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Protecting Your Motor with

ESP100™

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The Right Choice

Congratulations!

You have purchased the world's finest industrial motor starter—the Furnas ESP100. It's a state-of-the-art device offering extra starter performance by combining a rock-solid NEMA rated contactor with a solid state overload relay.

Development of ESP100 is based on years of research and experience in electronic, melting alloy and bimetal overload relays. The result is unprecedented motor protection.

This unique technology comes from our desire to provide you with the best possible control for heavy duty motor applications. This guide was written to help you take full advantage of the increased motor protection provided by ESP100—the first major advancement in NEMA rated starters in more that 20 years.

ESP100™

NEMA rated starter with a solid state overload for extra starter performance and even greater motor protection.

- Heaterless Construction
- True Phase Loss Protection
- 2:1 FLA Adjustment Range
- NEMA Sizes 0-6

Easily Replaces Sizes 0-1:

Cutler Hammer Allen Bradley
Square D Westinghouse
GE

Problem-Solving ...at a Glance

When the ESP100 Trips... First, check amps in all 3 phases.

When the 3 phase currents are balanced...

If trip is on start up...

1. Check for proper class of overload. Class 20 is the recommended protection for most American motors (see below for more details).

2. Make sure load is not too heavy for motor to handle.

3. Adjustable frequency drives or DC injection (electronic) brakes will cause nuisance tripping.

4. The overload may be misadjusted (see below right for the details).

If trip is during normal operation...

2. Make sure load is not too heavy for motor to handle.

3. Adjustable frequency drives or DC injection (electronic) brakes will cause nuisance tripping.

4. The overload may be misadjusted (see below right for the details).

5. Check for the correct overload adjustment when using the looping option. Multiply the FLA by the number of times the motor lead passes though the sensing window to determine the proper adjustment.

When the overload trips within 3 seconds on start up...

If there is current in 2 phases only...

6. Phase loss is in the motor branch circuit (the motor is single phased).

Restore 3 phase power.

If there is a severe phase imbalance...

7. Current is present in all 3 phases, but large differences (2:1) exist between the phases. This may indicate a loss of phase ahead of the motor branch circuit or a damaged motor.

Restore missing primary phase or repair/replace motor winding.

Tools needed:

Clamp-on ammeter, continuity checker and tools to tighten connections.

(For more detailed information, see following pages.)

Always check for proper class of overload:

A key ingredient in protecting a motor is the selection of the class of overload relay for the acceleration time of the motor and its FLA (Full Load Amperage). An overload relay may trip before the motor accelerates to its full rated speed if starting current extends beyond the overload relay trip curve. Using a class of overload too fast to allow the motor to accelerate to full speed will cause nuisance tripping. Change to the correct class of overload relay (i.e. Class 10 instead of Class 20).

When the overload is adjusted too low:

A. ESP100 is very accurate, taking up to 6 or more clicks of the dial to cover the same range as one heater coil. Adjusting upward just one or two clicks may solve the problem.

B. Some applications take advantage of the motor service factor, or a short load cycle versus a long unloaded cycle, to operate the motor at currents above the motor FLA. The NEC 430-34 allows an overload setting of up to 10% over motor FLA if the motor cannot be started or run at the motor FLA setting.

When ESP100 trips on startup

Various types of motors require different types of overload relays to provide adequate protection. There are three different levels of overload relay protection available. These levels are differentiated by the assignment of a trip "class" number as follows:

Class 20 is the designation assigned to a "standard trip" overload relay and is designed to protect standard industrial motors including T-frame motors. Most NEMA rated General Purpose motors will be protected by a Class 20 overload relay.

Class 10 or "quick trip" overload relays are designed to protect low thermal capacity motors. Examples would include motors used for hermetic refrigeration compressors, submersible pumps and similar applications.

Class 30 refers to "slow trip" overload relays which are designed to protect *special* motors driving high inertia loads (long start up times). Some examples include ball mills, reciprocating pumps, loaded conveyors, etc.

The time required for an overload relay to trip under locked-rotor (stalled) motor conditions is ideally the time that permits use of the available motor horsepower and starting torque. The overload must allow sufficient time for the motor and its load to accelerate to rated speed. Nuisance tripping occurs when an overload relay, or its adjustment, is selected that does not allow the motor to reach proper operating speed or performance ratings. This may cause the user to adjust the FLA upward, which will result in reduced protection.

Section 430-34 of the National Electric Code (NEC) permits a user to adjust the overload relay 10% higher than appropriate for the motor FLA, under certain conditions. These conditions include (a) when the properly adjusted overload relay trips before the motor can accelerate to its rated speed, and (b) provided the overload relay is adjusted no greater than 130% of motor FLA for service factor 1.0 motors, or not greater than 140% of motor FLA for motors with a service factor of 1.15. Rather than give up running protection by adjusting the FLA, a user should select a higher class of overload relay. This will provide more time for motor and load acceleration, yet retain the level of overload protection specified by the NEC. The graph (Fig. 1) illustrates the danger of an overload relay class that is too fast for its motor.

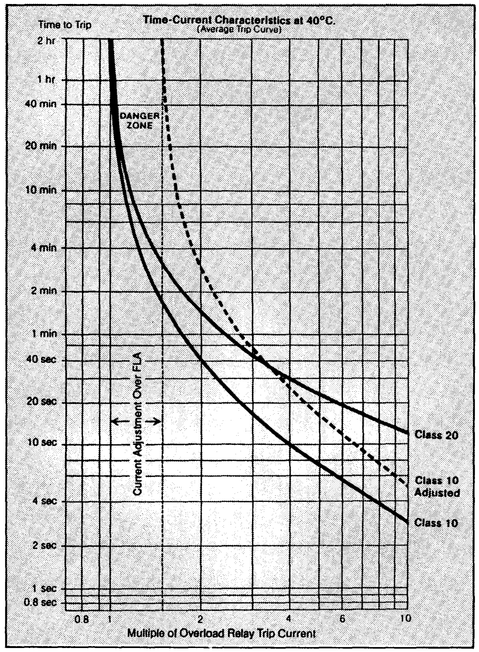


Fig. 1 Dangers of adjusting an overload relay above the FLA of the motor to prevent nuisance tripping on start up. Trip curve moves to the right and lessens or negates motor running protection.

Motor Overloaded

An electric motor is not capable of knowing when it is being worked too hard. If a load placed on a motor is too great, it will simply draw extra current and continue to handle the increased load. If this situation persists, it will eventually cause the overload to trip.

In contrast, temporary overloads may be handled easily if brief enough in duration to not cause overheating.

Typical overloading is caused by problems such as increased friction (bad bearings, poor lubrication, etc.), over feeding machinery (too heavy a cut, excess material, etc.) or too heavy a weight (conveyors, cranes, etc.).

The solution is to locate and remove the cause of the overload. The motor must also be allowed to to cool down before a restart is attempted.

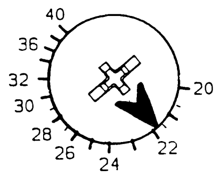
The ESP100 overload is rated 50/60 Hertz, AC only

Other frequencies will change the calibration of the overload relay and possibly cause nuisance tripping. A DC injection brake will be mistaken by the overload relay for a phase loss condition and will subsequently cause tripping. The ESP100 *should not* be applied on circuits containing adjustable frequency drives or DC injection brakes. The ESP100 *can be* applied with a soft start or solid state starter rated 50 or 60 Hertz.

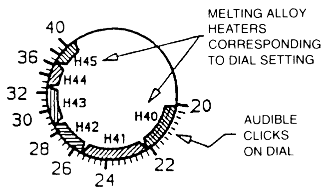
Overload Misadjustment

There is a tendency to set the current adjustment of the ESP100 overload relay *too low*. This is contrary to most people's experiences with thermal overload relays, which if misadjusted tend to be set *too high*. In fact, on retrofit applications in which oversized heater coils are used to prevent nuisance tripping, there is still a tendency to adjust the overload to less than motor rated full load current. *There seems to be a misconception that the high accuracy of a solid state overload relay necessitates setting the current adjustment below the motor's rated FLA.* This practice certainly protects the motor, but will not allow the motor to be used up to its rated horsepower.

Heater coils for thermal overload relays are sized in 10% steps. The adjustable ESP100 can have as many as 6 or more settings (clicks) to cover the same current range as one heater element. Adjusting upward one or two clicks tends to solve a nuisance tripping problem. This has been found to be particularly true on punch presses and other types of machinery where die sizes can vary widely and jogging set up may be necessary.



TYPICAL SOLID-STATE OVERLOAD ADJUSTMENT DIAL MARKINGS



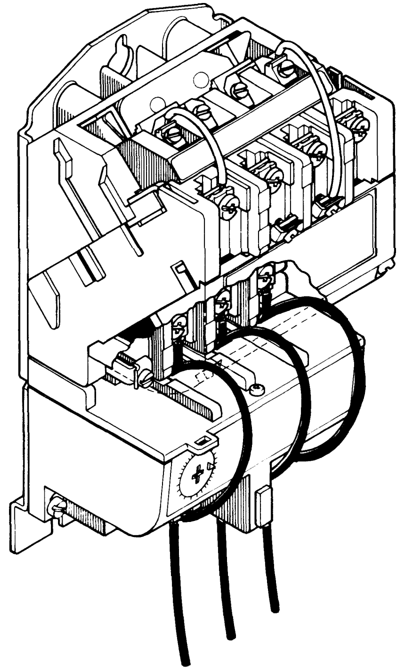
Other factors to consider:

1. Was the overload relay set to the maximum motor load? It has been found that when the overload relay was initially set with a small die in a press, it later tripped when the largest die was in operation. **Remember** that as many as 6 clicks of the ESP100 adjustment dial equals the same current range as one heater coil.

2. Some machinery or applications make deliberate use of the service factor of the motor to operate the motor temporarily or continuously at currents above the motor's rated FLA. Theoretically a motor may be used continuously at its service factor without harm (i.e. a motor with a service factor of 1.15 being used at 115% of rated FLA). This type of motor application is found on conveyors, air compressors, and light duty machinery. The ESP100 overload must be set at the motor FLA actually being used.

3. The duty cycle of the application may have allowed the use of an undersized motor to withstand short overloads providing the loaded cycle is not long enough to overload the motor.

Correct overload relay adjustment when using the looping option



Math errors being common, it is always worth double checking to see that the ESP100 overload relay has been adjusted properly when using the looping option. By passing the current to the motor through the ESP100's sensing windows more than once the current range can be extended downward. This allows the overload relay to sense two, three, four, or more times the current which is actually flowing to the motor. Using this option does not decrease motor protection in any way.

The easiest way to determine the correct ESP100 setting is to multiply the motor FLA by any whole number which falls within the current adjustment of the relay. For example, you have a motor rated at 5 full load amps and a 9-18 amp ESP100 overload relay. Five amps times two equals ten amps so that the motor loads can be **looped once** around the relay and the motor lead passes through the sensing window twice. The correct ESP100 setting would be 10 amps as the overload relay is sensing twice the 5 amps the motor is drawing. Using the same motor and relay as an example, the motor leads could be **looped twice** so that they pass through the sensing window three times (5 amps x 3 = 15 amp setting) and the correct ESP100 overload relay setting would be 15 amps.

The following table demonstrates how the looping process reduces the current setting of the overload by the number of times the wires pass through the windows of the overload.

All current values are expressed in Amps.

	Overload Current Range	# of Loops	# of Times Wire Passes Thru Window
Shown on label	9-18	0	1
	4.5-9.0	1	2
	3.0-6.0	2	3
	2.25-4.50	3	4
	1.80-3.60	4	5
	1.50-3.00	5	6

Phase loss (only 2 of 3 phases present)

Phase loss as used in this guide refers to a loss of a single phase of a three phase motor branch circuit. The ESP100 is designed to react to phase loss within three seconds. A continuity check will normally pinpoint this problem quickly. The most typical cause of phase loss is a blown fuse. Single phasing is an important cause of motor failure and deserves immediate attention.

Severe Phase Imbalance

In this situation there will still be current in all three phases, but large differences (2:1) exist between the phases. The most likely two causes of this situation are:

A. *Loss of phase in the primary of the circuit.*

For example one of the test manufacturing plants was operating on a severe phase imbalance due to a loss of phase in the utilities power lines. The operating motors in the plant then acted as generators and produced some current in the missing phase. Overload relays are *not* designed to protect against phase imbalance. Various phase monitoring relays on the incoming power lines is perhaps the most popular way to provide this protection.

B. *A damaged or defective motor winding can also be the cause of severe current imbalance.*

During one in-plant test, two motors with damaged windings were found. One had a 51.5% current imbalance. These damaged motors were operating completely undetected by thermal overload relays. The ESP100 allowed the defective motors to be pinpointed and repaired or replaced before they could burn out at a critical time.

ESP100 Specifications

- Available in NEMA Sizes 0-6
- Dual voltage coils readily available
- Front mounted auxiliary contacts
- Common coil for Sizes 0-2½
- Snap-in coil through Size 4
- Encapsulated coils on all sizes
- Inspectable contacts through Size 4
- Replaceable contacts on all sizes
- Key hole/slot mounting through Size 4
- Trips in 3 seconds on phase loss condition
- Class 10, 20 or 30 overload protection
- NO or NC isolated alarm contacts for overload relay
- Trip free overload mechanism
- Overload contact test function
- Tamper proof cover for overload dial
- 2:1 FLA adjustment range
- Visible trip indication on overload relay
- Overload relay is impervious to short circuit currents
- Thermal memory on overload relay
- NEMA A600 contacts on overload relay
- Sizes 0 & 1 provide mounting dimensions of competitive devices for easy retrofitting
- Heaterless construction
- Ambient insensitive
- Overload relay is close coupled to contactor –not panel mounted
- Smaller overloads can be looped to extend range to 4:1 for more versatility

NOTES

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