PRODUCT INFORMATION

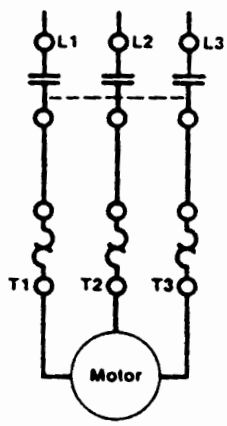
MOTOR

Thermistors and Thermostats

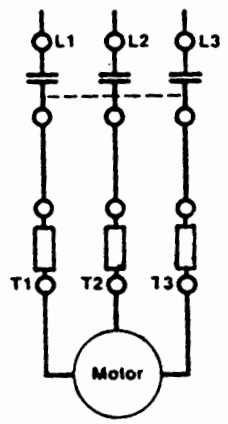
Motors can be protected by:

- Current sensing devices
- Temperature sensing devices

1. A current sensing device can be a set of heater coils in a motor starter or a set of fuses which are installed in series with the motor windings.



THERMAL
HEATER
COILS



FUSES

Current sensing with thermal heater coils or fuses is effective and sufficient if a motor runs continually at rated load and speed.

A motor is designed to operate at its nameplate current continuously. If an over-current condition exists, the motor could overheat and burn-out.

The current sensor's job is to detect the over-current and shut the power off to the motor to prevent a burn-out.

The current sensors are usually slow reacting which means they open up when the high current draw persists for several seconds (10 or more seconds). This time period depends on the size of the motor or application.

2. A temperature sensing device, such as a thermistor or thermostat, monitors the temperature of the motor winding. It does not monitor current draw.

   When a motor operates above the nameplate rating, the temperature in the motor windings will increase. If the temperature increases above the trip temperature (safe temperature) of the thermistor/thermostat the motor will be shut off until the temperature has come down far enough to allow the motor to be started again.

   The thermistors and thermostats can be seen as normally closed contact or switch. When a thermistor/thermostat heats up above its trip temperature, the device will act as an open contact (switch). When the temperature is below the trip temperature the contact will close.

   The temperature sensing devices are very useful in applications where there are frequent starts and stops of the motor. The frequent starts and stops will heat up a motor considerably, even if the full load current draw is below the nameplate rating. The temperature increase of the winding is the result of the starting current (5-6 times the rated current). If the motor starts frequently, the high currents will increase the winding temperature because the motor may not have the ability to or time to cool-off. (Cooling-off in this case is called heat dissipation).

   Another application where thermistors/thermostats are used is on 3 phase AC motors operated by variable frequency inverters. When an AC motor is operated at low frequencies (less than 30Hz) the motor will heat up from a lack of air cooling from the fan. The standard cooling fan, which is connected to the rotor, will not force enough air over the motor due to the slower rotation of the fan. As the result of this, a motor can overheat and may burn-out, despite the lower current draw at full load.

   Motors operating at frequencies below 30Hz may, therefore, require temperature sensors. If an auxiliary blower is used to cool off a motor, a temperature sensor may not be required.

   • **Thermistor - Temperature Sensors**

   A thermistor is a solid state device which is embedded in the windings of a motor. This embedding is done in the motor manufacturing department. Usually there is one (1) thermistor per phase. This means three (3) thermistors in a 3 phase, single speed motor. Two speed motors may have three (3) to six (6) thermistors depending on the motor design. A 2 speed motor, single winding has three (3) thermistors and a 2 speed motor, separate windings has six (6) thermistors.

MOTOR

A thermistor operates as a temperature sensitive variable resistor whose resistance rises very rapidly when a certain trip temperature is reached. This trip temperature is a function of the insulation class of the motor windings. Motors, therefore, can be supplied with thermistors for B, F and H insulation protection.

When thermistors are used, a trip control is required. The trip control monitors the temperature sensors and detects resistance of the sensors. A contact in the trip control is used in series with the motor starter's holding circuit. This means when the trip control drops out, the starter coil will de-energize, opens the starter contacts and the motor will stop. The motor can only be restarted if the motor is cooled-off below the trip temperature and the reset button is pressed.

The "cold" resistance of thermistors may be 80-800 ohm depending on how many thermistors are wired in a series.

The "hot" resistance of the thermistor may be 2000-4000 ohm.

- **Thermostats - Temperature Sensors**

A thermostat is a solid state device or a bimetal switch which is usually installed in or against the winding head of the motor. This thermostat is glued or epoxied against the winding head.

A thermostat operates as a normally closed switch when a motor is in a cooled-off condition and opens above the trip temperature. Thermostats can be selected for protection of motors with B, F or H insulation, and open-up at different temperature levels depending on their design.

Thermostats do not require a trip control. The thermostats are high voltage devices. This means a thermostat can be connected in series with a motor starter holding circuit. When the thermostat acts as an open switch, the holding circuit drops out the starter and the motor will come to a stop.

A motor can only be restarted when the thermostat in the motor is cooled off sufficiently so it closes again.

A closed thermostat may have an ohm reading of 1 ohm or less.

An open thermostat shows a very high resistance.