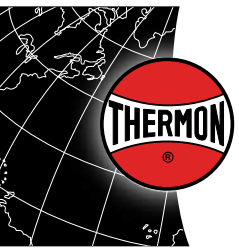


SKIN EFFECT HEATING SOLUTIONS

THERMTRAC™



THERMON The Heat Tracing Specialists®



SKIN EFFECT HEATING SOLUTIONS

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INTRODUCTION

The ThermTrac system is ideally suited for long pipeline heating applications involving movement of materials to and from tank farms, process units and loading/unloading facilities. The versatility of the system makes it ideal for temperature maintenance, freeze protection and heat-up applications. Adaptable to varying site conditions both above and below ground, a ThermTrac system can traverse terrains with significant elevation changes.

A ThermTrac system provides a cost-effective alternative to conventional resistance heat tracing on long line piping by eliminating the need for an extensive power distribution system. A pipeline up to 15 miles (25 kilometers) long can be traced from a single power point.

Thermon has a proven track record with skin effect heating systems installed around the world in a wide variety of industries including:

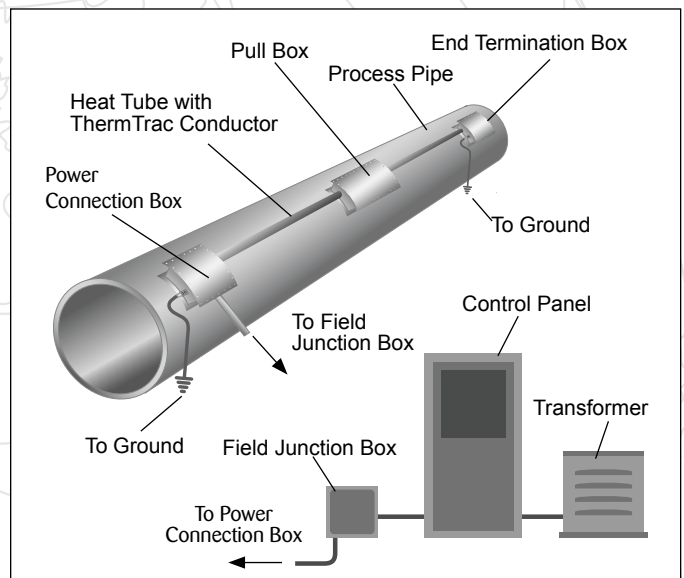
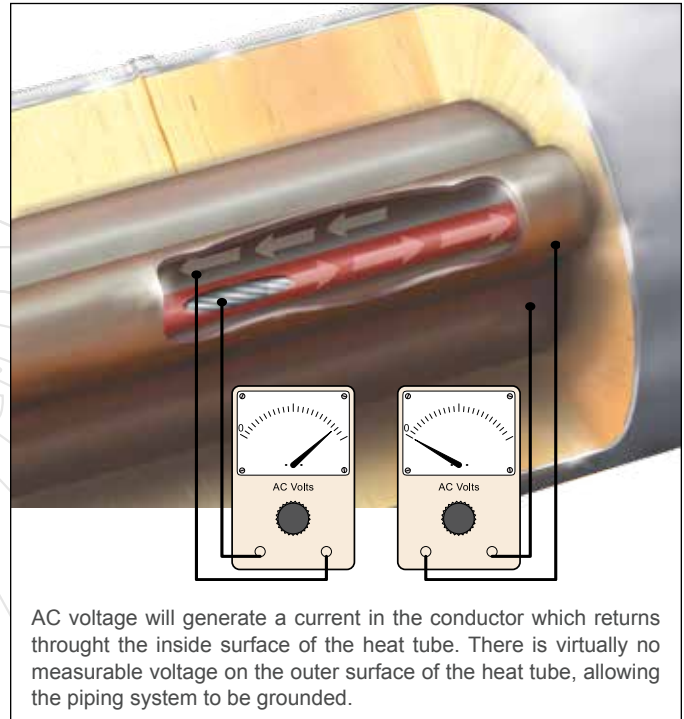
- Chemical
- Oil
- Power
- Petrochemical
- Gas
- Pulp/Paper
- Steel
- Mining
- Refining

HEATING SYSTEM DESCRIPTION

The operating principle of a ThermTrac skin effect heating system is based on two phenomena, proximity effect and skin effect. The heating device is a ferromagnetic pipe, called a "heat tube", through which a specially designed skin effect conductor has been pulled. The heat tube and insulated conductor are joined together at one end, while at the opposite end the heat tube and the conductor are connected across an AC voltage source (typically 50 or 60 Hz). The impressed AC voltage will generate a current in the conductor which will return through the inside surface of the heat tube. The concentration of the return current on the inside surface of the heat tube is due to the magnetic flux linkages originated by the currents in the insulated conductor and the ferromagnetic pipe. This current penetrates into the heat tube a distance termed the "skin depth." Due to the phenomena described, there is virtually no measurable voltage on the outer surface of the heat tube, allowing the piping system to be grounded. The heat generated in a ThermTrac system is the result of the resistance that occurs on the inner skin of the heat tube. While the electrical current is concentrated on the

inner surface of the heat tube, the heat generated will dissipate from the tube into the attached carrier pipe to increase the surface temperature of the pipe and its contents to a designed level.

An additional advantage of the ThermTrac Skin Effect system is its ability to work with a cathodic protection system.



THERMON HAS A **SOLUTION** FOR LONG LINE PIPING APPLICATIONS

Skin effect utilizes an alternating AC power source, while cathodic protection requires a DC potential. Since no voltage exists between the outer wall of the pipe and ground, there is no relationship between the skin effect system and the cathodic protection. ThermTrac Delivers

Performance

A ThermTrac system meets the demanding heat tracing requirements of long line piping:¹

Power Outputs.....up to 50 W/ft (165 W/m)
System operating voltagesup to 5 Kv
Maintenance temperature..... up to 392°F (200°C)
Exposure temperatureup to 500°F (260°C)
Minimum installation temperature..down to -40°F (-40°C)
T-rating²T6 to T2

Notes . . .

1. Each ThermTrac system is custom designed for the application. Please consult ThermTrac for specific project details.
2. Hazardous area temperature classifications are determined for each installation in accordance with the guidelines set forth in IEEE Std 844, IEEE Recommended Practice for Electrical Impedance, Induction, and Skin Effect Heating of Pipelines and Vessels.

Reliability

Typically, long line piping is located in areas where access is limited. Frequent maintenance and troubleshooting are costly in both time and money. Since one ThermTrac circuit can heat trace over six times the length of pipe that could be protected using conventional resistance heating cables, the power distribution and temperature control requirements are significantly reduced.

Design Solutions

Thermon engineers evaluate the design parameters of each application using CompuTrace® heat tracing design software and analytical thermal modeling technologies including Finite Element Analysis (FEA) and Computational

Fluid Dynamics (CFD). Based on any design requirements or limitations, numerous options are reviewed to establish the best solution for the specific project.

A THERMTRAC SYSTEM INCLUDES

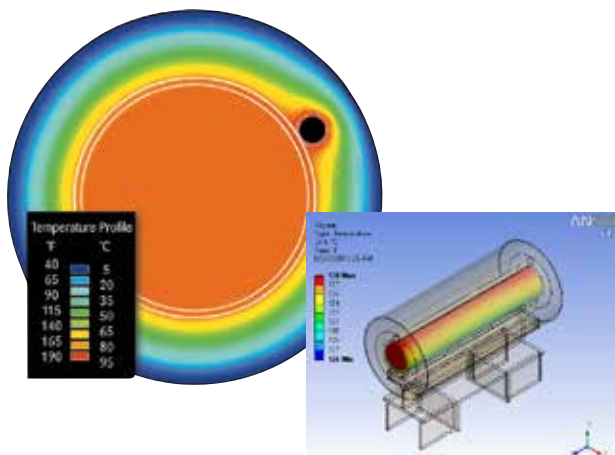
Thermon custom-engineers every ThermTrac system to meet the requirements of each specific application. The Thermon scope of work typically includes:

- Reviewing the application's design parameters and calculating the heating requirements using CompuTrace and thermal modeling as necessary.
- Selecting the heat tube size, ThermTrac conductor and secondary voltage required to feed electrical power to the system.
- Designing and supplying the transformer and control panel including temperature sensor.
- Designing and supplying ancillary equipment consisting of field junction boxes, power connection boxes, end termination boxes and pull boxes.
- Providing engineered drawings indicating heat tube routing, box locations, electrical wiring diagrams, field connections, transformer connections and power distribution and control panel connections, plus operation and maintenance manuals for the complete system.
- Supplying specifications for the carbon steel heat tube and related accessories including specifications for installation, welding and testing.

TRANSFORMER AND CONTROL PANEL

The Transformer and Control Panel is designed to meet the requirements of each specific project based on the available voltage, load requirements, number of circuits and the operating environment. The power/load center typically consists of a specialty transformer equipped with over/under primary taps and additional power adjustment taps on the secondary side. Load contactors, circuit overload protection and other protective devices also form a part of the load center. When multiple skin effect circuits exist (powered from a common location), Scott-tee type transformers may be used to balance a three-phase power supply to feed two ThermTrac circuits.

The control and monitoring panel typically includes temperature control and monitoring with high and low temperature alarms, differential current relay safety protection and current/voltage monitoring.



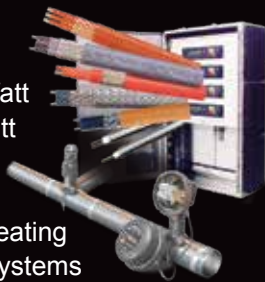
Thermon Worldwide

With global manufacturing and warehouse facilities, Thermon supplies heat tracing products to meet the needs of customers around the world. Thermon offers complete heating solutions, including heating cables and terminations, control systems, engineering/design services, and installation.

Electric Heat Tracing

The demands placed on heat tracing systems vary based on the design parameters specific to each application. To meet these needs, Thermon manufactures the widest variety of electric heating cables and control systems in the world.

- Self-Regulating
- Power-Limiting
- Parallel Constant Watt
- Series Constant Watt
- Mineral Insulated
- Skin Effect
- Tank and Hopper Heating
- Complete Control Systems



Heat Tracing Software

CompuTrace® is an integral part of Thermon's heat tracing package. Whether your project involves winterization, maintenance of elevated temperatures, complex piping, long piping runs or any combination of these, CompuTrace has what it takes to help design your heat tracing system.

CompuTrace allows the user to perform designs in compliance with four globally recognized electrical standards. The program performs heat up calculations using any of Thermon's cables. Five report formats are available to choose from. All reports can be exported to a Microsoft Excel compatible file for electronic file transfer or customization.



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