Types E, 4E, V4E, H, 4H, V4H, L, and V4L single-phase recloser installation and operation instructions

Powering Business Worldwide

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Contents

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 arc 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 *MN280051EN* provides installation instructions, operation information, and testing procedures for Cooper Power series single-phase reclosers from Eaton. Before installing and operating this recloser, carefully read and understand the contents of this manual.

The information contained in this manual is organized into the following major categories: *Safety Information, Product Information, Ratings and Specifications, Dimensions and Weights, Installation Procedure, Operation, and Maintenance Information*. Refer to 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 or operating this equipment.

Additional information

These instructions cannot cover all details or variations in the equipment, procedures, or process described, nor 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.

Acceptance and initial inspection

Each recloser is completely assembled, inspected, tested, and adjusted at the factory and is filled to the correct level with insulating oil. It is in good condition when accepted by the carrier for shipment. Upon receipt of a recloser:

1. Inspect the recloser thoroughly for damage and/or 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 all bolts that may have loosened during shipment, especially the bolts attaching the head to the tank.

Handling and storage

If the recloser is to be stored for an appreciable period of time before installation, provide a clean, dry storage area. Locate the recloser so as to minimize the possibility of mechanical damage, particularly to the bushings.

Standards

Eaton's Cooper Power series reclosers are designed and tested in accordance with the following standards: ANSI/IEEE C37.60-1981 and IEEE Std C37.85™-1989 standard and ANSI Guide C37.61-1973.

Quality standards

ISO 9001 Certified Quality Management System

Description of operation

Reclosers in the E, H, and L groups (see cover photo) are self-contained, hydraulically controlled devices that sense and interrupt fault currents on single-phase lines of an electrical power distribution system. If the fault is temporary, the recloser automatically recloses and restores service. If the fault is permanent, the recloser locks open after one to four operations, depending upon its setting. Automatic resetting of this device enables it to distinguish between permanent and temporary faults. Thus, if a fault is temporary, the recloser resets and is then ready for a complete reclosing sequence should another fault occur.

Operating sequences of the recloser can be all fast, all delayed, or a combination of fast followed by delayed operations. Further, any one of up to three delay curves (depending upon recloser type) can be used to assure coordination with other reclosers or protective devices. On coordinated systems, fast recloser operations ("A" curve) are used to clear temporary fault currents before branch-line fuses are damaged. Subsequent delayed openings (see Figure 1) allow time for fault currents to be cleared by branch-line fuses. Outages caused by permanent faults are thereby confined to shorter sections of line.

Tripping is initiated by a series-connected coil. Current-carrying and interrupting capacities vary with the operating coil's rating, which is selected to meet circuit requirements. A non-reclosing feature, standard on all Eaton's Cooper Power series reclosers, is set with a hotstick-operated lever for one operation to lockout without removing the recloser from service.

Series-trip solenoid

Fault-current sensing is provided by a series-connected solenoid coil that carries line current. When a fault occurs, tripping is initiated by the solenoid plunger.

The plunger, normally held at rest by the closing springs, is drawn into the coil by the magnetic force generated by the fault current. Downward travel of the plunger overtoggles springs in the contact assembly that open the recloser contacts. The same motion charges the closing springs in preparation for a reclosing operation.

When the circuit is opened, the solenoid coil is de-energized, allowing the closing springs to close the contacts and simultaneously return the plunger to its original position.

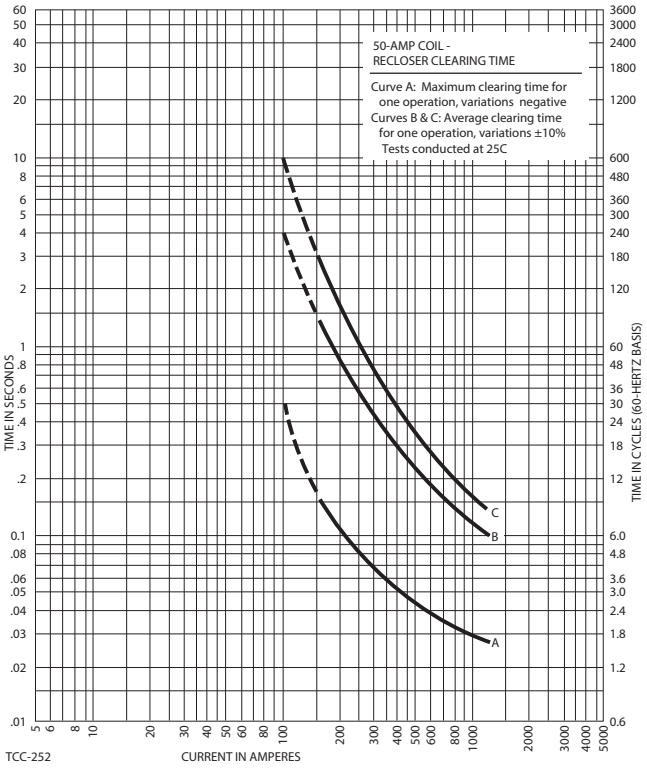


Figure 1. Type H time-current characteristics, 50 amp coil

Hydraulic control mechanism

The hydraulic control mechanism provides selectivity in timing, enabling flexibility in application and coordination with other equipment. All timing is governed by the hydraulic mechanism that:

1. Controls the timing before contact opening.
2. Establishes the time delay before the contacts reclose.
3. Counts the number of operations.
4. Causes the recloser to lock out when the preset number of trip operations has been completed.

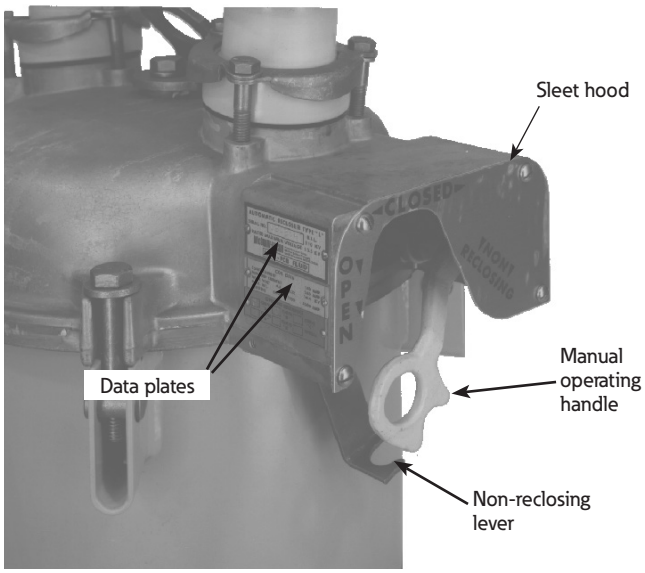


Figure 2. Recloser operating levers, indicators, and data plates

Fast and delayed timing characteristics

Variations of timing characteristics and sequences can be programmed for a maximum of four operations. When a recloser is programmed for both fast and delayed operations, the fast operations, involving no intentional time- delay, occur first in the sequence, according to the recloser's "A" curve time-current characteristic. Delayed operations are according to the recloser's "B" or "C" time-current curve ("B", "C", or "D" curves for Types E, 4E, V4E, L and V4L). See *Time Current Curves R280-91-10* for Type E reclosers; *R280-91-8* for Type 4E; *R280-91-1* for Type H; *R280-91-2* for Types 4H, V4H; *R280-91-15* for Types V4E, V4L; and *R280-91-3* for Type L.

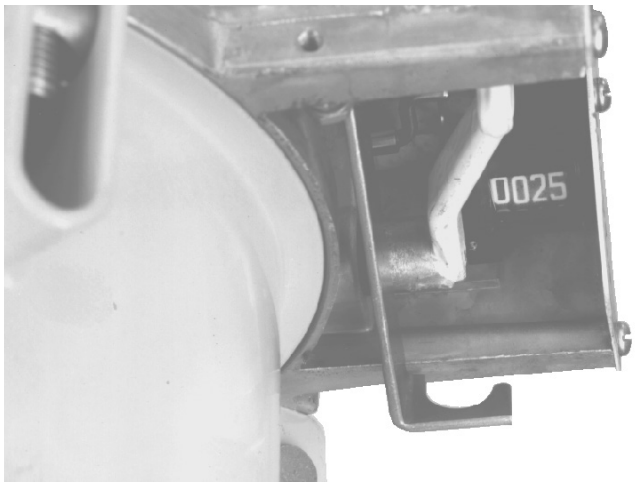


Figure 3. Operations counter located under sleet hood

Data plates

The recloser data plates, located on the sleet hood (see Figure 2), provide ratings information including: product type and serial number, nominal operating voltage, maximum-interrupting current, trip coil rating, operating sequence, and number of operations to lockout. Be sure that the ratings and settings are correct for the planned installation.

Manual operating levers and indicators

⚠ 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. This device is not a substitute for a visible disconnect. Follow all locally approved safety practices. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G112.1

The operating levers and indicators for the recloser are located under the sleet hood. See Figure 2.

Manual operating handle

⚠ WARNING

Hazardous voltage. Do not rely on the open position of the yellow operating handle or the contact position indicator; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G114.1

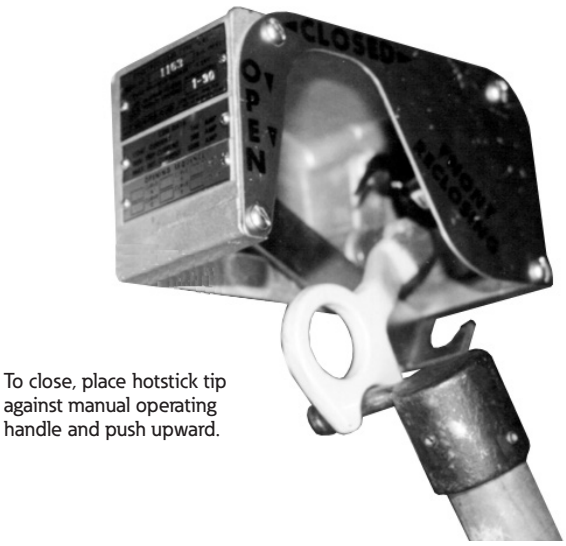
The manual operating handle (yellow handle) permits manual opening and closing of an energized recloser. It is not to be used as a substitute for a visible disconnect during line work. Pulling down the handle trips and locks open the main contacts of the recloser. Lifting up the handle closes the main contacts. The handle is operated with a hotstick.

IMPORTANT

The hotstick tip must be placed in the groove under the eyelet of the manual operating handle when closing the switch.

IMPORTANT

The manual operating handle is trip-free. If the recloser is closed against a fault, it will continue to trip and reclose until the handle is allowed to drop to the open position.



To close, place hotstick tip against manual operating handle and push upward.

Figure 4. Correct placement of the hotstick to close the recloser

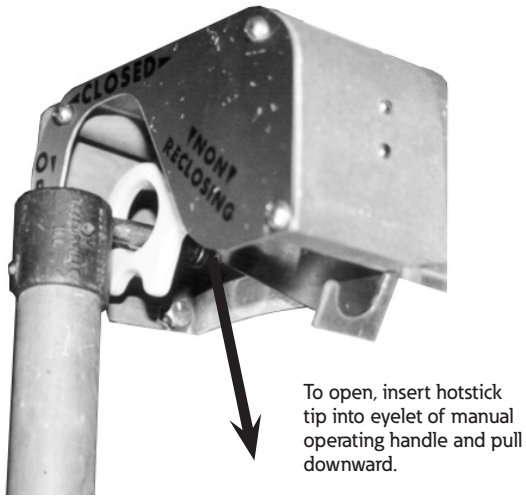
The correct placement of the hotstick for closing the recloser is shown in Figure 4. The correct placement of the hotstick to open the recloser is shown in Figure 5. Place the hotstick hook into the eyelet of the manual operating handle and pull downward.

Non-reclosing lever

The non-reclosing lever provides the recloser with the capability of locking out on the first trip operation for added safety during downline, hot-line work. This lever is also hotstick operated.

Operations counter

A four-digit mechanical counter, which records all trip operations, is located under the sleet hood. See Figure 3.



To open, insert hotstick tip into eyelet of manual operating handle and pull downward.

Figure 5. Correct placement of hotstick to open recloser

Ratings and specifications

Table 1. Ratings and specifications

Recloser type	Rated system nominal voltage (kV)	Rated system max. voltage (kV)	Rated system withstand voltage (BIL) (kV)	60 Hz Insulation level withstand rating		Continuous current (amps)
				Dry 1-Min. (kV)	Wet 10-Sec (kV)	
E	24.9	27	150	60	50	100
4E	24.9	27	150	60	50	280
V4E	24.9	27	150	60	50	280
H	14.4	15.0	95	35	30	50
4H	14.4	15.5	110	50	45	100
V4H	14.4	15.5	110	50	45	200
L	14.4	15.5	110	50	45	280
V4L	14.4	15.5	110	50	45	280

Table 2. Rated interruptions

Recloser type	% Interrupting rating	Maximum circuit X/R ratio	Number unit operations	Total unit operations
E	15-20	2	40	72
	45-55	5	20	
	90-100	12	12	
4E	15-20	3	32	64
	45-55	6	20	
	90-100	13	12	
V4E	15-20	3	96	248
	45-55	7	120	
	90-100	15	32	
H	15-20	2	40	100
	45-55	4	40	
	90-100	8	20	
4H	15-20	2	32	68
	45-55	5	24	
	90-100	10	12	
V4H	15-20	2	128	272
	45-55	5	96	
	90-100	10	48	
L	15-20	3	32	64
	45-55	6	20	
	90-100	12	12	
V4L	15-20	3	96	248
	45-55	7	120	
	90-100	15	32	

Table 3. Interrupting ratings

Recloser type	Trip-coil continuous current (amps)	Minimum-trip current (amps)	Interrupting current (rms symmetrical amps)		
			@24.9 kV		
E	5	10	300		
	10	20	600		
	15	30	900		
	25	50	1500		
	35	70	2100		
	50	100	2500		
	70	140	2500		
	100	200	2500		
4E	50	100	3000		
	70	140	4000		
	100	200	4000		
	140	280	4000		
	200	400	4000		
	280	560	4000		
V4E	15	30	900		
	25	50	1500		
	35	70	2100		
	50	100	3000		
	70	140	4200		
	100	200	6000		
	140	280	6000		
	170	340	6000		
	200	400	6000		
	280	560	6000		
H			@2.4 through 14.4 kV		
	5	10	125		
	10	20	250		
	15	30	375		
	25	50	625		
	35	70	875		
	50	100	1250		
4H			@4.8	@8.32	@14.4
	5	10	200	200	200
	10	20	400	400	400
	15	30	600	600	600
	25	50	1000	1000	1000
	35	70	1400	1400	1400
	50	100	2000	2000	2000
	70	140	2800	2500	2000
	100	200	3000	2500	2000
V4H	5	10	200	200	200
	10	20	400	400	400
	15	30	600	600	600
	25	50	1000	1000	1000
	35	70	1400	1400	1400
	50	100	2000	2000	2000
	70	140	2800	2500	2000
	100	200	3000	2500	2000
	140	280	3000	2500	2000
	200	400	3000	2500	2000

Recloser type	Trip-coil continuous current (amps)	Minimum-trip current (amps)	Interrupting current (rms symmetrical amps)		
			@4.8	@8.32	@14.4
L	25	50	1500	1500	1500
	35	70	2100	2100	2100
	50	100	3000	3000	3000
	70	140	4200	4200	4000
	100	200	6000	5000	4000
	140	280	6000	5000	4000
	200	400	6000	5000	4000
	280	560	6000	5000	4000
V4L			@2.4 through 14.4 kV		
	15	30	900		
	25	50	1500		
	35	70	2100		
	50	100	3000		
	70	140	4200		
	100	200	6000		
	140	280	6000		
	170	340	6000		
	200	400	6000		
	280	560	6000		

Dimensions and weights

Figure 6 provides dimensional information for the Type H recloser. Figure 7 provides dimensions for the E, H, and L group reclosers. Weights and oil capacities are given in Table 4.

Note: Dimensions shown are approximate. For critical construction dimensions, refer to factory. Dimensions are given in mm (in).

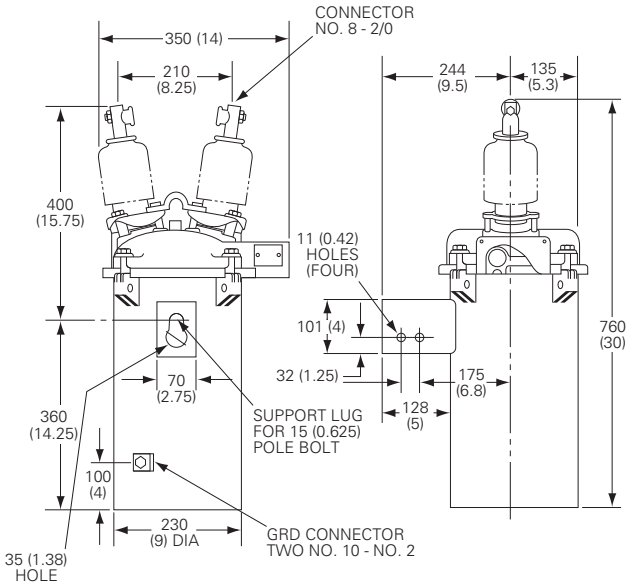


Figure 6. Dimensions of type H recloser

Table 4. Weight, kG (lb) and oil capacity, L (gal)

	Recloser type						
Description	E mm (in)	4E mm (in)	V4E mm (in)	H mm (in)	4H, V4H mm (in)	L mm (in)	V4L mm (in)
Weight without oil, kG (lb)	48.5 (107)	64 (142)	67 (147)	25 (55)	34.5 (76)	48 (106)	64 (142)
Weight with oil, kG (lb)	76.5 (169)	93 (205)	95 (210)	38.6 (85)	51.5 (114)	48 (159)	95 (205)
Oil capacity, L (gal)	30.7 (8.25)	35.4 (9.5)	35.4 (9.5)	15 (4)	18.5 (5)	26 (7)	35.4 (9.5)

Table 5. Recloser dimensions

	Recloser type				
Description	E mm (in)	4E, V4E mm (in)	4H, V4H mm (in)	L mm (in)	V4L mm (in)
A	380 (15)	380 (15)	355 (14)	380 (15)	380 (15)
B	405 (16)	405 (16)	355 (14)	405 (16)	405 (16)
C	1050 (41.5)	1240 (49)	900 (35.5)	940 (37)	1140 (45)
D	505 (20)	570 (22.5)	430 (17)	480 (19)	480 (19)
E	230 (9)	368 (14.5)	175 (7)	150 (6)	368 (14.5)
F	254 (10)	254 (10)	230 (9)	254 (10)	254 (10)
G	280 (11)	305 (12)	215 (8.5)	280 (11)	280 (11)
H	280 (11)	280 (11)	230 (9)	280 (11)	280 (11)

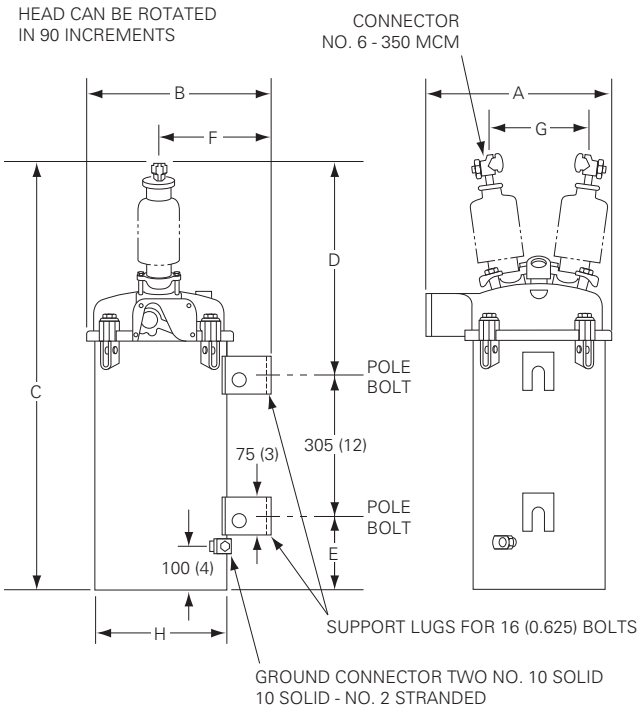


Figure 7. Dimensions of types E, 4H, and L reclosers

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

⚠ CAUTION

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

When untanking the recloser for inspection prior to installation, remove the four bolts that secure the tank and head casting. Trip the recloser and carefully lift the mechanism out of the tank.

1. **Check oil level.** Before installing the recloser, check for proper oil level. With the mechanism removed from the tank, the oil level should be up to the fill line marked on the tank liner.
2. **Test oil dielectric strength.** If the recloser has been stored for some time or is being relocated, perform a dielectric test on the oil in accordance with ASTM- approved testing procedures.
   A. On 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 an acceptable minimum level.
3. **Replace head casting and mechanism in tank.**
   A. Wipe clean the O-ring type gasket, the gasket recess in the recloser head, and the tank gasket.
   B. Position and tighten the four head bolts alternately. The cover can be rotated to accommodate installation. Torque each head bolt to 11-16 ft-lbs.
   C. Operate the unit manually eight times to ensure that no air remains in the hydraulic mechanism.
4. **Test mechanical operation.** An effective test can be performed as follows:
   A. Move the yellow manual operating handle to the CLOSED position and wait at least 4 minutes.
   B. Move the manual operating handle to the OPEN position and listen for opening of the main contacts. (A dull "clunk" will be audible.) Then quickly move the lever back to the CLOSED position.(A metallic "click" can be heard.)
   C. Continue opening and closing the recloser manually until lock-out is achieved. This can be determined by listening for unlatching of the lock-out mechanism and also by noting that the recloser mechanism will not latch when the operating handle is moved to the CLOSED position. This test can be used to determine the number of operations to lock-out. The number of fast and delayed operations can also be identified. With fast operations, the main contacts will open almost instantaneously when the operating handle is moved to the OPEN position, while, with delayed operations, a short time elapses between opening of contacts and placement of the operating handle in the OPEN position.
5. **Check data plates.** Make sure the ratings and settings on the recloser data plates are correct for the planned installation.

⚠ CAUTION

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

6. **Mount the recloser.**

⚠ WARNING

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

7. **Ground the recloser.** Make the ground connection to the recloser ground connector (located 4" from the bottom of the tank).

Line installation

Provide the recloser with bypass switches and surge protection as shown in Figure 8. Surge protection on both sides of the recloser is advisable. If surge protection is provided on only one side,though, it should be located on the **source side for line installations** and on the **load side for substation installations.**

Connect the primary leads to the recloser. The source-side bushing is located above the sleet hood. To facilitate connection, rotate the cover of the recloser in 90-degree increments, as required. The universal clamp-type terminals accept No. 6 through 350-mcm conductors (No. 8 through 2/0 for Type H reclosers).

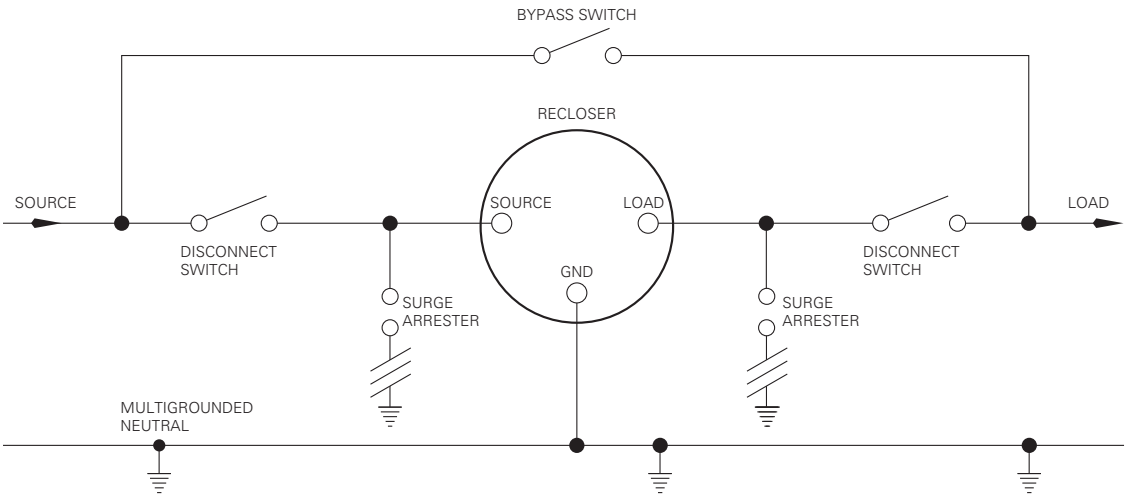


Figure 8. Connection diagram with switches to facilitate maintenance and complete surge protection

Operation

Initial operation

⚠ 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

Hazardous voltage. This device is not a substitute for a visible disconnect. Follow all locally approved safety practices. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G112.1

With the recloser connected as shown in Figure 8, close the source-side disconnect switch. Move the yellow manual operating handle under the sleet hood to the CLOSE position as indicated on the head cover. The recloser should immediately close. Close the load-side disconnect switch and open the bypass switch. The recloser is now in service. To remove from service, close the bypass switch and open the disconnect switches.

Manual operation

⚠ WARNING

Hazardous voltage. Do not rely on the open position of the yellow operating handle or the contact position indicator; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G114.1

Manual operation of an energized E, H, or L group recloser requires a hotstick engagement of the yellow operating handle located under the sleet hood. When the handle is pulled down, the mechanism is tripped to open the main contacts. When the handle is pushed up, the main contacts close.

Non-reclosing operation

When the non-reclosing lever (Figure 2) has been manually pulled down into the non-reclosing position, any current over minimum-trip rating will automatically lock open the recloser on the first trip operation instead of cycling through the normal operating sequence. This immediate lockout protection is especially desirable for hot-line work. However, the non-reclosing lever does not interfere with manual recloser operation. The recloser can be opened or closed manually regardless of the position of the non-reclosing lever.

Maintenance information

Maintenance requirements

⚠ 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 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

All Eaton's Cooper Power series reclosers require routine inspection and maintenance to ensure proper operation. If the equipment is not adequately maintained, it may fail to operate properly.

Maintenance manuals

Maintenance instruction manuals for single-phase reclosers are listed in Table 6 by their Service Information Number.

Table 1. Maintenance Instructions for Single-Phase Reclosers

Recloser type	Service information number
E	S280-25-5
4E	S280-25-4
H, 4H, V4H	S280-10-9
L	S280-15-1
V4L, V4E	S280-15-7

Frequency of maintenance

To assure proper and trouble-free operation, oil interrupting reclosers must be maintained when they have operated the equivalent of a rated duty cycle (see Table 2). Vacuum interrupting reclosers must be maintained when they have operated the equivalent of twice the rated duty cycle (see Table 2).

Note: ANSI Guide C37.61-1973, "*Guide for the Application, Operation and Maintenance of Automatic Circuit Reclosers*", provides a procedure for converting the rated standard duty cycle into an equivalent duty cycle based on the actual operating duty of the recloser.

Recloser maintenance intervals

In the absence of specific operating experience, use the following guideline(s) to establish maintenance intervals for single-phase reclosers:

Oil interrupting reclosers should be maintained *at minimum* every three (3) years.

Vacuum interrupting reclosers should be maintained *at minimum* of fifteen (15) years.

For additional information and specific maintenance requirements, including periodic routine inspection procedures, refer to the appropriate maintenance manual as indicated in Table 6.

Replacement parts

Replacement parts for Eaton's Cooper Power series reclosers are available through the factory service department. To order replacement parts, refer to the applicable maintenance manual. Contact your Eaton representative for additional information and ordering procedures.

Factory-authorized service centers

Factory-authorized service centers are located throughout the continental United States to provide maintenance, repair and testing services for Eaton's Cooper Power series reclosers. For further information, contact your Eaton representative.

Factory maintenance classes

The factory service department offers recloser maintenance-training classes. These classes, taught by experienced service technicians, are held at the factory in-house training facility.

The courses provide hands-on instruction and factory recommended procedures for the routine maintenance, troubleshooting, repair, and testing of Eaton's Cooper Power series switchgear. It is strongly recommended that all personnel who service and maintain Eaton's Cooper Power series switchgear attend the appropriate classes. For additional information, contact your Eaton representative.

Instructional video programs

Two DVD video maintenance-training programs, *KSPV1A, General Maintenance and Inspection Procedures For Kyle Reclosers and KSPV2A, Mechanical Operation Service and Testing For Kyle Single-Phase Reclosers*, are available as supplemental training aids for maintenance personnel.

These video programs, developed for use in factory maintenance classes, are to be used in conjunction with existing service literature. For additional information, contact your Eaton representative.

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