Schneider Learning Series – ASCO Offer
Low Voltage Construction
27th April 2021

Presented by: Pete Rossomando – Director of PCS Applications Engineering
# Learning Objectives

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<th>Switchgear Design Features</th>
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<td>General Cubicle Dimensions</td>
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<td>Cubicle Modular Construction</td>
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This webinar will be recorded and made available through our website.

Please use the “Q&A” feature to ask technical questions.
Low Voltage Construction

- **Switchgear Design Features**
- General Cubicle Dimensions
- Cubicle Modular Construction
- Conduits and Cable Considerations
- Switchgear Options
- Breaker Stacking Arrangements
- Seismic Considerations
- UL 891 & UL 1558
Low Voltage Construction – Current Design

• All 11 Gauge Steel
• All silver plated copper bus (tin plated available if specified)
• Modular Cubicle design
• Standardized parts and section dimensions
• Standardized bus configurations
• Seismic Design Standard
• Lug pads designed for use with either mechanical or compression lugs
• Standard modular conduit area
• Rear Doors Standard
• All cubicles designed for either top or bottom cable entry
• Design Based on Square D NW/MTZ circuit breakers
• Common UL 891 & UL 1558 Structural Design
Low Voltage Construction

- Switchgear Design Features
- General Cubicle Dimensions
- Cubicle Modular Construction
- Conduits and Cable Considerations
- Switchgear Options
- Breaker Stacking Arrangements
- Seismic Considerations
- UL 891 & UL 1558
Low Voltage Construction - Mechanical Layout....How wide?

**General Switchgear Widths**

26”, 32”, 36” & 40” are standard widths
others are custom

Widths apply to Generator, Distribution, Tie and Utility Sections.

26”, 32”, 36”, 40” Wide
What’s in the 3” wire way?

- Cubicle Interconnect harnesses
- No interwiring between cubicles, plug and jack connections
- DC Bus – Distributes DC Power to each switchgear section

Interconnect Control Wires

Red, Blue, Black Wires are DC bus
Plug and Jack Connections

- Cubicle Interconnect harnesses
- No interwiring between cubicles, plug and jack connections
- Makes life easy for the contractor
Low Voltage Construction - Section Depths

Section Depth is Determined by Main Bus Ampacity

<table>
<thead>
<tr>
<th>Main Bus Ampacity</th>
<th>Section Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls Only</td>
<td>24”-30”</td>
</tr>
<tr>
<td>3000A – 6000A</td>
<td>72”</td>
</tr>
<tr>
<td>8000A – 10,000A</td>
<td>84”</td>
</tr>
</tbody>
</table>
Low Voltage Construction

- Switchgear Design Features
- General Cubicle Dimensions
- Cubicle Modular Construction
- Conduits and Cable Considerations
- Switchgear Options
- Breaker Stacking Arrangements
- UL 891 & UL 1558
Low Voltage Construction - Cubicle/Compartment Layout

Note: #2 or #3 breaker compartment can be replaced with controls – CB control switches, metering, control power transformers, I/O
Low Voltage Construction – Modular Cubicle Design

**Front – Breaker and/or Control Section**
- 24”
- Panels for controls

**Middle - Bus Section**
- 18” up to 6000A
- 30” 8000A & 10,000A

**Rear – Cable Section**
- 30”

- Conduits - Up to 16 3-1/2” conduits for 26”W section, 20 for 32”W section

Front Door

Side Barriers

Rear Door
Low Voltage Construction

▪ Switchgear Design Features
▪ General Cubicle Dimensions
▪ Cubicle Modular Construction
▪ Conduits and Cable Considerations
▪ Switchgear Options
▪ Breaker Stacking Arrangements
▪ UL 891 & UL 1558
## Low Voltage Construction – Standard Conduit Design

*Typical Cables if cable schedule not known*

<table>
<thead>
<tr>
<th>Breaker Frame Size</th>
<th># of cables/ Phase &amp; N</th>
</tr>
</thead>
<tbody>
<tr>
<td>800AF</td>
<td>3</td>
</tr>
<tr>
<td>1200AF</td>
<td>4</td>
</tr>
<tr>
<td>1600AF</td>
<td>5</td>
</tr>
<tr>
<td>2000AF</td>
<td>6</td>
</tr>
<tr>
<td>2500AF</td>
<td>7</td>
</tr>
<tr>
<td>3000AF</td>
<td>8</td>
</tr>
<tr>
<td>3200AF</td>
<td>8</td>
</tr>
<tr>
<td>4000AF</td>
<td>12</td>
</tr>
<tr>
<td>5000AF</td>
<td>15</td>
</tr>
</tbody>
</table>
Low Voltage Construction – Cable Entry & Lugs

- All Switchgear cubicles designed for top or bottom cable entry – No dimensional changes, just specify what’s required
- Mechanical Lugs Provided as standard
- Optional Compression Lugs provided if specified
- Optional Inspection windows provided if specified
- All lugs are two hole anti-turn type
- Bus Lug pads designed to accommodate either Mechanical or Compression lugs
- Cable entry area does not change based on lug type
- Unlike some ATS, dimensions do not change based on lug size or type
- Lug type can be either, we just need to know which.

2 hole mechanical screw type lug

2 hole long barrel compression lug
Low Voltage Construction

- Switchgear Design Features
- General Cubicle Dimensions
- Cubicle Modular Construction
- Conduits and Cable Considerations

**Switchgear Options**

- Breaker Stacking Arrangements
- UL 891 & UL 1558
# Low Voltage Construction Switchgear Options

## Optional Features

<table>
<thead>
<tr>
<th>Options</th>
<th>Master/Control</th>
<th>Generators</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead Lifting Device</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Portable Lifting Device</td>
<td>NA</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Steel &amp; Glastic Side Barriers</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Glastic Rear Barriers/Isolated bus</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mimic Bus</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mechanical/Compression Lugs</td>
<td>NA</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>IR Viewing Ports</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3” Steel Cubicle Base</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>System SPD</td>
<td>X</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Bus Duct Risers</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>200K AIC bus bracing</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Low Voltage Construction - Options

**Overhead Circuit Breaker Lifting Device**

- Rail mounted
- Ships separately and mounted in field
- Can be provided on projects with bus risers
- IBC 2018 Seismic Certified
- Adds 18" to overall height
**Low Voltage Construction - Mechanical Layout**

*Square D NW or MTZ 3 Pole Circuit Breakers*

*Total section width with various stacking arrangements are determined by the width of the largest individual breaker*

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>65KAIC - 100KAIC</th>
<th>150KAIC</th>
<th>200KAIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>800AF-1600AF</td>
<td>26”</td>
<td>26”</td>
<td>26”</td>
</tr>
<tr>
<td>2000AF</td>
<td>26”</td>
<td>32”</td>
<td>32”</td>
</tr>
<tr>
<td>2500AF-3000AF</td>
<td>26”</td>
<td>32”</td>
<td>32”</td>
</tr>
<tr>
<td>3200AF</td>
<td>32”</td>
<td>36”</td>
<td>36”</td>
</tr>
<tr>
<td>4000AF</td>
<td>36”</td>
<td>36”</td>
<td>36”</td>
</tr>
<tr>
<td>5000AF</td>
<td>36”</td>
<td>36”</td>
<td>36”</td>
</tr>
<tr>
<td>6000AF</td>
<td>40”</td>
<td>40”</td>
<td>40”</td>
</tr>
</tbody>
</table>
Low Voltage Construction

▪ Switchgear Design Features
▪ General Cubicle Dimensions
▪ Cubicle Modular Construction
▪ Conduits and Cable Considerations
▪ Switchgear Options

▪ Breaker Stacking Arrangements
▪ UL 891 & UL 1558
Low Voltage Construction Mechanical Layout – Master Control Section

- Standard Master Section 36” wide
- PLC Redundancy does not change width
- Circuit Breakers typically *can not* be mounted in Master Section due to space required for controls
- SPD can be mounted in rear
- Standard Master OIT is 24” Wonderware
- Typically an Aux Master is required when *redundant I/O* is required, adds an additional 36” wide Auxiliary Section or I/O can be mounted in the rear of the section.
Low Voltage Construction Mechanical Layout – Generator Sections

- Generator Section widths vary based on breaker size - 26” up to 2000AF circuit breaker
- Dual Gen Sections available always a minimum of 36”W

800-2000AF

Up to (2) 3200AF
Low Voltage Construction - 1 High NW/MTZ 800 – 3200A Breaker Sections

Standard Sections for Generators or Distribution – 100KAIC

1 High Gen or Distribution Section

1 high Distribution Section w/controls

1 High Gen or Distribution Section

1 High Gen or Distribution Section

<table>
<thead>
<tr>
<th>Width</th>
<th>800-2000</th>
<th>800-2000</th>
<th>800-2000</th>
<th>3200</th>
</tr>
</thead>
<tbody>
<tr>
<td>26” Wide</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26” Wide</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32” Wide</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Typical Generator Controls

Width increases to 32” for 3200AF CB
Low Voltage Construction Breaker Sections 3200 & 4000AF Breakers

**NW/MTZ 1-High Sections for Generator or Distribution Sections**

<table>
<thead>
<tr>
<th>Width</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>26&quot; Wide</td>
<td>1 High Distribution Section, 26&quot; Wide, 3200AF Breaker @ 200KAIC, Door height increases for more venting at 3200AF and above @200KAIC</td>
</tr>
<tr>
<td>26&quot; Wide</td>
<td>1 High Distribution Section w/controls, 3200AF Breaker @ 200KAIC</td>
</tr>
<tr>
<td>32&quot; Wide</td>
<td>1 High Gen or Distribution Section, 3200AF Breaker @ 200KAIC</td>
</tr>
<tr>
<td>36&quot; Wide</td>
<td>1 High Gen or Distribution Section, 4000-5000AF Breaker @ 200KAIC</td>
</tr>
<tr>
<td>36&quot; Wide</td>
<td>1 High Gen or Distribution Section, 5000-6000AF Breaker @ 200KAIC</td>
</tr>
</tbody>
</table>

- Width increases to 36" for 3200AF CB @ 200KAIC
- Door height increases for more venting at 3200AF and above @200KAIC
Low Voltage Construction 2 High NW/MTZ Breaker Sections 800AF – 3200AF

Dual Generator Sections -100KAIC Only

- Dual Generator Design available up to (2) 3200AF circuit breakers @100KAIC
- Sections always 36” wide
Low Voltage Construction 2 High NW/MTZ Breaker Sections – Up to 100KAIC

- Width increases to 32” for 3200AF CB @ 100KAIC
- Width increase to 36” for 4000AF CB @100KAIC

Typical Controls

Area Available for Controls

26” Wide
- 800
- 800-2000

26” Wide
- 800
- 800-2000

32” Wide
- 800
- 800-2000
- 800-2000

36” Wide
- 800
- 800-2000
- 800-2000
- 800-2000

Area Available for Controls

Area Available for Controls

Area Available for Controls

Area Available for Controls
Low Voltage Construction 2 High NW/MTZ Breaker Sections

*Distribution Sections – 150-200KAIC*

- Width increases to 32” for 2000AF CB @ 200KAIC
- Width increases to 36” for 4000AF CB @100KAIC

**Available Area for Controls**

- 26” Wide: 800-1600
- 32” Wide: 800-2000
- 36” Wide: 800-1600, 3200-4000
Low Voltage Construction 3 High NW/MTZ Distribution Sections

**Distribution Sections up to 100KAIC**

- Width remains at 26” on all 3 high combinations 800AF – 2000AF
- Width increase to 32” with 3200AF breaker included
## Low Voltage Construction - 3 High NW/MTZ Distribution Sections

*Distribution Sections up to 150-200KAIC*

<table>
<thead>
<tr>
<th>Width</th>
<th>Area Available for Controls</th>
<th>Area Available for Controls</th>
<th>Area Available for Controls</th>
<th>Area Available for Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>26”</td>
<td>800</td>
<td>800</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>26”</td>
<td>800-1600</td>
<td>800-1600</td>
<td>800-1600</td>
<td>800-1600</td>
</tr>
<tr>
<td>32”</td>
<td>800</td>
<td>800</td>
<td>800</td>
<td>800</td>
</tr>
</tbody>
</table>

- **Width remains at 26” on all 3 high combinations 800AF – 1600AF 2 200KAIC**
- **Width increase to 32” with 2000AF breaker included**
4 high Sections are **26”W** for manually operated breaker

- **32”W** for electrically operated

- Electrically operated requires additional room for CPTs and CB control switches
Low Voltage Construction - Tie and Utility Sections NW/MTZ 800AF to 6000AF

Sections – Up to 100KAIC

- Width remains at 26” up to 2000AF
- Width increase to 32” with 3200AF breaker
- Width increases to 36” for 4000 & 5000AF
- Width increases to 40” for 6000AF
Low Voltage Construction - Tie and Utility Sections NW/MTZ 800AF to 6000AF

Sections – Up to 150-200KAIC

- Width remains at 26” up to 1600AF
- Width increases to 32” for 2000AF breaker
- Width increases to 36” for 3200-5000AF
- Width increases to 40” for 6000AF
Low Voltage Construction – Additional Sections

Controls Only Section

I Line Panelboard Section

6 High 1200AF P Frame
Low Voltage Construction – Depths and Conduit Areas

- **Up to 6000A Main Bus**
- **72” Depth**
- **UL 891 or UL 1558 Design**

- **Up to 8000A – 10000A Main Bus**
- **84” Depth**
- **UL 891 or UL 1558 Design**
Low Voltage Construction– Front Connected Switchgear

- Designed/listed to UL 891
- Bus Bracing - 100k Max
- Main Bus Max - 4000A
- Up to 3000A Drawout UL489 NW/MTZ Breakers
- 48” Depth, Top or Bottom Cable entry
- Section Types -1 – 4 high NW/MTZ, Tie & I Line Panelboard
Low Voltage Construction – Insulated Bus

• Insulated Bus is not required by any UL or ANSI low voltage standard
• Some customers have moved to insulated bus for perceived safety reasons – Government, US Embassies, Water Treatment
• Insulated bus applications utilize Square D PZ4 type Switchgear
• UL1558 listed
• Bus Bracing – up to 200k
• Main Bus Max - 5000A
• Includes separate control sections
Low Voltage Construction – Bus and Bracing

- All bus designed at minimum 1000A/Square inch current density. UL rating based on current density not thermal rating–NYC requires some different current density (700A/Square Inch) – Requires more copper.

- There’s lots of industry bus bracing levels – 50K, 65K, 85K, 100K, 150K, 200K

- ASCO provides two bus bracing designs – 100K and 200K

- Switchgear obtains label based on rating of lowest rated device.

- That means the switchgear can have bus bracing of 200K but be labeled 100K if the breakers are rated 100K. Occurs more than you may think based on spec requirements. *Ex: 100K rated Generator Breakers with 200K Distribution Breakers*
Low Voltage Construction – Bus Risers

- Up to 2 Risers per section
- Cubicle dimensions (width and/or depth) can change based on bus duct flange
- Bus Duct Flange drawings required to make accurate drawings and complete design
- SqD, Siemens, GE, CH all have different flanges with different dimensions
- ASCO doesn’t supply the flange or associated mounting hardware
- Flanges can be shipped to manufacturing facility for fitting on riser.
Low Voltage Construction – Bus Risers

Need to know the flange type and specific drawing for proper design

Most flanges look like this
Low Voltage Construction – Bus Risers

- But some look like this
- The Square D Qwik Flange
- Mounts differently than a flanged end
- Requires custom engineering design
- Can physically mount internal to switchgear

<table>
<thead>
<tr>
<th>Ampacity Ratings</th>
<th>3-Pole</th>
<th>4-Pole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>IN</td>
<td>IN</td>
</tr>
<tr>
<td>Copper</td>
<td>min</td>
<td>min</td>
</tr>
<tr>
<td>600</td>
<td>19.03</td>
<td>19.03</td>
</tr>
<tr>
<td>1000</td>
<td>19.03</td>
<td>19.03</td>
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<tr>
<td>1500</td>
<td>19.03</td>
<td>19.03</td>
</tr>
<tr>
<td>2000</td>
<td>19.03</td>
<td>19.03</td>
</tr>
<tr>
<td>2500</td>
<td>19.03</td>
<td>19.03</td>
</tr>
<tr>
<td>3000</td>
<td>19.03</td>
<td>19.03</td>
</tr>
<tr>
<td>4000</td>
<td>19.03</td>
<td>19.03</td>
</tr>
</tbody>
</table>

Busway Systems
800 A–5000 A Catalog Numbering System/Physical Data

Qwik Flange (Indoor Only)
Low Voltage Construction – Side Barriers

- Barriers provided between sections if specified – required by code in some areas – Ex: NYC
- Sectional Barriers are steel and glastic
- *Not* a UL1558 requirement

Steel Side Barriers at control and cable compartments

Glastic Side Barriers around bus compartment
Low Voltage Construction – Rear Barriers

- Barriers provided to isolate main bus from cable compartment
- Rear Barriers are glastic
- Rear Barriers are vented for heat rise purposes

Glastic Rear Barriers to prevent contact with main bus
Low Voltage Construction – Lifting Means

- How do we pick this thing up?
- Are their lifting eyes?
- Is sling rigging required?
- ASCO gear at one time had to be sling rigged per NEMA PB-2 Guidelines
Low Voltage Construction – Lifting Means

Bolted on Lifting Plates

Bolted on Lifting Plates
Low Voltage Construction

• Switchgear Design Features
• General Cubicle Dimensions
• Cubicle Modular Construction
• Conduits and Cable Considerations
• Switchgear Options
• Breaker Stacking Arrangements
  • Seismic Considerations
• UL 891 & UL 1558
Low Voltage Construction - Seismic Requirements

- All ASCO 4000 & 7000 Series Low Voltage Switchgear has been shake table tested to IBC and OSHPD requirements
- All ASCO 4000 & 7000 Series Low Voltage Switchgear is in compliance with IBC 2018 when using Square D, 3 Pole circuit breakers
- All other breaker manufacturers are in compliance with IBC 2009
- All ASCO 4000/7000 Power Control Systems are constructed to these requirements
- Not all Systems are shipped with Seismic labels, it has to be specified or requested. New ASCO Guide Spec includes Seismic Label on all switchgear
- All ASCO Switchgear is Seismic Certified to OSHPD (California) requirements
ASCO SEISMIC Compliance - IBC

Certificate of Compliance available at www.ibcapproval.com

ASCO Power Technologies, LP  The International Building Code
VMC Group

Product Type: ASCO Low Voltage Switchgear and Controls

Model Number: 300, 4000, 7000  Equipment Rating: up to 600V

Seismic Performance Characteristics: Sse (g)=2.46  z/h=1.0  lp=1.5

Examine Seismic Labels Attached To Any Non-Factory Components

Reference Certificate of Compliance: VMA-45810-01C

To Verify System Compliance

www.IBCApproval.com  VMA-45810-01B

Seismic Certificate of Compliance

Scanning Barcode will bring you to our Certificate of Compliance

Seismic Equipment Label
SEISMIC Code Requirements (OSHPD)

• What is OSHPD?
  • Office of Statewide Health Planning and Development
  • OSHPD is one of 13 departments within the California Health and Human Services Agency
  • The Facilities Development division is responsible for approval of special seismic certification for hospitals and skilled nursing facilities

• Applicable Codes:
  • CBC - California Building Code
  • IBC - International Building Code
  • ICC – ES AC156 (Seismic Qualification by Shake Table Testing)
Low Voltage Construction

• Switchgear Design Features
• General Cubicle Dimensions
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• Seismic Considerations

• UL 891 & UL 1558
UL 891 and UL 1558

UL 891

Switchboards

UL 1558
ISBN 0-7506-2338-0

Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
Power Control Systems Standards – UL891

- Developed from NEMA Standards – Dead Front Switchboard Construction in accordance with NEC
- Molded Case, Panelboards, Insulated case breakers as defined in UL 489 allowed
- Fusible Switches allowed
- ANSI Rated Breakers as defined by ANSI 37.16, ANSI 37.13 and UL1066
- 3 cycle short circuit rating/test
- No barriers or compartmentalization required
- Typical AIC ratings 42KAIC, 50KAIC, 65KAIC, 100KAIC & 150KAIC. Can go up to 200KAIC
- Defines an interrupting current rating for the breaker
Power Control Systems Standards– UL 1558

- Based on ANSI Standard C37.20.1 for Metal Enclosed Low Voltage Circuit Breaker switchgear
- Drawout Power circuit breakers as defined in UL 1066 and ANSI are the only type allowed
- 4 cycle short circuit rating/test
- 30 or optional 60 cycle short time test
- Panelboards, UL489 listed circuit breakers and fusible switches can NOT be used in UL 1558 switchgear
- Complete breaker compartmentalization required
- Typical AIC ratings (65KAIC, 85KAIC, 100KAIC & 200KAIC)
- Defines an interrupting current rating and short time rating (30 cycle rating) for circuit breakers
- ASCO UL1558 listing is for up to 200KAIC for 4 cycles and 85KAIC for 60 cycles
Low Voltage Standards FAQ’s

- FAQ: When I buy UL 1558 labeled switchgear I get full depth barriers between sections right?
  - Answer – No, UL 1558 does not require full depth barriers between sections, it requires compartmentalization.

- FAQ: What’s the difference between UL891 design and 1558 design?
  - Answer – UL 891 is switchboard construction (Fixed group mounting) & UL 1558 is Switchgear Construction (Individually compartmentalized draw-out type breakers).

- FAQ: Aren’t UL 891 designs less expensive than UL 1558?
  - Answer – Not necessarily, it depends on several variables including breaker type and AIC rating.

- FAQ: UL 1558 requires insulated bus right?
  - Answer – UL 1558 does not require insulated bus
For further information

• Quiz, PDH and CEU certificates
All attendees will receive an email an hour after the webinar with instructions regarding the link to download your PDH certificate and Quiz Questions for you to receive your CEU certificate.

• Speaker’s contact
Feel free to reach out to the speaker by email should you have any questions

pete.rossomando@ascopower.com
Thank You!

For more information, contact:

customercare@ascopower.com or +1 800.800.2726