

# How Impedance Heating Works

The basic concept of impedance heating is quite simple: Terminals are attached to each end of the pipe, and a low voltage current is passed through it. In other words, the pipe acts as its own heating element.

The explanation of how impedance heating works is a bit more complex. Traditionally, electric heat is generated by passing current through a wire that is purely resistive. This is how electrical resistance tape or cable tracing produces heat. With the impedance method, heat is generated by combining three different effects:

1. The pipe acts as a resistor, much the same as a wire in the traditional method. The electrical resistance of the pipe depends upon its length, composition and wall thickness.
2. When heating a straight length of pipe, it is necessary to attach a power cable to one end (see Figure 1). The cable is normally laid on the pipe's insulation jacket. The current flow in a typical impedance system is enough to set up a significant magnetic field around the cable. Since most pipes are made from magnetic materials, steel being the most common, the magnetic field interacts with the pipe, producing the second component of heat, skin effect/proximity effect.

3. A 60 hertz power source produces a magnetic field that changes direction 60 times per second. The electrical inertia of the pipe relative to these changes produces a hysteresis effect, which is the third source of heat in the impedance method.

Taking all of these effects into account, HEATREX designs and furnishes a hardware package to generate the proper amount of heat for a given pipeline system. That package consists of the following:

- **Power Transformer** — A transformer, fed from a commercial power source, produces the correct voltage to give adequate heat and safe operating conditions. Furnished in its own enclosure, the transformer has multiple taps to fine-tune the voltage output in the field. Output voltages range from 1 to 30 Volts.
- **Control Panel** — Pipe temperature is controlled by a thermocouple sensor attached to the pipe. The standard control panel includes a process temperature controller, magnetic contactor and all necessary pilot lights, relays, fuses, etc. Optional solid-state proportional control, with fully modulated SCR, is also available for more precise temperature control.
- **Terminal Plates with Cable Lugs** — Terminal plates are supplied for field attachment to the pipe and low voltage power cabling.
- **Flange Isolation Kits** — In order to confine the electrical current to the section of pipe being heated, HEATREX can furnish isolation kits consisting of an isolator gasket for each end of the pipe and isolator bolts with proper washers to secure the gasket and mating flanges. Note that standard field-furnished flanges are used with the isolation kits. No special flange treatment is necessary.

