

ADDENDA

**ANSI/ASHRAE/IES Addendum bt to
ANSI/ASHRAE/IES Standard 90.1-2022**

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on October 31, 2025; and by the Illuminating Engineering Society on October 16, 2025.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (<https://www.ashrae.org/continuous-maintenance>).

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FOREWORD

Addendum bt requires that insulation for covered process piping systems be designed for optimal thermal efficiency. The insulation must meet or exceed the minimum thickness and thermal conductivity standards specified for water heating and HVAC piping currently required in ASHRAE/IES Standard 90.1-2022. The purpose of this addendum is to save energy and reduce carbon emissions by improving the thermal efficiency of process heating and cooling systems in commercial and industrial facilities. Properly insulated piping systems for processes such as steam, hot water, and other thermal fluids are essential for maintaining efficient energy use and reducing utility costs. The proposal aims to standardize insulation practices, ensuring that all covered process piping systems are equipped with insulation that maximizes energy retention and minimizes environmental impact.

The table below shows the scalar ratio for pipe insulation at different diameters for both steam and hot-water applications. Assuming a 20-year life, the scalar ratio for pipe insulation is 14.4 years. As shown below, the pipe insulation requirement easily meets this cost-effectiveness requirement.

Steam Pipe Cost Effectiveness					
Diameter (in)	Surface Temp (F)	Insulation Thickness (in)	Annual Cost Savings (\$/100 ft)	Total Cost (\$/100 ft)	Scalar Ratio
0.75	250	1	\$ 6.03	\$ 16.16	2.7
1.5	250	1	\$ 11.19	\$ 17.85	1.6
3	250	1.5	\$ 18.82	\$ 21.73	1.2
5	250	1.5	\$ 31.35	\$ 32.42	1.0
10	250	2	\$ 56.04	\$ 50.66	0.9
0.75	298	1	\$ 8.58	\$ 18.27	2.1
1.5	298	1.5	\$ 15.91	\$ 28.49	1.8
3	298	1.5	\$ 27.24	\$ 34.51	1.3
5	298	1.5	\$ 44.43	\$ 44.79	1.0
10	298	2	\$ 80.62	\$ 67.92	0.8

Hot Water Pipe Cost Effectiveness					
Diameter (in)	Surface Temp (F)	Insulation Thickness (in)	Annual Cost Savings (\$/100 ft)	Total Cost (\$/100 ft)	Scalar Ratio
0.75	140	1	\$ 1.58	\$ 15.65	9.9
1.5	140	1.5	\$ 2.92	\$ 12.47	4.3
3	140	1.5	\$ 5.22	\$ 15.13	2.9
5	140	1.5	\$ 8.11	\$ 19.28	2.4
10	140	1.5	\$ 15.40	\$ 32.03	2.1
0.75	200	1.5	\$ 3.80	\$ 20.97	5.5
1.5	200	2	\$ 6.85	\$ 15.22	2.2
3	200	2	\$ 12.16	\$ 18.64	1.5
5	200	2	\$ 18.93	\$ 24.55	1.3
10	200	2	\$ 35.89	\$ 39.83	1.1

Informative Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~striking through~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum bt to Standard 90.1-2022

Add new Section 6.8.4 as shown (I-P and SI).

10.4.9 Process Pipe Insulation. Piping for *process applications* shall be insulated to not less than the thickness specified in Table 10.8-7 and shall be provided with insulation within the *thermal conductivity* ranges specified in Table 10.8-7, or, where the insulation *thermal conductivity* is not within the range the minimum insulation thickness shall be calculated as follows:

$$t_{alt} = r[(1 + t_{table}/r) \times k_{alt}/k_{upper} - 1]$$

where

- t_{alt} ≡ minimum insulation thickness of the alternate material, in. (mm)
- r ≡ actual outside radius of pipe, in. (mm)
- t_{table} ≡ insulation thickness listed in Table 10.8-7 for applicable fluid temperature and pipe size, in.(mm)
- k_{alt} ≡ thermal conductivity of the alternate material at mean rating temperature indicated for the applicable fluid temperature, Btu·in./h·ft²·°F [W/(m·°C)]
- k_{upper} ≡ upper value of the thermal conductivity range listed in this table for the applicable fluid temperature, Btu·in./h·ft²·°F [W/(m·°C)]

Exceptions to 10.4.9:

1. For nonmetallic piping thicker than Schedule 80 and having a thermal resistance greater than steel pipe, reduced insulation thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot (meter) than a steel pipe of the same size with the insulation thickness shown in the tables.
2. Fluid pumps, steam traps, blow-off valves, and piping within equipment for process applications.
3. Valves, strainers, coil u-bends, and air separators with at least 0.5 in. (12.5 mm) of insulation.
4. For piping that is smaller than 1.5 in. (40 mm) and located in partitions within conditioned spaces, reduction of the insulation thickness specified in Table 10.8-7 by 1 in. (25 mm) shall be permitted provided the piping has not less than 1 in. (25 mm) of insulation.
5. For direct-buried system piping for process applications, reduction of the insulation thickness specified in Table 10.8-7 by 1.5 in. (40 mm) shall be permitted provided the piping has not less than 1 in. (25 mm) of insulation.

Add new Table 10.8-7 (I-P).

Table 10.8-7 Minimum Piping Insulation Thickness for Process Applications^a

<u>Fluid Operating Temperature Range (°F) and Usage</u>	<u>Insulation Thermal Conductivity</u>		<u>Nominal Pipe or Tube Size</u>				
	<u>Conductivity, Btu·in./h·ft²·°F</u>	<u>Mean Rating Temperature, °F</u>	<u><1</u>	<u>1 to <1 1/2</u>	<u>1-1/2 to <4</u>	<u>4 to <8</u>	<u>≥8</u>
<u>Insulation Thickness, in.</u>							
<u>>350</u>	<u>0.32 to 0.34</u>	<u>250</u>	<u>4.5</u>	<u>5.0</u>	<u>5.0</u>	<u>5.0</u>	<u>5.0</u>
<u>251 to 350</u>	<u>0.29 to 0.32</u>	<u>200</u>	<u>3.0</u>	<u>4.0</u>	<u>4.5</u>	<u>4.5</u>	<u>4.5</u>
<u>201 to 250</u>	<u>0.27 to 0.30</u>	<u>150</u>	<u>2.5</u>	<u>2.5</u>	<u>2.5</u>	<u>3.0</u>	<u>3.0</u>
<u>141 to 200</u>	<u>0.25 to 0.29</u>	<u>125</u>	<u>1.5</u>	<u>1.5</u>	<u>2.0</u>	<u>2.0</u>	<u>2.0</u>
<u>105 to 140</u>	<u>0.22 to 0.28</u>	<u>100</u>	<u>1.0</u>	<u>1.0</u>	<u>1.5</u>	<u>1.5</u>	<u>1.5</u>

a. These thicknesses are based on *energy efficiency* considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature

Add new Table 10.8-7 (SI).

Table 10.8-7 Minimum Piping Insulation Thickness for Process Applications^a

Fluid Operating Temperature Range (°C) and Usage	Insulation Thermal Conductivity		Nominal Pipe or Tube Size, mm.				
	Conductivity, W/(m·°C)	Mean Rating Temperature, °C	<25	25 to <40	40 to <100	100 to <200	≥200
			Insulation Thickness, mm				
<u>>177</u>	<u>0.046 to 0.049</u>	<u>121</u>	<u>115</u>	<u>125</u>	<u>125</u>	<u>125</u>	<u>125</u>
<u>122 to 177</u>	<u>0.042 to 0.046</u>	<u>93</u>	<u>80</u>	<u>100</u>	<u>115</u>	<u>115</u>	<u>115</u>
<u>94 to 121</u>	<u>0.039 to 0.043</u>	<u>66</u>	<u>65</u>	<u>65</u>	<u>80</u>	<u>80</u>	<u>80</u>
<u>61 to 93</u>	<u>0.036 to 0.042</u>	<u>52</u>	<u>40</u>	<u>40</u>	<u>50</u>	<u>50</u>	<u>50</u>
<u>41 to 60</u>	<u>0.032 to 0.040</u>	<u>38</u>	<u>25</u>	<u>25</u>	<u>40</u>	<u>40</u>	<u>40</u>

a. These thicknesses are based on *energy efficiency* considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.

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ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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