INSULATION REQUIREMNETS FOR PESTAN PPRCT PIPES

Pestan PPRCT pipe have coefficient of thermal conductivity is 1.67 BTU*in/hr*ft^2*F at medium temperature of 68°F (20°C). Because of this natural high level of thermal insulation, certain systems can be designed with no or less insulation then metallic systems. Following table shows Pestan's recommendation for insulation depending on the project type. Before making decision on weather system qualifies for reduction or no insulation, please consult with professional designer/engineer in regards to all local code requirements.

SYSTEM TYPE	THERMAL INSULATION FOR PIPE	
	Commercial Projects	Residential Projects
Domestic Cold Water	No	No
Domestic Hot Water	Yes	No
Heating Hot Water and Hot Water Return	Yes	Yes
Above Ground Chilled Water, Condenser Water	Yes	Yes
Underground Chilled Water, Condenser Water	No	No

Per 2010 & 2012 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-10 all piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Tables 6.8.3A, Table 6.8.3B and C403.2.8.

2012 IECC, Table C403.2.8
MINIMUM PIPE INSULATION THICKNESS (thickness in inches)[a]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu*in/(h*ft^2*°F)[b]	Mean Rating Temperature, °F	< 1	1 to < 1.5	1.5 to < 4	4 to < 8	≥ 8
Above 350	0.32 - 0.34	250	4.5	5.0	5.0	5.0	5.0
251 - 350	0.29 - 0.31	200	3.0	4.0	4.5	4.5	4.5
201 - 250	0.27 - 0.30	150	2.5	2.5	2.5	2.5	3.0
141 - 200	0.25 - 0.29	125	1.5	1.5	2.0	2.0	2.0
105 - 140	0.22 - 0.28	100	1.0	1.0	1.5	1.5	1.5
Cooling systems (chilled water, refrigerant and brine)							
40 - 60	0.21 - 0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.20 - 0.26	75	0.5	1.0	1.0	1.0	1.5

[a]For piping smaller than 1 1/2 inch (38 mm) and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch (25 mm) shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch (25 mm).
[b]For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: T=r(1+t/r)K/k-1

Where:

T = minimum insulation thickness,
r = actual outside radius of pipe,
t = insulation thickness listed in the table for applicable fluid temperature and pipe size,
K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu × in/h × ft^2 × °F) and
k = the upper value of the conductivity range listed in the table for the applicable fluid temperature.
[c]For direct buried heating and hot water system piping, reduction of these thicknesses by 11/2 (38mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch (25 mm).

ASHRAE 90.1-10, Table 6.8.3A
MINIMUM PIPE INSULATION THICKNESS
HEATING AND HOT WATER SYSTEMS [a,b,c,d]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu*in/(h*ft^2*°F)	Mean Rating Temperature, °F	< 1	1 to < 1.5	1.5 to < 4	4 to < 8	≥ 8
			Insulation Thickness (in)				
Above 350	0.32 - 0.34	250	4.5	5.0	5.0	5.0	5.0
251 - 350	0.29 - 0.32	200	3.0	4.0	4.5	4.5	4.5
201 - 250	0.27 - 0.30	150	2.5	2.5	2.5	2.5	3.0
141 - 200	0.25 - 0.29	125	1.5	1.5	2.0	2.0	2.0
105 - 140	0.22 - 0.28	100	1.0	1.0	1.5	1.5	1.5

[a]For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: T = r {(1 + t/r)K/k – 1} where T = minimum insulation thickness (in.), r = actual outside radius of pipe (in.), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu•in./h•ft2• °F); and k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.
[b]These thicknesses are based on energy efficiency considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.
[c]For piping smaller than 1-1/2" and located in partitions within conditioned spaces, reduction of these thicknesses by 1" shall be permitted (before thickness adjustment required in footnote a) but not to thicknesses below 1".
[d]For direct-buried heating and hot water system piping, reduction of these thicknesses by 1.5" shall be permitted (before thickness adjustment required in footnote a) but not to thicknesses below 1".

ASHRAE 90.1-10, Table 6.8.3B
MINIMUM PIPE INSULATION THICKNESS
COOLING SYSTEMS (CHILLED WATER, REFRIGERANT AND BRINE)[a,b,c]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu*in/(h*ft^2*°F)	Mean Rating Temperature, °F	< 1	1 to < 1.5	1.5 to < 4	4 to < 8	≥ 8
			Insulation Thickness (in)				
40 - 60	0.21 - 0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.20 - 0.26	50	0.5	1.0	1.0	1.0	1.5

[a]*For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: T = r {(1 + t/r)K/k – 1} where T = minimum insulation thickness (in.), r = actual outside radius of pipe (in.), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu•in./h•ft2• °F); and k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.*
[b]*These thicknesses are based on energy efficiency considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retardes or additional insulation*
[c]*For direct-buried cooling system piping, insulation is not required*
[d]*The table is based on steel pipe. Non-metallic pipes Schedule 80 thickness or less shall use the table values. For other non- metallic pipes having thermal resistance greater than that of 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 with insulation shown in the table.*

There are many exceptions where insulation is not required and there are footnotes that allows insulation reduction if "*non- metallic pipes having thermal resistance greater than that of 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 with insulation shown in the table.*"
Please refer to the footnotes above for the calculations and requirements.

Exceptions for HVAC System Piping insulation:

Per 2012 IECC, Section C403.2.8

3. Piping that conveys fluids that have a design operating temperature range between 60 °F (15 °C) and 105 °F (41 °C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
6. Direct buried piping that conveys fluids at or below 60 °F (15 °C).

Per ASHRAE Standard 90.1-2010, Section 6.4.4.1

2. Piping that conveys fluids having a design operating temperature range between 60F and 105F, inclusive.

3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electricity (such as roof and condensate drains, domestic cold water supply, and natural gas piping).

4. Where heat gain or heat loss will not increase energy usage (such as liquid refrigerant piping).

Footnote C Table 6.8.3B *For direct-buried cooling system piping, insulation is not required*

Pestan recommends using metric size pre-formed insulation for the pipes. If not available, the chart to the right makes recommendations on which IPS or CTS sizes of pre-formed insulation are best suited for equivalent size.

RECOMMENDED SIZE OF PRE-FORMED INSULATION	
PIPE DIMENSION	**INSULATION SIZE**
N.D. - O.D.	BEST FIT (OTHER SOLUTION)
½" - 20 mm	½" IPS
¾" - 25 mm	¾" IPS
1" - 32 mm	1" IPS
1¼" - 40 mm	1½" CTS (1¼" IPS)
1½" - 50 mm	1½" IPS
2" - 63 mm	2" IPS
2½" - 75 mm	2½" IPS
3" - 90 mm	3" CTS (3" IPS)
4" - 125 mm	5" CTS (5" IPS)
6" - 160 mm	6" IPS
8" - 200 mm	8" CTS (8" IPS)
10" - 250 mm	10" CTS (10" IPS)
12" - 315 mm	12" IPS