

# Electrical Calculations Workbook



U.S. Department of Labor  
Mine Safety and Health Administration

West Virginia Office of Miners'  
Health, Safety and Training

March 2003  
Revised July 2003



**“Helping You to Work More Safely  
in the Mining Industry”**

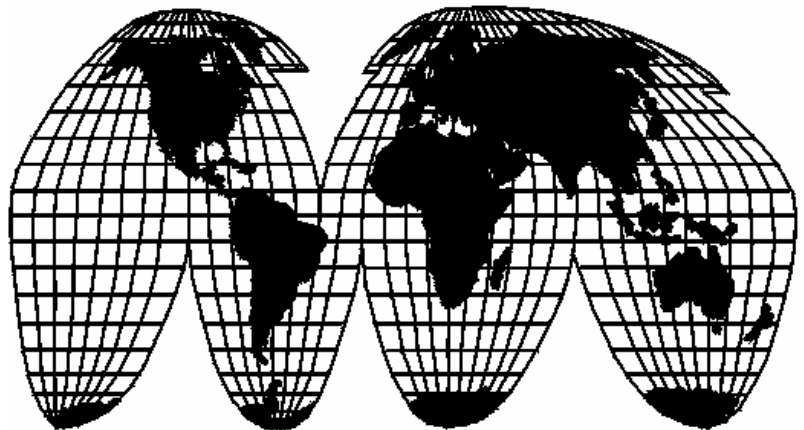
## **DISCLAIMER**

This booklet is published as a joint effort between the West Virginia Office of Miners' Health, Safety and Training and the National Mine Health and Safety Academy. The material should be used by mine electricians to assist in selecting the proper protective settings and cable sizes for electrically-powered motor circuits. The material is not all-inclusive and should be used only as an aide in gaining compliance with the applicable regulations. The material is based upon several different publications including West Virginia State Mining Regulations, the National Electrical Code, Title 30 CFR, and the Program Policy Manual. Only one manufacturer of motor overloads is listed; however, products of other manufacturers can easily be cross-referenced to those listed. Nothing herein should be construed as recommending any manufacturer's products.

**Visit our websites**

**[www.msha.gov](http://www.msha.gov)**

**[www.wvminesafety.org](http://www.wvminesafety.org)**



# Electrical Calculations Workbook

---



U.S. Department of Labor  
Elaine L. Chao  
Secretary

Mine Safety and Health Administration  
Dave D. Lauriski  
Assistant Secretary

West Virginia Office of Miners'  
Health, Safety and Training

Doug Conaway  
Director

C. A. Phillips  
Deputy Director

Tom Harmon  
Electrical Inspector

John Scott  
Electrical Inspector

Bob Thornsbury  
Electrical Inspector

March 2003  
Revised July 2003

## DEFINITIONS

### **VOLTS**

Operating voltage.

### **MOTOR HORSEPOWER**

Horsepower of the motor.

### **MOTOR FLC**

Full-load current of the motor.

### **FLC X 125%**

Motor full-load current x 125% to determine required cable size and overload protection. (Some manufacturers have the 125% already calculated into their heater charts).

### **CABLE SIZES**

Power cables are rated at different temperatures. Normally the mining industry uses 75 and 90 degree insulation ratings. Underground mining cables listed have been calculated for the underground ambient temperature factors. The surface charts utilize the standardization of the National Electrical Code for jacketed-cables or enclosed in conduit.

### **CIRCUIT BREAKER AND FUSE SIZE**

Standard Listings 15-20-25-30-35-40-45-50-60-70-80-90-100-110-125-150-175-200-225-250-300 350-400-450-500-600-700-800-1000-1200-1600-2000-2500-3000-4000-5000 and 6000.

### **FULL-LOAD CURRENT X 250%**

Motor full-load current X 250% to determine low setting for short circuit protection if thermal circuit breaker or fuses are used.

### **FULL-LOAD CURRENT X 400%**

Motor full-load current X 400% to determine maximum allowable short circuit protection if thermal circuit breaker or fuses are used.

### **FULL-LOAD CURRENT x 700%**

To determine low setting for short circuit protection using a magnetic CB.

### **FULL-LOAD CURRENT X 1300%**

To determine short circuit protection using a magnetic circuit breaker, try to start at 700% of motor full-load current. If motor will not start, keep increasing but do not exceed 1300% of motor full-load current.

### **BREAKER TRIP RANGE**

The variable adjustable short circuit protection of a circuit breaker.

### **TRIP RANGE SET ON**

From 700% to 1300% of motor full-load current (For a magnetic CB).

### **HEATER SIZE**

No greater than 125% of motor full load current.

### **HEATER AMPS**

Set point of heaters which will open the circuit.

### **CT RATIO**

Current transformer used in conjunction with thermal overloads to provide motor overload protection.

### **STARTER SIZE**

Minimum size starter.

## SINGLE MOTOR EXAMPLE

|   |            |            |             |                          |
|---|------------|------------|-------------|--------------------------|
| <p><b>(SURFACE)</b> This example utilizes a thermal circuit breaker or fuses although a thermal magnetic circuit breaker is acceptable.</p> <p><b>(UNDERGROUND)</b> This example utilizes a magnetic circuit breaker.</p> | <b>S</b>   | <b>U</b>   |             |                          |
|   | <b>U</b>   | <b>N</b>   |             |                          |
|   | <b>R</b>   | <b>D</b>   |             |                          |
|   | <b>F</b>   | <b>E</b>   |             |                          |
|   | <b>A</b>   | <b>R</b>   |             |                          |
|   | <b>C</b>   | <b>G</b>   |             |                          |
|   | <b>E</b>   | <b>R</b>   |             |                          |
|   |            | <b>O</b>   |             |                          |
|   |            | <b>U</b>   |             |                          |
|   |            | <b>N</b>   |             |                          |
|   |            | <b>D</b>   |             |                          |
| <b>VOLTS</b>  | <b>460</b> | <b>460</b> |             |                          |
| Operating voltage.  |            |            |             |                          |
| <b>HORSEPOWER</b>   | <b>25</b>  | <b>25</b>  |             |                          |
| Rated motor horsepower.   |            |            |             |                          |
| <b>MOTOR FLC</b>  | <b>34</b>  | <b>34</b>  |             |                          |
| Motor full-load current.  |            |            |             |                          |
| <b>FLC X 125%</b>   | <b>43</b>  | <b>43</b>  |             |                          |
| Motor full-load current X 125% = 43 amps.   |            |            |             |                          |
| <b>CABLE SIZE</b>   | <b>8</b>   | <b>8</b>   |             |                          |
| No. 8 AWG copper rated for 50 amps surface or No.8 copper rated for 70 amps underground.  |            |            |             |                          |
| <b>CABLE AMPACITY</b>   | <b>50</b>  | <b>70</b>  |             |                          |
| No. 8 copper rated for 50 amps surface and 70 amps underground.   |            |            |             |                          |
| <b>FLC X 250%</b>   | <b>85</b>  |            |             |                          |
| FLC 34 amps X 250% = 85 amps low setting for short circuit protection (thermal circuit breaker or fuses).   |            |            |             |                          |
| <b>FLC X 400 %</b>  | <b>136</b> |            |             |                          |
| FLC 34 amps X 400% = 136 amps Maximum setting for short circuit protection (thermal circuit breaker or fuses).  |            |            |             |                          |
| <b>THERMAL BK OR FUSE SIZE</b>  |            |            | <b>90</b>   |                          |
| FLC X 250% = 85 amps ( a standard size 90 amp thermal CB or fuse is acceptable).  |            |            |             |                          |
| <b>FLC X 700%</b>   |            |            |             | <b>238</b>               |
| FLC X 700% = 238 amps is low setting for short circuit protection (magnetic CB).  |            |            |             |                          |
| <b>FLC X 1300%</b>  |            |            |             | <b>442</b>               |
| FLC X 1300% = 442 amps is maximum setting for short circuit protection (magnetic CB).   |            |            |             |                          |
| <b>BREAKER TRIP RANGE</b>   |            |            |             | <b>150</b><br><b>480</b> |
| Magnetic CB with adjustable trip range between 150 to 480 amps.   |            |            |             |                          |
| <b>TRIP RANGE SETTING</b>   |            |            |             | <b>250</b>               |
| CB with 150 to 480 trip range and 13 settings set on No.4 (250 amps ) would be acceptable.  |            |            |             |                          |
| <b>CT RATIO</b>   |            |            |             |                          |
| Normally not used in motors below 100 HP.   |            |            |             |                          |
| <b>HEATER SIZE</b>  |            |            | <b>FH56</b> | <b>FH56</b>              |
| FH 56 rated for 41.5 amps. Rating not to exceed 125% of motor FLC.  |            |            |             |                          |
| <b>HEATER AMPS</b>  |            |            | <b>41.5</b> | <b>41.5</b>              |
| FH 56 will open circuit if amperage reaches 41.5 amps.  |            |            |             |                          |
| <b>STARTER SIZE</b>   |            |            | <b>2</b>    | <b>2</b>                 |
| Minimum size starter.   |            |            |             |                          |

| <b>MULTI-MOTOR EXAMPLE</b>   |              |             |              |
|--|--------------|-------------|--------------|
| <b>VOLTS</b>   |              | <b>460</b>  |              |
| System operating voltage.  |              |             |              |
| <b>MOTOR FLC</b>   |              | <b>180</b>  |              |
| Motor full-load current.   |              |             |              |
| <b>FLC X 125%</b>  |              | <b>225</b>  |              |
| Motor FLC x 125% = 225 amps.   |              |             |              |
| <b>FLC + (FLC X 125%)</b>  |              | <b>405</b>  |              |
| To determine required size feeder conductor in a multi-motor installation. The largest HP FLC X 125% + FLC of other motors connected to the feeder circuit. EXAMPLE: Installation Contains two (2) 460 volt, 150 HP, 180 amp motors. Multiply (180 amps by 125% = 225 amps + 180 amps = 405 amps). |              |             |              |
| <b>FEEDER SIZE</b>   |              | <b>600</b>  |              |
| A 600 MCM copper cable would be the minimum size for surface installation. If this Circuit were to be installed underground, referring to the underground cable ampacity chart 0-2K volts, a 300 MCM 90 degree cable rated at 421 Amps would be acceptable.  |              |             |              |
| <b>FEEDER AMPACITY</b>   |              | <b>420</b>  |              |
| Rated ampacity of cable from power Source to beginning of branch circuits.   |              |             |              |
| <b>TRIP RANGE</b>  |              | <b>15-3</b> |              |
| Thermal magnetic CB with adjustable trip range. Low setting 1500 high 3000 amps.   |              |             |              |
| <b>TRIP RANGE SETTING</b>  |              | <b>1500</b> |              |
| 150 HP 180 amps 180 X 700% = 1260, set trip range on low (1500 amps).  |              |             |              |
| <b>FUSE &amp; THERMAL CB SZ</b>  |              | <b>450</b>  |              |
| Fuse or (thermal CB only) for short circuit protection of feeder cable, try to start at 250%. If motors will not start, increase up to 400% max.   |              |             |              |
| <b>MOTOR HORSEPOWER</b>  | <b>150</b>   |             | <b>150</b>   |
| Rated motor horsepower.  |              |             |              |
| <b>MOTOR FLC</b>   | <b>180</b>   |             | <b>180</b>   |
| Motor full-load current.   |              |             |              |
| <b>FLC X 125%</b>  | <b>225</b>   |             | <b>225</b>   |
| Motor FLC 180 X 125% = 225 amps.   |              |             |              |
| <b>BRANCH CIR CABLE SIZE</b>   | <b>4/0</b>   |             | <b>4/0</b>   |
| Minimum size cable for motors receiving power from feeder circuit 125% of motor FLC.   |              |             |              |
| <b>BR. CIR CABLE AMPAC.</b>  | <b>230</b>   |             | <b>230</b>   |
| Rated ampacity of branch circuit cable.  |              |             |              |
| <b>FLC X 250%</b>  | <b>450</b>   |             | <b>450</b>   |
| FLC 180 X 250% = 450, low setting for short Circuit protection (fuses or thermal CB).  |              |             |              |
| <b>FLC X 400%</b>  | <b>720</b>   |             | <b>720</b>   |
| FLC 180 X 400% = 720, maximum setting for short circuit protection (fuses or thermal CB).  |              |             |              |
| <b>FLC X 700%</b>  | <b>1260</b>  |             | <b>1260</b>  |
| FLC of motor X 700% low setting for magnetic CB.   |              |             |              |
| <b>FLC X 1300%</b>   | <b>2340</b>  |             | <b>2340</b>  |
| FLC of motor X 1300% maximum setting for magnetic CB.  |              |             |              |
| <b>CT RATIO</b>  | <b>300/5</b> |             | <b>300/5</b> |
| A 300/5 CT=60/1 (300 divided by 5 = 60/1)<br>A motor operating at 60 amps, the secondary output would be 1 amp.  |              |             |              |
| <b>HEATER SIZE</b>   | <b>FH 30</b> |             | <b>FH 30</b> |
| Multiply CT ratio (60/1) by FH-30 (3.73 amps) = 224 amps. This is 1 amp under 225 amp max.   |              |             |              |
| <b>HEATER AMPS</b>   | <b>3.73</b>  |             | <b>3.73</b>  |
| Rated amperage for heater strips will open Circuit if overload condition occurs.   |              |             |              |
| <b>STARTER SIZE</b>  | <b>5</b>     |             | <b>5</b>     |
| Minimum size starter.  |              |             |              |

### CT RATIO HEATER SIZE FOR MOTOR PROTECTION

| 460V                | 100 HP | 125 HP | <b>150 HP</b> | 200 HP | 250 HP |
|---------------------|--------|--------|---------------|--------|--------|
| FLC X 125%          | 155    | 195    | <b>225</b>    | 300    | 378    |
| 100/5 = 20/1        | FH-37  | FH-40  | FH-41         | FH-45  | FH-47  |
| 150/5 = 30/1        | FH-33  | FH-36  | FH-37         | FH-40  | FH-43  |
| 200/5 = 40/1        | FH-30  | FH-33  | FH-34         | FH-37  | FH-40  |
| 250/5 = 50/1        | FH-27  | FH-30  | FH-32         | FH-35  | FH-37  |
| <b>300/5 = 60/1</b> | FH-26  | FH-28  | <b>FH-30</b>  | FH-33  | FH-35  |
| 350/5 = 70/1        | FH-24  | FH-26  | FH-28         | FH-31  | FH-34  |
| 400/5 = 80/1        | FH-22  | FH-25  | FH-26         | FH-30  | FH-32  |
| 450/5 = 90/1        | FH-21  | FH-24  | FH-25         | FH-28  | FH-31  |
| 500/5 = 100/1       | FH-20  | FH-23  | FH-24         | FH-27  | FH-30  |
| 600/5 = 120/1       | FH-18  | FH-21  | FH-22         | FH-25  | FH-28  |

Normally motors over 100 horsepower use current transformers (CT) to provide overload protection.

Overload protection shall not be greater than 125% of the motor rated full-load current.

EXAMPLE: A 300/5 CT=60/1 (300 divided by 5=60). If a motor is operating at 60 amps, the secondary amperage of the CT would be 1 amp.

The chart above has been calculated to determine the maximum overload heater size for proper overload protection not to exceed 125% of motor full-load operating current.

EXAMPLE: A 150 horsepower, 460 volt motor operates at 180 amps full-load current. 180 amps X 125% = 225 amps. Overload protection shall not exceed 225 amps.

The heater size FH-30 is rated for 3.73 amps. Multiply CT ratio (60/1) by FH-30 (3.73 amps) = 224 amps. This is one amp under the 225 amp maximum.

If FH series heaters are not used, this chart can be used to cross reference amperage rating of other heaters.

| H<br>P<br>4<br>6<br>0 | F<br>L<br>C | 1<br>2<br>5<br>% | 2<br>5<br>0<br>% | 4<br>0<br>0<br>% | 7<br>0<br>0<br>% | 1<br>3<br>0<br>0<br>% | H<br>T<br>S<br>Z | S<br>T<br>S<br>Z |
|-----------------------|-------------|------------------|------------------|------------------|------------------|-----------------------|------------------|------------------|
| 0.5                   | 1.1         | 1.3              | 2.75             | 4.4              | 7.7              | 14.3                  | FH 18            | 0                |
| 0.75                  | 1.6         | 2                | 4                | 6.4              | 11.2             | 21                    | FH 23            | 0                |
| 1                     | 2.1         | 2.6              | 5.25             | 8.4              | 14.7             | 27                    | FH 26            | 0                |
| 1.5                   | 3           | 3.75             | 7.5              | 12               | 21               | 39                    | FH 30            | 0                |
| 2                     | 3.4         | 4.25             | 8.5              | 13.6             | 23.8             | 44                    | FH 31            | 0                |
| 3                     | 4.8         | 6                | 12               | 19.2             | 33.6             | 62                    | FH 35            | 0                |
| 5                     | 7.6         | 9.5              | 19               | 30.4             | 53.2             | 99                    | FH 40            | 0                |
| 7.5                   | 11          | 14               | 27.5             | 44               | 77               | 143                   | FH 44            | 1                |
| 10                    | 14          | 17.5             | 35               | 56               | 98               | 182                   | FH 47            | 1                |
| 15                    | 21          | 26.3             | 52.5             | 84               | 147              | 273                   | FH 50            | 2                |
| 20                    | 27          | 34               | 67.5             | 108              | 189              | 351                   | FH 53            | 2                |
| 25                    | 34          | 43               | 85               | 136              | 238              | 442                   | FH 56            | 2                |
| 30                    | 40          | 50               | 100              | 160              | 280              | 520                   | FH 81            | 3                |
| 40                    | 52          | 65               | 130              | 208              | 364              | 676                   | FH 83            | 3                |
| 50                    | 65          | 81               | 163              | 260              | 455              | 845                   | FH 86            | 3                |
| 60                    | 77          | 96               | 193              | 308              | 539              | 1001                  | FH 88            | 4                |
| 75                    | 96          | 120              | 240              | 384              | 672              | 1248                  | FH 90            | 4                |
| 100                   | 124         | 155              | 310              | 496              | 868              | 1612                  | FH 93            | 4                |
| 125                   | 156         | 195              | 390              | 624              | 1092             | 2028                  |                  | 5                |
| 150                   | 180         | 225              | 450              | 720              | 1260             | 2340                  |                  | 5                |
| 200                   | 240         | 300              | 600              | 960              | 1680             | 3120                  |                  | 5                |
| 250                   | 302         | 378              | 755              | 1208             | 2114             | 3926                  |                  | 6                |
| 300                   | 361         | 451              | 902              | 1444             | 2527             | 4693                  |                  | 6                |
| 350                   | 414         | 517              | 1035             | 1656             | 2898             | 5382                  |                  | 6                |
| 400                   | 477         | 596              | 1192             | 1908             | 3339             | 6201                  |                  | 6                |
| 450                   | 515         | 644              | 1287             | 2060             | 3605             | 6695                  |                  | 7                |
| 500                   | 590         | 738              | 1475             | 2360             | 4130             | 7670                  |                  | 7                |

| H<br>P<br>5<br>7<br>5 | F<br>L<br>C | 1<br>2<br>5<br>% | 2<br>5<br>0<br>% | 4<br>0<br>0<br>% | 7<br>0<br>0<br>% | 1<br>3<br>0<br>0<br>% | H<br>T<br>S<br>Z | S<br>T<br>S<br>Z |
|-----------------------|-------------|------------------|------------------|------------------|------------------|-----------------------|------------------|------------------|
| 0.5                   | 0.9         | 1.2              | 2.25             | 3.6              | 6.3              | 11.7                  | FH17             | 0                |
| 0.75                  | 1.3         | 1.62             | 3.25             | 5.2              | 9.1              | 16.9                  | FH 21            | 0                |
| 1                     | 1.7         | 2.12             | 4.25             | 6.8              | 11.9             | 22.1                  | FH 23            | 0                |
| 1.5                   | 2.4         | 3                | 6                | 9.6              | 16.8             | 31.2                  | FH 27            | 0                |
| 2                     | 2.7         | 3.3              | 6.7              | 10.8             | 18.9             | 35.1                  | FH 28            | 0                |
| 3                     | 3.9         | 4.8              | 9.75             | 15.6             | 27.3             | 50.7                  | FH 32            | 0                |
| 5                     | 6.1         | 7.6              | 15               | 24.4             | 42.7             | 79.3                  | FH 37            | 0                |
| 7.5                   | 9           | 11.2             | 22.5             | 36               | 63               | 117                   | FH 41            | 1                |
| 10                    | 11          | 13.75            | 27.5             | 44               | 77               | 143                   | FH 44            | 1                |
| 15                    | 17          | 21.25            | 42               | 68               | 119              | 221                   | FH 48            | 2                |
| 20                    | 22          | 27.5             | 55               | 88               | 154              | 286                   | FH 51            | 2                |
| 25                    | 27          | 33.7             | 67               | 108              | 189              | 351                   | FH 53            | 2                |
| 30                    | 32          | 40               | 80               | 128              | 224              | 416                   | FH 78            | 3                |
| 40                    | 41          | 51               | 102              | 164              | 287              | 533                   | FH 79            | 3                |
| 50                    | 52          | 65               | 130              | 208              | 364              | 676                   | FH 83            | 3                |
| 60                    | 62          | 77               | 155              | 248              | 434              | 806                   | FH 85            | 4                |
| 75                    | 77          | 96               | 192              | 308              | 539              | 1001                  | FH 88            | 4                |
| 100                   | 99          | 124              | 247              | 396              | 693              | 1287                  | FH 91            | 4                |
| 125                   | 125         | 156              | 312              | 500              | 875              | 1625                  |                  | 5                |
| 150                   | 144         | 180              | 360              | 576              | 1008             | 1872                  |                  | 5                |
| 200                   | 192         | 240              | 480              | 768              | 1344             | 2496                  |                  | 5                |
| 250                   | 242         | 302              | 605              | 968              | 1694             | 3146                  |                  | 6                |
| 300                   | 289         | 361              | 722              | 1156             | 2023             | 3756                  |                  | 6                |
| 350                   | 336         | 420              | 840              | 1344             | 2352             | 4368                  |                  | 6                |
| 400                   | 382         | 477              | 955              | 1528             | 2674             | 4966                  |                  | 6                |
| 450                   | 412         | 515              | 1030             | 1648             | 2884             | 5356                  |                  | 7                |
| 500                   | 472         | 590              | 1180             | 1888             | 3304             | 6136                  |                  | 7                |





| HEATER SIZE |      |       |       |       |      |
|-------------|------|-------|-------|-------|------|
| FH-3        | 0.27 | FH-26 | 2.58  | FH-49 | 21.7 |
| FH-4        | 0.31 | FH-27 | 2.83  | FH-50 | 23.9 |
| FH-5        | 0.34 | FH-28 | 3.11  | FH-51 | 26.2 |
| FH-6        | 0.38 | FH-29 | 3.42  | FH-52 | 28.7 |
| FH-7        | 0.42 | FH-30 | 3.73  | FH-53 | 31.4 |
| FH-8        | 0.46 | FH-31 | 4.07  | FH-54 | 34.5 |
| FH-9        | 0.5  | FH-32 | 4.39  | FH-55 | 37.9 |
| FH-10       | 0.55 | FH-33 | 4.87  | FH-56 | 41.5 |
| FH-11       | 0.62 | FH-34 | 5.3   | FH-78 | 37.5 |
| FH-12       | 0.68 | FH-35 | 5.9   | FH-79 | 41.5 |
| FH-13       | 0.75 | FH-36 | 6.4   | FH-80 | 46.3 |
| FH-14       | 0.83 | FH-37 | 7.1   | FH-81 | 50   |
| FH-15       | 0.91 | FH-38 | 7.8   | FH-82 | 55   |
| FH-16       | 1    | FH-39 | 8.5   | FH-83 | 61   |
| FH-17       | 1.11 | FH-40 | 9.4   | FH-84 | 66   |
| FH-18       | 1.22 | FH-41 | 10.3  | FH-85 | 73   |
| FH-19       | 1.34 | FH-42 | 11.3  | FH-86 | 78   |
| FH-20       | 1.47 | FH-43 | 12.4  | FH-87 | 84   |
| FH-21       | 1.62 | FH-44 | 13.5  | FH-88 | 92   |
| FH-22       | 1.78 | FH-45 | 14.9  | FH-89 | 101  |
| FH-23       | 1.95 | FH-46 | 16.3  | FH-90 | 110  |
| FH-24       | 2.15 | FH-47 | 18    | FH-91 | 122  |
| FH-25       | 2.35 | FH-48 | 19.8  | FH-92 | 129  |
|             |      |       | FH-93 |       | 133  |

| CT RATIO HEATER SIZE FOR MOTOR PROT. |       |       |       |       |       |
|--------------------------------------|-------|-------|-------|-------|-------|
| 460 V                                | 100HP | 125HP | 150HP | 200HP | 250HP |
| FLC X 125%                           | 155   | 195   | 225   | 300   | 378   |
| 100/5=20/1                           | FH-37 | FH-40 | FH-41 | FH-45 | FH-47 |
| 150/5=30/1                           | FH-33 | FH-36 | FH-37 | FH-40 | FH-43 |
| 200/5=40/1                           | FH-30 | FH-33 | FH-34 | FH-37 | FH-40 |
| 250/5=50/1                           | FH-27 | FH-30 | FH-32 | FH-35 | FH-37 |
| 300/5=60/1                           | FH-26 | FH-28 | FH-30 | FH-33 | FH-35 |
| 350/5=70/1                           | FH-24 | FH-26 | FH-28 | FH-31 | FH-34 |
| 400/5=80/1                           | FH-22 | FH-25 | FH-26 | FH-30 | FH-32 |
| 450/5=90/1                           | FH-21 | FH-24 | FH-25 | FH-28 | FH-31 |
| 500/5=100/1                          | FH-20 | FH-23 | FH-24 | FH-27 | FH-30 |
| 600/5=120/1                          | FH-18 | FH-21 | FH-22 | FH-25 | FH-28 |
| CT RATIO HEATER SIZE FOR MOTOR PROT. |       |       |       |       |       |
| 575 V                                | 100HP | 125HP | 150HP | 200HP | 250HP |
| FLC X 125%                           | 124   | 156   | 180   | 240   | 302   |
| 100/5=20/1                           | FH-35 | FH-38 | FH-39 | FH-42 | FH-45 |
| 150/5=30/1                           | FH-31 | FH-33 | FH-35 | FH-38 | FH-40 |
| 200/5=40/1                           | FH-27 | FH-30 | FH-32 | FH-35 | FH-37 |
| 250/5=50/1                           | FH-25 | FH-28 | FH-29 | FH-32 | FH-35 |
| 300/5=60/1                           | FH-23 | FH-26 | FH-27 | FH-30 | FH-33 |
| 350/5=70/1                           | FH-21 | FH-24 | FH-25 | FH-29 | FH-31 |
| 400/5=80/1                           | FH-20 | FH-23 | FH-24 | FH-27 | FH-30 |
| 450/5=90/1                           | FH-19 | FH-21 | FH-23 | FH-26 | FH-28 |
| 500/5=100/1                          | FH-18 | FH-20 | FH-22 | FH-25 | FH-27 |
| 600/5=120/1                          | FH-16 | FH-18 | FH-20 | FH-23 | FH-25 |
| STANDARD FUSE AND THERMAL BREAKER SZ |       |       |       |       |       |
| 15                                   | 50    | 125   | 350   | 1000  | 5000  |
| 20                                   | 60    | 150   | 400   | 1200  | 6000  |
| 25                                   | 70    | 175   | 450   | 1600  |       |
| 30                                   | 80    | 200   | 500   | 2000  |       |
| 35                                   | 90    | 225   | 600   | 2500  |       |
| 40                                   | 100   | 250   | 700   | 3000  |       |
| 45                                   | 110   | 300   | 800   | 4000  |       |

| LOCATION              |  |  |
|-----------------------|--|--|
| VOLTS                 |  |  |
| HORSEPOWER            |  |  |
| MOTOR FLC             |  |  |
| FLC X 125%            |  |  |
| CABLE SIZE            |  |  |
| CABLE AMPACITY        |  |  |
| FLC X 250 %           |  |  |
| FLC X 400 %           |  |  |
| THERM. BKR OR FUSE SZ |  |  |
| FLC X 700 %           |  |  |
| FLC X 1300 %          |  |  |
| BKR TRIP RANGE        |  |  |
| TRIP RANGE SETTING    |  |  |
| CT RATIO              |  |  |
| HEATER SIZE           |  |  |
| HEATER AMPS           |  |  |
| STARTER SIZE          |  |  |

| LOCATION              |  |  |
|-----------------------|--|--|
| VOLTS                 |  |  |
| HORSEPOWER            |  |  |
| MOTOR FLC             |  |  |
| FLC X 125%            |  |  |
| CABLE SIZE            |  |  |
| CABLE AMPACITY        |  |  |
| FLC X 250 %           |  |  |
| FLC X 400 %           |  |  |
| THERM. BKR OR FUSE SZ |  |  |
| FLC X 700 %           |  |  |
| FLC X 1300 %          |  |  |
| BKR TRIP RANGE        |  |  |
| TRIP RANGE SETTING    |  |  |
| CT RATIO              |  |  |
| HEATER SIZE           |  |  |
| HEATER AMPS           |  |  |
| STARTER SIZE          |  |  |

| LOCATION             |  |  |
|----------------------|--|--|
| VOLTS                |  |  |
| HORSEPOWER           |  |  |
| MOTOR FLC            |  |  |
| FLC X 125%           |  |  |
| CABLE SIZE           |  |  |
| CABLE AMPACITY       |  |  |
| FLC X 250 %          |  |  |
| FLC X 400 %          |  |  |
| THERM BKR OR FUSE SZ |  |  |
| FLC X 700 %          |  |  |
| FLC X 1300 %         |  |  |
| BKR TRIP RANGE       |  |  |
| TRIP RANGE SETTING   |  |  |
| CT RATIO             |  |  |
| HEATER SIZE          |  |  |
| HEATER AMPS          |  |  |
| STARTER SIZE         |  |  |

| LOCATION             |  |  |
|----------------------|--|--|
| VOLTS                |  |  |
| HORSEPOWER           |  |  |
| MOTOR FLC            |  |  |
| FLC X 125%           |  |  |
| CABLE SIZE           |  |  |
| CABLE AMPACITY       |  |  |
| FLC X 250 %          |  |  |
| FLC X 400 %          |  |  |
| THERM BKR OR FUSE SZ |  |  |
| FLC X 700 %          |  |  |
| FLC X 1300 %         |  |  |
| BKR TRIP RANGE       |  |  |
| TRIP RANGE SETTING   |  |  |
| CT RATIO             |  |  |
| HEATER SIZE          |  |  |
| HEATER AMPS          |  |  |
| STARTER SIZE         |  |  |

| LOCATION           |  |  |  |
|--------------------|--|--|--|
| VOLTS              |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| FLC + (FLC X 125%) |  |  |  |
| FEEDER SIZE        |  |  |  |
| FEEDER AMPACITY    |  |  |  |
| TRIP RANGE         |  |  |  |
| TRIP RANGE SETTING |  |  |  |
| FUSE OR TH BKR SZ  |  |  |  |
| HORSEPOWER         |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| BR CIR CABLE SZ    |  |  |  |
| BR CIR CABLE AMP.  |  |  |  |
| FLC X 250%         |  |  |  |
| FLC X 400%         |  |  |  |
| FLC X 700%         |  |  |  |
| FLC X 1300%        |  |  |  |
| CT RATIO           |  |  |  |
| HEATER SIZE        |  |  |  |
| HEATER AMPS        |  |  |  |
| STARTER SIZE       |  |  |  |

| LOCATION           |  |  |  |
|--------------------|--|--|--|
| VOLTS              |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| FLC + (FLC X 125%) |  |  |  |
| FEEDER SIZE        |  |  |  |
| FEEDER AMPACITY    |  |  |  |
| TRIP RANGE         |  |  |  |
| TRIP RANGE SETTING |  |  |  |
| FUSE OR TH BKR SZ  |  |  |  |
| HORSEPOWER         |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| BR CIR CABLE SZ    |  |  |  |
| BR CIR CABLE AMP.  |  |  |  |
| FLC X 250%         |  |  |  |
| FLC X 400%         |  |  |  |
| FLC X 700%         |  |  |  |
| FLC X 1300%        |  |  |  |
| CT RATIO           |  |  |  |
| HEATER SIZE        |  |  |  |
| HEATER AMPS        |  |  |  |
| STARTER SIZE       |  |  |  |

| LOCATION           |  |  |  |
|--------------------|--|--|--|
| VOLTS              |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| FLC + (FLC X 125%) |  |  |  |
| FEEDER SIZE        |  |  |  |
| FEEDER AMPACITY    |  |  |  |
| TRIP RANGE         |  |  |  |
| TRIP RANGE SETTING |  |  |  |
| FUSE OR TH BKR SZ  |  |  |  |
| HORSEPOWER         |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| BR CIR CABLE SZ    |  |  |  |
| BR CIR CABLE AMP.  |  |  |  |
| FLC X 250%         |  |  |  |
| FLC X 400%         |  |  |  |
| FLC X 700%         |  |  |  |
| FLC X 1300%        |  |  |  |
| CT RATIO           |  |  |  |
| HEATER SIZE        |  |  |  |
| HEATER AMPS        |  |  |  |
| STARTER SIZE       |  |  |  |

| LOCATION           |  |  |  |
|--------------------|--|--|--|
| VOLTS              |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| FLC + (FLC X 125%) |  |  |  |
| FEEDER SIZE        |  |  |  |
| FEEDER AMPACITY    |  |  |  |
| TRIP RANGE         |  |  |  |
| TRIP RANGE SETTING |  |  |  |
| FUSE OR TH BKR SZ  |  |  |  |
| HORSEPOWER         |  |  |  |
| MOTOR FLC          |  |  |  |
| MOTOR FLC X 125%   |  |  |  |
| BR CIR CABLE SZ    |  |  |  |
| BR CIR CABLE AMP.  |  |  |  |
| FLC X 250%         |  |  |  |
| FLC X 400%         |  |  |  |
| FLC X 700%         |  |  |  |
| FLC X 1300%        |  |  |  |
| CT RATIO           |  |  |  |
| HEATER SIZE        |  |  |  |
| HEATER AMPS        |  |  |  |
| STARTER SIZE       |  |  |  |