Panelboards and Swbds

2012
Brent ‘Vild Application ‘Engineer
Overview

Introduction to Panelboards:

Definition of a Panelboard
Panelboard Components
Application Considerations
Standards and Code Requirements
Support Tools
Definition

A wall-mounted electrical power distribution device for use in commercial and industrial applications. It provides circuit control and over-current protection for light, heat or power circuits.
Components

Box
Ships First

Chassis
Ships Later

Trim
Ships Last
Panelboard and Loadcenter Industry Standards

Underwriters’ Laboratories, Inc. (UL)
Panelboards: UL 67
Cabinets and Boxes: UL 50

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)
Standard: PB1

Federal Specifications
Panelboards: W-P 115c
Molded Case Circuit Breakers: W-C 375a, b
Fusible Switches W-S 865c
Question 1

- What is the UL standard for panelboards?
Chassis - Three Types

- Main Lugs Only
- Main Circuit Breaker
- Main Fusible Switch
Question 2

• What is difference between a power panel and a lighting panel?
Feed Options

Top Feed

Side Feed ??

Bottom Feed
Standard Panelboard Trims

Surface Trim  Flush Trim
Special Panelboard Trims

Fast Concealed Trim Clamps

Door-in-Door Trim
Question 3

• What are the major components of panelboards?
EZ Trim

Laser cut door
Concealed hardware
Door-in-door standard
New heavy duty lock
Keying options with standard lock
Installs in less than 20 seconds vs. 5 minutes for standard trim
No tools are required to install trim!

High ratings from customers
EZ Trim

To complete the installation:

1. Push the door closed
2. Push the trim up, to the right, then in so that trim is flush against the box
3. Let trim drop into place
4. Close door

Trim is installed without tools
Classifications

Panelboards are classified by the National Electrical Code (NEC) and by Underwriters’ Laboratories (UL) in two categories:

- **Lighting and Appliance Branch Panelboards***
- **Power Panelboards***
Lighting and appliance branch circuit panelboards are defined in the NEC (Article 384) as:

“One having more than 10% of its overcurrent devices rated 30 amperes or less for which neutral connections are provided.”

Article 384 also limits the number of overcurrent branch devices (branch circuit poles) to a maximum of 42 in any one cabinet.

When the 42 poles are exceeded, two or more separate panelboards are required.
Question 4

• What is the UL standard for lighting panels?
Panelboard Poles

Total number of poles = 42
10% of poles = 4.2 or 5 poles
10 poles are 30A or less and a neutral is provided

Therefore, by definition, this panelboard is a...

Lighting and Appliance Branch Panelboard
Multi-Section Connections

When a panelboard (*for connection to one feeder*) must be furnished in more than one section (*box*), each section must be furnished with main bus and terminals of the same rating; unless a main over-current device is provided in each section.

There are two commonly used modifications for connecting multi-section panels:

*Sub-Feed Lugs*

*Through-Feed Lugs*
Sub-Feed Lugs

**First Panel**
Main lugs only with sub-feed lugs *(dual main lugs)*

**Second panel**
Main lugs only, *may require additional panel height*

**Panel Chassis**

**Incoming Cables**
Sub-Feed Lugs
**Through-Feed Lugs**

**First Panel**

*May have main lugs only or main breaker.*

**Second Panel**

*Main lugs only, may require additional panel height.*

Incoming Cables
Through-Feed Lugs
Power Panelboards

Power panelboards (*all others not defined as lighting and appliance branch circuit panelboards by jurisdictions not using the 2008 NEC*) are restricted only to practical physical limitations such as standard box heights and widths.

It is important to note that the NEC requires that the operating handle of the top most mounted device to be no more than 6’ 6” above the finished floor.

Additional boxes and fronts are required when the components required for one panelboard exceed standard box dimensions.
• Section 10 defines bus ampacity (TABLE 10.2 DENSITY)

• Table 19.2 defines Test Current 80% and 100% (page 86) called out in section 19

• Table 19.1 defines Temperature Rise called out in Section 19 (Heat test)

• Cable bending space determined by table 15.1
• Definition of Ampacity: Carry current continuously under condition of use without exceeding temp rating (table 13 in section 8.4)
• 5.3.2 determines Section rating determining by sections 8.8.1.6.9 -16.2 which references Tables 23(1000A/in² Cu & 750A/in² Al), 24, & 25
Compare heat and density sheets to UL Tables
EXAMPLE INCLUDES –

SYSTEM: 3P 4W
MAIN: 225A MCB  VOLTAGE: 480Y/277VAC

INCL OPTIONS: PRC2000 AND INTEGRAL SPD

NOTE: SHOWN INSTALLED IN 28W BOX
OPTIONS
225A GFP for Lighting Panelboards

• New small neutral sensor
  • Lighting panels as main
  • Power panels & switchboard feeder
• For use with FDE breakers
  • GFP or GFA
• First in the industry to offer GFP in lighting panels
• Shipping in June 2012
OPTIONS

Drawout MCCB Panelboard/Switchboard

• Joint Project with Canada
• Ability to drawout MCCB’s
• Accessories wired to pull-apart terminal block
• Panelboards
  • 20 – 600 ampere MCCB feeder
• Switchboard
  • 15-600 ampere MCCB feeder
  • > 600A - Drawout Magnum/NRX
• Options include IR windows
• Release date: June 2012
• Source plant: Atlanta Satellite
• Automated Logic Control
• Environmental Systems
• Facility Solutions Group
  (PRCEP and BCB with Modbus Communication)
UL 891

- UL 891 - Standard for Dead-Front Switchboards
  - No ANSI standard referenced.
UL 891

- Service Conditions
- Testing
- Construction
- Control Power
- Production Tests
Question 5

• What ANSI standard is referenced in UL891?
## UL 891 Talking Point

<table>
<thead>
<tr>
<th>Service Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>891</strong></td>
</tr>
<tr>
<td>Service conditions not addressed</td>
</tr>
<tr>
<td>Life of equipment will decline with increase in temperature and altitude</td>
</tr>
</tbody>
</table>
# UL 891 Talking Point

<table>
<thead>
<tr>
<th><strong>Temperature Tests</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>891</strong></td>
</tr>
<tr>
<td>Required for only some bus ratings</td>
</tr>
<tr>
<td><strong>Thus</strong></td>
</tr>
<tr>
<td>Equipment may overheat (which shortens life) if temperature test is not conducted</td>
</tr>
</tbody>
</table>
## Short Circuit Ratings

<table>
<thead>
<tr>
<th>891</th>
<th>Determined by testing at 600V for 3 cycles at 60 HZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thus</td>
<td>More demanding test of 4 cycles and 635V indicates a more robust design</td>
</tr>
</tbody>
</table>
**UL 891 Talking Point**

<table>
<thead>
<tr>
<th><strong>Short Circuit Bus Testing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase to neutral only required under certain conditions and phase to ground not required</td>
</tr>
<tr>
<td><strong>891</strong></td>
</tr>
<tr>
<td>Verifies that Neutral and Ground bus can withstand rated faults</td>
</tr>
<tr>
<td><strong>Thus</strong></td>
</tr>
</tbody>
</table>

Verifies that Neutral and Ground bus can withstand rated faults.
# UL 891 Talking Point

## Enclosure Finish

<table>
<thead>
<tr>
<th>891</th>
<th>Requires indoor finish to pass 24 hour salt spray test.</th>
</tr>
</thead>
<tbody>
<tr>
<td>891</td>
<td>Outdoor finish must pass 600 hour test</td>
</tr>
<tr>
<td>Thus</td>
<td>C-H switchboards exceed 600 hour test. Magnum DS has passed 1000 hour test</td>
</tr>
</tbody>
</table>
### UL 891 Talking Point

**Barriers**

<table>
<thead>
<tr>
<th>891</th>
<th>Does not require internal barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thus</td>
<td>Faults in equipment without internal barriers can result in longer outages</td>
</tr>
</tbody>
</table>
# UL 891 Talking Point

<table>
<thead>
<tr>
<th>Service Entrance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>891</strong></td>
</tr>
<tr>
<td>Requires barriers for “line of sight” contact</td>
</tr>
</tbody>
</table>

**Thus**

891 allows barriers to be placed to prevent inadvertent contact. 1558 does not allow for any contact.
<table>
<thead>
<tr>
<th>Means of Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>891</strong></td>
</tr>
<tr>
<td><strong>Thus</strong></td>
</tr>
<tr>
<td>Does not require mechanical tripping of E.O. breakers</td>
</tr>
<tr>
<td>Method of mechanical tripping provides an added safety feature</td>
</tr>
</tbody>
</table>
### Production Tests

<table>
<thead>
<tr>
<th></th>
<th>Requires only 3 production tests**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>891</strong></td>
<td>More tests ensure greater safety and correct operation</td>
</tr>
<tr>
<td><strong>Thus</strong></td>
<td></td>
</tr>
</tbody>
</table>
### UL 891 Talking Point

#### Key Spec References

<table>
<thead>
<tr>
<th>UL 1558</th>
<th>UL 891</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Switchgear</strong></td>
<td><strong>Switchboards</strong></td>
</tr>
<tr>
<td><strong>Front and Rear Access</strong></td>
<td><strong>Front Access or Front and Rear Access</strong></td>
</tr>
<tr>
<td><strong>NEMA SG3, SG5, ANSI C37.20.1</strong></td>
<td><strong>NEMA PB2</strong></td>
</tr>
<tr>
<td><strong>Power Circuit Breakers</strong></td>
<td><strong>Molded Case or Insulated Case Circuit Breakers</strong></td>
</tr>
<tr>
<td><strong>Usually Draw-Out Mounted</strong></td>
<td><strong>Fixed Mounted (Some Mains May be Draw-Out)</strong></td>
</tr>
<tr>
<td><strong>Individually Mounted</strong></td>
<td><strong>Group Mounted (can be Individually Mounted in Some Cases)</strong></td>
</tr>
</tbody>
</table>