

General

All tables are based on the operation of the motor and controller in the same ambient temperature, 40 °C (104 °F) or less. Always be certain the correct thermal units are installed in the starter before operating the motor. Each thermal unit shall be installed such that its catalog number is visible. See page 16-136 for information on installing thermal units. On melting alloy thermal units the ratchet wheel must engage the pawl assembly.

Selection Procedure

1. Determine motor data:
 - a. Full load current rating
 - b. Service factor
NOTE: If motor full load current (FLC) is not known, a tentative thermal unit selection could be made, based on horsepower and voltage. Refer to page 16-136.
2. Motor and controller in *same ambient temperature*:
 - a. All starter classes, except Class 8198:
 1. For 1.15 to 1.25 service factor motors use 100% of motor FLC for thermal unit selection.
 2. For 1.0 service factor motors use 90% of motor FLC for thermal unit selection.
 - b. Class 8198 only:
 1. For 1.0 service factor motors use 100% of motor FLC for thermal unit selection.
 2. For 1.15 to 1.25 service factor motors use 110% of motor FLC for thermal unit selection.
3. Motor and controller in *different ambient temperatures*:
 - a. Multiply motor FLC by the multiplier in [Selection of Thermal Units for Special Applications](#), page 16-132. Use the resultant full load current for thermal unit selection.
4. Locate the proper selection table from the index, pages [page 16-133](#) and [page 16-134](#).
 - a. The proper thermal unit number will be found adjacent, to the right of the range of full load currents in which the motor FLC or resultant full load current falls.
5. See [page 16-135](#) for calculation of trip current rating.

Slow Trip Thermal Unit Selection

To select Type SB slow trip thermal units, the selection table for a standard Type B thermal unit may be used with the following modifications: For continuous rated motors having service factors of 1.15 to 1.25, select thermal units from the standard Type B table using 93% (102% for Class 8198) of the full load current shown on the motor nameplate and then substitute an SB for the B in the thermal unit type number.

Example: A motor with a full load current of 12 A controlled by an 8536SCG3 would require B22 thermal units for standard trip applications and SB19.5 thermal units for slow trip applications. The SB is selected by multiplying 12 A times 93% for 11.16 A and using this value to select B19.5. Then add the S prefix to arrive at SB19.5.

For continuous rated motors having a service factor of 1.0, select thermal units in the same manner using 84% (93% for Class 8198) of full load current shown on the motor nameplate.

NOTE: SB thermal units are used on Size 0, 1, 2, and only some Size 3 applications. Check thermal unit tables for current ranges.

Table 16.391: Thermal Unit Trip Types

Melting Alloy	
Type of Trip	Thermal Unit Type
Standard	A
	B
	C
	CC
	DD
Quick	FB
Slow	SB

Table 16.392: Selection of Thermal Units for Special Applications

Class of Controller	Continuous Duty Motor Service Factor	Melting Alloy		
		Ambient Temperature of Motor		
		Same as Controller Ambient	Constant 10 °C (18 °F) Higher Than Controller Ambient	Constant 10 °C (18 °F) Lower Than Controller Ambient
			Full Load Current Multiplier	
All Classes, Except 8198	1.15 to 1.25	1.0	0.9	1.05
	1.0	0.9	0.8	0.95
Class 8198	1.15 to 1.25	1.1	1.0	1.15
	1.0	1.0	0.9	1.05

Approximate Thermal Unit Selection Based On Horsepower and Voltage

General—Thermal units selected using approximate full-load currents from Table 16.395 will provide a trip current between 101% and 125% of full-load current for many 4-pole, single speed, normal torque, 60 Hz motors. Since full-load current rating of different makes and types of motors vary so widely, these selections may not be suitable.

Thermal units should be selected on the basis of motor nameplate full-load current and service factor. Thermal unit sizes originally selected on an approximate basis should always be rechecked and corrected at the time of installation if required.

How to use Table 16.395:

- Locate the motor horsepower and voltage.
- Determine the approximate full-load current from Table 16.395.
- Use the approximate full-load current in place of actual nameplate full-load current and follow the Selection Procedure on page 16-132.

Table 16.395: Use This Table Only When the Motor Full-Load Current Is Not Known

Motor Horsepower	Motor Full-Load Current					
	Three Ø				Single Ø	
	200 V	230 V	460 V	575 V	115 V	230 V
1/6	—	—	—	—	4.4	2.2
1/4	—	—	—	—	5.8	2.9
1/3	—	—	—	—	7.2	3.6
1/2	2.5	2.2	1.1	0.9	9.8	4.9
3/4	3.7	3.2	1.6	1.3	13.8	6.9
1	4.8	4.2	2.1	1.7	16	8
1-1/2	6.9	6.0	3.0	2.4	20	10
2	7.8	6.8	3.4	2.7	24	12
3	11.0	9.6	4.8	3.9	34	17
5	17.5	15.2	7.6	6.1	56	28
7-1/2	25.3	22	11	9	80	40
10	32.2	28	14	11	—	50
15	48.3	42	21	17	—	—
20	62.1	54	27	22	—	—
25	78.2	68	34	27	—	—
30	92	80	40	32	—	—
40	120	104	52	41	—	—
50	150	130	65	52	—	—
60	177	154	77	62	—	—
75	221	192	96	77	—	—
100	285	248	124	99	—	—
125	359	312	156	125	—	—
150	414	360	180	144	—	—
200	552	480	240	192	—	—

NOTE: These currents should not be used for selection of fuses, circuit breakers or wire sizes. See NEC tables 430-248 through 430-250. For motors rated 208-220 volts, use 230 V column. For motors rated 440 to 550 volts, use 460 and 575 V columns, respectively.

Mounting of the Thermal Units

Always be certain the correct thermal units are installed in the starter before operating the motor. Thermal units should always be mounted so that their type designation can be read from the front of the starter (see Figure 1). Melting alloy thermal units should be mounted so that the tooth of the pawl assembly can engage the teeth of the ratchet wheel when the reset button is pushed.

Mounting surfaces of starter and thermal units should be clean and care should be taken to insure that thermal unit mounting screws are fastened securely.



Figure 1

Thermal Unit Selection Tables

Thermal Unit Table 1

(index and instructions: [page 16-132 to page 16-136](#))

Motor FLC (A)		Thermal Unit Number
1 T.U.	3 T.U.	
0.33-0.36	0.29-0.32	B 0.44
0.37-0.40	0.33-0.36	B 0.51
0.41-0.45	0.37-0.39	B 0.57
0.46-0.52	0.40-0.47	B 0.63
0.53-0.59	0.48-0.56	B 0.71
0.60-0.66	0.57-0.63	B 0.81
0.67-0.73	0.64-0.69	B 0.92
0.74-0.81	0.70-0.77	B 1.03
0.82-0.91	0.78-0.86	B 1.16
0.92-1.02	0.87-0.96	B 1.30
1.03-1.14	0.97-1.11	B 1.45
1.15-1.29	1.12-1.23	B 1.67
1.20-1.42	1.24-1.37	B 1.88
1.43-1.64	1.38-1.55	B 2.10
1.65-1.80	1.56-1.75	B 2.40
1.81-2.10	1.76-1.92	B 2.65
2.11-2.30	1.93-2.16	B 3.00
2.31-2.61	2.17-2.50	B 3.30
2.62-2.99	2.51-2.81	B 3.70
3.00-3.37	2.82-3.16	B 4.15
3.38-3.94	3.17-3.40	B 4.85
3.95-4.24	3.41-3.76	B 5.50
4.25-4.54	3.77-4.00	B 6.25
4.55-5.29	4.01-4.68	B 6.90
5.30-5.73	4.69-5.18	B 7.70
5.74-6.35	5.19-5.51	B 8.20
6.36-7.08	5.52-6.19	B 9.10
7.09-7.83	6.20-7.12	B 10.2
7.84-8.47	7.13-8.15	B 11.5
8.48-9.83	8.16-8.60	B 12.8
9.84-10.5	8.61-9.21	B 14.0
10.6-11.4	9.22-10.1	B 15.5
11.5-12.8	10.2-11.2	B 17.5
12.9-13.9	11.3-12.0	B 19.5
14.0-16.1	—	B 22.0
16.2-18.0	—	B 25.0
Following Selections for Size M-1 & M-1P Only.		
—	11.3-12.1	B 19.5
—	12.2-13.6	B 22.0
16.2-17.6	13.7-15.3	B 25.0
17.7-20.6	15.4-17.3	B 28.0
20.7-23.1	17.4-19.1	B 32.0
23.2-26.0	19.2-21.7	B 36.0
—	21.8-24.2	B 40.0
—	24.3-26.0	B 45.0
Following Selections for Size M-1P Only		
23.2-27.1	—	B 36.0
27.2-29.2	—	B 40.0
29.3-33.0	—	B 45.0
33.1-36.0	—	B 50.0

Thermal Unit Table 2

(index and instructions: [page 16-132 to page 16-136](#))

Motor FLC (A)		Thermal Unit Number
1 T.U.	3 T.U.	
0.35-0.38	0.30-0.32	B 0.44
0.39-0.43	0.33-0.37	B 0.51
0.44-0.48	0.38-0.39	B 0.57
0.49-0.56	0.40-0.48	B 0.63
0.57-0.63	0.49-0.57	B 0.71
0.64-0.71	0.58-0.64	B 0.81
0.72-0.78	0.65-0.70	B 0.92
0.79-0.88	0.71-0.78	B 1.03
0.89-0.99	0.79-0.87	B 1.16
1.00-1.15	0.88-0.98	B 1.30
1.16-1.23	0.99-1.13	B 1.45
1.24-1.43	1.14-1.25	B 1.67
1.44-1.51	1.26-1.40	B 1.88
1.52-1.75	1.41-1.58	B 2.10
1.76-1.93	1.59-1.79	B 2.40
1.94-2.25	1.80-1.91	B 2.65
2.26-2.47	1.92-2.20	B 3.00
2.48-2.81	2.21-2.55	B 3.30
2.82-3.20	2.56-2.87	B 3.70
3.21-3.63	2.88-3.24	B 4.15
3.64-4.19	3.25-3.48	B 4.85
4.20-4.53	3.49-3.85	B 5.50
4.54-4.89	3.86-4.10	B 6.25
4.90-5.68	4.11-4.79	B 6.90
5.69-6.27	4.80-5.31	B 7.70
6.28-6.85	5.32-5.65	B 8.20
6.86-7.73	5.66-6.35	B 9.10
7.74-8.50	6.36-7.31	B 10.2
8.51-9.29	7.32-8.34	B 11.5
9.30-10.4	8.35-8.84	B 12.8
10.5-11.3	8.85-9.47	B 14.0
11.4-12.3	9.48-10.4	B 15.5
12.4-13.9	10.5-11.5	B 17.5
14.0-15.0	11.6-12.0	B 19.5
15.1-18.0	—	B 22.0
Following Selections for Size M-1 & M-1P Only.		
—	11.6-12.4	B 19.5
15.1-17.4	12.5-14.0	B 22.0
17.5-19.2	14.1-15.8	B 25.0
19.3-22.0	15.9-17.8	B 28.0
22.1-24.6	17.9-19.7	B 32.0
24.7-26.0	19.8-22.4	B 36.0
—	22.5-25.1	B 40.0
—	25.1-26.0	B 45.0
Following Selections for Size M-1P Only.		
24.7-29.1	—	B 36.0
29.2-31.7	—	B 40.0
31.8-36.0	—	B 45.0

Thermal Unit Table 3
(index and instructions: [page 16-132](#) to [page 16-136](#))

Motor FLC (A)		Thermal Unit Number
1 T.U.	3 T.U.	
0.29-0.31	0.28-0.29	B 0.44
0.32-0.36	0.30-0.33	B 0.51
0.37-0.39	0.34-0.36	B 0.57
0.40-0.47	0.37-0.44	B 0.63
0.48-0.56	0.45-0.52	B 0.71
0.57-0.63	0.53-0.59	B 0.81
0.64-0.69	0.60-0.64	B 0.92
0.70-0.77	0.65-0.71	B 1.03
0.78-0.86	0.72-0.80	B 1.16
0.87-0.97	0.81-0.90	B 1.30
0.98-1.12	0.91-1.03	B 1.45
1.13-1.24	1.04-1.14	B 1.67
1.25-1.39	1.15-1.27	B 1.88
1.40-1.57	1.28-1.44	B 2.10
1.58-1.78	1.45-1.63	B 2.40
1.79-1.96	1.64-1.79	B 2.65
1.97-2.20	1.80-2.01	B 3.00
2.21-2.41	2.02-2.19	B 3.30
2.42-2.75	2.20-2.52	B 3.70
2.76-3.25	2.53-2.95	B 4.15
3.26-3.50	2.96-3.17	B 4.85
3.51-3.87	3.18-3.50	B 5.50
3.88-4.13	3.51-3.73	B 6.25
4.14-4.69	3.74-4.22	B 6.90
4.70-5.20	4.23-4.68	B 7.70
5.21-5.53	4.69-4.98	B 8.20
5.54-6.23	4.99-5.59	B 9.10
6.24-7.18	5.60-6.43	B 10.2
7.19-8.20	6.44-7.41	B 11.5
8.21-8.98	7.42-8.02	B 12.8
8.99-9.63	8.03-8.59	B 14.0
9.64-10.6	8.60-9.52	B 15.5
10.7-11.8	9.53-10.5	B 17.5
11.9-12.7	10.6-11.2	B 19.5
12.8-14.3	11.3-12.0	B 22.0
14.4-16.1	—	B 25.0
16.2-18.0	—	B 28.0
Following Selections for Size M-1 & M-1P Only.		
—	11.3-12.7	B 22.0
—	12.8-14.3	B 25.0
16.2-18.3	14.4-16.1	B 28.0
18.4-20.2	16.2-17.8	B 32.0
20.3-23.0	17.9-20.1	B 36.0
23.1-26.0	20.2-22.6	B 40.0
—	22.7-25.5	B 45.0
—	25.6-26.0	B 50.0
Following Selections for Size M-1P Only		
25.9-29.0	—	B 45.0
29.1-30.8	—	B 50.0
30.9-32.7	—	B 56.0
32.8-36.0	—	B 62.0

Thermal Unit Table 5
(index and instructions: [page 16-132](#) to [page 16-136](#))

Current Transformer Ratio										Thermal Unit Number
25/5	50/5	75/5	100/5	150/5	200/5	250/5	300/5	400/5	500/5	
Motor FLC										
10.6-11.7	21.1-23.6	31.7-35.4	42.3-47.2	63.4-70.9	84.5-94.6	106-117.	127-141.	169-188.	211-236.	B 3.00
11.8-13.2	23.7-26.5	35.5-39.8	47.3-53.1	71.0-79.7	94.7-105.	118-132.	142-159.	189-212.	237-265.	B 3.30
13.3-14.8	26.6-29.6	39.9-44.5	53.2-59.4	79.8-89.1	106-118.	133-148.	160-177.	213-237.	266-296.	B 3.70
14.9-17.2	29.7-34.5	44.6-51.8	59.5-69.2	89.2-103.	119-138.	149-172.	178-207.	238-276.	297-345.	B 4.15
17.3-19.6	34.6-39.2	51.9-58.9	69.3-78.6	104-117.	139-156.	173-196.	208-235.	277-314.	346-360.	B 4.85
19.7-22.3	39.3-44.6	59.0-67.0	78.7-89.3	118-133.	157-178.	197-223.	236-267.	315-357.	—	B 5.50

Thermal Unit Table 9
(index and instructions: [page 16-132](#) to [page 16-136](#))

Motor FLC (A)	Thermal Unit Number
15.3-16.7	C 20.0
16.8-19.8	C 22.0
19.9-22.8	C 26.0
22.9-25.8	C 30.0
25.9-30.4	C 34.0
30.5-31.9	C 40.0
32.0-34.2	C 42.0
34.3-38.8	C 45.0
38.9-44.2	C 51.0
44.3-50.2	C 58.0
50.3-57.1	C 66.0
57.2-63.2	C 75.0
63.3-68.6	C 83.0
68.7-78.6	C 90.0
78.7-86.9	C 103.0
87.0-100.0	C 114.0

Thermal Unit Table 4
(index and instructions: [page 16-132](#) to [page 16-136](#))

Motor FLC (A)		Thermal Unit Number
1 T.U.	3 T.U.	
0.32-0.33	0.29-0.30	B 0.44
0.34-0.38	0.31-0.35	B 0.51
0.39-0.41	0.36-0.37	B 0.57
0.42-0.50	0.38-0.45	B 0.63
0.51-0.61	0.46-0.54	B 0.71
0.62-0.68	0.55-0.61	B 0.81
0.69-0.74	0.62-0.66	B 0.92
0.75-0.83	0.67-0.74	B 1.03
0.84-0.93	0.75-0.83	B 1.16
0.94-1.05	0.84-0.93	B 1.30
1.06-1.21	0.94-1.07	B 1.45
1.22-1.34	1.08-1.19	B 1.67
1.35-1.50	1.20-1.33	B 1.88
1.51-1.70	1.34-1.51	B 2.10
1.71-1.93	1.52-1.70	B 2.40
1.94-2.12	1.71-1.87	B 2.65
2.13-2.38	1.88-2.10	B 3.00
2.39-2.61	2.11-2.29	B 3.30
2.62-2.99	2.30-2.63	B 3.70
3.00-3.53	2.64-3.09	B 4.15
3.54-3.80	3.10-3.32	B 4.85
3.81-4.21	3.33-3.67	B 5.50
4.22-4.49	3.68-3.91	B 6.25
4.50-5.10	3.92-4.43	B 6.90
5.11-5.66	4.44-4.91	B 7.70
5.67-6.03	4.92-5.23	B 8.20
6.04-6.79	5.24-5.88	B 9.10
6.80-7.84	5.89-6.77	B 10.2
7.85-8.96	6.78-7.90	B 11.5
8.97-9.82	7.91-8.44	B 12.8
9.83-10.4	8.45-9.05	B 14.0
10.5-11.6	9.06-9.99	B 15.5
11.7-12.9	10.0-11.0	B 17.5
13.0-13.9	11.1-11.9	B 19.5
14.0-15.7	12.0-12.0	B 22.0
15.8-18.0	—	B 25.0
Following Selections for Size M-1 & M-1P Only.		
—	12.0-13.4	B 22.0
—	13.5-15.1	B 25.0
17.8-20.1	15.2-17.0	B 28.0
20.2-22.2	17.1-18.9	B 32.0
22.3-25.3	19.0-21.4	B 36.0
25.4-26.0	21.5-24.0	B 40.0
—	24.1-26.0	B 45.0
Following Selections for Size M-1P Only.		
25.4-28.4	—	B 40.0
28.5-33.1	—	B 45.0
33.2-36.0	—	B 50.0

Thermal Unit Table 10
(index and instructions: [page 16-132](#) to [page 16-136](#))

Motor FLC (A)	Thermal Unit Number
43.6-47.3	CC 54.5
47.4-51.3	CC 59.4
51.4-54.6	CC 64.3
54.7-59.7	CC 68.5
59.8-65.1	CC 74.6
65.2-70.1	CC 81.5
70.2-75.1	CC 87.7
75.2-82.2	CC 94.0
82.3-89.2	CC 103.0
89.3-96.5	CC 112.0
96.6-104.	CC 121.0
105-113.	CC 132.0
114-123.	CC 143.0
124-132.	CC 156.0
133-150.	CC 167.0