



Information Sheet # 07

Your Reliable Guide for Power Solutions

Short Circuit and Overload Protection Devices Within an Electrical System

1.0 Introduction

The designer of an electrical system has the responsibility to meet code requirements and to ensure that the equipment and conductors within a system are protected against current flows that will produce destructive temperatures above specified rating and design limits.

This information sheet discusses protective devices that are used within a system, how they work and where they are used.

2.0 Overcurrent protection devices:

Protection against temperature is termed "overcurrent protection." Overcurrents are caused by equipment overloads, by short circuits or by ground faults. An overload occurs when equipment is subjected to current above its rated capacity and excessive heat is produced. A short circuit occurs when there is a direct but unintended connection between line-to-line or line-to-neutral conductors. Short circuits can generate temperatures thousands of degrees above designated ratings. A ground fault occurs when electrical current flows from a conductor to uninsulated metal that is not designed to conduct electricity. These uninsulated currents can be lethal.

The designer has many overcurrent protection devices to choose from. The two most common are fuses and circuit breakers. Many circuit breakers are also known as molded case breakers or MCBs.

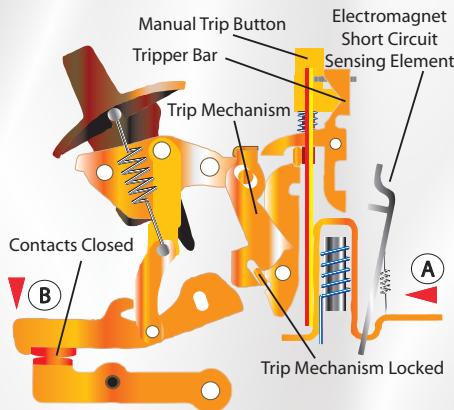
Fuses: A fuse is the simplest form of overcurrent protective device but it can be used only once before it must be replaced. A fuse consists of a conducting element enclosed in a glass, ceramic or other non-conductive tube and connected by ferrules at each end of the tube. (See Diagram 2) The ferrules fit into slots at each end to complete a split in a circuit. Excess current flowing through the fuse melts the device's conducting element and interrupts current flow.

Fuses are rated by the amperage they can carry before heat melts the element. The fuse is ideal for protection against short circuits. Short circuits produce enough amperage to vaporize a fuse element and break connection in one cycle of a 60-cycle system. Fuses are more commonly used in devices connected to a system than within the system's circuit.

Circuit Breakers: Now, conductors in systems are usually protected by circuit breakers. Tripped circuit breakers can be reset after the fault is cleared, an advantage over fuses that must be replaced. (Continued over)

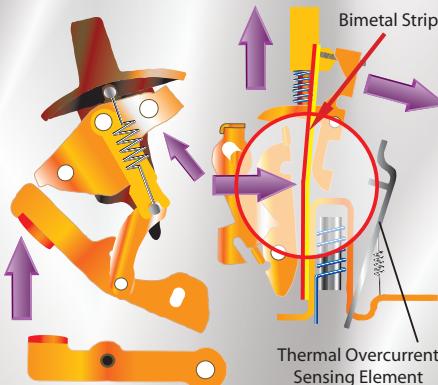
Diagram 1 - Thermal and Magnetic Trip Elements of a Circuit Breaker

Closed Energized Circuit Position



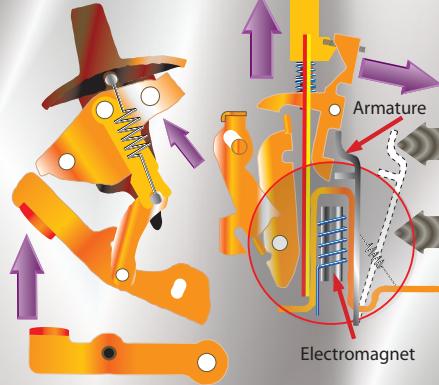
In the "ON" position, as above, the trip mechanism keeps the circuit closed and lets current flow from "A" to "B". The trip mechanism can be engaged manually for overload by thermal sensing and short circuit by an electromagnetic device. There is also a manual trip button.

Tripped Thermal Overload Position



Current flowing through the bimetal strip causes it to heat up. When a certain heat is reached, the strip bends and operates the trip mechanism. The strip is calibrated to start bending when overload amperage is reached. The higher the current flow, the quicker the bimetal trips the breaker.

Tripped Magnetic Short Circuit



Short circuit protection is provided by the electromagnet. The electromagnet produces a magnetic field sufficient to pull the armature only when overload amperages are reached. Tripping occurs when the armature strikes the trip bar. This cuts current flow and releases the armature.

Copyright 2006 PLC Enterprises, LLC

To fulfill our commitment to be the leading supplier and preferred service provider in the Power Generation Industry, the Clifford Power Systems, Inc. team maintains up-to-date technology and information standards on Power Industry changes, regulations and trends. As a service, our **Information Sheets** are circulated on a regular basis, to existing and potential Power Customers to maintain awareness of changes and developments in engineering standards, electrical codes, and technology impacting the Power Generation Industry.

