# BTS SAFETRACE® HEAT TRANSFER RATES COMPARED WITH BARE TRACERS

During the research and testing stages of the BTS SafeTrace product development, it was surprisingly found that the heat transfer rate of the product was equivalent to a "Bare" steam tracer of the same tube size. The heat transfer rate was observed when both methods of tracing were mounted on a process pipe in the same manner and under identical design conditions including the thermal insulation used to cover the traced pipe. The word "Bare" is capitalized herein because it refers to a type or method of tracing.

**"Air convection" tracing defined:** Tracers that are not thermally bonded to the process pipe with heat transfer compound are called "air convection" tracers because the primary method of heat transfer is by the movement of air in the "annular space" between the oversized thermal insulation and the traced process pipe (see attached pipe and BTS cross section). When air convection tracers such as BTS or Bare tracers are installed on an insulated pipe, the heat circulates by natural convection from the tracer to the annular space and from the annular space to the process pipe. Some of the heat in the annular space will pass through the thermal insulation material to the ambient air. An equilibrium temperature is reached when the amount of heat passing to the pipe is equivalent to the heat being lost through the thermal insulation. In a convection tracing system, a smaller amount of heat is also transferred by radiation and a smaller amount is transferred by conduction at contact points between the tracer and the process pipe.

The BTS tracer has a silicone rubber jacket. Even though the thermal conductivity of silicone rubber is considerably lower than metal, it is 4 to 6 times higher than air. The thermal conductivity of air is approximately 0.0346 W/m-°C (0.24 Btu/hr-ft$^2$-°F-inch) although it varies somewhat with temperature. The conductivity of silicone rubber is from 0.1442 W/m-°C to 0.2163 W/m-°C (1 to 1.5 Btu/hr-ft$^2$-°F-inch). It is well known that silicone rubber is a pliable material that will yield under pressure. Without being held to theory, one explanation as to why the BTS tracer supplies an equivalent heat transfer rate to that of a Bare tracer is as follows.

**Heat transfer by conduction:** When the BTS tracer is attached to a process pipe with high temperature tape tightly wrapped around the tracer and the process pipe on 0.3 meter (1 foot) centers, the pliable silicone rubber material is placed under a certain amount of compression. The compression forces the silicone rubber to yield to the shape of the surface between the tracer and the process pipe. The silicone rubber takes the place of some of the air that would normally exist between a Bare tracer and the process pipe. Hence, it provides more contact with the process pipe and transfers more heat by conduction than does the Bare tracer. Since the metal of a Bare tracer is not pliable, most

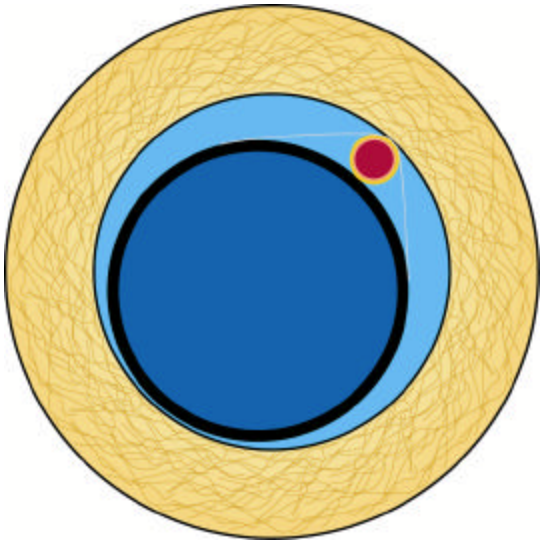
of the space between it and the process pipe is filled with air, which is a poor conductor of heat.

**Surface area:** The outside surface area of a 10 or 12mm (3/8" or 1/2") BTS tracer will be somewhat larger than a 10 or 12mm (3/8" or 1/2") Bare tracer since it contains a thin layer of silicone rubber. For example, a BTS tracer made with a 10 mm (3/8") tube and an extruded jacket of silicone rubber will have an outside (O.D.) dimension of 12 mm (1/2"). Instead of a surface area of 0.0298 $m^2$ per linear meter (0.098 $ft^2$ per linear foot) conforming to a 10mm (3/8") tube, it will have a surface area of 0.0396 $m^2$ per linear meter (0.130 $ft^2$ per linear foot) or about 25% more surface area than a Bare tracer of the same tube size.

**Heat transfer by convection:** The heat transferred by natural convection inside the thermal insulation envelope for the BTS tracer may be somewhat lower than for the Bare tracer due to the difference in thermal diffusivity between silicone rubber and copper or stainless steel construction of the Bare tube. But, the predominate method of heat transfer from the BTS tracer is still considered to be by air convection.

A BTS tracer can transfer as much heat as a Bare tracer of the same tube size because it:

1. Provides more contact area to the traced pipe than a Bare tracer of the same size.
2. Has an outer surface area larger than a Bare tracer of the same size due to the thickness of the extruded silicone rubber jacket.



**BTS SafeTrace® Tracer**

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