>
<td>Professional</td>
</tr>
<tr>
<td>202X</td>
<td>Treatment Equipment Installers</td>
<td>Qualifications</td>
</tr>
</tbody>
</table>

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Note: ASSE Series 22000 and ASSE 22010 are working drafts and are not completed at the time of this monograph.

SUBSTANTIATION:
This standard series covers certification criteria for water treatment equipment personnel and installers. This certification will ensure that the minimum level of knowledge is present for the proper installation and will provide appropriate cross connection protection.
APPENDIX Q
THE SAFE OPERATION, CLOSURE AND REOPENING OF BUILDING WATER SYSTEMS

Part I – General.

Q 101.0 General.
Q 101.1 Applicability. This appendix shall apply to risk management practices for all potable and non-potable water supply systems during normal operation, when closing, during interruptions to normal operation, and when reopening building water systems in specific occupancy types. Part I shall apply to potable water systems and nonpotable water systems. Part II shall apply to potable water systems. Part III shall apply to nonpotable water systems.

Q 101.2 Building Water Systems. This appendix shall be applicable to building water systems for plumbing systems including the following:
1. Potable water systems
2. Non-potable water systems shall include, but not limited to, the following:
   a. Alternate water systems for outdoor use and indoor water use (dual plumbing systems)
   b. Utility supplied reclaimed water
   c. Rainwater catchment
   d. Gray water
   e. Landscape irrigation
   f. Decorative features
   g. Outdoor use systems (showers, hose bibs, etc.)

Q 101.3 Occupancy Types. This appendix shall be applicable to the following occupancies:
1. Non-residential (low- and high-rise)
   a. Office buildings
   b. Mercantile (seasonal retail)
   c. Schools/dormitories
   d. Hotels/motel
   e. Assembly
   f. Healthcare
2. Residential
   Exception: One- and two-family occupancies.

Q 201.0 Definitions.
Q 201.1 General. For the purpose of this appendix, the following definitions shall apply:
Building Water. Water collected, conveyed, circulated, stored, drained, or discharged by building plumbing systems for use in and around buildings.
Building Water Systems. Potable and non-potable water systems in the building, or on site.
Potable Water System. A building water distribution system that provides hot or cold water intended for direct or indirect human contact or consumption.

Risk. The potential to cause harm resulting from exposure.

Risk Management. Systematic activities to reduce risk.

SUBSTANTIATION:

Proposal Items #331 - #341, which cover potable and non-potable water systems, were rejected during the 2021 Technical Committee meetings because the provisions related to potable water had not yet been finalized. The Technical Committee asked that a change be submitted when the peer review of these provisions had been completed. This proposal reflects the results of that peer review.

UPC Appendix Q has been proposed to address the safe operation, closure and reopening of building water systems with a specific emphasis on reducing Legionella risks. There are general provisions that apply to both Potable and Non-Potable water systems and provisions that are specific to each type. Definitions have been added to this appendix. Additionally, when existing buildings are closed down for renovation, in order to prepare for the new construction, this appendix would be applicable to help keep the building water systems safe.

The content of the proposed appendix was developed by joint working group formed by IAPMO and the AWWA to develop a: Manual of Recommended Best Practice for: The Safe Closure and Reopening of Building Water Systems. As the world emerges from the COVID-19 pandemic, there will be countless studies that will consider where proactive efforts could have reduced the health and safety and the economic related impacts that resulted. Indeed, as a society we have learned a great deal and we will be better prepared for the next time we will need to respond to a similar threat on a global or regional scale, but only if we take the time to capture the best practices that are identified and put them into practice.

This Manual of Recommended Best Practice is intended to provide expert guidance on building water system safety. It provides sound and effective risk management practices for preparing water systems when buildings must be shut down or put into low use modes, “exercising” building water systems during periods of no or low use and evaluating and preparing water systems for reopening. It covers potable water systems, non-potable water systems and mechanical systems. While the Manual was developed as a guidance document, it was written in mandatory language so building and health departments can more easily appropriate and codify these requirements.

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**Proposed Text:**

**Q 301.0 Water Management Program.**

**Q 301.1 Development.** Where a water management program is not in place, a water management program shall be developed for the building water systems covered in this appendix in accordance with ASHRAE 188 and the Centers for Disease Control and Prevention (CDC) that addresses:

1. All building water systems described in Section Q 101.2.
2. The physical, chemical, and biological risks to the building water systems.
3. The normal operation, shutdown, maintenance, and start-up of building water systems.

**Q 301.2 Application.** Where a water management program is in-place, it shall be reviewed prior to applying this appendix to ensure it covers the above information. When a water management program is not in place, the following elements of a water management program shall be developed, in accordance with ASHRAE 188, prior to implementing this appendix:

1. A program team shall be identified.
2. The potable and non-potable building water systems shall be described, and process flow diagrams created.
3. An analysis of the building water systems, including all engineering controls, shall be conducted and documented.

**Note:** ASHRAE 188 defines a water management program as, “the risk management plan for the prevention and control of legionellosis associated with building water systems, including documentation of the plan’s implementation and operation.” Building water systems, including water supply and sanitary drainage, can present many additional risks to water quality and human health that warrant careful management of physical, chemical, and biological characteristics through a water management program. Managing water quality can also improve the performance of building water systems and extend the life of plumbing system. Managing water in building plumbing systems further requires understanding and monitoring the interaction between supply water and premise plumbing systems, compelling coordination with water providers to ensure building managers are aware of upstream risks that may impact building water quality.

**Q 301.3 Utility Coordinator.** Information shall be obtained about the specific disinfection and corrosion control chemicals being used in the supply water to the building from the water utility, including the following:

1. General water quality information
2. Type and level of disinfectant residual
3. Corrosion control chemicals added to the water
4. Distribution system maintenance near the building
5. Expected water quality changes

**Note:** It is important to notify the water utility of any sensitive water quality parameters for the building or facility, and to review/develop the notification protocol for significant water quality.

**Q 301.4 Microbiological Testing.** Microbial testing shall be done in accordance with Sections Q 301.4.1 and Q 301.4.2.

**Q 301.4.1 Microbiological Testing.** Microbiological testing shall be conducted by an accredited laboratory in accordance with the Authority Having Jurisdiction.

**Q 301.4.2 Legionella Testing.** Legionella culture and qPCR testing shall be conducted by an accredited laboratory in accordance with the Authority Having Jurisdiction.
Q 201.0 Definitions.
Q 201.1 General. For the purposes of this appendix, the following definitions shall apply.

Legionella. The name of the genus of bacteria that can cause a pneumonia called Legionnaires’ disease or a flu-like illness called Pontiac fever when inhaled, aspirated, or directly introduced into the lungs of susceptible individuals. Legionella are common aquatic bacteria found in natural and building water systems, as well as in some soils. [ASHRAE 188:3]

Legionellosis. The term used to describe Legionnaires’ disease, Pontiac fever, and any illness caused by exposure to Legionella bacteria. [ASHRAE 188:3]

Program Team. The group or individual designated by the building owner or designee to be responsible for developing, implementing, and maintaining the program. [ASHRAE 188:3]

Risk. The potential to cause harm resulting from exposure. [ASHRAE 188:3]

Risk Management. Systematic activities to reduce risk. [ASHRAE 188:3]

System Reopening. The set of actions that should be taken to ready a building for normal operations after an extended period of no or limited operations.

Water Management Program (WMP). A risk management plan to help building managers identify risks to water quality and establish clear guidelines for managing these risks at various points in the building lifecycle, including start-up, normal operation, under occupancy, water system shutdown, and water system restart. Such programs often focus on Legionella risk prevention, as practiced in some states for certain building types to combat waterborne pathogens such as Legionellosis.

SUBSTANTIATION:
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UPC Appendix Q has been proposed to address the safe operation, closure and reopening of building water systems with a specific emphasis on reducing Legionella risks. There are general provisions that apply to both Potable and Non-Potable water systems and provisions that are specific to each type. Definitions have been added to this appendix. Additionally, when existing buildings are closed down for renovation, in order to prepare for the new construction, this appendix would be applicable to help keep the building water systems safe.

The content of the proposed appendix was developed by joint working group formed by IAPMO and the AWWA to develop a: Manual of Recommended Best Practice for: The Safe Closure and Reopening of Building Water Systems. As the world emerges from the COVID-19 pandemic, there will be countless studies that will consider where proactive efforts could have reduced the health and safety and the economic related impacts that resulted. Indeed, as a society we have learned a great deal and we will be better prepared for the next time we will need to respond to a similar threat on a global or regional scale, but only if we take the time to capture the best practices that are identified and put them into practice.

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mandatory language so building and health departments can more easily appropriate and codify these requirements.
Proposed Text:

Part II – Potable Water Systems

Q 401.0 General.
Q 401.1 Scope. This section focuses on potable water plumbing systems inside larger buildings and building campuses with complex plumbing. Each shall be considered different and require unique actions based on its plumbing systems, use patterns, and source of water supply. Buildings that have a WMP shall be exempt from these requirements. This section applies to, but not limited to the following infrastructures:
(1) Hotels, motels, and or other similar short-term stay, multi-room buildings.
(2) Multi-family buildings of any height that have a central water heating system that delivers hot water to the units using circulation loops or heat traced supply piping. (e.g. condominiums, townhouses, apartments, etc.).
(3) Office buildings and other facilities of any height that have a central water heating system that delivers hot water using circulation loops or heat traced supply piping.
(4) K-12 schools and university dormitory and classroom buildings.
(5) Industrial facilities and campuses with shared hot and cold-water supplies.
This section does not apply to buildings such as healthcare, hospital, and long-term care facilities or other facilities with a higher risk level that already have a water management program in place specific to their facility per regulatory requirements.
Responsible parties shall utilize Section Q 401.0, Section Q 402.0 and Section Q 403.0 to make the determination of whether to maintain the water systems during periods of low or no use (Section Q 404) or to restore the water systems after the periods of low or no use have ended (Section Q 405). They shall also use these three sections to determine how to manage the water systems after the building has been returned to normal occupancy (Section Q 406.0). Responsible parties shall refer to Figure Q 401.1 in accordance with the requirements of this Appendix.
Q 401.2 Occupancy Status and Duration of Stagnation. Responsible parties shall use Table Q 401.2 to assist in their determination of risks and the steps they will take to address them.
TABLE Q 401.2

OCCUPANCY STATUS AND DURATION OF WATER STAGNATION

<table>
<thead>
<tr>
<th>OPEN/CLOSED STATUS</th>
<th>&lt;2 Weeks Stagnant</th>
<th>&gt;/=2 Weeks Stagnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Normal Occupancy</td>
<td>N/A</td>
</tr>
<tr>
<td>Not Normal</td>
<td>Normal Occupancy</td>
<td>Limited Occupancy</td>
</tr>
<tr>
<td>Partially Closed</td>
<td>Normal Occupancy</td>
<td>Partial Shutdown</td>
</tr>
<tr>
<td>Completely Closed</td>
<td>Normal Occupancy</td>
<td>Complete Shutdown</td>
</tr>
</tbody>
</table>

Q 201.0 Definitions

Q 201.1 General. For the purpose of this appendix, the following definitions shall apply.

Responsible Party. The people who will conduct work and are accountable for building water system operations (e.g., building owner, tenant, management company, contractor/operator, etc.).

Stagnation. When water in the water supply piping (e.g., domestic water) of a building, or other built water system, does not move, or moves very slowly, causing water quality to deteriorate. This may occur due to seasonal changes in the occupancy of the building, during construction of a section of a building, or due to other conditions where water does not move normally through the plumbing.

Flushing. The action of moving water through the plumbing to improve water quality. The purpose is to distribute fresh water throughout the building water supply system with water of a quality similar to what is supplied at the building inlet. This action moves fresh water from the city water supply through the building and moves hot water from the water heater or boiler to the point of use.

Remedial Flushing. The action of replacing or replenishing the water in the plumbing network with a one-time intervention to end a stagnation period.

Routine Flushing. The action of moving water through the plumbing that is implemented to improve or maintain water quality in the building on a regular basis.

Occupancy.

Normal Occupancy. The building is being used as intended. This includes periods of reduced occupancy and closure for less than two weeks.

Limited Occupancy. When there is a reduction in the number of people using a facility, resulting in significantly reduced water use for at least two weeks.

Partial Shutdown. When a portion of the building is not in use, and can result in no water use in that part of the building for at least two weeks.

Complete Shutdown. When the entire building is not in use, resulting in no water use in the building for at least two weeks.

Point of entry (POE). Where the water from the city enters a building. Some buildings may have more than one point of entry (e.g., hospitals and other healthcare facilities that may have at least two points of entry).

Point of use (POU). The location where water is used in the building (e.g., faucet or water closet).

SUBSTANTIATION:

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SUBMITTER: Gary Klein
Organization Name: Gary Klein Associates
Organization Representation: Self

RECOMMENDATION:
Add new text

Proposed Text:
Q 402.0 Preparations.

Q 402.1 Communication. Building owners and operators shall work with the internal and external building operations individuals to assess risks and determining appropriate responses.

SUBSTANTIATION:
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RECOMMENDATION:
Add new text

Proposed Text:

**Q 402.2 Water Supply. Responsible Parties shall:**

(1) Obtain from the water supplier the following:
   (a) The type of disinfectant is being used.
   (b) The typical disinfectant residual (or goal) is in the portion of the water delivery system that supplies the building for all four seasons of the year.
   (c) Changes to the levels and types of disinfectant are made.
   (d) Flushing activities in the portion of the water delivery system that supplies the building are planned or underway.

(2) Measure the disinfectant residual at the POE to the building.

(3) Determine if their building(s) are using on-site water treatment (adding supplemental disinfectant, adding corrosion scale inhibitors, etc.).

**Note:** Nearly all buildings have water meters owned and monitored by water suppliers that track total water usage. Billing for water service is typically based upon the amount of water used in a month or quarter. The type and level of disinfectant (free chlorine or chloramine), vary in the portion of the water delivery system that supplies your building(s) seasonally or due to other factors. These changes will impact building operations (e.g., a change in disinfectant measurement equipment/supplies will be needed). Periodically, the water supplier flushes all or portions of the water delivery system. Like flushing in a building, flushing distribution system main pipelines is used to improve water quality. It can also affect the water quality that is supplied to your building(s).

SUBSTANTIATION:

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**Proposed Text:**

**Q 402.3 Water Quality.** The provisions in this section shall be implemented as part of Section Q 404, Section Q 405.0, and Section Q 406.0.

1. **Scheduling and Frequency of Sampling.** Water quality samples shall be obtained before, during, and after flushing activities.

2. **Water Quality Parameters to be Monitored.** Sampling shall take place to characterize both cold and hot water depending on the sample being analyzed, as follows:
   - Disinfectant residual: Cold water.
   - Temperature: Cold and hot water.
   - Legionella: Hot water (or warmed water, such as at the temperature that is normally used during operating a shower).

3. **Procedure for Monitoring Water Quality.** The following initial assessment of disinfectant residuals and water temperatures shall be conducted:
   - **Disinfectant residuals**
     1. An initial assessment of disinfectant residuals throughout the building shall be conducted as follows:
        1. Measure and record incoming disinfectant residual at the POE.
        2. Measure and record disinfectant residual at locations entering the hot water system after the water heater, and in recirculating systems.
        3. Measure and record disinfectant residual at cold water sites throughout the building. Include sites that are hydraulically distant from the POE.
     2. The data obtained shall be used to identify and select critical control sampling locations that reflect locations in the plumbing system that have the lowest disinfectant residual and any other key locations.
     3. After flushing, measure and record disinfectant residual at the disinfectant-based critical control sampling locations.
   - **Cold and hot water temperatures**
     1. An initial temperature assessment of hot and cold water throughout the building shall be conducted:
        1. Measure and record incoming cold-water temperature at the POE.
        2. Measure and record water temperature at locations entering the hot water system after the water heater, and in recirculating systems.
        3. Measure and record water temperature at the critical control locations selected based on disinfectant residual.
        4. Measure and record cold and hot water temperatures at all taps that are flushed for both cold and hot water (this does not include where end-use devices are installed such as water closets, urinals, ice machines, or other...
(i) All monitoring results shall be recorded and reviewed.
(ii) After flushing, measure and record temperature at the temperature-based critical control sampling locations.

(d) Legionella.

(i) Water samples shall be collected to test for Legionella after flushing has been completed and disinfectant residual and water temperature levels are acceptable. Sampling for Legionella shall be conducted at not more than two weeks of returning the building water system to normal usage.

1. Sampling protocols which include collection procedures, equipment, and bottles) for water samples shall follow that outlined by the Centers for Disease Control and Prevention (CDC) guidelines.

2. Samples for Legionella shall be collected under normal water flow conditions at the point of sampling, or from a valved location allowing for a sample to be collected (such as for a misting device).

3. Molecular analysis methods shall be used to screen samples prior to using culture methods to confirm results, but all positive screening samples shall have a paired sample (collected at the same time at the same location) analyzed by culture method.

4. Laboratories used to perform Legionella analysis shall be accredited to conduct such analysis or by a laboratory approved by the Authority Having Jurisdiction.

(ii) Sampling sites for testing of Legionella shall be identified and shall be included in the water management program.

(iii) Test water samples shall be collected at not less than once per year. Initial monitoring shall be done more frequently to establish a baseline of results in accordance with the water management program.

Note: Legionella testing results reflect both the concentration of organisms at individual sites and may show organism detections at a few or many sample locations. Refer to Table 402.3 for recommended colony forming units (CFU) and recommended action required.

<table>
<thead>
<tr>
<th>Legionella CFU/Liter</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Detected</td>
<td>Acceptable – continue monitoring</td>
</tr>
<tr>
<td>&lt; 100 to 1,000</td>
<td>Refer to responsible person and assure water quality values are within target</td>
</tr>
</tbody>
</table>
| > 1,000 to < 10,000  | i) Resample if small percentage (10-20%) are positive; review control measures 
|                      | ii) If >20% positive may indicate low level colonization, disinfection of system, and risk assessment to determine additional actions |
| ≥ 10,000             | Resample, immediate review of control measures, disinfection of whole system |

Source: EU (2017).

The EU guidelines emphasize the goal to achieve no cultural Legionella, but acknowledge that occasional detection (<20%) of low levels of Legionella (<1,000 CFU/L) may be acceptable provided that other water quality values (e.g., temperature, disinfectant) and operational parameters are within the water management plan guidelines. Intermediate levels (1,000 to <10,000 CFU/L) and high levels (≥10,000 CFU/L) trigger a series of actions including resampling, remedial measures such as disinfection, and overall review of the water management plan program.
SUBSTANTIATION:
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Proposed Text:

**Q 403.0 Flushing.**

**Q 403.1 Manage Risk.** The provisions in this section shall be implemented as part of Section Q 404.0, Section Q 405.0, and Section Q 406.0. The following risks shall be considered during flushing:

1. **Flushing activities:**
   (a) Scald risk: Exposure to high water temperatures of 130°F (54.4 °C) or more pose a risk for scalding
   (b) Inhalation risk: Exposure to aerosols generated during flushing activities and outlets that have low flow or tempered water 120°F (48.9 °C) or less pose the highest risk for exposure to pathogens that grow in stagnated conditions

**Q 403.2 Develop a Flushing plan.** A flushing plan shall be developed that includes the following information:

1. The following key system locations shall be identified and located:
   (a) All water service lines from the municipal water supply to a building point of entry
   (b) Water storage tanks (e.g., water heaters, pressure tanks)
   (c) Mechanical equipment supplied by potable water
   (d) Devices in the building water system (e.g., backflow preventers, filters, disinfection systems, water softeners, etc.)
   (e) Identify POE devices (e.g., strainers) to conduct service line flushing
   (f) Identify cold and hot water supply pipes including mains, branches, risers, and manifolds (headers)
   (g) Identify outlets furthest away from the point of entry (the longest plumbing runs)
   (h) Separate outlets into different service “zones.” (e.g., systems, risers, floors) organized by proximity to the source(s) of water supply to that zone
   (i) Identify locations at which plumbing is to be flushed efficiently (e.g., service sinks, riser drains, hot water return pipes, industrial kitchen faucets, water closets, etc.)
   (j) Identify drain locations for flushed water capable of accepting anticipated flows without creating a backflow or flooding hazard

2. Specialty devices plumbed into the building water system (e.g., ice/coffee/soda machines, drinking fountains, dishwashers, eye-wash stations, safety showers, medical equipment, salon chairs, or other devices serviced by potable water), shall be identified and located, and shall be organized by zones.

3. Protocols shall be established to prevent:
   (a) Water hammer (e.g., slowly opening and closing valves during flushing activities)
   (b) Back-siphonage
   (c) Flooding

4. Confirm the critical control sampling locations identified in Section Q 402.3 that will be used to assess the effectiveness of flushing.

**Note:** Building managers must evaluate the water use and occupancy patterns of their buildings, health risks, and the resources available to design an appropriate flushing plan. The amount of flushing necessary to prevent water quality issues will vary by building.
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RECOMMENDATION:
Add new text

Proposed Text:

Q 403.3 Flushing the System. Flushing shall be conducted from the entry points to the hydraulic extremities of the building.
Note: The purpose of flushing is to bring in fresh water from the municipal supply pipe to the POE, from the POE through the building to the POU locations, and then through any end-use devices. This allows disinfectant and corrosion inhibitors from the city water supply to flow through the building’s plumbing.

Q 403.3.1 Flushing Protocol. The following flushing protocols shall be implemented:
(1) Prior to flushing, the water quality shall be measured.
(2) Flush the service main to the point(s) of entry (POE) to obtain representative temperature and disinfectant residual entering the building.
(3) Flush mechanical room cold water mains.
(4) Flush mechanical room potable service water heating equipment and piping.
(5) Flush all end points throughout the building.
(a) The cold water shall be flushed first:
(i) until temperatures at all POU locations are similar to that entering the building.
(ii) until disinfectant residual at all cold water POU locations are similar to that entering the building.
(b) The hot water shall be flushed:
(i) until temperatures at all POU locations are similar to where they start in the service water heating system
(ii) obtain disinfectant residual at all hot water POUs locations to be similar to where they start in the service water heating system.
(c) All other end-use devices are brought on-line and flushed after the building shall include fresh water.
(6) If discoloration appears, the water shall be flushed until it runs clear.
(7) Consider automating flushing at key locations.
(8) Where possible, consider bypassing mixing valves to increase flow rates during flushing.
(9) Water quality shall be assessed in accordance with Section Q 402.5.
Note: The goal of flushing is for the cold-water disinfectant levels at the POU to be at least 80 percent of the incoming disinfectant at the POE. Lower percentages are indicative of something in the building’s water distribution system that is reacting with the disinfectant and needs to be addressed.

SUBSTANTIATION:
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The content of the proposed appendix was developed by joint working group formed by IAPMO and the AWWA to develop a: **Manual of Recommended Best Practice for: The Safe Closure and Reopening of Building Water Systems.** As the world emerges from the COVID-19 pandemic, there will be countless studies that will consider where proactive efforts could have reduced the health and safety and the economic related impacts that resulted. Indeed, as a society we have learned a great deal and we will be better prepared for the next time we will need to respond to a similar threat on a global or regional scale, but only if we take the time to capture the best practices that are identified and put them into practice. 

This Manual of Recommended Best Practice is intended to provide expert guidance on building water system safety. It provides sound and effective risk management practices for preparing water systems when buildings must be shut down or put into low use modes, "exercising" building water systems during periods of no or low use and evaluating and preparing water systems for reopening. It covers potable water systems, non-potable water systems and mechanical systems. While the Manual was developed as a guidance document, it was written in mandatory language so building and health departments can more easily appropriate and codify these requirements.
Proposed Text:

Q 404.0 Maintaining Building Water Systems - Periods of Low or No Water Use.

Q 404.1 Application. Where maintaining the water quality during periods of limited occupancy, partial shutdown and complete shutdown, the responsible parties shall follow the water management program or the provisions of Section Q 404.0 shall be implemented.

Consistent water flows in the building plumbing shall be maintained to prevent plumbing material corrosion caused by variable water quality conditions in accordance with the following:

(1) The water quality of the building water system shall be maintained during periods of limited occupancy and partial shutdown.

(2) It shall be permitted to maintain the water quality of the building water system during periods of complete shutdown.

(3) Where the building water systems have not been maintained during periods of limited occupancy, partial shutdown and complete shutdown, responsible parties shall implement the provisions in Section Q 405.0.

Q 404.2 Preparing for Maintaining System. Where a water quality baseline has not been established, an initial assessment in accordance with the procedures in Section Q 402.3 shall be conducted.

Q 404.3 Actions During Maintaining System. The following actions shall be taken during system maintenance:

(1) Signage and Communications. Signs indicating the status of the system as being maintained shall be posted. If building or portion of building is shut down, signage indicating that the building is shut down shall be provided and that the water shall not be used.

(2) Records & Documentation. All actions taken to maintain water quality in the building shall be documented. All disinfectant residual, water usage, and temperature measurements shall be recorded.

(3) Maintenance Flushing. Conduct flushing activities in accordance with Section Q 403.0.

(4) Water Quality Sampling. Water quality sampling activities in accordance with Section Q 402.3 shall be conducted.

Q 404.4 Returning to Service - After System Maintenance. The following shall be implemented when returning to service:

(1) Before returning a building to service, the following conditions shall be achieved:

(a) Cold-water disinfectant residual levels at the POU shall be at least 80 percent of the incoming disinfectant residual at the POE.

(b) Cold-water temperatures at the POU shall be similar to the water temperature at the POE.

(c) Hot water temperatures measured at the POU shall reach operating setpoints. Where applicable, thermal mixing valves shall be adjusted to reach these setpoints.

(d) Legionella test results, if measured, shall meet the conditions referenced in Section Q 402.3.

(2) Post signage that states the building water systems are ready for use.

(3) Responsible Parties shall implement Section Q 406.1(5) activities to ensure that water does not stagnate prior to occupancy.

(4) After the building has been returned to service, responsible parties shall check in with occupants over the next several weeks to determine if problems have been identified and shall address those that have arisen.
SUBSTANTIATION:
Proposal Items #331 - #341, which cover potable and non-potable water systems, were rejected during the 2021 Technical Committee meetings because the provisions related to potable water had not yet been finalized. The Technical Committee asked that a change be submitted when the peer review of these provisions had been completed. This proposal reflects the results of that peer review.

UPC Appendix Q has been proposed to address the safe operation, closure and reopening of building water systems with a specific emphasis on reducing Legionella risks. There are general provisions that apply to both Potable and Non-Potable water systems and provisions that are specific to each type. Definitions have been added to this appendix. Additionally, when existing buildings are closed down for renovation, in order to prepare for the new construction, this appendix would be applicable to help keep the building water systems safe.

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SUBMITTER: Gary Klein
Organization Name: Gary Klein Associates
Organization Representation: Self

RECOMMENDATION:
Add new text

Proposed Text:

Q 405.0 Restoring Water Quality After Periods of Low or No Water Use.
Q 405.1 Application. Where the water quality is not maintained during periods of limited occupancy, partial shutdown and complete shutdown, responsible parties shall follow the water management program or implement the provisions of Section Q 405.0.

Q 405.2 Actions During Complete Shutdown. The following actions shall be taken during complete shutdown:
(1) Signage and Communications. Signs stating the building water system has been shut down shall be posted and that the water shall not be used.
(2) Records & Documentation. All actions taken to shut down the building water system shall be documented.
(3) Drain the potable water system. Where the duration of the downtime for the potable water supply is expected to be extensive the responsible parties shall consider completely draining the water from the cold and hot water systems.
(4) Other devices connected to the potable water. These devices include, but not limited to, water storage tanks; pressure and expansion tanks; treatment devices; pools/spas/hot tubs and related features; decorative features, safety devices (eyewash, shower); hot water tempering devices; showerheads; ice machines; bottle filling devices; water drinking stations; secondary/under-the-sink water heaters; drink/coffee/tea machines; etc. The responsible parties shall:
(a) Follow manufacturer recommendations concerning long periods of no use.
(b) Post signage that water is shut until further notice for all equipment that is taken off-line.

Q 405.3 Restoring the System. The actions in this section shall occur toward the end of the low or no use period and prior to returning the building to normal operations. The responsible parties shall:
(1) Refill. Where the building water systems have been drained, the system shall be filled with water.
(2) Conduct Remedial Flushing. Remedial flushing in accordance with Section Q 403.0 shall be conducted in accordance with Section Q 403.0 and the following:
(a) Flush all water heaters primary and secondary.
(b) Flush all devices that are part of the building water distribution systems.
(c) Where applicable, disinfect the building water system in accordance with local codes.
(3) Restore Operations. In the appropriate sequence in accordance with the manufacturer’s instructions, restart all primary potable water mechanical equipment, treatment devices, storage tanks, and pressure and expansion tanks and water heating systems.
(4) Water Quality Sampling. Conduct water quality sampling activities in accordance with Section Q 402.3. Legionella testing shall be required.
(5) POU Devices. Clean and disinfect all end point devices after water sampling has verified that the flushing is complete. Restart these devices.
(6) Signage and Communications. Post new signage indicating the status of the system is being restored. Include an estimated timeline for restoring the system and state that ready for use signage will be installed when appropriate.

Note: The purpose of remedial flushing is to refresh the building water system and transition the potable water pipelines from off-line or stagnant conditions to fresh water with the proper disinfectant residual level and
temperature. It is likely that remedial flushing will take longer than routine flushing because the water will have been sitting stagnant (or plumbing will have been sitting empty/drained) for an extended period.

Q 405.4 Returning to Service After Restoring the System. The following shall be achieved when returning the system to service:

1. Before returning a building to service, the following conditions shall be achieved:
   a. Cold-water disinfectant residual levels at the POU shall be at least 80 percent of the incoming disinfectant residual at the POE.
   b. Cold-water temperatures at the POU shall be similar to the water temperature at the POE.
   c. Hot water temperatures measured at the POU shall reach operating setpoints. Where applicable, thermal mixing valves shall be adjusted to reach these setpoints.
   d. Legionella test results, shall meet the conditions referenced in Section Q402.3.

2. Responsible Parties shall implement Section Q406.1(5) activities to ensure that water does not stagnate prior to occupancy.

3. Post signage that states the building water systems are ready for use.

4. After the building has been returned to service, responsible parties shall check in with occupants over the next several weeks to determine if problems have been identified and shall address those that have arisen.

SUBSTANTIATION:
Proposal Items #331 - #341, which cover potable and non-potable water systems, were rejected during the 2021 Technical Committee meetings because the provisions related to potable water had not yet been finalized. The Technical Committee asked that a change be submitted when the peer review of these provisions had been completed. This proposal reflects the results of that peer review.

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Proposed Text:

**Q 406.0 Managing Water Systems During Normal Occupancy.**

**Q 406.1 Return to Normal Occupancy.** After the building is returned to normal occupancy, the responsible parties shall:

1. A water management program shall be created for the potable water systems in accordance with Section Q 301.0.
2. A new baseline once the building has been reopened shall be established, and the water usage and occupancy shall be recorded.
3. The total water use and occupancy levels on a regular basis either monthly or more frequently shall be monitored and recorded.
4. The water quality in accordance with Section Q 402.5 shall be monitored and recorded.
5. The water system stagnation shall be managed:
   a. Implement routine outlet flushing
   b. Guide the frequency and duration of routine flushing by reduction of potable water stagnation that results in adequate disinfectant residual, hot and cold-water temperature, and microorganism levels at POU locations.

**Note:** Routine outlet flushing is a preventative action performed during periods of low water use during otherwise normal occupancy throughout a building or at specific unused outlets. There are no default recommendations with respect to duration, location, or frequency of routine outlet flushing that will reduce or eliminate risks in all settings. Incomplete flushing increases the risk levels of some contaminants by not thoroughly removing stagnant water or renewing water frequently enough.

**SUBSTANTIATION:**

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Proposed Text:

R 101.0 Tiny Houses.

R 101.1 Applicability. This appendix shall apply to structures permanently attached to a foundation tiny houses used as a dwelling or for commercial use. The tiny house plumbing systems shall be designed and installed in accordance with the requirements of this appendix and the requirements of this code and applicable to all types and sizes of tiny house structures ranging from 120 square feet (11.148 m²) to 1200 square feet (111.484 m²) that are built on skids, installed on a permanent foundation, structurally attached to a chassis, or built on a integrated retractable trailer platform. The provision of this appendix shall apply to permanent structures of 400 square feet (37 m²) or less. The provisions of this appendix shall not apply to recreational vehicles as defined in NFPA 1192 or to manufactured homes as defined in NFPA 501A.

R 101.2 Sprinkler Systems. Fire Sprinklers shall be required for a tiny house for commercial, residential use, or built as an ADU if the primary dwelling has a fire sprinkler system as required by the Authority Having Jurisdiction. The fire sprinkler system shall be installed by personnel, installers, or both, certified in accordance with ASSE/IAPMO/ANSI Series 7000 or NFPA 13D.

R 102.0 Definitions.

R 102.1 General. For purposes of this appendix, the following definition shall apply:

Accessory Dwelling Unit (ADU). An accessory unit to a primary residence that is self contained and has complete independent living facilities.

Tiny House. A single family dwelling that, is not greater than 400 square feet (37 m²), not including loft area. A structure ranging from 120 square feet (11.148 m²) to 1200 square feet (111.484 m²) that is built on skids, installed on permanent foundation or a tiny house on wheels that is a portable unit that is structurally attached to a chassis, or built on a integrated retractable trailer platform. Tiny houses used as a dwelling include sleeping, cooking, bathing, sanitation and habitable areas for living. Lofts and decks are not included in calculating square footage for a tiny house on wheels that is 400 square feet (37 m²) or less. Tiny houses are also built for commercial use including hair salons, medical clinics, kiosks, etc.

SUBSTANTIATION:

The term ‘tiny house’ is an umbrella term that is inclusive of tiny houses on wheels, tiny houses with retractable trailer platforms, on skids, and on both temporary and permanent foundations. Tiny houses are built for both residential and commercial use. The 400 square footprint is restrictive, not cost effective and is no longer reflective of where the tiny house industry is heading. International standards are being developed specific to tiny houses currently under the auspices of ASTM International in the E06.26 subcommittee Tiny Houses within E06 Performance Of Buildings.

Expanding the footprint to 1200 square feet will encompass the various sizes of accessory dwelling units, known as (ADUs), granny flats, carriage houses, and studios to name a few. ADUs can be an additional source of income, and are becoming a global solution to contribute to the housing crisis, increasing density on lots, and encouraging
multigenerational housing. The increased size will allow the tiny house to be constructed with ‘universal design elements’ in mind that could be used by all people, without having to adapt to construction changes in the future, such as a disability, injury, or vulnerability, where the inhabitant can age in place, and even meet ADA compliance.

Additionally, text is being added to address the requirements for sprinkler systems. It is common for fire Sprinklers to be required for a new ADU if the existing primary residence has a fire sprinkler system.
**RECOMMENDATION:**
Revise text

**Proposed Text:**

<table>
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<tr>
<th>WATER USE SCENARIO</th>
<th>ENTERIC VIRUSES</th>
<th>PARASITIC PROTOZOA</th>
<th>ENTERIC BACTERIA</th>
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</thead>
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<td></td>
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<tr>
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<td>Indoor use</td>
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<td><strong>STORMWATER WITH LESS THAN OR EQUAL TO 0.1% FECAL CONTAMINATION CONTRIBUTION</strong>²</td>
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</tr>
<tr>
<td>Ornamental plant irrigation¹/dust suppression</td>
<td>3.0</td>
<td>2.5</td>
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</tr>
<tr>
<td>Indoor use</td>
<td>3.5</td>
<td>3.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Notes:**

1 Non-food.

2 Stormwater can contain some quantity of fecal contamination. The extent of fecal contamination present will depend on site-specific conditions. The appropriate LRT to apply for a stormwater treatment system depend on the site-specific extent of likely contamination of Stormwater with fecal contamination.

**SUBSTANTIATION:**
The proposed update will correlate with the 2023 WeStand values for enteric bacterial in the indoor-use category in Table S 101.7.
RECOMMENDATION:
Revise text

Proposed Text:
221.0 -S-
Stormwater. Natural precipitation that has contacted a surface at grade, below grade, an above-grade parking structure, and has not been put to beneficial use.

L 201.0 Definitions.
Stormwater. Natural precipitation that has contacted a surface at grade or below grade and has not been put to beneficial use.

S 102.0 Definitions.
Stormwater. Natural precipitation that has contacted a surface at grade, below grade, or above-ground parking surfaces.

SUBSTANTIATION:
The definitions for "stormwater" are being relocated from Appendix L and Appendix S to Chapter 2 (Definitions) so the definition is harmonized across "all" chapters and appendices.
APPENDIX T

Guidance for Operating Medical Air and Oxygen Systems with Nonstandard Pressure

T 101.0 Introduction to Operating Medical Air and Oxygen Systems with Nonstandard Pressures.

T 101.1 General. This appendix shall provide essential guidance on designing medical oxygen and medical air systems with higher pipeline pressures than traditionally employed. This appendix shall focus on a practical implementation of elevated pressure capabilities for medical gas systems with the capacity to operate under elevated pressures for healthcare facilities to enhance their ability to respond to surges in demand, ensuring the continuous and reliable delivery of critical gases. All design considerations shall be approved by the Authority Having Jurisdiction prior to implementation.

T 102.0 Reference Publications.

T 102.1 General. The following reference documents are supporting documents for this appendix:

(1) NFPA 99, Healthcare Facilities Code – 2021 (NFPA)
(2) IAPMO/ANSI UPC-1 Uniform Plumbing Code – 2024 (IAPMO)
(3) Plumbing Engineering Design Handbook Volume 3 (ASPE)
(4) Medical Gas Design Guide (Beacon Medaes Medical Gas)
(5) 2009 Edition of Technical Paper No. 410 (Crane Fluid Handling)
(6) Medical Gas Design Guide (Amico Medical Gas)
(8) WHO Oxygen 93 Pharmacopeia

T 103.0 Definitions and Abbreviations.

T 103.1 General. For the purpose of this appendix, the following definitions shall apply:

Accepted Engineering Practice. That which conforms to technical or scientific-based principles, tests, or standards that are accepted by the engineering profession.

Central Supply System. The entirety of the components comprising the oxygen source on the source side of the Source Valve. Required components for various configurations of Central Supply Systems are detailed in the Medical Gas Standards.

Main. The principal artery of a system of continuous piping to which branches may be connected.

Medical Gas Standards. Depending on the locality(ies) in which the User is based, the standard(s) in use may vary (see the reference standards list) and may involve standards other than the medical gas systems technical standard. The locally relevant standards should be consulted when using this Guidance.

Pressure. The normal force exerted by a homogeneous liquid or gas, per unit of area, on the wall of the container.

Supply Source. A collection of components necessary to control, monitor and supply oxygen, whether from a liquid container, cylinder(s) or cylinder header(s) or a concentrator. Required components are detailed in the Medical Gas Standards.

Source Valve. The control valve on the patient side of all components of the Central Supply System which shuts off...
flow from the Central Supply System to the distribution piping.

Terminal. The attachment point and valve, located on the wall, ceiling or other device where the user will connect their clinical equipment and access the oxygen supply. Terminals are always gas specific to prevent misconnection. The keying systems are detailed in the Medical Gas Standards.

User. A trained medical professional capable of administering medical gases to a patient, assessing the condition of that patient, and adjusting the administration of the gases in response.

T 104.0 Operating Medical Air and Oxygen Systems with Nonstandard Pressures.

T 104.1 Scope. This appendix shall serve as a guide in assessing medical gas flow rates associated with varying pressures. This appendix shall be considered where the medical gas piping systems stretched to their design limits resulting in insufficient flow rates and pressures at patient outlets. This document shall be considered when evaluating the medical gas systems and flow rates for temporary operations at elevated pressures.

For existing systems, this appendix shall provide guidance on how to determine the limitations of the line pressure increase and estimating the performance improvements using the pressure loss charts provided or by developing new charts.

This appendix shall provide additional concepts in using pressure regulators in accordance with Section 5.1.3.5.7 of NFPA 99. Pressure regulators shall be considered to provide higher pressures in areas needing elevated pressure due to increased demand without having to increase pressure everywhere.

This appendix shall be considered a guide for performing medical gas assessments on existing medical gas systems and design considerations for medical gas systems that may function at pressures beyond traditional standards, to establish consistent principles for pressure loss, provides a framework for designers to systematically evaluate design documents, and appraise both existing and new oxygen and medical air piping systems.

The appendix shall serve a design guide for recommendations and standards for designers when sizing medical gas piping for pressures exceeding the usual 55 psi (379 kPa), and for preparing medical gas documentation. This design guide shall identify requirements and recommended design standards for ensuring safe and reliable oxygen and medical air pipe sizes at non-standard delivery pressures.

T 104.2 Limitations. This guide shall not restate a regulatory requirement. This appendix shall be considered a best practices guide on what constitutes the basis for designing a safe, reliable, and sustainable oxygen and medical air piping system. This appendix shall be used in conjunction with other standards to balance the reduction of risk against the added cost to provide that reduced risk and the capacity of oxygen and medical air piping systems to handle anticipated flow rates at varying pressures. This appendix shall serve to encourage design engineers to consider various alternatives and options, but at no time shall a design conflict with regulations and standards. All designs shall approved by the Authority Having Jurisdiction prior to implementation.

T 104.3.1 Healthcare Facility Considerations. This appendix shall be used as a guide to obtain, vaporize, and convey through the piping, massive quantities of oxygen into parts of their facilities which had never been designed to handle these flows. When implementing updates to the system, the following parameters shall be considered:

1) Vaporizers. Keeping the vaporizer's ice free and therefore able to convert the liquid to gas.
2) Piping. The pipes in the building were never sized with this kind of flow rate in mind, and therefore facilities found that they struggled to maintain pressures at peak flows. We are now in the third phase.
3) Ventilators. Ventilators and the effects of lower oxygen pressure compared to the medical air pressure being used on the ventilator. Where the oxygen pressure falls below a certain pressure compared to the medical air, the patient may go into low O2 stats alarm and the ventilator will start to use medical air or room air to compensate.
4) Expedient of raising the pressure at the source. More pressure, more flow through the same piping. Care shall be taken with doing this and limits on how far one can take it shall be considered.
Designers and medical professionals shall consider what flow rates they want to use in designing their systems, this document shall serve as a necessary tool for implementing those designs.

Data for standard pressures and for somewhat elevated pressures shall be considered in determining what might be possible in the event of unexpected demand.


T 104.4.1 Existing System Considerations. The following shall be considered when increasing the supply pressure which can have a significant impact on system capacity. There are two components to this performance improvement.

The available pressure loss within the system increases by the difference in supply pressure. The following is an example:

Example: Increasing the supply pressure from 55 (379 kPa) to 65 psi (448 kPa) changes the available pressure loss from 5 psi (34 kPa)(standard design of 10 percent loss) to 15 psi (103 kPa). Also, the fluid density is increased, which reduces the average velocity providing a 5 percent to 10 percent improvement (reduction in pressure loss). In combination, increasing an oxygen or medical air source supply from 55 (379 kPa) to 65 psi (448 kPa) can theoretically result in a capacity increase of up to 70 percent while still maintaining 50 psi (379 kPa) at the most remote outlet. Likewise, increasing from 55 (379 kPa) to 75 psi (517 kPa) can theoretically result in a capacity increase of up to 220 percent. However, the full increase may not be realized due to other factors such as limitations at the cryogenic fluid central supply system (for example, the capacity of the line pressure reducing valve or vaporizer limitations), relief valve setpoint or other mechanical device choke-points. There are a number of system design considerations and patient risk issues that will limit the ability to safely operate the system at a higher-than-standard operating pressure.

Clinical staff, respiratory equipment manufacturers, as well as the responsible facility authority, facilities engineers, etc. shall be integrally involved in the evaluation and decision-making process. Considerations shall include:

(1) Standard operating pressure for medical air and oxygen at 50 (379 kPa) to 55 psig (379 kPa) shall be in accordance with Table Table 5.1.11 of NFPA. Code allows for establishment of a higher operating pressure if all design considerations are addressed. However, most applications of this guide (to increase line pressure) would occur in systems originally designed to operate at standard operating pressure. Therefore, several system parameters would need to be evaluated before establishing a higher operating pressure including but not limited to relief valve settings, alarm set-points, pressure testing, medical equipment, flow meter calibration etc.

(2) Piping is initially subjected to a 150 psi (1034 kPa) (minimum) initial pressure test (NFPA 99-2021 paragraph 5.1.12.2.3) which establishes the maximum operating pressure for the piping [e.g. a 150 psi (1034 kPa) initial pressure test establishes a maximum operating pressure of 100 psi (689 kPa)]. This test is performed after the installation of rough-in assemblies but prior to the installation of station outlet/inlet valve bodies and faceplates etc. The complete piping system (with all outlet/inlet valve bodies, faceplates etc.) is only subject to a pressure test of 20 percent above operating pressure [e.g. 66 psi for a 55 psi (379 kPa) system] in accordance with Section 5.1.12.2.6 of NFPA 99 for the installers standing pressure test. This test pressure may be interpreted as the maximum allowable working pressure (MAWP) although code does not clearly define it as such. This test pressure or MAWP establishes a practical limit on system pressure increase without needing to retest the piping system.

(3) Medical Air compressors are required by Section 5.1.3.6.3.2 of NFPA 99 to include a pressure relief valve set at 50 percent above the line pressure (e.g. 75 psi for standard system pressure). Medical air equipment dewpoint monitor, control and alarm accuracy may be impacted by the higher supply pressure as these devices are calibrated at the standard 50 (379 kPa) to 55 psi (379 kPa) line pressure.

(4) Line pressure regulators are required by NFPA 99 to be in an N+1 configuration with each sized for 100 percent of the peak calculated demand in accordance with Section 5.1.3.5.5 of NFPA 99 at the operating pressure. Therefore, depending on the nominal manifold selection, there may not be spare capacity in any single line pressure

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regulator to achieve a higher flow at a higher line pressure. A temporary increase in capacity may be obtained by activating both line pressure regulators simultaneously. Use of this approach should be carefully sized and not utilized for normal operation as the 100 percent redundancy requirement may no longer be met. While opening the second line pressure regulator may be a temporary emergency option a better approach would be to provide a third regulator that could be opened in the event additional capacity is needed.

(5) Alarms are required to activate at 20 percent above normal operating pressure [e.g. 66 psi (455 kPa) for a 55 psi (379 kPa) system]. These will most likely need to be adjusted for the temporary operating condition in order to maintain the safety device. However, many are factory set and cannot be adjusted.

(6) Component ratings throughout the system must be evaluated for limiting ratings (e.g. demand checks, gauges, sensors, boom hoses, manufactured assemblies etc.). Some devices have minimum ratings established by code and others by the manufacturer. For example, minimum burst pressure for hoses and flexible connections is 1000 psi (6895 kPa) in accordance with NFPA 99. Manufacturer component ratings vary but some examples include: Amico inlets/outlet complete with latch-valve assembly are rated at a maximum operating pressure of 100 psi (689 kPa) except for Nitrogen/Instrument Air DISS assemblies which are rated at 200 psi (1379 kPa).

(7) Medical equipment ratings. Assess operational limitations on medical equipment utilized. Examples include: Thorpe tube flowmeters (rotameters) are typically calibrated at an operating pressure of 50 psig (379 kPa). Higher pressures will result in meter error, inaccurate dosing or possible shutdown of the medical devices served. Manufacturers also produce flow meters calibrated for 60 psi (413 kPa) however, a system temporarily operating at a line pressure of 65 psi (448 kPa) may have outlets seeing anywhere from 65 psi (448 kPa) (nearest outlet to the source) to 50 psi (379 kPa) (most remote outlet) under an emergency demand scenario. This would result in uncertainty of the gas delivery with potential patient risk. This patient risk must be carefully considered. Respiratory equipment which blends medical gases is designed and calibrated around use of standard design pressures. Non-standard pressures or unequal supply pressures could impact the dosing mixture, cause bleed-through or cause a safety shut-down of the equipment. Clinical input including a comprehensive evaluation of all respiratory equipment in use is critical in such decisions.

(8) Labelling requirements for nonstandard system pressures shall include special labelling of alarm panels in accordance with Section 5.1.11.4 NFPA 99.

(9) Valving shall be in accordance with Section 5.1.11.2 of NFPA 99.

(10) Outlets shall be in accordance with Section 5.1.11.3 of NFPA 99.

T 104.7 Pressure Loss Charts for Oxygen and Medical Air at Selected Source Pressures

T 104.7.1 Oxygen Pressure loss charts for Type L. Pressure loss values shall be in accordance the following charts. [Medical Gas Resiliency: Manual of Recommended Practice]

[See supporting documentation on KAVI for Medical Air Piping Pressure Loss Data]

SUBSTANTIATION:

COVID-19 served as a wakeup call, revealing the limitations of conventional medical gas systems in meeting the demands associated with respiratory pandemics. In response to this urgent need for improved resiliency, the IAPMO Medical Gas Resiliency Group was formed, comprising medical gas industry and design professionals dedicated to offering guidance on designing systems that can effectively respond to and overcome future crises.

This appendix provides essential guidance on designing medical oxygen and medical air systems with higher pipeline pressures than traditionally employed. It addresses the practical implementation of elevated pressure capabilities, which proved instrumental during the COVID-19 pandemic in managing crisis level caseloads. By equipping medical gas systems with the capacity to operate under elevated pressures, healthcare facilities can enhance their ability to respond to surges in demand, ensuring the continuous and reliable delivery of critical gases.

This appendix shall serve as a guide in assessing medical gas flow rates associated with varying pressures. Since the COVID-19 pandemic, the medical gas piping systems were stretched to their limits resulting in insufficient flow.
rates and pressures at patient outlets, due in part to undersized lines for elevated flow rates. The pandemic required facilities to alter their medical gas pressures for medical air and oxygen. This document will assist you in evaluating the medical gas systems and flow rates for temporary operations at elevated pressures. For existing systems, this document provides guidance on how to determine the limitations of the line pressure increase and estimating the performance improvements using the pressure loss charts provided or by developing new charts. This document looks to provide additional concepts in using pressure regulators (refer to 2021 NFPA 99 5.1.3.5.7 in regard to multiple pressure requirements). Pressure regulators help to provide higher pressures in areas needing elevated pressure due to increased demand without having to increase pressure everywhere.

What this appendix is meant to be is a guide in performing medical gas assessments on existing medical gas systems and design considerations for medical gas systems that may function at pressures beyond traditional standards. This appendix aims to establish consistent principles for pressure loss and provides a framework for designers to systematically evaluate design documents and appraise both existing and new oxygen and medical air piping systems. The design guide offers recommendations and standards for designers when sizing medical gas piping for pressures exceeding the usual 55 psi and for preparing medical gas documentation. This document provides innovative engineering principles for optimal practices in creating oxygen and medical air piping systems capable of accommodating elevated pressures and flow rates within existing pipelines. It also aids in assessing the sizing of piping to support increased flow rates at non-standard pressures. This design guide identifies requirements and recommended design standards for ensuring safe and reliable oxygen and medical air pipe sizes at non-standard delivery pressures. Where this design guide doesn't restate a regulatory requirement, it reflects best practices on what constitutes the basis for designing a safe, reliable, and sustainable oxygen and medical air piping system. While establishing these standards, we attempted to balance the reduction of risk against the added cost to provide that reduced risk and the capacity of oxygen and medical air piping systems to handle anticipated flow rates at varying pressures. We also strive to share our collective experience to promote construction and operation of appropriate, safe and reliable oxygen and medical air piping systems. The goal is to assist the design engineer and designers build a project that will be safe and reliable now and into the future. We do this by asking questions, exploring risk versus available resources in the design phase, and helping oxygen and medical air piping system owners and design engineers identify potential consequences of operational failure. Design engineers need to know what we think are appropriate design standards, but they also need flexibility to approach the unique design circumstances they face. We encourage design engineers to consider various alternatives and options, as long as the selected approach does not conflict with regulation. If the designer's selected approach differs from these guidelines, we expect the design engineer to justify their design decisions.

Background.
Healthcare Facility Pandemic Reactions. The COVID-19 pandemic can be seen to have three phases with regards to the reactions from facilities management. In the first phase, the medical people believed that intubation ventilation would be necessary for every patient. That would have impacted medical air, vacuum and oxygen demand as well as requiring space that facilities did not have. In this time, the unlikeliest of companies prepared to manufacture ventilators, convention centers were configured as COVID wards, and other preparations were made to support that worst case assumption. In the second phase, it was discovered that intubation was the wrong approach clinically, and instead a variety of techniques based on CPAP and BIPAP practices proved to be more effective. These were almost entirely oxygen based, with little to no impact on other systems. However, they demanded quantities of oxygen which were inconceivable in the past. The impact on facilities managers was dramatic, as they had to discover ways to obtain, vaporize and convey through the piping massive quantities of oxygen into parts of their facilities which had never been designed to handle these flows. In the developed world, gas suppliers responded well, and there was relatively little concern over obtaining the liquid or gas itself.

The Vaporizers.
Keeping the vaporizer’s ice free and therefore able to convert the liquid to gas was a widespread and major challenge.
The Piping.
The pipes in the building were never sized with this kind of flow rate in mind, and therefore facilities found that they struggled to maintain pressures at peak flows. We are now in the third phase. COVID is endemic, and we must all expect to contract the disease at some time and possibly repeatedly. But vaccination has reduced the severity of the disease for most who contract it, and therefore the number of patients requiring the heroic respiratory support which was so challenging during the first two phases is much reduced. Another issue to be aware of, is with ventilators and the effects of lower oxygen pressure compared to the medical air pressure being used on the ventilator. If the oxygen pressure falls below a certain pressure compared to the medical air, the patient may go into low O2 stats alarm and the ventilator will start to use medical air or room air to compensate which will cause patient to go into alarm. So the crisis may be past, but the question now becomes how to ensure we are not unprepared for surges and conceivably by the next pandemic? In large, that question is outside the scope of this document, but one tool used successfully during the worst of the pandemic and which will always be worth understanding is the simple expedient of raising the pressure at the source. More pressure, more flow through the same piping. While there are issues with doing this and limits on how far one can take it, it proved to be a way to overcome some of the limitations of existing piping for facilities where the piping was otherwise inadequate. As designers and medical professionals consider what flow rates they want to use in designing their systems, this document provides the tool necessary for implementing those designs. In addition, it provides the data for standard pressures and for somewhat elevated pressures should that be needed in determining what might be possible in the event of unexpected demand.

Foundational Equations and Assumptions.
The pressure loss charts were developed utilizing the Darcy-Weisbach formula in combination with the Moody Diagrams (found in Crane Fluid Handling Technical Paper No. 410).

The Moody Diagram provides a method to obtain the friction factor as a function of the Reynolds number without the need for iterative calculations. The Moody Diagram was curve-fit to a set of equations in order to easily calculate each point. The output data in the pressure loss charts is almost exclusively in the turbulent flow region ensuring accurate results except for limited values at the top of each column (representing the lowest velocities) that enter the critical flow regime (Reynolds numbers below 4000).

However, the pressure drop per 100ft for these entries is extremely low (0.02 psi/100 ft or less) which makes the impact of the inaccuracy insignificant in the overall calculation (typically 5 psi total pressure loss). All calculations are based on a uniform definition of Standard Temperature and Pressure (68 Deg F and 14.7 psia respectively). Pipe dimensions are based on ASTM B819 Type L copper with a surface roughness (e) = 0.000005.

Gas properties are applied to each table (specific gravity of air is 1.0 and specific gravity of oxygen is 1.1). Table values are limited to a pressure drop of 10% of the supply pressure (gauge pressure) or less. This is based on the published limitation of Darcy-Weisbach. For example, the 65 psig Oxygen chart cuts off any pressure drop values that exceed 6.5 psi.

Developing Charts.
There are several industry standard pressure loss charts available for standard system pressures and pipe sizes, however, most do not provide the calculation assumption in order to validate or extrapolate for other conditions. Also, most sources only provide data for Type L copper which may not address all field conditions as some jurisdictions mandate Type K copper which has a reduced internal diameter. This reduced internal diameter can have a significant impact on the pressure drop for smaller pipe sizes if not considered in the design.

For example, if Type L copper charts are inadvertently used, the pressure drop error introduced for pipes sizes in the range of ½ inch to 1-½ inch can be 25% or more. The pressure drop error gradually reduces as the pipes sizes get larger (e.g. less than 10% error for sizes over 2 inch) and insignificant for 6-inch pipe. If there is a need to create additional tables or calculations, the Darcy-Weisbach equations represent the most accurate engineering approach.
The Darcy-Weisbach equation is empirically based. However, it can be difficult to utilize due to the potential need to iterate to get the friction factor. Alternatives such as the Moody diagram or Colebrook equations can avoid the need for iteration.
APPENDIX U

Guidance for the use of Concentrator Plant with Centrally Piped Medical Oxygen Systems

U 101.0 Concentrator Plant with Centrally Piped Medical Oxygen Systems.
U 101.1 General. This appendix material offers comprehensive guidance and considerations for the utilization of oxygen concentrators in various configurations within centrally piped medical oxygen systems.

U 102.0 Reference Publications.
U 102.1 General. The following reference documents are supporting documents for this appendix:
NFPA 99, Healthcare Facilities Code – 2021 (NFPA)

U 103.0 Definitions and Abbreviations.
U 103.1 General. For the purpose of this appendix, the following definitions shall apply:
Accepted Engineering Practice. That which conforms to technical or scientific-based principles, tests, or standards that are accepted by the engineering profession.
Central Supply System. The entirety of the components comprising the oxygen source on the source side of the Source Valve. Required components for various configurations of Central Supply Systems are detailed in the Medical Gas Standards Ceramic Ion transfer Membrane (MCOG). MCOG systems disassociate O2 into oxygen ions, transfer those ions across a selective membrane, and return them to O2. The nature of the process is such that these concentrators produce essentially 100 percent oxygen. MCOG systems were under development at the time of writing, and may become commercially available during the life of this Guidance.
Concentrator. The device which actually performs the separation of oxygen from air typically using a zeolite molecular sieve and one of: Pressure Swing Adsorption (PSA), Vacuum Swing Adsorption (VSA), or Pressure-Vacuum Swing Adsorption (PVSA) (see Annex). However, the definition is not technology restrictive and any device which can produce the concentration and purity required by the pharmacopeia might be included.
Concentrator Plant. A source of supply, based on concentrator technology, connected to a piped oxygen distribution network in a medical facility. Depending on context, this may be a full Concentrator based Central Supply System or a single Concentrator based Supply Source.
Main. The principal artery of a system of continuous piping to which branches may be connected.
Medical Gas Standards. Depending on the locality(ies) in which the User is based, the standard(s) in use may vary (see the reference standards list) and may involve standards other than the medical gas systems technical standard. The locally relevant standards should be consulted when using this Guidance.
Pressure. The normal force exerted by a homogeneous liquid or gas, per unit of area, on the wall of the container.
Pressure-Vacuum Swing Adsorption (VPSA). VPSA systems apply pressurized gas to the separation process and also apply a vacuum to the purge gas. VPSA systems, like one of the portable oxygen concentrators, are among the most efficient systems measured on custom industry indices, such as recovery (product gas out/product gas in) and productivity (product gas out/mass of sieve material). Generally, higher recovery leads to a smaller compressor, blower, or other compressed gas or vacuum source and lower power consumption. Higher productivity leads to smaller sieve beds.
Pressure Swing Adsorption (PSA). A technique used to separate some gas species from a mixture of gases (typically air) under pressure according to the species' molecular characteristics and affinity for an adsorbent material. It operates at near-ambient temperature and significantly differs from the cryogenic distillation commonly used to separate gases. Selective adsorbent materials (e.g., zeolites, aka molecular sieves, activated carbon, etc.) are used as trapping material, preferentially adsorbing the target gas species at high pressure. The process then swings to low pressure to desorb the adsorbed gas.

Supply Source. A collection of components necessary to control, monitor and supply oxygen, whether from a liquid container, cylinder(s) or cylinder header(s) or a concentrator. Required components are detailed in the Medical Gas Standards.

Source Valve. The control valve on the patient side of all components of the Central Supply System which shuts off flow from the Central Supply System to the distribution piping.

Terminal. The attachment point and valve, located on the wall, ceiling or other device where the user will connect their clinical equipment and access the oxygen supply. Terminals are always gas specific to prevent misconnection. The keying systems are detailed in the Medical Gas Standards.

User. A trained medical professional capable of administering medical gases to a patient, assessing the condition of that patient, and adjusting the administration of the gases in response.

Vacuum Swing Adsorption (VSA). Segregates certain gases from a gaseous mixture at near ambient pressure; the process then swings to a vacuum to regenerate the adsorbent material. VSA differs from other PSA techniques because it operates at near-ambient temperatures and pressures. VSA typically draws the gas through the separation process with a vacuum. For oxygen and nitrogen VSA systems, the vacuum is typically generated by a blower.

U 104.0 Use of Concentrator Plant with Centrally Piped Medical Oxygen Systems.

U 104.1 Scope. This appendix shall provide guidance and considerations for the usage of Oxygen concentrators in various configurations. While detailed in nature, this guide shall not be used without first referring to your local codes and standards (including all applicable pharmacopia requirements). The designer shall consent from facility's clinical teams as well as following good engineering practices. This guide shall not be considered absolute or exhaustive in any means or methods. Considerations shall not be limited to devices and configuration. The designer shall consider all applicable pharmacopia requirements for their location and the capabilities, limitations, and policies of the facility's clinical operations department. An essential result of that global experience has been to focus attention on concentrator plants as a tool for ensuring oxygen access. The following specifics shall be considered:

U 104.1.1 Concentrator plants as primary Central Supply Systems. Access to oxygen produced by air separation. COVID made it clear that even where liquid oxygen is plentiful there are situations when oxygen may not be deliverable from those air separation plants in time or in sufficient quantity. Therefore, on site production under the facility's control merits careful consideration.

U 104.1.2 Concentrator plants as supplements to other primary central supply systems (liquid or cylinder based). This has been contemplated and attempted where facilities already had normally sized and fully functional liquid or cylinder systems in place but struggled with the capacity of those systems during the crisis. These struggles included (as examples):
1) Inadequate stored volume and therefore high frequency cylinder changes or storage vessel fills.
2) Throughput or an inability of the existing supply to flow sufficient gas into the piping system.
3) Lack of any backup or reserve supply - the entire capacity of the installed Central Supply System was needed just to keep up, so if any failure should occur the facility would simply be unable to respond.
4) Supply chain disruption or unreliable supply.

A Concentrator Plant shall be a viable way to resolve many of these concerns both by providing additional supply and as a way of having capacity on standby.

U 104.1.3 Concentrator Plants as the primary Central Supply System, supplemented by liquid or cylinder supplies. A properly designed Concentrator Central Supply System is always provided with the capability to employ this strategy with no change to the base installation. As Concentrator Plants have a fixed output, a surge in oxygen requirements as occurred during COVID could easily overwhelm the Concentrator Plant’s capacity. Where facilities are able to obtain liquid or cylinder supplies, those can provide a quick and effective way to boost capacity immediately, which can continue through an indefinite time, thereby avoiding the capital investment for additional concentrator plant which may not be usable after the crisis is passed. This strategy was also considered by facilities with some access to cylinders, but who found them to be too expensive, too labor intensive, unreliable, or too subject to supply chain interruption to be used as the primary supply.

This appendix shall be considered as guidance to assist in understanding how these systems may be implemented while ensuring safety both for patients and facilities maintenance personnel working with the systems.
U 104.2 Applicability. This appendix shall provide the basics necessary for understanding and applying this guidance.

U 104.2.1 The Pharmacopeia. The clinical value of Concentrators is recognized in both the U.S. Pharmacopeia and the European Pharmacopeia, and by World Health Organization's International Pharmacopeia. All include monographs that specifically address zeolite based Concentrator oxygen as "Oxygen 93". The older monograph, "Oxygen" or "Oxygen 99" is designed for oxygen from air separation by liquefaction. The difference results from the fact that the zeolite molecular sieve is also quite effective at concentrating the trace Argon in the air. Argon is nontoxic and inert, and has been shown to present no clinical concerns, but it does reduce the concentration of oxygen in the final product gas. It is essential to understand that these monographs are production standards, defining the quality of the product as it emerges from the production process (the outlet of the Concentrator Supply Source or the air liquefaction plant). In the pipeline and at the Terminal, the gas administered to the patient is the responsibility of the User. A moment's thought, and you will appreciate why this is true - every patient must be dosed as an individual, and therefore the concentration they are given of a specific drug must be the subject of a user's understanding of the clinical need subject to monitoring the patient's condition. The two monographs are summarized below. In general, Concentrators are designed to meet the production standard for Oxygen 93, air separation will meet Oxygen 99.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Oxygen</th>
<th>Oxygen 93</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assay (O2)</td>
<td>$\geq 99%$</td>
<td>90-96%</td>
</tr>
<tr>
<td>Balance</td>
<td>na</td>
<td>argon ($\approx 5%$) and nitrogen</td>
</tr>
<tr>
<td>Odor</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>CO2</td>
<td>0.03%</td>
<td>0.03%</td>
</tr>
<tr>
<td>CO</td>
<td>0.001%</td>
<td>0.001%</td>
</tr>
<tr>
<td>USP is used for this comparison</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that the monographs are the same with the exception of the concentration of oxygen in the gas. Therefore, they are not different gases, they are different concentrations of the same gas. The analogy would be aspirin 60 mg versus aspirin 100 mg. Both aspirin, same clinical indications. There are legal jurisdictions which do not recognize this and treat these two as if they were entirely separate drugs. The analogy would be aspirin and acetaminophen (paracetamol). Different chemical compounds entirely, different clinical indications. However much separating the two may ignore the clinical realities (ref. Annex on Clinical References), where that pharmacologic limitation exists you may not be able to use much of this guidance because you may not be permitted to mix the two concentrations. Most relevant to you in this Guidance will be the section entitled Concentrators as Central Supply Systems and the Annexes. Everything that follows in this Guidance is based on this essential understanding.

U 104.2.2 Clinical Equipment. It is known that some manufacturers of medical equipment (anesthesia workstations, ventilators, etc.) have designed their equipment on the assumption that the oxygen from a wall outlet was 99+ percent and thus could be used as an internal machine reference. While this has always been a questionable assumption, when zeolite based Concentrator oxygen is used, it naturally becomes entirely invalid. Oxygen concentration from an ordinary zeolite based Concentrators can and will vary during normal operation. While this has been demonstrated to mean little to the patient, it can be of the first importance with the clinical apparatus. This problem is a limited one, as only some equipment has this problem. It is also obvious from the experiences of many Users that it has not proven much of an obstacle to the use of Concentrators. However, until this is fully addressed by the medical device manufacturers, Users of oxygen 93 must choose their equipment with this in mind and may need to obtain calibration gases with known values to ensure certain clinical apparatus and flowmeters be accurately calibrated. This subject is outside of the scope of this Guidance, but this concern should be noted, and the medical staff should always be aware when a Concentrator is used as an oxygen supply. Otherwise, when Concentrators are employed, the usual guidelines that would be expected of any clinical situation are sufficient. Patient SaO2 (blood saturation) should be monitored and the FiO2 (fraction inspired oxygen) of the inspired gas adjusted as required to titrate the desired SaO2. It is always inappropriate to base any respiratory treatments on FiO2 alone.
U 104.2.3 Compliance with Existing Medical Gas Standards. The Medical Gas Standards deal with the basic requirements for any piped medical gas system. These usually deal with essentials such as basic safety and qualifications, sizing, operation both in normal circumstances and in single fault, the cascade from primary to secondary to reserve Supply Source(s) within the Central Supply System, installation requirements, monitoring, maintenance, and other concerns. Anyone using this Guidance document should first verify that their current Central Supply System is in compliance with their Medical Gas Standards before considering any of the concepts discussed here. Much of what we will discuss here will not be found in any Medical Gas Standard, rather it will be covered under the clauses which are intended to allow for alternative methods and technologies (e.g., NFPA 99 2021 clause 1.4, CSA Z 7396-1 2017 Preface and Annex O, ISO 7396-1 2016 clause 4.2). Applying the concepts in this Guidance will require understanding of the rules in your Medical Gas Standards so as to apply these concepts within those rules where possible, and safely in every case. The reader should understand the alternative methods and technologies allowances in their Medical Gas Standards and also know any procedures needed to obtain any required authorizations under these exceptions from their local regulatory authorities. Any Concentrator employed in any centrally piped medical gas system must be a complete Supply Source as per the relevant technical Medical Gas Standard, including all operating safety elements, installation considerations, location, power supply, monitoring, and alarms, etc. (ref. Annex II). This Guidance expects in all cases that only compliant Supply Sources will be employed in implementing any suggestions herein. It should also be considered that the optimal application of a concentrator system is to maintain continual operation. Increasing and decreasing the output of a concentrator is acceptable but cycling it on and off will not provide optimal performance and may negatively impact the equipment's lifespan. Once a concentrator is cycled off it can take some time when turning it back on to achieve acceptable concentration.

U 105.0 Common Elements and Control Techniques.

U 105.1 Control techniques. The most essential starting point for any of the methods discussed herein is how one intends to control the available sources. This includes how and when they will stop and start, how their output (both pressure and volume) will be managed, and the consequences of blending them. The first essential is to understand the method in use on the Central Supply System to be supplemented. It may be possible to link the Supplementing Supply Source into that control mechanism, but it is more likely to be necessary or desirable to replace the mechanism with another better suited to the new setup. Three controls techniques can be considered: Pressure control, Flow control and Concentration control. U 105.1.1 Pressure control. will set a target pressure and will place regulators in position to ensure that the set pressure is maintained. As the pressure falls (e.g. as one source begins to be overdrawn) the regulators on the supplemental source will open, admitting gas from the supplemental source to the line. (See Fig U 105.1.)
In Fig U 105.1 the system pressure is maintained by the Final Line Regulator and the three Supply Sources are controlled by a regulator on each Supply Source controlling against an intermediate pressure (IP). As the system demand increases, the intermediate pressure will fall, so that first source A, then the Supplemental Source, then Source B comes on line to feed the system. The graph shows a two source Central Supply System with Supply Sources A and B being supplemented by a smaller Supplemental Source.

Pressure control in some cases can also be achieved with electronic controls such as variable speed controlled on pressure or start-stop machines controlled on pressure. In all methods, the basic idea is the same: each source is set at a different output pressure and comes on line when that pressure cannot be maintained by the preceding source(s). The limitation with pressure control is that it cannot ensure that all sources are used proportionately. This can be problematic with cryogenic liquid sources where the normal evaporation of the liquid must be used or lost and with concentrators which must be operated to maintain readiness. More complex controls will need to be added to this basic scheme to ensure these additional concerns are addressed.

U 105.1.2 Flow control is primarily intended to ensure proportionate use of all Supply Sources. The basic principle is to meter the total demand, and then to supply a preset proportion of that demand from each of the available sources. (See Fig U 105.1)
In Fig 105.1.2 each Supply Source is fitted with a flow controller and flowmeter, to control the output from that specific Supply Source. The system is also fitted with a flowmeter to monitor the total flow.

As the demand increases on the system overall, each of the Supply Source flow controllers opens to allow a metered portion of the total requirement to flow from that Supply Source into the system. This output is monitored by the flowmeter for that Supply Source. Flow control will allow each source to operate at a level preset by the operator for that demand. In the example, Supply A is a liquid source, the Supplemental Supply Source is a concentrator and Supply Source B is a cylinder header. At very low flows, the flow controller first activates the Liquid Source (A) to account for evaporation. Because concentrators do not like to start and stop, the system continues to draw from the Supply Source A until the demand is sufficient high to operate the concentrator efficiently, at which point it actually reduces the flow from the Liquid Supply Source back to the evaporative rate and ramps up the concentrator in the Supplemental Source. When the Supplemental Source reaches full capacity, the controller begins to any draw additional requirements from Source A. Only when both Source A and the Supplemental Source are at full capacity, does the controller begin to draw from Source B, the cylinder supply. Across the demand curve, the flow from each Supply Source can thus be tuned to keep all the sources running optimally. The disadvantage of flow control is that it is complex and adds a number of relatively expensive components to the system. Setup requires expertise in the devices and in the required programming of the computer or PLC which will manage the flow controllers.

U 105.1.3 Concentration control, is the most complex, but offers all the advantages of flow control while adding the additional benefit of being able to actually increase the total output of the system. Here, the control will be set to manage the flow from each Supply Source as with flow control but with the additional element of control over the final oxygen concentration as well. Concentrator sources are typically rated at 93 or 95% concentration. However, the pharmacopoeial requirements allow for a concentration between 96 and 90%. The volume output increase from the concentrator at lower concentrations can be significant (10% or more). Therefore, running the concentrator at the lowest allowed concentration can improve total gas availability from the overall Central Supply system. Clinicians also sometimes find that variability of the concentration
undesirable, particularly in facilities treating very small neonates. Concentration control offers a way to stabilize that output concentration as well.

In Fig U 105.1.3 the Supplemental (Concentrator) Supply Source is fitted with a flow controller to control the output. This flow controller is driven from the concentration monitor and operated in a manner which will hold the concentration just at 90%, thereby optimizing the output from the Concentrator source.

The other Supply Sources may have concentration monitors, or they may be assumed to be 99%. Their flow controllers will meter a portion of the total requirement to compensate for the lower concentration from the Supplemental Supply Source, or may simply operate as in the Flow Control example above (in the graphic here the various complex effects of the flow control are removed to emphasize only the result of concentration control). The controls are metering the flow from the sources to ensure the final concentration is maintained at whatever set point the facility has determined. They will draw first from the Supplemental Supply Source, and mix as needed gas from Supply Source A to maintain the flow at the concentration decided. There will come a point in this configuration where the concentration control can no longer operate, and that is of course when the concentrator is producing maximum output. Beyond that point, the concentration will inevitably rise as the additional load is drawn entirely off the other (99% concentration) sources. Note that all of this is dependent on the concentration chosen. A higher concentration will naturally draw more from the higher concentration source, and less from the low concentration source, greatly changing the shape of the graph, and there are limits to how much the concentration can be "boosted" from a low concentration source. The disadvantage of concentration control is of course the additional complexity and setup involved. However, many concentrators use concentration control as their standard method to manage the process internal to the concentrator itself. The example is a basic idea of what concentration control can achieve. It is possible to take this further, and actually run the concentrator below 90%, compensating with the high concentration gas from the other sources to produce the desired final concentration. Note that doing that greatly complicates the regulatory problems with the Central Supply System and should not be undertaken without detailed understanding of the operation of the system, close operator...
supervision, and appropriate regulatory approvals. The figures illustrate these control strategies applied by adding a single concentrator supply source as supplement to an existing two source Central Supply System (e.g. NFPA type). They could also be applied in the same manner to a three source Central Supply System (ISO Type). There is also the possibility of using Flow control and/or concentration control to operate multiple supplemental sources, thus achieving additional capacity or load balancing multiple sources to manage very wide swings in demand.

U 106.0 Configurations and Operations.

U 106.1 Concentrators as standalone Central Supply Systems. The essentials for using Concentrators as Central Supply Systems will be the rules defined by your Medical Gas Standards. There is therefore no need for this Guidance to review this option.

U 106.2 Concentrators used to supplement liquid or cylinder based Central Supply Systems. The goal of using a Concentrator to supplement an existing liquid or cylinder based Central Supply system might be: To increase the total quantity of oxygen available, typically because at peak flows the current source cannot keep up. This is probably the result of exceeding the full capacity of the existing Central Supply System equipment. To provide a backup source when the current Central Supply System can keep up, but it must draw from the secondary or reserve supply to do so, which leaves the facility no resort in the event of any failure. This may be on a short to medium term basis, or a permanent installation for emergency preparedness.

U 106.2.1 Configuring a system; First, ensure that your existing Central Supply System is compliant with your Medical Gas Standards.

U 106.2.2 Sizing. The sizing of a concentrator source for use in supplementing an existing Central Supply System will naturally come down to the degree of supplementation required. However, the capacities of the two systems types are typically sized differently. To have a clear understanding of how one will interact with the other, these need to be reconciled. The primary constraint on a liquid supply or cylinder manifold generally arises from the total volume of gas available in the containers or cylinders. The analogy would be the size of a battery. Sizing is largely an exercise in determining how big to make the “battery” (how many cylinders, how big a liquid container). In liquid and cylinder sources, before other output problems will generally appear, the number of cylinders being changed or times the liquid container is being refilled is what will come to the operator's attention. As an example, a properly sized manifold with 10 cylinders on a side will typically experience a long-term average draw rate of perhaps 600 liters per hour (lph). Thus, 10 cylinders, one side of the manifold, will be changed once a week, which will take perhaps 10 minutes per cylinder, so the whole exchange will require about an hour and a half’s effort. If the draw rate doubles to 1,200 lph, then the same 10 cylinders will now need attention roughly twice a week, or three hours labor weekly. The output (flow) capability of even a relatively poor manifold is typically well over 20,000 liters per hour, and a good one can flow better than three times this (90-95,000 lph). Therefore, before the manifold’s maximum draw rate has even been approached, the manager is going to notice the inconvenience of the extra cylinder changes. By the time the manifold cannot manage the flow, the changing of cylinders will have to be continuous, as a bank of 10 cylinders would last as little as 40 minutes. By comparison, a concentrator's primary constraint is the output. A concentrator rated for 1,000 lph cannot be expected to produce 1,001 lph. This “hard limit” means that the rated output is all that will be available for supplementation.

U 106.2.3 Operation and Maintenance. Operation and maintenance should be conducted and followed based on the concentrators manufactures requirements. Disclaimer: Always follow manufacturer’s recommendations and adhere to the local authority having jurisdiction.

U 106.3 Liquid or Cylinder Supply Sources used to supplement Concentrator Based Central Supply Systems. Concentrators have a defined output, determined by the Medical Gas Standards and the requirement to maintain the pharmacopeia's production quality. It is very possible in a crisis for the draw on the Concentrator to reach this limit. The typical goal of supplementing a Concentrator Central Supply System from liquid or cylinders Supply system would be to increase the total quantity of oxygen available to the distribution pipeline. The disadvantage of the system is that when there is an emergency demand surge for a large system, it will require large capacity of supplemental source(s). Having a liquid bulk tank system on standby is not practical nor economical, having a large number of cylinders will not be practical either. An emergency oxygen trailer connected to EOSC would be a suitable option.

U 106.3.1 Configuring a system. First, ensure that your existing Central Supply System is compliant with your Medical Gas Standards.

U 106.3.2 Sizing. Recommended procedures include the following:

1. Obtain historic consumption data from the facility and clinical teams. We recommend consumption data collected from 1 to 5 years, including descriptions of any abnormal usage, leading to sudden increase in consumption.
2. Determine required system capacity based on historic peak flow, balanced with cylinder storage.
3. Obtain consent with the clinical team of the sizing.
(4) Provide N+1 units for minimum redundancy. It is highly recommended to provide redundant 2N concentrator systems.

(5) Provide separate oxygen cylinder storage room with proper fire rating per code.

It is prudent to provide bottle-filling unit, to provide additional buffer/storage as well as for portable O2 use. Although it is not a code requirement, it is highly recommended to provide EOSC (Emergency Oxygen Supply Connection) with parking space for emergency oxygen trailer and oxygen fill truck access at building exterior nearby, so the facility has more flexibility to handle sudden O2 demand surge.

U 106.3.3 Operation and Maintenance. Regular routine maintenance is critical to maintain the optimal operation condition of the concentrator system.

Disclaimer: Always follow manufacturer's recommendations and adhere to the local authority having jurisdiction.

107.0 Typical Components for Concentrator Supply Source Types.

107.1 Typical Components of a Pressure Swing Adsorption (PSA) Concentrator Supply Source

(Components shown are typical arrangements - other arrangements are possible. NFPA 99 was used for reference)

<table>
<thead>
<tr>
<th>A</th>
<th>Inlet filter</th>
<th>J</th>
<th>Sample and purge port</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Compressor</td>
<td>K</td>
<td>Oxygen receiver</td>
</tr>
<tr>
<td>C</td>
<td>Aftercooler</td>
<td>L</td>
<td>Final filter (0.01 μ)</td>
</tr>
<tr>
<td>D</td>
<td>Refrigerated Air dryer</td>
<td>M</td>
<td>Vent valve (optionally automatic)</td>
</tr>
<tr>
<td>E</td>
<td>Dew point monitor (optional)</td>
<td>N</td>
<td>Automatic Concentrator isolation valve</td>
</tr>
<tr>
<td>F</td>
<td>Filter</td>
<td>O</td>
<td>Pressure gauge</td>
</tr>
<tr>
<td>G</td>
<td>Air receiver</td>
<td>P</td>
<td>Flow control (optional)</td>
</tr>
<tr>
<td>H</td>
<td>Concentrator</td>
<td>Q</td>
<td>Outlet pressure regulator (optional)</td>
</tr>
<tr>
<td>I</td>
<td>Oxygen concentration monitor</td>
<td>R</td>
<td>Manual Supply Source isolation valve</td>
</tr>
</tbody>
</table>

Available Alarm Connections:

Low Oxygen Concentration (<91%) Supply Source Disconnected (Valve “N” Closed)

U 107.2 Typical Components of a Vacuum Swing Adsorption (VSA) Concentrator Supply Source
COVID-19 served as a wakeup call, revealing the limitations of conventional medical gas systems in meeting the demands associated with respiratory pandemics. In response to this urgent need for improved resiliency, the IAPMO Medical Gas Resiliency Group was formed, comprising medical gas industry and design professionals dedicated to offering guidance on designing systems that can effectively respond to and overcome future crises.

Oxygen concentrator plants have long been recognized as a viable option for central supply systems in healthcare facilities worldwide. However, the global impact of the COVID19 pandemic exposed certain issues related to oxygen supply that were previously underestimated or overlooked. In response to these challenges, this appendix aims to provide assistance to healthcare facilities in managing the valuable lessons learned from recent experiences around the world. This appendix material offers comprehensive guidance and considerations for the utilization of oxygen concentrators in various configurations within centrally piped medical oxygen systems.

Oxygen Concentrator Plants have been in medical use for decades. Worldwide they are accepted as a viable option for Central Supply Systems. Rules for their safe application are found in all of the world's major standards, and the requirements for the quality of the product gas are contained in the major pharmacopeia. The COVID-19 pandemic exposed several issues...
with oxygen supply worldwide, many of which were previously considered to be problems only of underdevelopment. These problems have been widely detailed elsewhere and need not be reviewed here. This Guidance attempts to provide assistance to facilities attempting to manage the important learnings from recent experience around the world. While detailed in nature, it is essential to consult local codes and standards, including applicable pharmacopeia requirements, as well as seek consent from the facility's clinical teams and adhere to good engineering practices. This appendix does not provide absolute or exhaustive means and methods but serves as a valuable resource for facilities to consider and navigate the complexities associated with incorporating oxygen concentrators, ensuring compliance with pharmacopeia requirements, and aligning with the capabilities, limitations, and policies of the facility's clinical operations department.
APPENDIX V
CONSTRUCTION PRACTICES FOR POTABLE WATER

V 101.0 General.

V 101.1 Scope. This appendix shall provide guidance on risk management practices specific to potable and non-potable water supply systems, during new building construction, expansion, renovation, and replacement projects.

V 101.2 Applicability. This appendix shall be applicable to the building water utilized during the various stages of construction in accordance with potable water systems. The potable water systems covered in this appendix includes, but is not limited to the following:

1. The incoming water supply or supplies
2. Alternative water supplies (e.g., onsite wells/groundwater, rainwater collection, onsite reuse/reclaimed water)
3. Water processing steps (e.g., softening, filtration)
4. Domestic cold water
5. Domestic hot water
6. Utility water systems (e.g., chillers/heat exchangers)

V 101.3 Building Types. This appendix shall be applicable to the following building types:

1. Non-residential (low- and high-rise)
   a. Office
   b. Commercial Retail
   c. Institutions
   d. Hospitality
   e. Public Assembly
   f. Industrial and manufacturing
   g. Healthcare
2. Residential
   a. Multiunit residential
   b. All except single family residence
3. Mixed use
   a. Multiunit residential
   b. Other Non-residential

V 102.0 Pre-Construction Design Criteria.

V 102.1 Design Considerations. Plumbing system design is an important part of the overall Legionellosis risk management process and the design of plumbing systems impacts water quality and water quality management over the lifespan of the system as well as during construction. Other important parts and players in the overall management of water quality and risks such as legionellosis are the water supply, practices used during construction and installation, and operations during beneficial occupancy (Figure V 102.1). Some elements of design such as inclusion of flushing points used during construction and building commissioning relate to construction practices, while others do not. Plumbing system design has a lasting impact on water quality and water quality management over the beneficial use lifespan of the system and on water quality and water quality management during construction.
Design aspects directly related to water quality and water quality management during construction include but are not limited to:

1. Location and type of flushing points in system design
2. Pipe sizing to ensure target scouring velocities can be met during flushing
3. Ensuring access in the system for critical water quality measurements and verification

V 102.2 Basic Design Features Related to Installation and Construction.

1. Temporary connections with associated drainage
2. Permanent connections with associated drainage
3. Alternate means for testing
4. Cross-connection control concerns
5. Flushing points that are used during construction
6. Water quality measurement locations
7. Phasing considerations
8. Construction Water Uses

V 102.3 Pre-Construction Design Criteria. Plumbing and mechanical plumbing systems are dynamic systems with ever-changing water quality profiles. The impact on water quality and water safety from construction and commissioning activities have resulted in cases and outbreaks of Legionellosis after beneficial occupancy. Water quality management needs to be an active process where the water management team is anticipating risk management needs prior to construction and commissioning activities and responding to changes in water quality and water safety. The initial step should be to review and confirm the water system design with the engineer/designer, contractor, installers, and the owner/operator. This should include a review of this guideline, and responsibilities and expectations during construction and at substantial completion (i.e., beneficial occupancy) confirmed. For existing buildings, initial water quality data should be reviewed if available and documented to compare with subsequent measurements. The minimum water quality data should include the disinfectant residual, the temperature (hot and cold water), and total heterotrophic aerobic bacteria (THAB) from water systems in the construction space. As risk is defined as the probability and severity of an event occurring, the owner should assess the complexity and size of the construction project and determine the types of persons (e.g., elderly, immunocompromised) who may be exposed.

V 102.4 Utility Coordination. Waterborne disease risk management is the responsibility of design professionals, construction professionals, and professionals operating water systems and public water systems. Prior to construction, the plumbing design professional should coordinate with the water-supplier (typically a regulated community water system [CWS], but sometimes a regulated Non-Transient Non-Community Water System [NTNCWS]) to determine the water system supply water quality characteristics. As water quality impacts both construction and normal operation of the building, having this information early is vital.

V 102.5 Water Quality and Water Safety Considerations. This section describes water quality and water safety parameters that should be considered prior to and during construction and renovation activities. A more complete review of water quality and characteristics is presented in Annex A.

V 102.6 Water temperature. Legionella grows rapidly between 68-113 °F (45° C). To maintain water temperatures outside the optimal growth range for Legionella, heat transfer to cold water systems should be minimized. Hot water system operations shall be delayed until necessary and the temperature within the hot water system must be maintained to compensate for heat loss. Maintenance personnel should monitor cold and hot water temperatures at critical control locations to confirm water management controls are effective. Because temperature is an important factor affecting microbial growth in building plumbing, all buildings should accurately measure and record water temperatures throughout construction and renovation. Within water management programs, temperature data are used to evaluate plumbing water age by identifying system components that may support the growth of pathogenic organisms and to develop strategies for control of pathogen growth. Temperatures should be evaluated in both cold-water and hot water systems.
systems. This is to identify potential sources of environmental heat gain in the cold water system and to maintain hot water control limits.

V 102.7 Water Stagnation. Prior to construction activities, the water management team should determine the locations or water systems that may be impacted due to construction activities including locations where water is not flowing or restricted from use. This determination should be used to identify strategies to reduce water age and prevent excessive water stagnation such as by means of manual flushing by personnel or by installation of automatic flushing strategies in accordance with the water management program. Because disinfectant must be present consistently to maintain biological control and because disinfectants decay, water must be turned over (refreshed) regularly to bring fresh disinfectant through the distribution system. Because plumbing components do not behave as “ideal” reactors, turning over the water in a given component requires up to five times the volume of water in the component. When water is not drawn through a plumbing system or other building water system over an extended period of time, the water becomes stagnant. During periods of stagnation, disinfectants decay, which results in accelerated growth of many harmful microorganisms, such as *Legionella*. Other impacts of stagnation are loss of corrosion control, release of metals into potable water, and tepid temperatures, all of which support the growth of *Legionella* and other environmental pathogens. Pathogens that survive and grow in the building water environment are typically opportunistic pathogens that pose greater risks to the elderly and immunosuppressed populations.

V 102.8 Disinfectant Residuals. Disinfectant in the water from the water purveyor impacts building water systems in multiple ways. A basic understanding of disinfectants and microbial control can promote informed decisions during construction through the reopener process into normal operation, as well as in flushing and pre-occupancy disinfection procedures. The disinfectant in a building’s water supply is intended as a bacteriostatic agent (preservative) not a primary disinfectant. As a bacteriostatic agent, the disinfectant creates conditions adverse to organisms (including pathogens like *Legionella*) that can grow in biofilms on pipe, fitting, and fixture surfaces. Because the disinfectant is a bacteriostatic agent, it does not need to be consistently present at concentrations as high as needed for pre-occupancy disinfection or for remediation, but it does need to be present consistently and it needs to penetrate biofilms and have contact with unwanted organisms. Ideally, disinfection is part of a multi-barrier approach to biological control and used in concert with other activities and controls such as flushing and temperature management.

Free chlorine and monochloramine (ammonia added to chlorine) are the most common secondary disinfectants in domestic water systems. Both free chlorine and monochloramine decay over time, chloramines at a slower rate than free chlorine. However, nitration (a condition associated with certain organisms that use ammonia as an energy source) can rapidly deplete monochloramine and is common in water distribution networks with a monochloramine disinfectant. Chlorine can produce a greater reduction in the concentration of planktonic bacteria with lower concentrations and contact times than monochloramine whereas monochloramine penetrates biofilm more readily than free chlorine. The minimum disinfectant residual concentration that public water systems are required to maintain to the distal ends of their distribution systems varies by state. Some states maintain different minimum disinfectant residual requirements for free chlorine and monochloramine and might also require higher minimum disinfectant residual requirements if the pH is high or based on other water quality characteristics. A 2017 study of disinfectant concentration measurements in public water systems assessed that disinfectant residual measurements above 0.2 mg/L indicate an effective disinfectant is present, whereas lower concentrations might arise from interference with commonly-used disinfectant measurement protocols and devices. Because disinfectant residual is an important factor affecting microbial control in building plumbing, all buildings should accurately measure and record disinfectant residuals and use this data to manage plumbing water age.

Disinfectant residual concentrations should be measured in both cold-water and hot water systems, as disinfectant levels in hot water are more difficult to maintain but shall consider the following recommendations:

1. All building water systems should have an accurate digital chlorine residual test kit that uses an EPA-approved test method for use in drinking water compliance. (See chlorine residual testing standard operating procedure – Annex).
2. Building owners should contact their water provider and find out whether they practice ‘free chlorination’ or ‘chloramination’.
3. Building owners should measure free chlorine if the utility disinfects using free chlorine.
4. Building owners should measure total chlorine if the utility disinfects using chloramine.

A low cost chlorine test should be practiced from the start of construction with testing throughout the duration for safety and detailed history, made part of the water management plan.

V 102.9 Suspended Solids. Sediment in the water has an impact on plumbing systems as it can clog strainers and cause ball valves to seize. Sediment can increase during periods of stagnation due to the oxidizing disinfectants corroding the metallic piping as the water is stagnant. It also has an impact on the microbiology and disinfectant of the building as sediment can:

1. Reduce the residual disinfectant by consuming the disinfectant.
2. Provide a food source for bacteria, as sediment can and will provide a carbon source of various quantities to support microbiological life; and
3. Shield bacteria from disinfection as the pathogens can attach themselves to sediment. The sediment can then carry the pathogen into an area in the building where water quality conditions are ideal for its’ growth.

Although there are laboratory and field methods for measuring suspended solids in water, visual inspection of water is an important means of early detection of suspended solids and related water quality problems. Turbid (cloudy) water, water with color and water with visible sediments are all causes for concern and should trigger follow-up measures including investigation of the cause of the sediments or color and mitigation (e.g., via high velocity flushing or implementation of corrosion control).

V 102.10 Legionella Considerations. Microbiological test results including *Legionella* spp. provides a measure of water safety. *Legionella* spp. is a genus of naturally occurring environmental bacteria (i.e., bacteria that can survive in certain environmental niches and that do not need to be inside a host to replicate) that thrive in stagnant and recirculated waters between 20 °C and 45 °C (68 °F and 113 °F). Not all species of *Legionella* bacteria are known to cause human infection and, in the United States, the majority of identified legionellosis cases have been associated with the species *Legionella pneumophila*. Because *Legionella* is a leading cause of waterborne disease outbreaks and cases, many water management programs (WMPs) focus on *Legionella* management, though WMPs, if developed as intended, can and should address other contaminants, both chemical hazards and other microbial species. Water samples for *Legionella* analysis should be analyzed by a culture method by an accredited laboratory, or other laboratory approved by the AHJ where *Legionella* culture appears on the laboratory's scope of accreditation. Results from the samples collected should be interpreted using the CDC’s assessment tool (Figure 104.3.5). Note that only results from culture assays are referenced in the CDC’s tool; results from other assays (e.g., qPCR) are fundamentally different from those from culture assays and should be used in concert with culture samples to confirm the presence/absence of viable *Legionella*.

V 102.11 Water Treatment Types.

V 102.11.1 Supplemental Disinfection Systems. If the building has supplemental disinfection of any type, the building owner or their designated operator
must monitor and record treatment operational parameters daily that the treatment operates. Every water supplemental disinfection system presents a risk
to building users from overfeeding of chemicals or by contamination of byproducts from disinfectant loss of treatment and control of microbes. Building
owners and operators should routinely inspect the treatment system for proper working order (chemical concentrations if adding chemicals) and be able
to adjust the treatment when needed. Continuous monitoring is an appropriate frequency for validation of supplemental disinfection systems.

V 102.11.2 Additional Treatment Types. Water softeners, reverse osmosis filtration systems, carbon filters, copper-silver ionization disinfection systems
and other additional treatment systems are frequently deployed in building water systems and must be installed and operated according to manufacturer
specifications and per code requirements. Treatment systems can impact water quality in multiple ways, and systems should be designed and operated to
ensure all water quality objectives are met. For example, over-softening can generate corrosive water and carbon filtration can remove disinfectant and
interfere with *Legionella* risk management. Installation and filling of additional treatment should be delayed until necessary, to avoid stagnant conditions,
growth of biofilm on treatment system media and other phenomena that can degrade water quality. Prior to installation, treatment apparitions should
be stored in a sanitary manner and intake and discharge ports should be capped or wrapped.

V 102.12 Water Quality Data Tracking and Evaluation. The purpose of testing water quality parameters is to obtain data to help a building owner not only
better manage building water systems but also to provide documentation as part of a legal defense. All building water sampling efforts should have an
electronic spreadsheet for entering results. Store all monitoring information to comply with all state and federal regulations. Consult legal counsel to
determine statute of limitations for jurisdiction and store data and relevant documentation until at least that point in time.

V 102.13 Water Management Minimum Design Needs, by Building Type. Building intended use and anticipated occupancy are related to the level of water
quality management required during both construction and during the building service life. Categories of buildings with different water management
requirements are presented in Table V 102.13. Water management activities recommended by building category are presented in Table V 102.13.

**TABLE V 102.13**

**WATER MANAGEMENT MINIMUM DESIGN NEEDS, BY BUILDING TYPE**

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| A        | Buildings with low likelihood of human exposure to aerosols such as:  
           - Single-family residences, duplexes, town homes and other small residential buildings |
| B        | Buildings with low/moderate likelihood of human exposure to aerosols such as:  
           - Commercial buildings without showering facilities  
           - Retail buildings  
           - Warehouses, server farms and other low occupancy buildings with low incidence of occupant exposure to aerosolized potable water |
| C        | Buildings with moderate likelihood of human exposure to aerosols with sensitive occupants/users (excludes healthcare) such as:  
           - Institutions, schools, and childcare facilities  
           - Hotels and resorts  
           - Gyms and Recreational facilities  
           - Large office buildings |
| D        | Buildings with high likelihood of human exposure to aerosols including healthcare facilities with sensitive occupants/users such as:  
           - Senior facilities (e.g., assisted living)  
           - Nursing and rehabilitation facilities  
           - All other health care facilities including those providing out-patient care |

Note: Buildings in categories C and D have specific water quality management requirements that must be considered in water system design.
All buildings of categories C and D should be disinfected per governing code and their designs must include disinfectant injection ports and sample ports
for drawing water samples for measuring disinfectant concentration. Disinfectant injection points should be designed such that they are not functional
dead legs when not in use. Disinfection injection points can also be used during beneficial occupancy if the system design includes supplemental
disinfection post-occupancy. Long-term supplemental disinfection often triggers environmental regulatory requirements under the Safe Drinking
Water Act and should be fully considered before it is added to a system.

**TABLE V 102.14**

**RECOMMENDED WATER MANAGEMENT CRITERIA, BY BUILDING TYPE**

<table>
<thead>
<tr>
<th>BUILDING TYPE</th>
<th>FLUSHING POINTS</th>
<th>SAMPLING POINTS</th>
<th>TEMPERATURE AND FLOW</th>
<th>WATER QUALITY HAZARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Drinking fountains</td>
<td>Temp Range: max allowed per AHJ</td>
<td>Dissolved inorganics (lead, copper)</td>
<td></td>
</tr>
<tr>
<td>BUILDING TYPE</td>
<td>FLUSHING POINTS</td>
<td>SAMPLING POINTS</td>
<td>TEMPERATURE AND FLOW</td>
<td>WATER QUALITY HAZARDS</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Healthcare (D)</td>
<td>Strategic locations closest to riser, distal locations, flushed at a rate/frequency required to simulate occupancy</td>
<td>Accessible distal locations, Distal points, (sink, shower, ice machine)</td>
<td>Temp Range: max allowed per AHJ</td>
<td>Disinfection by-products (DBP)</td>
</tr>
<tr>
<td></td>
<td>Drinking fountains</td>
<td>Accessible distal locations, Distal points, (sink, shower, ice machine)</td>
<td>Flow: Continuous</td>
<td>Dissolved inorganics (e.g., lead, copper)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Designated valves</td>
<td>As required by AHJ</td>
<td>Legionella pneumophila</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Implement construction-specific validation responses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(e.g., flushing, disinfection)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Implement construction-specific validation responses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(e.g., flushing, disinfection)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Provide and install injection points for preoccupancy disinfection or as required by the Authority Having Jurisdiction</td>
</tr>
<tr>
<td>Hospitality (C)</td>
<td>Strategic locations closest to riser, distal locations, flushed at a rate/frequency required to simulate occupancy</td>
<td>Accessible distal locations, Distal points, (sink, shower, ice machine)</td>
<td>Temp Range: max allowed per AHJ</td>
<td>Dissolved inorganics (e.g., lead, copper)</td>
</tr>
<tr>
<td></td>
<td>Drinking fountains</td>
<td>Accessible distal locations, Distal points, (sink, shower, ice machine)</td>
<td>Flow: Continuous</td>
<td>Legionella pneumophila</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Designated valves</td>
<td>As required by AHJ</td>
<td>Implement construction-specific validation responses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(e.g., flushing, disinfection)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Implement construction-specific validation responses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(e.g., flushing, disinfection)</td>
</tr>
<tr>
<td>Commercial (B)</td>
<td>All public use locations (sinks, drinking fountains, drink stations, ice machines)</td>
<td>Accessible Distal Outlets, Designated valves, As required by AHJ</td>
<td>Temp Range: max allowed per AHJ</td>
<td>Dissolved inorganics (e.g., lead, copper)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flow: Continuous</td>
<td>Legionella pneumophila</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>As required by AHJ</td>
<td>Implement construction-specific validation responses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(e.g., flushing, disinfection)</td>
</tr>
</tbody>
</table>
Water is used for many purposes during construction. The impacts of those uses on water quality during and post-construction need to be addressed in planning and scooping, and during construction activities. Contaminants that can be or have been introduced during construction include sediment and debris, chemical contaminants (e.g., disinfection byproducts, inorganics), and waterborne pathogens, the presence of which should be minimized and kept independent from the potable water system, through means of an approved cross connection device. Cross connection prevention devices should be installed prior to use of water systems to prevent the ingress of debris, chemical contaminants, and waterborne pathogens. In many cases, required flow rates and frequency of use for construction water uses are significantly different from those during beneficial occupancy. The differences between water use during construction and after beneficial occupancy require system design elements to accommodate construction water uses and practices that reduce the likelihood of contamination of the water system during construction and that promote worker safety and safety of nearby building occupants during construction.

Common construction water uses are listed and reviewed in Table V 103.1.1. Water used during construction may be supplied by temporary connections to the water supply or to a segment of the building water system that is already connected and active. In both of these cases, backflow prevention should be practiced and may be required by code. Temporary connections can sometimes be left in place after construction and can pose water quality...
challenges because they are stagnant, oversized, or otherwise interfere with the turnover of water in the plumbing system. Temporary supplies can also have different drainage requirements than the post-construction plumbing system and drainage that can accommodate construction wastewater must be available prior to use of temporary supplies.

### Table V 103.1.1

<table>
<thead>
<tr>
<th>CONSTRUCTION USE FOR POTABLE WATER</th>
<th>CROSS CONNECTION CONTROL METHODS, DEVICES AND ASSEMBLIES</th>
<th>POTENTIAL IMPACTS ON WATER QUALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary construction toilet facilities <em>(Bathrooms, pantry, etc.)</em></td>
<td>All faucet types shall have an airgap ASME A112.1.2 between the spout and bowl. Spout shall be without hose threads. Airgap ASME A112.1.2 on faucets any temporary piping shall be of approved materials for potable water. If supplied by a hose, the hose shall be composed of ANSI/NSF 61 certified material. The hose shall not supply water to any other non-potable outlet.</td>
<td>Connections to drinking water or hydration stations must be onto a commissioned and disinfected potable water system that is maintained under a building water management plan. Characteristics list: Infrequent turnover of water Water in unconditioned spaces Exposed piping to the elements Dead legs if temporary and unused piping not removed.</td>
</tr>
<tr>
<td>Drinking water (hydration stations)</td>
<td>If supplied by continuous pressure it shall be protected by an ASSE 1056, ASSE 1020, or an ASSE 1013 certified vacuum breaker. All backflow prevention devices shall be installed per the applicable standards and local codes. Labeled &quot;non-potable, do not drink&quot; downstream of the assembly. If supplied by a non-continuous hose supplied by an ASSE 1019, ASSE 1011, or ASSE 1052 Hose bib, labeled &quot;non-potable, do not drink&quot; downstream.</td>
<td>Characteristics list: Infrequent turnover of water Water in unconditioned spaces Exposed piping to the elements Dead legs if temporary and unused piping not removed.</td>
</tr>
<tr>
<td>Material mixing <em>(Cement, grout, etc.)</em></td>
<td>If supplied by continuous pressure it shall be protected by an ASSE 1056, ASSE 1020, or an ASSE 1013 certified vacuum breaker. All installations shall be per the standards and local codes. Labeled &quot;non-potable, do not drink&quot; downstream of the assembly. If supplied by a non-continuous hose supplied by an ASSE 1019, ASSE 1011, or ASSE 1052 Hose bib, labeled &quot;non-potable, do not drink&quot; downstream. If supplied by non-continuous pressure downstream of an ASSE 1001 pipe applied vacuum breaker. If supplied by non-continuous pressure Airgap (ASME A112.1.2) or an Airgap fitting (ASME A112.1.3).</td>
<td>Characteristics list: Infrequent turnover of water Water in unconditioned spaces Exposed piping to the elements Dead legs if temporary and unused piping not removed.</td>
</tr>
<tr>
<td>Washdown <em>(Dust-suppression, hydro-demolition, power washing)</em></td>
<td>If supplied by continuous pressure it shall be protected by an ASSE 1056, ASSE 1020, or an ASSE 1013 certified vacuum breaker. All installations shall be per the standards and local codes. Labeled &quot;non-potable, do not drink&quot; downstream of the assembly. If supplied by a non-continuous hose supplied by an ASSE 1019, ASSE 1011, or ASSE 1052 Hose bib, labeled &quot;non-potable, do not drink&quot; downstream. If supplied by non-continuous pressure downstream of an ASSE 1001 pipe applied vacuum breaker. If supplied by non-continuous pressure Airgap (ASME A112.1.2) or an Airgap fitting (ASME A112.1.3).</td>
<td>Characteristics list: Infrequent turnover of water Water in unconditioned spaces Exposed piping to the elements Dead legs if temporary and unused piping not removed.</td>
</tr>
<tr>
<td>Construction equipment with reservoirs <em>(Cutting, paving, tankers)</em></td>
<td>ASSE 1013 labeled &quot;non-potable, do not drink&quot; downstream of the assembly.</td>
<td>Characteristics list: Infrequent turnover of water (Needs approval from local Fire Dept and Municipality to connect)</td>
</tr>
<tr>
<td>Interim Fire Hydrant building water supply</td>
<td>ASSE 1019, ASSE 1011, or ASSE 1052, labeled &quot;non-potable, do not drink&quot; downstream.</td>
<td>Characteristics list: Infrequent turnover of water Infrequent turnover of water</td>
</tr>
<tr>
<td>Hose Bibbs, yard hydrants and other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Any temporary hoses used for potable drinking or handwashing shall be maintained not to have additional non-potable connections to them. Unmanaged plumbing systems with building water supply connections may pose a hazard and contaminate the water system and/or supply. This will pose a health risk to construction workers and future occupants. All of the construction water uses described in Table V 103.1.1 pose potential backflow risks.

### V 103.2 Pressure Testing Impacts on Water Quality

Pressure testing can be conducted with water, air, or dry nitrogen purging. Air and nitrogen testing allow delay of filling the system and have water quality and water conservation benefits. When pressure testing is conducted with water, the system must be filled with potable water; water for pressure testing must be from a regulated water supplier or a regulated and tested community water system (if self-supplied). Tests to ensure water quality is fit for purpose include visual inspection of water clarity, confirmation that there is no unusual odor to the water.
(beyond the smell of disinfectant), disinfectant concentration, and pH. Other tests that should be considered are total coliforms (an indicator of sewage contamination) and HPC (if high, an indication of poorly controlled biological water quality). Total coliform and HPC tests must be conducted by a certified laboratory and may require more than 24 hours to produce a result. Water should be considered unsuitable for human consumption if water quality samples are positive for total coliforms or if water samples have HPC > 500 / mL. Pressure testing with water should be conducted according to manufacturer testing considerations and methods.

V 103.3 Alternative to Using the Permanent Water System for Construction Water. Alternatives to using the permanent potable water system during extensive construction or renovation projects should be considered. Use of alternative systems can postpone filling the permanent system, can prevent the oversizing of pipes to accommodate higher than normal construction water flows that can be higher than those during normal operation and can promote water conservation. Temporary systems should be isolated from the permanent system via backflow prevention devices and should be labeled “temporary use.” When construction is completed, branches to temporary piping should be removed and capped to avoid the creation of dead legs.

V 103.4 Pre-Installation Material Management. Prior to installation, plumbing materials should be stored in a manner that protects them from contamination. Sanitary storage and handling of pipes and distribution system components is a common requirement for contractors for installation of new mains for drinking water systems and has been demonstrated to reduce the likelihood of contamination after installation and the effort required to disinfect new mains before they are put into service. The same benefits can be expected from sanitary storage of building water system plumbing materials.

V 103.5 Practices to Prevent Contamination Onsite. Practices to prevent contamination during storage and pre-installation shall include but are not limited to the following best practices:

1. Capping or wrapping pipe, valves, and other plumbing material;
2. Capping or sealing the intake, discharge, and drain ports of water heaters and other water treatment devices such as water softeners;
3. Storing plumbing system components in well-drained areas with low likelihood of water accumulation; and
4. Avoiding long-term on-site storage of plumbing components prior to installation.

V 103.5.1 Flushing Activity purposes. Flushing is conducted for at least three purposes during construction of building water systems. The three types of flushing, their objectives and characteristics of the flushing protocols are presented in Table V 103.5.1.

<table>
<thead>
<tr>
<th>TABLE V 105.5.1</th>
<th>FLUSHING ACTIVITY PURPOSES, OBJECTIVES AND CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLUSHING TYPE</td>
<td>PURPOSES</td>
</tr>
<tr>
<td>Initial flushing (Prior to system filling and before disinfection)</td>
<td>(1) Removes debris, construction residuals, and environmental contaminants introduced into plumbing components during storage and installation</td>
</tr>
<tr>
<td>Routine flushing (After the system is filled and before disinfection)</td>
<td>(1) Simulate occupancy by replacing old water with new water with disinfectant and maintain temperature outside the growth range of environmental pathogens (2) Remove loose biofilm and organisms that accumulated during stagnation</td>
</tr>
<tr>
<td>Supplemental Flushing (After the system is filled and event based)</td>
<td>(1) Remove water with high disinfectant concentration (2) Remove detached and degraded biofilm and other materials generated during disinfection</td>
</tr>
</tbody>
</table>

V 105.5.2 Flushing Target Velocity and Duration. Dedicated flushing points and plumbing fixtures used for flushing branches should be sized to generate a velocity of at least 5 fps in as much of the system as feasible and no less than 2.5 fps throughout the system. Required flows to achieve 5 fps and 2.5 fps velocities for different pipe sizes are provided in Table V 105.5.2. This table reinforces the need for dedicated flushing points and sufficient drainage, particularly for flushing large diameter pipes. Note that flushing points must also have drains that can accommodate the required flow.

<table>
<thead>
<tr>
<th>TABLE V 105.5.2</th>
<th>FLOWS TO ACHIEVE 5 FPS VELOCITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIPE NOMINAL</td>
<td>PEX</td>
</tr>
</tbody>
</table>

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V 105.5.2 Water Volume / Flushing Duration Calc. Due to hydraulics and mixing in pipes and fittings, flushing a single pipe volume of water does not reliably remove contaminants from the pipe. A minimum of 4-5 pipe volumes must be flushed at the target velocity to achieve a high level of contaminant removal. Table 104.5.3 provides the volume in five pipe volumes of water and the flushing time required at 5 gpm for 10 linear feet of pipe of various diameter.

**TABLE V 105.5.3**

<table>
<thead>
<tr>
<th>PIPE NOMINAL DIAMETER (INCHES)</th>
<th>PEX</th>
<th>COPPER TYPE L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VOL. TO FLUSH TO COMPLETELY TURN OVER 5 VOLUMES FOR 10 FT OF LINEAR PIPE</td>
<td>5 GPM (SEC)</td>
</tr>
<tr>
<td></td>
<td>VOLUME IN 10 FT OF LINEAR PIPE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GAL</td>
<td></td>
</tr>
<tr>
<td>⅜</td>
<td>0.36</td>
<td>0.26</td>
</tr>
<tr>
<td>⅝</td>
<td>0.485</td>
<td>0.48</td>
</tr>
<tr>
<td>⅞</td>
<td>0.681</td>
<td>0.95</td>
</tr>
<tr>
<td>1</td>
<td>0.875</td>
<td>1.56</td>
</tr>
<tr>
<td>1½</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

V 105.6 Water Quality Testing. Generally, water quality monitoring should be conducted as specified by ANSI/ASHRAE 188 and the CDC report “Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings.” Because those resources provide only general recommendations and requirements for monitoring and because those documents address only operational buildings, additional recommendations specific to water quality monitoring during construction are presented below.

V 105.6.1 Water Quality Parameters. Water quality data can be found in water supplier water quality reports (consumer confidence reports). These parameters can be measured at key milestones during construction and compared to data in the consumer confidence report. Measurements that should be collected, documented, and analyzed include, but are not limited to the following:

1. Disinfectant residual type
2. Disinfectant residual concentration
3. Water temperature
4. Water pressure
5. Flow rate
6. pH and
7. *Legionella* concentration (for building types C and D).

Process control parameter measurement (e.g., disinfectant concentration, water temperature and pH) should be made for each *Legionella* sample collected. Analysis of this data allows better interpretation of *Legionella* results and assessment of whether *Legionella* are well controlled. Measurements that can also be made, documented, and analyzed shall include the following:
A construction water management program that is administered by a designated authority and with responsibilities of all parties clearly delineated.

the shared responsibility of multiple parties, potable water system construction and commissioning should be under the governance of an overarching and subcontractors such as consultants specializing in commissioning and pre-occupancy disinfection. Because protecting the potable water system is commissioned in stages) and require the coordination of multiple parties such as design engineers, prime contractors, plumbing professionals, and risk management and testing activities. A simplified timeline for construction-related potable system is commissioned in stages) and require the coordination of multiple parties such as design engineers, prime contractors, plumbing professionals, and risk management and testing activities. A simplified timeline for construction-related potable water quality. The construction schedule should include the analytical testing events that are necessary to monitor water quality and water safety activities. The facility should develop and maintain a construction project schedule to identify the risk management activities and key milestones that are available at faucet that use may see. First draw samples often have no disinfectant residual due to decay and demand during stagnation. First draw samples can have much higher microbiological concentrations than flushed samples.

V 105.6.5.2 Long-Draw Flush. Determine distance into water main or branch inside building that results are desired for. Calculate the time needed to flush (volume of water based on pipe size, divide by flow rate of fixture) in order to obtain water from that portion. Flush for three to five times longer than that time, and then collect sample. Long-draw will give a better indication of the water quality in the water main. The longer the flush before the draw, the further upstream in the piping system the test results will describe.

V 106.0 Construction Project Scope, Schedule & Testing. V 106.1 Construction Schedule to Minimize Risk and Conserve Water. By following the requirements described in Section V 107, the building owner should be able to demonstrate acceptable potable and non-potable water quality upon beneficial occupancy and that assessments of the water system were carried out to prevent unintended consequences from construction-related activities. The facility should develop and maintain a construction project schedule to identify the risk management activities and key milestones that impact water quality. The construction schedule should include the analytical testing events that are necessary to monitor water quality and water safety up until the first date of operations. All phases of a construction or renovation project should be addressed in the schedule with the determination of risk (e.g., extensive renovation, sensitive exposed population) and risk management and testing activities. A simplified timeline for construction-related potable water systems activities is shown in Figure V 106.1. For complex installations, the five phases shown in Figure V 106.1 frequently overlap (e.g., when a system is commissioned in stages) and require the coordination of multiple parties such as design engineers, prime contractors, plumbing professionals, and subcontractors such as consultants specializing in commissioning and pre-occupancy disinfection. Because protecting the potable water system is the shared responsibility of multiple parties, potable water system construction and commissioning should be under the governance of an overarching construction water management program that is administered by a designated authority and with responsibilities of all parties clearly delineated.
Each of the phases shown in Figure V 106.1 can be designed and executed to protect the potable water system from contamination and reduce the likelihood that potable water systems begin their service life contaminated. Construction potable water system management is similar to water management during normal operation with the addition of several activities that address hazards or hazardous conditions that are present during construction but not normal operation. Construction potable water system activities that can contribute to water quality control both during construction and after beneficial occupancy are listed in Table V 106.1. A fundamental aspect of this appendix is that all of these activities are a part of water management during construction. At present, there is a misplaced conception that disinfection alone is sufficient for ensuring a potable water system is ready for beneficial occupancy. The reality is that many potable water systems that were designed and installed by conscientious professionals and disinfected according to requirements in place at the time have entered their service life contaminated, resulting in avoidable illnesses and expenses to the building owner. Although addressing water quality management during all of the potable water system construction activities is not a guarantee that all systems will be contamination free at beneficial occupancy, it does represent the highest standard of care possible during construction and will reduce the likelihood of contamination.

### TABLE V 106.1

<table>
<thead>
<tr>
<th>POTABLE WATER SYSTEM CONSTRUCTION ACTIVITY</th>
<th>GENERAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-construction supply water assessment and design for maintaining water quality</td>
<td>The water quality of the future potable water system supply is tested and results are used to determine controls required during construction. System design includes features related to water quality management such as dedicated flushing points and associated drainage. Certified plumbing materials and designs are chosen to be compatible with the water supply characteristics.</td>
</tr>
<tr>
<td>Construction water uses</td>
<td>Construction water uses that impact the potable water system are documented and designed to ensure non-potable water does not enter the potable water system and that construction water components do not present a residual risk when construction is completed, and construction water plumbing is disconnected.</td>
</tr>
<tr>
<td>Transport, storage and handling of plumbing equipment</td>
<td>Plumbing materials are transported, stored, and handled to minimize the risk that contaminants are present. Contaminants present in the system can be hazardous, can reduce the effectiveness of disinfectants in the water and can present conditions for biofilm growth and water quality degradation.</td>
</tr>
<tr>
<td>Charging (filling) the potable water system</td>
<td>Only potable water is used to charge the system. Practices are in place to ensure a sanitary connection to the water supply. If the water quality of the supply does not meet specifications, supplemental treatment may be required. Pressure testing is conducted to minimize the likelihood that contaminants are introduced. After connection, flushing is conducted to eliminate</td>
</tr>
</tbody>
</table>
### POTABLE WATER SYSTEM CONSTRUCTION ACTIVITY

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debris and contaminants present in the system prior to installation and debris and contaminants introduced during installation.</td>
</tr>
<tr>
<td>Staging Construction of the water system is staged to reduce the possibility of contamination between filling and disinfection, to the extent feasible. For example, downstream system components are not connected to active parts of the system until necessary.</td>
</tr>
<tr>
<td>Preventing non-potable water from entering the potable water system Backflow prevention and cross connection control activities are in place, monitored and documented.</td>
</tr>
<tr>
<td>Potable water system management between filling and disinfection Potable water system management between filling and disinfection is similar to water management during normal operation and is governed by a water management program that requires a system assessment, implementation of water quality controls, regular turnover of water throughout the connected system and monitoring of both the controls and the biological water quality.</td>
</tr>
<tr>
<td>Pre-occupancy disinfection and commissioning The potable water system is disinfected according to standards. Disinfection requires pre- and post-disinfection flushing, maintaining a target disinfectant residual throughout the system for a specified duration and monitoring to ensure that the target disinfectant concentration and contact duration are met.</td>
</tr>
</tbody>
</table>

#### V 106.2 Construction Risk Assessment

- Conducting risk assessments prior to and during construction and renovation projects allows the facility to establish and maintain potable and non-potable water of acceptable quality. The risk assessment should be reviewed once the water system is operational and include the risk determination based on the extensiveness of the project and the areas in which people may be exposed. The construction risk assessment is overseen by the construction water steward (section 107.3.1) and the steward and water management team should consult the following in developing and reviewing the risk assessment:
  1. Architectural composite floor plans
  2. As-built drawings
  3. Historical water quality data, if available
  4. Commissioning requirements for plumbing systems
  5. Water management programs, if programs have been developed for post-occupancy or if the project is a major renovation of a building with an operational water management program.

### V 106.2.1 Developing a Risk Assessment

A risk assessment shall include the following:

1. Identification of the hazards, hazardous conditions, and hazardous locations potentially present on the construction site or within the water system.
2. Assigning a qualitative (high, medium, low) risk to the hazard or hazardous condition based on the likelihood of occurrence and severity of negative outcome associated with not controlling the risk.
3. Determining locations and conditions that require controls because they pose medium or high risks. The first step of the risk assessment is hazard identification. The water management team should identify and document the hazards, hazardous conditions, and locations where hazardous conditions could be present on the construction site and in the water system. The output of this process is a list of hazards that could be present in the absence of controls and a notated version of the process flow diagram identifying all control locations and conditions in the building water system under construction.

### V 106.2.2 Defining the Risk

The hazards of general concern for water systems include the following:

1. Environmental pathogens (pathogens that can grow in the plumbing system ecosystem). Based on their prevalence in water systems and their burden of disease, the most important environmental pathogens are Legionella, Pseudomonas aeruginosa, nontuberculous mycobacteria (NTM), and free-living amoebae (FLA). Although only some FLA species infect humans, many can harbor environmental pathogens such as Legionella and NTM. Given their importance as an agent of waterborne disease, Legionella are typically the only environmental pathogens specifically monitored and controlled in water systems. Other pathogens should be considered in the risk assessment for health care facilities or buildings intended to serve sensitive populations based on guidance in such standards as ANSI/ANSI/ASHRAE 514.
2. Fecal pathogens introduced to the system via non-potable water, intrusion of sewage, cross connections, backflow, poor system integrity etc. Fecal pathogens is a wide grouping of organisms that includes viruses, bacteria and protozoa. The diversity of fecal pathogens makes their direct measurement impractical and the potential for the presence of fecal contamination is usually inferred based on the presence/absence of indicator bacteria such as E. coli or fecal coliforms.
3. Toxic plumbing system construction residues such as solvents and compounds used for joining pipe.
4. Sediments and debris are present in plumbing materials prior to installation or introduced during installation.

### V 106.2.3 Common Hazards and Risks

A risk assessment is performed to determine whether hazardous conditions have adequate controls and, if not, what controls are required to protect water quality during water system construction. Table V 106.2.1 shows a framework for risk assessment for the most common hazardous conditions and locations likely to be present during water system construction. Alternative frameworks can be found in other reference documents on WSPs and WMPs. The risk associated with a given location or hazardous condition is assessed based on the likelihood of loss of control and the severity of the consequences if control is lost. The hazardous conditions of greatest concern and that are most common during construction of water systems include:
Plumbing system components with temperatures in the range 20-45 °C (68-113 °F)
Water ages greater than 1-3 days
Cold water system components with no disinfectant (if disinfection is the primary strategy for maintaining biological control)
Storage (including water heater tanks), particularly with incomplete turn-over of water, temperature in the Legionella growth range or with no disinfectant residual.
Showerheads and shower hoses that are used infrequently.
Connections to the potable water system with the potential for backflow
Unprotected storage of plumbing system components prior to installation.

### TABLE V 106.2.1
**HAZARD IDENTIFICATION AND RISK ASSESSMENT FRAMEWORK**

<table>
<thead>
<tr>
<th>Location</th>
<th>Potentially Hazardous Condition</th>
<th>Controls</th>
<th>Status</th>
<th>Likelihood of hazardous condition</th>
<th>Severity of potential consequence of hazardous condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter pit</td>
<td>Flooding and intrusion during low pressure transients</td>
<td>Periodic inspection; meter pit designed and built to promote drainage</td>
<td>Date of most recent inspection</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Service connection(s) (listed separately)</td>
<td>Low quality water enters the building water system</td>
<td>Water supply flushed prior to establishing service connection; supply water temperature, disinfectant concentration, pH and turbidity measured after supply is flushed; if water supply quality does not meet design criteria (e.g., disinfectant concentration ≥ 0.3 mg/L and no color or visible particles), supplemental treatment may be applied.</td>
<td>Date of service connection and results of water quality tests</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Service line(s)</td>
<td>High water age and low velocity if service line is oversized or sized for meeting both fire protection and potable water flows</td>
<td>Water fully exchanged in each service line a minimum of once per day; velocity during daily water exchange of at least 5 ft/s (1.5 m/s); service line flushing point with sufficient drainage designed into the system; where code allows, fire protection system separate from potable water system and service line right sized.</td>
<td>Service line flushing point noted on process flow diagram and log of flushing maintained.</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Storage tank(s), including storage water heaters</td>
<td>High water age</td>
<td>Cycling to maintain $T_{avg} &lt; 1.5$ days</td>
<td>Flushing log maintained</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Sediment accumulation</td>
<td>Periodic cleaning; at a minimum, during the initial water system flush and prior to final disinfection before occupancy</td>
<td>Date of most recent flush/cleanout</td>
<td>Medium</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Temperature in the range 22-42°C (72-108°F)</td>
<td>Monitoring; if low residual observed, increased flushing and/or supplemental treatment may be considered.</td>
<td>Monitoring results and dates of corrective actions</td>
<td>Medium</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Branches (each assessed individually)</td>
<td>Low disinfectant residual (daily average &lt; 0.3 mg/L)</td>
<td>Monitoring; if low residual observed, increased flushing and/or supplemental treatment may be considered.</td>
<td>Monitoring results and dates of corrective actions</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Fixtures</td>
<td>High water age and unmanaged biofilm growth</td>
<td>Fixtures not connected until required, particularly showerheads and hoses; connected fixtures flushed a minimum of once per day for health care facilities and facilities expected to serve</td>
<td>Fixture connection dates recorded</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

† Schedule of water exchange: if automated flushing, so noted.
susceptible populations and at least once per three days for all other water systems.

| Materials storage | Debris and environmental organisms in components prior to installation | Pipes and plumbing materials capped/sealed during storage; plumbing materials stored in a well-drained or protected area without the potential for water pooling | Storage SOP | Medium | Low

| Construction water connections to main system | Backflow and cross connections | Cross connection control program implemented and documented, and no connections made with potential for backflow (checks and air gaps) | Cross connection control program documented; inspections documented | Medium | High

Note: Recommendations are consistent with findings of recent research (Grimard-Conea, M, and Prévost, M., 2023. Controlling *Legionella pneumophila* in Showerheads: Combination of Remedial Intervention and Preventative Flushing. *Microorganisms* 11,1361 and with guidance for health care facilities. Because water systems are highly diverse and microbial growth in operational systems is not fully understood, water turn over recommendations should be reviewed by the water management team and, if circumstances require, flushing frequency should be increased. Conducting risk assessments prior to and during construction and renovation projects allows the facility to establish and maintain potable and non-potable water of acceptable quality. The risk assessment should be reviewed once the water system is operational and include the risk determination based on the extensiveness of the project and the areas in which people may be exposed.

V 106.3 Construction Project Schedule Development and Documentation. Key events and critical milestones for the construction/installation of new water systems and major renovations are presented in Table 106.3. With the exception of building types, A and B (small residential buildings and buildings with low likelihood of aerosol exposure for construction workers or future occupants), the events in Table 106.3 must be documented in the project’s construction water management program.

### TABLE V 106.3

**KEY EVENTS AND MILESTONES**

<table>
<thead>
<tr>
<th>KEY EVENT OR MILESTONE</th>
<th>DETAILS AND REQUIREMENTS</th>
</tr>
</thead>
</table>
| Service connection to water supply | 1. Water provider to determine schedule for connections in coordination with the construction project schedule and shall ensure adequate flushing in accordance with the Authority Having Jurisdiction.  
2. Document the following dates: Taps and connections, shutdowns and lockouts, flushing events prior to connection or any service interruptions. |
| Construction start date | 1. Document temporary water connection requirements and or permits in Water Management Plan/Program. (Such as hydrant connections).  
2. Document permanent water connection requirements and or permits in the Water Management Plan/Program. |
| Cold water activation start date | 1. Document first time the system is filled or charged  
a. Partial system activation dates  
2. Document adequate flushing  
a. Partial system flushing dates  
3. Document cross connection device testing reports  
4. Testing |
| Hot water system activation start date | 1. Document permanent start date (activation).  
2. Document temporary start date (activation).  
3. Document temperatures  
4. Equipment maintenance schedules |
| Piping system installation (cold, hot, sanitary, storm) | 1. Determine schedule to minimize the risk  
2. Inspection records  
3. Drainage scheduling for flushing availability  
4. Insulation  
5. Punch List  
6. AHJ inspections |
| Equipment installation (ice machines, etc.) | 1. All equipment start up documentation  
2. Procedures for health and safety |
| System purging (sediment and debris) | 1. Dry Nitrogen  
2. Strainers/equip |
| Flushing protocols (start and duration) | See Section 105.5 |
| Installation testing | 1. Pressure testing |
| Water quality testing | 1. Flushing  
2. Analytical water testing: Dates, Level/results |
| Disinfection | 1. Procedure and testing results documented |
**Beneficial occupancy (substantial completion)**

1. AHJ final inspections/certificate of occupancy

**Building owner transition to ongoing operations**

1. Utilities on and commissioned

**First day of business operations to public**

1. Actual occupancy

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**V 107.0 Water Management during Construction.** This section of the appendix specifies the activities that should be undertaken to manage potable water systems during construction and which activities should be undertaken, depending on the type of building, anticipated uses for the water system and anticipated population that will occupy the building post-construction. Many of the activities suggested in this section are already recommendations or requirements within water management frameworks such as ANSI/ASHRAE 188. The WHO's Water Safety Planning for Buildings, the CDC's Water Management Toolkit and VHA Directive 1061(1). Because some activities are relevant only during construction and not during normal occupancy, additional activities are specified beyond those of WMPs/WSPs for use during normal occupancy. Note: Additional activities beyond those of normal occupancy WMPs/WSPs are pointed out.

**V 107.1 Equipment Requirements.**

**V 107.1.1 Personal Protective Equipment (PPE).** Personnel that perform flushing shall utilize appropriate personal protective equipment (PPE) based on a task specific risk assessment and any OSHA requirements.

**V 107.1.2 Other Equipment Requirements.** The following equipment shall be required for plumbing system evaluation:

1. Appropriate sampling bottles/supplies for laboratory samples. Sample bottles for microbial parameters (HPC, Legionella and others) must be sterile and contain a disinfectant quenching agent.
2. A chlorine meter/test kit with an accuracy of +/- 3 percent.
3. A digital thermometer for measuring water temperature. Thermometers should be accurate to within +/- 2°F (+/- 1°C).
4. Tools for removing aerators and supply stop covers (check with the appropriate manufacturers)

Note: Additional equipment recommendations can include a digital camera, record book (for documentation), stopwatch, graduated measuring device (which, in combination with the stopwatch, can be used to estimate flowrates and calculate flush volumes) turbidimeter and pH probe.

**V 107.2 Overview of Water Management Activities.** Potable water system construction activities differ with building type and users. Some activities such as preventing cross connections and backflow and keeping non-potable water out of the potable water system at all times apply to all building types. Other activities such as Legionella monitoring differ with building type and the characteristics of future building occupants. For example, Legionella monitoring during construction is not recommended for single family residences, should be conducted for schools and should be more intensive for health care facilities. Construction activities for four classes of buildings are outlined in Table 107.2 and specific guidance on activities is provided in the subsequent sections of this chapter.

Note: This appendix addresses only potable water systems, including domestic hot water systems. Water quality concerns are not limited to potable water systems and plumbers and other construction personnel should refer to appropriate guidance to ensure water quality is managed during construction for other water assets such as cooling towers and fire protection systems.

### TABLE V 107.2

**CONSTRUCTION WATER ACTIVITIES AND SCOPE**

<table>
<thead>
<tr>
<th>What?</th>
<th>How? (Relevant sections)</th>
<th>Where?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop a formal construction water management program</td>
<td>106.2, 107.3</td>
<td>A1 b b</td>
</tr>
<tr>
<td>Sanitary storage and handling of plumbing system components</td>
<td>107.4</td>
<td>b b b b</td>
</tr>
<tr>
<td>Scoping and staging to limit contamination risk &amp; conserve water</td>
<td>106.1, 107.5</td>
<td>b b b b</td>
</tr>
<tr>
<td>Cross connection control and backflow prevention</td>
<td>107.6</td>
<td>b b b b</td>
</tr>
<tr>
<td>Filling the system</td>
<td>107.7</td>
<td>b b b b</td>
</tr>
<tr>
<td>Initial flush</td>
<td>107.8</td>
<td>b b b b</td>
</tr>
<tr>
<td>Water turn-over after filling and prior to disinfection</td>
<td>107.9</td>
<td>b b b b</td>
</tr>
<tr>
<td>Legionella and water quality monitoring (verification and validation)</td>
<td>107.10</td>
<td>b b b</td>
</tr>
<tr>
<td>Pre-occupancy disinfection and flushing</td>
<td>107.22</td>
<td>b b</td>
</tr>
</tbody>
</table>

1. Single-family residences, duplexes, town homes and other small residential buildings
2. Buildings with low likelihood of human exposure to aerosols. E.g.,
   - Commercial buildings without showering facilities, child care facilities or medical offices
   - Retail buildings
V 107.3 Develop a Water Management Program. (Building Categories B, C and D) As noted in Table 107.2, a formal construction water management program (WMP) is required for large buildings with a high likelihood that occupants will be exposed to aerosols from showers, faucets and other fixtures and for all health care facilities and buildings expected to serve elderly and sensitive populations. No requirements of a formal WMP for some residences and low-risk buildings does not relieve plumbers of the responsibility of using best practices for delivering systems free of contamination. Rather, it reduces the administrative responsibilities of plumbers and reduces water quality monitoring requirements.

V 107.3.1 Developing a Team. Refer to ASSE 12000 series, ANSI/ASHRAE 188 or the WHO WSP for Buildings Guidance on how to assemble the team.

Differences from those documents are that there is not a single operator and responsibility for the water system is shared by:

1. Community Water System Representative
2. Project Water Steward
3. Site owner
4. Prime contractor
5. Prime Plumbing Contractor
6. Plumbing Design Professional (Registered)
7. Third Party Contractors
8. Other water system contractors such as subcontractors that will conduct pre-occupancy disinfection

V 107.3.1.1 Team Member Roles. A designated water steward maintains overall responsibility and oversight of the team and is a liaison between the team, the building owner, the water supplier and other contractors. Roles and responsibilities that may fall to the water steward or may be designated to other team members shall include:

1. Sampling for water quality
2. Data logging and updating the Water management plan (WMP)
3. Water quality assessment and management (i.e., analyze and interpret test results and recommend actions)
4. Plumbing installation and repair
5. Third party inspections

Note: These roles shall be transferred to the building owner and building operations team after construction and at the onset of beneficial occupancy.

V 107.3.2 System Characterization and Assessment. The water management team conducts a system characterization and risk assessment, as described in section 106.2 and below.

V 107.3.2.1 System characterization. A process flow diagram is developed and reviewed by the construction water management program team. The diagram must be sufficiently detailed to allow identification of system components with the potential for contamination and pipe dimensions (diameters and lengths). Pipe dimensions allow calculation of volumes that are used in determining flushing durations. The diagram shall include, at a minimum the following recommendations:

1. The water system entry point and service connection
2. The service line and meter
3. Backflow prevention devices
4. Main hot and cold water distribution plumbing
5. Water heaters and associated ASSE 107-listed mixing valves
6. Storage tanks including water heaters with storage
7. Branches to building areas likely to be used by sensitive populations (e.g., individuals undergoing treatment involving immunosuppression, wings of assisted living and elderly care facilities etc.)
8. Temporary connections for construction water and associated temporary piping

V 107.3.2.2 System Assessment. The water management team lists all hazards that might be present on the construction site or in the plumbing system, identifies hazardous conditions that could promote the amplification/occurrence of hazards on the process flow diagram and locations within the water system with the potential for hazardous conditions. Locations with the potential for hazardous conditions are noted on the process flow diagram. The hazards list, hazardous location identification and notated process flow document are incorporated into the water management plan.

A hazard is a source or a situation with the potential for human injury or ill-health, damage to property, damage to the environment, avoidable economic cost, or a combination of these. For building water systems and on construction sites, the primary hazards of concern are pathogenic organisms, disinfectants and other oxidants at concentrations posing risk of damage to plumbing system components, toxic chemicals, sediments, and avoidable water wastage. Chlorine and monochloramine should be considered safe at long-term concentrations less than 4 ppm and safe for short durations at concentrations less than 20 ppm. Some construction sites will have other hazards and hazardous conditions beyond those listed here and they should be identified. Hazardous conditions are plumbing system physical characteristics or operating conditions that can promote the occurrence or amplification of hazards. The primary hazardous conditions on construction sites are stagnant water and water with excessive age, water temperature in the growth range of Legionella, and other opportunistic environmental pathogens, cross connections, and potential for backflow, and low or no disinfectant residual in cold water plumbing components.

For each of the hazardous conditions identified on the process flow diagram, the water management team determines the risk in the absence of controls, identifies controls in place to mitigate the risk and assesses whether controls are adequate. In nearly all cases, the risk assessment for each hazardous
V 107.3.3 Identify Controls, Control Points and Control Limits. Based on the risk assessment and system characterization (sections 107.3.1 and 107.3.2), the water management team identifies control points and control limits that are applied and monitored at those control points. The most common controls applicable to construction water management are flushing (limiting water age), maintaining a disinfectant residual of at least 0.2 mg/L in filled portions of the water system and regulating temperature outside the optimal growth range of Legionella bacteria (i.e., cold water distribution temperature is maintained at less than 22°C (72°F) and hot water portions of the system are maintained at temperature greater than 42°C (108°F). Specification of controls entails identifying the control point (location where control is applied and measured), the control limit (a numerical target or range for the control parameter), the measurement frequency and the actions that will be taken if a control parameter measurement is outside the control limit range for each of the control points. Controls, control points, control limits and monitoring data are maintained in the water management program documentation.

V 107.3.4 Process Control Parameter and Legionella Monitoring. Based on the risk assessment and system characterization (sections 107.3.1 and 107.3.2), the water management team identifies control points and control limits that are applied and monitored at those control points. The most common controls applicable to construction water management are flushing (limiting water age) and maintaining a disinfectant residual in filled portions of the water system.

V 107.3.5 Sanitary Storage and Handling of Plumbing Materials. All building types shall safely store plumbing materials and manage diligently to prevent contamination with sediments, debris, sewage, microorganisms, and other contaminants to the extent practicable. Legionella, Mycobacterium, free living amoebae and other environmental pathogenic organisms survive and grow in soils and natural waters and pose a contamination risk for unprotected plumbing materials. Best practices for materials management are described in section V 105.4 shall include but are not limited to the following:
(1) Capping pipes and fixtures during storage
(2) Storage only in well-drained and covered areas
(3) Storage away from and physically separated from chemical and fuel storage facilities and sewage collection systems.

V 107.5 Scoping and Staging to Limit Contamination Risk & Conserve Water. System components should not be filled until necessary. Leaving components dry until necessary delays formation of biofilms and conserves water because water turn-over is not required until the system is filled (Section V 107.10). Opportunities for delaying filling the system and system components are:
(1) Dry system pressure testing (Nitrogen, Etc.)
(2) Filling the system in stages
(3) Temporary water supply (separate from the permanent distribution system) for construction water.

V 107.5.1 Pressure Testing.

V 107.5.1.1. Dry System Procedures. Leave the system dry until two weeks prior to occupancy. No additional actions are required. Consider sloping all domestic hot and cold-water supply piping and providing drain valves in a way that allows the systems to be completely drained with no standing water or ponding. This would assist in keeping dry pipes during construction or during system shut down.

V 107.5.1.2 Wetted System Procedures.

V 107.5.2 Filling the System in Stages. Downstream system components should be filled and commissioned only when necessary. Once a part of the system is filled, it is subject to biofilm formation and water must be turned over regularly. Delaying filling until necessary can reduce the risk of contamination and has water savings benefits. When the system is filled in stages, the upstream, filled portion of the system is the supply for the newly connected and filled downstream component. The water quality at the point of connection should be assessed prior to connection of the downstream segment. At a minimum, flushed water samples from the upstream system water should have a disinfectant concentration of at least 0.2 mg/L and should be visibly clear. The upstream portion of the system should be thoroughly flushed prior to connecting the downstream portion.

V 107.6 Cross Connection Control and Backflow Prevention. All buildings must have cross connection control programs in place and must apply backflow prevention as specified in the governing code. Cross connections and backflow risks are never acceptable, even for temporary plumbing installed for use during construction. Cross connection control for construction water uses is described in section 105.1. Locations often associated with cross connections and that should be addressed specifically in cross connection control include, but are not limited to, connections to non-potable water systems (e.g., for make-up water), the main water intake, and fire suppression system off-takes. The responsible person with overall authority for water management shall ensure the following:
(1) Routine inspections to identify and, if found, disconnect cross connections
(2) Routine inspections to identify and, if found, remediate configurations/connections with the potential for backflow.

V 107.7 Filling the Building Water System. For all building types filling considerations shall include, only verified potable water may be introduced into the system, even though the system will be flushed and disinfected. Prior to filling the system, the water steward should(I) communicate with the water purveyor to coordinate the connection and to verify that water quality in the intended supply meets goals and specifications and (ii) develop a plan to ensure only water from a suitable, potable supply is used for filling the system and that no non-potable water from environmental sources near the connection (e.g., ground or surface waters, ponded water from pre-connection flushing of the water service, soils or sewage in the vicinity of the service connection) intrudes into the plumbing system. For buildings of type C and D, the plan should be documented and incorporated into the water management program document. When the building water supply is a public water system (PWS), the water purveyor should be contacted prior to connection and the following information should be requested:
(1) Annual average and minimum disinfectant concentration for the PWS monitoring location nearest the new connection
(2) Whether main breaks or other significant events occurred in the vicinity of the new connection over the past year
(3) Whether there were any total coliform positive samples or E. coli positive samples in the vicinity of the new connection over the past year
If the annual average disinfectant concentration is less than 0.2 mg/L or does not meet regulatory requirements or if there have been recent main breaks or total coliform positive results, the water management team should consider supplemental treatment while filling the system. Supplemental treatment can be temporary and removed after the system is filled or can become a permanent component of the water system. Permanent supplemental treatment is a major design modification with long-term implications and must be coordinated with the system design engineer and building owner.
When water is self-supplied (e.g., onsite wells, rainwater systems, onsite reuse systems), the supply should be a regulated community water system or transient non-community system and should be tested. Self-supplied water should be tested, at a minimum, for total coliforms and E. coli, turbidity, pH, hardness, nitrate and, if the supply system includes disinfection, disinfectant type and concentration. The following indicate water quality is not sufficient for filling the system:
(1) Positive total coliform and E. coli results.
(2) nitrate concentration > 10 mg/L as nitrogen
(3) visibly cloudy, colored or turbid water after flushing and
(4) disinfectant concentrations less than the design concentration for the supply.

Nitrate, appearance, and disinfectant concentration can be tested on-site and within a short time frame. Total coliform samples must be collected in appropriate sample bottles and analyzed by a certified laboratory. If the supply is determined to be of too low quality to fill the system, supplemental treatment such as filtration and UV or chemical disinfection can be used to polish the water prior to filling the system. Supplemental treatment may be deployed temporarily or may become a permanent element of the water system.

To fill the system, the supply is flushed until the supply water is visibly clear, the supply is connected to the building water system and hot and cold water distribution systems are filled with cold water. Sufficient drainage should be available at the point of connection to ensure water does not pool and there is no opportunity for flushed water to enter the newly-connected building water system. In some cases, the water purveyor will have standard operating procedures (SOPs) for connecting new building water systems; the water management team should request an SOP and the connection process should follow the SOP.

V 107.8 Initial System Flush. All building types shall follow and document the introduction of water into newly constructed plumbing distribution systems, the system should be flushed to remove sediments, debris, loose deposits, and other residuals from the system installation process.

High velocities are required to transport sediments and debris through the system and a target velocity of 5 ft/s should be used for the initial system flush. For portions of the system unable to achieve 5 ft/s flushing velocities (e.g., large diameter service lines or distal locations with insufficient pressure), the velocity during initial flush should be at least 2.5 ft/s. To achieve the target velocity, aerators, showerheads, and other flow regulating fixtures should be removed prior to flushing and sufficient drainage must be in place to accommodate flushing flows. To the extent possible, valves should be opened quickly; opening valves quickly produces a rapid change in shear at pipe walls and can contribute to more complete removal of sediments. At least five pipe volumes should be flushed to account for nonideal flow and mixing in pipes. Water heaters with storage should be flushed through their drain port. Water heaters should remain off (non-heating) during the flush and until necessary. Other appurtenances with storage (e.g., water softeners) should be flushed according to manufacturer instructions. Cold water storage tanks should be cleaned prior to filling and flushed to drain. Flushing should be conducted sequentially from the service line toward the distal system segments; progressive flushing prevents entrainment of contaminants deeper into the system.

After flushing, disinfectant residual and temperature should be measured at representative fixtures and flushing points. For building types C and D, disinfectant and temperature measurements post-flush should be recorded in the water management program document. Those values serve as baseline values. New copper pipe can exert a very high disinfectant demand and it is likely that the disinfectant concentration at distal locations in the system that are plumbed with copper pipe will be much less than the disinfectant concentration in the building supply and for locations nearer to the service line.

V 107.9 Water Turn-Over after Filling and Prior to Disinfection. For buildings that will service sensitive/susceptible populations (type D), water is turned over in all filled components at least once per day. Turning over the water requires opening faucets or flushing point fixtures until at least 5 pipe volumes of the connected plumbing have been discharged. For other buildings (types A, B and C), water in filled system components is turned over at least once every three days. As noted in section 107.5, delaying filling of system components until necessary can prevent water wastage and contamination and should be practiced when possible. Flushing should be conducted sequentially from the service line toward the distal system segments; progressive flushing prevents entrainment of contaminants deeper into the system.

After flushing, disinfectant residual and temperature should be measured at representative fixtures and flushing points. For building types C and D, disinfectant and temperature measurements post-flush should be recorded in the water management program document. Those values serve as baseline values. New copper pipe can exert a very high disinfectant demand and it is likely that the disinfectant concentration at distal locations in the system that are plumbed with copper pipe will be much less than the disinfectant concentration in the building supply and for locations nearer to the service line.

V 107.10 Legionella and Water Quality Monitoring. After the system is filled, samples should be collected and tested monthly for Legionella and weekly for other water quality parameters (process control parameters including, at a minimum, disinfectant concentration, temperature, and water age) for building types C and D or as required by the local Authority Having Jurisdiction.

V 107.10.1 Legionella Testing. For buildings with high likelihood of exposure of building occupants to aerosols and that are required to develop construction Water Management Programs (categories C & D in Table 107.2.1), test the building supply and at least 5 percent but no more than 20 plumbing fixtures monthly for Legionella. First-draw cold and hot water samples are collected and analyzed for each fixture except the building entry point. Legionella samples should be taken from the building entry point (cold water sample only) and locations determined to be elevated risk of Legionella growth. Locations with elevated risk of Legionella growth are fixtures at distal ends of the distribution system, discharge of storage (cold water only), and fixtures used infrequently. Water quality information including disinfectant concentration, temperature, pH and, if the water management plan includes it, HPC should be collected with each Legionella sample, recorded, and referenced to the Legionella sample (e.g., recorded with the sample identification number of the Legionella sample). The additional water quality data are essential for diagnosing causes of frequent or high Legionella detections. Results from Legionella monitoring should be used to assess whether the system is well controlled, per the CDC framework for determining the level of control of Legionella (Table V 104.3.1). Only results from culture Legionella assays may be used within the CDC framework; results from molecular assays such as qPCR are fundamentally different from those of culture assays and cannot be used within the CDC framework. Cultural assays must be performed by a qualified laboratory and may be for Legionella spp. or specific to L. pneumophila.

V 107.10.2 Other Water Quality Testing. Disinfectant residual concentration, water temperature and other water quality measures related to process control should be monitored at a sufficient frequency to ensure hazardous conditions are detected early and to allow assessment of process control. Process control monitoring should be conducted at least weekly and should be conducted more frequently when results are outside control limits. New copper pipe is known to exert a high disinfectant demand and disinfectant measurements downstream of long runs of new copper pipe may be low or zero, even when disinfectant in the building supply is within control limits.

V 107.11 Pre-Occupancy Disinfection and Building Opening.

V 107.11.1 General. System Opening is the set of actions that should be taken to ready a building for normal operations after an extended period of no or limited operations. Systems that are being reopened after prolonged vacancy or partial vacancy shall comply with AWWA-IAPMO Responding to Water Stagnation in Buildings with Reduced or No Water Use, ASHRAE 188, and section V 107.11.

V 107.11.2 Pre-Occupancy Disinfection. Biofilms and, potentially, environmental pathogens are likely in any plumbing system; even those managed as described in this guidance and other guidelines such as ANSI/ASHRAE 188. As directed in plumbing codes, building water systems must be purged and disinfected after construction/installation and prior to occupancy. Disinfection reduces the biofilm mass in the water system and reduces the concentration of pathogens that might be present, though it is unlikely to completely eradicate pathogen populations established in the system. Disinfection entails filling the building water system with a high concentration solution of disinfectant, holding the disinfectant in the system for sufficient time for the disinfectant to reduce the microbial population, and flushing the system to remove the high-concentration disinfectant solution, inactivated
organisms, and biofilm materials.

Note: At present, disinfection is conducted per AWWA Standard C561 (Disinfecting Water Mains) or 652 (Disinfection of Storage Facilities). Standard C651 was developed for disinfection of water mains in public water systems and directs use of very high concentrations of disinfectant – much higher than those required for effective disinfection of building water systems and high enough to pose a damage risk to plumbing system components. An alternative AWWA standard more appropriate to new building water systems is under development and should be considered for adoption in code when it is complete.

V 107.11.3 Opening Process.

V 107.11.3.1 Opening Communication. An occupancy date and communicate date of occupancy to all building occupants shall be determined and the steps required from maintenance staff shall be provided and available. The required steps shall provide clear instructions to occupants on how to avoid hazards and how to report concerns once a building is occupied.

V 107.11.3.2 Pre-Startup inspection. The preparation of the documentation and pre-startup inspection shall be conducted by a qualified person. The required inspection shall include but is not limited to:

1. visually assessing the potable water system
2. inspecting all components for the presence of contaminants and other adverse conditions
3. checking that the equipment is working properly
4. ensuring that records are complete.

### TABLE 1701.2

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI/AWWA 561-2004</td>
<td>Fabricated Stainless Steel Slide Gates</td>
<td></td>
</tr>
<tr>
<td>ANSI/AWWA 652-2011</td>
<td>Disinfection of Water-Storage Facilities</td>
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</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**

Systematic water management during construction of new and existing buildings (including significant additions to the envelope of an existing building) is necessary to manage the risk of building water systems becoming contaminated with pathogenic organisms such as *Legionella pneumophilia* (the etiological agent responsible for most cases of Legionnaires’ disease) and to prevent infections of contractors and others at or near the site during the construction process.

This Appendix provides education and guidance to help plumbers and other personnel responsible for the design, construction and commissioning of water systems reduce the likelihood of contaminating plumbing systems during construction. If unmanaged, construction and commissioning activities contribute to the growth and spread of opportunistic premise plumbing pathogens (OPPPs) in potable and non-potable building water systems. According to the CDC, 75% of the unmanaged external changes that have resulted in outbreaks of Legionnaires’ disease were attributable to construction activities.

Activities are described that shall be practiced during installation and commissioning of new water systems to reduce the likelihood that water systems begin their service life contaminated. Recommended practices include many practices and procedures that make up water management programs that govern operation and monitoring of operational water systems and that are required for many building types such as health care facilities. Other practices are specific to risks associated with construction activities. Healthy building water systems are the shared responsibility of design engineers, plumbers and construction personnel, public water systems and other water purveyors, system operators and building owners and managers.
APPENDIX W
WATER QUALITY FOR PLUMBING INDUSTRY PROFESSIONALS AND BUILDING MANAGERS

W 101.0 General.
W 101.1 Scope. This appendix summarizes water quality information plumbers and engineers might use for designing, monitoring and operating building potable water systems. The water quality parameters described in this appendix were selected because they can impact system performance or are, at least to some extent, under the control of designers and operators. Information presented for each water quality parameter includes background information on the parameter, applicable guidelines and standards, the importance of the parameter to building water systems, information that can be requested from water suppliers, and where to sample and how to test samples.

W 101.2 Background.
Water Sources for Supply: It can be important to know whether your water utility's source of water supply is surface water (e.g., rivers, reservoirs) or groundwater (wells) or a combination of the two. Various water quality characteristics can change depending on the type of source water that is used. In some cases, differences in water quality can vary from one surface water source to another, or from one groundwater source to another. These changes may occur based on drought conditions, seasonal changes, and changes in water demand.

Water Main Supplying your Water Service: It may be important to know the age, size, and material of the water main(s) that supplies water to your building's service connection(s). For example, an old water main consisting of unlined cast iron could release iron rust to your water. An over-sized water main for the local demand could result in high water age which reduces the chlorine residual of the water entering your building.

<table>
<thead>
<tr>
<th>TABLE W 102.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPORTANT WATER QUALITY PARAMETERS FOR BUILDING WATER SYSTEMS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARAMETERS OF INTEREST</th>
<th>INFORMATION TO REQUEST</th>
<th>WHY THEY ARE IMPORTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters That Are Beneficial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorine or Chloramine Residual</td>
<td>Target residual for your area; actual annual maximum and minimum</td>
<td>Chlorine acts as a preservative, limiting biofilm and microbiological activity</td>
</tr>
<tr>
<td>pH</td>
<td>Annual average pH for your area and in pH affect water chemistry</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>registration for corrosion control.</td>
<td>Sufficient alkalinity deters changes in pH and helps with corrosion control.</td>
</tr>
<tr>
<td>Phosphate Inhibitor</td>
<td>Does the utility use a phosphate inhibitor for corrosion control?</td>
<td>Phosphate inhibitors can help to reduce corrosion.</td>
</tr>
<tr>
<td>Parameters That Cause a Nuisance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>5-year average, minimum, and maximum</td>
<td>Solids can accumulate in plumbing and affect processes in use.</td>
</tr>
<tr>
<td>Hardness</td>
<td>5-year average, minimum, and maximum</td>
<td>Hard water has calcium and magnesium carbonates which form scales.</td>
</tr>
<tr>
<td>Conductivity</td>
<td>5-year average, minimum, and maximum</td>
<td>Conductivity is a general measure of the various salts in water and can affect processes in use.</td>
</tr>
<tr>
<td>Sodium</td>
<td>5-year average, minimum, and maximum</td>
<td>Sodium can, at high levels, cause a salty taste.</td>
</tr>
<tr>
<td>Chloride</td>
<td>5-year average, minimum, and maximum</td>
<td>Chlorides can cause a salty or bitter taste and can impact on corrosion.</td>
</tr>
<tr>
<td>Iron Manganese</td>
<td>5-year average, minimum, and maximum; whether iron and manganese are treated for reductions from the source of water supply</td>
<td>Iron and manganese can accumulate as sediment, cause staining, and color the water. Iron can cause a metallic flavor and decrease the chlorine residual.</td>
</tr>
<tr>
<td>Sulfate</td>
<td>5-year average, minimum, and maximum</td>
<td>Sulfate is a source of sulfur which can cause odors. Sulfate can also impact on corrosion.</td>
</tr>
<tr>
<td>Sulfides</td>
<td>Whether sulfides are treated for and a cause of customer complaints</td>
<td>Sulfides can cause odors such as with hydrogen sulfide.</td>
</tr>
<tr>
<td>Taste and Odor</td>
<td>Taste and odor issues that can occur and cause customer complaints</td>
<td>Tastes and odors cause complaints from consumers of water.</td>
</tr>
<tr>
<td>Parameters of Health Concern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Copper</td>
<td>The water supplier's 90% reported value under the Lead and Copper Rule</td>
<td>Copper can cause staining, colored water, and a metallic flavor.</td>
</tr>
<tr>
<td>Lead</td>
<td>The water supplier's 90% reported value under the Lead and Copper Rule</td>
<td>Lead is of health concern.</td>
</tr>
<tr>
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W 103.0 Water Quality Parameters for Building Water Systems.  
W 103.1 Parameters That are Beneficial.  
W 103.1.2 Disinfectant Residual.  
**Background:** In the United States, the typical disinfectant residual (that is, the disinfectant that is maintained in the water after it leaves the treatment plant and passes through the distribution system pipes) that water suppliers carry in their drinking water is either a free chlorine residual or a chloramine (chlorine combined with ammonia) residual. The concentration of residual is expressed as mg/L or ppm. This parameter is not conservative because both chlorine and chloramine dissipate with time, more quickly in warmer water and more quickly when exposed to other conditions wherein there is a demand for chlorine; for example, dissolved iron will exert a demand for chlorine. New copper pipe will exert a demand for chlorine. Biofilm will exert a demand for chlorine. Therefore, the chlorine or chloramine residual varies quite significantly. In general, chlorine dissipates faster than chloramine.
though, under some conditions, chloramine can decay rapidly. Those conditions are well known by drinking water suppliers who often have control plans in place when those conditions arise.

Guidelines or Standards: The US EPA requires that a minimum detectable residual (not currently defined as a numeric value at the national level) be maintained in most public drinking waters, but that it not exceed an average of 4.0 mg/L. Many state primacy agencies have set numeric minimum residual level requirements that can be different for chlorine and chloramine. Not all public water supplies that use groundwater carry a disinfectant residual.

Importance to Building Water Systems: A free chlorine or chloramine residual acts as a preservative or deterrent to the regrowth of microorganisms in water. The longer water sits in plumbing and the warmer the water temperature is, the greater the rate of dissipation. Free chlorine is more likely to dissipate more quickly than chloramine. Once the disinfectant dissipates to a low enough level, it no longer deters regrowth of microorganisms. The timely turnover of water in building plumbing can help to bring in fresher water containing an adequate chlorine residual.

Information to Request: This information should already be available in your water utility's Consumer Confidence Report. However, you want to know whether the water provided to your building has a free chlorine or chloramine residual, what the maximum and minimum level for your area is, what target residual they aim for and whether that varies seasonally. Request an average, maximum, and minimum for the most recent year. Also ask if the water utility performs any "chlorine burns" which is when the utility switches from a chloramine to a free chlorine residual for weeks at a time to manage microorganism activity in their system.

Where to Sample and How to Test: Total and free chlorine residual can be measured using test kits that are readily available. Testing should be done soon after a water sample is collected. Samples should be collected at the service connection, representing water entering the building, and at distal taps to determine how much the residual dissipates within the building's plumbing system. When a fixture is first used after a long stagnation period, the water usually has no chlorine left in it. Once the fixture has been run (flushed) until the water temperature is relatively steady, the disinfectant concentration increases to the concentration in the water supply. Hot water may not sustain a disinfectant residual.

W 103.1.3 pH.Background: pH is expressed as units. It ranges from 0 to 14 with 7 being neutral. pH is a measure of the acidity of water; a level below 7 is in the acidic range and a level above 7 is in the basic range. Water pH does not have any health implications. pH changes, especially when the alkalinity is low, for various reasons. Surface water systems tend to manage the pH of the water because their treatment process is affected by pH and because the type of corrosion control, they use may be based on pH. Hopefully, your water utility manages pH for optimum corrosion control.

Guidelines or Standards: The EPA's SMCL is a range of ideal pH between 6.5 and 8.5 units.

Importance to Building Water Systems: In general, a high pH water may deposit carbonate scale and a low pH water can be corrosive to metal pipe. If the water supplier has corrosion control treatment, then it may be adjusting its pH to reduce the likelihood of corrosion in their customers' plumbing. pH influences the chemical and microbiological activity of a water system in various ways. It is helpful to know how variable or stable the pH is for the water supplied to your building.

Information to Request: You should ask if pH is adjusted as part of the corrosion control program, and the average pH for the water provided to your building.

Where to Sample and How to Test: The water utility's information on pH should be sufficient unless you suspect that pH could be changing within your building's plumbing system, such as if the water supplier reports a low alkalinity for the water supplied, or if your plumbing shows signs of advanced corrosion. There are measurement kits by which to readily check pH onsite and pH should be measured soon after sample collection.

W 103.1.4 Alkalinity.Background: The concentration for alkalinity is expressed as mg/L or ppm. Alkalinity is the buffering capacity (tendency to resist changes in pH) of water and is based on carbonate chemistry. At a neutral pH, bicarbonates are favored over carbonates, and adding carbon dioxide to water results in more bicarbonates instead of lowering the water pH. Sufficient alkalinity helps deter changes in pH and is typically associated with harder water and the presence of calcium carbonates. The carbonate/bicarbonate chemistry, or alkalinity is important in determining the availability and occurrence of minerals in water. Alkalinity, for surface water sources, will vary.
according to climate conditions; it will decrease with an increase in rainfall, for example, due to dilution of the carbonates in the source water. Alkalinity is often adjusted in treatment and remains fairly stable after it leaves the treatment plant.

**Guidelines or Standards:** Natural alkalinity can range from around 20 mg/L to over 200 mg/L. Alkalinity could be a required part of the water supplier's corrosion control treatment.

**Importance to Building Water Systems:** It is helpful to know the corrosion control provided by the water supplier, and whether alkalinity is part of that program, especially if corrosion is important for your plumbing system.

**Information to Request:** Since alkalinity can vary, it would be good to obtain a 5-year average, minimum, and maximum for your region of the distribution system.

**Where to Sample and How to Test:** The water utility's information on alkalinity should be sufficient unless you suspect that pH could be changing within your building's plumbing system. Alkalinity would be measured by a certified laboratory. If you decide to collect samples, a sample from the service connection should be adequate.

**W 103.1.5 Phosphate Inhibitor.**

**Background:** Orthophosphate is a common corrosion inhibitor used in corrosion control treatment. A phosphate inhibitor is intended to help coat water mains as well as building plumbing to reduce the corrosive action of the water on the infrastructure. Other forms of corrosion inhibitors may also be used.

**Guidelines or Standards:** If the water utility uses a corrosion inhibitor, then it has a permit from the state that prescribes the levels that must be maintained.

**Importance to Building Water Systems:** The use of a corrosion inhibitor is good information for a building water system as it will help protect the building plumbing from corrosion.

**Information to Request:** Ask if the water utility uses corrosion control treatment and how that is achieved (by adjusting the pH, by adjusting the alkalinity, or by adding a phosphate or other corrosion inhibitor to the water).

**Where to Sample and How to Test:** The water utility's information on phosphate inhibitors should be sufficient. Testing would be done by a certified laboratory. If you decide to collect samples, a sample from the service connection should be adequate.

**W 103.2 Parameters That Cause a Nuisance.**

**W 103.2.1 Total Dissolved Solids.**

**Background:** The concentration of total dissolved solids (TDS) is expressed as mg/L or ppm. It is a measure of anions and cations, or minerals, in water. TDS changes for surface water sources depending on climate conditions; for example, during a drought, TDS will increase because the minerals in the source water are less diluted. During times of plentiful rainfall, minerals will be more dilute and TDS will decrease. TDS does not tend to change in a distribution system but will change when a building's point-of-entry treatment is used, especially reverse osmosis.

**Guidelines or Standards:** The EPA's SMCL is 500 mg/L to avoid taste problems, solids accumulation, and staining. Typical tap water ranges, for low, moderate, and high TDS waters are <100, 101-250, and 251-500 mg/L, respectively. Mineral waters have high TDS.

**Importance to Building Water Systems:** TDS can accumulate in plumbing systems and affect corrosion, and TDS can affect processes in use within the building.

**Information to Request:** Since TDS can vary, obtain a 5-year average, minimum, and maximum TDS for your region of the distribution system.

**Where to Sample and How to Test:** The water utility's information on TDS should be sufficient unless your building water system uses point-of-entry treatment. Testing would be done by a certified laboratory. If you decide to collect samples, a sample from the service connection should be adequate as well as a sample following any water treatment system.

**W 103.2.2 Hardness.**

**Background:** Calcium and magnesium hardness is expressed as mg/L or ppm as calcium carbonate (magnesium is usually very low thus making calcium the primary component), and sometimes as grains per gallon which is different. Hardness is conservative for the most part. That is, it tends to be steady as water passes through building water systems. Hardness is largely due to the water source for the water utility and tends to be higher for systems with groundwater sources than for those using surface water. However, some water systems treat their source
water, or soften it, because it is very hard. For surface water supplies, hardness can vary according to climate conditions; it will decrease following heavy rainfall as calcium and magnesium carbonates are diluted down. **Guidelines or Standards:** Water is considered soft at 060 mg/L, moderately hard to hard at 60180 mg/L, and very hard when over 180 mg/L.

**Importance to Building Water Systems:** Hard water makes it harder to wash with soap and it also deposits a residual or scale. Deposits can build up in the bottom of water heaters where they can make the heaters less efficient and can contribute to degraded water quality.

**Information to Request:** Since hardness can vary, it would be good to obtain a 5-year average, minimum, and maximum for your region of the distribution system.

**Where to Sample and How to Test:** The water utility's information on hardness should be sufficient unless you have a water softening system for the building. Testing would be done by a certified laboratory. If you decide to collect samples, a sample from the service connection should be adequate as well as a sample following any treatment.

### W 103.2.3 Conductivity.

**Background:** Conductivity is expressed as µmho/cm. Conductivity is conservative as a measure of the natural salts in water and would not be expected to change during the distribution of water. It will vary according to climate conditions; when water levels are high then it would be more dilute. Also, salts can be washed into source water during the winter when road salt is applied to roadways, and most water treatment systems do not remove these salts. Desalination technologies would reduce conductivity.

**Guidelines or Standards:** The conductivity of water can vary from <10 to > 1000 µmho/cm. Pure water has a conductivity close to zero and sea water can exceed 1000 µmho/cm.

**Importance to Building Water Systems:** Conductivity is a measure of the salts in water, and as such can affect processes being used within the building and can affect any water treatment systems in use. Also, high conductivity causes a salty or bitter taste thus causing complaints from consumers. Rapid changes in conductivity (e.g., as is sometimes observed during runoff of road salt) can also change the scale that has built up on pipes and can contribute to the release of scale and colored water events, or periods of higher metals concentration, at fixtures.

**Information to Request:** Since conductivity can vary, it would be good to obtain a 5-year average, minimum, and maximum for your region of the distribution system.

**Where to Sample and How to Test:** The water utility's information on conductivity should be sufficient. Testing would be done by a certified laboratory. However, if conductivity is important for a process used within the building, then conductivity meters, which are reliable and relatively inexpensive, can be used.

### W 103.2.4 Sodium.

**Background:** Sodium concentration is expressed as mg/L or ppm. Sodium is conservative and usually remains steady during the distribution of water. It varies according to climate conditions; when water levels are high, sodium is more diluted. Also, it can be washed into source water when road salt, that is applied to roadways, runs off into streams. Most water treatment systems do not remove sodium, though water treatment systems using desalination or reverse osmosis do remove sodium.

**Guidelines or Standards:** A sodium level of 30-60 mg/L would be on the high end for natural levels. Much higher levels that affect the water's taste can occur due to severe drought, saltwater intrusion of well supplies, and winter runoff of road salt.

**Importance to Building Water Systems:** Water softening systems might add more sodium to the water. High enough levels can impart a salty taste and affect processes used within the building. Very high sodium concentrations can pose a health risk to sodium sensitive building occupants.

**Information to Request:** Since sodium can vary, it would be good to obtain a 5-year average, minimum, and maximum for your region of the distribution system.

**Where to Sample and How to Test:** The water utility's information on sodium should be sufficient. Testing would be done by a certified laboratory. If you decide to collect samples, a sample from the service connection should be adequate.

### W 103.2.5 Chloride.

**Background:** Chloride concentration is expressed as mg/L or ppm. Chloride is conservative and usually remains
steady during the distribution of water. It will vary according to climate conditions; when water levels are high then
close to is more dilute. Also, it can be washed into source water during the winter when road salt is applied to
roadways, and most water treatment systems do not remove chloride unless they apply desalination technologies.
Some water treatment systems introduce chloride to the water such as when ferric chloride is used as a coagulant in
the treatment process.
Guidelines or Standards: The EPA's SMCL is 250 mg/L. Higher levels can affect the water's taste, and can occur
during severe drought, saltwater intrusion, and winter runoff of road salt.
Importance to Building Water Systems: Chloride can affect corrosion, and it can impart a salty or bitter taste to the
water that would cause complaints from consumers of the drinking water.
Information to Request: Since chloride concentration can vary widely with time, it would be good to obtain a 5year
average, minimum, and maximum for your region of the distribution system.
Where to Sample and How to Test: The water utility's information on chloride should be sufficient. Testing would be
done by a certified laboratory. If you decide to collect samples, a sample from the service connection should be
adequate.
W 103.2.6 Iron Manganese.
Background: Iron and manganese concentrations are expressed as mg/L or ppm. They come from source waters,
may be reduced during water treatment, and can accumulate as sediment and as part of scale in water mains. Iron
and manganese are very complicated in their chemistry. Only some forms found in water cause aesthetic or taste
problems or accumulate as sediment. Iron can be released from old, unlined cast iron water mains and from
corroding galvanized service lines. When watermain work is done, or water hydrants are flushed, episodes of rusty
water can occur.
Guidelines or Standards: The EPA's SMCL guidance is 0.3 mg/L for iron to prevent staining, rust color, and taste;
and 0.05 mg/L for manganese to prevent staining and color.
Importance to Building Water Systems: Iron and manganese can accumulate as sediment, clog filters, and make
water aesthetically unacceptable. Iron and manganese sediment can also contain other contaminants of health
concern. Those other contaminants can be released into water when iron and manganese scales are disturbed.
Information to Request: Since iron and manganese can vary, it would be good to obtain a 5year average, mini¬
mum, and maximum for your region of the distribution system. Ask if the water utility treats to remove iron or
manganese from their source water, and whether they experience customer complaints concerning these
parameters.
Where to Sample and How to Test: The water utility's information on iron and manganese should be sufficient if you
experience no possible problems. Testing for total iron and total manganese would be done by a certified
laboratory. If you decide to collect samples, a sample from the service connection could be combined with samples
from taps where you experience problems, as well as from hot water systems or any storage tanks.
W 103.2.7 Sulfate.
Background: The concentration of sulfate is expressed as mg/L or ppm. Sulfate is somewhat conservative and
usually remains steady during the distribution of water. It varies with climate conditions; when source water levels
are high it is more dilute. Some water treatment systems introduce sulfate to the water such as when ferric sulfate
is used as a coagulant during water treatment. Sulfate is a source of sulfur and can be biologically converted to
inorganic sulde such as hydrogen sulde.
Guidelines or Standards: The EPA's SMCL is 250 mg/L for taste and higher levels can cause intestinal discomfort
for consumers of the drinking water.
Importance to Building Water Systems: Sulfate can be a precursor for sulde odors as can occur in water heaters
and storage tanks. Sulfate can also encourage corrosion and be a source of nutrient for bacteria that participate in
corrosion.
Information to Request: Since sulfate can vary, it would be good to obtain a 5year average, minimum, and
maximum for your region of the distribution system.
Where to Sample and How to Test: The water utility's information on sulfate should be sufficient. Testing would be
done by a certified laboratory. If you decide to collect samples, a sample from the service connection should be
adequate.

W 103.2.8 Sulfides.

**Background:** Inorganic sulfides would be expressed as mg/L or ppm. Some groundwater supplies have sulfides in them, such as hydrogen sulfide. Water utilities may treat the water to reduce sulfides. Sulfides can change in chemical nature during water distribution since some microorganisms utilize sulfides. Sulfides can also be liberated during the corrosion of iron as from unlined cast iron water mains.

**Guidelines or Standards:** Some state primacy agencies have recommendations for sulfides. They are mostly found at levels of concern in groundwaters. Inorganic sulfur chemicals can occur as hydrogen sulfide or other sulfides. These can occur naturally or be produced microbiologically. Hydrogen sulfide at 1 mg/L can be a nuisance. Sulfides can also produce a burnt match odor along with turbidity. A low pH favors the nuisance odor of rotten eggs.

**Importance to Building Water Systems:** Sulfides can accumulate in plumbing systems where they can cause odors that are objectionable. Hot water systems and storage tanks would be more prone to this problem. Sulfide odors can also signal active corrosion conditions.

**Information to Request:** Ask if your water utility treats for the removal of sulfides in their source water. Ask if the water utility receives customer complaints concerning sulfide odors (rotten eggy, burnt match, sewer like smell).

**Where to Sample and How to Test:** The water utility's information on sulfides should be sufficient. Testing for hydrogen sulfide would be done by a certified laboratory. If you decide to collect samples, a sample from where a problem is reported is appropriate.

W 103.2.9 Taste and Odor.

**Background:** A variety of contaminants in water can affect its taste (e.g., iron, copper, TDS) and odor (e.g., chlorine, chloramine, hydrogen sulfide and other sulfides). Groundwater sources can have natural problems (e.g., iron and sulfides) as well as manmade problems (e.g., chemical contamination). Surface water sources can have natural problems (e.g., iron, sulfides, earthy and musty odors from cyanobacterial blooms, stormwater and snowmelt runoff) as well as chemical contamination such as from industrial spills. There are water treatment technologies to control these problems. The water distribution system can also contribute tastes and odors (e.g., due to iron corrosion, stagnant water, backflow through cross connections).

**Guidelines or Standards:** The basic guideline for drinking water is to be free of a noticeable odor and pleasing to the taste. Note that most public water supplies have a noticeable odor from the chlorine residual they carry as a preservative. This is unavoidable. As for taste, truly pure water does not have a pleasant taste because good tasting water requires a background of cations and anions, or minerals, to taste good.

**Importance to Building Water Systems:** Taste and odor problems can cause complaints from users of the water. Such problems can also arise within plumbing systems because of stagnant water, corrosion, cross connections, hot water systems, and newly installed plastic pipe. Taste and odor problems arising in plumbing systems can often be addressed through changes in operations and materials of the plumbing system.

**Information to Request:** Ask the water utility about their typical customer complaints concerning taste and odor; when and where they tend to occur, and what they are caused by.

**Where to Sample and How to Test:** The water utility's information should be sufficient. Testing would be done by a certified laboratory but if the cause is not known, then it could cost a lot of money to test for all possible causes. If the cause originates within the building's plumbing, then investigations should be done to identify the cause.

W 103.2.10 Color.

**Background:** Color can be measured in various ways; often it is expressed as color units. Source water can have color such as from tannins and organic matter, and water utilities would apply treatment to control it.

**Guidelines or Standards:** The EPA's SMCL is 15 color units. Essentially, water should not have a noticeable color.

**Importance to Building Water Systems:** Drinking water with a color will cause complaints from consumers and users. Color can be an indication of backflow through a cross connection within the building or of active corrosion.

**Information to Request:** Since color can vary in water supplies, it would be good to obtain a 5-year average, minimum, and maximum for your region of the distribution system and to know if the water treatment process addresses color.

**Where to Sample and How to Test:** The water utility's information on color should be sufficient. Testing would be
done by a certified laboratory. If you decide to collect samples, a sample from the location where a color problem is being experienced is appropriate. However, visible color often provides a clue as to the cause and, therefore, follow up testing should be done to verify the cause (such as for iron, manganese, or copper).

W 103.3 Parameters of Health Concern:

W 103.3.1 Copper:

Background: Copper concentration is expressed as mg/L or ppm. Copper is most often introduced to potable water from the corrosion of copper plumbing. Copper occurs in a dissolved and oxidized form for which issues vary depending on the chemical form.

Guidelines or Standards: The EPA's SMCL for copper is 1 mg/L to avoid taste and staining. The EPA's Action Level for copper is 1.3 mg/L under the Lead and Copper Rule.

Importance to Building Water Systems: A building water system may need to have water samples collected and tested to know what the copper levels are for drinking water in the building since copper comes from copper plumbing. Copper can cause unpleasant taste, color, and staining.

Information to Request: The water utility's Consumer Confidence Report should already provide information on the 90th percentile level of copper for samples taken from homes with copper plumbing, as compared to the Lead and Copper Rule's Action Level for the 90th percentile copper at 1.3 mg/L. This provides a general idea of the corrosivity of the water utility's water toward copper.

Where to Sample and How to Test: The water utility's information on copper helps to identify the potential for copper to be an issue. Testing would be done by a certified laboratory. Since copper comes from building plumbing, samples should be collected at distal taps after water has been sitting stagnant for about 6 hours or longer.

W 103.3.2 Lead:

Background: The concentration of lead is often expressed as ug/L or ppb because the ideal drinking water should have no detectable lead. Lead is typically introduced to potable water from lead service lines and piping, lead-based solder, and older brass fixtures and valves. Galvanized pipe and iron deposits can also be a source of lead. Building water supplies seldom and perhaps never contain appreciable concentrations of lead. Lead can occur dissolved in water or as a particulate, and it can be associated with iron.

Guidelines or Standards: The EPA's Lead and Copper Rule set a 15 ppb Action Level for lead based on the 90th percentile of a number of homes in the water system. Levels above this concentration, or lower if a state regulator has set a lower action level, should result in action taken to reduce the lead since it is a direct health hazard.

Importance to Building Water Systems: Water that is used for consumption should have low or no detectable levels of lead in order to protect the health of the consumer. A building would need to have its water tested, from taps used for drinking and cooking purposes, to determine if lead is a problem. If problematic lead concentrations are observed, lead plumbing system components should be identified and removed and remedial actions should be followed until lead is cleared out of the plumbing system.

Information to Request: The water utility's Consumer Confidence Report should already provide information on the 90th percentile level of lead for samples taken from homes with leaded materials in their plumbing, as compared to the Lead and Copper Rule's Action Level for the 90th percentile lead at 15 ppb. This information provides a clue as to whether the corrosion of lead-based materials is an issue.

Where to Sample and How to Test: The water utility's information on lead helps to identify the potential for lead to be an issue. Testing would be done by a certified laboratory. But to know if lead is an issue, since it would come from a lead service line and building plumbing, then samples should be collected at distal taps after water has been sitting stagnant for about 6 hours or longer. The building's service should be examined as to whether it consists of lead.

W 103.3.3 Total Coliform and E. Coli:

Background: Total coliforms are an indicator of the sanitary condition of water. They are a group of bacteria that should be readily controlled by disinfection. When they are detected in drinking water, a follow-up investigation should be done to make sure that the water has not been contaminated. However, they can occur and grow in drinking water systems. The same test that looks for coliform bacteria also looks for the presence of E. coli (a member of the coliform group of organisms), which can be an actual pathogen, and which more clearly indicates
that the water is likely contaminated. Again, detection of E. coli should be followed up with an investigation. A water system can detect total coliform bacteria on occasion without having water contamination, but such detection should not be a regular occurrence. E. coli should never be detected. However, there are instances of detection due to unsanitary sampling conditions and poor sampling practices.

Guidelines or Standards: Total coliform and E. coli can be expressed as colony forming units (cfu) or most probable number (MPN) per 100 mL, however, the SDWA regulation only requires the measurement of their presence or absence from a sample of water.

Importance to Building Water Systems: The detection of either total coliform bacteria or E. coli at or within a building water system should be followed up with an investigation such as for the occurrence of backflow through a cross connection.

Information to Request: It is helpful to know whether the water supplier is or has been experiencing violations of the SDWA regulation for total coliform or E. coli. This should be published in the Consumer Confidence Report or sent out with notifications when boil water advisories are issued.

Where to Sample and How to Test: The water utility's information on coliforms should be sufficient. Testing would be done by a certified laboratory. If you decide to collect samples, a sample from where a problem is suspected is appropriate, along with a sample from the service connection. It is easy to contaminate a sample and protocols for sanitary sample collection should be established and reviewed prior to sampling.

W 103.4 Parameters That Influence Others.

W 103.4.1 Water Temperature.

Background: Water temperature can vary naturally from a low of about 5°C to a high of about 30°C for water sources that are affected seasonally such as rivers and reservoirs. Water temperature remains more consistent in groundwater sources. Water temperature tends to change when water enters building plumbing or is stored for extended time in storage tanks; more typically warming up.

Guidelines or Standards: In general, it is best to keep water as cold as possible as one would do with any consumable product. Colder water reduces chemical and microbiological activity.

Importance to Building Water Systems: In general, the higher the water temperature, the greater the rates of microorganism activity and growth, chlorine residual dissipation, corrosion, and other water quality changes.

Information to Request: You should ask for the annual minimum and maximum water temperature for the water provided to your region of the distribution system.

Where to Sample and How to Test: The water utility's information on water temperature should be sufficient for the water supplied to your building. Using a common water thermometer, you can test yourself at the distal taps throughout the building's plumbing system to understand how water temperature varies, at different times of year, within the plumbing system. Unusually warm water could indicate stagnant conditions or conditions that favor water quality deterioration.

W 103.4.2 Ammonia.

Background: Free ammonia concentration is expressed as mg/L or ppm. Some water sources have levels of ammonia which affect the chlorination of water during water treatment. Ammonia reacts with free chlorine to form chloramine. Many water treatment plants add ammonia to the finished water to form chloramine, and as a result the drinking water has a residual of free ammonia. Ammonia can be used by bacteria in the water system and converted to nitrate and nitrite, a process called nitrification.

Guidelines or Standards: Free ammonia should be minimized, such as below 0.3 mg/L, to prevent nitrification; nitrification can promote corrosion and dissipate the chlorine residual.

Importance to Building Water Systems: Nitrification in a building plumbing system can exacerbate corrosion and increase microbiological activity in the water. Studies indicate that nitrification is very common in building plumbing systems that are supplied by water with chloramine disinfectant.

Information to Request: If the water utility provides a chloramine residual, then it also has a free ammonia residual in its water. Higher chloramine residuals usually mean higher ammonia residuals. In addition, when chloramine dissipates it releases ammonia to the water. In this case, ask the water utility if they experience nitrification in your region of the distribution system.
Where to Sample and How to Test: The water utility’s information on ammonia residual should be sufficient. Testing would be done by a certified laboratory. If you decide to collect samples, a sample from the service connection is a starting point.

W 103.4.3 Heterotrophic Plate Count.

Background: Heterotrophic Plate Count (HPC) is an indicator of the background level of bacteria in water. There are many species of heterotrophic bacteria, most of which pose no health risk. Water utilities who measure this parameter establish a baseline from which they can observe when conditions favor the amplification or growth of bacteria. This growth can indicate whether undesirable conditions are occurring such as advanced corrosion and uncontrolled biofilm development.

Guidelines or Standards: HPC is expressed as colony forming units (cfu) or most probable number (MPN) per mL. The twoday incubation test should indicate cfu/mL less than 500; ideally less than 100. A 5–7 day incubation test produces much higher numbers and results should be interpreted against the water system's baseline.

Importance to Building Water Systems: Bacterial regrowth and amplification can lead to nuisance problems (e.g., corrosion, odors, biofilm, nitrification) as well as indicate conditions that are favorable for opportunistic pathogens such as Legionella.

Information to Request: It would be helpful to know the average and maximum cfu/mL for HPC for the water supply in your area of the distribution system, during the warmest months of the year when bacterial growth is at its greatest rate. It is also important to know which test method the water utility uses.

Where to Sample and How to Test: The water utility’s information on HPC provides a baseline for the water supply. Testing would be done by a certified laboratory and should use the same test method as the water supplier. If you decide to collect samples, samples from distal taps in the plumbing system would be informative, especially following low water usage periods. It is easy to contaminate a sample and protocols for sanitary sample collection should be established and reviewed prior to sampling.

SUBSTANTIATION:

This appendix provides basic guidance to help plumbing system design engineers, building owners, and water system managers obtain important information from their water suppliers (PWSs; water suppliers or purveyors) and to collect samples and assess water quality. This information will help them design, install, and manage potable water systems that maintain water quality all the way to the end users and help protect the pipes, fittings, fixtures, and other components that make up their plumbing systems.
APPENDIX X

HYDROGEN FUEL GAS PIPING

X 101.0 General.

X 101.1 Applicability. The regulations of this Appendix shall govern the installation of new hydrogen fuel gas piping in or in connection with a building, structure or within the property lines of premises, and as supplied by an authorized hydrogen generator or supplier. In accordance with Chapter 12 of this code, fuel gas includes natural gas (up to 5 percent hydrogen by volume), manufactured liquefied petroleum or a mixture of these.

X 102.0 Hydrogen Gas Piping System Requirements.

X 102.1 General. The purpose of this Appendix is specific to gas piping systems utilizing 95 percent to 100 percent gaseous hydrogen, unless otherwise noted.

X 102.2 Applications. This Appendix shall not apply to fuel gas types described in Chapter 12 of this code.

X 102.3 Definitions. For the purpose of this appendix, the following definitions shall apply:

Hydrogen Gas. For purposes of this Appendix, “Gas” is described as 95 percent or more gaseous hydrogen, unless otherwise specified as a hydrogen admixture.

Hydrogen Admixtures. Fuel gas to which hydrogen is blended and/or mixed over 5 percent but not exceeding 20 percent by volume from the generator or supplier at the point of delivery.

X 103.0 Inspection.

X 103.1 Inspection Notification. Upon completion of the installation, alteration, or repair of hydrogen gas piping, and prior to the use thereof, the Authority Having Jurisdiction shall be notified that such hydrogen gas piping is ready for inspection.

X 103.2 Excavation. Excavations required for the installation of underground piping shall be kept open until the piping has been inspected and approved. Where such piping is covered or concealed before such approval, it shall be exposed upon the direction of the Authority Having Jurisdiction.

X 103.3 Type of Inspections. The Authority Having Jurisdiction shall make the following inspections and either shall approve that portion of the work as completed or shall notify the permit holder wherein the same fails to be in accordance with this Appendix.

X 103.3.1 Rough Piping Inspection. This inspection shall be made after hydrogen gas piping authorized by the permit has been installed and before such piping has been covered or concealed or fixture or appliance has been attached thereto. This inspection shall include a visual inspection to determine that the hydrogen gas piping size, material, and installation meet the requirements of this code, and a pressure test in accordance with the Authority Having Jurisdiction.
103.3.2 Final Piping Inspection. This inspection shall be made after hydrogen gas piping authorized by the permit has been installed, and after portions thereof that are to be covered or concealed are so concealed, and before fixtures, appliances, or shutoff valves has been attached thereto. This inspection shall comply with Section X 103.0. Test gauges used in conducting tests shall be in accordance with The Authority Having Jurisdiction.

104.0 Certificate of Inspection.

104.1 Issuance. Whereupon final piping inspection, the installation is found to be in accordance with the provisions of this Appendix, evidence of inspection shall be provided by the Authority Having Jurisdiction.

104.2 Hydrogen Gas Generator or Supplier. When requested by the hydrogen gas supplier, a copy of the certificate of such final piping inspection shall be issued by the Authority Having Jurisdiction to the serving hydrogen gas supplier supplying gas to the premises.

104.4 Unlawful. When piping has been installed or replaced, it shall be unlawful for a serving hydrogen gas supplier to turn on or cause to be turned on, a hydrogen gas or a hydrogen gas meter or meters, without approval from the Authority Having Jurisdiction. All piping, appliances and appurtenances shall be listed and approved.

105.0 Authority to Render Hydrogen Gas Service.

105.1 Authorized Personnel. It shall be unlawful for a person, firm, or corporation, except the Authority Having Jurisdiction to turn on or reconnect hydrogen gas service in or on a premises where and when hydrogen gas service is, at the time, not being rendered.

105.2 Outlets. It shall be unlawful to turn on or connect gas in or on the premises unless outlets are securely connected to gas appliances or capped or plugged with screw joint fittings.

105.3 Notification. The utility provider shall supply the Authority Having Jurisdiction a notification letter of any changes to hydrogen gas supplies that include admixtures of gaseous hydrogen above 5 percent by volume.

106.0 Authority to Disconnect Service.

106.1 Disconnection. The Authority Having Jurisdiction or the serving hydrogen gas supplier is hereby authorized to disconnect hydrogen gas piping or appliance or both that shall be found not to be in accordance with the requirements of this Appendix or that are found defective and, in such condition, as to endanger life or property.

106.2 Notice. Where such disconnection has been made, a notice shall be attached to such hydrogen gas piping or appliance or both that shall state the same has been disconnected, together with the reasons thereof.

106.3 Capped Outlets. It shall be unlawful to remove or disconnect hydrogen gas piping or appliance without capping or plugging with a screw joint fitting, the outlet from which said pipe or appliance was removed. Outlets to which appliances are not connected shall be left capped and gastight on a piping system that has been installed, altered, or repaired.

107.0 Temporary Use of Hydrogen Gas.

107.1 General. Where temporary use of hydrogen gas is desired, and the Authority Having Jurisdiction deems the use necessary, a permit shall be permitted to be issued for such use for a period not to exceed that designated by the Authority Having Jurisdiction, provided that such hydrogen gas piping system otherwise is in accordance with the requirements of this Appendix regarding material, sizing, and safety.

X 108.1 Design of Hydrogen Piping System. Where required by the Authority Having Jurisdiction, a piping sketch or plan shall be prepared prior to commencing with the installation. This plan must display the intended material to be used, the piping's location, the dimensions and lengths of different branches, the assorted load demands, and the point of delivery's position.

X 108.2 Maximum Hydrogen Gas Demand.
X 108.2.1 Sizing of Hydrogen Gas Piping Systems. Hydrogen gas piping systems shall be sized and installed to provide the maximum demand, and supply hydrogen gas to each appliance inlet at no less than the minimum supply pressure in accordance with the requirements of the appliance manufacturer.

X 108.2.2 Sizing Methods. Hydrogen gas piping shall be sized in accordance with one of the following:
(1) Pipe sizing tables or sizing equations in this Appendix.
(2) In accordance with the piping manufacturer's instructions.
(3) Approved engineering methods.

X 108.3 Maximum Operating Pressure in Buildings. The maximum operating pressure for any piping systems located inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:
(1) The piping joints are welded or brazed.
(2) The piping joints are flanged, and all pipe-to-flange connections are made by welding or brazing.
(3) The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
(4) The piping is located inside buildings or separate areas of buildings used exclusively for one of the following:
   (a) Industrial processing or heating
   (b) Research
   (c) Warehousing
   (d) Boiler or mechanical rooms
(5) Piping is a temporary installation for buildings under construction.
(6) The piping serves appliances or equipment used for agricultural purposes.
(7) Manufacturer products shall be specifically listed and approved for pressures exceeding 5 psi (34 kPa) distributing gaseous hydrogen.

X 108.4 Acceptable Piping Materials and Joining Methods. The materials used in the piping system shall comply with the listed and approved standards outlined in this Appendix or as approved by the Authority Having Jurisdiction.
X 108.4.1 Used Materials. Pipe, fittings, valves, or any other materials cannot be reused unless they are entirely devoid of foreign substances and deemed suitable for the use of hydrogen gas.

X 108.4.2 Other Materials. Material not covered by specifications listed herein shall meet the following criteria:
(1) Be investigated and tested to determine that it is safe and suitable for the proposed service.
(2) Be recommended for that service by the manufacturer.
(3) Be acceptable to the Authority Having Jurisdiction.

X 108.5 Metallic Pipe. Wrought and Cast-iron pipe shall not be used.

X 108.5.1.2 Steel, Stainless Steel, and Copper Pipe. Steel, stainless steel, copper and copper alloy tubing pipe and tubing shall be listed for the use with hydrogen gas.

X 108.6 Metallic Tubing.

X 108.6.1 Steel and Stainless Steel Tubing. Steel and stainless-steel tubing shall be listed for the use with hydrogen gas.
108.2 Copper and Copper Alloy Tubing. Copper and copper alloy tubing shall be of Type K or L and shall be listed for the use with hydrogen gas.

108.3 Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing systems shall be listed for the use with hydrogen gas.

108.7 Metallic Piping Joints and Fittings. The piping joint used shall be suitable for the pressure and temperature conditions while taking into consideration joint tightness and mechanical strength under the service conditions. The joint shall have the capacity to withstand the maximum end force resulting from internal pressure, temperature-induced expansion or contraction, vibration, fatigue, or the weight of the pipe and its contents.

108.7.1 Pipe Joints. Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded, or assembled with press-connect fittings listed for the use with hydrogen gas.

108.7.2 Metallic Pipe Threads. Metallic pipe and fitting threads shall be taper pipe threads and shall be listed for the use with hydrogen gas. Thread sealant shall also be listed for use with hydrogen gas.

108.7.3 Copper Tubing Joints. Copper tubing joints shall be brazed using a material that melts at over 1000°F (538°C) or assembled with press-connect fittings listed for use with hydrogen gas. Brazing alloys should not contain more than 0.05 percent phosphorus.

108.7.4 Stainless Steel Tubing Joints. Stainless steel joints shall be welded, assembled with listed tubing fittings, brazed using materials that melt at over 1000°F (538°C), or assembled with press-connect fittings listed for use with hydrogen gas. Only manufacturer-recommended brazing alloys and fluxes shall be used when working with stainless steel alloys.

108.7.5 Metallic Pipe Fittings. Metallic fittings shall comply with the following:

1. Threaded fittings in sizes larger than 4 inches (100 mm) shall not be used.

2. Fittings used with steel, stainless steel, or copper alloy pipe shall be steel, stainless steel, or copper alloy.

3. Fittings used with copper or copper alloy pipe shall be copper or copper alloy.

4. Special fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression-type tubing fittings shall be as follows:
   (a) Used within the fitting manufacturer’s pressure-temperature recommendations.
   (b) Used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion, or contraction.
   (c) Acceptable to the Authority Having Jurisdiction.
   (d) Listed for use with hydrogen gas.

108.8 Plastic Piping, Joints, and Fittings. Plastic pipes, tubing, and fittings shall only be installed outdoors and underground in accordance with the instructions provided by the manufacturer and this code. All plastic piping and fittings shall be listed for use with hydrogen gas.

108.8.1 Joint Design. The joint shall be created and installed in a way that the longitudinal pullout resistance of the joint is equivalent to, or greater than, the tensile strength of the plastic piping material. The joints shall be listed for use with fer Hydrogen gas.

108.8.2 Heat-Fusion Joint. Heat-fusion joints shall be performed based on qualified and approved procedures. Heat fusions fittings shall be approved and tested for hydrogen gas applications.

108.9 Flange Specification. Flanges shall be approved and listed by the manufacturer in accordance with Section X 108.9.1 through Section X 108.9.2
X 108.9.1 Flange Gaskets. Gasket material shall be able to endure the design temperature and pressure of the piping system, along with the chemical elements of hydrogen gas being transmitted without any alteration to its chemical or physical characteristics. When selecting the gasket material, the potential impact of fire exposure on the joint shall be considered.

X 108.9.2 Flange Gasket Materials. Acceptable materials shall be approved and listed by the manufacturer for the use of hydrogen gas.

X 109.0 Hydrogen Gas Meters. Meters shall be listed for hydrogen use and in accordance with the testing procedures in accordance with Chapter 12 of this code, manufacturer approved installation instructions, and the Authority Having Jurisdiction.

X 110.0 Hydrogen Gas Pressure Regulators. Regulators shall be listed for hydrogen use and in accordance with the testing procedures in accordance with Chapter 12 of this code, manufacturer approved installation instructions and the Authority Having Jurisdiction.

X 110.1 Identification. A metal tag or another form of permanent identification shall be used to label all line pressure regulators in multi-regulator installations, indicating the building or specific area being serviced.

X 110.2 Discharge of Vents. The discharge stacks, vents, or outlet parts of all pressure relieving and pressure limiting devices shall be located so that gas is safely discharged outdoors. Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage.

X 111.0 Gas Piping Installation. Piping systems shall be installed in accordance with the testing procedures in accordance with Chapter 12 of this code, Fuel Gas Chapter, manufacturer approved installation instructions and the Authority Having Jurisdiction.

X 111.1 Hydrogen Gas Shutoff Valves. Shutoff valves shall be listed for hydrogen use and in accordance with the testing procedures in accordance with Chapter 12 of this code, manufacturer's approved installation instructions, and the Authority Having Jurisdiction.

X 112.0 Appliance and Equipment Connections to Building Piping.

X 112.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with the following:

1. Rigid metallic pipe and fittings.
2. Semirigid metallic tubing and metallic fittings.
3. A listed connector shall be used in accordance with the manufacturer’s installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
4. Only one connector shall be used per appliance.
5. CSST where installed in accordance with the manufacturer’s installation instructions. CSST shall connect only to appliances that are fixed in place.

X 113.0 Pressure Testing, Inspection, and Purging.

X 113.1 Test Preparation. Test preparation shall be in accordance with the testing procedures in accordance with Chapter 12 of this code, manufacturer approved installation instructions and the Authority Having Jurisdiction.

X 113.2 Test Pressure. The pressure test shall be performed using air, CO₂, or nitrogen at a test pressure, not less than 10 psi (69 kPa) gauge pressure. Test pressures shall be held for a length of time satisfactory to the Authority Having Jurisdiction but in no case less than 15 minutes with no perceptible drop in pressure. These tests shall be made in the presence of the Authority Having Jurisdiction. Necessary apparatus for conducting tests shall be furnished by the permit holder. Test gauges used in conducting tests shall be in accordance with this code.

X 113.3 Purging and Initial Filling Requirements. Purging of pressure test gas shall be performed be in accordance with the purging requirements of the Authority Having Jurisdiction. Initial filling of the piping system with hydrogen gas shall be monitored at each outlet to ensure that all the pressure test gas has been removed. Once hydrogen gas is detected at each outlet, the purging process shall be stopped, and the piping system capped leak-tight at each outlet.
X 114.0 Required Gas Supply.
X 114.1 General. The installation of hydrogen gas piping shall comply with this section, Sections X 114.2 through Section X 114.4 and Section X 115.0. The hydrogen gas piping regulations and tables are based on the use of a gas having a specific gravity of 0.07. Where blended gas of a different specific gravity is to be delivered, the specific gravity conversion factors provided by the serving gas supplier shall be used in sizing piping systems in lieu of the hydrogen gas demand sizing table in this Appendix.

X 114.2 Volume. The hourly volume of gas required at each piping outlet shall be taken at not less than the maximum hourly rating as specified by the manufacturer of the appliance or appliances to be connected to each such outlet.

X 114.3 Gas Appliances. Where the gas appliances to be installed have not been specified, the piping system designer shall be permitted to estimate the hourly volume requirements of the expected hydrogen appliances. To obtain the cubic feet per hour (m³/h) of gas required, divide the input of the appliances by the average Btu (kW•h) heating value per cubic foot (m³) of the hydrogen gas. The average Btu (kW•h) per cubic foot (m³) of the hydrogen gas in the area of the installation shall be permitted to be obtained from the serving gas supplier.

X 114.4 Size of Piping Outlets. The size of the supply piping outlet for a gas appliance shall be not less than 1/2 of an inch in diameter (15 mm). The size of a piping outlet for a mobile home shall be not less than 3/4 of an inch in diameter (20 mm).

X 115.0 Required Gas Piping Size.
X 115.1 Pipe Sizing Methods. When determining the pipe size using methods in Section X 115.2.2. The diameter of each pipe segment should be obtained from the pipe sizing tables in Section X 115.2. or the sizing tables supplied by the manufacturer of a listed hydrogen gas piping system.

X 115.2 Sizing of Hydrogen Gas Piping Systems. The sizing of the hydrogen gas piping shall be in accordance with Table X 115.2.1(A) or Table X 115.2.1(B).

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**Table X 115.2.1(A)**

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</tr>
<tr>
<td>350</td>
<td></td>
<td>74</td>
<td>155</td>
<td>292</td>
<td>600</td>
<td>899</td>
<td>1,732</td>
<td>2,762</td>
<td>4,885</td>
<td>9,968</td>
<td>18,040</td>
<td>29,219</td>
</tr>
</tbody>
</table>

**TABLE X 115.2.1(B)**

100% HYDROGEN GAS (SG=0.07, HV=325 BTU/cu.ft.)

Capacities in CFH (Cubic Feet per Hour)

Schedule 40 Steel Pipe

Less than 2-PSI and 0.5-inch WC Drop
X 115.2.2 Sizing Equations. The internal diameter of smooth wall pipe or tubing can be determined in accordance with Table X 115.2.1(A) and Table X 115.2.1(B) based on the capacity or calculated with the following equation.

\[
Q = 187.3 \frac{D^3 \cdot \Delta H}{C_r \cdot fba \cdot L}
\]

\[
= 2313 D^{2.623} \left( \frac{\Delta H}{C_r \cdot L} \right)^{0.341}
\]

X 115.2.3 Sizing of Piping Sections. To determine the size of each section of pipe in a system within the range of Table X 115.2.1 proceed as follows:

1. Measure the length of the pipe from the gas meter location to the most remote outlet on the system.

2. Select the length in feet (ft) column and row showing the distance, or the next longer distance where the table does not give the exact length.

3. Starting at the most remote outlet, find in the row just selected the gas demand for that outlet. Where the exact figure of demand is not shown, choose the next larger figure in the row.

4. At the top of this column will be found the correct size of pipe.

5. Using this same row, proceed in a similar manner to each section of pipe serving this outlet. For each section of pipe, determine the total gas demand supplied by that section. Where gas piping sections serve both heating and cooling appliances and the installation prevents both units from operating simultaneously, the larger of the two demand loads shall be used in sizing these sections.

6. Size each section of branch piping not previously sized by measuring the distance from the gas meter location to the most remote outlet in that branch and follow the procedures of steps 2, 3, 4, and 5 above. Size branch piping in the order of their distance from the meter location, beginning with the most distant outlet not previously sized.

X 116.0 Variable Gas Pressure. Where the supply hydrogen gas pressure exceeds 5 psi (34.6 kPa) or is less than 6 inches of water column (1.5 kPa), or where diversity demand factors are used, the design, pipe sizing, materials, location, and use of such systems first shall be approved by the Authority Having Jurisdiction. Piping systems designed for pressures exceeding the serving gas supplier’s standard delivery pressure shall have prior verification from the gas supplier of the availability of the design pressure.

X 117.0 Engineering Methods. For conditions other than those covered by Section X 115.0, such as longer runs or greater hydrogen gas demands, the size of each hydrogen gas piping system shall be determined by standard engineering methods acceptable to the Authority Having Jurisdiction, and each such system shall be so designed that the total pressure drop between the meter or another point of supply and an outlet where full demand is being supplied to all outlets, shall be in accordance with the requirements of Section X 108.0.

SUBSTANTIATION:
Hydrogen has become an emerging energy source that is being utilized worldwide. Hydrogen is the smallest molecule and blending it in excess of 25% can cause leakage of those molecules with existing piping materials. This proposal
substantiates that any mixture that exceeds 20% hydrogen gas is a possible danger to life safety. Blends that are under 20% are safe to utilize existing piping that is in good working condition. This proposal for revising the fuel gas chapter is to confirm that hydrogen blends above 20% do not get utilized in existing piping meant for other fuels. Life safety is a priority of model codes and due to technological advances, I feel that this change is necessary to ensure that.

The world-wide energy industry seeks to address the impact of global climate change through a reduction in the use of fossil fuels. One of the many proposed approaches includes the use of alternative clean fuels, renewable fuels, and fuel blends. These approaches include gaseous hydrogen, hydrogen blended with natural gas, and renewable natural gas. These alternative fuels are not new, but the mainstream introduction of these fuels into the flow of commerce dictates that the model fuel gas codes be amended to accommodate their anticipated impact on general safety, reliability, and efficiency.

This appendix for Hydrogen Fuel Gas Piping contains many new and/or amended industry practices for designing, sizing, installing, and inspecting new fuel gas piping systems containing either hydrogen admixtures or pure gaseous hydrogen. As a fuel, hydrogen has the smallest molecule, and thus presents a challenge to piping system designers and operators regarding containment of the fuel within the piping system. Furthermore, hydrogen has three times less energy content than natural gas making it more challenging to deliver sufficient fuel to maintain proper operation and efficiency within traditional gas appliances.

This manual provides the user with guidance on how the use of hydrogen fuel and admixtures will impact the customary industry practices associated with the distribution of fuel gas within buildings. The user is advised to ensure that only appliances and piping system components that have been tested and listed to a nationally recognized consensus standard for hydrogen service be specified for use within hydrogen piping systems. Furthermore, the user of this document must be aware that the practices recommended within are subject to frequent updating and revision as newer data and research become known regarding the impact of hydrogen gas for this type of service.
APPENDIX Y
ECOLOGICAL-SANITATION: COMPOSTING TOILET AND URINE REUSE SYSTEMS

Y 101.0 General.
Y 101.1 Applicability. The provisions of this appendix shall apply to the design, construction, performance, alteration, and repair of composting toilet and urine diversion systems.

Y 201.0 Definitions.
Y 201.1 General. For the purpose of this appendix, the following definitions shall apply:

Agricultural Amendment. A synthetic chemical, natural, or manufactured substance or by-product, or a combination of those substances or by-products, intended to induce crop yields, plant growth or to produce any physical, microbial, or chemical change in the soil.

Biosolid. A semisolid, nutrient-rich product of the sewage wastewater treatment process. (Also known as sewage sludge).

Compost Additives. Any material such as sawdust, wood shavings, and other compostable material added to the dry toilet or compost processor to maintain operational conditions within the composting toilet system.

Compost Processor. The site of aerobic decomposition transforming excreta and compost additives into humus.

Composting Toilet System. A system designed to safely collect and process excreta and compost additives into humus through aerobic decomposition.

Diverted Urine. Urine that is collected and has not made contact with feces.

Dry Toilet. A fixture for collecting, containing, or transporting excreta without the use of water to move contents to the compost processor. (Also known as commode, site-built toilet, or foam flush toilet.)

Excreta. Includes but is not limited to urine, feces, menses, toilet paper, and other human body emissions and biodegradable cleaning products.

Fertilizer. A synthetic chemical, natural, or manufactured substance or by-product or a combination of those substances or by-products, intended to induce crop yields, plant growth or to produce any physical, microbial, or chemical change in the soil. Such substances or by-products contain 5 percent or more of total nitrogen (N), available phosphate ($P_2O_5$), or soluble potash ($K_2O$), singly, collectively, or in combination.

Humus. The biologically decomposed, soil-like output of the compost processor.

Leachate. Liquid draining from the compost processor.
Owner's Manual. A manual provided to the owner containing instructions for all management aspects of the system.

Raw Urine. Urine which has minimal contact with biofilms, feces, or similarly contaminated materials. Fresh urine is subject to biochemical reactions which are difficult to control.

Sanitized Urine. Raw urine which has been treated and is therefore classified as a fertilizer and/or an agricultural amendment. Leachate of less than 3 percent solids which has been treated and is therefore classified as a fertilizer and/or an agricultural amendment.

Stored Urine. Raw urine which is collected for beneficial use, is biologically active, and is not a biosolid or part of a private sewage treatment system.

Urine Diversion. Separation of urine from other excreta that occurs at the dry toilet.

Urine Diverting Dry Toilet (UDDT). A fixture for collecting, containing, or transporting urine and feces separately without the use of water through independent piping.

Urine Diverting Toilet. A fixture for collecting, containing, or transporting urine and feces separately through independent piping.

Y 301.0 Design and Construction.
Y 301.1 Requirements. Composting toilets, composting toilet systems, and urine diversion systems shall meet the design, construction, and performance requirements of Section Y 301.1.1 or Section Y 301.1.2.

Y 301.1.1 Composting Toilets and Composting Toilet Systems. Composting toilets and composting toilet systems shall be listed to NSF/ANSI 41 or approved by the Authority Having Jurisdiction.

Y 301.1.2 Alternative Design Systems. Where approved by the Authority Having Jurisdiction, composting toilets, urine diverting toilets, urine diverting dry toilets (UDDTs), and urine diversion systems for residential and commercial applications shall comply with the provisions of Section Y 301.2 through Section Y 701.1.

Y 301.2 System Materials and Components. Pipe, pipe fittings, traps, fixtures, material, and devices used in composting toilet and urine diversion systems that are expected to contact leachate or diverted urine shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body), unless otherwise approved by the Authority Having Jurisdiction. Materials and components shall comply with the approved applicable recognized standards referenced in this appendix and Chapter 17 and shall be free from defects.

Y 301.3 System Design. Composting toilet and urine diversion systems shall be designed by a person who is either registered or licensed to perform plumbing design work, or who demonstrates competency to design composting toilet and urine diversion systems.

Y 401.0 Permits.
Y 401.1 General. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any composting toilet and urine diversion system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

Exception: A urine reuse system that meets the following criteria:
1. Volume does not exceed 16 ounces (473 mL) per day;
2. Originates from a private residence;
3. Is used by the occupants of that residence for gardening, composting, or landscaping at the residence;
4. Does not discharge to surface waters of the state, a municipal separate storm sewer system, an industrial stormwater system, or a stormwater management structure;
5. Provides groundwater and wellhead protection as regulated by the Authority Having Jurisdiction; and
6. Is not subject to flooding or high-water table conditions.

Y 401.1.1 Urine Diversion Systems. No permit for any urine diversion system shall be issued until the following information is provided to the Authority Having Jurisdiction:
Y 501.0 Maintenance and Inspection.

Y 501.1 General. Composting toilet and urine diversion systems and components shall be maintained and inspected in accordance with Section Y 501.1.1 through Section Y 501.1.3.

Y 501.1.1 Maintenance Responsibility. The required maintenance and inspection of composting toilet and urine diversion systems shall be the responsibility of the property owner, unless otherwise specified by the Authority Having Jurisdiction. The property owner shall be responsible for retaining test result records in accordance with Section Y 601.6.2 and making them available to the Authority Having Jurisdiction upon request.

Y 501.1.2 Operation. Composting toilet and urine diversion systems shall be operated in accordance with the owner's manual.

Y 501.1.3 Inspection. In the event of a nuisance complaint or documented system failure, the composting toilet and urine diversion system shall be made available for inspection, and the owner or the owner's agent shall be responsible for making repairs or alterations as ordered by the Authority Having Jurisdiction. At the request of the Authority Having Jurisdiction, results of all laboratory testing and new tests in accordance with Section T 601.6 following repairs to alleviate dangerous or unsanitary conditions, shall be provided at the owner's expense.

Y 501.2 Composting Toilet; Operation and Maintenance Manual. An owner's manual shall be made available to the Authority Having Jurisdiction upon request and shall be provided to the new owner upon transfer of property or tenancy. The owner's manual shall include the following:

(1) Schedule for addition of necessary compost additives.
(2) Source or provider of necessary compost additives. The source shall be permitted to be onsite.
(3) Schedule and instructions for all regular maintenance tasks.
(4) Expected input of and capacity for excreta and compost additives to the composting toilet system specifying loading of dry toilet(s) and compost processor(s).
(5) Plan for container transfer and cleaning where transfer is used.
(6) Expected schedule for removing humus from composting processors and where used, secondary composting bins.
(7) Plan for onsite disposal of humus or professional removal.
(8) Plan for managing leachate.
(9) Plan for microbial testing in accordance with Section Y 601.6.2.

Y 501.3 Urine Diversion; Operation and Maintenance Manual. An owner's manual shall be made available to the Authority Having Jurisdiction upon request and shall be provided to the new owner upon transfer of property or tenancy. The owner's manual shall include the following:

(1) Expected input of and capacity for urine storage and urine treatment additives.
(2) Nutrient management plan (sample plan).
(a) Expected schedule for application.
(b) Plan for application.
(c) Source of additional additives (including onsite materials).
(3) Schedule and instructions for all regular maintenance tasks.
(4) Plan for container transfer and cleaning where transfer is used.
(5) Plan for testing in accordance with the following:
(a) Nutrient management plan.
(b) Certification of commercial products, such as fertilizers and agricultural amendments.

Y 601.0 Composting Toilet System Design.

Y 601.1 Requirements. The design and installation of composting toilet systems shall be in accordance with Section Y 601.2 through Section Y 601.7.

Y 601.2 Corrosion Resistance. All components expected to contact excreta or leachate shall be constructed of corrosion-resistant material such as stainless steel or durable polymers. Concrete in contact with excreta or leachate shall meet the requirements of Section Y 601.3.

Y 601.3 Concrete Construction. Concrete construction shall be reinforced, watertight, and able to withstand loading conditions. Where drainage is required, the processor floor shall be sloped not less than ¼ inch per foot (2.0 percent slope). The flange of each sub-drain shall be set level.

Y 601.4 Dry Toilets. Dry toilets shall comply with Section T 601.4.1 through Section Y 601.4.3.

Y 601.4.1 Odor. Dry toilets shall be designed to prevent the infiltration of odors into the building during normal operation and in the event of temporary power failure.

Y 601.4.2 Contact. Dry toilets shall be capable of transporting excreta into the compost processor or containing excreta for transfer as specified in the owner's manual.

Y 601.4.3 Vectors. Dry toilets shall be designed to limit vectors and prevent human contact, except where required for regular maintenance as specified in the owner's manual.

Y 601.5 Compost Processors. Compost processors shall be designed in accordance with Sections Y 601.5.1 through Y 601.5.9 and shall maintain unsaturated aerobic composting conditions within the compost mass, through the drainage, absorption, or desiccation of leachate, and aeration of the processor.

Y 601.5.1 Leachate. Leachate shall be collected for removal or recirculation within the processor, evaporated, or drained to an approved plumbing drainage system or other location approved by the Authority Having Jurisdiction. Leachate storage tanks shall be constructed and installed in accordance with Section Y 601.5.1.1 through Section Y 601.5.1.7.

Y 601.5.1.1 Venting. Leachate storage tanks shall be vented as required for pressure equalization. Where required, vents shall be installed on leachate storage tanks and shall extend from the top of the tank. The connection of storage tank vents to the plumbing venting system shall be not less than 6 inches (152 mm) above the flood level rim of the highest fixture. Vents extending to the outdoors shall terminate not less than 12 inches (305 mm) above grade. The vent terminal shall be directed downward and shall be covered with a 3/32 inch (2.4 mm) mesh screen to prevent the entry of vermin and insects.

Y 601.5.1.1.1 Vent Size. Pressure equalization vents that prevent nitrogen loss by the use of restrictions or of vent piping or tubing that is less than the minimum pipe diameter required in Section 904.1, shall be approved by the Authority Having Jurisdiction.

Y 601.5.1.2 Overflow. Where storage tank overflows are installed, they shall be connected to the plumbing drainage system.

Y 601.5.1.2.1 Backwater Valve. Storage tank overflows, when subject to backflow, shall be provided with a backwater valve at the point of connection to the plumbing drainage system. The backwater valve shall be accessible for inspections and maintenance.

Y 601.5.1.3 Construction. Leachate storage tanks shall be constructed of polyethylene terephthalate (PET), polyethylene naphthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to 49 CFR 178.274.

Y 601.5.1.4 Above Grade. Above grade storage tanks shall be prohibited where subject to freezing conditions unless such tanks are provided with a means of freeze protection. Above grade leachate storage tanks shall be
Y 601.5.1.5 Below Grade. Leachate storage tanks installed below grade shall be structurally designed to withstand all anticipated loads. Tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft\(^2\)) (1465 kg/m\(^2\)) when the tank is designed for underground installation. Below grade leachate tanks installed underground shall be provided with manholes. The manhole opening shall have a diameter of not less than 20 inches (508 mm) and shall be located not less than 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system shall be equal to or greater than the buoyancy force of the tank. The below grade leachate storage tank level shall be provided with an audible and visual high-water alarm.

Y 601.5.1.6 Marking. Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following words: “DANGER-CONFINED SPACE.”

Y 601.5.1.7 Openings. All openings shall be covered and secured to prevent tampering. Openings shall be screened or covered to prevent rodent, vermin, and insect infiltration and shall be protected against unauthorized human entry.

Y 601.5.2 Vectors. The compost processor shall be designed and installed to limit vector access.

Y 601.5.3 Transfer. Where unfinished excreta or diverted urine is transferred between processors or from a dry toilet to a processor, transfer and cleaning of containers and provisions for limiting user exposure shall be in accordance with the owner’s manual.

Y 601.5.4 Watertightness. Processors shall be constructed of watertight material in accordance with Section Y 601.2.

Y 601.5.5 Vermin (Rodent) Proofing. The compost processor shall be protected to prevent the entrance of rodents, vermin, and insects. Other than vents, drainage, or dry toilets, no unsecured openings shall exceed ½-inch (12 mm) in the least dimension.

Y 601.5.6 Active Conditions. The compost processor or processors shall be sized to compost excreta for a minimum of one year of biologically active conditions. Biologically active conditions shall be where the daily average temperature is equal to or greater than 42°F (6°C).

Exception: Systems with shorter retention shall be permitted where either of the following conditions are met:

1. Humus from the compost processor has been tested in accordance with Section Y 601.6.2 and there is either a secondary composting stage where humus is retained in a compost bin or other facility designated for the exclusive purpose of containing humus removed from the compost processor; or

2. Humus is removed off site for processing or disposal at an approved facility.

Y 601.5.7 Secondary Composting. Humus to be transferred to secondary composting shall first be tested in accordance with Section Y 601.6.2. Secondary composting shall be labeled and protected from human contact. Contact with precipitation and surface waters shall be prohibited.

Y 601.5.8 Ventilation. Negative ventilation between the dry toilet and compost processor shall be provided when the compost processor is connected directly to the dry toilet without a trap. Dry toilets without connection to the compost processor shall not require a vent.

Y 601.5.8.1 Vent Terminals. Vent stacks shall terminate to the building’s exterior as required by this code or mechanical code.

Y 601.5.9 Sizing. The compost processor shall be sized to accommodate the maximum daily adult usage as specified by the manufacturer’s published ratings. Site built compost processors shall be sized to hold not less than 10 gallons (38 L) of material per person per year while allowing for the removal of the humus, or as specified by the system designer.

Y 601.6 Testing. Composting toilet systems shall be tested in accordance with Section Y 601.6.1 and Section Y 601.6.2.

Y 601.6.1 Compost Processors. Compost processors shall be tested for water tightness by filling the system to the maximum designed liquid storage capacity of the unit for a duration of 24 hours.
Y 601.2 Humus. The owner or owner’s agent of the composting toilet system shall verify compliance with the manufacturer’s maintenance and operation manual in accordance with Section Y 501.2. Prior to removal of humus from the composting processor, a sample of the humus from the first treatment period shall be submitted to a certified laboratory. The sample shall be collected after a minimum of one year of biologically active conditions. Where multiple compost processors are installed, the humus sample shall be removed from the last compost processor. The sample collection shall be tested in accordance with EPA/625/R-92/013 using the Class A, Alternative 1 procedure. Humus shall not have a moisture content exceeding 75 percent by weight and shall not exceed 200 fecal coliforms per gram.

Y 601.7 Humus Removal. Humus shall be removed in accordance with the owner’s manual. Humus from the compost processor used around ornamental shrubs, flowers, trees, or fruit trees shall be mixed with soil or mulch and covered with not less than 3 inches (76 mm) of cover material. Depositing humus from any composting toilet system around any edible vegetable or vegetation shall be prohibited.

Y 701.0 Urine Diversion System Design.
Y 701.1 Requirements. The design and installation of urine diversion systems shall be in accordance with Section Y 701.2 through Section Y 701.14.
Y 701.2 Purpose. The purpose of this section is to enable the installation of urine reuse systems for beneficial use and to prevent nutrient pollution of ground and surface waters.
Y 701.3 Material Requirements. Materials used in urine reuse systems shall be impermeable and corrosion resistant.
Y 701.4 Identification. All urine diversion piping shall be identified.
Y 701.5 Change of Direction. Changes in direction of urine diversion piping shall be made by a long-sweep 90 degree fitting or other approved fittings of equivalent sweep.
Y 701.6 Pipe Sizing. Pipe sizes shall be in accordance with Chapter 7. Each urine diversion fixture shall be rated as one drainage fixture unit. Piping or tubing for urine diversion that is less than the minimum pipe diameter required in Chapter 7 shall be approved by the Authority Having Jurisdiction.
Y 701.7 Traps. Fixtures discharging into urine diversion piping connected to the plumbing drainage system shall be trapped and vented in accordance with this code.
Y 701.7.1 Vapor Backflow Protection. Where the urine diversion system is not connected to the plumbing drainage system, urine diversion fixtures discharging into piping shall be protected with a vapor backflow seal.
Y 701.8 Gradient of Horizontal Piping. Urine diversion piping shall be installed at a minimum gradient of ½ inch per foot (in/ft) (41.7 mm/m), or 4 percent toward the point of disposal or storage.
Y 701.9 Cleanouts. A cleanout shall be provided at the upper terminal of each drain line, every 50 feet (15 m), and where an aggregate horizontal change of direction exceeds 135 degrees (2.36 rad).
Y 701.10 Venting. Dry toilet fixtures without traps that require ventilation shall be connected to either a dry toilet ventilation stack or a urine diversion ventilation stack. Nonwater urinals used as urine diversion systems shall be connected to a dry toilet ventilation stack or a urine diversion ventilation stack.
Y 701.11 Discharge. A urine diversion system shall be diverted to a storage tank or shall discharge to an approved plumbing drainage system.
Y 701.12 Urine Storage Tanks. Urine storage tanks greater than 55 gallons (208 L) and having an application area of not less than 1150 square feet (106.8 m²) shall be constructed and installed in accordance with Section Y 701.12.1 through Section Y 701.12.9.
Y 701.12.1 Total Storage Volume. The total required storage volume (V) for a urine diversion system shall be determined in accordance with Equation Y 701.12.1. The use of multiple storage tanks to meet the required total storage volume shall be permitted.
\[ V = A \times N \times t \times \left( \frac{h}{24} \right) \]

Where:
\[ A = 0.4 \]
\[ h = \text{number of hours where the system is accessible to users, hours per day} \]
\[ N = \text{number of expected users} \]
\[ t = \text{duration of storage time, days} \]
\[ V = \text{total required volume, gallons} \]

For SI units: 1 gallon = 3.785 L, \( A = 1.5 \)

Y 701.12.2 Venting. Urine storage tanks shall be vented as required for pressure equalization. Where required, vents shall be installed on urine storage tanks and shall extend from the top of the tank. The connection of storage tank vents to the plumbing venting system shall be not less than 6 inches (152 mm) above the flood level rim of the highest fixture. Vents extending to the outdoors shall terminate not less than 12 inches (305 mm) above grade. The vent terminal shall be directed downward and shall be covered with a 3/32 inch (2.4 mm) mesh screen to prevent the entry of vermin.

Y 701.12.2.1 Vent Size. Pressure equalization vents that prevent nitrogen loss by the use of restrictions or of piping or tubing that is less than the minimum pipe diameter required by this code, shall be approved by the Authority Having Jurisdiction.

Y 701.12.3 Traps. Urine storage tanks shall prevent odors and nitrogen loss from the tank inlet by means of a trap, submerged inlet piping, or other means approved by the Authority Having Jurisdiction. Submerged inlet piping shall remain submerged during use and after pumpout. Exception: Where tanks have a volume not exceeding 5.5 gallons (20 L) and comply with one of the following:

(1) Are connected to a fixture(s) with active ventilation, or
(2) Have an integrated seal.

Y 701.12.4 Overflow. Where storage tank overflows are installed, they shall be connected to a plumbing drainage system.

Y 701.12.4.1 Backwater Valve. Storage tank overflows subject to backflow shall be provided with a backwater valve at the point of connection to the plumbing drainage system when connected to a public sewer system or on-site wastewater system. The backwater valve shall be accessible for inspection and maintenance.

Y 701.12.4.2 Alarms. Storage tanks shall be equipped with a visible and audible alarm to indicate when the tank has reached 80 percent capacity. Exception: Urine storage tanks utilized for sterilization or other approved treatment methods in accordance with Section Y 701.14.

Y 701.12.5 Construction. Urine storage tanks shall be constructed of polyethylene terephthalate (PET), polyethylene naphthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to 49 CFR 178.274.

Y 701.12.6 Above Grade. Above grade storage tanks shall be prohibited where subject to freezing conditions unless such tanks are provided with a means of freeze protection.

Y 701.12.7 Below Grade. Urine storage tanks installed below grade shall be structurally designed to withstand all
anticipated loads. Tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft$^2$) (1465 kg/m$^2$) when the tank is designed for underground installation. Below grade urine tanks installed underground shall be provided with manholes. The manhole opening shall have a diameter of not less than 20 inches (508 mm) and shall be located not less than 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system shall be equal to or greater than the buoyancy force of the tank.

Y 701.12.8 Marking. Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following words: “DANGER-CONFINED SPACE.”

Y 701.12.9 Openings. All openings shall be covered and secured to prevent tampering. Openings shall be screened or covered to prevent vermin entry and shall be protected against unauthorized human entry.

Exception: Where tanks have a volume not exceeding 5.5 gallons (20 L) and comply with one of the following:

1. Are connected to a fixture(s) with active ventilation, or
2. Have an integrated seal.

Y 701.13 Maintenance Plan. Every urine diversion system shall have a maintenance plan supplied to the building owner.

Y 701.13.1 Contents of Maintenance Plan. The maintenance plan shall include the following information:

1. Either a pumpout schedule and a contract, or an onsite discharge plan;
2. A pipe cleaning schedule; and
3. Designation of one or more of the following agents used for pipe cleaning:
   (a) Acetic acid,
   (b) Citric acid,
   (c) Sodium hydroxide,
   (d) Suitable biodegradable surfactant, or
   (e) Other cleaning agents approved by the Authority Having Jurisdiction.

Y 701.14 Treatment and Application. Where stored urine is to be reused onsite, a treatment method shall be included in the owner’s manual. Approved methods of treatment shall include:

1. Retention of stored urine without addition for six months before usage. Two or more holding tanks shall be required for retention.
2. Direct application to the compost processor, or through an approved nutrient management plan (NMP) meeting fecal coliforms not exceeding 2.2 CFU/100 mL, or as determined by the Authority Having Jurisdiction.
3. Alkaline treatment, or
4. Where urine is heated for at least 15 seconds and not more than 30 minutes, Equation Y 701.14(1) shall be used to determine the required duration of treatment (D). Where urine is heated for at least 30 minutes at a temperature of not less than 122°F (50°C), Equation Y 701.14(2) shall be used to determine the required duration of treatment (D).

\[ D = \frac{131\,700\,000}{10^{0.14}T} \]  

[Equation Y 701.14(1)]

\[ D = \frac{50\,070\,000}{10^{0.14}T} \]  

[Equation Y 701.14(2)]
Where:

\[ D = \text{duration of treatment, days} \]

\[ T = \text{temperature, °C} \]

**SUBSTANTIATION:**

The proposal language (above) is taken and reformatted from the WE•Stand 2023 Chapter 6 Ecological-Sanitation; Composting Toilet and Urine Reuse Systems. It began development with the 2011 Oregon Reach Code provisions on composting toilets, which was expanded to include urine diversion and other protections for public health through the public domain Recode Model Code. The Recode Model Code was created through a consensus process with a national team of experts, and continues today to incorporate refinements from the WE•Stand / ANSI process and lessons learned by designers, regulators, installers and practitioners.

**Model Code Development Background**

The Model Code was integrated into ANSI/IAPMO WE•Stand 2017, which was revised and updated in 2020 and 2023 by the IAPMO technical committees and the international Gold Ribbon Commission on Urine Reuse. Major additions from the WE•Stand 2017 process include a supplementary inspection checklist (2020); guidance for urine land application through nutrient management planning, a urine tank volume calculator, and numerous language requirements (2023). The 2023 WE•Stand edition also separates the composting toilet and urine diversion sections, rather than intermingling them. The intent of this change is to separate out urine diversion systems connected to plumbing drainage systems from dry toilet systems. This separation is also easier to understand the different public health risks, handling and treatment levels between urine reuse and composting toilet systems.

**2024 UPC Submittal - The Need**

The goal of the Code is to encourage the growth of an ecological sanitation industry through harmonization of urine diversion and composting toilet regulation across jurisdictions and code standards bodies. The code language provides a comprehensive regulatory coverage between plumbing and on-site disposal system rules and regulations in order to protect public health and the environment. This code has been successfully used in installing multiple systems throughout the country and abroad using ‘alternative means and methods’ and other permitting strategies. A comprehensive understanding of the WE•Stand success is due to its 10-year history, active ANSI / peer review development, and the successful implementation of these systems all support the adoption of this tested and mature code language for adoption into the Unified Plumbing Code standard.

**Sub-Section Summary:**

**Compost Toileting:** The proposed language would move language from the current WE•Stand into the Unified Plumbing Code. This language offers approval either following NSF 41 or having a site-built system inspected and tested to standards that are as strict or stricter than NSF 41. Integration of this proposal into the UPC will promote best practices by placing clear requirements for each system component directly into the code. Each method of approval is verified for watertightness, mandated to have a 1-year treatment period to ensure pathogen destruction, tested for proper operation, and required to document and preserve operation and maintenance information. System following NSF 41 requirements allows individual manufacturers and jurisdictions to set compliance requirements for venting, screening for insects and vermin, leachate management, and disposal of the outputs of compost processors away from human contact, and are subject to clear and enforceable standards under this proposal. However because NSF 41 treats composting toilet systems as manufactured products rather than
systems assembled from a variety of components, the size of composting chambers is limited. The proposed code addresses this limitation by allowing site-built system which adhere to the same tested standards or higher. For instance, the Bullitt Center in Seattle, WA\(^1\) required multiple Phoenix composting chambers, and load balancing the various chambers created maintenance headaches that were pivotal to removal of the composting toilet system. Under the requirements of this proposal, larger composting chambers could be assembled on-site and tested for watertightness and treatment efficacy, potentially simplifying system design and long-term maintenance. Such site-built composting chambers have become a common feature of large-scale projects in the Netherlands, Sweden, France and elsewhere\(^2\). Urine diversion systems, which can improve the function of a composting toilet system and were also a core recommendation of the Bullitt Center and recently incorporated into the PAE Living Building (Portland, OR), are explicitly allowed under this proposal.


**Urine Diversion:** Urine diversion captures urine at restroom fixtures and directs it to collection tanks, enabling the conversion of a polluting waste into a resource. Urine diversion has been extensively researched over more than 40 years, largely in an international development context, and is now being deployed as a nutrient recovery technology at the building and municipal scales. Clear code guidance is needed to enable consistent and strict public health protections, provide reliable and maintainable plumbing, and encourage the growth of an emerging industry. This proposal in addresses the following features:

- Contains clear and enforceable standards.
- Mandates documentation on all aspects of system operation and maintenance.
- Ensures urine sanitization through onsite treatment or professional disposal.
- Controls onsite land application through nutrient management requirements.

Urine diversion has emerged as a leading technology for nutrient recovery, because 70-80% of the nitrogen and 50-65% of the phosphorus in residential wastewater come from urine alone. To meet nutrient discharge limits, wastewater treatment plants must remove extremely dilute nutrients from wastewater streams using processes that are capital and energy intensive and generate potent greenhouse gasses\(^3\). Although nutrient recovery is a major goal of wastewater treatment, only 11% of nitrogen and 21% of phosphorus are recovered in the US\(^4\). Urine diversion has the potential to cut the energy demands and greenhouse gas emissions of water treatment by approximately a third to a half\(^5\).

The cost of nutrient removal from wastewater is increasingly constraining sewer districts, thereby limiting development\(^6\). To increase the supply of housing without increasing nutrient discharges, many cities are exploring urine diversion. For example, in 2020, the OCAPI program, a collaboration between Toulouse and Paris water authorities, installed urine diversion in a 1000-person district of Paris, France to pilot municipal-scale urine diversion and protect the Seine River\(^7\). In the US, the PAE Building in Portland, Oregon has a urine diversion system licensed by the Oregon Departments of Environmental Quality and Agriculture to produce commercial fertilizer directly from diverted urine\(^8\). The University of Michigan Department of Civil & Environmental Engineering was
recently invited by the New York Department of Environmental Protection to evaluate if adding urine diversion to new buildings in New York City could enable development in an area whose treatment plant is at capacity\(^9\). Urine diversion can also be used for nutrient removal in areas served by private sewage disposal systems, and to improve the function of composting toilet systems.


\[\text{Supporting documentation provided in KAVI for TC review}\]
### TABLE 1701.1
**REFERENCED STANDARDS**

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<thead>
<tr>
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(portion of table not shown remain unchanged)
Updating the version of the standard with the current year of publication or reaffirmation date and the standards which were harmonized with CSA.
TABLE 1701.1
REFERRED STANDARDS

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Note: ASME standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
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SUBSTANTIATION:
The above revisions reflect the latest updates to the ASSE standards that are referenced in Table 1701.1 and Table 1701.2.
**RECOMMENDATION:**
Revise text

**Proposed Text:**

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**SUBSTANTIATION:**
The above revisions reflect the latest updates to the ASTM standards that are referenced in Table 1701.1 and Table 1701.2.
RECOMMENDATION:
Revise text

Proposed Text:

TABLE 1701.1
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SUBSTANTIATION:
The above revisions reflect the latest updates to the AWWA standards that are referenced in Table 1701.1 and Table 1701.2.
RECOMMENDATION:
Revise text

Proposed Text:

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SUBSTANTIATION:
The above revisions reflect the latest updates to the CSA standards that are referenced in Table 1701.1. CSA B79-2008 (R2018) is being superseded by ASME A112.6.3-2022/CSA B79.3-2022, ASME A112.6.4-2022/CSA B79.4-2022, ASME A112.6.7-2022/CSA B79.7-2022,ASME A112.6.9-2022/CSA B79.9-2022 and ASME A112.36.2-2022_CSA B79.2-2022.
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**SUBSTANTIATION:**
The above revisions reflect the latest updates to the CSA standards that are referenced in Table 1701.1 and Table 1701.2.
SUBMITTER: Nikki Kidd

Organization Name: CSA

RECOMMENDATION: Revise text

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SUBSTANTIATION:
The above revisions reflect the latest updates to the CSA standards that are referenced in Table 1701.1. CSA B481-2012 (R2017) is being superseded by ASME A112.14.3-2022_CSA B481.1-2022 and ASME A112.14.4-2022_CSA B481.5-2022.
**Proposed Text:**

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<tr>
<td>IAPMO/ANSI Z601-2018 (R2023)</td>
<td>Scale Reduction Devices</td>
<td>Water Conditioning, Water Treatment 611.1.2</td>
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<td>IAPMO/ANSI Z1088-2019 (R2023)</td>
<td>Pre-Pressurized Water Expansion Tanks</td>
<td>Miscellaneous 608.3</td>
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<td>CSA B125.5-2011 (R2022)/IAPMO Z600-2011 (R2016) 2022</td>
<td>Flexible Water Connectors with Excess Flow Shut-off Device</td>
<td>Miscellaneous 604.5</td>
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(portions of table not shown remain unchanged)

Note: IAPMO standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
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<tr>
<td>ASSE/IAPMO/ANSI 5110-2015 2022</td>
<td>Backflow Prevention Assembly Testers</td>
<td>Professional Qualifications</td>
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<td>ASSE/IAPMO/ANSI 5120-2015 2022</td>
<td>Cross-Connection Control Surveyors</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE/IAPMO/ANSI 5130-2015 2022</td>
<td>Backflow Prevention Assembly Repairers</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE/IAPMO/ANSI 5140-2015 2022</td>
<td>Fire Protection System Cross-Connection Control Testers</td>
<td>Professional Qualifications</td>
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<td>ASSE/IAPMO/ANSI 5150-2015 2022</td>
<td>Backflow Prevention Program Administrators</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE/IAPMO/ANSI 16010-2019</td>
<td>Professional Qualifications Standard for the Plumbing Inspector</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE/ARCSA/IAPMO/ANSI 21130-2017 2022</td>
<td>Professional Qualifications Standard for Inspectors of Rainwater and Stormwater Catchment Systems</td>
<td>Professional Qualifications</td>
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<tr>
<td>IAPMO IGC 330-2018 2023</td>
<td>Recirculating Shower Systems Fixtures</td>
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<tr>
<td>IAPMO IS 26-2019</td>
<td>Trenchless Insertion of Polyethylene (PE) Pipe for Sewer Laterals Piping</td>
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<tr>
<td>IAPMO PS 23-2021 2022</td>
<td>Dishwasher/Reverse Osmosis Drain Airgaps Backflow Protection</td>
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<tr>
<td>IAPMO PS 25-2019 (WITHDRAWN)</td>
<td>Metallic Fittings Joining Polyethylene Pipe for Water Service and Yard Piping (WITHDRAWN)</td>
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<td>Standard</td>
<td>Description</td>
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<td>IAPMO PS 42-2013 &amp; 2022</td>
<td>Pipe Alignment and Secondary Support Systems with or without Pipe Safety or Protection</td>
<td>Miscellaneous</td>
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<tr>
<td>IAPMO/ANSI Z124.8-2013 (R2018)(R2023)</td>
<td>Plastic Liners for Bathtubs and Shower Receptors</td>
<td>Fixtures</td>
</tr>
<tr>
<td>IAPMO/ANSI Z1000-2019 (R2023)</td>
<td>Prefabricated Septic Tanks</td>
<td>DWV Components</td>
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(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
The above revisions reflect the latest updates to the IAPMO standards that are referenced in Table 1701.1 and Table 1701.2.
**TABLE 1701.1**
**REFERENCED STANDARDS**

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<thead>
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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tr>
<td>ANSI/ISEA Z358.1-2014 (R2020)</td>
<td>Emergency Eyewash and Shower Equipment</td>
<td>Miscellaneous</td>
<td>416.1, 416.2</td>
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(portions of table not shown remain unchanged)

Note: ANSI/ISEA Z358.1 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The above revision reflects the latest update to the ISEA standard that is referenced in Table 1701.1.
TABLE 1701.1
REFERENCED STANDARDS

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<tr>
<td>MSS SP-67-2017-2022</td>
<td>Butterfly Valves</td>
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(portions of table not shown remain unchanged)

Note: MSS SP-67 meets the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

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<td>MSS SP-104-2018-2022</td>
<td>Wrought Copper, Solder-Joint Pressure Fittings</td>
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<td>MSS SP-109-2018-2022</td>
<td>Weld-Fabricated, Copper Solder-Joint Pressure Fittings</td>
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(portions of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the MSS standards that are referenced in Table 1701.1 and Table 1701.2.
### TABLE 1701.1
**REFERENCED STANDARDS**

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<th>STANDARD NUMBER</th>
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<th>REFERENCED SECTION</th>
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<tr>
<td>NFPA 31-2020</td>
<td>Standard for the Installation of Oil-Burning Equipment</td>
<td>Fuel Gas, Appliances</td>
<td>505.3, 1201.1</td>
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<tr>
<td>NFPA 58-2020</td>
<td>Liquefied Petroleum Gas Code</td>
<td>Fuel Gas</td>
<td>1208.4(8), 1208.5.6.3, 1208.5.10.4, 1212.11</td>
</tr>
<tr>
<td>NFPA 70-2020</td>
<td>National Electrical Code</td>
<td>Miscellaneous</td>
<td>508.2.2, 1210.12.5.2, 1211.2.4, 1211.7, 1317.1(11), 1323.3.1, 1326.4(3)</td>
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<tr>
<td>NFPA 99-2023</td>
<td>Health Care Facilities Code</td>
<td>Miscellaneous</td>
<td>1301.3, 1309.13(2), 1317.1(9), 1324.5.9.4, 1326.3, 1326.4(3), 1326.8(4), 1327.1</td>
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<tr>
<td>NFPA 211-2019</td>
<td>Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances</td>
<td>Fuel Gas, Appliances</td>
<td>509.5.2, 509.5.3, 509.5.6.1, 509.5.6.3</td>
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<tr>
<td>NFPA 780-2020</td>
<td>Standard for the Installation of Lightning Protection Systems</td>
<td>Fuel Gas</td>
<td>1211.5</td>
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**Proposed Text:**

**RECOMMENDATION:**

Revise text
Note: NFPA Standards meet the requirements for mandatory referenced standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

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<tr>
<td>NFPA 5000-2024</td>
<td>Building Construction and Safety Code</td>
<td>Miscellaneous</td>
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SUBSTANTIATION:
The above revisions reflect the latest updates to the NFPA standards that are referenced in Table 1701.1 and Table 1701.2.
### TABLE 1701.1

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<th>STANDARD NUMBER</th>
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<tr>
<td>NSF/ANSI 14-2020-2022</td>
<td>Plastics Piping System Components and Related Materials</td>
<td>Miscellaneous</td>
<td>301.2.3, 604.1, 606.1</td>
</tr>
<tr>
<td>NSF/ANSI 42-2021-2022</td>
<td>Drinking Water Treatment Units – Aesthetic Effects</td>
<td>Appliances</td>
<td>Table 611.1</td>
</tr>
<tr>
<td>NSF/ANSI 44-2018-2022</td>
<td>Residential Cation Exchange Water Softeners</td>
<td>Appliances</td>
<td>Table 611.1</td>
</tr>
<tr>
<td>NSF/ANSI 53-2020-2022</td>
<td>Drinking Water Treatment Units-Health Effects</td>
<td>Appliances</td>
<td>Table 611.1</td>
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<tr>
<td>NSF/ANSI 55-2020-2022</td>
<td>Ultraviolet Microbiological Water Treatment Systems</td>
<td>Appliances</td>
<td>Table 611.1</td>
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<tr>
<td>NSF/ANSI 58-2020-2022</td>
<td>Reverse Osmosis Drinking Water Treatment Systems</td>
<td>Appliances</td>
<td>Table 611.1, 611.2</td>
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<tr>
<td>NSF/ANSI/CAN 61-2021-2023</td>
<td>Drinking Water System Components – Health Effects</td>
<td>Miscellaneous</td>
<td>415.1, 417.1, 604.1, 604.9, 606.1, 607.3, 608.2, 609.8.2, Table 611.1</td>
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<td>NSF/ANSI 62-2021-2022</td>
<td>Drinking Water Distillation Systems</td>
<td>Appliances</td>
<td>Table 611.1</td>
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<td>NSF/ANSI 350-2020-2022</td>
<td>Onsite Residential and Commercial Water Reuse Treatment Systems</td>
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<td>1501.7, 1506.8, 1603.4</td>
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### TABLE 1701.2

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<td>Food Equipment</td>
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<td>NSF/ANSI 4-2020-2022</td>
<td>Commercial Cooking, Rethermalization, and Powered Hot Food Holding and Transportation Equipment</td>
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<td>NSF/ANSI 12-2018-2023</td>
<td>Automatic Ice Making Equipment</td>
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<td>NSF/ANSI 18-2023</td>
<td>Manual Food and Beverage Dispensing Equipment</td>
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<td>NSF/ANSI 40-2023</td>
<td>Residential Wastewater Treatment Systems</td>
<td>DWV Components</td>
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<td>NSF/ANSI 41-2023</td>
<td>Non-Liquid Saturated Treatment Systems</td>
<td>DWV Components</td>
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<td>NSF/ANSI 46-2022</td>
<td>Evaluation of Components and Devices Used in Wastewater Treatment Systems</td>
<td>DWV Components</td>
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<td>NSF/ANSI 169-2023</td>
<td>Special Purpose Food Equipment and Devices</td>
<td>Appliances</td>
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<td>NSF/ANSI/CAN 372-2022</td>
<td>Drinking Water System Components - Lead Content</td>
<td>Miscellaneous</td>
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**SUBSTANTIATION:**
The above revisions reflect the latest updates to the NSF standards that are referenced in Table 1701.1 and Table 1701.2.
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<tr>
<td>UL 174-2004</td>
<td>Household Electric Storage Tank Water Heaters (with revisions through December 16, 2021 October 12, 2023)</td>
<td>Appliances</td>
<td>Table 501.1(1)</td>
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<td>UL 399-2017</td>
<td>Drinking Water Coolers (with revisions through July 31, 2020 July 20, 2023)</td>
<td>Fixtures</td>
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<td>UL 467-2013</td>
<td>Grounding and Bonding Equipment (with revisions through June 7, 2017)</td>
<td>Miscellaneous</td>
<td>1211.2.5</td>
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<td>UL 499-2014</td>
<td>Electric Heating Appliances (with revisions through October 22, 2023 May 31, 2023)</td>
<td>Appliances</td>
<td>Table 501.1(1)</td>
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<td>UL 641-2010</td>
<td>Type L Low-Temperature Venting Systems (with revisions through April 23, 2018 October 20, 2022)</td>
<td>Fuel Gas</td>
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<td>UL 723-2018</td>
<td>Test for Surface Burning Characteristics of Building Materials (with revisions through April 27, 2023)</td>
<td>Miscellaneous</td>
<td>701.2(2), 903.1(2), 1101.4</td>
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<td>UL 749-2013</td>
<td>Household Dishwashers</td>
<td>Appliances</td>
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<td>UL 1453-2016</td>
<td>Electric Booster and Commercial Storage Tank Water Heaters (with revisions through May 18, 2018 May 15, 2023)</td>
<td>Appliances</td>
<td>Table 501.1(1)</td>
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<td>UL 1479-2015</td>
<td>Fire Tests of Penetration Firestops (with revisions through May 18, 2023 August 15, 2023)</td>
<td>Miscellaneous</td>
<td>1404.3, 1405.3</td>
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<td>UL 1738-2019</td>
<td>Venting Systems for Gas-Burning Appliances, Categories II, III, and IV (with revisions through August 26, 2021)</td>
<td>Fuel Gas, Appliances</td>
<td>509.4.1, 509.4.2, 509.4.3</td>
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<td>UL 2523-2009</td>
<td>Solid Fuel-Fired Hydronic Heating Appliances, Water Heaters, and Boilers (with revisions through March 16, 2018 October 20, 2022)</td>
<td>Fuel Gas, Appliances</td>
<td>Table 501.1(1)</td>
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<td>UL 2561-2016</td>
<td>1400 Degree Fahrenheit Factory-Built Chimneys (with revisions through April 19, 2018 October 20, 2022)</td>
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<td>509.5.1</td>
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<td>UL 252-2017</td>
<td>Compressed Gas Regulators (with revisions through August 10, 2018 August 11, 2023)</td>
<td>Fuel Gas</td>
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<tr>
<td>UL 296-2017</td>
<td>Oil Burners (with revisions through January 8, 2021 November 16, 2022)</td>
<td>Fuel Gas, Appliances</td>
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<tr>
<td>UL 404-20102022</td>
<td>Pressure-Indicating Gauges, Indicating Pressure, for Compressed Gas Service (with revisions through February 11, 2015)</td>
<td>Fuel Gas</td>
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<tr>
<td>UL 569-2013</td>
<td>Pigtails and Flexible Hose Connectors for LP-Gas (with revisions through July 28, 2017 November 8, 2022)</td>
<td>Fuel Gas</td>
</tr>
<tr>
<td>UL 726-1995</td>
<td>Oil-Fired Boiler Assemblies (with revisions through October 9, 2013 October 12, 2023)</td>
<td>Fuel Gas, Appliances</td>
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</table>

SUBSTANTIATION:
The above revisions reflect the latest updates to the UL standards that are referenced in Table 1701.1 and Table 1701.2.

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Proposed Text:

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<tr>
<td>AHAM FWD-12-2016-2021</td>
<td>Method for Measuring Performance of Household Food Waste Disposers</td>
<td>Appliances</td>
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SUBSTANTIATION:
The above revision reflects the latest update to the AHAM standard that is referenced in Table 1701.2.
SUBMITTER: Emily Toto
Organization Name: ASHRAE

RECOMMENDATION: Revise text

Proposed Text:

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<th>APPLICATION</th>
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SUBSTANTIATION:
This code change proposal updates UPC Table 1701.2 to reflect the most recent edition of ASHRAE 90.1.
RECOMMENDATION:
Revise text

Proposed Text:

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<td>ARCSA/ASPE/ANSI 78-2015</td>
<td>Stormwater Harvesting System Design for Direct End-Use Applications</td>
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SUBSTANTIATION:
The above revision reflects the latest update to the ARCSA/ASPE standard that is referenced in Table 1701.2.
TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

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<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>Energy Star-2007-2018 (version 3.0)</td>
<td>Program Requirements for <strong>Automatic Commercial Ice Machines</strong></td>
<td>Miscellaneous</td>
</tr>
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<td>Energy Star-2012 (version 2.0) 2021 (version 3.0)</td>
<td>Program Requirements <strong>Product Specification</strong> for Commercial Dishwashers</td>
<td>Appliances</td>
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<tr>
<td>Energy Star-2016 (version 6.0) 2023 (version 7.0)</td>
<td>Program Requirements for Residential Dishwashers</td>
<td>Appliances</td>
</tr>
<tr>
<td>Energy Star-2018 (version 8.0-8.1)</td>
<td>Program Requirements <strong>Product specification</strong> for Clothes Washers (effective February 5, 2018)</td>
<td>Appliances</td>
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(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
Revise document number columns as follows:

ENERGY STAR-2018
(version 3.0)

ENERGY STAR-2021
(version 3.0)

ENERGY STAR-2023
(version 7.0)

ENERGY STAR-2018 Commercial clothes washers (version 8.0)

ENERGY STAR-2018 Clothes washers (version 8.1)
SUBMITTER: Terry Burger

Organization Name: IAPMO

RECOMMENDATION: Revise text

Proposed Text:

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<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
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<tbody>
<tr>
<td>IAPMO IGC 330-2018</td>
<td>Recirculating Shower Systems</td>
<td>Fixtures</td>
</tr>
<tr>
<td>IAPMO Z1398-202X</td>
<td>Pipe Support, Hangers, and Hooks</td>
<td>DWV Components</td>
</tr>
<tr>
<td>(Working Draft)</td>
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<td>IAPMO PS 119-2012a</td>
<td>Water-Powered Sump Pumps</td>
<td>Miscellaneous</td>
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<tr>
<td>IAPMO Z1095-202X</td>
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(portions of table not shown remain unchanged)

Note: IAPMO Z1398, IAPMO Z1095, and IAPMO Z1119 are working drafts and were not completed at the time of this monograph.

SUBSTANTIATION:
The IAPMO Z1398, IAPMO Z1095, and IAPMO Z1119 standard is being designated as an ANSI designated National Standards.
SUBMITTER: Karl Aittaniemi
Organization Name: ICC
Organization Representation: 

RECOMMENDATION: Revise text

Proposed Text:

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<tbody>
<tr>
<td>ASABE/ICC 802-2014 2020</td>
<td>Landscape Irrigation Sprinkler and Emitter Standard</td>
<td>Irrigation</td>
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</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The above revision reflects the latest update to the ICC standard that is referenced in Table 1701.2.
SUBMITTER: David Lentz

Organization Name: Infiltrator Water Technologies

Organization Representation: Infiltrator Water Technologies

RECOMMENDATION:
Add new text

Proposed Text:

<table>
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<tr>
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<tbody>
<tr>
<td>NSF/ANSI 245-2023</td>
<td>Residential Wastewater Treatment Systems – Nitrogen Reduction</td>
<td>Private sewage disposal systems</td>
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(portions of table not shown remain unchanged)

SUBSTANTIATION:
This proposal complements the proposal to add a new section H 1001.1, which references NSF/ANSI 245.
Task Group Report
UPC
Adult Changing Station
Task Group Report
The members of the Adult Changing Station Task Group are:
- Brad Senecaut
- April Trafton
- Kim Paarlberg
- Arnie Rodio
- Phil Ribbs
- Misty Guard
- Gary Bonetti
- Julius Ballanco, P.E.

The Task Group received great assistance from IAPMO staff members:
- Enrique Gonzalez
- Taylor Duran

The scope of the Adult Changing Station Task Group is to address concerns and establish health and safety requirements, including:
- design and minimum equipment requirements
- minimum fixture requirements
- hygiene and sanitation
- further development of the provisions from the 2024 UPC Item #097

The Adult Changing Station Task Group met on 4 occasions to develop code requirements to regulate the location and sanitation for adult changing stations. The Task Group received input from the ICC A117.1 Committee regarding new requirements in the standard on adult changing stations. The Task Group also received input from the Chair of the Adult Changing Table Product Standards Committee.

The Task Group developed three code changes to the Uniform Plumbing Code. The first change proposes the location for adult changing stations where they are required by the Building Code or state law. This code change includes a requirement for a lavatory in the vicinity of the adult changing station.

The second code change is an option to the first change with two additional requirements, one being a requirement for a hose bibb in the toilet room, the other being a requirement for a floor drain. The Task Group debated the need for these two additional fixtures and believe they are necessary for proper sanitation. However, the Task Group recognized that not everyone is in agreement with the need for the additional fixtures.

The third change adds the floor drain location requirements to the floor drain section. This is a companion change to the second code change.

The Task Group appreciates the opportunity to review this very important subject matter.