NOTE: This version of the code change proposal has been updated to include all reported errata.

GEW103-14

607.6, 607.6.1(New), 607.6.2 (New), Table 607.6.2 (New)

Proponent: Brenda Thompson, Chair, representing Sustainability, Energy, High Performance Code Action Committee

Revise as follows:

607.6 Service water heating system piping insulation. Service water heating system piping that conveys heated water shall be ~~thermally~~ insulated in accordance with ~~Table 606.4~~ either Section 607.6.1 or Section 607.6.2. The insulation requirements of this section shall supersede the insulation requirements of the *International Energy Conservation Code*. Insulation shall be installed in accordance with the insulation manufacturer's instructions. Piping insulation shall be continuous except where the piping passes through a framing member. ~~Where hot water distribution piping is installed within attics and crawlspaces, the insulation shall continue to cover the pipe for a distance not less than 6 inches (152 mm) beyond the *building thermal envelope*. Where hot water distribution piping is installed within walls, the insulation shall completely surround the pipe with not less than 1 inch (25 mm) of insulation.~~ Where piping is installed in locations subject to freezing temperatures, Section 305.4 of the *International Plumbing Code* or Section P2603.4 of the *International Residential Code*, as applicable, shall apply. ~~Where hot water piping is installed in a wall cavity of insufficient size to accommodate the pipe and insulation levels of Table 606.4, the insulation thickness shall be permitted to have the maximum thickness that the wall cavity can accommodate, but not less than 1/2-inch (12 mm) thick.~~

Exceptions: Piping insulation ~~is~~ shall not be required for the following:

1. Factory-installed piping within service water heating equipment tested and rated in accordance with Section 606.4.
2. ~~Piping conveying fluids that is neither heated nor cooled, including cold water supply and natural gas piping.~~ Portions of piping that radiate heat to concrete slabs for the purposes of preventing ice and snow accumulation on the top surface of the slab.
3. ~~Hot water supply piping under sinks, lavatories and similar fixtures.~~ Tubing and connectors from the termination of the outlet end of fixture supply piping to a fixture fitting or a water consuming appliance.
4. ~~Hot water distribution piping buried within blown-in or sprayed roof /ceiling insulation, such as fiberglass or cellulose, where the insulation completely and continuously surrounds the pipe.~~
4. Valves, pumps, strainers and threaded unions in piping that is 1 inch or less in nominal diameter.
5. Piping from user-controlled shower, tub/shower, and tub mixing valves to the water outlets.
6. Cold water piping utilized by a demand recirculation water system.
7. Tubing from a hot drinking-water dispensing unit to the water outlet.

607.6.1 Piping insulated with tube or sheet insulation. Service water heating system piping conveying heated water shall be insulated with tube or sheet insulation having a thermal conductivity of not greater than 0.29 Btu per inch/h×ft^2×F[0.42 W/(m×K)]. The wall thickness of the insulation shall be not less than the diameter of the pipe that is being insulated except that a wall thickness greater than 2 inches (50.8 mm) shall not be required.

607.6.2 Piping insulated with building thermal envelope insulation. Service water heating system piping conveying heated water shall be insulated with building thermal envelope insulation. The minimum insulation R-value shall be not less than that indicated in Table 607.6.2. The required insulation shall completely surround the piping.

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TABLE 607.6.2
MINIMUM BUILDING THERMAL ENVELOPE R-VALUE FOR INSULATING PIPE AND TUBING[a]

NOMINAL PIPE OR TUBE SIZE (Inch)	MINIMUM INSULATION R-VALUE
≤ 3/8	R-1.6
> 3/8 ≤ 1/2	R-2.1
> 1/2 ≤ 3/4	R-3.1
> 3/4 ≤ 1	R-4.2
> 1 ≤ 1½	R-6
> 1½ ≤ 2	R-8
> 2	R-8

For SI: 1 inch = 25.4 mm

a. The minimum required thickness of R-value rated insulation to be installed shall be the R-value in this table divided by the published R-value/inch of the insulation to be used.

Reason: The language of the section is very confusing and desperately needs repair and clarification. The main intent of the *existing* section is two- fold: 1) provide reasonable insulation thicknesses for smaller diameter piping utilizing a simple "wall thickness of insulation = size of pipe" approach and 2) provide an alternate way of insulating piping using the building thermal envelope insulation that is already being installed for insulating the building. The existing language is unclear and vague resulting in confusion on what the section requires and allows. Also, the *existing* language (poorly) attempts to cover the topic of protection of piping against freezing temperatures that is not within the scope of this code (the IPC addresses protection of piping against freezing).

The proposed modifications to this section are:

The reference to Table 606.4 (under the HVAC piping insulation section) was removed because it is poor code practice to use tables from other "unrelated" sections of the code for another purpose. The table in the other section could be changed without the knowledge that another section in the code refers to that table. This can lead to future problems in the code. Rather than make a new table for this section with one row ("hot water"), the requirement is best stated in code language that is being placed in new subsection 607.6.1. Another new subsection (Section 607.6.2) is added for clarifying the requirements for the alternate way to insulate piping by "nesting" or covering the piping with the building thermal envelope insulation that is already being installed for insulating the building. Discussions of new subsections 607.6.1 and 607.6.2 are provided later in this reason statement.

The new language "The insulation requirements of this section shall supersede the insulation requirements ofthe *International Energy Conservation Code*." may, at first reading, seem to imply that the insulation requirements of this section are more stringent than what is in the IECC. This is *not* necessarily the case. But don't throw out this proposal because of this perceived "reduced stringency" because the *existing* reference to Table 606.4 *already* forces the reader to address and resolve what appears to be conflict between the insulation requirements of the IECC and this section. For example, Table C403.2.8 of the 2012 IECC indicates the insulation wall thickness for 1 inch and smaller piping (with 105F-140F fluid temperature) to be 1 inch. So, if you have a 1/2 inch pipe, the insulation wall thickness needs to be 1 inch. A 3/8 inch pipe? 1 inch insulation wall thickness. IgCC Section 607.6 requires not less than a 1:1 ratio of insulation wall thickness to pipe diameter (i.e. "wall thickness of insulation = size of pipe"). Therefore, a ½ inch nominal size pipe is required to have ½ inch wall thickness insulation. A 3/8 inch nominal size pipe is required to have 3/8 inch wall thickness insulation. But which code's insulation thickness requirements should prevail? To answer this question, the reader must keep in mind that the intent of the IgCC is to be an overlay code to the other I-codes to "reduce the negative impacts and increase the positive impacts of the built environment on the natural environment and the building occupants". This section's *existing* piping insulation requirements (as opposed to the IECC's insulation requirements) are intended to prevail because:

1) Thick insulation for small diameter piping creates difficulty in getting the insulated piping (given the piping "crossover" issues) into a typical 3 ½ inch thick wall. To accommodate the thick insulation, walls need to be deeper which means deeper framing members or " furring out" of 3 ½ inch walls. Thicker walls (=more costly framing materials) less usable building spacelarger buildings for same usable floor areaè less "green".

2) The insulation provisions of the IECC do not consider the need for hot water piping diameters that are smaller than ½ inch nominal. Small diameter hot water piping is needed to reduce the amount of time (and reduce the amount of water waste) waiting for hot water to arrive at the point of use. Piping as small as 1/4 inch nominal could be necessary to accomplish this. Tube type insulation products with 1 inch wall thickness are not currently available for nominal pipe diameters smaller than ½ inch. It just doesn't make practical sense to insulate such small pipe diameters with the same insulation thickness that also serves a ¾ inch nominal pipe. Less insulation thickness for the smaller pipe diameters is more "green" because the thicker insulation is just not necessary given the limited amount of time that these small pipes are conveying hot water. The "energy savings" of thicker insulation is negligible/insignificant as compared to the real waste of energy and water caused by poor hot water distribution system design. The bottom line is: don't use more insulating materials than the application actually warrants! The fact that there is some level of insulation on the piping as opposed to no insulation on the piping is where the real energy

savings occurs. In these small pipe diameters, where the flow of hot water is often intermittent, the insulation thickness is a very small part of energy savings.

For these reasons, the intent of this section in the 2012 IgCC was always to "override" the insulation requirements of the IECC. The statement "The insulation requirements of this section shall supersede the insulation requirements of the *International Energy Conservation Code*." is necessary to make it clear that the IgCC requirements in this section are not to be "trumped" by the IECC. Note that *this is not a new requirement* but a necessary clarification of what is already intended by Section 607.6 of the 2012 IgCC.

The new language "Insulation shall be installed in accordance with the insulation manufacturer's instructions." is a simple but meaningful addition. In applications where tube-style insulation is installed, some installers try to "cheat" by not taping/sealing joints and by not covering fittings properly. This sloppy practice defeats the purpose of installing the insulation in the first place. Insulation manufacturer's installation instructions are specific about how to achieve the rated insulation value from their products. It is absolutely critical that the instructions be followed.

The new language "Piping insulation shall be continuous except where the piping passes through a framing member." answers the significant question about whether the insulation needs to be continuous through framing members. Realize that even for a small diameter pipe such as ½ inch nominal size (about 5/8 inch actual OD), the outside diameter of the required insulation for the pipe is 1 5/8 inches. This requires a 1 ¾ inch diameter hole to be bored through wood framing and the webs of light frame steel framing. This weakens the framing member and often requires "doubling" of framing members or increasing the depth (thickness) of walls so that the deeper framing members are less affected by such a large hole. This is unnecessary as the short length of uninsulated pipe within the thickness of the "web" of the framing member will have negligible/insignificant heat loss, especially if attention is paid to assuring that the adjacent insulation is "butted- up to" the face of the "web" of the framing member.

The new language "Where piping is installed in locations subject to freezing temperatures, Section 305.4 of the *International Plumbing Code* shall apply." replaces the two previous sentences in the existing section. The original author's intent was to try to address situations where the water piping was installed in an attic, crawl space or exterior wall where one "side" of the insulated piping could be exposed to freezing temperatures (outdoor temperature). The original author's language for making sure that not less than 6 inches of building thermal envelope insulation covers the pipe where it is located in an attic or crawl space; and making sure that the piping in an [exterior] wall has at least 1 inch insulation around the pipe are merely "guidelines" that might only work for some climates. For example, those requirements *might* work for buildings in Texas but not work for buildings in North Dakota. This section in the IgCC needs to be concerned *only* with efficient use of insulation to maintain water temperature within the pipe, given that the temperature on the outside of the insulation around the pipe is somewhat above freezing. Section 305.4 of the IPC addresses the issue about protection of piping from freezing and that is all that needs to be said. Protection of piping from freezing is a design decision that varies with the geographic region that the building is located in. In many large commercial buildings where outdoor freezing temperatures could occur, piping is simply not located in "unconditioned areas" of the building. In in smaller commercial buildings, builders and code officials "know" from extensive experience in each geographic region where not to locate piping and how to "protect" piping against freezing. For example, locating water piping in attics of buildings in North Dakota just isn't done. But doing so in southern Florida is an accepted practice. This IgCC section should not attempt to address the freezing temperature issue (in the way that it has) because doing so seems to imply that this will work for ALL regions. This could lead to disastrous results. It is not a subject that needs to be addressed in the IgCC. Let the plumbing code deal with the issue as it has adequately done so for many years.

A number of the exceptions were clarified and added:

Existing exception 2 does not make sense. The section is about service water heating system piping so there is no need to discuss fluids neither heated or cooled, or natural gas piping. The main section has been revised to simply say that the section is about insulating piping conveying heated water. New exception language was put in place to cover ice and snow melt piping under slab-on-grade concrete slabs (as the IECC and the IgCC consider hot water for snowmelt systems as service heating water). Obviously, piping in those applications should *not* be insulated as the purpose of the piping is to give off heat to the concrete. (Piping for radiant heating for *comfort* is *not* covered under service water heating systems.)

Exception 3 is reworded to be more specific about what exposed piping is being discussed. Basically, the tubing or connectors from the fixture back to the outlet end termination of the fixture supply pipes do not have to be insulated as it would be much too difficult to install insulation on these small connectors and tubes – the heat loss from these small diameter tubes and connectors into a conditioned space is negligible/insignificant. Why complicate final plumbing connections and future fixture service work by requiring insulation that has no real benefit?

The purpose of existing exception 4 is to not require service water heating system piping to be insulated with pipe insulation where there is going to be building thermal envelope insulation installed where the pipe is located. The existing language of exception 4 is extremely vague about what constitutes 'buried'. Does that mean one inch or 6 inches of insulation around the piping? The phrase "hot water distribution" might lead a reader to believe that only *hot water* piping (IPC-defined as equal to, or greater than 110F) is permitted to use the "buried in blown-in or sprayed roof/ceiling fiberglass or cellulose insulation method". Note that first sentence of Section 607.6 was revised to clarify that the piping is conveying *heated water* because if water is heated, then energy can be lost from the piping on its way to the point of use. While the energy lost from heated water of a low temperature is minimal, the point is that *the desired water temperature might not ever reach the point of use if the piping was not insulated*. Because of the vagueness of existing exception 4, the exception was eliminated and those concepts put into new sections 607.2.1 and 607.2.2 (which will be discussed later in this reason statement).

New exception 4 provides relief from insulating "bulky" components in smaller diameter (1 inch or less) piping. The heat loss from these items is negligible/insignificant and it is not worth the time spent trying to insulate such components. This is simply a matter of practicality. Is it really necessary to insulate a shower mixing valve given the complexity of doing so compared to the limited amount of time that the mixing valve actually conveys heated water?

New exception 5 provides relief from insulating piping from the user-controlled valves indicated. Although a simple shower riser might not be too difficult to insulate, other piping for multiple shower heads, spray ports, transfer valves, etc. can be

complex and the area that they are located in, congested. It just isn't worth the time and effort for this small amount of small diameter piping.

New exception 6 is simple to understand if one understands the type of demand recirculation system that uses a cold water pipe (near or at a fixture) for the return of heated water in a cold water pipe back to the water heater. The water pumped into a cold water line is really never "hot" (it's barely luke warm) and the only purpose for moving the "hot" water into the cold water line is to provide a return path back to the water heater. The barely luke warm water being returned serves no other purpose. There is no need to insulate cold water lines used for such purpose. It is actually better that the cold water pipe gives off some heat so that the cold water flow to the fixture is barely warm for only a second or two, depending on the fixture flow rate.

New exception 7 clarifies that tubing from under counter "insta-hot" units (used for making instant coffee and package soup mixes) do not need insulated. The tubing is so small and short that any heat lost is negligible/insignificant as compared to the heat loss from the unit itself.

New Section 607.6.1 is *not* adding a new set of requirements to the code. This new section simply puts into text, what the existing section's reference to Table 606.4 was trying to accomplish. The use of text instead of a table for these requirements is cleaner and straight forward. Section 607.6.1 provides the insulation requirements for where tube-type and sheet insulation is installed on piping (sheet product being used for large pipe diameters). The material is the familiar closed-cell-expanded-foam tube and sheet, and fiberglass insulation tube and sheet, that are commonly available to the plumbing/insulation trades. The thermal conductivity value of 0.29 Btu per inch/h●ft^2●F covers the largest value of those two materials at the maximum temperature that would be used for service hot water. Again, the 1:1 insulation- wall-thickness-to-nominal-pipe-diameter concept is *not* new – this is exactly what the existing section language required.

New Section 607.6.2 provides the insulation requirements for where building thermal envelope insulation (such as fiberglass batts, blown-in fiberglass, sprayed-in cellulose, sprayed (expanding) foams, polystyrene board or any one of a number of insulating products) is used for insulating buildings. Although this section is new, the concept was what was intended in the existing language of Section 607.6 of the 2012 IgCC. But the existing language did not make clear what was really intended. This new section adds to the existing concept by providing prescriptive language that can be easily understood given the variety of applications that will be encountered in the built environment.

The required R-values in Table 607.6.2 reflect the same insulating effect achieved as if the piping was insulated in accordance with minimum requirements of Section 607.6.1. These R-values come from the published data of one manufacturer of closed-cell-expanded-foam sheet material….the same material and density that is used to make the familiar closed-cell-expanded-foam tube [ref: Armacell technical bulletin #004]. This R-value information provides some basis for determining an equivalency between a pipe insulated with tube-type pipe insulation and a pipe that is insulated by the virtue of being "buried" in building thermal envelope insulation that is already required for the building. It really isn't important that complex mathematics and analysis are used to *exactly* determine this equivalency because in practice, the piping will be covered with far more insulation than is needed in most of the circumstances. All Table 607.6.2 does is establish a "minimum cover" dimension. Because building thermal envelope insulation is available in many forms, each having different R-values for a given thickness, Table 607.6.2 provides the minimum R-value so that along with table footnote a, the required minimum thickness can be determined for the type of building thermal envelope insulation to be installed.

For example, a 3/8 inch pipe is in a 3 ½ inch deep wall that will require R-13 insulation. Fiberglass batt insulation is chosen that is rated for R-13 for a 3 ½ inch installation depth. The R-value *rating* per inch of this product would be 13/3.5=3.7 per inch. The minimum R-value in Table 607.6.2 for 3/8 inch nominal size pipe is R-1.6. Using footnote a, the minimum thickness (cover) of this fiberglass insulation on the pipe must be not less than 1.6/3.7 = 0.43 inch. The plumbing installer then knows he has to locate the 3/8 inch pipe no closer to than 0.43 inch to either face of the wall. The installer will most likely round this number up to, say, ½", and install the piping in the wall cavity accordingly to accommodate the insulators work of "nesting" the piping into the insulation as the fiberglass batts are installed. There is no extra work for the insulators as they have to place insulation around piping and other items anyhow. And the piping doesn't require a layer of tube-type insulation before building thermal envelope insulation is installed (which eliminates redundancy of insulation materials).

As stated previously, in the majority of circumstances when using the method of Section 607.6.2, the piping will, overall, be covered with far more insulation than what Table 607.6.2 requires. Even though the insulation thickness from the outside of the pipe to the face of the wall might only be ½ inch, in a direction perpendicular to that, there will be many inches of insulation against the pipe. Table 607.6.2 is not really intended to be used for trying to create a "tube-type pipe insulation effect" using building thermal envelope insulation. For instance, someone cutting a strip of fiberglass insulation and wrapping it around a pipe to serve as the required pipe insulation. This practice would not benefit from the added insulating value from greater insulation thickness that would be present in a "nested into the cavity insulation" situation. The entire premise of developing the R-value equivalency using an approximation (and not rigid computational methods) depends on a greater thicknesses of insulation being present around most of the circumference of the piping. As such, it is not necessary to insulate over or through support clamps.

This proposal was submitted by the ICC Sustainability Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). This includes both the technical aspects of the codes as well as the code content in terms of scope and application of referenced standards. In 2012 and 2013, the SEHPCAC has held six two-day open meetings and 50 workgroup calls, which included members of the SEHPCAC as well as any interested parties, to discuss and debate proposed changes and public comments. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx.

Cost Impact: Will not increase the cost of construction

Providing for alternate methods and more efficient methods for insulating piping will, cost less than the methods that are required by the IECC.