Fuseology - Fuse Troubleshooting

Overcurrent devices provide two main purposes in an electrical circuit:

1. To protect components, equipment and associated wiring from costly damage.
2. To isolate sub-systems from the main system once a current fault has occurred.

Fuses and circuit breakers are commonly selected as the preferred overcurrent devices.

Fuses

Fuses are current sensitive devices and selected to be the weakest link in the circuit. Circuit protection is provided when the fuse link melts and safely interrupts the overcurrent demand. The key criteria to judge the performance of a fuse is the time versus current characteristic curve. This curve can be used to match the fuse with the anticipated overcurrent load expected in the application.

Thermal Circuit Breakers

The basic components of a thermal circuit breaker are the composite alloy reed, two precious metal contacts and the interconnecting terminals. When an overcurrent occurs, heat is generated as the current flows through the reed causing the reed to deflect and snap open. This separates the contacts and safely interrupts the current flow. Two important parameters used to judge the performance of thermal circuit breakers are the time versus current characteristic curve, similar to the fuse, along with the speed at which the contacts snap open. The relative speed at which, the contacts separate is a measure of the cycle life under electrical loading demands. Cooper Bussmann carefully designs its snap acting reed element to ensure long cycle performance for its products.

Types of Overcurrent

Short-Circuit: Short-circuit is a current condition that greatly exceeds the rating of the device. It is caused when a malfunction or accident creates a break in the normal path allowing electricity to flow directly to ground. This shorter current path bypasses the resistance offered by the circuit components connected in the normal current path. In this situation, there is virtually no resistance to impede the current and the current will build to a level where the heat generated can cause insulation and/or equipment breakdown.

Overload: An overload is an overcurrent that is within the normal current path. Overloads occur when the current exceeds the value for which the equipment or associated wiring is rated. This typically occurs when too many devices are connected to the circuit or when a device connected to the circuit malfunctions. Sustained overloads may slowly cause overheating of the wiring and the components. The circuit protection device must open before these types of overloads cause damage.

Selecting Overcurrent Protection

During normal conditions, an overcurrent protection device must carry the current without nuisance openings. However, when an overload or short-circuit occurs, the device must interrupt the overcurrent and withstand the voltage across the device after arcing. To properly select an overcurrent device, the following items must be carefully considered:

- **Voltage Rating:** Represents the maximum system voltage present in the circuit in which the overcurrent device is installed. The system voltage should not exceed this value for proper operation of the device during an overcurrent event.
- **Current Rating:** This is the amp value marked on the circuit protection device. The circuit protection device is designed to handle this value under steady operating conditions and at ambient temperatures near 25°C. The current rating of the fuse should not exceed the rating of the device.

Characteristics of Equipment to be Protected/In-rush Characteristics:

During the operation of protected equipment, system current can significantly vary. This is particularly evident when motor or other inductive loads in the circuit cause large current surges during start-up or shutdown. A time-delay fuse should be used in applications where in-rush currents are possible.

Troubleshooting Technique

Important: Before replacing any fuse or circuit breaker, always turn off power, and determine and remedy the cause of the fuse or circuit breaker opening.

- Always replace an open fuse with one of the same type having the correct voltage and amp rating for the application or called for by the equipment manufacturer.
- Always replace a non-working circuit breaker with one of the same type having the correct voltage and amp rating for the application or called for by the equipment manufacturer. If replacing a fuse with a circuit breaker, consult your owner’s manual for recommendations.

Because fuses contain no moving parts, they do not generally operate due to wear-and-tear. When a fuse opens, it’s important that you determine and correct what caused the overcurrent situation in the first place. Otherwise, the replacement fuse is likely to open, too - and the circuit will still not function as intended.

Automotive: Fuses are installed in one or more fuse blocks - which can be located in various locations in the vehicle, depending on its make and model. Typically, fuse panels can be found in the passenger compartment, below the steering wheel; in the engine compartment; or in some cases, in the trunk. See the vehicle owner’s manual for the precise location of the fuse block(s).

On most vehicles, each clip in the fuse block will be labeled, to help you identify which circuit the fuse protects (wipers, radio, dome light, etc.). The fuse itself is labeled with an amp rating, and (in the case of blade fuses) a color coding.

Home: For circuits carrying 120/240 volts, please refer troubleshooting and servicing to a qualified electrician.

For product information and Data Sheets, visit [www.cooperbussmann.com](http://www.cooperbussmann.com)