UL 508A
Industrial Control Panels
Power Distribution and Control

Lunch & Learn Training
Agenda

- Who is UL and what role do they play?
- What is the UL 508A Standard?
- Implementation of the Standard
  - Component Selection
  - Short Circuit Current Ratings
- Common Application Questions
- How can Eaton help?
- Q & A
UL’s Role

- Who is UL and what role do they play?
  - Independent Testing Company
  - Offer 3rd Party Certification
  - USA Centric, but Going Beyond (cUL)
  - Consistent with NEC
  - Offer a Variety of Listing Services
    - UL 891 – Deadfront Switchboards
    - UL 1058 – Drawout ACBs
    - UL 67 – Panelboards
    - UL 98 – Disconnect Switches
    - UL 489 – Molded Case Circuit Breakers
    - **UL 508A – Industrial Control Panels**
    - UL 508E – Self Protecting MMPs
    - UL 508F – Combination Motor Controllers (CMCs)
UL 508A – The Standard

- The Standard Covers…
  - Industrial Control Panel Assemblies which may contain:
    - Motor controllers
    - Overload relays
    - Fused Disconnects / Circuit Breakers
    - Buttons, Switches, Timers & Controllers
    - Wiring
    - Terminals
    - Enclosures

- Four Parts
  - Part 1 – General Use
  - Part 2 – Specific Use
  - Part 3 – Specific Component Requirements
  - Part 4 – Short Circuit Current Ratings
UL 508A – The Standard

- Guideline for Construction and General Design
  - First Edition was Released in April 2001
    - Revised September, 2005
  - Subsets of the Guideline
    - General Use
    - Specific Use
      - Enclosures
      - Industrial Machinery
      - Crane Control
      - Service Equipment Use
    - Flame Control
    - Marine Use
    - Air Conditioning and Refrigeration
    - Elevator Control

- Manufacturers that adhere to the requirements are eligible for UL 508A Listing of their product.
UL 508A – The Standard

- UL 508A – Industrial Machinery

“The following types of machines are identified as industrial machinery:
- Metalworking machine tools, machines that cut or form metal
- Plastics Machinery, including injection molding, extrusion, blow molding, specialized processing, thermoset molding and size reduction machines
- Wood machinery, woodworking, laminating and sawmill machines
- Assembly Machines
- Material handling machines, including industrial robots and transfer machines
- Inspection and testing machines including coordinate measuring and in-process gauging machines”
UL 508A Industrial Control

- Panels for Industrial Machinery are rated:
  - 600V or less
  - 40°C
- UL 508A Industrial Rating does **not** include panels for Hazardous Locations “NRBX” which is covered under UL698A
Applying the Standard

Before we apply

- Control Circuit vs Power Circuit
Applying the Standard

- Before we apply
  - Branch Circuit vs. Feeder Circuit
Applying the Standard

- Before we apply
  - Control Circuit vs Power Circuit
- Component Selection
  - What can be used in UL 508A Control Panel
    - Category Control #
Applying the Standard

- Category Control Numbers
  - Four to Five digit alphanumeric code
  - Identifies product categories in UL’s Listed Product and Recognized Components Directory
    - AAAA (No Suffix) = Listed
    - AAAA2 (Suffix “2”) = Recognized
    - AAAA7 (Suffix “7”) = Listed for Canada
    - AAAA8 (Suffix “8”) = Recognized for Canada
    - For example “NITW” is CCN for Industrial Control Panels and “DIVQ” for branch circuit protection (UL489 devices)
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- Electrical Insulation Systems
- Fire Resistant Assemblies and Systems
- Plastics
- Registered Firms
- Roof Deck Constructions

Can search by a wide variety parameters for components
If we search by ‘DIVQ’ we can find the following...

<table>
<thead>
<tr>
<th>Company</th>
<th>Product Description</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRPAX CORP LLC</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.58739</td>
</tr>
<tr>
<td>AMERICAN CIRCUIT BREAKER CORP</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.9800</td>
</tr>
<tr>
<td>AMERICAN CIRCUIT BREAKER CORP</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.61478</td>
</tr>
<tr>
<td>AMPHENOL INDUSTRIAL OPERATIONS</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.64527</td>
</tr>
<tr>
<td>CARLING TECHNOLOGIES</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.129899</td>
</tr>
<tr>
<td>CERUS INDUSTRIAL</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.224404</td>
</tr>
<tr>
<td>CIRCUIT BREAKER INDUSTRIES LTD</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.6192487</td>
</tr>
<tr>
<td>CONNECTICUT ELECTRIC &amp; SWITCH MFG CO</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.153753</td>
</tr>
<tr>
<td>CONNECTICUT ELECTRIC &amp; SWITCH MFG CO</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.162462</td>
</tr>
<tr>
<td>DURHAM CO</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.76624</td>
</tr>
<tr>
<td>E-T-A CIRCUIT BREAKERS</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.228877</td>
</tr>
<tr>
<td>EATON</td>
<td>Circuit Breakers, Molded-case and Circuit Breaker Enclosures</td>
<td>DIVO.7819</td>
</tr>
</tbody>
</table>
If we search by ‘DIVQ’ we can find the above…
Applying the Standard

- Before we apply
  - Control Circuit vs Power Circuit
- Component Selection
  - What can be used in UL 508A Control Panel
    - Category Control #
  - *Examples of Component Selection*
## Component Selection

### Table SA1.1 Continued

<table>
<thead>
<tr>
<th>Paragraph reference</th>
<th>Component description</th>
<th>UL Standard</th>
<th>Category control number(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.1.1</td>
<td>Listed Molded case circuit breaker</td>
<td>UL 489</td>
<td>DIVQ</td>
<td></td>
</tr>
<tr>
<td>31.1.1</td>
<td>Recognized Instantaneous-trip circuit breaker</td>
<td>UL 489</td>
<td>DKPU2</td>
<td>Procedure described only</td>
</tr>
<tr>
<td>31.1.1</td>
<td>Listed Low Voltage AC Power Circuit Breakers</td>
<td>UL 1066</td>
<td>PAQX</td>
<td></td>
</tr>
<tr>
<td>31.1.2</td>
<td>Listed Class CC fuses</td>
<td>UL 248-1, UL 248-4</td>
<td>JDDZ</td>
<td></td>
</tr>
<tr>
<td>31.1.2</td>
<td>Listed Class G fuses</td>
<td>UL 248-1, UL 248-5</td>
<td>JDDZ</td>
<td></td>
</tr>
<tr>
<td>31.1.2</td>
<td>Listed Class H fuses</td>
<td>UL 248-1, UL 248-6</td>
<td>JDDZ</td>
<td></td>
</tr>
<tr>
<td>31.1.2</td>
<td>Listed Class J fuses</td>
<td>UL 248-1, UL 248-8</td>
<td>JDDZ</td>
<td></td>
</tr>
<tr>
<td>31.1.2</td>
<td>Listed Class K fuses</td>
<td>UL 248-1, UL 248-9</td>
<td>JDDZ</td>
<td></td>
</tr>
</tbody>
</table>
Component Selection

- Branch Circuit Protection
  - (DIVQ) Molded Case Circuit Breaker
  - (DKPU2) Recognized Component Instantaneous-trip Circuit Breaker - *Procedure Described
  - (PAQX) LV AC Power Circuit Breaker
  - (JDDZ) Fuses
  - (NKJH) Self Protected Combination Motor Controller
  - NO Supplementary Protectors
  - NO MMPs
Applying the Standard

- **Supplementary Protectors**
  - UL 1077 (QVNU2)
- **Procedure Defined**
  - Future Product Developments

<table>
<thead>
<tr>
<th>Paragraph reference</th>
<th>Component description</th>
<th>UL Standard</th>
<th>Category control number(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.1.2</td>
<td>Recognized Miscellaneous or miniature fuse</td>
<td>UL 248-1 UL 248-14</td>
<td>JDYX2</td>
<td>Procedure described only</td>
</tr>
<tr>
<td>40.1.3</td>
<td>Recognized Supplementary protector</td>
<td>UL 1077</td>
<td>QVNU2</td>
<td></td>
</tr>
<tr>
<td>40.1.4</td>
<td>Recognized Cartridge Fuse Fuseholders</td>
<td>UL 512</td>
<td>IZLT2</td>
<td></td>
</tr>
</tbody>
</table>

Section 40 – Overcurrent protection of control circuit meeting the component selection requirements
Branch Circuit Protection

NEC 210

BRANCH CIRCUIT PROTECTION

Panelboard with UL 489 MCCB

wiring system

OUTLET

OUTLET

OUTLET
Supplementary Protection

Application:

- Supplementary Protectors are to be used for overcurrent protection within appliances or electrical equipment, where branch circuit protection is already provided or not required.

**Definition of a Branch Circuit (NEC Article 210)**

- the circuit conductors between the final overcurrent device protecting the circuit and the outlet(s), where:
  - the overcurrent device is the branch circuit protection
  - the Outlet(s) is a point on the wiring system at which current is taken to supply utilization equipment

**Supplementary Overcurrent Protection (NEC Article 240-10)**

- where used.... it shall not be used as a substitute for branch circuit O\C devices or in place of the branch circuit protection in Article 210.
Supplementary Protection

Motor Control Circuit.

UL489\ CSA5.1 MCB

UL489\ CSA 5.1 Motor Circuit Protector

HMCPE + Universal Rotary

UL508 Manual Motor Controller (UL508E MMP or UL508F CMC)

NEC 430 Part F\ CEC

Control Circuit Transformer

480 - 120

Supplementary Protector

UL1077

PLC I/O

Contactor Coils

Relays

UL1077

UL1077

UL1077
Applying the Standard

- Branch Circuit Protection
  - Component Selection, but what about sizing….
    - Feeder Protection
    - Branch Protection
    - Components
      - Transformers
Applying the Standard

- Short Circuit Protection – Panel Rating
  - New Standard requirements effective April 2006
  - Panel Builders will have to label with a value
  - Panel Builders can use breakers or fuses
Short Circuit Current Ratings

- Requires marking SCCR (Short Circuit Current Rating) on industrial control panels.
  - To provide info for safe installation and inspection of panels based on application: i.e. available fault current to panel.

- Components not to be considered in Short Circuit Current Ratings
  - Transformers, reactors, dry-type capacitors, resistors, varistors, and voltmeters
Fault Current in a System

Unlimited Fault Current
2,500 kVA, Z = 5.75%
Calculated Fault
12 Feet, 3,200A Copper Feeder Busway
3,200A
3,200A Bus

Note:
Obtain specific impedance values for each system. Do not assume the values shown here will be typical.

Calculated at 100% Motor Contributions

12,470VΔ
480Y/277V

52,296
64,328
29,560

200A
200A
150A

10,968

60 Feet
(3) 1-Conductor
#4/0 Copper
THW Insulation
Steel Conduit

100 Feet
(3) 1-Conductor
#2 Copper
THW Insulation
Steel Conduit

Main Control Panel

Bus Plug
Applying the Standard

Short Circuit Current Ratings

- OEM / Panelbuilder determines SCCR on panel by:
  - Short circuit test of the panel construction
    - or
  - Obtain documented tested combinations of components list from a manufacturer who has tested and documented combinations of components, and add these combinations to panelbuilder’s UL procedure.
  - Evaluate panel per UL508A, Supplement B (required by 4-06 if jurisdiction does not adopt 2005 NEC earlier).
    - All components in power circuit must have ratings
    - Ratings of starters are typically based on HP rating
    - Supplement SB, Table SB4.1, provides tables of components w/o marked short circuit ratings
Table SB4.1  
Assumed maximum short circuit current rating for unmarked components  
Table SB4.1 effective April 25, 2006

<table>
<thead>
<tr>
<th>Component</th>
<th>Short circuit current rating, kA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus bars</td>
<td>10</td>
</tr>
<tr>
<td>Circuit breaker (including GFCI type)</td>
<td>5</td>
</tr>
<tr>
<td>Current meters</td>
<td>a</td>
</tr>
<tr>
<td>Current shunt</td>
<td>10</td>
</tr>
<tr>
<td>Fuseholder</td>
<td>10</td>
</tr>
<tr>
<td>Industrial control equipment:</td>
<td></td>
</tr>
<tr>
<td>a. Auxiliary devices (overload relay)</td>
<td>5</td>
</tr>
<tr>
<td>b. Switches (other than mercury tube type)</td>
<td>5</td>
</tr>
<tr>
<td>c. Mercury tube switches</td>
<td></td>
</tr>
<tr>
<td>Rated over 60 amperes or over 250 volts</td>
<td>5</td>
</tr>
<tr>
<td>Rated 250 volts or less, 60 amperes or less, and over 2 kVA</td>
<td>3.5</td>
</tr>
<tr>
<td>Rated 250 volts or less and 2 kVA or less</td>
<td>1</td>
</tr>
<tr>
<td>Motor controller, rated in horsepower (kW)</td>
<td></td>
</tr>
<tr>
<td>a. 0 – 50 (0 – 37.3)</td>
<td>5&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>b. 51 – 200 (38 – 149)</td>
<td>10&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>c. 201 – 400 (150 – 298)</td>
<td>18&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>d. 401 – 600 (299 – 447)</td>
<td>30&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>e. 601 – 900 (448 – 671)</td>
<td>42&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>f. 901 – 1500 (672 – 1193)</td>
<td>85&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Meter socket base</td>
<td>10</td>
</tr>
<tr>
<td>Miniature or miscellaneous fuse</td>
<td>10&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Receptacle (GFCI type)</td>
<td>2</td>
</tr>
<tr>
<td>Receptacle (other than GFCI type)</td>
<td>10</td>
</tr>
<tr>
<td>Supplementary protector</td>
<td>0.2</td>
</tr>
<tr>
<td>Switch unit</td>
<td>5</td>
</tr>
<tr>
<td>Terminal block or power distribution block</td>
<td>10</td>
</tr>
</tbody>
</table>

<sup>a</sup> A short circuit current rating is not required when connected via a current transformer or current shunt. A directly connected current meter shall have a marked short circuit current rating.  
<sup>b</sup> The use of a miniature fuse is limited to 125-volt circuits.  
<sup>c</sup> Standard fault current rating for motor controller rated within specified horsepower range.
Determining Panel SCCR

CPD = Circuit Protective Device

- SB4.4.1 – Compare SCCR of all power components to SCCR of branch CPD. Use smaller value for line side of branch CPD.

- SB4.4 overall SCCR of panel:

<table>
<thead>
<tr>
<th>Branch Circuit</th>
<th>Branch CPD</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>No</td>
<td>Lowest SCCR for any power component or control overcurrent protection device</td>
</tr>
<tr>
<td>Single</td>
<td>Yes</td>
<td>Determine per SB 4.4.1 above</td>
</tr>
<tr>
<td>Multiple</td>
<td>Yes</td>
<td>Determine per SB 4.3 (next slides)</td>
</tr>
</tbody>
</table>
Applying the Standard

- SB.4.3 Feeder Components that limit Short Circuit
  - Power Transformers
  - Current Limiting Circuit Breakers
  - Fuses
## Applying the Standard

- SB 4.3.1 Transformers

### Limiting Short Circuit Current Using Power Transformers

<table>
<thead>
<tr>
<th>Rating</th>
<th>Secondary Voltage</th>
<th>Secondary Devices</th>
<th>SCCR on line side of circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than or = 10kVA</td>
<td>not specified</td>
<td>greater than or = 5kA</td>
<td>Use rating on primary overcurrent device</td>
</tr>
<tr>
<td>less than or = 5kVA</td>
<td>120V maximum</td>
<td>greater than or = 2kA</td>
<td>Use rating on primary overcurrent device</td>
</tr>
<tr>
<td>greater than 10kVA</td>
<td>-</td>
<td>-</td>
<td>Use lowest SCCR of secondary circuit components</td>
</tr>
</tbody>
</table>

Codes & Standards
UL508A
Applying the Standard

- SB 4.3.2 Current Limiting Circuit Breakers

SCCR on line side of the Feeder CB is:

1. The SCCR of the Feeder breaker *if*:
   a. Peak let-through is less than SCCR of load side components
      AND
   b. SCCR of load side components \(\geq\) SCCR of feeder breaker

2. The smallest SCCR of any branch circuit protective device *if*:
   - #1 exists, except for b, SCCR of load side components < SCCR of feeder breaker

3. The smallest SCCR of any branch circuit on the load side of the feeder breaker, where neither #1 or #2 exist.
Current Limiting Breakers

Figure SB4.1
Sample plots of current limiting circuit breakers let-through values
Added Figure SB4.1 effective April 25, 2006

[Graph showing the relationship between available short circuit current and let-through current for different voltages.]
Determining Peak & \( I^2t \)

a) Obtain plots of the maximum let-through values for the specific current limiting circuit breaker from the manufacturer.

b) Select the available short circuit current along the horizontal axis at the bottom of the chart that is equal to the short circuit current rating of the industrial control panel.

c) Move vertically to the intersection with the curve corresponding to the rated voltage of the circuit breaker that is not less than the rated voltage of the industrial control panel.

d) Move horizontally left to intersection with the vertical axis to determine the peak let-through current or \( I^2t \) value.
Eaton C-H
Current Limiting Breakers

- New labeling per UL508A SB4.3.2 “Current Limiting”
- Let-through Curves
- High AIC breakers; lowest let-through values
- Target completion: end of 2005

One test is better than a million calculations.
Applying the Standard

- SB 4.3.3 Fuses

Table SB4.2
Peak let through currents, $I_p$, and clearing, $I^2t$, for fuses
Table SB4.2 effective April 25, 2006

<table>
<thead>
<tr>
<th>Fuse types</th>
<th>Fuse rating amperes</th>
<th>Between threshold and 50 kA</th>
<th>100 kA</th>
<th>200 kA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$I^2t \times 10^3$</td>
<td>$I_p \times 10^3$</td>
<td>$I^2t \times 10^3$</td>
</tr>
<tr>
<td>Class R</td>
<td></td>
<td>RK1</td>
<td>RK5</td>
<td>RK1</td>
</tr>
<tr>
<td>30</td>
<td>RK1</td>
<td>10</td>
<td>50</td>
<td>6</td>
</tr>
<tr>
<td>60</td>
<td>RK5</td>
<td>200</td>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td>100</td>
<td>RK1</td>
<td>500</td>
<td>500</td>
<td>14</td>
</tr>
<tr>
<td>200</td>
<td>RK5</td>
<td>1600</td>
<td>1600</td>
<td>18</td>
</tr>
<tr>
<td>400</td>
<td>RK1</td>
<td>5000</td>
<td>5000</td>
<td>33</td>
</tr>
<tr>
<td>600</td>
<td>RK5</td>
<td>10000</td>
<td>10000</td>
<td>43</td>
</tr>
</tbody>
</table>

Same criteria as for breakers, except use table instead of curves to determine values
Fuse Let-Through Chart

Fuses Tested at 15% Power Factor

\[ I_p = 2.3 \times I_{RMS\,SYM} \]

Available Fault Current:

- 100 kA: 600A
- 65 kA: 600A
- 35 kA: 600A
- 30 kA: 600A

Let-Through Current:

- 45 kA: 600A
- 40 kA: 600A
- 32 kA: 600A
- 30 kA: 600A

X/R Ratio = 6.6
Current Limiting

$I^2t = (I_{RMS})^2t$

Available Short Circuit Current

Peak Let-Through Current ($I_p$)

$I_{RMS}$

Let-Through Current (Calculated)

$t_{melt}$

$t_{arc}$

$t$

Total Clearing Time

Available Short Circuit Current
Applying the Standard

The diagram on the left is a common circuit that we would see in a typical control panel.

Let’s analyze the circuit and determine what SCCR we can apply to the panel using breakers and fuses.
Applying the Standard

The first step is to determine the SCC of each device. This can be done by looking at the device label.

If the device is not marked UL provides a table (SB4.1) of standard SCC ratings in the UL 508A guideline.
Applying the Standard

In the breaker example we know –

- Main Breaker is rated 65kA
- Starter is rated 10kA
- Contactor is rated 5kA
- QC breaker is rated 10kA

We need to determine the SCCR of the HMCP and the PLC.

The PLC can be ignored because it is part of the control circuit.

The starter information states that when used in conjunction with a HMCP it carries a rating is 65kA.

Therefore the panel rating is 5kA.
Applying the Standard

Step 2: Calculate the available SCC when taking into account current limiting components like CPT’s, fuses and circuit breakers.

The available fault current is 50kA. Per the UL 508A guideline a power transformer rated 5kVA or lower will limit the fault to 2kA on the secondary side of the transformer (Section SB4.3).

Therefore, because the rating of all of the devices on the secondary of the transformer are greater than 2kA, the SCCR of the panel in this example would be 65kA.
Let’s follow the same procedure and determine the SCCR using a fuse.

As with the breaker example, we can eliminate the branch circuit feeding the transformer, since it limits the current to 2kA.

We need to determine if the 100A fuse will limit the current enough to protect the starter rated at 10kA.

From Table SB4.2 we can determine that at 50kA, $I_p$ for a Class R 100A fuse is 14kA. Therefore the panel would need to be rated at 10kA.
Summary: From this example we can see that using an HMCP in combination with a starter allows for a higher SCCR rating.

The bottom line is that this standard is not about Breakers vs. Fuses, but rather determining the SCC of the components in the panel and then assigning a SCCR to the panel based upon the guidelines in the UL508A standard.

The clear intent of this standard is to provide an additional level of safety for you and your customers.
Application Recap

- For SCCR, power circuit is only area of concern
  - Control circuit has small ampacity devices, small wire, and greater impedance due to amount of wire which will limit current
- For branch protection > 30A for any 10kA or less devices: fuses don’t limit current to necessary level. Thus breakers and fuses are on a level playing field. Breaker and starter combinations can offer higher interrupting ratings.
- For branch protection < 30A for any 10kA or less devices: Rate panel 10kA (or lowest device). Use CL breakers or fuses to boost rating if unsure of available fault current.
  - Note: Many motor loads require Class R Fuses.
Why Use a Breaker?

- Prevents single-phasing
- Motor protection
- Ground fault detection
- Resettable
- Dead front, no exposed parts
- Space savings
- Uptime
- Accessorization
- Testable

Motor Circuit Protector (MCP)

Clears in less than one cycle.
Multiwire Connectors

Field-installed multiwire connectors for the load side (OFF) end terminals. They are used to distribute the load from the circuit breaker to multiple devices without the use of separate distribution terminal blocks.

Multiwire lug kits include mounting hardware, insulators and tin-plated aluminum connectors to replace three mechanical load lugs. UL listed for copper only as used on the load side (OFF) end.

Table 12-428. Multiwire Connectors Ordering Information (Package of 3)

<table>
<thead>
<tr>
<th>Maximum Amperes</th>
<th>Wires per Terminal</th>
<th>Wire Size Range AWG Cu</th>
<th>Kit Catalog Number</th>
<th>Price U.S. $</th>
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<tr>
<td>100</td>
<td>3</td>
<td>14 – 2</td>
<td>3TA100G3K</td>
<td>62.50</td>
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<tr>
<td>100</td>
<td>6</td>
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<td>3TA100G6K</td>
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</tr>
<tr>
<td>225</td>
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<tr>
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</table>

- Breaker accessory
- Distributes load to multiple devices
How Can Eaton Help?
Information!

- Breaker AIC ratings are listed on the devices
- UL Approved High SCCR Combinations are published (see Tab 8 of binder)
  - HMCPs & IT
  - GMCPs & Freedom
  - HMCPs & Freedom
  - XT Control (UL508 E, F)
  - MMPs, HFDs w/ SVX, HVX Drives
- Sample Procedure Descriptions (see Tab 7 of binder)
  - Circuit Breaker Accessories
  - Supplementary Protectors
  - HMCPs
Resources & Training

- Fault Current Calculation Software
  - AMTEC™ ProDesign™
  - Allows selection of C-H and other components
  - www.amtech-power.com

- Eaton Electrical Website
  - www.eatonelectrical.com
  - Learning on the Go
    - 101 Basics Series
    - Product Expert
  - Other Industry Topics
    - Arc Flash Overview & Technical Papers
Select "Learning" Tab
### 101 Basics Modules and Exams

<table>
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<th>Module Number</th>
<th>Description</th>
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<th>Download Mastery Exam</th>
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<tr>
<td>1</td>
<td>Series Introduction</td>
<td>Module 1</td>
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<td>2</td>
<td>Fundamentals of Electricity</td>
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<tr>
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<td>Fundamentals of Electrical Distribution</td>
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New Required Safety Practices to Prevent Arc Flash

The operation and maintenance of the electrical facilities that are the core of our utility business pose very specific dangers to electrical workers. Among them is the very real danger of burns that result from exposure to powerful electrical arcs.

Changes in the 2002 National Electric Code® and the 2000 edition of the National Fire Protection Association Standard 70E mandate new required safety practices for personnel working on energized electrical equipment. Following suit, the Institute of Electrical & Electronic Engineers has developed its own Standard 1584. These standards determine the circumstances in which workers should wear specific clothing to protect them from the dangers posed by electrical arcs.

Operators who work with this equipment must become familiar with new terms such as Arc Thermal Performance Exposure Value (ATPV), Hazard Risk Category and Flash-Protection Boundary. They must also understand how the power of a potential arc, along with its duration and distance from the worker, interact to determine the potential for personal injury.

In turn, the burden is on employers to provide the training, equipment, and work rules that let workers perform safely in situations where arcs might occur. This requires staff to make the necessary calculations and to apply very specific recommendations that will protect workers. In many cases, the necessary skills to do this aren’t available in-house.

This is where Cutler-Hammer specialists step up to the plate with the tools to help make your work environment a safe one. We have developed an intensive, eight-hour training course, Understanding Arc Flash, that will impart the know-how to:

- Understand the latest standards
- Define hazard risk categories
- Determine the incident Energex exposure
Active UL508 Projects

- Combination Ratings posted on UL Database / Website
- Comprehensive list of SCCRs posted on Eaton website
  - Includes: Power Control, Circuit Breakers, Supplementary Protectors, Drives, Disconnect Switches
Questions?
Thank You!