

# STEAM TRACING AND ELECTRIC HEAT TRACING COMPARISON

Steam traps, a vital part of any steam-tracing system, must be frequently inspected – and replaced – to assure continued operation. As many as 6% of the steam traps may need to be replaced annually.



## STEAM TRACING

Historically, steam tracing has been used more often than any other type of pipeline heating, for freeze protection and for process heating. Steam typically has an advantage of having a high heat capacity combined with a suitable heat transfer coefficient. This high heat input has been advantageous in the past because thermal insulation systems on pipelines were often left for years without maintenance. When energy costs were negligible, this was an acceptable method of operation, since steam was perceived as being “free of costs”.

When flowing through a tube, the steam will dissipate its latent heat to the process pipe to compensate for the loss in heat. During this process the steam temperature remains constant. However when all steam condenses, the tube will then be filled with condensate which has a significantly lower heat capacity and a worse heat transfer coefficient. This process occurs gradually and along the entire length of the heating tube. Therefore it is necessary to install a steam trap at the end of the heating circuit to “trap the steam” and discharge the condensate with a minimum loss of fresh steam. Because the condensate in the heating tube has to be “pushed” to the steam trap (often upwards), the steam system must have sufficient pressure, which limits the maximum length of the heating circuits. Circuits which are too long will “drown” in condensate and the heat transfer will become very unpredictable and unstable, which adds complexity to the steam-tracing system. The inherent result of the short heat tracing circuits is that valuable space in the process area is used for the steam distribution and condensate collection infrastructure. Steam traps are the most critical and at the same time most sensitive component of the steam-tracing system. Due to the mechanical nature of the steam system with constantly moving parts often resulting in abrasion by the steam and blockage because of poor steam quality; steam traps are subject to frequent inspections (at least once annually) to ensure continued operation of which a significant number of the traps (roughly 6%) must be replaced each year.

Energy waste is often high on steam-tracing systems. Steam being a constant temperature source, any non-flowing pipeline is elevated to the temperature of the steam-tracing circuit over a period of time. On flowing pipelines the steam will continually transfer energy to the fluid at a higher rate because the temperature differential between the steam and the fluid essentially stays constant. Both conditions provide more heat energy to the system than is required to maintain design conditions. To date, there is no reliable method for controlling the pipeline temperature and energy usage. Depending on the type of steam trap used; even under perfect working conditions, there will always be some loss of steam. If the traps fail-open, there will be a significant amount of steam loss especially because these systems are in operation 24/7.

A brief technical differentiation between steam and electric heat tracing (mineral insulated) is provided in the table below.

To date, there is no reliable method of control and/or monitoring of steam-tracing systems, making it less desirable for process maintenance systems where tight temperature control is necessary.

	Electric	Steam †
Maintain Temperatures	550°C (1022°F)	120°C (248°F)
Exposure Temperatures	650°C (1202°F)	204°C (400°F)
Circuit Lengths	244 m (800 ft)	76 m (250 ft)
Temperature Control (typical)	±5°F	±25°F
Remote Monitoring Capability	Yes	Yes ‡
Design Time per Circuit (indexed)	1	2

† Based on a steam pressure of 5 bar

‡ Based on the functionality of the steam trap

The Total Installed Cost of an Electric Heat-Tracing System is typically 75% of the Total Installed Cost of a Steam-Tracing System for the same application type.

The annual maintenance costs for a steam-tracing system are considerably higher than that of an electric heat-tracing system for the same heat-tracing application.



When comparing the total installed cost, total operating cost and total maintenance cost - electric heat-tracing systems are typically your best overall value.

## COMPARING STEAM TRACING TO ELECTRIC HEAT TRACING

Typically, an electric heat-tracing system is approximately 75% of the total installed cost of a steam-tracing system, when taking into account the tracing system, the control & monitoring, and the power distribution system.

The total installed cost will vary according to location and specific heat-input requirements, but remain constant as an industry average. nVent can perform a complete technical and economic analysis on a customer's heat-tracing system to determine the best value for that specific application.

From a safety perspective, there is a much higher probability of the potential for maintenance personnel to be susceptible to burns while working on and around steam-traced systems due to the exposed valves and traps. Electric heat tracing on the other hand, is intrinsically safe since it has no exposed circuits and also has ground fault protection.

Electrical heating systems can include a wide variety of control and monitoring products, from simple mechanical thermostats and signal lights to sophisticated multi-circuit digital controllers. These control products vary the output of the heating source to keep pipes from freezing or to maintain process piping at elevated temperatures. From a maintenance perspective, with the electric heating system, most maintenance can be based on results from control and monitoring incorporated into the design of the system itself.

Steam-tracing systems, on the other hand, do not offer any reasonable form of control and monitoring. The largest maintenance items in a steam-tracing system are the steam traps, as they are typically the items which are most likely to fail during operation. The documented service life of a typical steam trap is three years, with a minimum replacement cost of approximately \$95. As a result, it is also recognized that the maintenance of the condensate return is always higher than that of the steam supply, as the liquid and steam cause erosion of the elbows in the system. This is why many condensate return systems are constructed of stainless steel.

The chart shown below provides an example of where the maintenance costs of

	Electric	Steam
Pipe Lengths to be Heated	12,192 m (40,000 ft)	12,192 m (40,000 ft)
Circuit Lengths	15 - 915 m (50 - 3,000 ft)	15 - 76 m (50 - 250 ft)
Total Annual Maintenance Cost (USD)	\$3,700	\$24,800

the electrical heat-tracing and steam-tracing systems are compared for a process maintenance heating application.

[\*] The data above was presented in an IEEE/PCIC Tutorial given to industry representatives at a PCIC annual meeting and was established using real data from a plant utilizing process maintain heating systems, and is merely intended for comparison purposes only.

From a total installed and total operations cost standpoint, electric heat-tracing systems are typically better than steam-tracing systems in terms of value.

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