

Heater Element Specifications

Bulletin Number 592

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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.



 <p style="text-align: center;">Type W Heater Elements</p>	<p>Eutectic Alloy Overload Relay Heater Elements</p> <ul style="list-style-type: none"> • Type J — CLASS 10 • Type P — CLASS 20 (Bul. 600 ONLY) • Type W — CLASS 20 • Type WL — CLASS 30 <p>Note: Heater Element Type W/WL does not currently meet the material restrictions related to EU ROHS</p>	
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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

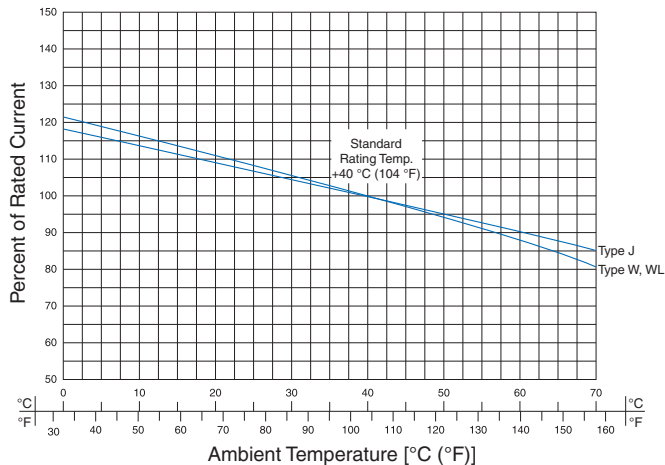
Ambient Temperature Correction

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:

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

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,

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

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

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

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:

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

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

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

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:

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

The readjusted value of current FLC for this example is:

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

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.

Heater Element Selection Procedure

Example 4: Starter Above +40 °C — Motor Lower. 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 +65 °C, Temperature at motor +35 °C.*

Now, consider the effect of a controller in a warmer environment and a motor in a cooler environment. In Example 4, the controller is at +65 °C ambient (warmer) and the motor at +35 °C ambient (cooler). As mentioned earlier, a motor at a cooler temperature can deliver more than its normal horsepower. The controller when in a warmer environment will heat up faster causing the eutectic alloy to melt before the normal overload condition. This requires upsizing the heater element rating. Referring to the Type W ambient temperature correction curve, the correction factor in this case is:

$$\text{C.F. Ratio} = \frac{\text{C.F. motor}}{\text{C.F. controller}} = \frac{103\%}{84.5\%} = 1.22$$

This correction factor allows a heater element with current rating of:

$$\begin{aligned} \text{FLC} &= 34.0 \times 1.22 \\ &= 41.48 \text{ A} \end{aligned}$$

Referring to Table 153, this value of 41.4 A falls between 40.5 A (W68) and 43.5 A (W69). Because 40.5 A is closer to the requirement, select heater element W68.

Example 5: Starter Above +40 °C — Motor Above. 3-Phase, AC, squirrel cage motor, 25 Hp, 460V, 60 Hz, 1800 rpm. FLC of 35 A, service factor 1.15. Type W heater elements, *Temperature at starter +45 °C, Temperature at motor +60 °C.*

Next, take an example where both the controller and the motor are both warmer than +40 °C ambient temperature but their ambient temperatures are different. For instance, the controller could be at +45 °C ambient and the motor is at +60 °C ambient. Since the difference in their ambient temperatures is greater than +10 °C an ambient temperature correction must be made. In Example 5 the correction factor is given by:

$$\text{C.F. Ratio} = \frac{\text{C.F. motor}}{\text{C.F. controller}} = \frac{88\%}{97\%} = 0.91$$

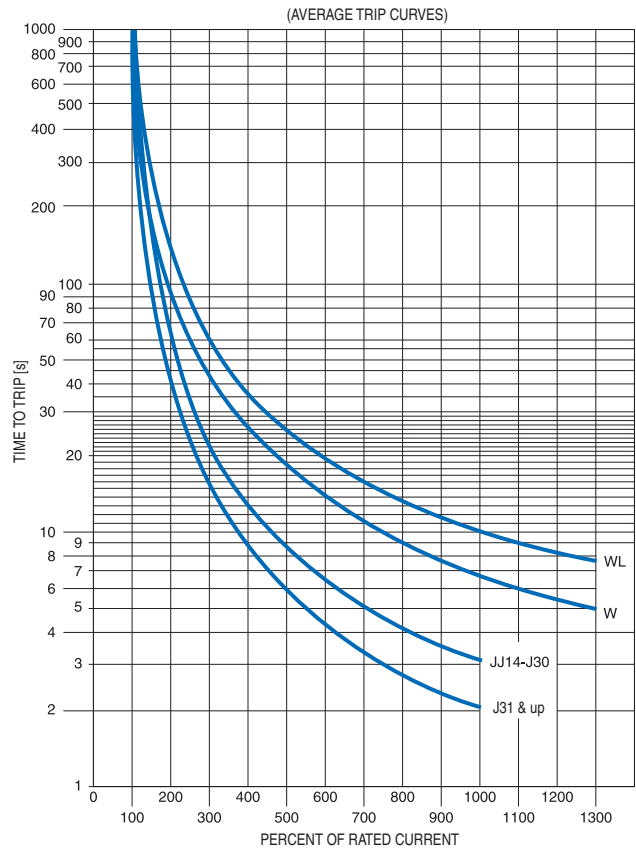
This means that the rating of the heater element should be 90% of the normal nameplate motor full load current or:

$$35.0 \times 0.91 = 31.9 \text{ A}$$

For Bulletin 512, Size 2 controller, Table 153 shows this rating to fall between 30.0 A (W64) and 32.5 A (W65). Because 32.5 A is closer, select heater element W65. Note here that the net effect has been to downsize the heater element rating compared to a normal +40 °C ambient operation.

Note: The heater element selection tables are designed to accommodate motor service factors of 1.15 or greater, as given in all the preceding examples. If the service factor had been less than 1.15 (for example, S.F. = 1.0) a heater element one rating smaller than selected in each example would have been the correct choice. This would provide protection at 10% lower current levels.

Time — Current Characteristics at +40 °C (+104 °F)



Index to Heater Element Selection Tables

Bulletin Number	Encl. Type	Size	Table No.			
			Manual Reset			
			Type W Element		Type J Element	
		1Ø, One Element	3Ø or 1Ø, Three Elements	1Ø, One Element	3Ø or 1Ø, Three Elements	
105, 109	Open	9...30 A	—	180	—	182
		36...110 A	—	191	—	187
		180 A	—	195	—	196
505	Open, 1, 3R/4/12	00	127	180	55	182
		0...4	156	151	164	162
		5	—	347	—	547
505	Open 1, 3R/4/12, 4/4X	6	—	195	—	196
		7...8	—	133	—	132
505	4/4X	0...4	—	146	—	158
		5	—	177	—	178
505	4X	0...2	—	145	—	158
505	Unilock 3R/7 & 9	0...1	—	166	—	159
505	Bolted 3R/7 & 9, 7 & 9	0...3	—	171	—	172
		4	156	168	164	162
505V	Open	0...4	—	154	—	—
506, 507	1, 3R/12, 4/4X, 4X	0...4	—	152	—	161
		5	—	347	—	547
507	1, 3R/4/12, 4/4X, 4X	6	—	195	—	196
		7	—	134	—	165
507	Bolted 3R/7 & 9, 7 & 9	0...2	—	168	—	172
		3	—	168	—	162
		4	—	171	—	172
509	Open, 1, 3R/12	00	127	180	55	182
509	Open	0...4, 1P	156	152	164	163
509	1, 3R/4/12	0...4	155	150	164	162
509 with control xfrmer	1, 3R/4/12	0...4, 1P	156	150	164	162
509	Open, 1, 3R/4/12	5	—	347	—	547
509	Open, 1, 3R/4/12, 4/4X	6	—	195	—	196
509	Open 1, 3R/4/12, 4/4X	7...8	—	133	—	132
509	4/4X	0...3	—	144	—	158
		4	—	148	—	—
		5	—	177	—	178
509	4X	0...2	156	146	164	158
		5	—	177	—	178
509	Unilock 3R/7 & 9	0...4	—	166	—	159
		5	—	177	—	178
509	Bolted 3R/7 & 9, 7 & 9	0...3, 1P	156	171	164	172
		4	—	171	—	162
509	Bolted 3R/7 & 9, 7 & 9	5	—	171	—	547
		5	—	171	—	547
512	1, 3R/4/12, 4/4X, 4X	0...4	—	152	—	163
		5	—	347	—	547
		6	—	195	—	196
512M	3R/4/12	1...2	—	153	—	163
513	1, 3R/4/12, 4/4X, 4X	0...4	—	152	—	160
		5	—	347	—	547
		6	—	195	—	196
513	Unilock 3R/7 & 9	0...4	—	167	—	159
		5	—	169	—	178

Bulletin Number	Encl. Type	Size	Table No.			
			Manual Reset			
			Type W Element		Type J Element	
		1Ø, One Element	3Ø or 1Ø, Three Elements	1Ø, One Element	3Ø or 1Ø, Three Elements	
513	Bolted 3R/7 & 9, 7 & 9	0...3	—	168	—	172
		4	—	168	—	160
		5	—	168	—	160
520	Open, 1, 3R/4/12	0...4	—	152	—	162
		5	—	347	—	547
		6	—	195	—	196
		7	—	133	—	132
520	4/4X	0...4	—	146	—	158
		5	—	177	—	178
520	4X	0...2	—	145	—	158
520E	Bolted 3R/7 & 9, 7 & 9	0...3	—	171	—	172
		4	—	168	—	162
520F & G	Bolted 3R/7 & 9, 7 & 9	0...2	—	168	—	172
		3	—	168	—	162
530*	1	1PW... 2PW	—	150	—	162
		3PW... 4PW	—	148	—	162
		5PW	—	347	—	547
		6PW	—	195	—	196
		7PW... 8PW	—	133	—	132
540*	1	1YD... 4YD	—	152	—	162
		5YD	—	347	—	547
		6YD	—	195	—	196
		7YD... 8YD	—	133	—	132
570	1	2...4	—	154	—	162
		5	—	347	—	547
		6	—	195	—	196
		7...8...9	—	133	—	132
592	Open	24...32 A	—	180	—	182
		40...165 A	192	191	198	187
592	1	40...165 A	192	181	198	183
592 with current xfrmer	Open	—	—	195	—	196
600	All	—	—	—	5 (Type P)	—
609, 609RS, 609TS, 609U, 609TU	All	0...1...1P	112	110	117	116
1232X, 1233X	—	0...2	—	152	—	163
		3, 4	—	149	—	163
		5	—	347	—	547

* When selecting heater elements for Bulletin 530, divide the motor nameplate full load amperes by 2.00 — use this value to select the proper "Heater Element Cat. No."

* When selecting heater elements for Bulletin 540, divide the motor nameplate full load amperes by 1.73 — use this value to select the proper "Heater Element Cat. No."

TABLE 5	
Heater Element Cat. No.	Full Load Amperes
P1	0.17
P2	0.21
P3	0.25
P4	0.32
P5	0.39
P6	0.46
P7	0.57
P8	0.71
P9	0.79
P10	0.87
P11	0.98
P12	1.08
P13	1.19
P14	1.30
P15	1.43
P16	1.58
P17	1.75
P18	1.88
P19	2.13
P20	2.40
P21	2.58
P22	2.92
P23	3.09
P24	3.32
P25	3.37
P26	4.16
P27	4.51
P28	4.93
P29	5.43
P30	6.03
P31	6.83
P32	7.72
P33	8.24
P34	8.90
P35	9.60
P36	10.8
P37	12.0
P38	13.5
P39	15.2

TABLE 55						
Heater Element Cat. No.	Full Load Amperes					
	Size 00	Size 0	Size 1	Size 1P	Size 2	Size 3
JJ14	0.22	0.22	0.22	—	—	—
JJ13	0.24	0.24	0.24	—	—	—
JJ12	0.27	0.27	0.27	—	—	—
JJ11	0.30	0.30	0.30	—	—	—
JJ10	0.33	0.33	0.33	—	—	—
JJ9	0.36	0.36	0.36	—	—	—
JJ8	0.40	0.40	0.40	—	—	—
JJ7	0.44	0.44	0.44	—	—	—
JJ6	0.48	0.48	0.48	—	—	—
JJ5	0.53	0.53	0.53	—	—	—
JJ4	0.58	0.58	0.58	—	—	—
JJ3	0.65	0.65	0.65	—	—	—
JJ2	0.71	0.71	0.71	—	—	—
JJ1	0.78	0.78	0.78	—	—	—
J1	0.87	0.87	0.87	—	—	—
J2	0.95	0.95	0.95	—	—	—
J3	1.05	1.05	1.05	—	—	—
J4	1.16	1.16	1.16	—	—	—
J5	1.28	1.28	1.28	—	—	—
J6	1.41	1.41	1.41	—	—	—
J7	1.55	1.55	1.55	—	—	—
J8	1.70	1.70	1.70	—	—	—
J9	1.87	1.87	1.87	—	—	—
J10	2.06	2.06	2.06	—	—	—
J11	2.27	2.27	2.27	—	—	—
J12	2.51	2.51	2.51	—	—	—
J13	2.78	2.78	2.78	—	—	—
J14	3.07	3.07	3.07	—	—	—
J15	3.38	3.38	3.38	—	—	—
J16	3.72	3.72	3.72	—	—	—
J17	4.10	4.10	4.10	—	—	—
J18	4.52	4.52	4.52	—	—	—
J19	4.98	4.98	4.98	—	—	—
J20	5.49	5.49	5.49	—	—	—
J21	6.04	6.04	6.04	—	—	—
J22	6.66	6.66	6.66	—	—	—
J23	7.35	7.35	7.35	—	—	—
J24	8.13	8.13	8.13	—	—	—
J25	8.96	8.96	8.96	—	—	—
J26	9.90	9.90	9.90	—	—	—
J27	—	10.9	10.9	11.0	—	—
J28	—	12.0	12.0	12.2	—	—
J29	—	13.2	13.2	13.4	—	—
J30	—	14.6	14.6	14.8	—	—
J31	—	16.1	16.1	16.3	—	—
J32	—	17.7	17.7	17.9	18.3	—
J33	—	—	19.5	19.8	20.2	—
J34	—	—	21.4	21.8	22.2	—
J35	—	—	23.6	24.0	24.4	—
J36	—	—	26.0	26.4	26.9	—
J37	—	—	28.5	29.0	29.8	—
J38	—	—	—	32.0	33.0	—
J39	—	—	—	35.0	36.5	40.5
J40	—	—	—	38.5	40.5	45.5
J41	—	—	—	—	45.5	51
J42	—	—	—	—	—	56
J43	—	—	—	—	—	62
J44	—	—	—	—	—	68
J45	—	—	—	—	—	74
J46	—	—	—	—	—	82
J70	—	—	—	—	—	90
J71	—	—	—	—	—	—
J72	—	—	—	—	—	—
J73	—	—	—	—	—	—
J74	—	—	—	—	—	—

Refer to Heater Element Selection Procedure on page 2 before using tables.

Heater Element Specifications

For Application on Bulletin 100/500/609/1200 Line Starters

TABLE 110		
Heater Element Cat. No.	Full Load Amperes	
	Size 0	Size 1
W10	0.18	0.18
W11	0.20	0.20
W12	0.22	0.22
W13	0.24	0.24
W14	0.27	0.27
W15	0.30	0.30
W16	0.33	0.33
W17	0.36	0.36
W18	0.40	0.40
W19	0.44	0.44
W20	0.48	0.48
W21	0.53	0.53
W22	0.59	0.59
W23	0.65	0.65
W24	0.71	0.71
W25	0.78	0.78
W26	0.86	0.86
W27	0.95	0.95
W28	1.05	1.05
W29	1.16	1.16
W30	1.27	1.27
W31	1.41	1.41
W32	1.55	1.55
W33	1.71	1.71
W34	1.89	1.89
W35	2.08	2.08
W36	2.30	2.30
W37	2.53	2.53
W38	2.79	2.79
W39	3.07	3.07
W40	3.38	3.38
W41	3.73	3.73
W42	4.11	4.11
W43	4.51	4.51
W44	4.96	4.96
W45	5.44	5.44
W46	5.98	5.98
W47	6.57	6.57
W48	7.21	7.21
W49	7.92	7.92
W50	8.70	8.70
W51	9.57	9.5
W52	10.5	10.5
W53	11.6	11.6
W54	12.7	12.7
W55	14.0	14.0
W56	15.4	15.4
W57	16.8	16.8
W58	18.3	18.3
W59	—	19.9
W60	—	21.7
W61	—	23.6
W62	—	25.7
W63	—	28.0

TABLE 112			
Heater Element Cat. No.	Full Load Amperes		
	Size 0	Size 1	Size 1P
W10	0.21	0.21	—
W11	0.23	0.23	—
W12	0.25	0.25	—
W13	0.28	0.28	—
W14	0.31	0.31	—
W15	0.34	0.34	—
W16	0.37	0.37	—
W17	0.41	0.41	—
W18	0.45	0.45	—
W19	0.49	0.49	—
W20	0.54	0.54	—
W21	0.59	0.59	—
W22	0.65	0.65	—
W23	0.71	0.71	—
W24	0.78	0.78	—
W25	0.86	0.86	—
W26	0.94	0.94	—
W27	1.04	1.04	—
W28	1.14	1.14	—
W29	1.26	1.26	—
W30	1.39	1.39	—
W31	1.53	1.53	—
W32	1.69	1.69	—
W33	1.86	1.86	—
W34	2.05	2.05	—
W35	2.26	2.26	—
W36	2.49	2.49	—
W37	2.74	2.74	—
W38	3.02	3.02	—
W39	3.33	3.33	—
W40	3.67	3.67	—
W41	4.04	4.04	—
W42	4.45	4.45	—
W43	4.89	4.89	—
W44	5.38	5.38	—
W45	5.92	5.92	—
W46	6.51	6.51	—
W47	7.16	7.16	—
W48	7.87	7.87	—
W49	8.66	8.66	—
W50	9.52	9.52	—
W51	10.5	10.5	10.5
W52	11.5	11.5	11.5
W53	12.6	12.6	12.6
W54	13.9	13.9	13.9
W55	15.2	15.2	15.2
W56	16.7	16.7	16.7
W57	18.3	18.3	18.3
W58	—	19.9	19.9
W59	—	21.8	21.8
W60	—	23.8	23.8
W61	—	26.0	26.0
W62	—	28.5	28.5
W63	—	—	31.0
W64	—	—	34.0
W65	—	—	37.0

Refer to Heater Element Selection Procedure on page 2 before using tables.

TABLE 116		
Heater Element Cat. No.	Full Load Amperes	
	Size 0	Size 1
JJ14	0.19	0.19
JJ13	0.21	0.21
JJ12	0.23	0.23
JJ11	0.26	0.26
JJ10	0.29	0.29
JJ9	0.31	0.31
JJ8	0.35	0.35
JJ7	0.39	0.39
JJ6	0.43	0.43
JJ5	0.47	0.47
JJ4	0.52	0.52
JJ3	0.58	0.58
JJ2	0.64	0.64
JJ1	0.71	0.71
J1	0.79	0.79
J2	0.87	0.87
J3	0.96	0.96
J4	1.07	1.07
J5	1.18	1.18
J6	1.31	1.31
J7	1.45	1.45
J8	1.60	1.60
J9	1.76	1.76
J10	1.94	1.94
J11	2.13	2.13
J12	2.35	2.35
J13	2.59	2.59
J14	2.85	2.85
J15	3.14	3.14
J16	3.45	3.45
J17	3.80	3.80
J18	4.19	4.19
J19	4.62	4.62
J20	5.08	5.08
J21	5.60	5.60
J22	6.17	6.17
J23	6.80	6.80
J24	7.48	7.48
J25	8.24	8.24
J26	9.08	9.08
J27	10.0	10.0
J28	11.0	11.0
J29	12.2	12.2
J30	13.6	13.6
J31	15.1	15.1
J32	16.7	16.7
J33	18.6	18.6
J34	—	20.4
J35	—	22.5
J36	—	24.8
J37	—	27.5
J38	—	—
J39	—	—
J40	—	—

TABLE 117			
Heater Element Cat. No.	Full Load Amperes		
	Size 0	Size 1	Size 1P
JJ14	0.20	0.20	—
JJ13	0.22	0.22	—
JJ12	0.24	0.24	—
JJ11	0.27	0.27	—
JJ10	0.30	0.30	—
JJ9	0.33	0.33	—
JJ8	0.37	0.37	—
JJ7	0.40	0.40	—
JJ6	0.45	0.45	—
JJ5	0.50	0.50	—
JJ4	0.55	0.55	—
JJ3	0.60	0.60	—
JJ2	0.67	0.67	—
JJ1	0.74	0.74	—
J1	0.82	0.82	—
J2	0.91	0.91	—
J3	1.00	1.00	—
J4	1.11	1.11	—
J5	1.22	1.22	—
J6	1.35	1.35	—
J7	1.49	1.49	—
J8	1.66	1.66	—
J9	1.83	1.83	—
J10	2.02	2.02	—
J11	2.24	2.24	—
J12	2.48	2.48	—
J13	2.75	2.75	—
J14	3.03	3.03	—
J15	3.35	3.35	—
J16	3.70	3.70	—
J17	4.10	4.10	—
J18	4.53	4.53	—
J19	5.01	5.01	—
J20	5.54	5.54	—
J21	6.13	6.13	—
J22	6.78	6.78	—
J23	7.49	7.49	—
J24	8.29	8.29	—
J25	9.16	9.16	—
J26	10.1	10.1	—
J27	11.2	11.2	—
J28	12.4	12.4	12.4
J29	13.7	13.7	13.7
J30	15.2	15.2	15.2
J31	16.8	16.8	16.8
J32	18.5	18.5	18.5
J33	—	20.5	20.5
J34	—	22.8	22.8
J35	—	25.0	25.0
J36	—	27.5	27.5
J37	—	—	30.0
J38	—	—	33.5
J39	—	—	36.0
J40	—	—	—

Refer to Heater Element Selection Procedure on page 2 before using tables.

TABLE 127	
Heater Element Cat. No.	Full Load Amperes
	Size 00
W10	0.21
W11	0.23
W12	0.25
W13	0.27
W14	0.30
W15	0.34
W16	0.37
W17	0.41
W18	0.45
W19	0.50
W20	0.55
W21	0.60
W22	0.65
W23	0.71
W24	0.78
W25	0.86
W26	0.95
W27	1.04
W28	1.14
W29	1.25
W30	1.36
W31	1.50
W32	1.65
W33	1.82
W34	2.01
W35	2.21
W36	2.45
W37	2.67
W38	3.00
W39	3.31
W40	3.65
W41	4.06
W42	4.49
W43	4.98
W44	5.48
W45	6.06
W46	6.68
W47	7.35
W48	8.09
W49	8.90
W50	9.80

TABLE 132		
Heater Element Cat. No.	Full Load Amperes	
	Size 7	Size 8
J7	231	350
J8	253	380
J9	276	415
J10	305	455
J11	330	495
J12	360	540
J13	400	600
J14	440	660
J15	485	722
J16	530	795
J17	585	880
J18	645	965
J19	710	1160
J20	780	1170
J21	860	1290

TABLE 133		
Heater Element Cat. No.	Full Load Amperes	
	Size 7	Size 8
W29	—	—
W30	—	—
W31	230	345
W32	248	375
W33	272	410
W34	305	460
W35	325	485
W36	355	535
W37	390	585
W38	430	645
W39	475	710
W40	520	780
W41	575	860
W42	630	945
W43	690	1035
W44	755	1135
W45	835	1255

TABLE 134	
Heater Element Cat. No.	Size 7
W29	240
W30	261
W31	285
W32	310
W33	340
W34	370
W35	405
W36	445
W37	490
W38	540
W39	590
W40	650
W41	710
W42	780
W43	860
W44	—

Refer to Heater Element Selection Procedure on page 2 before using tables.

TABLE 144					
Heater Element Cat. No.	Full Load Amperes				
	Size 0	Size 1	Size 2	Size 3	Size 4
W10	0.18	0.18	—	—	—
W11	0.20	0.20	—	—	—
W12	0.22	0.22	—	—	—
W13	0.24	0.24	—	—	—
W14	0.26	0.26	—	—	—
W15	0.29	0.29	—	—	—
W16	0.32	0.32	—	—	—
W17	0.35	0.35	—	—	—
W18	0.38	0.38	—	—	—
W19	0.42	0.42	—	—	—
W20	0.46	0.46	—	—	—
W21	0.51	0.51	—	—	—
W22	0.56	0.56	—	—	—
W23	0.62	0.62	—	—	—
W24	0.68	0.68	—	—	—
W25	0.75	0.75	—	—	—
W26	0.82	0.82	—	—	—
W27	0.90	0.90	—	—	—
W28	0.99	0.99	—	—	—
W29	1.09	1.09	—	—	—
W30	1.20	1.20	—	—	—
W31	1.32	1.32	—	—	—
W32	1.45	1.45	—	—	—
W33	1.59	1.59	—	—	—
W34	1.75	1.75	—	—	—
W35	1.93	1.93	—	—	—
W36	2.12	2.12	—	—	—
W37	2.33	2.33	—	—	—
W38	2.56	2.56	—	—	—
W39	2.81	2.81	—	—	—
W40	3.09	3.09	—	—	—
W41	3.40	3.40	—	—	—
W42	3.74	3.74	—	—	—
W43	4.11	4.11	—	—	—
W44	4.52	4.52	—	—	—
W45	4.97	4.97	—	—	—
W46	5.46	5.46	5.60	—	—
W47	6.01	6.01	6.15	—	—
W48	6.60	6.60	6.76	—	—
W49	7.26	7.26	7.43	—	—
W50	7.98	7.98	8.17	—	—
W51	8.78	8.78	8.98	—	—
W52	9.65	9.65	9.87	—	—
W53	10.6	10.6	10.8	—	—
W54	11.7	11.7	11.9	—	—
W55	12.8	12.8	13.1	—	—
W56	14.1	14.1	14.4	—	—
W57	15.4	15.4	15.7	—	—
W58	16.8	16.8	17.1	—	—
W59	18.3	18.3	18.6	—	—
W60	—	19.8	20.1	—	—
W61	—	21.3	21.7	25.5	—
W62	—	22.7	23.1	28.1	—
W63	—	24.4	24.8	31.0	32.0
W64	—	26.2	28.6	34.0	35.0
W65	—	28.2	30.5	37.0	38.5
W66	—	—	33.0	40.0	42.5
W67	—	—	35.5	43.5	46.5
W68	—	—	38.0	47	51
W69	—	—	40.5	51	55
W70	—	—	43.5	55	59
W71	—	—	47.0	59	64
W72	—	—	—	63	69
W73	—	—	—	67	74
W74	—	—	—	71	79
W75	—	—	—	76	84
W76	—	—	—	80	90
W77	—	—	—	85	96
W78	—	—	—	90	102
W79	—	—	—	—	107
W80	—	—	—	—	113
W81	—	—	—	—	118
W82	—	—	—	—	124
W83	—	—	—	—	130
W84	—	—	—	—	135
W85	—	—	—	—	—

TABLE 145			
Heater Element Cat. No.	Full Load Amperes		
	Size 0	Size 1	Size 2
W10	0.18	0.18	—
W11	0.20	0.20	—
W12	0.22	0.22	—
W13	0.24	0.24	—
W14	0.27	0.27	—
W15	0.30	0.30	—
W16	0.33	0.33	—
W17	0.36	0.36	—
W18	0.40	0.40	—
W19	0.44	0.44	—
W20	0.49	0.49	—
W21	0.54	0.54	—
W22	0.60	0.60	—
W23	0.66	0.66	—
W24	0.73	0.73	—
W25	0.80	0.80	—
W26	0.88	0.88	—
W27	0.97	0.97	—
W28	1.06	1.06	—
W29	1.17	1.17	—
W30	1.29	1.29	—
W31	1.42	1.42	—
W32	1.56	1.56	—
W33	1.71	1.71	—
W34	1.89	1.89	—
W35	2.08	2.08	—
W36	2.28	2.28	—
W37	2.51	2.51	—
W38	2.76	2.76	—
W39	3.04	3.04	—
W40	3.34	3.34	—
W41	3.68	3.68	—
W42	4.05	4.05	—
W43	4.45	4.45	—
W44	4.90	4.90	—
W45	5.39	5.39	5.58
W46	5.88	5.88	6.11
W47	6.41	6.41	6.70
W48	6.99	6.99	7.34
W49	7.63	7.63	7.97
W50	8.32	8.32	8.69
W51	9.07	9.07	9.52
W52	9.89	9.89	10.4
W53	10.8	10.8	11.4
W54	11.8	11.8	12.5
W55	12.9	12.9	13.6
W56	14.2	14.2	14.9
W57	15.5	15.5	16.2
W58	16.8	16.8	17.4
W59	18.5	18.5	19.3
W60	—	20.3	21.0
W61	—	22.2	23.0
W62	—	24.0	25.0
W63	—	26.1	27.1
W64	—	28.4	29.6
W65	—	—	32.0
W66	—	—	34.5
W67	—	—	38.0
W68	—	—	41.5
W69	—	—	45.0
W70	—	—	—
W71	—	—	—
W72	—	—	—
W73	—	—	—
W74	—	—	—
W75	—	—	—
W76	—	—	—
W77	—	—	—
W78	—	—	—
W79	—	—	—
W80	—	—	—
W81	—	—	—
W82	—	—	—
W83	—	—	—
W84	—	—	—
W85	—	—	—