

# Eaton Switchgear Power Center construction features



## **Introducing the Eaton Switchgear Power Center**

The Eaton Switchgear Power Center is a state-of-the-art solution for integrating 5 kV through 38 kV metal-clad switchgear and other electrical control and protection equipment into a single outdoor enclosure. The Eaton Switchgear Power Center enclosure can be provided with additional space for control and protection panels, dc battery systems, security equipment, communications panels, local HMI, accessory and spare parts storage, and other equipment, as specified. The Power Center enclosure, along with the switchgear and other equipment, is designed, manufactured, and tested as a combined assembly at Eaton's Omaha, NE, facility.

One of the many benefits of an Eaton Switchgear Power Center is its thermal insulation and HVAC system, which are included to maintain a safe, climate-controlled environment for maintenance and operations personnel.

For proven performance and pioneering technology, choose an Eaton Switchgear Power Center.

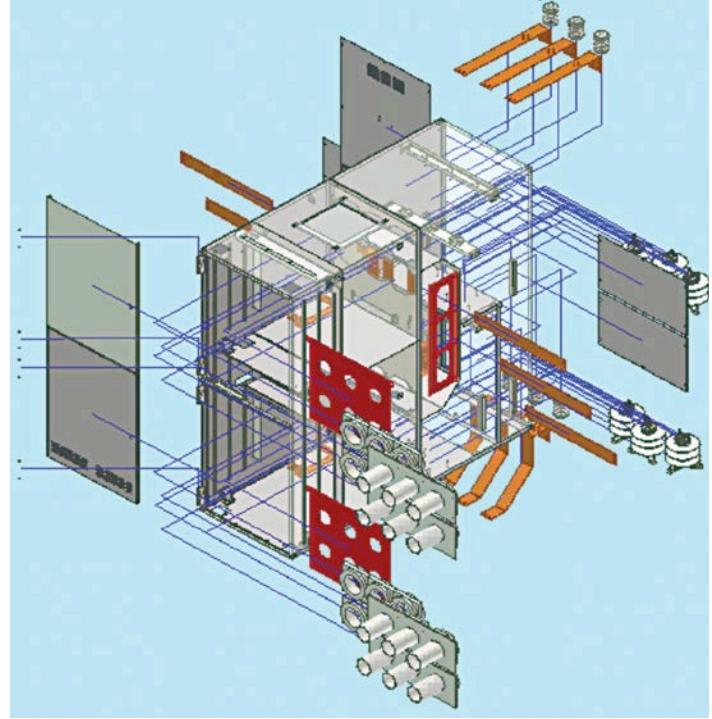
# **EATON**

*Powering Business Worldwide*

### Autodesk Inventor

Design of an Eaton Switchgear Power Center begins with the use of the best available design tools. Eaton uses Autodesk Inventor® for development of its mechanical designs. Autodesk Inventor is a three-dimensional modeling program that will automatically check interferences to ensure that all components and subassemblies fit together properly. It allows Eaton to view the complete assembly from any angle so the design can be optimized to take advantage of the most efficient fabrication and assembly methods.

Customer drawings can be prepared in AutoCAD® or MicroStation® format and can be supplied in the medium desired by the customer, including drawing files transmitted electronically or on a compact disc. Eaton can also use an FTP site for efficient exchange of technical information during the life of a project.

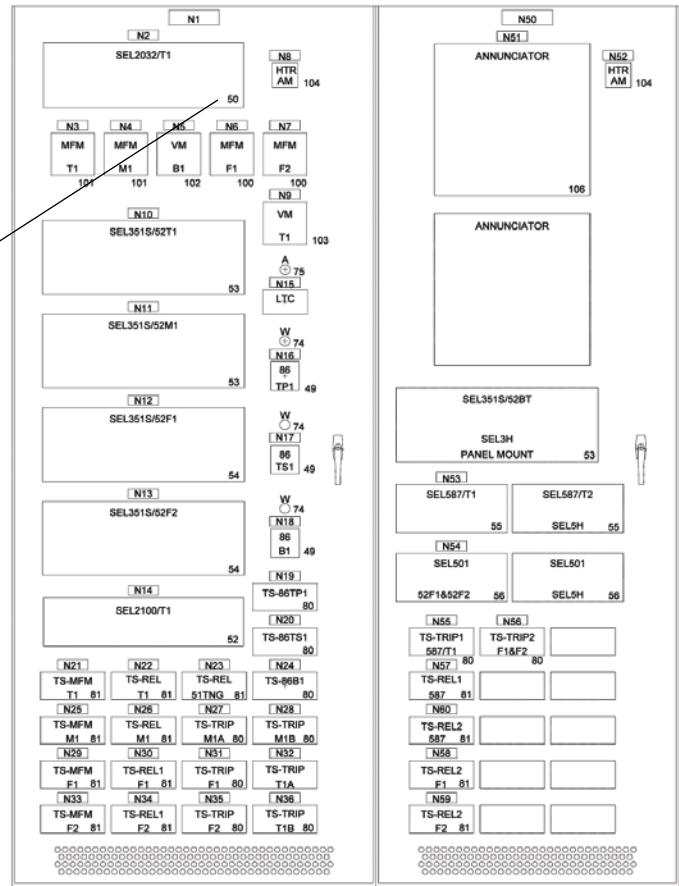


### Bill-of-material callouts

Eaton's Omaha Power Center uses bill-of-material callouts on drawings so that customers can easily identify installed components. The callouts reference the bill-of-material item number so that technical information relating to operation or maintenance can be easily located. Operation and Maintenance manuals can be provided on CD in fully indexed pdf format for easy access from any computer.

Bill-of-material item description

Item	Qty	Description
50	1	Communications Processor Schweitzer SEL2032/T1 Cat. No. 203233X344XXXX Standard with SCADA RTU functions, remote access, and plug-in protocol cards. Horizontal panel mount. Standard memory for database and settings storage with archive storage memory. Power supply input 85–140 Vac, output 38–200 Vdc, I/O board with four outputs, 16 inputs, and input voltage of 125 Vdc.

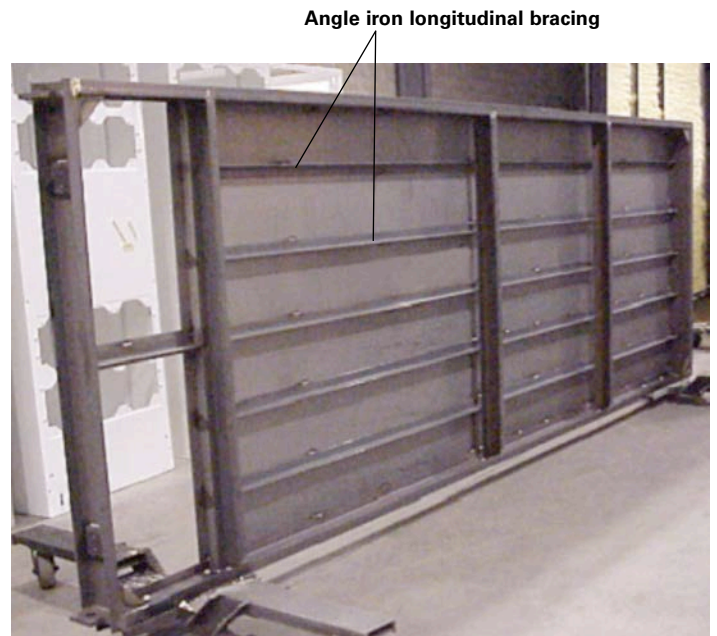


### Fabrication

Each Eaton Switchgear Power Center and every switchgear enclosure manufactured in Eaton's Omaha facility is fabricated from 11-gauge steel. All steel is cut on a fully automated high-energy laser. Programming is downloaded directly from the Eaton engineering server. The precision of the laser ensures that all pieces are cut to the correct size every time. The net result is that pieces fit to exacting tolerances to ensure weatherproof integrity of the Power Center enclosure. The smooth edges left by laser cutting allow excellent adhesion of the protective powder coating and prevent possible damage to wiring.

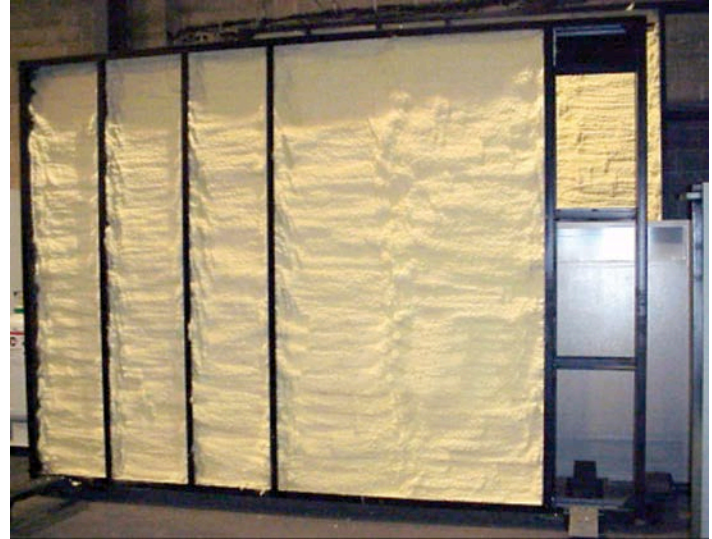


Eaton Switchgear Power Center equipment bases are fabricated from structural steel channel. This allows the switchgear to be installed cantilevered over a concrete pad or on piers, without the need for additional bracing. Floors are fabricated from 7-gauge plate steel with structural steel angles installed along the entire length of the base on 12-inch centers. This system provides superior performance over 1/4-inch plate steel floors and ensures that breakers battery systems, test equipment, and other materials located in the aisle or work areas are properly supported at all times.



### Protective coatings

An amine-cured, coal tar epoxy protective coating is applied to the bottom of each Eaton Switchgear Power Center base to prevent corrosion after installation. Spray-on foam insulation is applied to meet building codes and customer specifications. The outside perimeter of each base is protected with a corrosion-resistant, black epoxy coating that adheres well to structural steel and is resistant to damage from impact. Permanent lifting eyes are integrally welded at the corners of each shipping section to facilitate unloading at the job site.



The floor is protected by a non-skid epoxy coating that resists marring and scratches. This coating is allowed to fully cure prior to the start of assembly. Cutouts are provided in the floor for entry of control or power cables, as required. A steel or aluminum cover plate is installed over each cutout. Access cutouts are provided at shipping splits, when required, to allow bolting of the base sections together. Cover plates for access openings are installed flush with the floor and held in place with countersunk screws that are level with the floor surface to eliminate any possible tripping hazard.

Access for shipping split



After fabrication is complete, all metal parts are cleaned under high pressure, followed by an application of a protective phosphate coating to improve corrosion inhibition. Each piece is then electrostatically coated with a polyester powder. The powder coating is fully cured in a baking oven so that parts can be assembled immediately after cool-down. Powder coating provides superior coverage on edges and hard-to-reach areas and is very resistant to high temperatures. A high-gloss finish prevents absorption of dust and dirt and is easy to clean.

The Eaton powder coat provides superior performance and resistance to the following conditions:

- Marring and scratching
- Direct impact
- Reverse impact
- Chipping
- Corrosive atmospheres
- Cracking from bending
- Ultraviolet radiation
- Extreme heat
- Wind-borne snow and rain
- Wind-borne dust and sand



Following are results of actual ASTM tests that compare performance of the powder coat to polyurethane and acrylic enamel finishes commonly used by other manufacturers.

**Pencil hardness (ASTM D3363)** (resistance to marring and scratches)

6B ... 5B ... 4B ... 3B ... 2B ... B ... HB ... F ... H ... 2H ... 3H ... 4H ... 5H ... 6H ...  
Softer Harder

Polyester powder	Polyurethane	Acrylic enamel
2H-4H	F-H	B-HB

**Chip resistance (ASTM D3170)** (resistance to chipping by impact)

3A-3D ... 4A-4D ... 5A-5D ... 6A-6D ... 7A-7D ... 8A-8D ... 9A-9D ...  
Worse Better

Polyester powder	Polyurethane	Acrylic enamel
5A	4A	3B

**Impact resistance (ASTM D2794)** (resistance to cracking under impact)

**Direct impact**

Polyester powder	Polyurethane	Acrylic enamel
+160 in-lb	+75 in-lb	+30 in-lb

**Reverse impact**

Polyester powder	Polyurethane	Acrylic enamel
+160 in-lb	+40 in-lb	+10 in-lb

**Flexibility (ASTM D522)** (cracking under bending)

Polyester powder	Polyurethane	Acrylic enamel
Pass	Pass	Fail

**Salt spray (ASTM B117)** (resistance to corrosion)

Polyester Powder	Polyurethane	Acrylic enamel
2X	1X	1X

**Accelerated weathering (QUV340A)** (gloss retention and color fastness)

Polyester powder	Polyurethane	Acrylic enamel
10% loss at 2000 hours	10% loss at 1000 hours	10% loss at 1000 hours

### Interior coating and floor protection

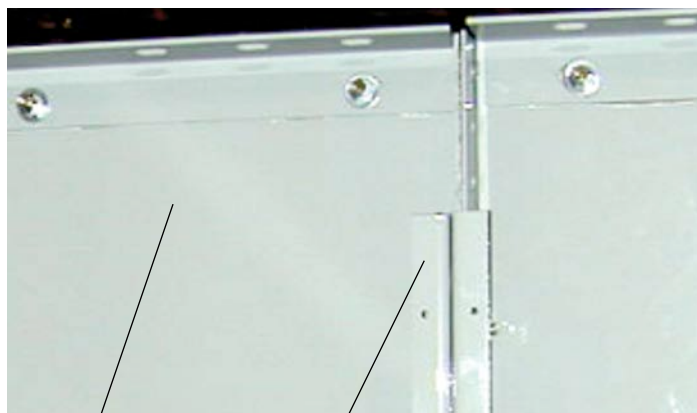
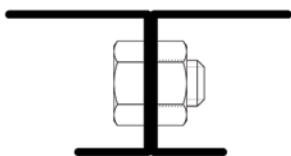
After fabrication, each switchgear cubicle receives a high-visibility white polyester powder coat inside and out. Cubicles are then assembled onto a base and bolted together to form the switchgear lineup. Masonite sheets are installed over all open floor areas to protect the floor surface during assembly and wiring. The masonite sheets are left in place to continue to protect the floor during installation and testing at the job site. As a result, floor surfaces stay in perfect condition, without the need for touchup or re-coating prior to placing the equipment into service.



Masonite sheets

### Walls

Eaton Switchgear Power Center walls are fabricated from 11-gauge steel and coated on both sides with a polyester powder. Each panel is fabricated with a double-return flange. When bolted together, they create an I-beam shape (as shown below) for added strength.

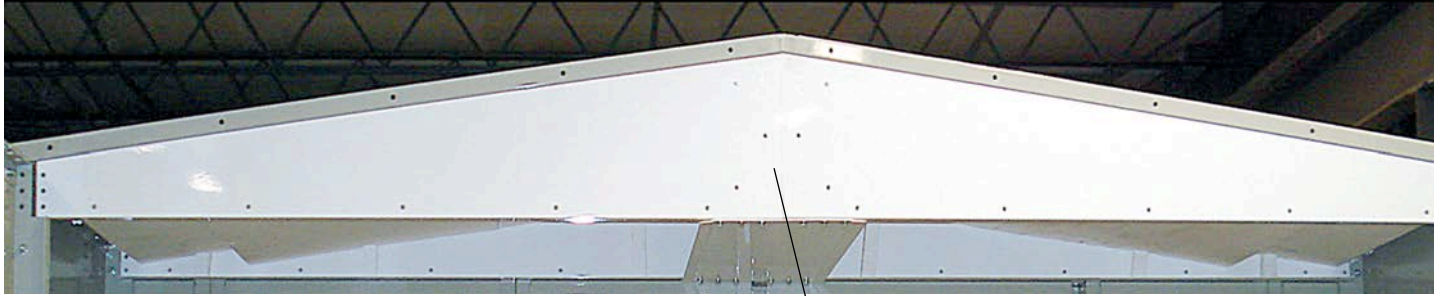


11-gauge steel

Double-return flange

Walls are thermally insulated with rigid, closed-cell foam to meet customer specifications or any applicable state building codes. This material has a higher insulation value than fiberglass batting and will not sag once installed. The rigid foam is easy to form around cutouts and other shapes in order to insulate all spaces, and will not absorb moisture should condensation be present. After installation, insulation is protected by 14-gauge steel wall panels.

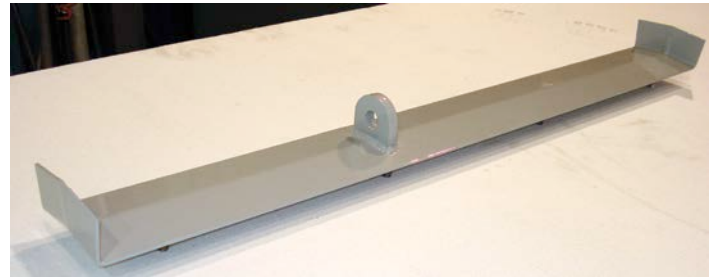




Tapered roof channel

## Roof

After the walls of the Eaton Switchgear Power Center have been erected, full-depth tapered roof channels, spaced every 36 inches, are bolted to and supported on the I-beam channel formed by the wall panels. Roof panels, fabricated from 11-gauge steel, are attached to the tapered roof channels and bolted together using stainless steel washers with impregnated neoprene rubber that fills in any gaps around bolt holes, as well as the bolt threads. Each roof joint is caulked with a long-life silicone sealant, and a full-length roof cap is installed to protect against direct exposure to the elements. Rigid, closed-cell foam insulation is installed under the roof panels to meet State Building Codes, if required, and customer specifications, and 18-gauge ceiling panels are installed to protect the insulation. Each tapered roof channel and roof panel receives Eaton's protective polyester powder coat on both sides. An optional cold roof design is available for switchgear power centers that are installed in cold climates with heavy accumulations of snow. The system prevents potential damage to the roof by not allowing ice dams to form. Interior surfaces are coated high-gloss white for improved visibility. Exterior wall seams are caulked with a long-life silicone rubber sealant that is able to expand and contract with changes in temperature. Personnel can attach safety harnesses to OSHA fall arrest anchors that are installed on the roof and spaced every 36 inches.



9 ft 5 in ceiling height

## Insulation

An important feature of the Eaton Switchgear Power Center construction is the complete insulation system. The entire roof over the aisle, switchgear, and work area is fully insulated. In addition, all exterior walls (including end walls) are fully insulated. This complete insulation system prevents condensation from forming on interior steel surfaces.

## Ceiling

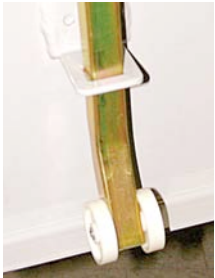
The interior ceiling height of the Eaton Switchgear Power Center is 9 feet 5 inches to accommodate the use of ladder tray.



Roof caps

## Rear doors and hardware

Eaton Switchgear Power Center rear cable compartment doors are flush with the enclosure when closed. A drip shield is installed above each door as standard. A roof overhang prevents melting ice or snow from dripping onto the operating handle and freezing. All door hardware is tamper-resistant to prevent unauthorized entry. A heavy-duty, three-point latching system is provided with nylon rollers at interface points. The operating handle is stainless steel and has provisions for padlocking. All exposed exterior hardware is non-corrosive stainless steel. The door gasket is similar to compressible gaskets that are used on automotive doors. The gaskets are installed on the edge of the door frame so that the doors fit flush with the enclosure. The gaskets compress against the door surface around the entire perimeter to prevent ingress of moisture due to rain or snow. An automatically engaging door stop is provided that is easy to disengage through use of a spring-loaded operating rod. Vent hoods are provided over all external ventilation openings to prevent entry of rain or snow during turbulent wind conditions. Air filters are washable and re-usable. Filters are installed inside the vent hoods and can be accessed without the need to open the door and expose personnel to the high-voltage cable compartment.



Nylon rollers



Vent hood



Self-engaging doorstop



Three-point latch



Stainless steel handle



Compressible gasket



### Personnel doors

Personnel doors are fully insulated and provided with interior panic bar hardware for emergency egress, even when locked. All exterior hardware is stainless steel and designed to be tamper-proof. Locksets can be supplied to match a customer's standard key. A padlock attachment or keyless entry system is optionally available.

An automatic door closer is provided, which can be set to hold the door open, when necessary.

Doors are 42 inches wide to allow easy access for personnel and testing equipment. Double side-by-side entry doors and door windows are optionally available.



Automatic door closer



Stainless steel handle with lockset



Panic hardware



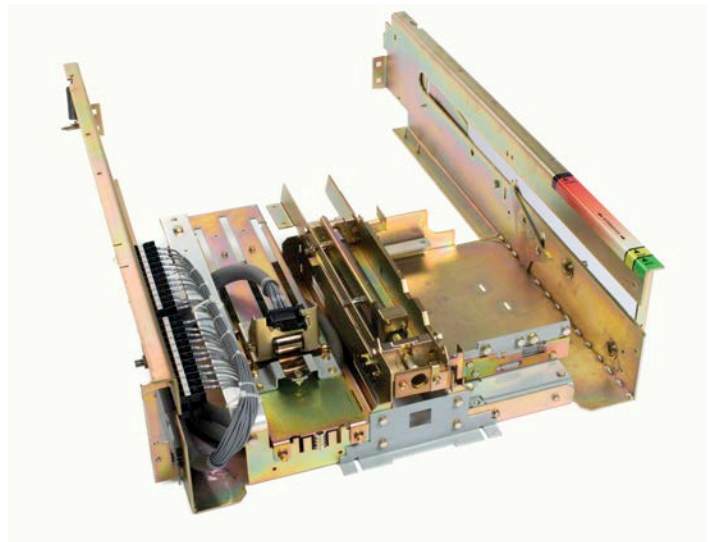
## Switchgear cubicles

Switchgear cubicles are individually welded to form rigid boxes that are bolted together to create a switchgear lineup. Welding ensures that each cubicle stays perfectly square during assembly of the lineup and maintains correct alignment of the breaker element to the racking mechanism, secondary contact block, and primary breaker connections. In addition, two thicknesses of 11-gauge steel are provided between vertical sections to offer additional protection against propagation of faults between adjacent cubicles.



## Breaker pan assembly

Eaton's breaker pan assembly for 5 kV, 15 kV, and 27 kV applications has been designed to exceed standard specifications and contains design enhancements to improve quality, safety, and maintenance. The breaker pan assembly includes dedicated positions for "Disconnect," "Test," and "Connect" and a viewing window mounted on the door allows the operator to visually confirm the position of the breaker without entering the equipment. As part of the dedicated "Test" position, the pan assembly contains an automatically engaging secondary that eliminates the need for manual connection of the secondary. In order to prevent possible damage to the contacts, an interlock is provided to ensure the secondary contacts are fully seated before they are allowed to carry current. Limit switches are available for use with our integral motorized remote racking (MR2) or breaker position indication lights on the front of the switchgear. The limit switch that indicates when the breaker is in the connected position can also be used to provide remote indication that the breaker is fully engaged to eliminate the need for a TOC switch. In order to improve performance and reduce maintenance, the number of grease points has been reduced to racking shaft only.



## Integral motorized remote racking (MR2)

Eaton's MR2 motorized remote racking system provides a means of remotely racking any VCP-W drawout circuit breaker and/or 5/15 kV auxiliary drawer used in metal-clad switchgear. The MR2 system can also be utilized to open and close the breaker remotely. Each MR2 system consists of a motor that is permanently integrated into the breaker or auxiliary compartment and a pendant that can be used universally between the different MR2 systems. The pendants are accompanied by a 30 ft cord to attach the pendant to the front of the switchgear. If specified, the operation of the MR2 can be performed from an HMI with touch screen controls. A standard feature of integral motorized remote racking (MR2) is the ability to sense a malfunction during racking of the breaker that will immediately stop the racking operation, once detected. An error code will then appear on the LED display on the front of the pendant with an explanation of the error codes printed on the back of the pendant. The addition of the MR2 system helps mitigate arc flash exposure for the user by removing the operator from the arc flash zone. MR2 is also available as an aftermarket purchase and field installation. Contact your Eaton sales rep for a quote.



### Insulation systems

Bus bar for 5 kV through 38 kV metal-clad switchgear is insulated with epoxy using the fluidized bed process. The process is controlled by a PLC that drives automated machinery. This process ensures an even and consistent coating thickness. Final cured thickness is checked with a depth gauge to verify that the coating meets specifications. A one-minute AC dielectric test is used to verify that the insulation system complies with IEEE® standards and to ensure that no hidden pinholes or voids are present in the insulation. In addition, epoxy is resistant to corrosive atmospheres, scratching, and chipping. The epoxy is colored red to indicate the presence of high voltage.

All copper bus bar is fully silver-plated at the mill to provide a uniform and consistent plating thickness that minimizes electrical resistance at bus joints.

Medium-voltage bus standoffs and bus feed-thru supports are molded from cycloaliphatic epoxy resin. This material has over 25 years of installed experience at investor-owned utilities in outdoor applications. Cycloaliphatic epoxy resin has proven to be superior to porcelain and is easy to mold to any desired shape.

A PVC bushing is inserted over the bus at feed-thru supports. This bushing eliminates any space between the insulated bus and the bus support to prevent corona activity.

When ground studs are required, they are installed before the bus bar is insulated so they can be integrated into the epoxy bus insulation system.



Fully silver-plated copper bars with red epoxy insulation



Cycloaliphatic bus standoffs



PVC insert



Vertical bus supports



Ground stud

### Terminations

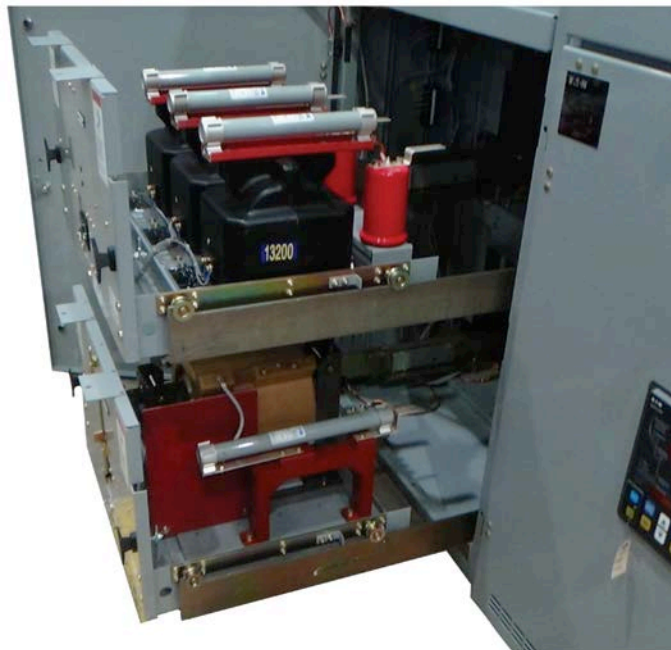
Eaton's power cable terminations are installed at a height to allow easy training of large diameter power cables and to provide adequate space for installation of stress cones. An adjustable cable support is provided to remove tension from the cable terminations. Two strip heaters are provided in each power cable compartment, as standard, to prevent formation of condensation on energized bus and bus supports. Should one of the two strip heaters fail, the remaining strip heater will continue to provide this protection until such time the customer is able to schedule an outage on that circuit to replace the failed heater. The strip heaters are energized at half voltage to increase their operating life. All strip heaters are provided with a protective guard to prevent accidental contact with the heating element by operating personnel.



Dual strip heaters

Adjustable cable support

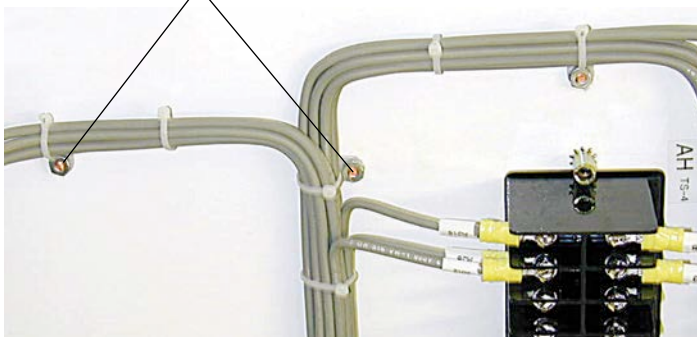
Eaton offers auxiliary drawers that can be engineered for up to four auxiliary drawers per structure. The drawers can be used for installing voltage, control power transformers, or primary fuses. The auxiliary drawers are designed for horizontal drawout that can be fully withdrawn on extension rails similar to the breakers, thus allowing front access to auxiliary equipment to permit easy testing and fuse replacement. A safety shutter (operated by the drawer) is included in each auxiliary drawer compartment. The safety shutters automatically operate when the auxiliary drawer is withdrawn to protect workmen from accidental contact with the stationary primary contacts. When fully withdrawn, the primary connections of an auxiliary drawer are grounded to allow maintenance and operations personnel to work on the equipment safely. The auxiliary drawers can be left in the disconnect position with front door closed.



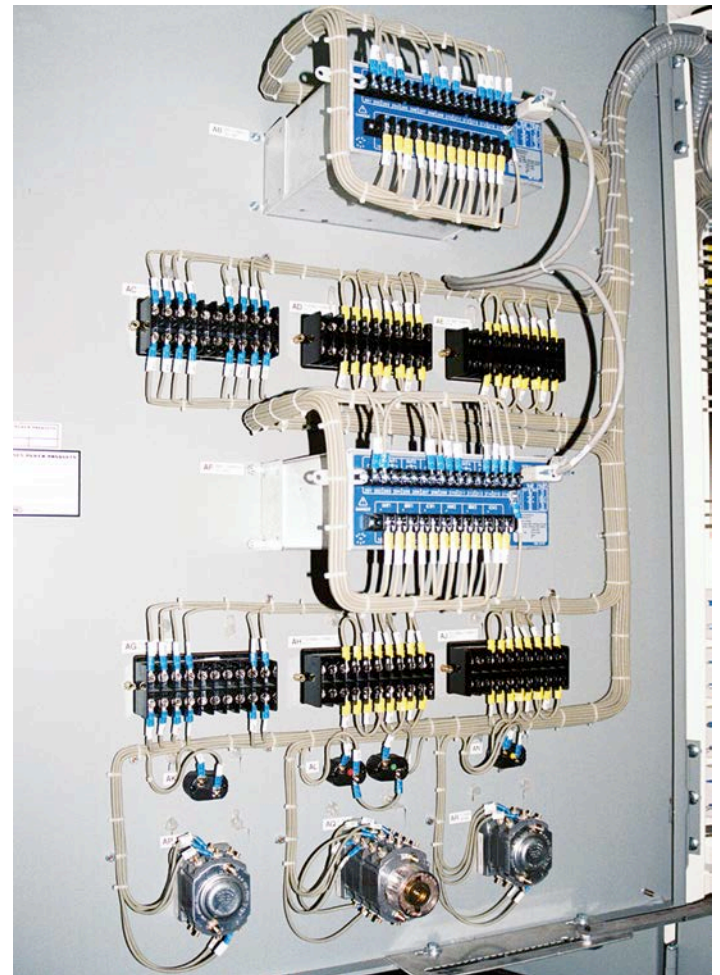
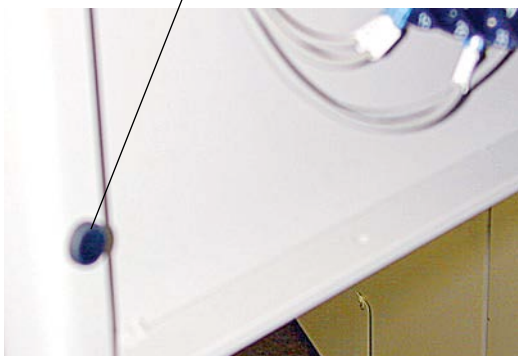
## Wiring

Control wire is neatly bundled and carefully trained to allow easy access to terminals and visibility of all wire markers. Wiring across door hinges is protected by heavy plastic wrap. Wire bundles are positioned above the height of the breaker element to prevent interference with the breaker during insertion or removal. Wiring is tied to clamps that are secured by a welded stud and nut. Insulated ring tongue lugs are standard for all control connections. A sleeve-type wire marker is installed on each wire that indicates the destination of the wire. Sleeve type wire markers can be rotated so that the marking is always visible and easily identifiable for maintenance personnel.

Welded hold-on studs



Vibration dampener



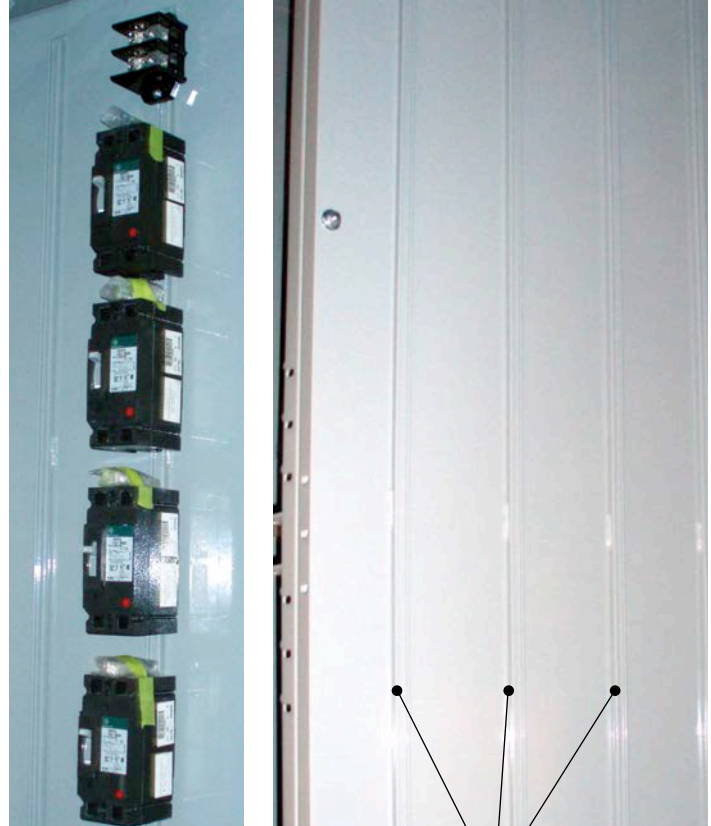
## Compartment doors

Front compartment doors are provided with a heavy-duty latch with two positive stops. One stop is used for testing of door-mounted devices, while the other allows safe withdrawal or insertion of breaker elements. Device doors have a double return at the front and rear edges to maintain door strength and rigidity. Rubber vibration dampeners are installed on the door return to protect the door surface and to prevent transmission of vibrations to door-mounted devices.



### Low-voltage component mounting

Eaton's Omaha Power Center welds unistrut channels to switchgear enclosure walls to allow easy installation of terminal blocks, fuse blocks, circuit breakers, control relays, and other surface-mounted low-voltage devices. This system provides great flexibility in location of devices and allows customers to add or relocate devices at any time in the future.

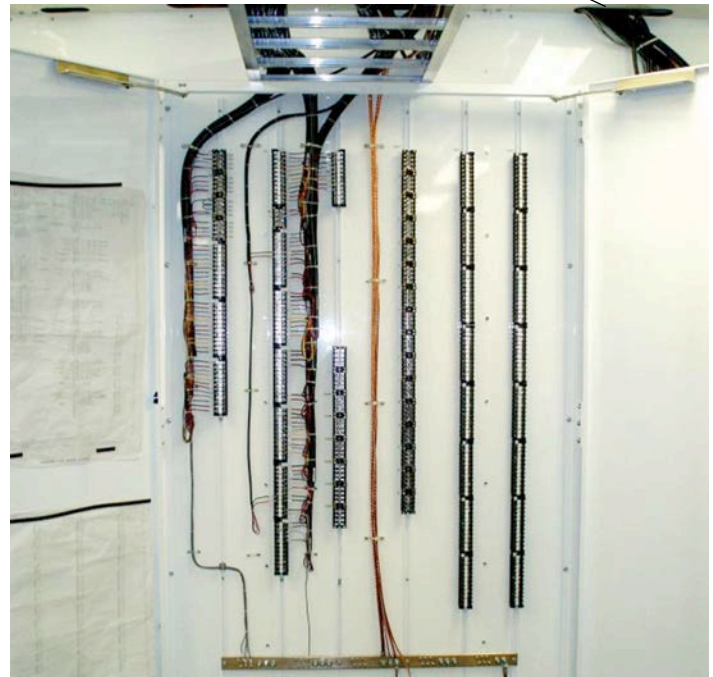


Unistrut channels

External cable riser

### Interface terminal cabinet

A popular option is installation of an interface termination cabinet that contains terminal block points for all external control connections. The terminal blocks can be provided in a separate cabinet, integrated into a relay panel enclosure, or located in a switchgear auxiliary cubicle. An external cable riser is commonly provided on the outside wall opposite the terminal blocks. Optionally, the interface termination cabinet can be located on the outside of the Eaton Switchgear Power Center. Use of a common interface point for all external control connections significantly reduces field installation time and cost.



## Proven weatherproof design

The Eaton Switchgear Power Center design has successfully passed a rain test in accordance with requirements contained in IEEE Standard C37.20.2. Eaton increased the severity of the test to help prove weatherproof integrity under hurricane-force wind and rain conditions. The table below compares the IEEE test criteria to the more stringent test conditions used by Eaton.

### Test criteria

Test parameter	IEEE requirement	Eaton test
Water flow rate	7.1 gal/min	15 gal/min
Water pressure	60 psi	120 psi
Distance to water nozzle	10 ft	6 ft
Number of surfaces tested	2	4
Number of joints tested	1	2

Eaton Switchgear Power Centers are available with optional stainless steel or marine-grade aluminum exteriors for installation in corrosive environments.



### Enclosure configurations

The Eaton Switchgear Power Center design is available in both single and common aisle arrangements. Work areas or control rooms can be integrated with the switchgear to meet other customer needs and requirements. Incoming power connections can be cable, bus duct, or overhead roof bushings. Eaton can supply non-segregated phase bus duct for connection to transformer secondaries at ratings up to 3000 A.



Standard-aisle design

The common-aisle lineup to the right illustrates the use of Masonite sheets to protect floor surfaces during assembly at the factory, as well as during installation and testing at the job site. This lineup has a control area at the far end for installation of relay and communications panels, plus a 125 Vdc lead-acid battery system. An internally mounted tie bus duct is used as a tie between the main bus of each lineup.



Common-aisle design

Masonite sheets

Other configurations can be designed to meet site-specific needs. A narrow-aisle design is available when job-site space is limited.



Narrow-aisle design



### IEEE standards testing

Eaton metal-clad switchgear has been subjected to and has passed all applicable IEEE design tests. Once manufacturing is completed, all equipment is subjected to IEEE standard production testing. In addition, all control and protection circuits are functionally tested. At Eaton's Omaha Power Center, inspection of equipment by the customer prior to shipment is available at no extra charge. Witness testing is also available for a nominal cost. During testing, the circuit breakers purchased for a project are used to confirm that all breakers operate in their respective cell, both mechanically and electrically, and to verify interchangeability of breakers of the same rating. Breakers are shipped with the switchgear, so they are immediately available for commissioning and startup testing.



### Shipping

Eaton Switchgear Power Centers are shipped on open-type, lowboy trailers. Eaton exercises extreme care in the preparation and packaging of equipment for shipment. All equipment is meticulously cleaned inside and out. Painted surfaces are wiped clean. Loose or spare parts are separately packaged and marked for easy identification. Circuit breakers can be installed or re-crated and shipped with the switchgear. Open ends of shipping splits are protected by a lumber framework and heavy-duty plastic that will not shred or rip during shipment. The leading and trailing edges of each load are protected against dirt and flying debris by a self-adhering transport mask that is easily removed and discarded after equipment has been delivered.



## Installation services

### Technical support services

A field installation specialist can be provided to supervise offloading and assembly by the customer's field crew or contractor.

### Complete installation

Eaton can provide experienced field technicians to assume responsibility for offloading and re-assembly of equipment. Installation includes the following services:

- Offload onto customer's foundation
- Reconnect and weatherproof any shipping splits
- Reconnect control cables across shipping splits
- Remove any shipping braces
- Re-install equipment packaged separately for shipment
- Uncrate and install batteries (if applicable)
- Uncrate and install vacuum circuit breakers
- Inspect the equipment for any signs of damage during shipment and offloading
- Verify receipt of all items on the bill-of-lading, including items packed in boxes

Eaton field installation personnel have over 30 years of experience in the installation of switchgear power centers.





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