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

## Public Review Draft

# Proposed Addendum bt to Standard 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

**First Public Review (February 2025)**
**(Draft Shows Proposed Changes to Current Standard)**

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# FOREWORD

## *Foreword*

This proposal 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 90.1-2022. The purpose of this proposal 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 measure 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 |

***Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and strikethrough (for deletions) unless the instructions specifically mention some other means of indicating the changes. Only these changes are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed substantive changes.***

***[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]***

# Addendum bt to 90.1-2022

*Add Section 6.8.4 (I-P and SI):*

**6.8.4 Process Pipe Insulation.** Piping for *process applications* shall be insulated to the minimum thickness required in Table 6.8.4 and shall either utilize insulation within the *thermal conductivity* ranges in the tables, or, when the insulation *thermal conductivity* is not within the range in the tables, the following equation shall be used to calculate the minimum insulation thickness:

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

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 6.8.4 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·ft$^2$·°F [W/(m·ºC)]
$k_{upper}$ = upper value of the *thermal conductivity* range listed in this table for the applicable fluid temperature, Btu·in/h·ft$^2$·°F [W/(m·ºC)]

**Exceptions to 6.8.4:**

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 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.

*Add Table 6.8.4 (I-P):*

**Table 6.8.4 Minimum Piping Insulation Thickness for Process Applications[a,b,c]**

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

a. These thicknesses are based on *energy efficiency* considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.
b. For *piping* smaller than 1.5 in. and located in partitions within *conditioned spaces*, reduction of these thicknesses by 1 in. shall be permitted (before thickness adjustment required in footnote [a]) but not to thicknesses below 1 in.
c. For direct-buried *system piping* for *process applications*, reduction of these thicknesses by 1.5 in. shall be permitted (before thickness adjustment required in footnote [a]) but not to thicknesses below 1 in.

*Add Table 6.8.4 (SI):*

**Table 6.8.4 Minimum Piping Insulation Thickness for Process Applications[a,b,c]**

| 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. | | | | |
| >177 | 0.046 to 0.049 | 121 | 115 | 125 | 125 | 125 | 125 |
| 122 to 177 | 0.042 to 0.046 | 93 | 80 | 100 | 115 | 115 | 115 |
| 94 to 121 | 0.039 to 0.043 | 66 | 65 | 65 | 80 | 80 | 80 |
| 61 to 93 | 0.036 to 0.042 | 52 | 40 | 40 | 50 | 50 | 50 |
| 41 to 60 | 0.032 to 0.040 | 38 | 25 | 25 | 40 | 40 | 40 |

a. These thicknesses are based on *energy efficiency* considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.
b. For *piping* smaller than 40 mm. and located in partitions within *conditioned spaces*, reduction of these thicknesses by 25 mm. shall be permitted (before thickness adjustment required in footnote [a]) but not to thicknesses below 25 mm.
c. For direct-buried *system piping* for *process applications*, reduction of these thicknesses by 40mm. shall be permitted (before thickness adjustment required in footnote [a]) but not to thicknesses below 25 mm.