

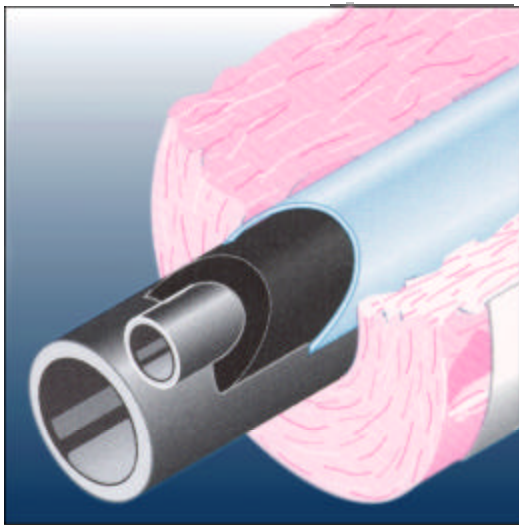


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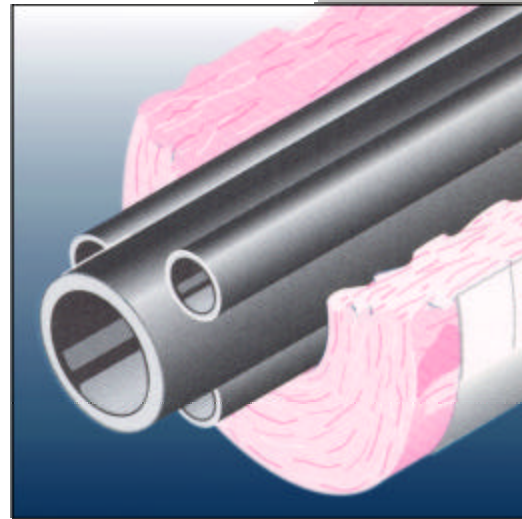
ThermoTips

The Use of Conduction Tracers Vs Bare Tracers

Metric Version



CONDUCTION TRACER



BARE TRACERS

The term “conduction” tracing refers to steam tracing systems utilizing a heat transfer compound to thermally bond the tracers to the pipe requiring heat. In the past, heat transfer compound was installed by trowelling the material over the tracers. Today, Thermon’s TFK Strap-On jackets are commonly used to permanently anchor one or more steam tracers to the pipe. These jackets assure that the heat transfer compound maintains a permanent thermal bond at the interface of the tracer and the pipe. Short sections of these jackets may also 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 or 12mm tubing which is hand formed to the valve in horizontal hairpin loops. Heat transfer compound is then trowelled or hand formed to completely encase the tubing.

Bare tracing is simply tubing or a small bore rigid pipe attached to the process pipe with tie wire or banding material. Where rigid pipe is used as the tracer, stitch welding is sometimes used at predetermined intervals along the tracer run to hold the tracer against the process pipe to improve contact and improve heat transfer.

The Benefits of Conduction Tracing

There are several reasons to choose conduction tracing over bare convection tracing. Designers should consider these points when making comparisons: predictability, reliability, efficiency, and cost.

Predictability

Because of the heat transfer compound, a conduction tracer always has a good thermal connection with the process pipe, resulting in high heat transfer rates and predictable results. The heat transfer coefficient from bare tracing, on the other hand, is entirely dependent upon the quality of the installation. Principally, the heat transfer rate depends upon the proximity of the tracer to the process pipe and to some extent on the location of the tracer on the pipe. How often and how well the tracer is secured to the pipe is of prime importance. The location of the tracer on a process pipe is of little or no consequence for a conduction tracer because heat transfer is by conduction directly into the pipe wall. However, depending on such factors as pipe size, pipe material, insulation type and thickness, and process fluid, a temperature differential of up to 12% can exist between a bare convection tracer located on the underside of the pipe versus the top of the pipe. For conduction tracers a temperature differential up to 2% may be expected.

Engineers frequently over design bare tracing systems in order to insure that minimum requirements are obtained. Over design results in wasted energy and if the bare tracers produce more heat than anticipated, a thermal expansion problem may be created in the piping network. One of the primary requirements in piping design is to provide adequate flexibility for absorbing the thermal expansion of the pipe. When the pipes are routed in a pipe rack, expansion is a major concern because space is usually limited.

Reliability

Heat transfer compounds developed almost 50 years ago have proven to be a reliable and efficient method for heating process equipment. Installations using Thermon heat transfer compounds have frequently outlasted the usefulness of the piping system where it was installed. Since the beginning, Thermon Manufacturing Company has continued to develop new compounds and refine the original ones to keep pace with industry's need for effective and efficient steam tracing systems. It is important to remember that not all heat transfer compounds are the same just as all industrial paints and primers are not the same. It is unwise for a specification to simply state "heat transfer compound". Tests carried out over the years has shown widely varying properties for these materials produced by manufacturers that have no research and development capability, no testing facilities, and no certified quality program. Poor quality materials may function satisfactorily for a time but will ultimately fail.

The effectiveness and durability of any conduction tracing system depends in large part on selecting a high quality heat transfer material for the application and then following proper installation techniques. The use of materials from an ISO9001 registered manufacturer is one means of assuring a reliable and durable steam tracing system.

Efficiency

One tracer with heat transfer compound more efficiently transfers heat in the tracing system than multiple bare tracers. **It takes approximately three (3) to six (6) bare tracers to**

match one (1) tracer with heat transfer compound. See Table 1 for cost comparison between one tracer with heat transfer compound and multiple bare tracers (\$ US) and, Figure 1 for typical layout and materials. Further, important energy savings can be realized due to the ability of a conduction tracer to maintain a relatively high process pipe temperature when supplied with lower pressure steam than that of a bare tracer. Low-pressure steam has a higher usable enthalpy than steam of a higher pressure. The use of flash steam or steam from an exothermic process can reduce energy costs considerably.

Cost

The cost of installing a conduction tracing system is considerably less than that of a bare tracing system especially where multiple bare tracers are needed to meet the temperature specifications. Fewer conduction tracers are required and therefore, fewer steam manifold connection points, condensate manifold connection points and trap stations, are needed. These equipment reductions not only lower the installation cost but also eliminate long term maintenance on the omitted equipment.

Using Tubing Vs Pipe as the Tracing Element

Although small bore rigid piping has been used for many years both for bare tracing and with heat transfer compound, it is generally not preferred due to its low workability. That is, elbows, valves, flanges, strainers and pumps prove to be difficult areas for installing steam tracers made of rigid piping. Designers should consider several factors when weighing the benefits of pipe versus tubing for steam tracing systems and those factors are: 1) installation; 2) maintenance 3) cost, and; 4) performance.

Installation:

Steam jacketing and small-bore rigid pipe tracers were used extensively in the early 1900's when the continuous-type refineries were first developed. These methods were employed to keep petroleum residues, tars and waxes flowing in pipelines. However, as dimensional control and precision fittings have been developed over the years, tubing has become a more popular material for tracing in many plants due to its flexibility and ease of installation. Today, some plants still use pipe tracers simply because they have been using them for many years and no attempt has been made to compare these tracers with modern tubing and compression fittings. Modern tubing tracers whether copper or stainless steel, are less costly, more reliable, and more efficient than pipe tracers. Although materials and equipment for pipe assembly have improved with time, pipe connection methods have changed very little in decades.

The small rigid pipe sizes used for tracing (15 mm to 25 mm) are generally connected with either screwed or socket welded joints and are field run by the piping contractor. Screwed joints (unions) designed for use with socket-welded piping are sometimes selected for installation and maintenance purposes. Welding requires skilled workers and the welding process is labor intensive. The pipe must be cut, deburred, and cleaned of all dirt, oil, and loose particles. It is then positioned in the coupling leaving a 1.6-mm gap

between the end of the pipe and the inside-butting surface of the coupling. Finally, A continuous fillet weld is made around the circumference of the joint. If the 1.6-mm gap is not maintained, the fillet weld can crack under thermal stress because the pipe will expand to a greater degree than the coupling. A costly and potentially dangerous steam leak can occur.

If butt-welding is required, the labor is even more intensive than for socket welding. The ends of the joining pipes must first be beveled. Next, the two pipes are aligned which is a tedious task for small bore pipes. After aligning the pipes, they are tack welded to hold them in place. Then, a continuous weld is made around the circumference of the pipe to complete the joint. Although current orbit welding machines will improve on the time required for butt-welding, it is still more costly than installing compression fittings.

Tubing on the other hand is cut to length and deburred, then precision fittings are installed by simply tightening a nut. Modifications only require a hacksaw and some new tubing. Steam tracing systems are frequently field routed without the benefit of detailed engineering drawings. Tubing being more flexible than pipe can be easily formed to fit elbows and bends or shaped into hairpin loops for installation on valves, pumps and other equipment. Therefore, tubing leads to a much faster and more efficient installation. Threaded couplings and unions are sometimes used to connect pipe tracers. Field threaded joints vary widely in quality. Sealing threaded joints on small-bore pipe tracers usually requires a temperature rated fluoropolymer tape or sealing compound. Thermal expansion and vibration causes steam leaks at these joints.

Installation Cost

Installation saving for tubing over rigid pipe tracers is substantial. The approximate average installation time for 10 mm to 20-mm size tubing is 1.3-man hours per linear meter including banding to the pipe and all necessary fittings. The approximate average installation time for pipe tracers from 15 mm to 25 mm in size is 4.1 man-hours per linear meter for erection and handling including joints. If the pipe tracer is stitch welded to the process pipe an additional 0.10 man-hours for each 50 mm-long stitch weld is required.

Maintenance

Threaded small-bore rigid pipe tracers must be assembled and disassembled sequentially making maintenance very labor intensive. Welded pipe tracers require costly and time consuming cutting and re-welding. Safety practices limit the use of welding torches in the field especially around refineries and chemical plants.

Performance

Tubing is readily bent to required angles and can easily be fitted to valves, pumps and other equipment using simple hand operated bending tools. Today's swaged tube fittings are manufactured for a precision fit and ensure leak-free performance. It is impractical to shape piping to fit on valves or pumps and the imprecise fittings depend on sealing

materials (pipe dope) such as Fluoropolymer based compounds or tape to reduce leakage problems.

Conclusion

Rigid pipe tracers are expensive to assemble, install and maintain, and the joints and fittings are subject to leak failures. Even though tubing has a higher ultimate tensile strength than pipe, the weak link in a tubing system is the tube while the weak link in a piping system is the fittings. Because tubing can be readily bent and formed, the use of elbows and joints are not generally required as they are in a rigid pipe tracing system. Therefore, fewer joints and fittings are required in a tubing system than in a piping system.

Reference:

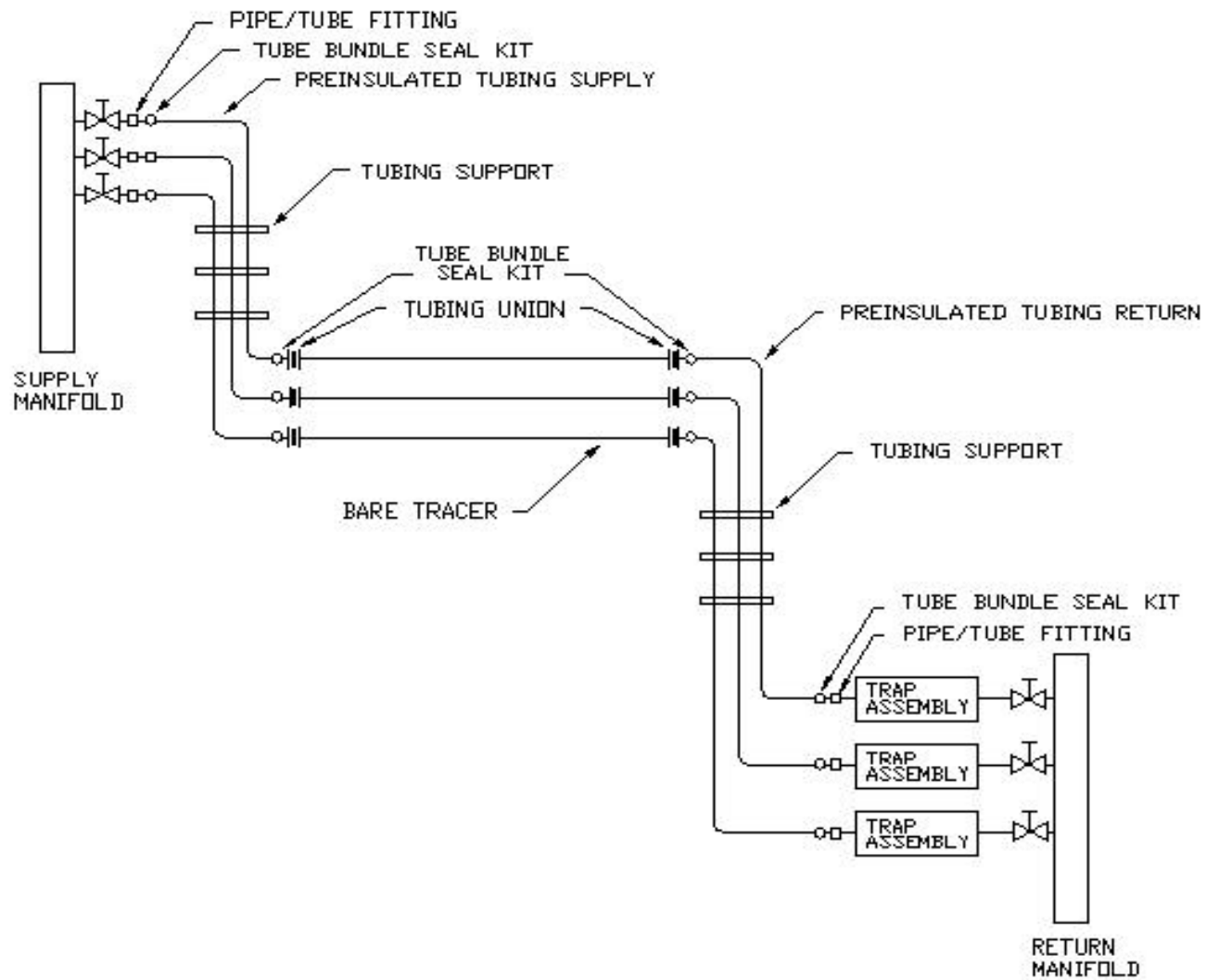
Burk, Richard and Colin, Ingram, Tubing and Pipe are not the Same; Machine Design, December, 1997.

See following pages for Table 1 and Figure 1.

Table 1
Installed Cost Comparison
Two & Three Bare Tracers vs. One Thermonized Tracer
On 100 meters of 100mm Process Pipe

Item	Description	One Thermonized Tracer	Two Bare Tracers	Three Bare Tracers
1	Supply Manifold Point	\$143.08 (.88 HRS.)	\$286.16 (1.76 HRS.)	\$429.24 (2.64 HRS.)
2	Pre-Insulated Tubing 6m each end- 12m. @ \$10.00/m.	\$120.00 (2.67 HRS.)	\$240.00 (5.34 HRS.)	\$360.00 (8.01 HRS.)
3	Pre-Insulated Tubing Supports 6 Each @ \$10.00 Each	\$60.00 (1.0 HRS.)	\$60.00 (1.0 HRS.)	\$60.00 (1.0 HRS.)
4	Pre-Insulated Tubing End Seals 4 Each @ \$6.00	\$24.00 (1.0 HRS.)	\$48.00 (2.0 HRS.)	\$72.00 (3.0 HRS.)
5	Tube Fittings 4 Each @ \$5.00 Each	\$20.00 (2.0 HRS.)	\$40.00 (4.0 HRS.)	\$60.00 (6.0 HRS.)
6	12mm Copper Tubing \$1.76/m	\$176.00 (20.1 HRS.)	\$352.00 (40.2 HRS.)	\$528.00 (60.3 HRS.)
7	Heat Transfer Cement ST-2 300 FT. @ \$10.91/m	\$1091.00 (3.28 HRS.)	\$0.00	\$0.00
8	SS Banding @ \$0.50/m and Seals @ \$0.05 Each	\$62.00	\$62.00	\$62.00
9	Condensate Manifold Point	\$164.21 (.63 HRS.)	\$328.42 (1.26 HRS.)	\$492.63 (1.89 HRS.)
10	Complete Trap Station 1 Each @ \$488.15 Each	\$488.15 (1 HR.)	\$976.30 (2.0 HRS.)	\$1,464.45 (3.0 HRS.)
11	Stainless Tags 4 Each @ \$5.00 Each	\$20.00 (1.0 HR.)	\$40.00 (2.0 HRS.)	\$60.00 (3.0 HRS.)
12	Testing – 1 Hour/Circuit	(1 HR.)	(2.0 HRS.)	(3.0 HRS.)
	Materials Total	\$2,368.44	\$2,432.88	\$3,588.32
	Labor Total @ \$35.00/HR.	34.56 Hours \$1,209.60	61.56 Hours \$2,154.60	91.84 Hours \$3,214.40
	Total Cost	\$3,578.04 or \$35.78/m	\$4,587.48 or \$45.87/m	\$6,802.72 or \$68.03/m

Figure 1
Typical Layout and Materials



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