Technical Data

Allen-Bradley

Heater Element Specifications

Bulletin Number 592

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Type W Heater Elements

Eutectic Alloy Overload Relay Heater Elements

- Type J — CLASS 10
- Type P — CLASS 20 (Bul. 600 ONLY)
- Type W — CLASS 20
- Type WL — CLASS 30

Note: Heater Element Type W/WL does not currently meet the material restrictions related to EU ROHS

Description

Overload Relay Class Designation

United States Industry Standards (NEMA ICS 2 Part 4) designate an overload relay by a class number indicating the maximum time in seconds at which it will trip when carrying a current equal to 600 percent of its current rating.

A Class 10 overload relay will trip in 10 seconds or less at a current equal to 600 percent of its rating.

A Class 20 overload relay will trip in 20 seconds or less at a current equal to 600 percent of its rating.

A Class 30 overload relay will trip in 30 seconds or less at a current equal to 600 percent of its rating.

Allen-Bradley standard overload relay protection is provided using Type W heater elements for the 500 Line. This provides Class 20 operation and is recommended for General Applications.

Specific Applications may require Class 10 or Class 30 overload relays. Class 10 overload relays are often used with hermetic motors, submersible pumps, or motors with short locked rotor time capability. Class 30 overload relays should be used with motors driving high inertia loads, where additional accelerating time is needed and the safe permissible locked rotor time of the motor is within Class 30 performance requirements.

For applications requiring Class 30 protection, Type WL heater elements are available. To order, use the applicable Type W selection table, follow the heater element selection instructions and change the "**W**" in the Heater Type Number to "**WL**".

For applications requiring Class 10 overload relays, Type J elements are available. See page 1-170 for Index to Heater Element Selection Tables.

Heater Element Selection

The "Full Load Amperes" listed in the tables are to be used for heater element selection. For Type J and W Heater Elements, the rating of the relay in amperes at +40 °C (+104 °F) is 115% of the "Full Load Amperes" listed for the "Heater Type Number". For Type WL Heater Elements, the rating is 120% of the "Full Load Amperes" listed for the "Heater Type Number."

Refer to the motor nameplate for the full load current, the service factor, and/or the motor classification by application and temperature rise.

Use this motor nameplate information, the application rules, and the "Full Load Amperes" listed in the proper table (see Index) to determine the "Heater Type Number."

The following is for motors rated for Continuous Duty: For motors with marked service factor of not less than 1.15, or motors with a marked temperature rise not over +40 °C (+104 °F), apply application rules 1 through 3. Apply application rules 2 and 3 when the temperature difference does not exceed +10 °C (+18 °F). When the temperature difference is greater, see below.

1. **The Same Temperature at the Controller and the Motor** — Select the "Heater Type Number" with the listed "Full Load Amperes" nearest the full load value shown on the motor nameplate.
2. **Higher Temperature at the Controller than at the Motor** — If the full load current value shown on the motor nameplate is between the listed "Full Load Amperes", select the "Heater Type Number" with the higher value.
3. **Lower Temperature at the Controller than at the Motor** — If the full load current value shown on the motor nameplate is between the listed "Full Load Amperes", select the "Heater Type Number" with the lower value.

For motors with Marked Service Factor of less than 1.15, select the "Heater Type Number" one rating smaller than determined by the rules in paragraphs 1, 2 and 3.

Motors rated for Intermittent Duty — Please contact your local Rockwell Automation sales office or Allen-Bradley distributor for additional information.

Heater Element Selection Procedure — When Temperature at Controller is ±10 °C (±18 °F) Greater than Temperature at Motor

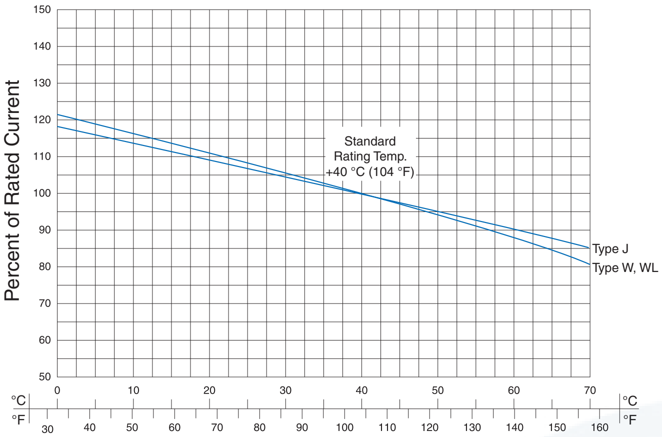
Ambient Temperature Correction

The ambient temperature at the motor and controller is the same in most applications. Under this condition, the overload relay is designed to sense changes in ambient temperature and also protect the motor over a range of temperatures.

Output that a motor can safely deliver varies with temperature. The motor can deliver its full rated horsepower at an ambient temperature specified by the motor manufacturers, normally +40 °C (+104 °F). At high temperatures (higher than +40 °C) less than 100% of the normal rated current can be drawn from the motor without shortening the insulation life. At lower temperatures (less than +40 °C) more than 100% of the normal rated current could be drawn from the motor without shortening the insulation life. Thus, there is an inverse relationship between motor ambient temperature and motor output. In any motor, allowable output decreases as the ambient temperature is raised and vice versa.

Heater Element Selection Procedure — When Temperature at Controller is ±10 °C (±18 °F) Greater than Temperature at Motor (Continued)

Ambient Temperature Correction Curve (See Performance Data on page Important-3)



When the temperature difference between the motor and controller does not exceed +10 °C the heater elements should be selected according to the directions given in the Heater Element Selection, page 2.

When the temperature difference is more than +10 °C an ambient temperature correction factor should be used as part of the process for selecting heater elements. The ambient temperature correction curve shown above shows the factor by which heater selection rating changes with ambient temperature changes.

Heater Element Selection Procedure

In solving problems where ambient temperature correction is necessary, the following simple procedure is recommended:

1. First find the correction factor ratio ("C.F.R."). This is the ratio of correction factor of the motor ambient temperature (C.F.m) to the correction factor for the controller ambient temperature (C.F.c). The formula for calculating the correction factor ratio is:

$$\text{C.F.R.} = \frac{\text{C.F. motor}}{\text{C.F. controller}}$$

   Both correction factors are selected from the curve for the type of heater element to be used. The heater element selection tables are based on a +40 °C ambient temperature. This means the correction factor for a +40 °C is 1.00. In other words, there is no correction factor at +40 °C.

2. Next in this heater element selection process is to adjust the motor nameplate full load current (FLC) by the C.F. Ratio. This readjusted value of motor nameplate full load current (FLC) is the yardstick in selecting the proper heater element.
3. The last step is to refer to the suggested heater element table and pick the element whose rating for the given controller size is closest to FLC.

Examples — To become familiar with this heater element selection process, consider a few examples.

Example 1. Starter at Normal +40 °C Ambient — Motor Lower. 3-Phase, AC, squirrel cage motor, 25 Hp, 460V, 60 Hz, 1800 rpm, FLC of 34 A, service factor 1.15, *Temperature at starter +40 °C, Temperature at motor +25 °C, Type W heater elements will be used.*

In Example 1, the motor is at a much cooler ambient temperature (+25 °C) compared to the controller which is at the normal +40 °C. Because the motor is normally rated for use at +40 °C, it will deliver a little more than its rated horsepower. This means that a heater element with a higher than normal motor nameplate full load current rating can be used.

Referring to the Type W ambient temperature correction curve on this page for a motor at +25 °C ambient, the motor correction factor (C.F. motor) is shown to be 108%. The correction factor for the starter ambient temperature is 100% since it is at +40 °C. Thus,

$$\text{C.F. Ratio} = \frac{\text{C.F. motor}}{\text{C.F. controller}} = \frac{108\%}{100\%} = 1.08$$

Now, using this correction factor, the readjusted full load current value can be determined by:

$$\text{FLC} = 34.0 \times 1.08 = 36.7 \text{ A}$$

A Bulletin 512, Size 2, was specified for this application. The directions for heater element selection indicate that Table 153 should be used. The table shows that 36.7 A falls between two values, 35.0 A (W66) and 38.0 A (W67). Because 38.0 A is closer to the requirement, select the heater element W67.

Example 2. Starter at Normal +40 °C Ambient — Motor Higher. 3-Phase AC, squirrel cage motor, 25 Hp, 460V, 60 Hz, 1800 rpm. FLC of 34 A, service factor 1.15. Type W heater elements, *Temperature at starter +40 °C, Temperature at motor +55 °C.*

This represents a situation where the motor ambient temperature is higher than +40 °C. In this example, the motor is at +55 °C ambient temperature and the controller is at +40 °C. When the motor is functioning in a warmer environment than the controller it will not be able to deliver the normal horsepower. To protect it from damage, it becomes necessary to downsize the heater element compared to the same motor operating in a +40 °C ambient temperature. Referring to the Type W ambient temperature correction curve, the correction factor would be:

$$\text{C.F. Ratio} = \frac{\text{C.F. motor}}{\text{C.F. controller}} = \frac{91\%}{100\%} = 0.91$$

Having determined the correction factor, the current rating to be used when selecting a heater element would be:

$$\text{FLC} = 34.0 \times 0.91 = 30.9 \text{ A}$$

For Bulletin 512, Size 2, again refer to Table 153. The value of 30.9 A falls between 30.0 A (W64) and 32.5 A (W66). Since 30.0 is closer to 30.9 specify the W64 heater element.

Example 3: Starter Lower than +40 °C — Motor Higher. 3-Phase, AC, squirrel cage motor, 25 Hp, 460V, 60 Hz, 1800 rpm. FLC of 34 A, service factor 1.15. Type W heater elements, *Temperature at starter +25 °C, Temperature at motor +55 °C.*

Next, consider a case where both the controller and the motor are at ambient temperatures other than +40 °C. In Example 3 the temperature of the controller is +25 °C ambient (cooler) while the temperature of the motor is +55 °C ambient (warmer). As stated earlier, a motor running in a warmer environment will deliver less than its normal horsepower. This requires downsizing the heater element rating. The controller in this case is in a cooler environment which prevents the heater element from heating up as much as in a +40 °C ambient temperature. This also requires downsizing the heater element rating to provide adequate protection. Thus, the net effect of a warmer motor and a cooler controller is to further downsize the heater element. Using the Type W temperature correction curve, the correction factor in this case is:

$$\text{C.F. Ratio} = \frac{\text{C.F. motor}}{\text{C.F. controller}} = \frac{91\%}{108\%} = 0.84$$

The readjusted value of current FLC for this example is:

$$\text{FLC} = 34.0 \times 0.84 = 28.6 \text{ A}$$

Table 153 shows that this value falls between 28.0 A (W63) and 30.0 A (W64). Because 28.0 A is closer to the requirement, select the heater element W63.