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Technical Information

Electrical Circuit Protection; Calculating Fuse Values & Types

First, What is a fuse? How does it work? What is its' purpose? What conditions is the fuse expected to encounter? How do you select the right value and type for maximum protection of a device?

A fuse is a replaceable device which is installed in a circuit between the power source and the load, which has a sacrificial element that will melt at a predetermined amperage load. It will serve three primary functions: 1. To protect the load from self destruction in case of an internal fault. 2. To protect the load from a fault in the poser source. 3. Protect the power source from excessive load.

1. A fuse may encounter high voltage from the power source due to a power surge, crossed lines, transformer malfunction of back feeding from an external source.

2. A fuse might also encounter an unusually high amperage draw from the load due to a failed component, faulty wiring or improper application.

3. A fuse might encounter high voltage generated within the load, due to induction induced transients. (an internal components acts like a generator or transformer).

Most loads have a calculable draw. IE: A 1 horse power single phase motor will theoretically draw 8 amps @ 230Volts. Here theory and reality part. Most motors operate below their nameplate horsepower, however, in some applications they operate above nameplate, or in their "service factor" . A service factor of 1.25 means that a 1 HP motor can be used up to 1.25 HP. Amperage will rise accordingly. Starting load can be many times the running load. A motor running, say a drill press may start with a fraction of its' running load because there is little inertia. The load is applied when the operator starts to drill. A large fan or air compressor has high inertia, and will start with a load 2-3 times its nameplate amperage.

These factors must be considered when choosing a fuse. and the fuse chosen should not be of a higher value than that which is needed.

Determining fuse value: In the case of a transformer, the easy answer is to calculate the maximum load rating of the transformer and use primary and secondary fuses which will handle the load.

A .500 KVA (500 Watt) transformer operating on 460 Volts will require a 1.25 A primary fuse for full protection. The secondary, if 115 volts would be 4 A. For most applications, fuses are sized at 1.25-1.5 times anticipated loads, to handle minor fluctuations. If the input voltage drops, the amperage will increase and possibly blow a fuse which is too close to actual calculated limit. Normally, a fuse is sized slightly over anticipated highest load. The KVA rating of the transformer must be higher than the normal anticipated load.

Many types of fuses are available with each having different characteristics. Types include fast blow, slow-blow, time delay, indicating, dual element, vibration resistant, and a variety of other variations. For an application with anticipated source fluctuations or load spikes, slow blow or time delay fuses are usually used. For extremely sensitive electronics, a fast blow fuse is used.

Many circuit boards include a metal oxide varistor (MOV) in the primary power circuit. The MOV is wired across L1 & L2 (or L1 & N) on the circuit side of the fuse. The MOV is voltage sensitive and will permanently short out and blow the fuse if in-rush voltage exceeds its rating. The purpose of the MOV is to protect the circuit from high voltage; since the fuse only protects against high amperage. A blown MOV will usually show burn or smoke marks on the board. In most cases, they can be easily replaced by a technician who is competent to solder components on a circuit board.

Fuses should be replaced with the proper type and amperage to prevent severe damage to equipment, or worse, electrical fires . Fuses of inadequate capacity can run fine for a period of time and fail unexpectedly. Think of a fuse as an electrical safety valve.

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