



ThermoTips

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CONDUCTION TRACING VERSUS STEAM JACKETING

Steam Jacketing

The commercial use of heat transfer compounds came into being as a response to the problems associated with steam jacketed pipes. A steam-jacketed pipe is where the core or inner pipe containing the product fluid is surrounded by a larger pipe called the jacket. Steam is carried in the annular region between the two pipes. The heat transfer coefficient for this system is very high. Typically, a jacketed system will maintain the product near the steam temperature (when there is little or no flow in the pipeline). On the negative side, the construction cost of a jacketed system is extremely high in both materials and labor. The system is very expensive to maintain. Leakage or failure of the system is difficult to locate. Where failure does occur, it is frequently due to leakage at the wall of the core pipe allowing steam to pass into the process material and vice versa. The removal of the material plugging the jacket is an expensive repair job. The usual solution is a complete replacement of the piping system. In addition, the possibility of cross contamination could cause complete loss of the product. In some processes, cross contamination may be a critical hazard.

Conduction Tracing

Steam Tracers installed with heat transfer compounds are called conduction tracers. The term "conduction" tracers refers to steam tracing systems utilizing a heat transfer compound to thermally bond the tracers to the process, service or utility pipes requiring heat. When heat transfer compound is used, the primary method of heat transfer is by conduction, whereas, the primary method of heat transfer for bare tracers is by convection and radiation. Bare tracers are often referred to as "convection" tracers. One conduction tracer can replace from 3 to 6 "convection" tracers. In the past, heat transfer compounds were installed by trowelling the material over the steam tracers. Today, Thermon TFK Strap-On Steel (or Stainless Steel) Jackets are mounted over the tracers and heat transfer compound and anchored with stainless steel straps by a force of up to 4,448 N (1000 lbs.). The anchored Strap-On Steel Jackets assure that the steam tracers and heat transfer compound are permanently fixed to the surface of the process pipe. Short sections of the Strap-On Jackets may be cut and placed over the tracer at elbows and bends to permanently hold the tracer against the pipe at these locations. Flexible steel or stainless steel jackets are also available for elbows and bends if desired. Valves and other equipment are generally traced with 10mm, 12mm or 20mm (3/8", 1/2" or 3/4") tubing which is hand formed to the valve in horizontal hairpin loops. Heat transfer compound is then applied to completely encase the tubing. Conduction tracing can:

1) provide a high heat transfer rate; 2) overcome the well known problem of cross contamination in jacketed systems, and 3) offset the high capital, maintenance and energy costs of a jacketed system.

Cross Contamination in Jacketed Systems

Cross contamination occurs when there is a leak in the jacketed core pipe (process pipe) due to stress cracks at the welds where the core pipe and the steam jacket is joined to the flange in a standard jacket. Additionally, cross contamination can occur due to the cutting action of high velocity steam where the steam impinges on the core pipe at the point of entry into the jacket causing erosion in the core pipe.

Fabrication and Testing

The capital cost of jacketing is high because it requires not only a larger pipe to surround the process pipe, but also special fittings, skilled welders and more trap stations. Today, fabricated jacket assemblies or "spools" are often built at fabrication shops and transported to the job site. Inspection and testing is quite expensive. Special testing such as dye penetrant, x-ray and hydrostatic testing increases the cost of a jacketed system even further. Construction time for jacketed pipe is quite long, and the final system cannot be easily adapted or modified. Conduction tracing, on the other hand, is more easily installed and can be readily modified to adapt to necessary changes in the process by the addition of more tracers. Reductions in capital costs are possible with conduction tracing with little decrease in system heating efficiency.

Of the many advantages of conduction tracing over jacketing, the most significant today is energy savings. Though energy savings are often low on a per unit basis, they can be startling when viewed from the perspective of an operative system. Energy savings are possible with conduction tracing because the number and size of tracers can be designed to provide the appropriate heat transfer area that closely matches the heat requirement. The heat transfer area for Steam jacketing is, of course, always equivalent to the outer surface of the Core (process) pipe.

Heat Loss

The heat loss from a process line with a conduction tracer is less than that of a jacketed line. The heat loss for a process pipe with a conduction tracer is based on the difference between the air temperature in the annular space between the traced pipe and the inner surface of the insulation, and that of the outside (ambient) air temperature. The annular temperature is a function of several variables but basically its value is reasonably close to the process pipe temperature.

The heat loss in a jacketed system is the difference between the steam temperature and the ambient air temperature because the outer surface of the steam jacket (at steam temperature) is against the inner surface of the insulation. In many cases, the insulation size is also larger to fit the jacketed pipe.

Reduced Heat Input to Product

Considerable energy savings can be realized by reducing the amount of heat input to the product. This condition exists when the operating temperature for the process line is lower than the steam temperature. Under static conditions, a jacketed pipe will drive the process material to within a few degrees (generally within 1°C to 3°C) of the steam temperature. This heat input is an unnecessary addition to the heat required to offset heat losses through the insulation.

Most designers do not take heat input to the product into consideration, but it quite often exists in actual practice. It occurs when: a) the steam temperature and pressure are higher than actually required and, b) the pumping temperature of the product is less than the temperature that can be maintained under equilibrium conditions by the jacketed or traced pipe.

The reduction of heat input to the product that results from using the correct number of conduction tracers as opposed to steam jacketing provides significant energy savings, and, consequently, significant savings in operating costs. These energy reductions not only lower cost but also reduce pollutants created by burning more fuel for steam generation.

Application

To prevent energy loss, the designer must be fully aware of the actual heating needs of the process and possible changes in conditions. By using the flexibility of single or multiple tracers a conduction tracing system can be closely designed to match the insulation heat loss at the "desired" process temperature. A proper design will transfer very little heat to the product during the temperature maintenance period, while still providing heat-up and melt out capability when needed.

Trap Stations

Jacketed lines are constructed in approximately 6m (20-foot) lengths and the condensate is removed from each section. Generally 12m (40-foot) lengths are the maximum lengths for removing the condensate at trapping stations. Conduction tracer circuits are frequently 30m to 90m or more (100 feet to 200 feet) in length. Reducing trap population lowers capital cost and maintenance cost as well as lowering the risk of steam leaks. In most plants, steam trap failures on an ongoing basis of 3% to 10% contribute to a considerable loss of steam. Each defective trap can waste over 182,000 kg (400,000 lb) per year.

Cost

The installed cost for conduction tracing generally ranges from only 10% to 20% of the cost of a fully jacketed system. The variance depends upon the following factors:

Jacketing

- (a) Size of the process pipe and the jacket.
- (b) Piping Material of Construction.
- (c) Configuration of the pipeline, effecting spool fabrication time.
- (d) Type of inspection and testing procedure required.
- (e) Number of supply & return manifolds and trapping stations required.

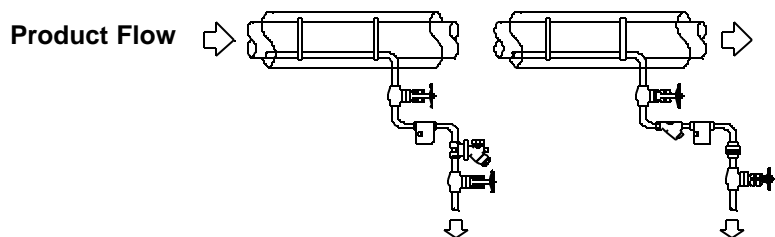
Tracing

- (a) Number and size of steam tracers required.
- (b) Type of tracer (small-bore hard pipe or tubing).
- (c) Tracer material of construction.
- (d) Number of supply & return manifolds and trapping stations required.

Conclusion

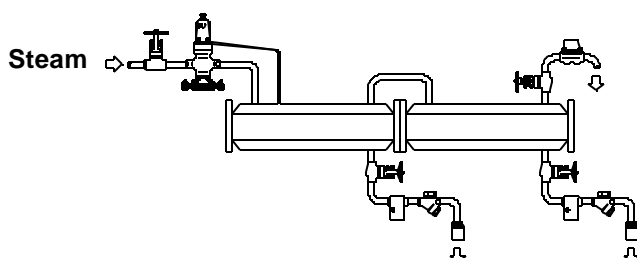
The steam jacket provides somewhat higher heat transfer rates than conduction tracers; however, frequently these higher rates are unnecessary and can cause significant energy losses. Conduction tracing, through its flexibility and sufficiently high heat transfer rates, can reduce energy consumption by adjustment of the number and size of tracers to more closely match the actual heat requirements while still providing melt out or heat up capability. Although energy savings and the resultant savings in operating and maintenance costs are of paramount interest, conduction tracing can offer substantial savings in capital outlay and future maintenance that should not be overlooked. See figure 1 and figure 2 below for typical steam trap spacing for steam traced and jacketed lines. Ask for a copy of the sulfur heat up- test for Conduction Tracing and Jacketing.

Figure 1

Tracing

30 to 90 meters between traps
(100 to 300 feet between traps)

Figure 2

Jacketing

6 meters between traps
(20 feet between traps)

References:

1. Figures 1 and 2, courtesy of Spirax/Sarco's Hook Up Drawings "Clip Art."
2. William C. Turner and John F. Malloy, "Thermal Insulation Handbook," McGraw-Hill Book Company, New York, 1981.

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