Understanding Heat Trace Business
- A Holistic View [Part-1]

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Preamble:
This article covers basic technical tips which would assist companies and their distributors to sell better, and the customer to purchase and use suitably a good Heat Tracing System. Historically, Steam tracers which were used predominantly are now being fast replaced by Electric Heating System, in the industry which needed heat tracing for their process plants. But since the early 1970's, the fuel/furnace oil scenario changed with the introduction of high viscosity and high pour point oil properties. Then on, the industry which did not require heat tracing for their processes in India had to resort to heat tracing for the fuel/furnace oil. Suddenly there were large number of smaller industrial users who were neither educated, nor knowledgeable or experienced on heat tracing choices, and they had to depend on the heat tracing specialist companies. Likewise, as Electric Heat Tracing gradually became a proven and growing preferred choice over steam tracing in selected large industries, the small number of larger industrial users of heat tracing had to depend on Electric Heat Tracing specialist, the manufacturers of electric heat tracers. Thus, Electric Heat Tracing and 'Thermonised' Steam Tracing became a speciality business in India.

Distinguishing between 'Heat Tracing' and 'Heating'
Whilst 'heating' is very widely used in the industrial processes for boiling, distillation, drying and the processes requiring change of phase of materials, the 'heat tracing' is used for maintaining process fluid temperatures within a precise temperature limits such that the fluid material properties are maintained at required levels so that it could be easily stored, transferred and handeled. Heat tracing is a delicate engineering science requiring great art and skill to go with it. Whilst 'heating' requires high rate of mass heating that is high-watt density heating, 'heat tracing' requires low-watt density heating with very low rate of heat transfer. Very often the industrial user is not able to distinguish between the two and desires or expects the 'heat tracer', to function as a 'heater'. The role of heat tracing specialists is to confine solutions to heat tracing needs only; however, understanding of heating needs of customers is necessary.

How Distributors came in to Heat Tracing business?
Mainly it is the Electric Heat Tracing business which grew in North America and Europe in the early1950's for water freeze protection and winterization market that established the Distributor business. Due to Electric Heat Tracing becoming a commercial household usage product, distributorship to service large spread of customers in smaller pockets became necessary.

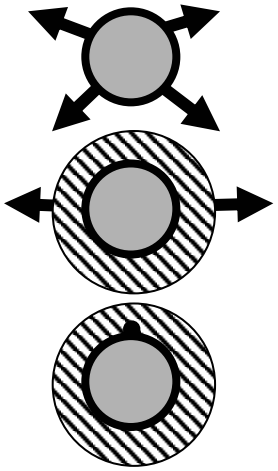
In India during the early 1970's the production and refining of Anlkeshwar waxy crude gave rise to availability of a new indigenous fuel oil known as the 'Low Sulphur Heavy Stock' oil most commonly known as LSHS. This fuel oil had a property of pour point being 55-deg.C, and below which temperature it would solidify into a solid mass. The LSHS oil, having a pour point of 50-55 deg.C, had to be heated and maintained at 65-Deg.C at all times. This gave rise to usage of steam tracing even into industries which were located in high ambient temperature zones, unlike North America and Europe where freezing temperature zones created an electric heat tracing market. The distribution of LSHS was initially to larger fuel oil customers such as Power Plants, and it gradually filtered down to the smallest consumer of fuel oil user. It was a National priority program to push this LSHS oil, and for which the Oil Industries needed to push LSHS oil to industries such as Steel and Glass industries which did not use any steam for their process. Thus the need of Electric Heat Tracing was encouraged and promoted from 1978 onwards. The bulk movement of waxy Ankleshwar crude and or refined LSHS oil by coastal route and by rail oil tanker rakes took LSHS oil to all corners of India. It became necessary for the electric heat tracing companies to train, support and establish distributors to service the multiple smaller

pockets. On establishing the use of Electric Heat Tracing for LSHS application, several other applications began to be established.

Heat Tracing: What? Why? How?

What is heat tracing?:

Heat tracing is a technique to minimise the heat loss, and to have means to replenish only the minimised loss which takes place, without over or under heating the fluid product, in the most efficient and economical method.

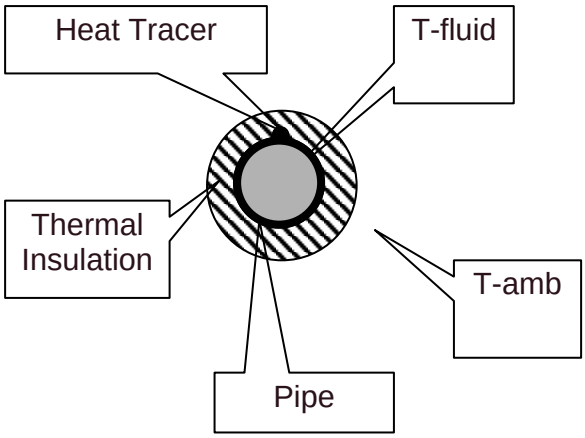


BARE PIPE- 100% Heat Loss

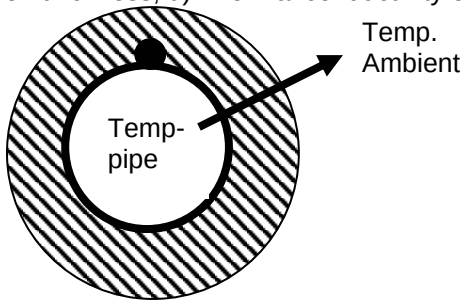
INSULATED PIPE- 15% Heat Loss

INSULATED & TRACED PIPE- 0% Heat Loss

A bare pipe having heated fluid would have a 100% heat loss rate. Whilst a thermally insulated pipe would cut down the heat loss rate by 85%, thus leaving the heat loss rate reduced to 15% only. Replenishing just this 15% heat loss rate by means of a heat tracer, would result in zero heat loss rate from the heated fluid in the pipe.



Heat Loss is a function of: a) differential temperature between Pipe fluid temperature and the Ambient temperature; b) outer surface area, which depends on the pipe outer diameter; c) Thermal Insulation thickness; d) Thermal conductivity of Insulation material



Higher the differential temperature, greater will be the heat loss rate, a condition which will arise when the fluid temperatures is at the highest and the ambient temperature is at the lowest.

Greater the thermal insulation thickness, lower will be the heat loss.
Lower the thermal conductivity of insulation material, lesser would be the heat loss; and likewise higher the thermal conductivity, greater would be the heat loss.

How to quickly determine heat loss rate for Pipes and Tanks?

$$\textbf{Heat Loss (pipe)} = \underbrace{\left(\frac{\textbf{2xPi}}{\textbf{(Log}_{\textbf{n}}\textbf{(Insu. OD/Insu. ID)}}\right)}_{\text{A}} \times \underbrace{\text{Differential Temp.}}_{\text{B}} \times \underbrace{\text{Thermal Conductivity}}_{\text{C}}$$

The component 'A' is based on physical parameters of pipe and insulation, and is termed as 'Normalising Factor' or simply (NF). A ready chart of NF for a range of pipe sizes and thermal insulation thickness enables one to easily calculate the heat loss rate for pipes. One could prepare a Heat Loss table for varying differential temperature for a range of pipe sizes and thermal insulation thickness.

Heat Loss rate for Tanks

$$\textbf{TANK HEAT LOSS (Kilowatt)} = \frac{\textbf{[}\text{(Area) sq.m}\textbf{]} \times \textbf{[}\text{(dTemp.) deg.C}\textbf{]} \times \textbf{[}\text{(k) W/m-deg.C}\textbf{]} \times \textbf{[}\text{(dM) \%}\textbf{]}}{\textbf{[Insulation thickness}\text{(t) mm}\textbf{]}}$$

Heat loss design has a direct bearing to overall installation and operating cost of a heat traced system. In the case of Electric Heat Tracing system, higher heat loss design would entail higher cost towards: tracer cost, cable cost, panel cost and operating power cost.

Heat Loss Profile from Pipe System
The heat loss rate profile for uniform pipe size and uniform insulation thickness varies greatly at flanges, supports, valves and at other fittings on the pipe. When Valves and Flanges over insulated, they would have lesser heat loss rate compared to an adjacent pipe; and likewise when under insulated, the heat loss rate would be more. The pipe portion inside the building would have lower heat loss rate compared to the outdoor pipe portion. Thus, under practical condition the heat loss profile from would not be uniform.

Why Heat Trace?

Freeze Protection: To prevent damage due to freezing of water.

Prevent Solidification: To prevent clogging of fluids inside pipes, valves, instruments.

Maintain Viscosity: To facilitate ease of pumping fluids and maintain combustion viscosity.

Prevent Condensation (Gases): To prevent damage due to erosion and corrosion.

Prevent Moisture (Low Temp.): To prevent damage to freezer room doors and drains.

Prevent Moisture (High Temp.): To prevent clogging of hoppers (ash, powder, etc)

Maintain Sterilization: To prevent infection inside pharmaceutical plants, hospitals, resorts

How to Heat trace?
There are several methods of heat tracing. Steam tracing, Electric tracing and thermic fluid tracing have been widely used, of which Steam tracing and now the Electric tracing are most widely used.

In **Steam trace** for pipes, you have Jacketed pipe tracer and external bare tracer pipes as the most widely used steam tracer system. SafeTrace® system from Thermon is the latest advancement for 21st centaury steam tracing needs. Steam tracing has a great limitation where a long transfer or cross-country pipes have to be heat traced.

In **Electric heat tracing** for tracing requirements within the battery limit of the plant you have a wide range of tracers. Basic categories of electric tracers are: a) Series resistance, and b) Parallel resistance. Whilst series resistance tracers have great many limitation for intricate process piping they offer an ideal solution to medium length (300 to 500 meters) transfer pipe lines. The parallel resistance tracers have a host of benefits for the intricate pipe tracing, but their circuit length is limited to short lengths generally 100 meters. Within parallel circuit tracers, Self Limiting Self Regulating (SLSR) conductive polymer tracers, and, Power Limiting® composite alloy tracer from Thermon offer solutions to 21st century needs. Skin effect tracers such as ThermTrac® from Thermon offer unique solutions to the very long transfer lines from few kilometres to several kilometres of pipe tracing.

Having understood the basics of Heat Loss and Heat Tracing, the mode and methods of Heat Tracing, when explained later, will be well understood.

Conclusion
With this note and the NF chart, one would now be able to understand and determine Heat Loss requirement for Pipes and Tanks.