TECHNICAL UPDATE - TU-6017

SUBJECT: USE OF GROUND FAULT CIRCUIT WITH UNITHERM ELECTRIC TRACED BUNDLES

Revisions to The National Electric Code, Article 427-22, in 1996 have made it necessary to install ground fault circuit protection of equipment on each branch circuit supplying electric heating equipment for pipe and vessel heating. The most common method of providing this protection is to use a ground fault circuit interrupter.

A Ground Fault Circuit Interrupter (GFCI) is a safety device used to open (turn off) an electrical circuit quickly in the event of an unwanted current path between the conducting bus wires and the electrical ground.

This device differs from a typical circuit breaker in the following manner:

For a standard circuit breaker (or fuse) to open, the electrical current used by the load (in our case, the heating element) must be above the rating of the circuit breaker for a period of time. This time period decreases as the level above the rating increases. For example, a 10 amp circuit breaker may trip almost immediately if we connect it to a heater that draws 100 amps, but will run for an extended period of time if we connect it to a 12 amp heater.

If the circuit breaker is sized correctly, it will then open only if a fault condition occurs, commonly called a short circuit or “short”.

A short circuit can only occur if the electrical current can flow from the heater to an electrical ground. If there is no ground path, no electricity flows and there is no short. (Now you know how a bird can sit on a high-tension electrical line and not be burned).

In most applications, the ground path is provided by either metal tubes or a metal braid over the heater. However, if the application uses non-metallic tubing or hose and a non-braided heater, or a braided heater with a high resistance (stainless steel) braid or a braid not connected to electrical ground, there is no ground path for a fault - until someone touches the bare wire.

In other cases, the heater may sustain mechanical damage that does not produce a fault current high enough to trip the circuit protection device, but can damage the heating element and surrounding equipment.

For these applications we need a GFCI.

The GFCI first found wide application in residential wiring as a means of protecting homeowners from electrical shock when using electrical appliances in damp areas as bathrooms, kitchens, garages, and for outdoor receptacles.

A GFCI senses an imbalance in the load carried by the two conductors in the heater. In other words, the current flowing in both conductors must be equal.

This difference in current flow is termed “leakage current”; and is most generally caused by a breakdown in the electrical insulation, allowing current to “leak” to a ground path. Leakage current is measured in “milliamps”, or 1/1000 ampere. A GFCI will trip if a certain leakage current is sensed, regardless of the current that the circuit is pulling.

GFCI’s are available in two trip ranges: personnel protection and equipment protection.

The personnel protection series will trip if it senses a leakage current in excess of 5 milliamps. The equipment protection series trips on a higher leakage current. There is no specification for equipment protection trip current, but the industry has seemed to settle on trip levels of 30 milliamps or more.

Short lengths of resistance-type heaters can generally be connected to “personnel protection” type GFCI’s. However, longer lengths of resistance-type heaters and most Self-Regulating or Self-Limiting heaters must be connected to an “equipment protection” type GFCI. The “self-regulating” action of the heater will cause “nuisance tripping” of the 5 milliamp personnel protection GFCI.

The GFCI will also trip if an overload is encountered, the same as a normal circuit breaker. But it should be restated, the GFCI will open if the leakage current exceeds its rated limit regardless of the load current.

Ground Fault Circuit Interrupters are available from most electrical supply houses in a variety of styles and current ratings, and can be retrofitted into most applications. The chart below lists products offered by five major circuit breaker manufacturers for this application.

Manufacturer	Designation/Part Number	Max Voltage	Max Current
Cutler-Hammer	CH1-XX-EPD	120VAC	15,20,30 Amps
	CH2-XX-EPD	240VAC	15,20,30,40,50,60 Amps
General Electric	THQB-11-GFEP	120 VAC	15,20,30 Amps
	THQB-21-GFEP	240 VAC	15,20,30 Amps
Siemens	BE1-XX	120 VAC	15,20,30 Amps
Square D	QOB1-XX-EPD	120 VAC	15,20,25,30 Amps
	QOB2-XX-EPD	240 VAC	15,20,25,30 Amps

Westinghouse	QBFEP10-XX	120 VAC	15,20,25,30 Amps
	QBFEP20-XX	240 VAC	15,20,25,30,40 Amps

XX in the part number indicates direct short fault current