TECH SOLUTIONS 606.0
STYROFOAM™ BRAND EXTRUDED POLYSTYRENE INSULATION FOR INSULATED REFRIGERANT LINES IN ICE ARENAS

BACKGROUND: ICE RINK DESIGN

The key element behind ice rink design is the effectiveness of the refrigerant system that is used to maintain the ice surface during the arena's operation. Most ice pad surfaces are formed and maintained by pumping calcium chloride brine solution or glycol through 6" – 8" (150 mm – 200 mm) diameter feed and return metal pipes. The solution is processed through a chiller, which in turn, feeds 1.25" (32 mm) diameter pipes. These pipes run perpendicular to the feeder pipes and under the ice pad to actually produce the ice surface (Figure 1). The larger feed and return pipes are usually hung on metal angle brackets inside a 2.5' wide x 2.5' deep (750 mm x 750 mm) concrete header trench. The 2" (50 mm) treated lumber covers the top of the header trench, so it can be removed for servicing.

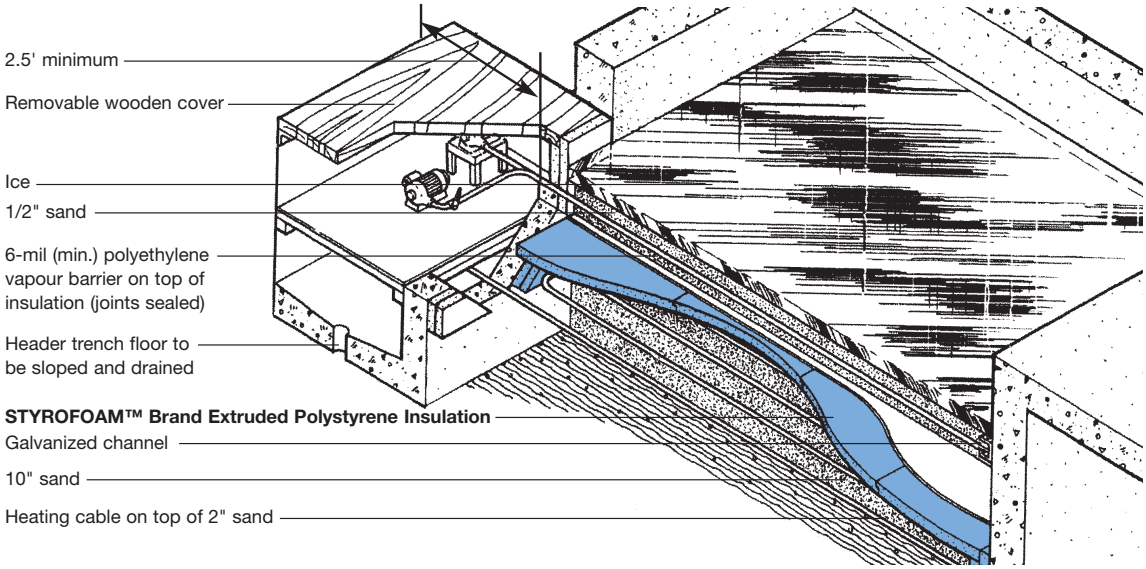
Under normal conditions, where these pipes are left uninsulated, 3" – 5" (75 mm – 125 mm) of solid ice can build up during operation. The refrigerant system sustains an extra load to maintain the buildup, thus consuming more electrical energy. The number of extra Btu/hr (watts) of energy can vary from one arena to another, and detailed calculations are required to obtain this number.

Several factors to obtain the actual energy efficiency rates should be considered:

- feed/return pipes
  - k-factor of material
  - wall thickness
  - outside diameter
  - length
- process temperature in/out
- ambient temperature: seasonal or full-year operation
- relative humidity of environment

Examples of typical heat loss calculations are shown in Table 1. Examined here are both seasonal rink operation (i.e., 10 months of the year; design ambient temperature = 50°F [10°C]) and year-round operation (i.e., 12 months of the year; design ambient temperature = 70°F [21°C]). Note that with these conditions and by insulating 250' (76 m) of feed and return pipe (having a 21°F [-6°C] process temperature) with 2" (50 mm) thick R-10 (RSI-1.76)* STYROFOAM™ Brand Extruded Polystyrene Insulation, it is estimated that an ice arena owner can save up to 39,400 Btu/hr (11,544 watts), or US $8,093/year, depending on energy costs.

Figure 1: Ice Rink Refrigerant Line System



*R means resistance to heat flow. The higher the R-value or RSI, the greater the insulating power. RSI (R-value Système Internationale) is the metric equivalent of R-value.

STYROFOAM™ Brand Extruded Polystyrene Insulation for Insulated Refrigerant Lines in Ice Arenas

Table 1: Typical Heat Loss Calculation Examples

Ambient Temp. °F (°C)	Pipe Diameter, in. (mm)	Insulation Thickness, in. (mm)	Heat Gain, Btu/hr (watt)	Savings, $/yr., if $0.06/kwh energy cost	Savings, $/yr., if $0.07/kwh energy cost	Savings, $/yr., if $0.08/kwh energy cost
50 (10)	6 (150)	None	19,137 (5,607)			
	6 (150)	2 (50) STYROFOAM™ Brand SM	1,516 (444)	2,262	2,639	3,016
	8 (200)	None	25,212 (7,387)			
	8 (200)	2 (50) STYROFOAM™ Brand SM	1,894 (555)	2,993	3,492	3,991
70 (21)	6 (150)	None	32,334 (9,474)			
	6 (150)	2 (50) STYROFOAM™ Brand SM	2,562 (751)	4,586	5,351	6,115
	8 (200)	None	42,600 (12,482)			
	8 (200)	2 (50) STYROFOAM™ Brand SM	3,200 (938)	6,069	7,081	8,093

Assumptions: 6" and 8" (150 mm and 200 mm) inside diameter black coloured steel feed/return pipes have wall thicknesses of 0.28" (7 mm) and 0.32" (8 mm), respectively. Thermal conductivity of steel pipe is 452.72 Btu-in/hr•ft²•°F (65,290 W-mm/m²•°C). Surface air film resistance on the pipe is 0.65 hr•ft•°F/Btu (0.11 m²°C/W). Pipe length is 250' (76 m). Process temperature is 21°F (-6.1°C). Electrical energy costs range from $0.06 per kwh to $0.08 per kwh; 1 kwh provides 3,412 Btu (3,600 Kilojoules).

Offsetting Installation Costs

Initial installation costs can vary, but can be absorbed directly within the first few years of ice rink operation. The cost savings for the remaining years of operation can be applied toward the maintenance costs of the arena. A further point of interest is that some local power providers have programs available to fund a significant portion of such installation costs. Actual savings may vary depending on site conditions, duration of operation and installation.

For further details concerning the actual heat loss calculation, please contact your local Dow sales representative.

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