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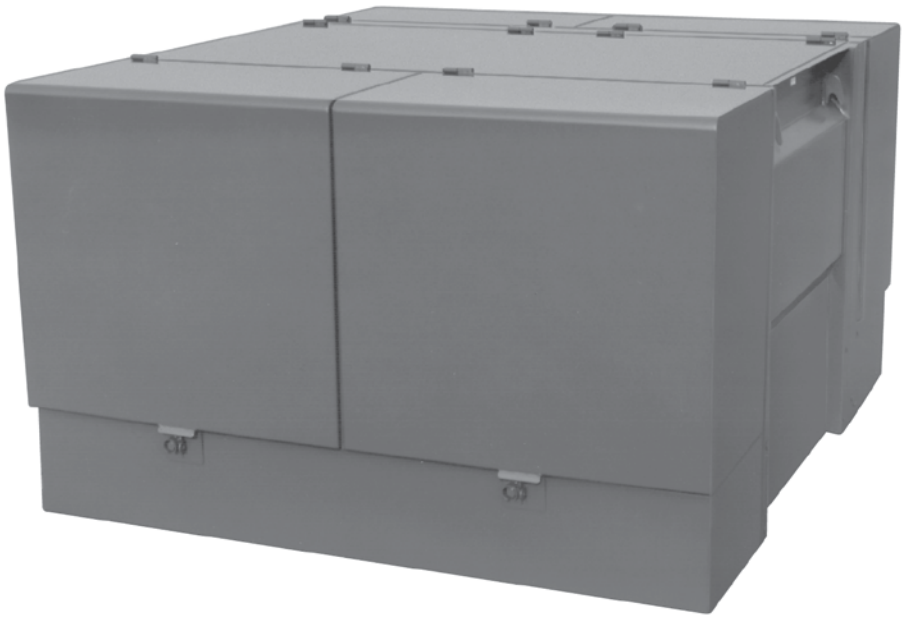
RVAC, SF_6 -insulated, vacuum break switch; installation, operation, and maintenance instructions



Powering Business Worldwide

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Contents

Safety for life

Eaton meets or exceeds all applicable industry standards relating to product safety in its Cooper Power™ series products. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Eaton employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment, and support our "Safety For Life" mission.

Safety information

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER

Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment. G103.3

WARNING

Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage. G101.0

WARNING

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage. G102.1

WARNING

Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage. G122.3

Product information

Introduction

Service Information MN285003EN provides installation instructions, operation information, maintenance procedures, and testing information for Eaton's Cooper Power™ series RVAC, SF_6 insulated, pad-mounted vacuum switchgear.

The information contained in this manual is organized into the following major categories: *Safety Information, Product Information, Installation Procedure, Operation, Maintenance Information*, and *Testing*. Refer to the table of contents for page numbers.

Read this manual first

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing, operating, or maintaining this equipment.

Acceptance and initial inspection

RVAC switchgear is completely assembled, tested, and inspected at the factory. The switchgear is filled with SF_6 to a pressure of 7 psig (± 0.5 psi) at an ambient temperature of approximately 20 to 25°C (68 to 77°F). It is in good condition when accepted by the freight carrier for shipment.

1. **Upon receipt, inspect the unit thoroughly** for damage and loss of parts or SF_6 incurred during shipment. If damage or loss is discovered, file a claim with the carrier immediately.
2. **Check and tighten any bolts** that may have loosened during shipment.
3. **Check SF_6 pressure gauge**, the pressure should be approximately 7 psi.

Note: The pressure of SF_6 will vary with temperature. If the unit is cold, move it to a warm, ventilated area, allow gas to warm, and check pressure again when possible. Units with a low reading should be checked for possible leaks.

4. **Make a permanent log record of the SF_6 pressure**, date, time, and approximate ambient temperature. A Switchgear Inspection and Maintenance Log should be established and stored with the switchgear. It should be updated each time the unit is inspected.

Handling and storage

The switchgear should remain on its shipping pallet until it is installed. When handling the switchgear, always use a fork truck that has adequate lifting capacity and forks that extend the entire length of the pallet. Improper handling can cause damage to the switchgear.

If the switchgear is to be stored for any appreciable time before installation, provide a clean, dry storage area. Be careful during handling and storage to minimize the possibility of mechanical damage. Do not stack other material on the switchgear.

Standards

RVAC switchgear is designed and tested in accordance with IEEE Std C37.74™-2003 standard.

Quality standards

ISO 9001 Certified Quality Management System

Product description

RVAC, SF_6 insulated, vacuum switchgear provides convenient load switching for 15-, 25- and 35 kV underground systems. RVAC switchgear is designed for outdoor mounting on a concrete pad. Power is fed to and from the switch from underground, through openings in the pad.

Deadfront construction minimizes the high-voltage safety hazards for both the operator and the general public. SF_6 insulation provides a compact, low-profile installation.

RVAC switchgear utilizes vacuum loadmake/loadbreak switches. Clampstick operable switch-operating handles are located on the front plates of the unit. Side mounted switch operating handles and motor operators can also be provided as accessories.

RVAC switchgear can be specified with a variety of options to meet specific requirements.

Vacuum interrupters

Loadbreak switching takes place within sealed vacuum interrupters (Figure 1). Vacuum interrupters provide fast, low energy arc interruption and produce no arcing by-products to contaminate the insulating medium.

Figure 1. Vacuum interrupter mechanism assembly.

Bushings

If 600 amp deadbreak aluminum type bushings are furnished, they conform to IEEE Std 386™ standard (latest version).

200 amp interfaces are provided with either 200 amp bushing wells or 200 amp one-piece 35 kV bushings; both conform to IEEE Std 386™ standard (latest version).

Bushings are mounted in-line and are located a minimum of 24 inches above the pad.

Cabinet construction

RVAC switchgear features deadfront, tamper-resistant, low-profile construction. It is suitable for operation in areas subject to excessive moisture, occasional flooding, and blowing snow. Cabinets meet the enclosure security requirements of IEEE Std C57.12.28™-2005 standard.

Note: Occasional flooding applies only to the RVAC unit and not any controls or motors attached to the unit. Per IEEE Std 37.74™-2003 standard, submersible units are able to operate at their standard ratings provided the water head does not exceed 3m above the top of the switchgear during occasional submersion.

Side-swing doors are provided with door stays and fitted with stainless steel hinges. On units wider than 46 inches, split doors are provided to allow easy operation by one person. Top-swing doors can also be provided as an option. Both source and tap doors can be fully open at the same time. Each door has a floating lock pocket with padlock provisions and pentahead silicon bronze door bolt.

Tank construction is of 7-gauge steel and doors are made of 12-gauge steel. Recessed lifting provisions are provided at each corner of the tank for a balanced lift.

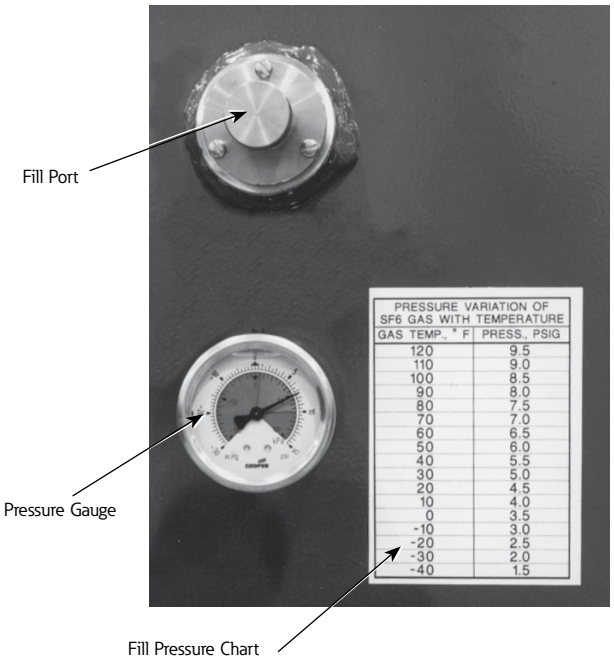

Figure 2. SF6 Fill Port, Pressure Gauge, and Fill Pressure Chart.

SF_6 dielectric insulating system

Pressurized SF_6 dielectric is employed as an insulator in the central tank containing the vacuum interrupter assemblies. SF_6 fill valve, pressure gauge, and fill pressure chart (Figure 3) are provided for monitoring and adjustment of SF_6 pressure levels.

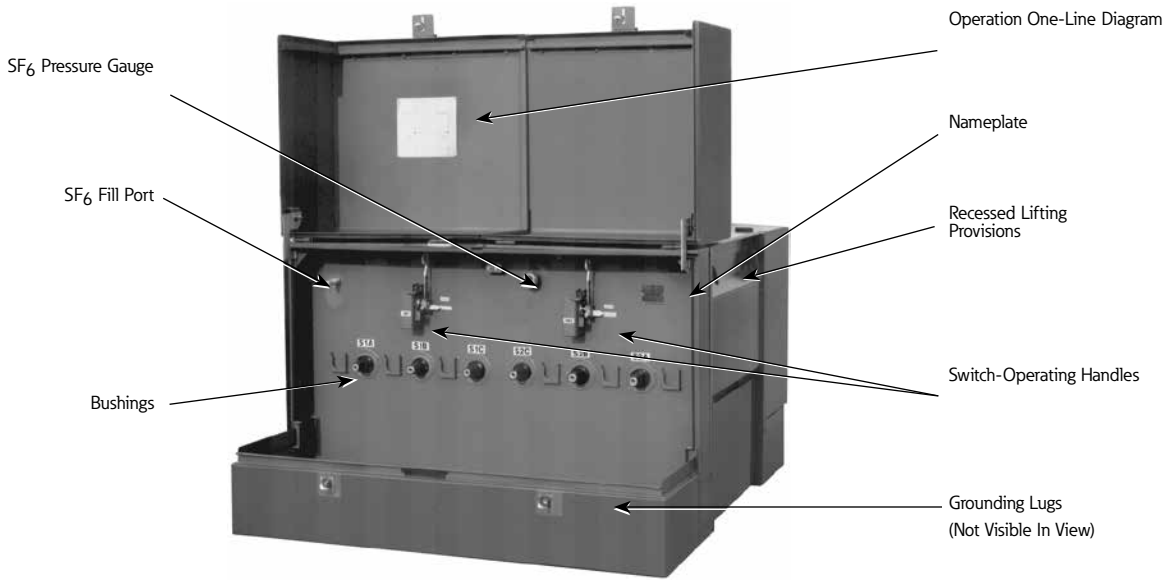

Figure 3. RVAC switchgear components.

Standard features

Standard features (refer to Figure 4) include SF_6 pressure gauge and fill port, operation one-line diagrams on the doors, and a standoff bracket for each bushing. Standard ground provisions include a 1/2-13 UNC stainless steel ground nut for each bushing.

Switch test sequence

The RVAC operating mechanism conforms to the switch test sequence requirements of IEEE Std C37.74™-2003 standard.

Finish

RVAC switchgear is finished in a green color which conforms to Munsell 7GY 3.29/1.5 Green.

The coating conforms to the following specifications: IEEE Std C57.12.28™-2005 standard, ASTM B1117 1000-hour 5% salt spray corrosion test, ASTM D2247 1000-hour humidity test, ASTM G53 500-hour ultraviolet accelerated weathering test, and ASTM D2794 impact test.

Padlocking provisions

⚠ WARNING

Hazardous voltage. Switchgear doors must be closed and padlocked at all times when unattended. Failure to comply can result in death, severe personal injury, and equipment damage. G168.1

Nameplate

Prior to installation, be sure to check the switchgear nameplate on the tank plate in the source side cabinet to verify that voltage and current ratings are correct for the system on which the switchgear is to be installed.

Weight

The weight of the switchgear is shown on the nameplate. Make sure that lifting equipment used has adequate capacity to safely handle the switchgear.

Switch-operating handles

⚠ WARNING

Hazardous voltage. Never rely on the open position of the operating handle or the contact position indicator; it does not ensure that the line is de-energized. Follow all locally approved safety practices. Failure to comply can result in contact with high voltage, which will cause death or severe personal injury. G123.1

RVAC switchgear is equipped with clampstick operable load-break switch handles are mounted on the source and/or tap-side front plates of the unit. The switch-operating handle (shown in Figure 5) provides convenient push-to-close and pull-to-open operation. The handle can be padlocked in either the open or closed position.

Side mounted switch-operating handles and motor operators can also be provided as accessories.

Figure 4. RVAC operating handle.

Table 1. Electrical Ratings

Nominal Voltage	5 kV	15 kV	25 kV	35 kV
Maximum Design Voltage, kV	15.5	15.5	27	38
BIL, kV	95	95	125	150
1-Minute Withstand (60 Hz) Switch* and Terminators, kV	35	35	60	70
Continuous Current (max), amps	600	600	600	600
Load Switching, amps	600	600	600	600
Momentary Current 10 Hz (asym.), amps	20,000	20,000	20,000	20,000
2 Sec. (sym.), amps	12,500	12,500	12,500	12,500
3 Shot Make and Latch (asym.), amps	20,000	20,000	20,000	20,000

* The withstand rating of the switch is higher than that of the connectors (IEEE Std C37.74™-2003 standard).

Installation procedure

⚠ WARNING

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury, and equipment damage. G102.1

1. **Check and record the SF_6 pressure.** Make sure the SF_6 gas within the switchgear tank is at proper pressure. Check the pressure gauge(s) on switchgear front plate(s). Some units have a pressure gauges on both the source- and tap-side front plates; both gauges should indicate the same pressure. Make a permanent log of the pressure reading.

   SF_6 pressure within switchgear will generally vary from 3 to 10 psig, due to changes in ambient temperature. It is recommended that SF_6 gas be added when the pressure gauge reads 2 psig lower than the expected gas pressure; refer to Table 2 to identify the approximate pressure that should be observed at different ambient temperatures.

Table 2. SF_6 Pressure Versus Ambient Temperature

Gas Temperature °F	Gas Pressure, psig
120	9.5
110	9.0
100	8.5
90	8.0
80	7.5
70	7.0
60	6.5
50	6.0
40	5.5
30	5.0
20	4.5
10	4.0
0	3.5
-10	3.0
-20	2.5
-30	2.0
-40	1.5

2. **Check the nameplate ratings.** Make sure the ratings on the switchgear nameplate are correct for the planned installation.

CAUTION

Follow all locally approved safety practices when lifting and mounting the equipment. Use the lifting lugs provided. Lift the unit smoothly and do not allow the unit to shift. Improper lifting can result in equipment damage. G106.2

CAUTION

Equipment damage. Never place jacks, tackle or other attachments under the unit for the purpose of lifting. Failure to comply will result in damage to the equipment. T240.0

3. **Mount switchgear on concrete pad.**

   A. The switchgear must be installed on a level concrete pad or structure that has been designed to support the size and weight of the unit.

   B. The switchgear must be hoisted only by the recessed lifting provisions provided at the four corners of the tank. Suitable lifting straps and spreader bar must be used to prevent damaging the switchgear housing.

⚠ WARNING

Hazardous voltage. Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T223.2

4. **Ground switchgear.** Switchgear must be adequately grounded. Install a permanent, low-resistance ground connection to the switchgear tank. Grounding provisions are provided near the bottom of the tank.

5. **Make high-voltage line connections.**

   A. Prior to making connections, make sure that the source-side and tap-side cable elbows are correctly identified and that the switchgear unit is oriented correctly for the installation. The source leads must connect to the source bushings; tap leads must connect to the tap bushings of the unit.

   B. Refer to the operation one-line diagram located inside the doors of the switchgear and make only those elbow connections shown. The voltage and current ratings shown on the nameplate must be correct for the planned installation.

   C. All cables or bushings not in use must be properly isolated from all other leads. Unused leads must be parked on standoff insulators or properly grounded using an elbow grounding kit. Unused bushings must be terminated by proper dead end caps. Dust covers used for shipping are not intended for use on energized equipment.

6. **Close the door and apply a padlock to secure the switchgear from unauthorized access**.

⚠ WARNING

Hazardous voltage. Switchgear doors must be closed and padlocked at all times when unattended. Failure to comply can result in death, severe personal injury, and equipment damage. G168.1

Operation

DANGER

Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment. G103.3

WARNING

Hazardous voltage. Never rely on the open position of the operating handle or the contact position indicator; it does not ensure that the line is de-energized. Follow all locally approved safety practices. Failure to comply can result in contact with high voltage, which will cause death or severe personal injury. G123.1

Application

This switchgear must only be applied within its specified ratings. At no time should the continuous total load exceed the ratings shown on the nameplate.

Switch-operating handles

WARNING

Hazardous Voltage. Always use a clampstick when working with this equipment. Failure to do so could result in contact with high voltage which will cause death or severe personal injury. G108A.0

The push/pull loadbreak switch-operating handles (Figures 5 and 6) are typically located on the front plates of the unit and must be operated by a clampstick. The loadbreak switch is opened by pulling the operation handle away from the front plate. Closing the switch is accomplished by pushing the operator toward the switchgear front plate. The handles can be padlocked in either the open or closed position. Always follow locally approved operating practices when working with this equipment.

Figure 5. **RVAC switch operating handle in the closed position.**

Figure 6. **RVAC switch operating handle in the open position.**

Maintenance information

⚠ CAUTION

This equipment requires routine inspection and maintenance to ensure proper operation. If it is not maintained, it can fail to operate properly. Improper operation can cause equipment damage and possible personal injury. G105.1

⚠ CAUTION

This equipment relies on SF_6 to provide electrical insulation between components. The pressure of the SF_6 within the unit must be checked on a regular basis, as part of the routine maintenance inspection, to ensure that it is at or above minimum requirements. Use of this equipment with low SF_6 pressure, can result in internal flashovers that will damage the equipment and can cause personal injury. G125.2

⚠ CAUTION

Toxic materials, skin irritant. Arcing in sulphur hexafluoride gas (SF_6) creates toxic by-products. Avoid breathing SF_6 that has been exposed to electrical arcing. Suitable protective clothing must be worn to avoid contact with the powder residues that remain after electrical arcing in SF_6. Failure to use a suitable mask and protective clothing can result in skin irritation and illness. G121.1

RVAC switchgear is a deadfront design. All live parts are contained within the sealed tank enclosure. A routine maintenance inspection program is required to ensure proper operation.

Routine inspection

It is necessary to establish and maintain a regular schedule for checking the pressure of the insulating SF_6 to ensure proper dielectric strength within the switchgear. Inspect the unit on 6 month intervals, whether in storage or in service, for the first year and annually thereafter. Check the gas pressure gauge and update the unit's inspection and maintenance log each time the switchgear is inspected.

Maintenance inspection procedure

RVAC switchgear must be de-energized, grounded, and removed from service before conducting any maintenance, or SF_6 sampling or filling procedures.

⚠ WARNING

Hazardous voltage. This equipment must be de-energized and grounded prior to conducting any maintenance, SF_6 sampling or SF_6 filling procedures. Failure to comply can result in death or severe personal injury. T242.0

1. De-energize and ground switchgear.
2. Check SF_6 pressure. Make sure SF_6 within the switchgear tank is at the proper pressure by checking the pressure gauge(s) on the front plate(s) of the unit.
3. Inspect for damage. Check for any unusual wear to the paint finish. Check bushings and elbows make sure connections are secure. Check for SF_6 leaks or other unusual or abnormal indications of wear or abuse. Make sure cabinet doors lock securely. Record any unusual conditions and make arrangements for immediate repair if required.

Internal inspection and repair

If internal damage is suspected, or if the switchgear must be returned to the factory for service, contact your Eaton representative for shipping instructions and a return authorization number.

Adding SF_6 gas

The SF_6 pressure in the unit will normally fluctuate due to changes in ambient temperature. SF_6 gas should be added when the pressure gauge reads 2 psig lower than the recommended gas pressure. Refer to Table 2 for a listing of the recommended gas at various ambient temperatures.

If SF_6 must be added, contact your Eaton representative for SF_6 Gas Top-Off Kit Catalog numbers KPA-1043-1/KPA-1043-2 ordering information. Be prepared to provide a copy of the switchgear inspection and maintenance log, the serial number of the unit and a status report of its condition. Refer to *Service Information S285-10-3, SF6 Gas Top-Off Kit Operating Instructions* for recommended SF_6 top-off procedures when using the KPA-1043-1/KPA-1043-2 Gas Top-Off Kit.

The recommended procedure for adding SF_6 gas is as follows.

IMPORTANT

Care should be exercised to avoid any introduction of moisture or air into the SF_6 gas chamber of the RVAC unit during filling operations. Introduction of air or moisture can result in reduced dielectric performance of the SF_6 gas.

IMPORTANT

Filling apparatus used to introduce and transfer SF_6 gas into the pressurized SF_6 gas chamber of the RVAC unit must contain an adjustable regulator for control of SF_6 flow during filling operations.

1. Verify the quality of SF_6 gas in the cylinder to be used during the transfer process.
2. Open the fill port of the pad-mounted switchgear tank.
3. Connect the coupling valve of the SF_6 gas filling apparatus to the fill port of the pad-mounted switchgear tank (Figure 8).
4. Slowly open the outlet valve of the regulated SF_6 source gas cylinder.
5. Refer to the chart on the switchgear tank to determine

the maximum fill pressure for the current ambient temperature (Figure 8). When the pressure gauge of the switchgear tank indicates the targeted maximum pressure, close the outlet valve of the regulated filling apparatus.

6. Disconnect the coupling valve of the filling apparatus from the fill port of the pad-mounted switchgear tank.
7. Close the fill port of the pad-mounted switchgear tank.

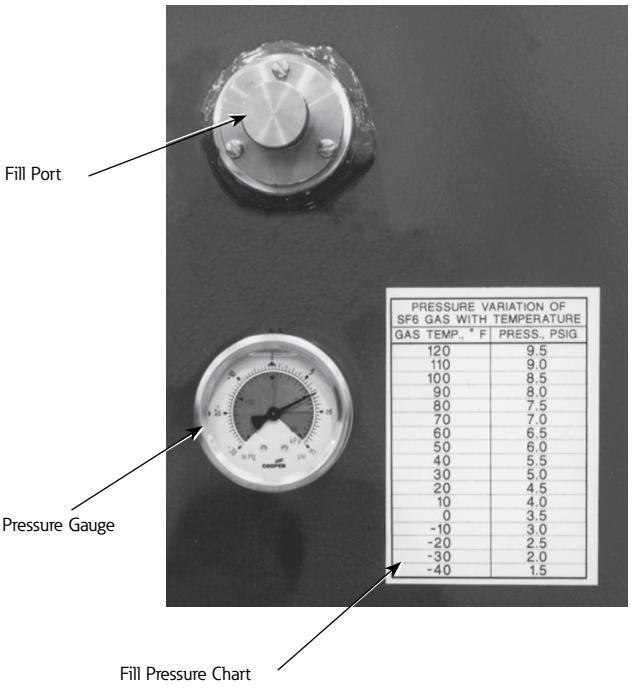

Figure 7. SF_6 Fill Port, Pressure Gauge, and Fill Pressure Chart.

SF_6 gas analysis

SF_6 gas analysis is available for Eaton's Cooper Power series pad-mounted switchgear products. Contact your Eaton representative for details on where to obtain sample kits and on the specific tests available through the service.

Replacement parts

Replacement parts for pad-mounted switchgear units are available through the factory Service Department. To order replacement parts, refer to the nameplate and provide the product type, serial number, catalog number, voltage rating, and a description of the part. Contact your Eaton representative for additional information and ordering procedures.

Testing

All pad-mounted switchgear is carefully tested and adjusted at the factory to operate according to published data. Well-equipped test facilities, a detailed testing procedure, and thoroughly trained personnel assure accurately calibrated equipment. Each unit leaves the factory ready for installation.

Pre-installation testing is not necessary. However, should verification of switchgear prior to installation be required, the vacuum interrupters can be tested using the following procedure.

High-potential withstand testing of vacuum interrupters

High-potential withstand tests can be performed to check the vacuum integrity of the interrupters used in RVAC switchgear.

Safety requirements

To prevent accidental contact with high-voltage parts, the switchgear and high-voltage transformer must be placed in a suitable test cage and all proper grounding procedures must be observed.

⚠ WARNING

Hazardous voltage. The switchgear (apparatus and control) and high-voltage transformer must be in a test cage or similar protected area to prevent accidental contact with the high-voltage parts.

Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T221.5

⚠ CAUTION

Radiation. At voltages up to the specified test voltages, the radiation emitted by the vacuum interrupter is negligible. However, above these voltages, radiation injurious to personnel can be emitted. See *Service Information S280-90-1, Vacuum Interrupter Withstand Test Voltage Ratings Information,* for further information. G109.2

With the vacuum interrupters open (manual operating handle(s) in the Open position), perform a hi-pot test for one minute AC (or 15 minutes DC) across each open vacuum interrupter assembly at the voltages shown in Table 3. The interrupter should withstand the test voltage and should not load down the source.

Table 3. High-Potential Withstand Test Voltages

Voltage Rating (kV)	High Potential Test Voltages
15	25.5 kV AC rms or 36.0 kV DC
25	30 kV AC rms or 42.4 kV DC
35	37.5 kV AC rms or 53 kV DC

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Cooper Power Systems Division
2300 Badger Drive
Waukesha, WI 53188
Eaton.com/cooperpowerseries

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