

# CIRCULATING INDUCED CURRENT DETECTION WITH THERMOGRAPHY

By Jeff Lebold

Infrared thermography has long been a leading method for providing early warning signs of existing electrical anomalies. An infrared image is a visual representation of heat; generally, white or lighter colours indicate hotter regions. By performing thermographic surveys on operating electrical equipment, loose connections and over-loaded or open circuits are detected. Loose connections show “hot spots” while open circuits are “cold”. Thermography has also proven very effective in locating another type of unwanted electrical condition produced in non-current carrying electrical equipment: circulating induced magnetic flux in ferrous metal.

## INDUCED MAGNETIC CURRENT FLUX

As electrical conductors carry a current to a load or device, they produce a magnetic flux around them. The “left hand rule” states that by using your left hand with the thumb pointing in the direction of current flow, the induced flux around the conductor travels in the direction indicated by the fingers. This rule is true for DC and AC current carrying conductors. With AC, of course, the current and flux is changing direction 60 times a second (60 hertz circuits).

## FLUX CAN CAUSE UNWANTED HEATING

When conductors enter metal electrical enclosures, and their accompanying flux comes in contact with ferrous metal, heating can be produced as the flux realizes a magnetic path. Heating is



Induced magnetic current heating noted on box connector and cable sheath

produced as the induced currents circulate in the magnetic material. Electrical enclosures, metal cable sheaths and cable connectors can provide the magnetic path. This phenomenon is more common in three-phase AC systems, especially if conductors enter enclosures separately. The quantity of heat depends on the amount of current in the conductor, which is a direct relation to the mass of produced flux. High amperage conductors, bus bars and phase buses can produce heat that is intense enough to melt insulation and even the metal itself.

## EARLY DETECTION WITH THERMOGRAPHY

If routine infrared inspections are conducted, and prime locations are known and surveyed, induced current heating can be detected. Three-phase AC systems should be inspected thoroughly, especially if it is noted that conductors are installed separately, as opposed to together, in one conduit or cable sheath.

An experienced thermographer, with an understanding of induced magnetic heating, is a great asset for seeking out this elusive condition. Heating of affected components is seen and monitored to access the degree of heating. Corrective actions are then planned and implemented before catastrophic failures result.

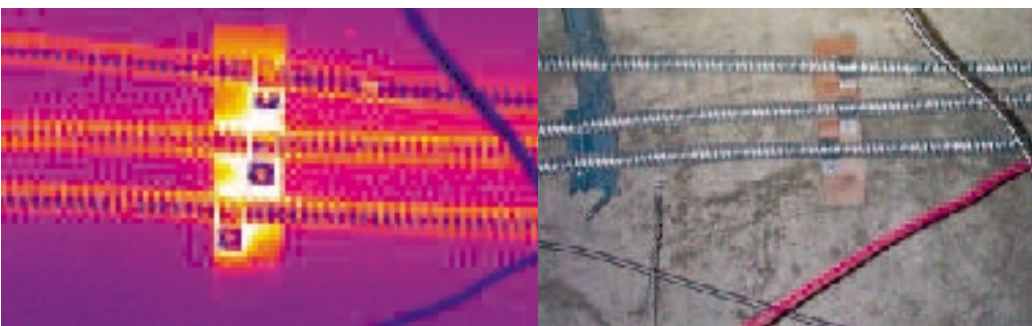
## CORRECTIVE ACTIONS

Good design is the best defense against induced current heating. In three-phase systems, current carrying conductors should enter enclosures together in one cable sheath or conduit. This will produce a cancelling effect and any stray flux is eliminated. Triangular supports should be used (versus flat, side-by-side runs) with large bus bars and phase buses. Triangular layouts also help to cancel out induced currents between the three phases.

## CONCLUSION

Induced current problems are often forgotten about or not realized during design and installation procedures. In the real world, induced current heating is an effect that is often overlooked. With training and understanding, thorough infrared thermographic inspections can prove to be the most valuable early warning defense against this interesting condition.

*Jeff Lebold of Boldstar Infrared Services can be reached at 905-579-9264 (1-888-847-0517) or [www.boldstarinfrared.com](http://www.boldstarinfrared.com). ET*



Induced magnetic heating of three-phase cable straps and supports