
USACE / NAVFAC / AFCEC / NASA UFGS-26 13 01 (August 2013)

Preparing Activity: NAVFAC NEW

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UML dated January 2016

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DIVISION 26 - ELECTRICAL

SECTION 26 13 01

PAD-MOUNTED DEAD-FRONT AIR INSULATED SWITCHGEAR

08/13

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SECTION 26 13 01

PAD-MOUNTED DEAD-FRONT AIR INSULATED SWITCHGEAR
08/13

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 items(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 PAD-MOUNTED TRANSFORMERS
--Section 26 12 21 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS
--Section 26 28 01.00 10 COORDINATED POWER SYSTEMS PROTECTION
--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 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 A167 (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM D1535 (2014) Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 386 (2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
- IEEE C2 (2012; Errata 1 2012; INT 1-4 2012; Errata 2 2013; INT 5-7 2013; INT 8-10 2014; INT 11 2015) National Electrical Safety Code
- IEEE C37.74 (2003; Int 1 2004) 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 (2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

- NETA ATS (2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
- NFPA 70B (2013) Recommended Practice for Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES (UL)

- UL 467 (2007) 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 to reflect only the submittals
required for the project. Submittals should be kept
to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the
submittal requires Government approval. Some
submittals are already marked with a "G". Only
delete an existing "G" if the submittal item is not
complex and can be reviewed through the Contractor's
Quality Control system. Only add a "G" if the
submittal is sufficiently important or complex in
context of the project.

For submittals requiring Government approval on Army
projects, a code of up to three characters within
the submittal tags may be used following the "G"
designation 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.

An "S" following a submittal item indicates that the
submittal is required for the Sustainability
Notebook to fulfill federally mandated sustainable
requirements in accordance with Section 01 33 29
SUSTAINABILITY REPORTING.

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" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00.

SD-02 Shop Drawings

Switchgear Drawings; G[, [_____]]

SD-03 Product Data

**NOTE: Include the following paragraph 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[, [_____]]
]
Include data and manufacturer's information on switches and each component, device, and accessory provided with the equipment.

SD-06 Test Reports

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

Submit reports, including acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

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

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 A167 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 A167 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 10% 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.

12.1.6 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 Fault Indicators

Provide fault indicators as indicated.

]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, other methods of grounding should be specified. Where it is impractical to obtain indicated ground resistance values, the designer should 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 [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 the paragraphs entitled, "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.

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

Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

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 testing megger 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.

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 --