

Type shrubline VFI, vacuum fault interrupter; installation, operation and maintenance instructions



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# Contents

- DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY . . . . . I**
- SAFETY FOR LIFE . . . . . III**
- SAFETY INFORMATION . . . . . III**
  - Safety instructions . . . . . iii
- PRODUCT INFORMATION . . . . . 1**
  - Introduction . . . . . 1
  - Additional information . . . . . 1
  - Acceptance and initial inspection . . . . . 1
  - Handling and storage . . . . . 1
  - Product description . . . . . 1
  - Shrubline VFI operation . . . . . 1
  - Electronic control . . . . . 1
  - Quality standards . . . . . 1
  - Vacuum interrupters . . . . . 2
  - Bushings . . . . . 2
  - Cabinet construction . . . . . 2
  - Padlocking provisions . . . . . 2
  - Standard features . . . . . 2
- INSTALLATION PROCEDURE . . . . . 4**
- OPERATION . . . . . 4**
  - Application . . . . . 5
  - Shrubline VFI interrupter operation . . . . . 5
- MAINTENANCE INFORMATION . . . . . 5**
  - Maintenance inspection procedure . . . . . 5
  - Inspection and repair . . . . . 6
  - Insulating oil maintenance . . . . . 6
  - Frequency of maintenance . . . . . 6
  - Oil samples . . . . . 6
  - Oil sampling guidelines . . . . . 7
  - Oil fill guidelines . . . . . 7
  - Oil testing . . . . . 7
- TESTING . . . . . 8**
  - High potential withstand testing of vacuum interrupters . . . . . 8
  - Trip and control testing . . . . . 8



## Safety for life



Eaton's Cooper Power series products meet or exceed all applicable industry standards relating to product safety. 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, 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 high 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 may 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 MN285013EN* provides installation instructions, operation information, maintenance procedures and testing information for Eaton's Cooper Power series Shrubline VFI padmounted vacuum switchgear.

For in-depth testing information, refer to *Service Information Bulletin MN285001EN, VFI Tester Operating Instructions* for complete information regarding operation of the VFI tester and in-depth VFI padmounted switchgear testing procedures.

### 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.

### Additional information

These instructions do not claim to cover all details or variations in the equipment, procedures, or process described, nor to provide directions for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, contact your Eaton representative.

### Acceptance and initial inspection

Shrubline VFI switchgear is completely assembled, tested, and inspected at the factory. The switchgear is filled to the correct level with insulating oil. 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 oil incurred during shipment. If damage or loss is discovered, file a claim with the carrier immediately.
2. Check for oil leakage and tighten any bolts that may have loosened during shipment.

### 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 cabinet.

## Product description

Eaton's Cooper Power series Shrubline VFI vacuum switchgear provides fault interruption and convenient load switching for underground systems through 25 kV. Shrubline VFI switchgear is designed for outdoor mounting on a concrete pad. Power is fed to and from the switchgear from underground cables through openings in the pad.

Deadfront construction minimizes the high voltage safety hazards for both the operator and the general public.

Shrubline VFI switchgear employs oil as the insulation medium to provide a compact, low-profile installation.

**Note:** R-TEMP® dielectric fluid may be provided instead of insulating oil, if specified at the time of order. R-TEMP® may not be suitable for applications where ambient temperatures drop below 0° F. Refer to the manufacturer's instructions for application specifications and ASTM-approved testing procedures.

Shrubline VFI switchgear can be specified with a variety of control options to meet specific distribution system protection requirements.

Shrubline VFI switchgear is designed and tested in accordance with ANSI standards C37.60 and C37.72.

### Shrubline VFI operation

Shrubline VFI switchgear utilizes a vacuum interrupter to provide fault current interruption and load make/break switching capabilities. A shotgun stick operable operating handle is located on the front plate of the unit.

A current sensing transformer, located inside the switchgear tank, provides line current information to the control. When line current exceeds the minimum trip setting, the control initiates a signal which causes the Shrubline VFI to interrupt the circuit.

### Electronic control

Refer to the applicable Installation and Operation manuals for electronic control operation and setting procedures.

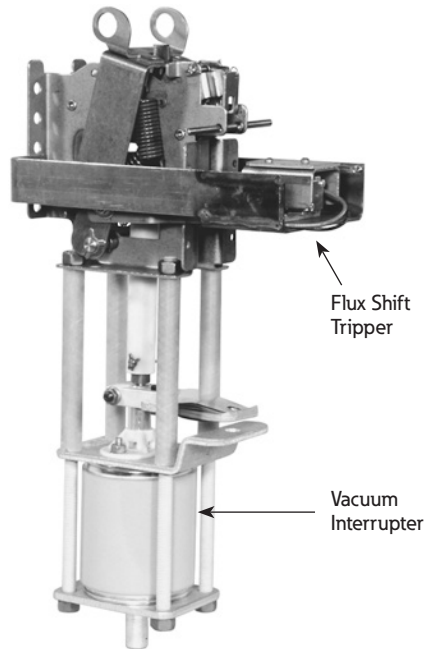
- *MN285008EN Tri-Phase Electronic Control, Installation and Operation Instructions.*

### Quality standards

ISO 9001 Certified Quality Management System

### Vacuum interrupters

Load and fault interruption take place within a sealed vacuum interrupter (Figure 2). The vacuum interrupter provides fast, low energy arc interruption and produces no arcing by-products to contaminate the insulating oil.



911072KMA

Figure 1. Vacuum interrupter mechanism assembly

### Bushings

Eaton’s Cooper Power series 15/25 kV 200A bushing wells are provided as standard. The wells meet the full requirements of ANSI/IEEE standard 386 for separable insulated connector systems.

Bushings are mounted in-line and are located a minimum of 20 inches above the pad.

### Cabinet construction

Shrubline VFI 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 ANSI standard C57.12.28.

A swing-up door is provided and fitted with stainless steel hinges. The door has a floating lock pocket with padlock provisions and stainless steel pentahead door bolt.

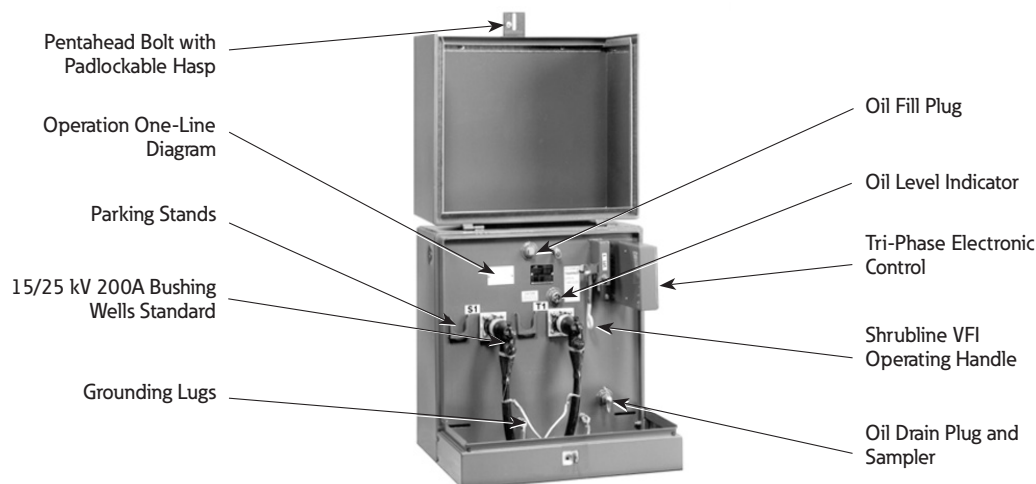
Standard tank construction is of 10-gauge mild steel and doors are made of 12-gauge mild steel. Lifting provisions on each side of the tank provide a balanced lift (Figure 5). A 304L stainless steel enclosure is available as an option.

### Padlocking provisions

Provisions are included for padlocking the cabinet in order to prevent unauthorized door opening. The cabinet must be locked at all times to prevent accidental contact with hazardous voltage.

### Standard features

Standard features (refer to Figure 3) include an oil level indicator, automatic pressure-relief valve, operation one-line diagram on the tank frontplate, oil fill plug, oil drain plug and sampler, and a standoff bracket for each bushing. Standard ground provisions include a 1/2-13 UNC stainless steel ground nut for each bushing.



931180KM

Figure 2. Shrubline VFI fault interrupter features

# Type shrubline VFI, vacuum fault interrupter; installation, operation and maintenance instructions

**Table 1. Electrical ratings**

Rating	15kV	25kV
Maximum design voltage, kV	15.5	27
BIL, kV	95	125
1-Minute withstand (60 Hz) interrupter and terminators, kV	34	40
Continuous current (max), A	200	200
Interrupting current (sym./asym.), kA	12/20	12/20
Momentary current 10 cycles (asym.), kA	20*	20*
3 Sec. (sym.), kA	12*	12*
Making current (sym.), kA	12	12*
Transformer magnetizing interrupting current, A	21	21
Cable charging interrupting current, A	10	25

\*Interrupter only. Short time-current ratings of bushings are 10 kA (sym.).

## Interrupter duty cycle

The Shrubline VFI fault interrupter conforms to the duty cycle requirements of ANSI C37.60.

## Switch test sequence

The Shrubline VFI conforms to the switch test sequence requirements of ANSI C37.72.

## Finish

The Shrubline VFI enclosure is finished in a green color equivalent to Munsell 7GY 3.29/1.5 Green.

The coating conforms to the following specifications: ANSI standard C57.12.28, 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.

## Nameplate

Prior to installation, be sure to check the switchgear nameplate on the tank frontplate to verify that the voltage and current rating is correct for the system on which the switchgear is to be installed.

## Operating handle

### 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

The Shrubline VFI interrupter is equipped with a shotgun stick-operable handle that is mounted on the front plate of the unit. The operating handle (shown in Figure 4) provides convenient push-to-close and pull-to-open operation. The operating handle may be padlocked in the open position.

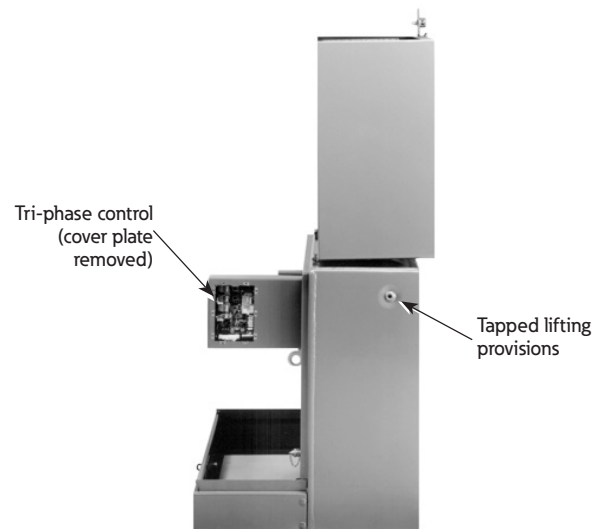
## Weight

The weight of the unit is shown on the nameplate. Make sure that lifting equipment used is rated sufficiently to safely handle the switchgear.



931181KM

**Figure 3. Shrubline VFI operating handle**



931182KM

**Figure 4. Shrubline VFI open profile**

## Installation procedure

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### WARNING

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**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

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### CAUTION

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**This equipment relies on dielectric fluid to provide electrical insulation between components. The dielectric strength of the fluid must be checked on a regular basis, as part of the routine maintenance inspection, to ensure that it is at or above minimum dielectric requirements. Use of this equipment with dielectric fluid that does not meet minimum requirements can result in internal flashovers that will damage the equipment and can cause personal injury.**

G107.3

1. **Check oil level.** Make sure the oil in the switchgear tank is at the proper level by checking the oil level indicator on the front plate.
2. **Test oil dielectric strength.** If the switchgear has been stored for some time, or is being relocated, perform a dielectric test on the oil in accordance with ASTM-approved testing guidelines.

**Note:** R-TEMP® dielectric fluid may be provided instead of insulating oil, if specified at the time of order. Refer to manufacturer's instructions for specifications and ASTM-approved testing procedures.

- A. In new equipment, the oil must have a minimum dielectric strength of 26 kV.
  - B. If the dielectric strength of the oil is less than 26 kV, filter the oil to restore its dielectric strength to acceptable minimum level.
  - C. For additional information on oil specifications and tests, refer to *Reference Data TD280022EN* and to the oil testing procedures on page 10 of this manual.
3. **Check the nameplate ratings.** Make sure the ratings on the switchgear nameplate are correct for the planned installation.

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### WARNING

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**Falling equipment. Use the lifting lugs provided and follow all locally approved safety practices when lifting and mounting the equipment. Lift the unit smoothly and do not allow the unit to shift. Improper lifting can result in severe personal injury, death, and/or equipment damage.**

G106.3

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### CAUTION

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**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

4. **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 tapped lifting provisions provided at the sides of the tank with 5/8-11 UNC bolts (Figure 5). Suitable lifting straps must be used to prevent damaging the switchgear housing.

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### WARNING

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

T223.2

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

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### WARNING

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**Hazardous voltage. Source and tap cable elbows must be correctly identified before making connections to the switchgear. Failure to do so can result in death or severe personal injury.**

T244.0

- A. Refer to the operation one-line diagram located on the frontplate of the switchgear and make only those elbow connections shown. The voltage and current ratings shown on the nameplate must be suitable for the planned application.
  - B. 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.
7. **Close and lock switchgear door.** Switchgear door must be closed and locked to prevent unauthorized access and accidental contact with high voltage.

## Operation

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### DANGER

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**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



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 **WARNING**

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**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

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 **WARNING**

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**Do not operate this equipment if energized parts are not immersed in dielectric fluid. Operation when parts are not properly immersed in dielectric fluid may result in internal flashovers that will damage the equipment and can cause death or severe personal injury.**

G104.4

### 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.

This switchgear must always be filled to the correct level with insulating oil, or R-TEMP® dielectric fluid.

### Shrubline VFI interrupter operation

The Shrubline VFI push/pull operating handle (shown in Figure 4) is located on the unit frontplate; it should be operated with a shotgun stick.

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 **WARNING**

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**Hazardous Voltage. Always use a shotgun stick 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

### Opening interrupter

The Shrubline VFI vacuum fault interrupter is opened by pulling the operation handle up to the open position. The handle may be padlocked in the open position to prevent accidental closure.

### Resetting interrupter

After the Shrubline VFI mechanism has been tripped, as the result of a fault condition, the mechanism must be reset before it can be closed. To reset the mechanism, firmly pull the operating handle up, until the latch resets. After the latch has been successfully reset, the Shrubline VFI interrupter mechanism can be closed normally.

### Closing interrupter

The Shrubline VFI vacuum fault interrupter is closed by pushing the operating handle down into the closed position. If the VFI mechanism does not latch properly during reset, the operating handle will move to the tripped position when the handle is released. If this occurs, repeat resetting and closing operations until successfully closed.

## Maintenance information

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 **WARNING**

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**Falling equipment. Use the lifting lugs provided and follow all locally approved safety practices when lifting and mounting the equipment. Lift the unit smoothly and do not allow the unit to shift. Improper lifting can result in severe personal injury, death, and/or equipment damage.**

G106.3

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 **CAUTION**

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**This equipment relies on dielectric fluid to provide electrical insulation between components. The dielectric strength of the fluid must be checked on a regular basis, as part of the routine maintenance inspection, to ensure that it is at or above minimum dielectric requirements. Use of this equipment with dielectric fluid that does not meet minimum requirements can result in internal flashovers that will damage the equipment and can cause personal injury.**

G107.3

The Shrubline VFI 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.

It is necessary to establish and maintain a regular schedule for sampling and testing the insulating oil to ensure proper dielectric strength and to maintain the correct oil level in the switchgear.

### Maintenance inspection procedure

The Shrubline VFI switchgear must be de-energized, grounded and removed from service before conducting any maintenance, oil sampling or oil-filling procedures.

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 **WARNING**

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

T239.2

1. **De-energize and ground switchgear.**
2. **Reduce internal tank pressure to 0 PSIG.** The switchgear is equipped with a pressure relief valve that opens at 5 PSIG and re-seals at 3 PSIG. To relieve internal tank pressure pull the ring on the pressure relief valve.
3. **Check oil level.** Make sure the oil in the switchgear tank is at the proper level by checking the oil level indicator on the front plate of the unit.

**Note:** Refer to Insulating Oil Maintenance section for additional information regarding oil maintenance and testing requirements.

4. **Inspect for damage.** Check for unusual wear to the paint finish. Check bushings and elbows. Make sure connections are secure. Check for oil leaks or other unusual or abnormal indications of wear or abuse. Make sure that cabinet doors will lock securely. Record and correct any unusual conditions.

### Inspection and repair

If damage is suspected, the following procedure is recommended.

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### WARNING

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

T239.2

1. **De-energize and ground switchgear.**
2. **Draw an oil sample.** Use the drain plug with sampler at the bottom of the tank. If moisture is found in the tank, filter existing oil or re-fill with clean, dry insulating oil. Take appropriate precautions to keep dirt, moisture and other foreign matter from entering the tank and contaminating the insulating oil.
3. **Inspect for damage.** Check the switchgear for damaged or loose parts. If any bushings or interrupters are damaged, replace as required.
4. **Bushing replacement.** The bushing wells are externally replaceable.
  - A. Lower the oil level as needed to make repairs. Store the drained oil according to locally approved procedures.
  - B. Remove the four nuts that secure the steel clamp on the bushing. Gently pull the bushing straight out until the bushing copper terminal bus is accessible. Remove only the nuts that fasten the copper terminal bus to the end of the bushing.
  - C. Replace the damaged bushing well with a new bushing well and a new gasket. Install the copper terminal bus onto the new bushing well. While installing the new bushing well, maintain the original position of the copper terminal bus.
5. **Re-fill with insulating oil.** Refer to the Oil Sampling and Testing Procedures in this manual and make sure that the unit is properly filled to the 77° F (25° C) oil fill level with clean, dry insulating oil.
6. **Close and lock door.** After repairs are completed, close and lock switchgear door to prevent unauthorized access and accidental contact with high voltage lines.

### Insulating oil maintenance

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### CAUTION

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**This equipment relies on dielectric fluid to provide electrical insulation between components. The dielectric strength of the fluid must be checked on a regular basis, as part of the routine maintenance inspection, to ensure that it is at or above minimum dielectric requirements. Use of this equipment with dielectric fluid that does not meet minimum requirements can result in internal flashovers that will damage the equipment and can cause personal injury.**

G107.3

To assure trouble-free operation of this equipment, a regular schedule of oil testing and oil maintenance is required. A routine oil testing and maintenance schedule is necessary to monitor changes that occur in the oil as a result of normal operation and to detect abnormal conditions that may occur.

Maintaining a record of this test data will help in assessing the condition of the oil over time.

**Note:** R-Temp® dielectric fluid may be provided instead of oil, if specified at time of order. Refer to manufacturer's instructions for specifications and ASTM-approved testing procedures.

### Frequency of maintenance

The insulating oil should be initially tested within two years after the installation of the equipment. That test will yield information required to establish a benchmark reference for observing trends in the unit's normal operation and to diagnose any abnormal conditions that may be present.

After the initial oil testing and inspection, vacuum switchgear should be maintained every six years.

Each scheduled maintenance of the switchgear should include a physical inspection of the unit, an oil level check and oil testing as described in the Oil Testing section of this manual.

### Oil samples

The unit must be de-energized before withdrawing an oil sample. Withdrawing an oil sample from a unit that has a critically low oil level could result in flashover and unit failure when the unit is re-energized. Never energize this equipment without ensuring that it is filled to the proper oil level with clean, dry insulating oil.

For general oil tests, a bulk oil sample of approximately one quart (one liter) should be taken in accordance with ASTM D923 (latest revision).

### Oil sampling guidelines

Use the following oil sampling guidelines to help prevent contamination of the samples taken:

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**⚠ WARNING**

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

T239.2

1. De-energize and ground the switchgear prior to sampling oil.
2. Never collect an oil sample immediately after oil has been added. A stabilization period of 96 hours is required prior to sampling.
3. Never sample oil during inclement weather (rain, sleet, snow). The oil sample could be contaminated by moisture.
4. Always use the drain plug and sampler, located near the bottom of the front plate of the tank, to collect oil samples.
5. Use only approved oil-resistant materials, such as nitrile rubber or silicone tubing for sampling the oil. Use of other materials can result in contamination of the oil sample.
6. Be careful to prevent contamination of the oil sample from foreign material such as dirt, dust, chemicals, etc., in oil carrying and holding apparatus such as oil cans, transfer tubes, syringes, etc.
  - Upon completion of the sampling, re-check the oil level and add clean oil if required.

### Oil fill guidelines

The oil level indicator sight gauge on the front plate of the switchgear provides a convenient method to check oil level. The indicator provides the correct level for oil at 77° F (25° C).

If the oil level is low, use the following procedure to add dry mineral insulating oil to fill the unit to the correct level:

1. De-energize and ground the switchgear prior to oil filling.
2. Use only insulating oil that complies with ASTM D3487 (latest revision). The oil must have a minimum dielectric strength of 26 kV. Never use oil that contains PCB's (Polychlorinated Biphenyls).
3. Use only transfer equipment that uses oil resistant materials for hoses, seals, valves, pumps, etc. Failure to use proper transfer equipment can result in contamination of the oil.

4. When adding oil, use the oil fill plug located on the front plate of the unit.
5. Avoid getting gas bubbles in the oil during filling. Gas bubbles in the oil can reduce the dielectric strength.
6. When filling is complete, check the oil level gauge to verify that the oil is filled to the correct level. Allow at least one hour for gas bubbles to dissipate prior to energizing the unit.
7. Replace oil fill plug and energize the unit.
8. Record the date and the amount of oil needed to re-fill the unit; retain information with the permanent maintenance record of the unit.

**Table 2. General oil tests**

Oil test	Method	Requirement
Dielectric breakdown	D877	26 kV minimum
Acid number	D974	0.35 mg KOH/g maximum
Dissipation factor (25°f)	D924	1.0% maximum
Interfacial tension	D971	23.6 dyne/cm minimum
Moisture content	D1533	50 ppm maximum

### Oil testing

The insulating oil in this equipment has been tested to meet the requirements of ASTM D3487 and it has been processed to remove moisture and dissolved gases. It must be tested on a regular basis to ensure that it meets those requirements.

### General oil tests

The general oil test requirements are taken from those described in IEEE Standard C57.106-1991, *IEEE Guide for Acceptance and Maintenance of Insulating Oil in Equipment*. The required oil tests and acceptable limits are shown in Table 2.

Oil test results that do not meet the requirements may indicate a problem with either the oil or the unit. Contact your Eaton representative for technical assistance.

### Dissolved gas analysis

Dissolved gas analysis is a useful technique for diagnosing abnormal conditions and assessing the "normal" condition of oil in oil-filled equipment. The method employed is ASTM D3612 which is used in conjunction with ANSI/IEEE C57.104-1987, *IEEE Guide for the Detection and Determination of Generated Gases in Oil Immersed Transformers and their Relations to the Serviceability of the Equipment*. Table 3 provides recommendations on dissolved gas levels in oil insulated switchgear.

**Table 3. Dissolved gas in insulating oil maintenance chart**

Acetylene level C <sub>2</sub> H <sub>2</sub>	Total combust-ible gas	Required action
Less than 35 ppm	Less than 500 ppm	<i>Normal Level</i> Re-sample per routine maintenance schedule
35 – 50 ppm	500 – 1000 ppm	<i>Caution Level</i> Re-sample at 3 - 6 months to establish trend; maintain oil if gas levels increase to hazardous level.
More than 50 ppm	More than 1000 ppm	<i>Hazardous Level</i> Remove unit from service and maintain the oil.

### Replacement parts

Replacement parts for Eaton’s Cooper Power series padmounted 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 and voltage rating and a description of the part. Contact your Eaton representative for additional information and ordering procedures.

### Testing

All padmounted 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 interrupter used in the Shroulne VFI 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 interrupter open (manual operating handle 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 4, which are 75% of the rated values from Table 1, per ANSI C37.61 for field tested units. The interrupter should withstand the test voltage and should not load down the source.

**Table 4. High potential withstand test voltages**

VFI nominal voltage rating (kV)	High potential test voltages
15	26.2 kV ac rms or 37.1 kV dc*
25	30 kV ac rms or 42.4 kV dc*

#### Trip and control testing

Eaton’s Cooper Power series VFI Tester device (Figure 6) is used for testing VFI padmounted units equipped with Tri-phase or TPG controls. It is self-contained and provides quick verification of the correct operation of VFI trip mechanisms, supervisory controls, and accessory SCADA boards.



**Figure 5. VFI Tester unit – catalog number KVFITESTER**

Refer to *Service Information Bulletin MN285001EN, VFI Tester Operating Instructions* for complete information regarding operation of the VFI tester and in-depth VFI padmounted switchgear testing procedures.

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

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

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information  
call 1-877-277-4636 or visit:  
[www.eaton.com/cooperpowerseries](http://www.eaton.com/cooperpowerseries).