Product Service Bulletin

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Ask the experts

Q: I just replaced an old "U" frame motor with a new "T" frame. The new motor seems to be running significantly hotter than the old one. Is this a cause for concern?

A: U.S. Electrical Motors uses a Class F insulation system in their motors. Motors designated Class F with a 1.15 service factor have an allowable average winding temperature rise of 115˚C, and a total temperature of 155˚C with the inclusion of the 40˚ C maximum allowable ambient. Frame surface temperatures are typically 15-20˚C less than the average winding temperature, depending on the size and type of motor involved. This means that motor frame surface temperatures could reach 135-140˚C (275-285˚F), as affected by ambient and load conditions. Motors will provide satisfactory life under these conditions, however, care should be exercised to avoid contact with motor surfaces in operation.

Have a question for the experts? Contact us at jim.bryan@emotors.com

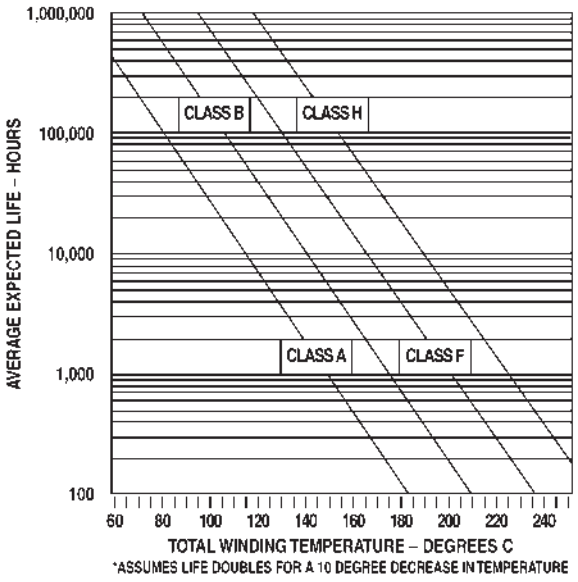
PART ONE

Winding Thermal Protection

by Ben Biondi

Providing winding protection is providing protection against excessive temperatures will help to extend the life of the motor. Excessive winding temperature can permanently damage the winding, greatly reducing winding life (see chart) and can cause complete winding insulation breakdown and failure. Down time in many motor applications isare prohibitive and a good monitoring system is essential to minimizinge costs which can be incurred as a result of downtime. A complete protection system for a winding is designed to remove the motor from the line when any of the following conditions occur:

TEMPERATURE VS. LIFE CURVES* FOR INSULATION SYSTEMS (PER IEEE 117 & 101)



*ASSUMES LIFE DOUBLES FOR A 10 DEGREE DECREASE IN TEMPERATURE

1. **Locked Rotor** - a mechanical failure of some type which locks the rotor and prevents it from turning when power is applied to the motor.

2. **Starting Overload** - an excessively high overload due to increased friction or inertia on the drive system can cause excessive temperature on the winding and permanent damage.

3. **Running Overload** - an abnormal condition which overloads the motor when it is running causing it causes motor to draw higher current thaen designed for and . This will permanently damage the motor winding.

4. **Abnormally High Temperatures** - an environmental condition where the motor is exposed to abnormally high temperatures can cause the total winding temperature canto reach a point where permanent damage can occur.

5. **Voltage Unbalance** - since the winding temperatures increases by a percentage equal to 2 times the square of the

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voltage unbalance, this can easily cause excessively high winding temperatures resulting in permanent winding damage.

High or Low Voltage - depending on winding design, high or low voltage can cause excessive currents and permanent winding damage.

Ventilation Failure - blocked air openings, broken fans, or anything which may disrupt the normal ventilation system on a motor to open when itthe motor is running will cause abnormally high winding temperatures resulting in failure.

Protecting Motors

There are three basic methods of protecting a motor from winding failure:

1. Current Sensitive Devices - these include circuit breakers, fuses, motor starter heaters of all types and instantaneous current relays. These are usually always external to the motor and are used in accordance with "National Electrical Code" which sets installation of motor branch circuits.

2. Combination Current & Temperature Sensitive Devices - these consist of a thermal disc and heater in one unit and are line break devices. TheyThese devices must be properly sized for each rating and application and. They are often used in high volume U/L listed applications such as air conditioning.

3. Temperature Sensitive Devices - since temperature is the limiting factor in protecting a motor, a direct sensing of motor winding temperature is the logical approach. There are a variety of winding temperature devices and systems all being designed to open the pilot circuit to the motor starter. These winding temperature protection systems can be classified according to their mode of operation. The basic detector systems in use today are:

A. Temperature Switches
B. Resistance Temperature Detectors (RTD's)
C. Thermistors
D. Therma Sentry®
E. Thermocouples

Winding Thermostats

Winding thermostats are snap-action, bi-metallic, temperature actuated switches normally installed in the connection end turns of the motor winding. They are used Their purpose is to activate a warning device, or shut down the motor upon excessive winding temperatures. Thermostats are the simplest and least expensive of the protective devices.

Thermostats are made with contacts that are either normally closed (N.C. - open at high temperatures) or normally open (N.O. - closed at high temperatures). The thermostat temperature switch point is pre-calibrated by the manufacturer and is not adjustable. Reset is automatic after winding cools down.a decrease in temperature. This feature allows the motor to cool before restarting. No control unit is required for use with thermostats.

The normal procedure is to install wire three thermostats together as a set, with one thermostat embedded in each phase. Normally open thermostats are wired in parallel internal to the motor and are. Generally normally open thermostats are used to activate a warning alarm (bell, light, etc.) Normally closed thermostats are normally wire in series so if any one reaches trip temperature the motor is shut down.

Sometimes A a customer may will specify both alarm and trip circuits. In this case two sets of dual thermostats are supplied. One set of normally open thermostats having different temperature trip points are usually chosen. Unless specified otherwise by the customer, the alarm thermostats (N.O.) usually have a trip point approximately 10°C lower than the shutdown thermostats (N.C.).

Thermostat Selection

1. If the customer does not specify alarm or shutdown the thermostat's purpose, U.S. Electrical Motors will supply N.C. shutdown thermostats with shutdown temperature ratings.
2. The thermostat switch point is based on motor temperature rating (insulation class), or on customer requirement.
3. The type of thermostat is based on the defined function or purpose (alarm or shutdown). U.S. Electrical Motors' Engineering Department usually chooses the type of thermostat from those available for a particular purpose.
4. U.L. explosion-proof motors require ments specify particular specific thermostat temperature ratings. All dual label and Class II explosion proof motors must have three (3) N.C. thermostats, which will not exceed the temperature rating necessary to shut down the motor before critical temperature is reached.

Winding Resistance Temperature Detectors (RTD's)

RTD's (Resistance Temperature Detectors) are precision, wire-wound resistors with a specific known temperature vs. resistance characteristic. In operation, the RTD is usually wired into a specific type of circuit (wheatstone bridge). RTD controllers monitor this resistance and The output of this circuit can be used to drive a meter or digital readoutwhich has been calibrated in temperature, or to operate a relay to sound an alarm or shut down the motor.

U.S. Motors uses flat, molded strip type RTDs that are only .030 inch thick.

The RTDs are installed in the slot portion of form wound motors, and either in the slot (standard) or in the end turns of mush wound motors. End turn installation is normally used when RTD's are installed after the winding has been completed (e.g. field installation).

The RTDs used in motor windings are either 10 ohm, 100 ohm or 120 ohm. Each type of RTD has its own particular resistance characteristic. The basic detectors are listed below:

Resistance	Element	No. of Leads
10 ohms at 25° C	Copper Wire	3
100 ohms at 0° C	Platinum Wire	3
120 ohms at 0° C	Nickel Wire	2*

*Also available with 3 leads (must be specified at order entry)

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