Copeland | application engineering bulletin | EMERSON Climate Technologies

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THE EFFECT OF ELECTRICAL COMPONENTS ON MOTOR PROTECTION

REPLACEMENT OF MOTOR PROTECTORS ON SERVICE REPLACEMENT COMPRESSORS

When service replacement compressors are installed in the field, no attempt should be made to salvage the external inherent protector or external supplementary protectors mounted in the terminal box of the compressor being replaced. Such protectors are considered part of the compressor exchange, and the replacement compressor is priced accordingly. Wholesalers should make certain that the original protectors are in the terminal box on compressors returned to the Copeland factory for replacement.

THE IMPORTANCE OF TERMINAL BOXES IN COMPRESSOR PROTECTION

All Copelaweld and Copelametic motor-compressors are equipped with integral terminal boxes which provide an enclosure for the electrical connections, and in the case of externally protected compressors, provide a location for mounting of the external protector. Each terminal box is equipped with a cover to protect the electrical connections and the external protector.

Occasionally field service personnel fail to replace the terminal box cover after installation or service work and this can result in conditions which may cause compressor damage.

Good electrical practice would always dictate that the electrical connections be protected from moisture, trash, dirt, or other items which might cause an electrical short, and that the cover be mounted securely so that it cannot drop into the terminal box and cause an electrical short.

Of much greater importance is the effect on the operation of an external protector. The trip point of an external protector is determined by the temperature of the protector sensing element, and this in turn is determined by the motor current, the temperature of the compressor body, and the temperature of the air surrounding the protector. If the terminal box cover is not in place, and especially if the protector is located in a moving air stream, its trip time may be greatly extended, and the reset time greatly shortened. Under such circumstances, the motor protection system is less effective, and motor failure during the starting cycle on PSC motors is quite possible.

On all motor-compressors equipped with external protectors, the protector must be properly seated against the compressor body or shell in order to quickly sense changes in compressor temperature. If the protector is not properly seated, the reaction time of the protector may be adversely affected, resulting in abnormally long “on” periods and abnormally short “off” periods in the event of a motor overload. This can result in compressor damage due to overheating.

External protectors have a locating notch on either side, and a projecting metal tab in the terminal box on all Copelaweld compressors fits into the notch to prevent movement. If the protector is not properly mounted with the tab in the locating notch, the protector base may reset on the metal tab, creating an air gap beneath the protector. Under no circumstances should the compressor be operated without the protector securely locked in place.

SIZING FUSES AND CIRCUIT BREAKERS FOR PSC MOTORS

On air conditioners having motor compressors with PSC motors, it is possible that nuisance tripping of household type circuit breakers may occur. PSC motors have very low starting torque, and if pressure are not equalized at start up, the motor may require several seconds to start and accelerate.

This is most apt to occur where a short cycle of the compressor can be caused by the thermostat making contact prematurely due to shock or vibration. Typically this can occur where the thermostat is wall mounted and can be jarred by the slamming of a door.

U.L. and most electrical inspection agencies not require that hermetic type refrigeration motor-compressors must comply with the National Electric Code maximum fuss sizing requirement (N.E.C., 1962 edition 430-52). This establishes the maximum fuse size at 225% of the motor full load current, and by definition the motor-compressor nameplate amperage is considered full load current, unless this rating is superseded by another on the unit nameplate.

Since the motor protector may take up to 17 seconds to trip if the compressor fails to start, it is probable that a standard type fuse or circuit breaker sized on the basis of 225% of full load current may break the circuit prior to the compressor protector trip, since locked rotor current of the motor may be from 400% to 500% of nameplate amperage.

To avoid nuisance tripping, Copeland recommends that air conditioners with PSC motors be installed with branch circuit fuses or circuit breakers sized as closely as possible to the 225% maximum limitation, the fuse or circuit breaker to be of the time delay type with a capability of withstanding motor locked rotor current for a minimum of 17 seconds.

The inherent protectors used on PSC motors are both current and temperature sensitive. In the event the compressor fails to start, and trips on the protector, it will normally reset very quickly after the initial trip. However, if several protector trips occur in succession due to unequalized pressures, especially when the motor is very hot from operation at heavily loaded conditions, the motor temperature will rise to a point exceeding the protector setting, and an off period varying from 20 minutes to one hour may be required for the compressor motor to cool sufficiently so that the protector may reset. When this occurs, particularly on across-the-line internally sealed protectors, service personnel frequently assume that the motor has been damaged and is inoperative, when in reality the motor protection system is performing its intended duty. In the event a compressor is checked and found to be inoperative, allow at least one hour for the motor to cool, and recheck after the cooling period before changing the compressor.

Short cycling on locked rotor protection can be prevented by the use of a 10 minute time delay lock out circuit, but it is recommended that start capacitors and a relay be used if frequent starting at unbalanced pressures can be expected.

Bleed Resistors on Start Capacitors

All standard Copeland starting capacitors are supplied with bleed resistors securely attached and soldered to their terminals.

The use of capacitors without these resistors may result in sticking relay contacts and/or erratic relay operation - especially where short cycling is likely to occur.

This is due to the starting capacitor discharging through the relay contacts as they close, following a very short running cycle. The resistor will permit the capacitor charge to bleed down at a much faster rate, preventing arcing and overheating of the relay contacts.

The use of capacitors supplied by Copeland is recommended, but in case of an emergency exchange, a 15,000-18,000 ohm, two watt resistor should be soldered across the terminals of each starting capacitor. Care should be taken to prevent their shorting to the case or other nearby metallic objects.

If sticking contacts are encountered on any starting relay the first item to check is the starting capacitor resistors. If damaged, or not provided, install new resistors, and clean the relay contacts or replace the relay.

Suitable resistors can be obtained from any radio parts wholesaler.

Capacitor Voltage Ratings

It is standard industry practice to use nominal voltage ratings for both run and start capacitors, and most manufacturers rate their capacitors in this manner. Use of a capacitor below its rating will do no harm. Run capacitors must not be subjected to voltages exceeding 110% of the nominal rating, and start capacitors must not be subjected to voltages exceeding 130% of the nominal rating.

Recently some capacitors have been produced incorporating an operating voltage range rather than a nominal voltage rating. When the manufacturer establishes an operating voltage range, the voltage limits specified must not be exceeded.

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