



Vacuum Jacket Pipe for Liquid Nitrogen Transfer Why Use It?

The thermodynamics of cryogenic liquid storage and transfer isn't an issue most people spend much time considering. Generally, laboratory personnel storing biologicals in liquid nitrogen freezers are quite aware that the freezer and the liquid are *really* cold and that the freezer consumes liquid nitrogen (see "Liquid Nitrogen Consumption in Cryogenic Freezers"). This paper addresses the issue of transferring liquid nitrogen from the source tank into your freezer and how you can save on the expense of buying liquid nitrogen by purchasing equipment that protects your investment better.

Consider that liquid nitrogen exists in an environment that is about 218°C above its boiling point. If you, as a human, had to do that you would want the best possible insulated box to live in to protect from the inferno all around (for you, that's almost 374°C above room temperature). Under that condition you would find it to be pretty destructive to travel from box to box without insulation to protect you, and liquid nitrogen is the same. The insulation provided by the source tank and the freezers is as good as it gets by using vacuum insulation. However, the standard transfer hose used in laboratories has barely any insulative property at all and does allow considerable loss of liquid nitrogen because the nitrogen boils away during passage.

Physical constants to consider:

- Bare copper pipe conducts 200 BTU/hr/foot
- Vacuum jacket pipe conducts 0.47 BTU/hr/foot
- Heat of vaporization of liquid nitrogen is 85.6 BTU/lb.

There is no question that these numbers show that vacuum jacket pipe is a tremendously better insulator than bare pipe (the typical braided transfer hose has no insulation and fairly closely resembles a bare pipe). Doing some calculations based on a 30-minute fill using a 6' hose to fill a CBS Isothermal V-3000 freezer every 2 days with 14" of liquid nitrogen (about 27 liters), you would save about 4 liters of liquid nitrogen on each fill by using the SuperFlex® VJ Hose rather than standard braided hoses. This can translate into an extra fill of your freezer from a properly-filled source tank by using SuperFlex VJ Hose. Depending on what you pay locally for liquid nitrogen you can have a payback period of 1-2 years for the hose (that typically has a 10-15 year useful lifetime). It should also be said that the savings go up quickly if the hose has to be longer due to local space restrictions.

Why use it? Clearly the SuperFlex VJ Hose is more expensive than a standard braided hose. However, the savings in liquid nitrogen usage over the course of the equipment lifetime more than justifies the purchase.

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