Siemens safety switches are available in two types: general duty and heavy duty, both of which are listed by Underwriters Laboratories (UL). Every safety switch has a specific ampere rating, which is the maximum continuous current it can carry without causing deterioration or exceeding temperature rise limits. General duty switches are available with ampere ratings of 30, 60, 100, 200, 400, and 600 amperes. Heavy duty switches are rated for 30, 60, 100, 200, 400, 600, 800, and 1200 amperes. (Though not discussed in this course, bolted pressure switches are also available, with ampere ratings of 800, 1200, 1600, 2000, 2500, 3000, and 4000 amperes.)
Short Circuit Withstandability

Safety switches must be capable of withstanding the largest potential short circuit current that can occur in the selected application. General duty switches have a maximum short circuit withstandability of 100,000 amperes, while the equivalent rating of heavy duty switches is 200,000 amperes.

Voltage Rating

Safety switches are also rated according to the maximum voltage they can handle. The voltage rating of the switch must be at least equal to the circuit voltage. In other words, it can be higher than the circuit voltage, but never lower. For example, a safety switch rated for 600 volts can be used on a 480 volt circuit, but a switch rated for 240 volts must not be used on a 480 volt circuit. The following chart reflects available voltage ratings.

<table>
<thead>
<tr>
<th></th>
<th>General Duty</th>
<th>Heavy Duty</th>
<th>Bolted Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Rating</td>
<td>240 VAC</td>
<td>240 VAC</td>
<td>240 VAC</td>
</tr>
<tr>
<td></td>
<td>250 VDC</td>
<td>600 VAC</td>
<td>480 VAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>600 VDC</td>
<td>600 VAC*</td>
</tr>
</tbody>
</table>

*600 VAC Bolted Pressure Switch is not UL Listed
Dual Horsepower Ratings

All Siemens safety switches have two horsepower ratings for motor applications. This is referred to as “dual horsepower rated.” For example, a switch might have a standard rating of 10 HP and a maximum rating of 30 HP. The standard rating, 10 HP, applies when non-time delay fuses are used.

The maximum rating of 30 HP applies when time delay fuses are used.

The following chart reflects the range of horsepower ratings for Siemens safety switches.

<table>
<thead>
<tr>
<th>Safety Switch Type</th>
<th>Voltage</th>
<th>Horsepower Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Duty</td>
<td>240 VAC</td>
<td>1½ - 200</td>
</tr>
<tr>
<td></td>
<td>250 VDC</td>
<td>5-50</td>
</tr>
<tr>
<td>Heavy Duty</td>
<td>240 VAC</td>
<td>1½ - 250</td>
</tr>
<tr>
<td></td>
<td>600 VAC</td>
<td>3-500</td>
</tr>
<tr>
<td></td>
<td>250 VDC</td>
<td>5-50</td>
</tr>
<tr>
<td></td>
<td>600 VDC</td>
<td>15-50</td>
</tr>
</tbody>
</table>
Pole

The term pole refers to the number of wires that a switch will disconnect at one time. The following drawing, for example, shows a 3-pole safety switch. The three circuits are mechanically connected so that all three poles connect and disconnect the line and load simultaneously when the switch is operated. In this case, each pole is fused for overcurrent protection.
Following are circuit configuration diagrams for 2- and 3-pole safety switches. Safety switches may be fusible, non-fusible, or fusible with a solid neutral.

The following circuit configurations are available in Siemens safety switches:

- 2-Pole
- 3-Pole
- 6-Pole (not shown)
- 2-Pole, 2-Wire
- 3-Pole, 3-Wire
- 4-Pole, 4-Wire (not shown)
- 6-Pole, 6-Wire (not shown)
- 2-Pole, 3-Wire
- 3-Pole, 4-Wire
The circuit configuration required depends on the load and on the power supply connected to it. For example, a three-phase motor needs a 3-pole switch to connect it to a three-phase power supply. If overcurrent protection is required, a fusible 3-pole safety switch should be selected, as in the following example.
Switch Throws

All the example switches shown so far have been single throw. “Throw” is the term used to refer to the number of different positions a switch has, that is, the number of different circuits it can connect a given wire to. Switches may be single throw, double throw, or multiple throw. The simplest is a single pole, single throw:

Next in complexity is the single pole, double throw which can connect a single wire to one of two different circuits:

Two- and three-pole single throw switches have already been shown. The double pole, double throw (DPDT) switch can connect each of two different wires to two different circuits:

Many different arrangements are possible. The following illustrates only a few of them:
Catalog Numbers

To help identify each type of safety switch, a catalog number is assigned. The catalog number provides a description of the safety switch. There are eight parts to the catalog number of Siemens VBII Safety Switches. The following figure illustrates a typical catalog number.

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Part 1</th>
<th>Part 2</th>
<th>Part 3</th>
<th>Part 4</th>
<th>Part 5</th>
<th>Part 6</th>
<th>Part 7</th>
<th>Part 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF364NRCU=</td>
<td>H</td>
<td>F</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>N</td>
<td>R</td>
<td>CU</td>
</tr>
</tbody>
</table>

**Part 1**

Part 1 indicates the switch type. There are three types available: General Duty 10k AIC Max. (Plug Fused & 60A Max Non-Fused); General Duty; and Heavy Duty.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Switch Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>General Duty 10k AIC Max</td>
</tr>
<tr>
<td>G</td>
<td>General Duty</td>
</tr>
<tr>
<td>H</td>
<td>Heavy Duty</td>
</tr>
<tr>
<td>DT</td>
<td>Heavy Duty Double Throw</td>
</tr>
<tr>
<td>DTG</td>
<td>General Duty Double Throw</td>
</tr>
</tbody>
</table>

From the above table, one can see that the example switch, type H, is a heavy duty switch.

**Part 2**

Part 2 indicates whether the switch is fused or non-fused. “F” designates a fused switch; while “NF” designates non-fused types. The example switch is fused.
Part 3

Part 3 of the catalog number indicates the number of poles. Siemens VBII safety switches can be provided with 1, 2, or 3 poles. (A neutral, if required, is not included in the number of poles.) The following shows a 3-pole safety switch used with a 3-phase AC motor. The example catalog number calls for a 3-pole safety switch.

![Diagram of a 3-pole safety switch with a 3-phase AC motor connected.]

Part 4

Part 4 of the catalog number indicates the voltage rating. The example catalog number indicates a safety switch with a maximum voltage rating of 600 volts.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>120V or 120/240V</td>
</tr>
<tr>
<td>2</td>
<td>240V</td>
</tr>
<tr>
<td>6</td>
<td>600V</td>
</tr>
</tbody>
</table>

Part 5

Part 5 of the catalog number refers to the switch’s current rating. The example indicates a safety switch with a 200 ampere rating.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30A</td>
</tr>
<tr>
<td>2</td>
<td>60A</td>
</tr>
<tr>
<td>3</td>
<td>100A</td>
</tr>
<tr>
<td>4</td>
<td>200A</td>
</tr>
<tr>
<td>5</td>
<td>400A</td>
</tr>
<tr>
<td>6</td>
<td>600A</td>
</tr>
<tr>
<td>7</td>
<td>800A</td>
</tr>
<tr>
<td>8</td>
<td>1200A</td>
</tr>
</tbody>
</table>
Part 6

Part 6 of the catalog number indicates whether or not a neutral is included with the switch. If no neutral is needed, part 6 of the catalog number is simply omitted. If a neutral is needed, an “N” is added to the catalog number, as in the example.

Part 7

Part 7 of the catalog number indicates the type of enclosure. The example catalog number indicates a safety switch in a NEMA Type 3R outdoor enclosure.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Enclosure Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omit</td>
<td>Type 1, Indoor</td>
</tr>
<tr>
<td>R</td>
<td>Type 3R, Outdoor</td>
</tr>
<tr>
<td>S</td>
<td>Type 4/4X, Stainless Steel</td>
</tr>
<tr>
<td>X</td>
<td>Type 4/4X, Non-Metallic</td>
</tr>
<tr>
<td>J</td>
<td>Type 12, Industrial</td>
</tr>
</tbody>
</table>

Part 8

Part 8 of the catalog number is for special applications. The following table lists the possible applications. For example, “CU” indicates factory-installed copper wire grips, as in the representative catalog number given above.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Special Applications With:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>Crouse-Hinds Receptacle</td>
</tr>
<tr>
<td>CJ</td>
<td>Factory J Fuse Spacings</td>
</tr>
<tr>
<td>CR</td>
<td>Class R Clips Installed</td>
</tr>
<tr>
<td>CU</td>
<td>Copper Wire Grips Installed</td>
</tr>
<tr>
<td>G</td>
<td>Factory-Installed Ground Bar</td>
</tr>
<tr>
<td>PN</td>
<td>Pyle-National Receptacle</td>
</tr>
<tr>
<td>W</td>
<td>Viewing Window</td>
</tr>
</tbody>
</table>
1. The ____________ rating is the maximum continuous current a safety switch can carry.

2. The maximum short circuit current withstandability of heavy duty switches is ____________ amperes.

3. The maximum horsepower available in a 240 VAC general duty safety switch is____________ HP.

4. A ____________ describes the number of isolated circuits that can pass through the safety switch at one time.

5. The number “3” in part five of the heavy duty catalog number indicates ____________.
   a. 3-pole  b. 3R enclosure  
   c. 100 amperes  d. 600 VAC

6. ____________ refers to the number of different positions of a given switch.
General Duty Safety Switches

General duty switches are intended for use primarily on power supplies rated at 240 VAC or less, where the available fault current is less than 100,000 amperes (with Class R or T fuses, or 10,000 A max with Class H fuses). They can be supplied in a Type 1 (indoor) or Type 3R (outdoor) enclosure.

**Plug Fuse Type Safety Switch**

The general duty plug fuse type switch is available for 120 or 240 volt systems. It is suitable for one- or two-pole applications, and is rated at 30 amperes. A separately supplied, 30-ampere Type S plug fuse is required. This switch is available for use on two-wire or three-wire motor applications up to three horsepower. A non-fusible model comes in a two-pole configuration. It is rated at 60 amperes, and can be used with motors up to 10 HP. There are also pullout models available in fused and non-fused versions.

**General Duty Switches**

The fusible general-duty safety switch is available in two and three poles, both with solid neutral, or with four poles. The non-fusible model is available with a two- or three-pole configuration. Fusible switches accept Class H fuses as standard. A field-installable rejection kit is available which rejects all but Class R fuses. All general duty switches have both cover and handle padlocking capabilities.

**Ratings**

- **Ampere ratings:** 30, 60, 100, 200, 400, or 600 amperes
- **Fuses:** 1 - 600 ampere Class H, K, or R
  - 70 - 600 ampere Class T cartridge fuse
- **Voltage ratings:** 240 VAC, 250 VDC
- **Max short-circuit current withstandability:** 100,000 amperes (with current limiting fuses)
Type 1 Enclosure

General duty switches are available in the NEMA Type 1 enclosure, which is intended for indoor use. An interlock prevents the cover from being opened when the switch is in the “On” position. A cover interlock also prevents turning the switch “On” with the door open. (There is a front operable release for this feature.) This enclosure is intended primarily to provide protection against contact with the safety switch, and is used in locations where unusual service conditions do not exist.
Type 3R Enclosure

General duty 2- and 3-pole safety switches are also supplied in a Type 3R enclosure, which is intended for outdoor use, and provides a degree of protection against falling rain and sleet. It is also able to withstand the formation of ice on the enclosure without damage, but is not intended to provide protection against conditions such as dust, internal condensation, or internal icing.
Heavy Duty Safety Switches

**Type 1 Enclosure**

Heavy duty safety switches can be used on power supplies up to 600 Volts, AC or DC. They can be used in applications where the available fault current is 200,000 amperes or less. A cover interlock prevents inadvertent opening of the cover while the switch is in the “On” position, and a mechanism interlock prevents inadvertent turning on of the switch while the cover is open. Heavy duty safety switches also have cover and handle padlocking capabilities.
Heavy duty safety switches can also be supplied with Type 3R, 4 / 4X, and 12 enclosures.

**Enclosures for Heavy Duty Safety Switches**

**Ratings**

Current ratings: 30, 60, 100, 200, 400, 600, 800, & 1200 amperes

Fuses: 1 - 600 ampere Class H, J, K, and R cartridge fuses
1 - 1200 ampere Class T cartridge fuses
601-1200 ampere Class L bolt-in fuses
(Fusible 800 and 1200 A switches have Class L fuse provisions as standard)

Voltage ratings: 240 / 480 / 600 VAC; 250 / 600 VDC

Max short-circuit current withstandability: 200,000 amperes
Interlock Receptacle

The interlock receptacle safety switch provides cord connection for heavy-duty portable equipment such as refrigerated trucks, welders, and other portable electric tools. It is fitted with a Crouse-Hinds Arktite® or similar receptacle. This receptacle is interlocked to prevent insertion or removal of the plug if the switch is in the “On” position. The Crouse-Hinds receptacle switch requires a Crouse-Hinds 4-wire, 3-pole, style 2, grounded APJ plug. The interlock receptacle safety switches are rated for 30, 60, and 100 amperes. The enclosure meets the requirements for Type 4, 4X, or 12/3R enclosures.

Arktite® is a registered trademark of the Crouse-Hinds Company.
Four- and Six-Pole Safety Switches

Four- and six-pole heavy-duty safety switches are available in current ratings of 30 - 200 amperes, in Type 1 / 3R / 12 or Type 4 / 4X enclosures, fusible or non-fusible. These switches are commonly used as a disconnecting means for two-speed, two-winding motors. A 4-pole switch is also used in 3-phase, 4-wire circuits when a switching neutral is required.

Double Throw Switches

Double throw switches are used to transfer loads from one power source to another. For example, a critical piece of equipment often needs a back-up power supply in case the main power supply fails or needs maintenance. Double throw switches are also used to connect a single power source to either of two loads. 30-600A double-throw fusible switches are available in Types 1 and 3R enclosures, while non-fusible models are available in Types 1 and 3R for 30 to 1200A, and in 4 / 4X and 12 for 30 to 200A. Double throw switches are rated for 240 VAC/250 VDC or 600 VAC.
A motor, for example, can be connected through a double throw switch to power supply A or power supply B. When the handle is in the center position the switch is “Off” and no power flows to the motor.

Moving the handle to the up position connects the motor to power supply A.

Moving the handle to the down position connects the motor to power supply B.
Safety Switch Accessories

A full range of accessories is available for Siemens VBII Safety Switches. Some of these are shown below.

Both General Duty and Heavy Duty Switches are field-convertible to accept Class J or Class T fuses.

Standard Neutral Kits can be field installed in both General and Heavy Duty Safety Switches, and UL listed 200% Neutrals are available on 100-600A Heavy Duty Switches.

The Multiple Padlock Accessory is a tamper-proof device to provide for multiple padlocking to meet OSHA or plant requirements.
The following illustrates some of the other accessories available for General and Heavy Duty Safety Switches.

Copper Lug Kits

HLC612

Isolated Ground Kits

HG261234

Standard Ground Kits

HG61234

Auxiliary Contacts

HA161234

Fuse Puller Kits

HP61

Class R Fuse Clip Kits

HR612

Heavy Duty Switches are UL approved to accept field installed Copper Lug Kits. Equipment Ground Kits are available for all General Duty and Heavy Duty Switches. They come standard in Type 4 / 4X and Type 12 Switches, and are field installable in Type 1 and Type 3R. Isolated Ground Kits are also available for 30-600A Heavy Duty Switches. Some circuits with a high degree of computer or other electronic loading require an isolated ground to prevent interference from the building ground and neutral lines.
Auxiliary Contacts are available only for Heavy Duty Switches. They come with 1 normally open and 1 normally closed or 2 normally open and 2 normally closed contacts. A PLC Auxiliary Switch for 30-200A switches is also available. It has very low contact resistance, which is compatible with the low voltages and currents typically found in PLC circuits.

Fuse Puller Kits are field installable in 30-100A Heavy Duty Switches.

Class R Fuse Clips are used to prevent the installation of noncurrent-limiting Class H or Class K fuses. All General and 30-600A Heavy Duty Switches are field convertible to accept Class R Fuse Clip Kits.
1. The maximum short circuit current withstandability of general duty switches is ____________ amperes.

2. The maximum short circuit current withstandability of heavy duty switches is ____________ amperes.

3. The maximum current rating of a VBII heavy duty switch that is not a bolted pressure switch is ____________ amperes.

4. The ____________ ____________ safety switch provides cord connection for heavy duty portable equipment.

5. ____________ ____________ switches are intended to transfer loads from one power source to another.
Selecting Safety Switches

While selecting a safety switch is not difficult, flow charts can help to make it even easier. The following flow chart can be used to make key decisions in the selection of a safety switch.
Selecting a Non-Fusible Switch

The first question is: Is circuit protection required? If circuit protection is not required a non-fusible switch would be selected.

Non-Fusible Switch not Used on a Motor Circuit

If a non-fusible switch is selected, the next question is: Is it a motor circuit? If the switch is not used on a motor circuit the following information must be known:

1) System voltage: 120 VAC, 240 VAC, 480 VAC, 600 VAC, 250 VDC, 600 VDC
2) Full-load amperes of the device to be used on the switch
3) The number of poles required, and if a neutral is needed
4) The environment (enclosure type)
Non-Fusible Switch Used on a Motor Circuit

If the switch is used on a motor circuit, the same data is required, except that motor horsepower replaces full-load current.

1) System voltage
2) Motor horsepower
3) The number of poles required, and if a neutral is needed
4) The environment (enclosure type)

Selecting a Fusible Switch

If circuit protection is required, a fusible switch would be selected.
If a fusible switch is selected, the next question is: Is it a motor circuit? If not, the following information must be known to select a fuse:

1) Available fault current
2) System voltage
3) Full-load amperes of the device to be used on the switch
4) Fuse class
5) Number of lines to be fused

The following must be known to select a switch:

1) Available fault current
2) System voltage
3) Full-load amperes of the device to be used on the switch
4) Number of poles, and if a neutral is needed
5) Fuse class
6) Environment (enclosure type)
If the switch is used on a motor circuit, the following information must be known to select a fuse:

1) Available fault current  
2) System voltage  
3) Full-load amperes required by the motor  
4) Fuse class  
5) Number of lines to be fused

The following must be known to select a switch:

1) Available fault current  
2) System voltage  
3) Motor horsepower  
4) Number of poles, and if a neutral is needed  
5) Fuse class  
6) Environment (enclosure type)
Example of Selecting a Non-Fusible Safety Switch

In the following example, a safety switch needs to be provided for an application that does not require circuit protection. The full-load current of the utilization device is 45 amperes. It is not a motor. The system voltage is 240 VAC, 3-phase, 3-wire (without neutral). The environment is indoors, and there are no unusual conditions such as dust or liquids.

Recall from earlier discussion that in general, all conductors (including the switch) must be capable of carrying 125% of the full-load current. The full-load current of the utilization device is 45 amperes; a switch must be selected that can carry 56 amperes.

\[
\frac{45 \text{ amperes}}{125\%} = \frac{56 \text{ amperes}}{100\%}
\]

Knowing that the switch will be used indoors, with no unusual conditions, a Type 1 enclosure can be selected. The other requirements can be met with a general duty switch. Referring to the General Duty Safety Switches section of the Speedfax catalog, the first 240 volt, 3-pole, non-fusible switch that will handle 56 amperes is a 60 amp switch. The catalog number is GNF322.

Since the required fuse is a Class R, and the circuit has a potential fault current of 200,000 amperes, a class R fuse kit (catalog number HR64) is required. This can be found in the accessory section of the Speedfax.
Fusible Safety Switch

provided for an application that does require circuit protection. This application will have a 480 VAC, three-phase, 75 HP motor, not needing a neutral connection. The customer has specified an RK5 time-delay fuse, for a potential fault current of 200,000 amperes. The switch will be located indoors with no unusual service conditions.

The 480 VAC requirement dictates a heavy duty, 600 volt, fusible switch. Turning to the appropriate Speedfax page, the enclosure type is located, that is, Indoor — Type 1. Next, the 600 Volt Fusible, 3-pole, 3-fuse table is found. From the horsepower ratings, in the 480 VAC, 3-phase, 3-wire section, a switch will be selected from the maximum (Max.) column. The maximum column is chosen because the customer selected time delay fuses. (Had non-time delay fuses been specified, the standard horsepower column would be used.) Reading down the maximum horsepower column, 125 HP, the first rating meeting the 75 HP requirement, is found. Reading to the left the catalog number, HF364, is found under Type 1. (It can also be seen that this safety switch is rated for 200 amperes.)

Since the required fuse is a Class R, and the circuit has a potential fault current of 200,000 amperes, a Class R fuse clip kit (catalog number HR64) is also required. This can be found in the accessory section of the Speedfax.
Selecting a Fuse

Section 430.6 of the NEC® requires that where the current rating of a motor is used to determine the ampacity of conductors or ampere ratings of switches, branch-circuit overcurrent devices, etc., the values given in Tables 430.247 through 430.250 are required to be used instead of the actual motor nameplate current rating. In order for a customer to properly select a fuse, NEC® Table 430.250 must be referred to. According to NEC® Table 430.250, a 75 HP, 460 VAC motor has a full-load current of 96 amperes.

Table 430.250 Full-Load Current, Three-Phase Alternating-Current Motors

The following values of full-load currents are typical for motor running at speeds usual for belted motors and motors with normal torque characteristics.

Motors built for low speeds (1200 rpm or less) or high torques may require more running current, and multispeed motors will have full-load current varying with speed. In these cases, the nameplate current rating shall be used.

The voltages listed are rated motor voltages. The currents listed shall be permitted for system voltage ranges of 110 to 120, 220 to 240, 440 to 480, and 550 to 600 volts.

<table>
<thead>
<tr>
<th>Horsepower</th>
<th>115 Volts</th>
<th>200 Volts</th>
<th>208 Volts</th>
<th>230 Volts</th>
<th>460 Volts</th>
<th>575 Volts</th>
<th>2300 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>½</td>
<td>4.4</td>
<td>2.5</td>
<td>2.4</td>
<td>2.2</td>
<td>1.1</td>
<td>0.9</td>
<td>-</td>
</tr>
<tr>
<td>¾</td>
<td>6.4</td>
<td>3.7</td>
<td>3.5</td>
<td>3.2</td>
<td>1.6</td>
<td>1.3</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>8.4</td>
<td>4.8</td>
<td>4.6</td>
<td>4.2</td>
<td>2.1</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td>1½</td>
<td>12.0</td>
<td>6.9</td>
<td>6.6</td>
<td>6.0</td>
<td>3.0</td>
<td>2.4</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>13.6</td>
<td>7.8</td>
<td>7.5</td>
<td>6.8</td>
<td>3.4</td>
<td>2.7</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>11.0</td>
<td>10.6</td>
<td>9.6</td>
<td>4.8</td>
<td>3.9</td>
<td>-</td>
</tr>
<tr>
<td>4½</td>
<td>-</td>
<td>15.5</td>
<td>16.7</td>
<td>15.2</td>
<td>7.6</td>
<td>6.1</td>
<td>-</td>
</tr>
<tr>
<td>7½</td>
<td>-</td>
<td>25.3</td>
<td>24.2</td>
<td>22</td>
<td>11</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>-</td>
<td>32.2</td>
<td>30.8</td>
<td>28</td>
<td>14</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>-</td>
<td>48.3</td>
<td>46.2</td>
<td>42</td>
<td>21</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>-</td>
<td>62.1</td>
<td>59.4</td>
<td>54</td>
<td>27</td>
<td>22</td>
<td>-</td>
</tr>
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</table>

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Table 430.52 of the NEC® is provided to help select a fuse that will not trip while starting a motor, and still provide adequate overcurrent protection. According to this table, the NEC® requires that the ampere rating of an AC motor protected by a time-delay fuse be multiplied by 175%.

Table 430.52 Maximum Rating or Setting of Motor Branch-Circuit Short-Circuit and Ground-Fault Protective Devices

<table>
<thead>
<tr>
<th>Type of Motor</th>
<th>Percentage of Full-Load Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nontime Delay Fuse</td>
</tr>
<tr>
<td>Single-phase motors</td>
<td>300</td>
</tr>
<tr>
<td>AC polyphase motors other than wound-rotor</td>
<td></td>
</tr>
<tr>
<td>Squirrel cage - other than Design E or Design B energy efficient</td>
<td>300</td>
</tr>
<tr>
<td>Design E or Design B energy efficient</td>
<td>300</td>
</tr>
<tr>
<td>Synchronous</td>
<td>300</td>
</tr>
<tr>
<td>Wound rotor</td>
<td>150</td>
</tr>
<tr>
<td>Direct current (constant voltage)</td>
<td>150</td>
</tr>
</tbody>
</table>

Multiplying the motor rating of 96 amperes times 175% results in a fuse size of 168 amperes. Since this is a non-standard fuse size, the next standard fuse size of 175 amperes would be selected.

\[
\frac{96 \text{ amperes} \times 175\%}{168 \text{ amperes}} = \text{Full-Load Motor Current}\] 

\[
96 \text{ amperes} \times 175\% \quad \text{NEC® Requirement}\] 

\[
168 \text{ amperes} \quad \text{Fuse Rating}\]
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A ____________ safety switch would be selected when circuit protection is not required.</td>
<td></td>
</tr>
<tr>
<td>2. A ____________ safety switch would be selected when circuit protection is required.</td>
<td></td>
</tr>
<tr>
<td>3. When selecting a non-fusible safety switch for utilization device rated at 100 amperes, a switch must be selected that can carry ____________ amperes.</td>
<td></td>
</tr>
<tr>
<td>4. According to the NEC®, the ampere rating of an AC motor protected by a time-delay fuse should be multiplied by ____________ %.</td>
<td></td>
</tr>
</tbody>
</table>
## Review Answers

### Review 1
1) fusible; 2) 50; 3) a; 4) overload, short circuit; 5) short circuit; 6) overload; 7) peak let-thru; 8) energy; 9) 240; 10) 310.16; 11) 125.

### Review 2
1) inverse; 2) half; 3) short; 4) Time-delay; 5) ampere; 6) higher, lower; 7) 200,000.

### Review 3
1) 1; 2) 3R; 3) contacts; 4) two.

### Review 4
1) ampere; 2) 200,000; 3) 200; 4) pole; 5) c; 6) Throw.

### Review 5
1) 100,000; 2) 200,000; 3) 1200; 4) interlock receptacle; 5) Double throw.

### Review 6
1) non-fusible; 2) fusible; 3) 125; 4) 175.
Final Exam

The final exam is intended to be a learning tool. The book may be used during the exam. A tear-out answer sheet is provided. Please fill out the answer sheet neatly and completely. After completing the test, mail the answer sheet in for grading. A grade of 70% or better is passing. Upon successful completion of the test a certificate will be issued.

1. The following symbol represents a non-fusible enclosed switch:

   a. 
   b. 
   c. 
   d. 

2. A safety switch combined with fuses in a single enclosure is referred to as a ____________ safety switch.

   a. non-fusible  c. heavy duty
   b. fusible      d. general duty

3. The National Electrical Code® defines “in sight” as visible and not more than ____________ feet distant.

   a. 10  c. 25
   b. 50  d. 100

4. With an increase of current, temperature will ____________

   a. increase  c. decrease
   b. remain the same  d. increase and decrease
5. Overcurrent protection is covered by NEC® article ____________.
   a. 110  c. 780
   b. 410  d. 240

6. The amount of current a conductor can carry on a continuous basis is known as ____________.
   a. AWG  c. instantaneous current
   b. peak current  d. ampacity rating

7. According to the NEC®, a continuous load is a load where the maximum current is expected to continue for ________ hours or more.
   a. 2  c. 3
   b. 6  d. 10

8. Fuses have a/an ____________ time-current characteristic.
   a. direct  c. indirect
   b. proportional  d. inverse

9. Class R fuses have an interrupting rating (AIC) of ________ amperes.
   a. 10,000  c. 100,000
   b. 50,000  d. 200,000

10. A UL Type ____________ enclosure is intended for indoor use primarily to provide protection against contact with the enclosed equipment in locations where unusual service conditions do not exist.
    a. 1  c. 4
    b. 3R  d. 12
11. UL Type ___________ enclosures are intended for outdoor use primarily to provide a degree of protection against falling rain and sleet and must remain undamaged by the formation of ice on the enclosure. They are not intended to provide protection against conditions such as dust, internal condensation, or internal icing.

   a. 1   c. 4
   b. 3R   d. 12

12. The maximum ampere rating of a general duty switch is ___________ amperes.

   a. 200   c. 600
   b. 1200   d. 4000

13. The maximum ampere rating of a heavy duty switch that is not a bolted pressure switch is ___________ amperes.

   a. 200   c. 600
   b. 1200   d. 4000

14. Heavy duty switches have a maximum short circuit current withstandability of ___________ amperes.

   a. 10,000   c. 50,000
   b. 100,000   d. 200,000

15. The maximum horsepower of a 240 VAC heavy duty switch is ___________ HP.

   a. 60   c. 250
   b. 150   d. 500

16. A catalog number beginning with “GF3” indicates a ______ ______ safety switch.

   a. general duty, fusible, single pole
   b. general duty, fusible, three pole
   c. general duty, non-fusible, single pole
   d. general duty, non-fusible, three pole
17. The ____________ safety switch provides cord connection for heavy duty portable equipment.
   a. interlocked receptacle  
   b. double throw  
   c. bolted pressure  
   d. plug fuse

18. Siemens VBII 30 - 200 amp safety switches use a ____________ _____________ switch action.
   a. Double Break  
   b. Knife-Blade  
   c. Stationary Contact  
   d. Fuse Ejector

19. When selecting a non-fusible switch for use on a non-motor circuit, which of following information is not needed?
   a. system voltage  
   b. full-load amperes  
   c. fuse class  
   d. number of poles

20. ____________ safety switches are intended to transfer loads from one power source to another.
   a. Interlock receptacle  
   b. Plug fuse  
   c. Bolted pressure  
   d. Double throw
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