UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 26 - ELECTRICAL

SECTION 26 13 01

PAD-MOUNTED DEAD-FRONT AIR INSULATED SWITCHGEAR

08/13, CHG 1: 02/20

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SECTION 26 13 01

PAD-MOUNTED DEAD-FRONT AIR INSULATED SWITCHGEAR
08/13, CHG 1: 02/20

****
NOTE: This guide specification covers the requirements for air insulated, dead-front, enclosed and non-enclosed, dead-front pad-mounted switchgear. This guide specification is not intended for Navy installations and will be used when specified for Army and Air Force projects.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

****
NOTE: Use the following related guide specifications for power distribution equipment:

--Section 26 08 00 APPARATUS INSPECTION AND TESTING
--Section 26 11 16 SECONDARY UNIT SUBSTATIONS
--Section 26 11 13.00 20 PRIMARY UNIT SUBSTATIONS
--Section 26 12 19.10 THREE-PHASE, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS
--Section 26 12 21 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS
--Section 26 05 73 POWER SYSTEM STUDIES
--Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION

--Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION

****

****

NOTE: Show the following information on the project drawings:

1. Site Plan showing location, space available, and desired arrangement of switchgear.

2. Single-line diagram showing: nominal system voltage; number and configuration of switched ways; type, number, and size of conductors for each circuit; and method of power cable termination (600 ampere deadbreak connectors). Individually identify each switched way as load or fault interrupter and single-pole or three-pole tripping.

3. Grounding Detail with ground rods, ground loop and interconnecting cables when interconnecting with other grounding systems or if multiple switches are provided.

4. Special conditions, such as altitude, temperature and humidity, exposure to fumes, vapors, dust, and gases.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2023) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE 495	(2007) Guide for Testing Faulted Circuit Indicators
IEEE C2	(2023) National Electrical Safety Code
IEEE C37.74	(2014) Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C62.11	(2020) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 70B	(2023) Recommended Practice for Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES (UL)

UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

****

NOTE: Include Section 26 08 00 APPARATUS INSPECTION AND TESTING on all projects involving medium voltage and specialized power distribution equipment.
****

Section 26 08 00 APPARATUS INSPECTION AND TESTING, applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Switched Way

A switched way is considered a three-phase circuit entrance to the bus through a switch.

1.4 SUBMITTALS

****
NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings; G[, [_____]]

SD-03 Product Data

****
NOTE: Include the following submittal when the switchgear will have fused switched ways.
****

[Fuse Time-Current Characteristic Curves; G[, [_____]]

] Air Insulated Pad-mounted Switchgear; G[, [_____]]

Insulated High-Voltage Connectors; G[, [_____]]

[Surge Arresters; G[, [_____]]

] SD-06 Test Reports

Acceptance Checks and Tests; G[, [_____]]

SD-07 Certificates

Paint Coating System; G[, [_____]]

SD-09 Manufacturer's Field Reports

Switchgear Design and Production Tests; G[, [_____]]

SD-10 Operation and Maintenance Data

Air Insulated Pad-Mounted Switchgear Operation and Maintenance, Data Package 5; G[, [_____]]

1.5 QUALITY ASSURANCE

1.5.1 Switchgear Drawings

Furnish drawings that include, but are not limited to, the following:

a. Overall dimensions, weights, plan view, and front view

b. Ratings

c. Single-line diagram.

1.5.2 Paint Coating System

****
NOTE: Select IEEE C57.12.29 when specifying stainless steel enclosures.
****

Submit [IEEE C57.12.28][IEEE C57.12.29] paint coating system performance requirement tests.

****

NOTE: Include the following only if the fuse time-current curves are not already provided in the specified electrical analysis software package. Most commercially available software packages already contain the typical fuses used in pad-mounted switchgear.

****

[1.5.3 Fuse Time-Current Characteristic Curves

Provide time-current characteristic curves in PDF format and in electronic format suitable for import or updating into the [EasyPower][SKM PowerTools for Windows][_____] computer program.

]1.6 MAINTENANCE

1.6.1 Air Insulated Pad-mounted Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 AIR INSULATED PAD-MOUNTED SWITCHGEAR

IEEE C37.74. Submit manufacturer's information on switches and each component, device, and accessory provided with the equipment.

2.1.1 Ratings and Test Requirements

****

NOTE: Select rated impulse voltage (BIL) to correspond with the selected rated maximum voltage.

Select short circuit current as applicable for the switchgear type.

Select power fuse style and interrupting rating based on desired system characteristics and fuse style.

****

Provide switchgear with a nominal voltage rating of [14.4][25] kV and the following corresponding ratings:

Rated Maximum Voltage, kV	[17][27][_____]
Rated Withstand Impulse Voltage, kV BIL	[95][125]
Continuous and Load Interrupting Current, A	600
Short-Circuit Current, kA rms Sym	[25][22.4][_____]

[Power Fuses, Amperes, Maximum Interrupting, kA rms Sym]	[[200][200E][200K][14][12.5][_____]]

Provide switched ways rated for the required continuous and load interrupting current.

2.1.2 Switchgear Construction

Provide switchgear with the following construction and configuration:

a. Switch contacts and cable entrance terminations contained in an enclosed, steel compartment.

b. Configured with[load interrupting][and][fused] switched ways as indicated.

c. Accessible terminations suitable for cables entering from below.

d. Switch contact positions for switched ways visible through viewing windows in the switchgear termination compartment.

e. Each switched way with two position switch; Open, Closed and provisions for grounding.

****

NOTE: For Navy-designed projects, select the option below with the switchgear installed on a concrete pad. For some Army and Air Force projects, installation on a fiberglass pad or above a vault is desired. In these cases, select the second bracketed option below. If the switchgear is installed above a vault, provide details on associated drawings.

****

[2.1.2.1 Pad-mounting Provisions

****

NOTE: Choose stainless steel enclosure where environmental conditions are not suitable for mild steel or where a higher level of corrosion protection is desired. Select IEEE C57.12.29 when enclosure is required to be stainless steel.

****

Provide enclosed switchgear suitable for installation on a concrete pad, including the following:

[a. Fabricate switchgear[enclosure and] enclosure base of ASTM A240/A240M type 304 or 304L stainless steel.

] b. Enclosure base includes any part of the switchgear enclosure that is within 75 mm 3 inches of concrete pad.

c. Paint enclosure including base ASTM D1535 [Munsell 7GY3.29/1.5 green][Munsell 8.3G6.1/0.5 light gray (ANSI No. 61)] [_____].

d. Comply with [IEEE C57.12.28][IEEE C57.12.29] for the paint coating

system regardless of equipment material.

][2.1.2.2 Pad/Vault-mounting Provisions

****
NOTE: Choose stainless steel enclosure where environmental conditions are not suitable for mild steel or where a higher level of corrosion protection is desired. Select IEEE C57.12.29 when enclosure is required to be stainless steel.
****

[Provide enclosed switchgear suitable for installation on a concrete pad or fiberglass box pad, including the following:][Provide enclosed switchgear on a concrete vault, as indicated, including the following:]

[a. Fabricate switchgear[enclosure and] enclosure base of ASTM A240/A240M type 304 or 304L stainless steel.

] b. Enclosure base includes any part of the switchgear enclosure that is within 75 mm 3 inches of concrete pad.

c. Paint enclosure including base ASTM D1535 [Munsell 7GY3.29/1.5 green][Munsell 8.3G6.1/0.5 light gray (ANSI No. 61)] [_____].

d. Comply with [IEEE C57.12.28][IEEE C57.12.29] for the paint coating system regardless of equipment material.

]2.1.3 Load Interrupting Switched Ways

Provide the following for load interrupter switched ways:

a. Three-pole group operated switching.

b. Interrupter switches operated by means of an externally accessible switch-operating hub.

c. Switch-operating hub located within a recessed stainless steel pocket mounted on the side of the pad-mounted gear enclosure.

d. Padlockable stainless steel access cover and hood on the switch-operating-hub pocket to protect the padlock shackle from tampering.

e. Stops on the switch-operating hub to prevent overtravel.

f. Labels in the switch-operating-hub pocket to indicate switch position.

g. Folding switch-operating handle for each interrupter switch.

2.1.4 Fused Ways

Provide the following:

a. Fuse mountings enclosed in an inner steel compartment.

b. Each fuse mounting installed as an integral part of a fuse handling mechanism that does not allow access to the fuse until the elbow for

that fuse has been disconnected and a mechanical interlock to the fuse-access panel has been actuated.

c. The opening into the component compartment covered by the fuse-access panel in both the open and closed positions to prevent access to high voltage.

d. Blown-fuse indicators for fused ways visible through viewing windows in the termination compartment.

2.1.4.1 Fuses

****

NOTE: Indicate on the drawings the fuse rating and type of fusing desired. The type of fusing is important to ensure the switch is equipped with correct fuseholder hardware.

****

Provide fuses in accordance with the following:

a. Fuse ratings as indicated.

b. Helically coiled fuses if rated 10 amperes or larger.

c. Solid-material power fuses capable of detecting and interrupting all faults under all realistic conditions of circuitry, with line-to-line or line-to-ground voltage across the fuse, and capable of handling the full range of transient recovery voltage severity associated with these faults.

d. All arcing accompanying operation of the fuse contained within the fuse, and all arc products and gases evolved effectively contained within the exhaust control device during fuse operation.

e. Fusible elements nonaging and nondamagable with melting time-current characteristics that are permanently accurate to within a maximum tolerance of 10percent in terms of current.

f. Equipped with a blown-fuse indicator that provides visible evidence of fuse operation while installed in the fuse mounting.

[2.1.5 Key Interlock

****

NOTE: Add requirements for key interlock if needed. Provide details of interlock system on the drawings.

Coordinate with the local installation to determine if interlocks are required. If interlocks are not required, then ensure the installation uses only qualified personnel to work on the equipment.

At least one manufacturer requires a formal letter from the installation if key interlocks are not desired.

****

Provide key interlock system as indicated on the drawings.

]2.1.6 Dead-Front High-Voltage Bushings

****
NOTE: Make selection below based on system voltage. Include fused way selection if fused compartments are intended.
****

[IEEE 386.[15 kV, 95 kV BIL][25 kV, 125 kV BIL]. Provide 600 ampere one-piece deadbreak apparatus bushings for each switched way.

][IEEE 386.[15 kV, 95 kV BIL][25 kV, 125 kV BIL]. Provide 200 ampere bushing wells and bushing well inserts for each fused way.
]

****
NOTE: Include standoff bushings only when the Activity requires the additional items.
****

a. Parking stands: Provide a parking stand near each dead-front bushing.[Provide insulated standoff bushings for parking of energized load-break connectors on each parking stand.]

2.2 Insulated High-Voltage Connectors

IEEE 386. Provide corresponding connector for each switched way; provide connectors with a grounding eye and test point.

****
NOTE: Provide 200 ampere bushing interface on all 600 ampere connectors.
****

[a. 600 Ampere deadbreak connector ratings: Voltage: [15 kV, 95 kV BIL][25 kV, 125 kV BIL]. Short time rating: 25,000 rms symmetrical amperes.[Include 200 ampere bushing interface[for surge arresters][as indicated].]

][b. 200 Ampere loadbreak connector ratings: Voltage: [15 kV, 95 kV BIL][25 kV, 125 kV BIL]. Short time rating: 10,000 rms symmetrical amperes.
]

****
NOTE: Provide bushing-mounted elbow type arresters at normally open switch locations.
****

[2.3 Surge Arresters

IEEE C62.11, rated[[3][6][9][10][12][15][18][_____] kV][as indicated], fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide arresters on switched ways as indicated.

]2.4 Grounding Provisions

Provide a ground-connection pad in each termination compartment.[Provide a continuous copper ground bus across the full width of each termination

compartment for fuses.]

****

NOTE: Include the following paragraph only when the activity requires additional grounding elbows and feed-thru inserts.

****

[a. Provide[[one][_____] set[s] of three grounding elbows][and][[one][_____] set[s] of three feed-thru inserts]. [Grounding elbows][and][feed-thru inserts]. Deliver to the Contracting Officer.
]

****

NOTE: Include the following paragraph only when the activity requires additional grounding elbows and grounded standoff bushings.

****

[b. Provide[[one][_____] set[s] of three grounding elbows][and][[one][_____] set[s] of three grounded standoff bushings]. [Grounding elbows][and][grounded standoff bushings]. Deliver to the Contracting Officer.
]

****

NOTE: If fault indicators are desired, determine type and locations. Provide information on the drawings.

****

[2.5 Faulted Circuit Indicators

Install one set of faulted circuit indicators on the test points of each set of separable insulated connectors. Faulted circuit indicators must comply with IEEE 495. Indicators must be self powered; with automatic trip with mechanical flag indication upon overcurrent followed by loss of system voltage. Indicators must be compact, sealed corrosion resistant construction with provision for hotstick installation and operation.

]2.6 SOURCE QUALITY CONTROL

2.6.1 Switchgear Design and Production Tests

Furnish reports which include results of design and production tests performed according to IEEE C37.74. Perform production tests by the manufacturer on each switchgear assembly to ensure that design performance is maintained in production.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

****

NOTE: Where rock or other soil conditions prevent obtaining a specified ground value, specify other methods of grounding. Where it is impractical to

obtain indicated ground resistance values, make every effort, within reason, to obtain ground resistance values as near as possible to the indicated values.
****

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding [25][_____] ohms. When work, in addition to that indicated or specified, is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.1 Grounding Electrodes

****
NOTE: Select the Section reference to correspond to the desired service activity.
****

Provide driven ground rods as specified in [Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION][_____][at each corner of switchgear pad][as indicated].

3.2.2 Switchgear Grounding

Connect #4/0 bare copper conductor ground loop, not less than 610 mm 24 inches below grade, to the upper end of the ground rods by exothermic welds or compression connectors. Provide #4/0 bare copper conductors connecting the switchgear grounding provisions to two different ground rods.

3.2.3 Connections

****
NOTE: Select the Section reference to correspond to the desired service activity.
****

Make joints in grounding conductors and ground loop by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section [33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION][_____].

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

****
NOTE: Select from the bracketed options below for the selected installation method. Coordinate with paragraphs PAD-MOUNTING PROVISIONS and PAD/VAULT-MOUNTING PROVISIONS.
****

Mount switch[on concrete slab][on concrete box pad][on fiberglass pad][on fiberglass box pad][on concrete vault][as shown on the drawings], including the following:

[a. Provide box pad with a minimum depth of[813 mm 32 inches][915 mm 36 inches][_____].

][b. Show vault size on the drawings.

][c. Provide slab of size at least 300 mm 12 inches thick, reinforced with a 152 by 152 - MW19 by MW19 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 100 mm 4 inches from the top of the slab.

] d. Place [Slab][Box pad] on a 150 mm 6 inch thick, well-compacted gravel base.

e. Install [top of concrete slab approximately 100 mm 4 inches above finished grade. Provide edges above grade with 15 mm 1/2 inch chamfer.]

f. Provide [slab] [box pad] of adequate size to project at least 200 mm 8 inches beyond equipment.

[g. For installations that use a box pad or vault, train the incoming cables around the box or vault prior to terminating at the switchgear.

][Stub up conduits, with bushings, 50 mm 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with switch cable training areas. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

]3.4 FIELD QUALITY CONTROL

3.4.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS and referenced ANSI standards. Submit reports, including acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 Switchgear

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Check for proper anchorage, alignment, required area clearances, and grounding.

(4) Perform mechanical operator tests in accordance with manufacturer's instructions.

(5) Inspect all indicating devices for proper operation.

****

NOTE: Include the following option when key interlocking is specified.

****

[(6) Test interlock systems for proper operation and sequencing.

] b. Electrical Tests

(1) Perform contact-resistance tests.

(2) Perform insulation-resistance tests.

(3) Perform an over-potential test on each switched way pole with the switched way in the open position in accordance with the manufacturer's instructions.

3.4.1.2 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

(1) Perform ground impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.4.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that devices are in good operating condition and properly performing the intended function. Perform each item not less than three times to demonstrate its function. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times for checks and tests.

****

NOTE: Select the option that best suits the project. For the Navy, do not apply Section 09 90 00 PAINTS AND COATINGS.

****

[3.5 FIELD APPLIED PAINTING

[Where field painting of enclosures is required to correct damage to the

manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.] [Apply field painting as specified in Section 09 90 00 PAINTS AND COATINGS.]

] -- End of Section --