

STANDARD SPECIFICATION FOR TYPE PSE DEAD-FRONT PAD-MOUNTED SWITCHGEAR

A. General

1. Product

The pad-mounted gear shall be in accordance with the applicable plans, drawings and one-line diagrams and shall conform to these specifications.

2. Assembly

The outdoor pad-mounted gear shall consist of a single self-supporting enclosure, containing three-phase group-operated interrupter switches and three-phase sets of single-pole fuses with the necessary accessory components, all completely factory assembled and operationally checked.

3. Coordination

To ensure a completely coordinated design, the pad-mounted gear shall be integrally designed and produced by the manufacturer of the basic switching equipment.

4. Ratings

Ratings for the integrated pad-mounted assembly shall be as designated below

System Voltage Class				
	15kV†	25kV†	35kV‡	
kV, Nominal	14.4	25	34.5	
kV, Maximum Design	17.5	27§	38	
kV, BIL	95	125	150	
Main Bus Continuous, Amps	600	600	600	
Switch Load-Interrupting, Amps	600	600	600	
Switch Fuse Load-Interrupting, Amps	200	200	200	
Switch Short-Circuit Ratings ① ② ③ ④				
Amps, RMS Symmetrical	Standard	14,000	12,500	25,000
	HFC	25,000	25,000	
Peak Withstand Current, Amperes	Standard	36,400	32,500	65,000
	HFC	65,000	65,000	
MVA, 3-Phase Symmetrical at Rated Nominal Voltage	Standard	350	540	1490
	HFC	620	1,080	
Fault-Closing Amps, RMS, Sym, 3-Time Duty-Cycle⑤	Standard	14,000	12,500	25,000
	HFC	25,000	25,000	

- ① These are nominal switch ratings. Integrated pad-mounted unit may be limited by fuse ratings. Use fuse rating chart in next column to select proper short circuit ratings.
- ② Select one set of the ratings shown. (Standard or High Fault Current - HFC)
- ③ Peak Current is 2.6 x Symmetrical Current
- ④ Asymmetrical Current is 1.6 x Symmetrical Current.
- ⑤ The three-time duty-cycle fault-closing rating means that the switch can be closed three times into rated symmetrical fault amperes and remain operable and able to carry and interrupt its rated load current
Note: These are symmetrical current test values per the standard. The use of asymmetrical or peak current values will provide seemingly higher ratings.

§ Maximum design of the 27kV switch is 29kV.

† For UL® Listed units, ratings are 15.5kV, 14,000 or 25,000 amperes rms symmetrical, 350 MVA, 22,400 or 40,000 amperes fault closing; and 27kV, 25,000 amperes rms symmetrical, 1080 MVA, 40,000 amperes asymmetrical fault closing.

‡ 35kV class designs are not UL® Listed. Check with the factory for available configurations and footprints.

5. Certification of Ratings

The manufacturer shall be completely and solely responsible for the performance of the basic switch and fuse components as well as the complete integrated pad-mounted gear assembly as rated.

The manufacturer shall furnish, upon request, certification of ratings of the basic switch and fuse components and/or the integrated pad-mounted gear assembly consisting of the switch and fuse components in combination with the enclosure. This certification of the integrated unit shall include testing the pad-mounted gear to the fault-close requirements of the specification to assure the bus support system and components are adequate.

Fuse Ratings				
Fuse Manufacturer	Fuse Type	Three-Phase MVA Sym.	Amps RMS Asym.①	Cont. Amps
14.4 kV Nominal Voltage				
S&C ④	SM-4	310	20000	200
S&C	SMU-20	350	22400	200
S&C ③	SM-5‡	-	-	-
Eaton	DBU	350	22400	200
Cooper④	CMU	350	22400	200
Cooper (M-E)②	NX	620	40000	100*
Cooper (CT)②	X-Limiter	620	40000	140
Thomas & Betts ② ③	Hi-Tech	620	40000	140
25 kV Nominal Voltage				
S&C ④	SM-4†	540	20000	200
S&C	SMU-20	540	20000	200
S&C ③	SM-5‡	-	-	-
Eaton	DBU	500	20000	200
Cooper ④	CMU	500	20000	200
Cooper (M-E)②	NX	1080	40000 ③	40
Cooper (CT)②	X-Limiter	1080	40000 ③	40
Thomas & Betts ② ③	Hi-Tech	1080	40000 ③	50
34.5 kV Nominal Voltage ⑤				
S&C	SMU-20	500	13500	200
Eaton	DBU	500	12500	200

- ① The fuse mounting can withstand rated fault amperes up to three times and remain operable and able to carry its rated load current. For rating applicable to fault-closing capability of the separable connector (elbow), refer to elbow manufacturer.
- ② Maximum current rating of the fuse mounting is 22,400 amperes rms asymmetrical. Fuse mounting ratings can be increased to the fuse-interrupting rating ONLY if the current-limiting fuse limits the let-through current to a value equal to or less than the short-circuit rating of the fuse mounting. Refer to current-limiting fuse manufacturer.
- ③ Models with this fuse-type are not UL® Listed.
- ④ Check with the factory for UL® Listing.
- ⑤ 35kV class designs are not UL® Listed.
- * 100 amp @ 13.5 kV max or 80 amp @ 15 kV.
- † Applicable to solidly-grounded-neutral systems only with fuses connected by a single conductor concentric neutral type cable to a transformer or transformers. Rating is 9,400 amperes RMS symmetrical, 15,000 amperes RMS asymmetrical (405 MVA symmetrical) for all other applications.
- ‡ SM-5 fuses cannot be used in PSE Pad-mounted Switchgear. Contact factory for SM-5 applications.

TYPE PSE MANUAL DEAD-FRONT PAD-MOUNTED SWITCHGEAR

The following optional feature may be specified:

- a) The pad-mounted switchgear shall be UL® Listed.

6. Submittals

When requested, the manufacturer shall furnish the following drawings and reports:

- a) Layout showing dimensions, arrangements, electrical ratings, components and weights.
- b) Certified test reports of similar manufactured units showing fault-closing capability and load-interrupting capability of switches and complete pad-mounted gear assembly based on maximum design voltage.

7. Compliance with Standards & Codes

The pad-mounted switchgear shall conform to or exceed the applicable requirements of the following standards and codes:

- a) All portions of ANSI/IEEE C57.12.28, covering enclosure integrity for pad-mounted equipment.
- b) Article 490.21(E) "Load Interrupters" in the National Electrical Code, which specifies that the interrupter switches in combination with power fuses shall safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating.
- c) All portions of IEEE C37.74 covering design and testing of the distribution switchgear, components and ways.
- d) All portions of ANSI, IEEE, and NEMA standards applicable to the basic switch and fuse components.

8. Enclosure Design

To ensure a completely coordinated design, the pad-mounted gear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances and adequate space for fuse handling.

In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access and tamper resistance.

B. Construction - Assembly

1. Insulators, Bushings and Bushing Wells

The interrupter-switch and fuse-mounting insulators and the bushings and bushing wells shall have the following material characteristics and restrictions:

- a) Operating experience of at least twenty (20) years under similar conditions.
- b) Ablative action to ensure non-tracking properties.
- c) Adequate leakage distance established by test per IEC Standard 60507.
- d) Adequate strength for short-circuit stress established by test.
- e) Conformance with applicable ANSI standards.
- f) Homogeneity of the cycloaliphatic epoxy resin throughout each insulator, bushing and bushing well to provide maximum resistance to power arcs. Ablation due to high temperature from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulating components during installation or maintenance of the pad-mounted gear shall expose material of the same composition and properties so that insulating components with minor surface damage need not be replaced.

- g) Each insulator, bushing and bushing well shall be x-rayed to assure it is essentially void free. An alternate testing method may be used only by approval of the engineer.
- h) Conductor rods of bushings and bushing wells shall be of all copper with silver flash at threaded studs.

2. High-Voltage Bus

- a) Bus and interconnections shall consist of bare aluminum bar of 56% IACS conductivity with an oxide-inhibiting agent at all bus joints.
- b) Bus and interconnections shall withstand the stresses associated with short circuits up through the maximum rating of the pad-mounted gear, including proper allowance for transient conditions.
- c) Bolted aluminum-to-aluminum connections shall be made with a suitable number of non-corrosive bolts and with two Belleville spring washers per bolt, one under the bolt head and one under the nut, or with a wide, flange-head bolt and one Belleville spring washer under the nut per bolt. As an alternate, bolted aluminum-to-aluminum connections shall be made with a suitable equivalent surface area, i. e. 1-bolt and spring washer. Bolts shall be tightened to an appropriate torque to assure good electrical connection.
- d) Before installation of the bus, all electrical contact surfaces shall first be prepared by abrading to remove any aluminum-oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.
- e) Silver-flashed copper bus is optionally available for 600A applications.
- f) 1200A bus shall be 1/2" x 2" silver-flashed copper.

3. Ground-Connection Pads

- a) A ground connection pad shall be provided in each termination compartment of the pad-mounted gear.
- b) The ground connection pad shall be constructed of 1/4" thick, stainless steel and have a NEMA 2-hole pattern for ground connections. The pad shall be welded to the enclosure and shall have a short-circuit rating equal to that of the integrated assembly.
- c) A full width copper grounding rod shall be provided in each cable-termination compartment.

C. Construction - Enclosure & Finish

1. Enclosure

- a) The pad-mounted enclosure shall be of unitized construction (not structural frame and bolted sheet) to maximize strength, minimize weight, and inhibit internal corrosion.
- b) The basic material for the enclosure, roof and doors shall be 11-gauge, hot-rolled, pickled-and-oiled steel sheet.
- c) All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. A welding process shall be employed that eliminates alkaline residues and minimizes distortion and spatter.
- d) To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.
- e) The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
- f) The door openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as

deep overlapping between doors and door openings to guard against water entry.

- g) In consideration of tamper resistance, the enclosure shall conform to or exceed the requirements of ANSI/IEEE C57.12.28.
- h) A heavy coat of insulating "no-drip" compound shall be applied to the inside surface of the roof to reduce condensation of moisture thereon. The roof shall be removable with bolts accessible in termination compartments.
- i) Lifting tabs shall be removable. Sockets for the lifting-tab bolts shall be blind-tapped. A protective material shall be placed between the lifting tabs and the enclosure to prevent the tabs from scratching the enclosure finish. This material shall be non-hygroscopic to prevent moisture from being absorbed.
- j) To prevent moisture ingress, the roof shall be one-piece construction and shall not include any gasketed joints or any unground weld butt joints exposed to the exterior.

The following optional feature may be specified:

- k) A steel (specify compartmented or non-compartmented) base spacer shall be provided to increase the elevation of live parts in the pad-mounted gear above the mounting pad by (specify 6, 12, 18, 24) inches.

2. Barrier Assembly

Insulating barriers shall be provided in each switch and fuse compartment as required to achieve necessary insulation levels. This barrier system shall be constructed of fiberglass reinforced polyester (NEMA rated GPO-3).

3. Doors

- a) Doors shall be constructed of 11-gauge hot-rolled, pickled-and-oiled steel sheet.
- b) Door edge flanges shall overlap with door opening flanges and shall be formed to create a mechanical maze that shall guard against water entry or discourage tampering or insertion of foreign objects.
- c) Doors shall have a minimum of three stainless steel hinges and hinge pins. The hinge pins shall be secured in place to guard against tampering.
- d) One active and one passive door shall be provided. In consideration of controlled access and tamper resistance, each active door shall be equipped with a positive-action three-point auto-latch mechanism and padlock hasp.
- e) Each active door shall be provided with a hinged stainless-steel cover over the operating bolt. The cover shall be padlockable and shall incorporate a hood to protect the padlock shackle from tampering and access to the operating bolt. Each handle shall be provided with a recessed penta-head (hex optional) bolt for additional security.
- f) Each passive door shall be independently secured and latched to the enclosure and shall not require a tool for opening.
- g) Doors providing access to fuses shall have provisions to store spare expulsion type fuse units or refills.
- h) Each door shall be provided with a stainless-steel door holder located above the door opening. These holders shall be hidden from view when the door is closed. It shall not be possible for the holders to swing inside the enclosure.

4. Finish

- a) Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.

- b) All exterior seams shall be sanded or ground smooth for neat appearance.

- c) All surfaces shall undergo a chemical cleaning, phosphatizing or zirconization and sealing process before any protective coatings are applied in order to remove oils and dirt, form a chemically and anodically neutral conversion coating, improve the finish-to-metal bond, and retard underfilm propagation of corrosion.

- d) The finishing system shall be applied without sags or runs.

- e) After the enclosure is completely assembled and the components (switches, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches.

- f) Blemishes shall be carefully touched up by hand to restore the protective integrity of the finish.

- g) Unless otherwise specified, the color shall be Munsell No. 7GY3.29/1.5, dark green.

- h) To ensure that the finishing system is capable of resisting corrosion, the manufacturer shall provide on request, certification that representative test panels, protected by the manufacturer's finish system, have passed the coating system performance requirements in section 5.5 of ANSI C57.12.28 as verified by an independent third party certifier, such as UL[®].

D. Basic Components

1. Interrupter Switches

- a) Interrupter switches shall have a three-time duty-cycle fault-closing rating equal to or exceeding the short circuit rating of the integrated pad-mounted gear assembly. These ratings define the ability to close the interrupter switch either alone (unfused) or in combination with the appropriate power fuses three times against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum design voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.

- b) Interrupter switches shall utilize a quick-make, quick-break mechanism installed by the switch manufacturer. The quick-make, quick-break mechanism shall be integrally mounted on the switch frame, and shall swiftly and positively open and close the interrupter switch independent of the speed of the switch operating handle.

- c) Interrupter switches shall be operated by means of an externally accessible switch-operating hub. The switch-operating hub shall be located within a recessed stainless-steel pocket mounted on the side of the pad-mounted enclosure. The switch-operating hub pocket shall include a padlockable stainless-steel access cover that shall incorporate a hood to protect the padlock shackle from tampering. Labels or targets to indicate switch positions shall be provided in the switch operating hub pocket.

- d) Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a rigid mounting frame. The frame shall be of heavy-gauge steel construction.

- e) Interrupter switch shall be provided with contact blades and interrupters for circuit closing, including fault-closing, continuous current carrying, and circuit interrupting. Spring loaded auxiliary blades shall not be permitted.

- f) Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence.

TYPE PSE MANUAL DEAD-FRONT PAD-MOUNTED SWITCHGEAR

- g) Interrupter switches shall have a readily visible open gap when in the open position, which shall be viewable through a mar-resistant clear barrier, to allow positive verification of correct switch position. In addition, an open/close label shall be provided in the termination compartment to give a supplemental visual indication of switch position.
- h) Each interrupter switch shall be provided with a switch operating handle. The switch-operating handle shall be secured to the inside of the switch-operating hub pocket and shall be stored behind the switch-operating hub access cover.
- i) To increase contact separation speed, interrupter switch contacts on both sides of the arcing area shall be spring assisted to reduce arcing time and to rapidly increase the dielectric gap.
- j) To further insure arc extinction, air shall be compressed and simultaneously injected into the arcing area to cool the arc and thereby not rely solely on blade travel to insure arc extinction.
- k) Arc extinction shall not rely on gases generated by ablative action of the arc playing on any interrupter switch components or materials which will carbonize, deplete or otherwise erode such components and materials.

The following optional features may be specified:

- l) Key interlocks shall be provided to prevent paralleling the two source interrupter switches.
- m) Key interlocks shall be provided to guard against opening fuse compartment door(s) unless all switches (series tap switch only, where furnished) are locked open.
- n) Provision to padlock switch-operating hub in open or closed position shall be provided.
- o) Cable guides shall be provided to help orient cables at switch and bus compartment terminals.
- p) Mounting provisions shall be provided to accommodate one three-phase fault indicator with three single-phase sensors in each switch compartment (except series tap switch, where furnished). External holes for fault indicators shall include a tamper-resistant arrangement where fault indicators are not shipped installed.
- q) Mounting provisions to accommodate LED-Type Fault Indicators. Holes for such fault indicators shall be plugged for shipment with tamper-resistant arrangement.
- r) To facilitate installation of elbow-connected surge arresters or grounding elbows, a set of three 200-ampere bushing wells shall be provided in each switch-termination compartment without increasing the height or depth of the basic unit.
- s) Cable supports - recommended for cables 350MCM or larger and for all parallel cable applications.

2. Switch Compartments

- a) Switch terminals shall be equipped with 600 ampere rated bushings that include removable tin-plated aluminum threaded studs (silver-plated copper studs optional) to accommodate a choice of termination systems.
- b) Bushings and bushing wells shall have interfaces in accordance with ANSI/IEEE Standard 386 (ANSI Standard C119.2) to accept all standard separable insulated connectors and inserts.
- c) Parking stands are provided adjacent to each bushing and bushing well to accommodate horizontal feed-throughs and standoff insulators.

- d) All medium-voltage switch and fuse components are completely encased in an inner grounded steel compartment. The component compartment floor shall be of 16-gauge galvanized steel sheet to exclude foliage and animals. The floor shall be cross-kinked and shall have a small stainless-steel screen in each corner.
- e) Viewing windows are provided within the termination compartments to allow visual verification of switch position, observation of switch-position open/close labels and inspection of blown-fuse indicators on power fuses.

3. Fuse Compartments

- a) Fuse terminals are equipped with 200 ampere rated bushing wells designed to accept 200 ampere bushing inserts and shall have removable, 303SS studs (tin-plated with copper undercoat).
- b) Bushings and bushing wells shall have interfaces in accordance with ANSI/IEEE Standard 386 (ANSI Standard C119.2) to accept all standard separable insulated connectors and inserts. Parking stands are provided adjacent to each bushing and bushing well to accommodate horizontal feed-throughs and standoff insulators.
- c) Fuse access panels shall have a mechanical interlock that guards against gaining access to the fuse before opening the load-break separable insulated connector at the fuse terminal.
- d) The fuse shall be accessible only when de-energized and isolated – for full-view non-loadbreak disconnection and removal with a shotgun stick. This mounting features positive latching in both the energized and de-energized positions. When latched in the open position, the de-energized fuse is electrically isolated and readily accessible to operating personnel for removal with full visibility of contact interfaces on both sides of the fuse.
- e) Access to the compartment containing energized components when fuses are being changed shall be blocked by a GPO-3 panel that is secured in position.
- f) Individual parking stands shall be provided for each fuse mounting to allow convenient installation of elbow accessories to accommodate grounding. A ground rod shall be installed across the full width of the fuse compartments for connecting of cable concentric neutrals. Fuse phases shall be equipped with cable guides to assist in cable training and to prevent cables from interfering with movement of the fuse-access panel.
- g) To provide maximum service life and to prevent corrosion of moving parts, all latches and pivots in the fuse-handling mechanism shall be either painted steel, stainless steel, or zinc-plated.

The following optional features may be specified:

- h) Fuse storage hooks shall be provided on fuse-termination compartment access door(s). Each set of hooks shall allow the storing of three complete fuse assemblies for power fuses. Storage hooks shall be for two holders when current-limiting fuses are used.

4. Bus Termination Compartments

- a) PSE dead-front bus termination compartments may be equipped with 200A bushing wells and/or 600A dead-break bushings.
- b) Default configurations, per bus termination compartment (verify with the factory when placing an order):
 - PSE-3 3 - 600A Bushings
 - PSE-8 3 - 200A Bushing wells
 - PSE-13 3 - 200A Bushing wells
- c) All other bus termination compartment configurations must be clearly specified.

E. Labeling

1. Warning Signs

All external doors shall be provided with approved "WARNING – HIGH VOLTAGE – KEEP OUT" signs.

2. Nameplate, Ratings Labels & Connection Diagrams

- a) The outside of both the front and back shall be provided with nameplates indicating the manufacturer's name, catalog number, model number, and date of manufacture.
- b) The inside of each door shall be provided with a ratings label indicating the following: voltage ratings; main bus continuous rating; short-circuit ratings (amperes, RMS symmetrical and MVA three-phase symmetrical at rated nominal voltage); the type of fuse and its ratings including duty-cycle fault-closing capability; and interrupter switch ratings, including duty-cycle fault-closing capability and amperes, short-time, RMS (momentary asymmetrical and one-second symmetrical). A label indicating equipment is UL® Listed shall be included when applicable.
- c) A three-line connection diagram showing interrupter switches, fuses and bus along with the manufacturer's model number shall be provided on the inside of both the front and rear doors, and on the inside of each switch-operating hub access cover.

F. Accessories

End fittings or holders, and fuse units or refill units for original installation, as well as spare fuse unit or refill unit for each fuse mounting, shall be furnished in accordance with the client's requirements when specified.