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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
NASA-16328 (June 2004)  
NASA  
Superseding NASA-16328  
(October 2003)  
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SECTION 16328

LOAD BREAK SF6 GAS SWITCHES  
06/04

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.  
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This guide specification covers the requirements for 5k through 38 kV, 600A load-break sulphur hexafluoride (SF6) gas switches. Drawings should indicate subsurface, vault, pad-mount, indoor, metal-enclosed, or pole mounted type; the number of switched ways; separable connections; and single-side, double-side, floor, wall, ceiling, or other type installation.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.  
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The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.12.28 (1999) Pad-Mounted Equipment - Enclosure Integrity

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2004) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM D 2472

(2000) Sulphur Hexafluoride

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386

(1995; R 2001) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V

IEEE C37.71

(2001) Standard for Three-Phase, Manually Operated Subsurface Load-Interrupting Switches for Alternating-Current Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C37.72

(1987) Manually-Operated Dead-Front Padmounted Switchgear with Load Interrupting Switches and Separable Connections for Alternating-Current Systems

1.2 GENERAL REQUIREMENTS

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**NOTE: If Section 16003 GENERAL ELECTRICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.**  
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Sections 16003 GENERAL ELECTRICAL PROVISIONS and 16286 OVERCURRENT PROTECTIVE DEVICES apply to work specified in this section.

Connection Diagrams for heater connections shall be marked permanently on drawings and shipping covers.

1.3 SUBMITTALS

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**NOTE: Review submittal description (SD) definitions in Section 01330 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. Include a columnar list of appropriate products and tests beneath each submittal description.**  
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The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Connection Diagrams for heater connections shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Detail drawings shall show mounting details and configuration for

the following:

Load- Break Switches

SD-03 Product Data

Equipment and performance data shall be provided for the following items:

SF6 Load-Break Switches  
Space Heaters  
Mounting Frames  
Accessories

SD-06 Test Reports

Test reports for the following shall be in accordance with [IEEE C37.71] and [NEMA C37.72].

Basic Impulse Insulation Level (BIL)  
Withstand Voltage Rating  
Momentary RMS Asymmetrical Rating  
Leak Tests

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for the following equipment:

Switches  
Space Heaters

#### 1.4 SHIPPING

Prior to shipment, leak tests shall be performed and the completed switch assembly shall be certified to have leak rate less than  $10^{-7}$  cubic (.0000001) centimeters per second by a helium mass spectrometer test. Switches shall be sealed and filled with SF6 to a nominal 10 psig 70 kilopascal positive pressure at 75 degrees F 24 degrees C.

## PART 2 PRODUCTS

### 2.1 SWITCHES

Gas insulated load-break switches shall be of the [subsurface] [pad-mounted] [vault] [\_\_\_\_\_] type and shall be in accordance with [IEEE C37.71] [NEMA C37.72] and IEEE 386.

Sulphur hexafluoride (SF6) gas shall be in accordance with ASTM D 2472.

SF6 load-break switches shall be manually operated, load-interrupting type, load-break switches and shall be rated [15] [\_\_\_\_\_] kV [600] [\_\_\_\_\_] amperes, minimum, continuous and load break for operation on a [12.47] [\_\_\_\_\_] kV, 3-phase, 3-wire system. Switch shall have momentary rms asymmetrical rating of [22.5] [\_\_\_\_\_] kA and close rms symmetrical rating of [12.5] [\_\_\_\_\_] kA for [1 minute] [\_\_\_\_\_] 60 Hz withstand voltage rating of [35] [\_\_\_\_\_] kV and basic impulse insulation level (BIL) of [95] [\_\_\_\_\_] kV. Switches shall be the type indicated and shall be designed to show the internal wiring, indicating each switch position. Each switching way shall

be provided with [600A dead break] [200A deep well] bushings.

Switch enclosures shall be in accordance with ANSI C57.12.28 and shall be equipped with ground bus capable of carrying the rated fault current for one second for each way.

Each switch shall have pressure gage, position viewing window and fill plug.

Incoming line position of switches shall be lockable to prevent unauthorized grounding.

Cable and cable terminations shall be in accordance with Section 16124 MEDIUM VOLTAGE CABLE. Switches shall be equipped with 600 amperes and bushings shall have inserts to accept load break elbows, as indicated.

Cable terminations from the fuse compartment shall be preformed stress-cones or have deep-well apparatus bushings in accordance with IEEE 386.

Provisions for padlocking each handle in any position shall be provided.

Each switch tank shall be constructed of stainless steel plate, fully TTG welded.

Operating mechanism shall come equipped with handles for manual operation and shall be operated by a non-teasible, snap-action, quick-make, quick-break. Opening and closing of the main contacts shall be totally independent of the speed or position of the operating handle. Operating handle shall be secured to the shaft in a manner that will ensure tightness and alignment.

## 2.2 ACCESSORIES

Fittings, lifting eyes, insulators, and other required accessories shall be provided with the switch as necessary.

All operating parts of switch assemblies shall be of corrosion-resistant metals.

Switches shall be provided with suitable attachments to permit closing and opening under full rated load current, without damage.

Fuses located in a separate compartment shall be provided on the outgoing feeders as indicated and per Section 16286 OVERCURRENT PROTECTIVE DEVICES. Fuse-compartment doors shall be interlocked with switch mechanisms.

Switches shall be provided with a visible break option that allows direct viewing of the switch contacts in the open and closed positions within the switch tank.

## 2.3 SPACE HEATERS

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**NOTE: Space heaters are seldom required with SF6 switches. Choose the following paragraphs only when metal enclosed SF6 switch/fuse modules are used and where moisture could condense on components in air-filled compartments.**

wattage supplied by heaters is one-fourth of the heater nameplate rating when 240-volt heaters are operated at 120 volts.

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Ventilated cable termination compartment and the fuse compartment on outdoor switches shall be equipped with externally energized space heaters to provide approximately [4] [\_\_\_\_\_] watts/square foot [40] [\_\_\_\_\_] watts/square meter of outer surface area. Heaters shall be such that the power density does not exceed [4] [\_\_\_\_\_] watts per square inch [4] [\_\_\_\_\_] watts per 650 square millimeter of heater element surface. Heaters shall be rated at [240] [\_\_\_\_\_] volts for connection at [120] [\_\_\_\_\_] volts. Heaters shall be located at the lowest portion of each space to be heated. Terminals shall be covered. Thermostats shall be used to regulate the temperature.

Heaters shall be installed and operable at the time of shipment so that the heaters can be operated immediately on arrival at the site, during storage, or before installation. Connection locations shall be marked prominently on drawings and shipping covers with temporary leads for storage operation easily accessible without removal of shipping protection.

#### 2.4 COORDINATION

Power fuses shall be coordinated with the circuit breaker settings in the substation and with the transformer rating. Time-current characteristics, minimum melt and total clear times shall be as required.

#### 2.5 MOUNTING FRAMES

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**NOTE: Choose the following paragraphs when pad-mounted switches are used. Subsurface switches do not require frames since they mount directly to the floor, walls, or ceiling.**

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Mounting frames of angle-iron construction, shall be furnished for all [pad] [\_\_\_\_\_] -mounted switches and shall be hot-dipped galvanized after fabrication in accordance with [ASTM A 123/A 123M] [ASTM A 153/A 153M].

After fabrication, all exposed ferrous metal surfaces of the pad mount enclosure shall be cleaned and painted.

Mounting frames shall be painted in accordance with NEMA C37.72.

#### 2.6 FACTORY FINISH

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**NOTE: For all outdoor applications and all indoor applications in a harsh environment refer to Section 09960 HIGH PERFORMANCE COATINGS." High performance coatings are specified for all outdoor applications because ultraviolet radiation will break down most standard coatings, causing a phenomena known as chalking, which is the first stage of the corrosion process. For additional information contact The Coatings Industry Alliance, specific suppliers such as Keeler and Long and PPG, and NACE International**

(NACE) .

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Switches shall be provided with the manufacturer's standard paint finish when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09960 HIGH PERFORMANCE COATINGS.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Switches shall be installed in accordance with the manufacturer's instructions. Installation shall include all necessary hardware, insulators, and connections to line wire or bus.

#### 3.2 GROUNDING

Switch tanks, mounting frames, and operating mechanisms shall be solidly bonded to the station ground counterpoise in accordance with [IEEE C37.71] [ NEMA C37.72] and Section 16065 SECONDARY GROUNDING.

Incoming line position shall have a warning tag that states "CAUTION: INCOMING LINE, DO NOT GROUND."

#### 3.3 FIELD TESTING

Load break switch assembly shall be disconnected from the power supply and feeder cables and the switch enclosure grounded before conducting insulation and high-voltage tests.

Load break switch assembly shall be given an insulation-resistance test with a 5000V insulation-resistance test set.

All tests shall be applied for not less than 5 minutes and until three equal consecutive readings one minute apart are obtained. Readings shall be recorded every 30 seconds during the first 2 minutes and every minute thereafter. Minimum acceptable resistance readings are 100 megohms.

Upon satisfactory completion of the insulation-resistance test, the load break switch shall be subjected to a high-voltage, 60-Hz withstand test. Test voltage shall be equal to 75 percent of the factory test values and shall be applied for one minute.

Upon satisfactory completion of the high-voltage, 60-Hz withstand test, the switch assembly shall be given a second insulation-resistance test as before. Results of the second insulation-resistance test shall be within 5 percent of the first test values and shall indicate no evidence of permanent injury by the high potential test.

Switch assembly shall be operated in the presence of the Contracting Officer. Final test reports shall be provided to the Contracting Officer. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --