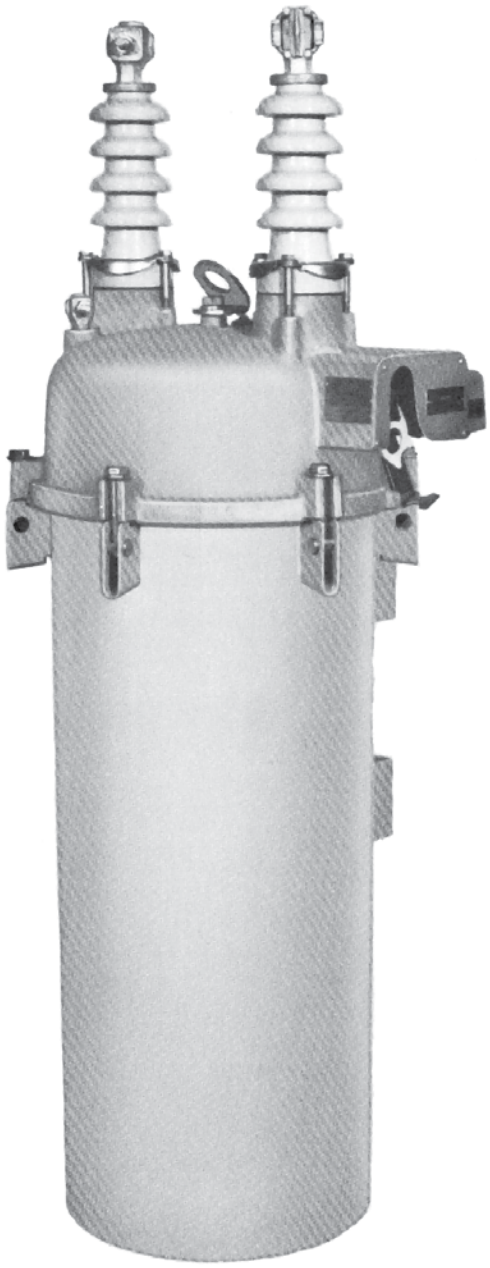
# Types D and DV recloser installation instructions



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 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.** G122.2

## Product information

### Introduction

*Service Information MN280030EN* provides installation instructions for Eaton's Cooper Power™ series Types D and DV reclosers. Prior to the installation or calibration process, carefully read and understand the contents of this manual.

### 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. For additional information, contact your Eaton representative.

### Quality standards

ISO 9001 Certified Quality Management System

### 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 fluid. 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 loss of parts or fluid incurred during shipment. If damage or loss is discovered, file a claim with the carrier immediately.
2. Check for fluid leakage and tighten all bolts that may have loosened during shipment, especially the bolts attaching the head to the tank.

### Handling and storage

Be careful during handling and storage of the time-delay unit to minimize the possibility of damage. If the unit is to be stored for any length of time prior to installation, provide a clean, dry storage area.

## Guarantee

Performance guarantees shall be limited to correction by repair or replacement, at Eaton's option, of such equipment or components that may fail due to defects in material or workmanship within a period of one year from date of shipment. The guarantee is valid only if the recloser has been properly inspected upon receipt, properly installed,and has not been subjected to abnormal conditions. The company will not, however, be liable for consequential damages or any expenses incurred in installation or transportation.

## Handling and storage

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

## Description

Types D and DV reclosers sense and interrupt fault currents on single-phase lines of distribution systems. The recloser automatically recloses and restores service if the fault is temporary. If the fault is permanent, the recloser locks open after the second, third, or fourth interruption depending upon its setting.

The recloser may be made non-reclosing (locks open after the first interruption) by actuating an external lever.

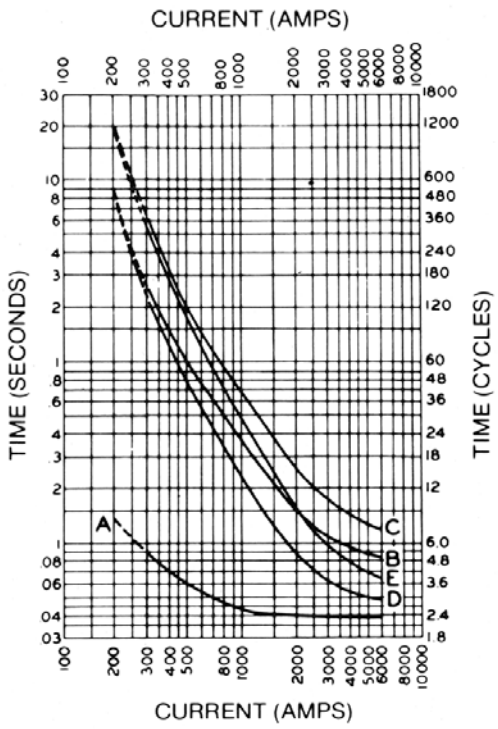
Sensing of fault currents is provided by a trip coil which is connected in series with the recloser contacts and can carry its rated line current. Continuous current and minimum trip values of the recloser can be changed by changing the coil.

Contact closing energy, as well as energy to charge the opening springs, is supplied by a high-voltage closing solenoid which is connected phase-to-ground on the source side of the recloser. A low-voltage closing solenoid, which is energized by an auxiliary AC or DC low-voltage source, is also available.

The opening sequences of the recloser can be all fast, all retarded, or a combination of both. In addition, one of four different time-current characteristics is available for the retarded opening sequences (Figure 1).

**⚠ WARNING**

**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




CURVE A GIVES MAXIMUM CLEARING TIME FOR ONE OPENING. VARIATIONS FROM CURVE ARE NEGATIVE. CURVES B, C, D, AND E GIVE AVERAGE CLEARING TIME FOR ONE OPENING. VARIATIONS FROM CURVES ARE ± 10%.

**Figure 1. Types D and DV time-current characteristics, 100-amp coil.**

## Specifications and ratings

**Table 1. Basic Recloser Data**

| Description | Type D | Type DV |
|---|---|---|
| Nominal voltage (kv) | 2.4-14.4 | 24.9-34.5 |
| Maximum design voltage (kv) | 15.5 | 38 |
| Impulse withstand (BIL), 1.2 x 50 microsecond wave, crest (kv) | 110 | 150 |
| 60-hz, withstand (kv rms) | | |
| Dry, one minute | 50 | 70 |
| Wet, ten seconds | 45 | 60 |
| Maximum continuous current (amps) | 560 | 560 |
| Reclosing time (seconds) | 2 | 2 |
| Bushing creepage distance (inches) | 115/8 | 17 |

**Table 2. Minimum Trip and Interrupting Ratings**

| Trip Coil Ratings Continuous amps | Minimum Trip Ratings (amps) | Interrupting Ratings (rms symmetrical apps) Types D @4.8 kv | @8.32 kv | @14.4 kv | Type DV @24.9 34.5kv |
|---|---|---|---|---|---|
| 100 | 200 | 6000 | 6000 | 6000 | 6000 |
| 140 | 280 | 8400 | 8400 | 8400 | 8000 |
| 160 | 320 | 9600 | 9600 | 9600 | 8000 |
| 185 | 370 | 11100 | 10000 | 10000 | 8000 |
| 225 | 450 | 12000 | 10000 | 10000 | 8000 |
| 280 | 560 | 12000 | 10000 | 10000 | 8000 |
| 400 | 800 | 12000 | 10000 | 10000 | 8000 |
| 400x | 560 | 12000 | 10000 | 10000 | 8000 |
| 560 | 1120 | 12000 | 10000 | 10000 | 8000 |
| 560x | 750 | 12000 | 10000 | 10000 | 8000 |

## Dimensions and weights

Figure 2 shows the essential dimensional information for the Types D and DV reclosers, along with weights and fluid capacities.

| Weights and Fluid Capacities | Type D | Type DV |
|---|---|---|
| Weight, dry (lb) | 210 | 255 |
| Weight, with fluid (lb) | 360 | 480 |
| Fluid capacity (gal) | 20 | 30 |

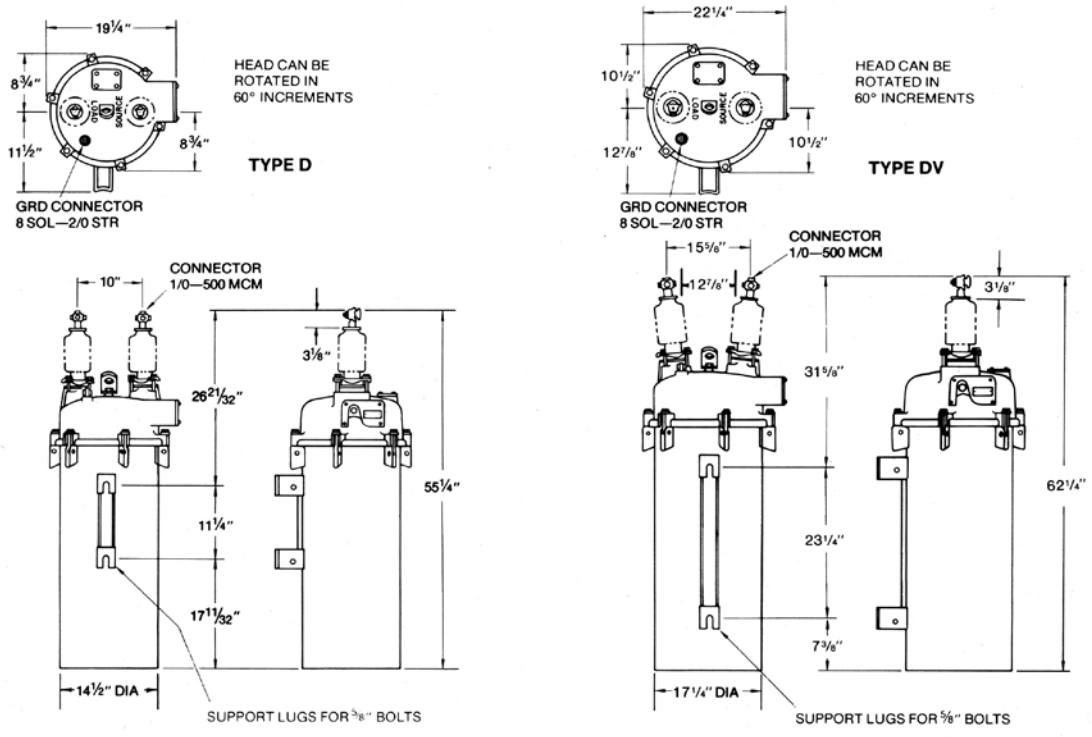



**Figure 2. Dimensional Information.**

## Operating levers and indicators

The operating levers and indicators for the reclosers are located under the sleet hood (Figure 3).

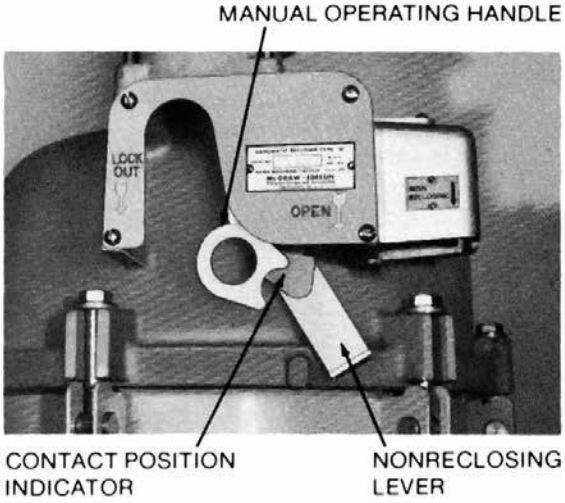



**Figure 3. Operating levers and indicators.**

### Manual operating handle

The manual operating handle (painted yellow) permits manual opening and closing of an energized recloser. Pulling down the handle trips and locks open the main contacts of the recloser. Lifting up the handle closes the closing-coil contactor and, if the closing circuit is energized, the closing coil will close the main contacts. The handle can be operated with a hookstick.

This 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.

### 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 hookstick operated.

### Contact position indicator

The red flag is coupled to the recloser mechanism and shows the position of the main contacts. When the flag is down, the main contacts are open; when the flag is up, the main contacts are closed.

### Operations counter

A three-digit counter which records all trip operations is located under the sleet hood.

## Closing solenoid

The recloser is closed by a high-voltage solenoid connected phase to the solid multi-grounded neutral. The solenoid coil must be replaced if the recloser is to be operated at a voltage other than that shown on the nameplate.

Low-voltage d-c coils (125 or 250 volts) are available for the closing solenoid. Rectifier kits to operate the d-c coils from a 120 or 240 Vac source, as applicable, are also available. Electrical power for low-voltage closing is supplied through a connector mounted on the recloser head.

Connection diagrams for the various modes of operation are shown in Figure 4.

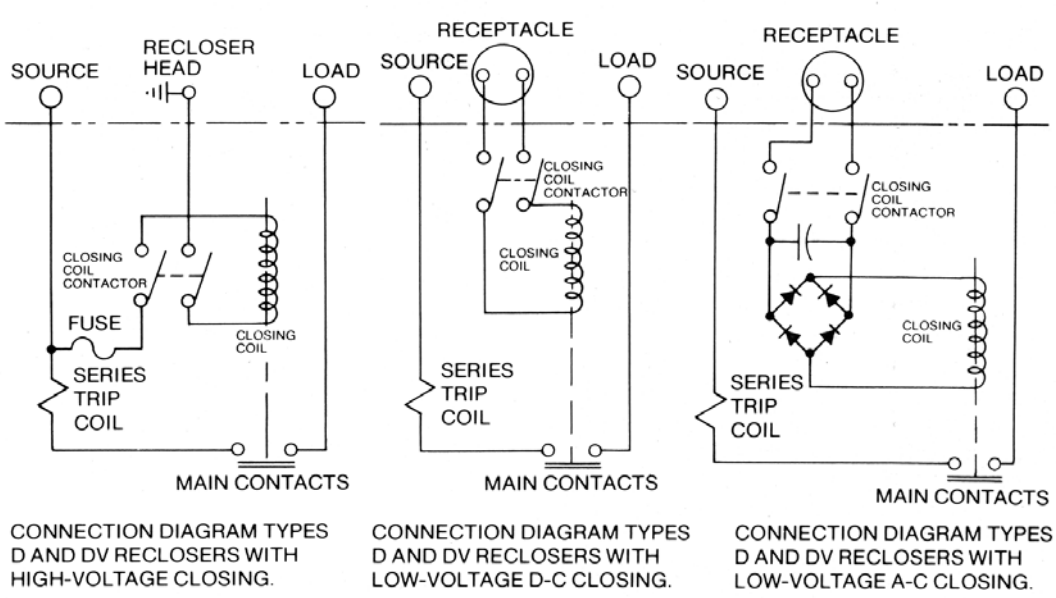



**Figure 4. Recloser connection diagrams.**

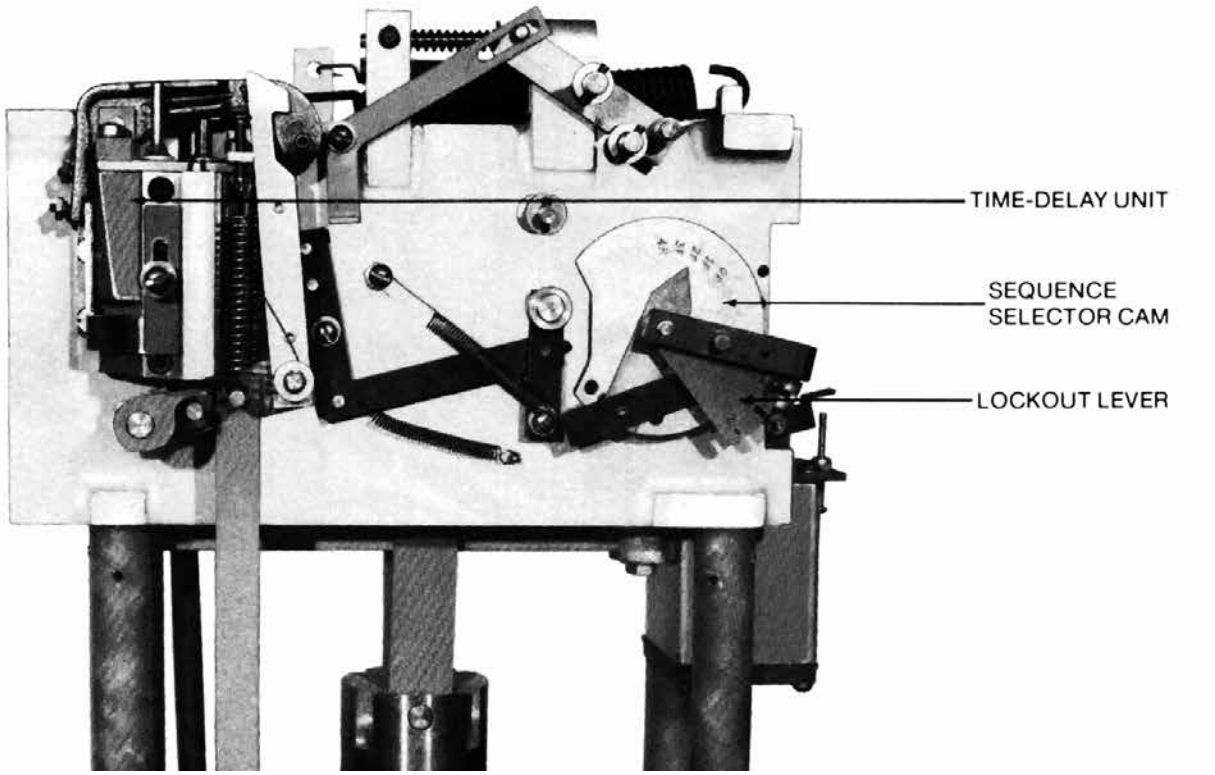



**Figure 5. Operations to lockout and sequence selection.**

## Adjustments

The operating characteristics of the Types D and DV reclosers are preset and tested at the factory and are stamped on the nameplate. However, if the recloser is relocated or the coordination scheme is modified, these characteristics can be easily changed in the field. The adjustments are accessible under the head casting after the tank has been lowered.

### Operations to lockout

The recloser can be set for 2, 3, or 4 operations to lockout. The lockout lever assembly is shown in Figure 5. To set operations to lockout, index the lever to the slot corresponding to the number of operations desired.

### Number of fast operations

The tripping sequence to lockout can be all fast, all retarded, or a combination of fast operations followed by retarded operations. To set the number of fast operations (0, 1, 2, 3, or 4), depress the spring-loaded sequence selector cam (Figure 5) to disengage the indexing pin. Move the cam until the desired number of fast operations is opposite the arrow point. Be sure the indexing pin is seated when the cam is released.

Setting the fast operations also determines the number of retarded operations that will remain in the total operating sequence. For example, if the recloser is set for four total operations to lockout and the sequence setting is made at 2F, two retarded operations remain in the operating sequence.

## Retarded-timing characteristics

Retarded-timing characteristics are determined by the sealed hydraulic time-delay unit shown in Figure 6. To insure reliable timing, the time-delay unit operates with special aircraft hydraulic fluid, which is about four times less subject to temperature changes than transformer fluid.

Two separate time-delay units are available; each provides two retarded time-delay characteristics. Thus, it is necessary to select one unit for B and C time-current curves or the other for D and E curves. The time-current curves for the various trip-coil ratings are shown in *R280-91-4, Types D and DV Reclosers—Time-Current Curves*, pages 1 through 10.

To change the retarded time characteristic of the time-delay unit, loosen the thumbscrew, index the desired marked adjustment bracket hole to the protruding pin on the time-delay unit, and then retighten the thumbscrew.

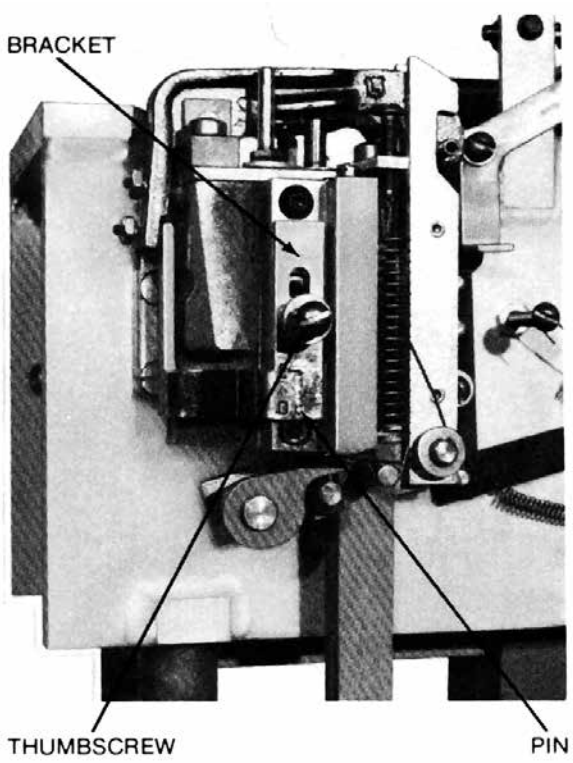



**Figure 6. Adjustments of time-delay unit to change time-current characteristics.**

## Installation and operation

### Preliminary checks

Before installing the recloser, check for proper fluid level. With the mechanism removed from the tank, the fluid level should be:

Type D Recloser . . . . . 3-1/2 inches from top of tank

Type DV Recloser . . . . . 2-1/4 inches from top of tank

If the recloser has been stored for any length of time, the dielectric strength of the fluid should be checked. See *Reference Bulletin R280-90-1, Oil Specifications and Test*, for test procedures and acceptable test values. Fluid that does not meet specifications should be refiltered or replaced.

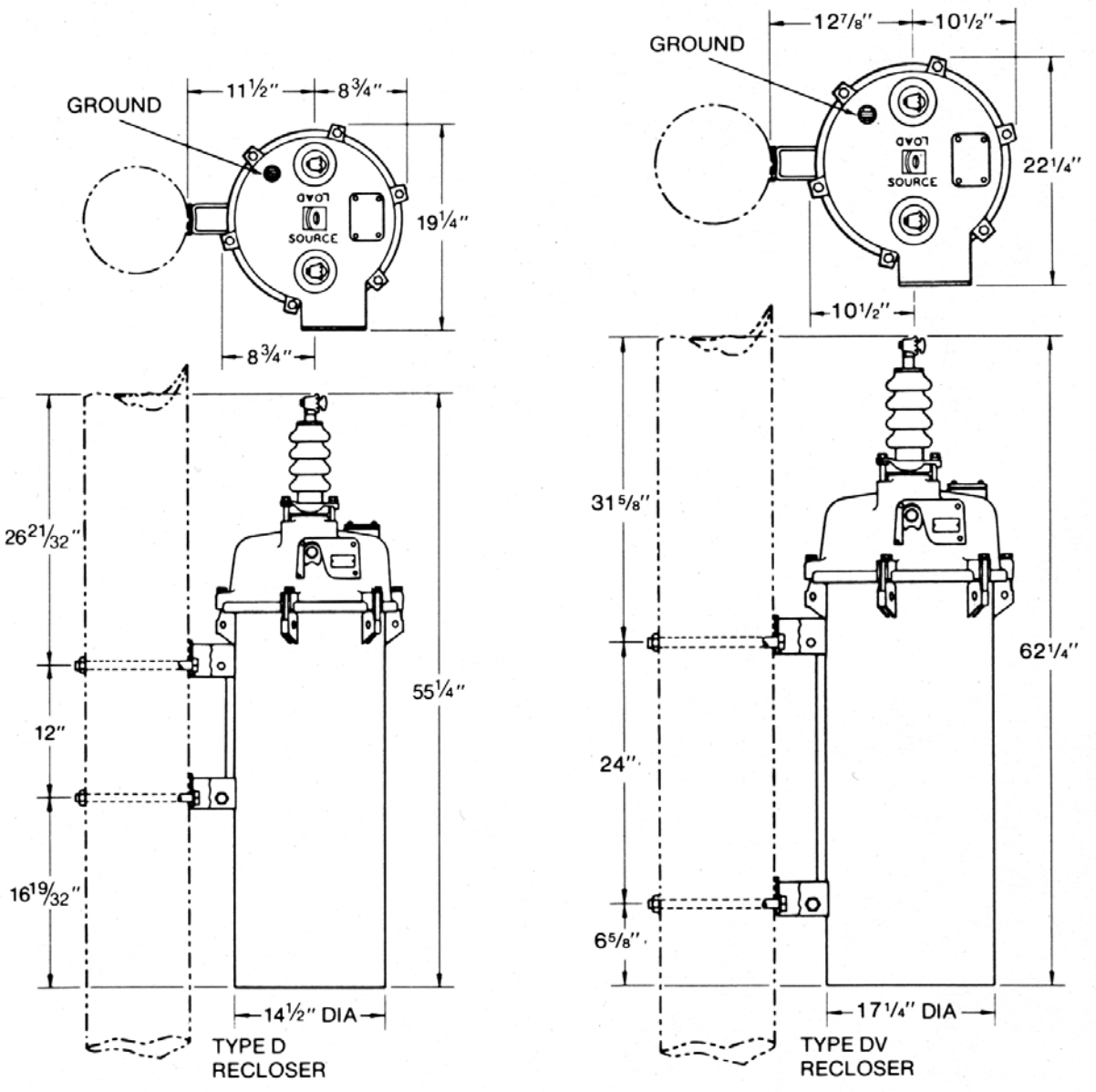



**Figure 7. Dimensions for direct pole mounting.**

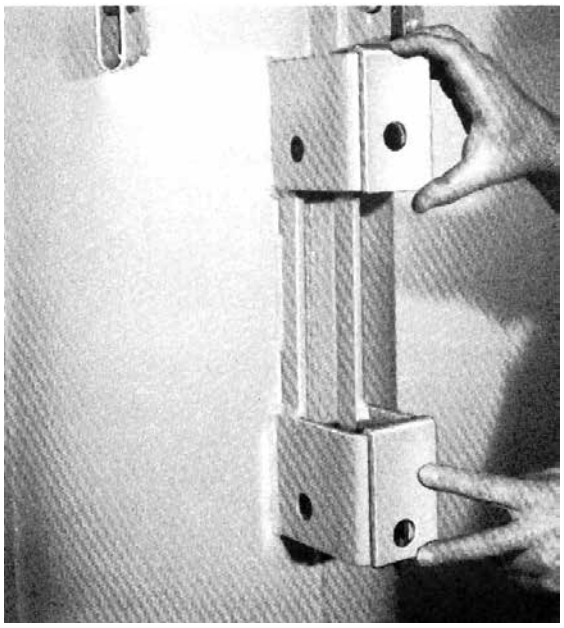


**Figure 8. Location and position of curved mounting plates used for direct pole mounting.**

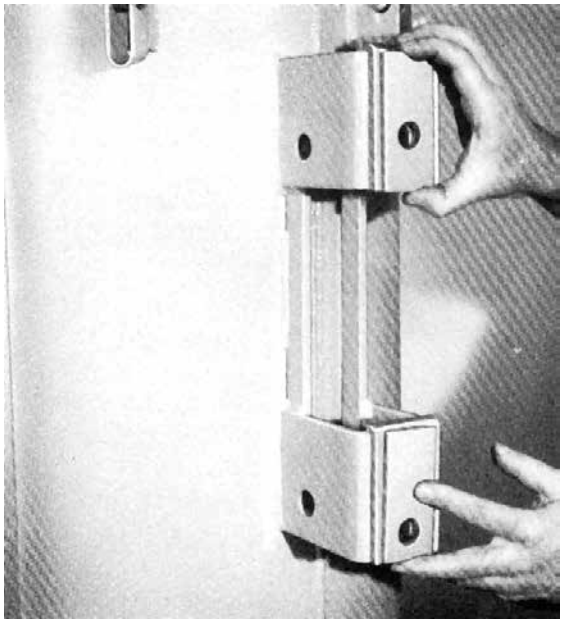


**Figure 9. Add flat adapter plates on curved plates for flat channel mounting.**

## Mounting hardware

### Direct mounting

The Types D and DV reclosers can be mounted directly on a pole or substation structure as shown in Figure 7. Mounting hardware is to be furnished by the customer.

Two sets of mounting plates are furnished with each recloser. For direct pole mounting, the curved plates are installed between the pole and the mounting brackets of the recloser. For mounting on a substation truss or a pole-mounted channel, add the flat adapter plates between the curved plates and the mounting surface.

### Cluster mounting

Three Type D reclosers can be mounted on a pole with the aid of a cluster rack as shown in Figure 10. Use both the curved mounting plates and the flat adapter plates when mounting the reclosers to the rack. Hardware for mounting the reclosers to the rack is provided with the rack. Hardware for mounting the rack to the pole is to be furnished by the customer. It is recommended that the reclosers be assembled to the rack on the ground, and the entire assembly hoisted and secured to the pole.

### Lifting

When lifting the recloser for mounting or any other purpose, follow approved safety practices with lifting methods and equipment. Lift the load smoothly and do not allow it to shift. The single lifting lug provided on the recloser is intended for vertical lifting of the recloser only. Lifting of attached frames or other equipment by means of the recloser lifting lug reduces the designed safety factor is not recommended.

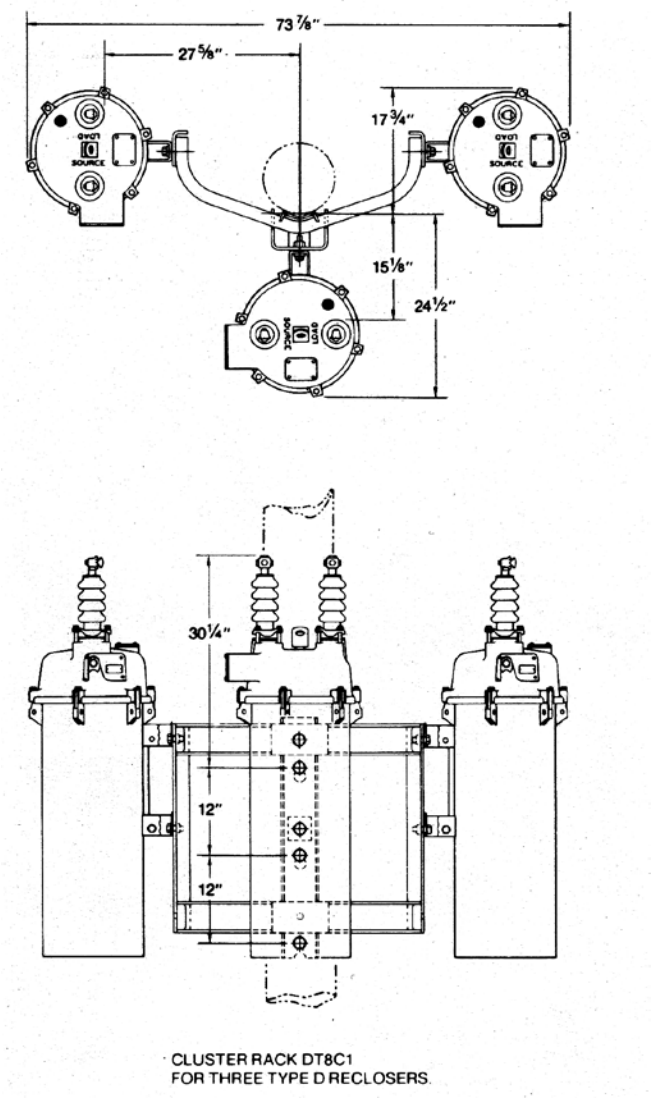



**Figure 10. Dimensions for cluster mounting.**

## Main wiring

It is desirable to provide the recloser with bypass switches and surge protection as shown in Figure 11. Surge protection on both sides of the recloser is advisable. However, if protection is provided on only one side, 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 in accordance with head-casting markings, SOURCE and LOAD. To facilitate connection, the cover of the recloser can be rotated in 60-degree increments with respect to the tank and its mounting. The universal clamp-type terminals accept no. 1/0 through 500 MCM conductors.

To furnish operating energy to the high voltage closing solenoid, the ground terminal on the top of the cover casting must be connected to the multi-grounded neutral of the system. This also is a universal clamp type terminal and has a conductor range of no. 8 solid to no. 2/0 stranded.

Operating energy for the low-voltage closing accessory is furnished through a two-pin receptacle and plug mounted on the recloser head. The outer portion of the plug is a weather-proof cable grip for 9/16 to 5/8-inch-oaf cables. For AC low-voltage closing, the solenoid coil draws 35 amps at 120 volts and 23 amps at 240 volts. Since the coil is energized for only a few cycles during each reclosing operation, voltage drop in the cable—rather than thermal rise—is of primary concern.

## Initial operation

With the recloser connected as shown in Figure 11, 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.

**Note:** For low-voltage closing, make sure that the auxiliary power is available at the recloser before starting the above procedure.

## Manual operation

To manually operate an energized Type D or Type DV recloser involves only a hookstick 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 closing solenoid is energized to latch the main contacts in the closed position.

A manual closing tool is available for closing a *de-energized* recloser. Remove the pipe plug on the side of the cover casting to provide access for the reclosing tool to engage the main operating shaft of the recloser mechanism. A de-energized recloser is tripped open merely by pulling down the yellow operating handle.

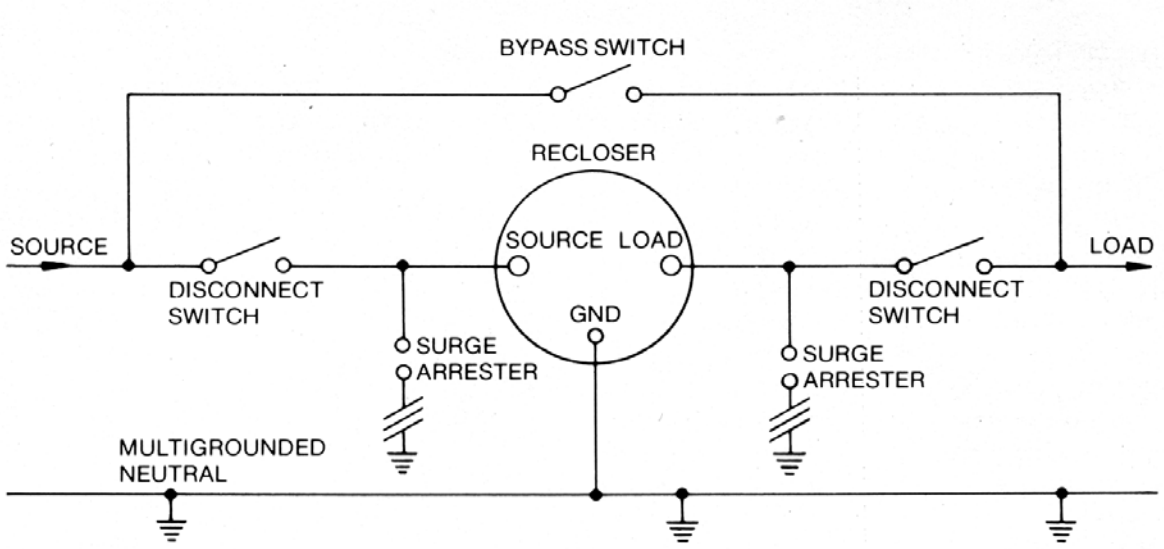



**Figure 11. Suggested connection diagram, high-voltage closing.**

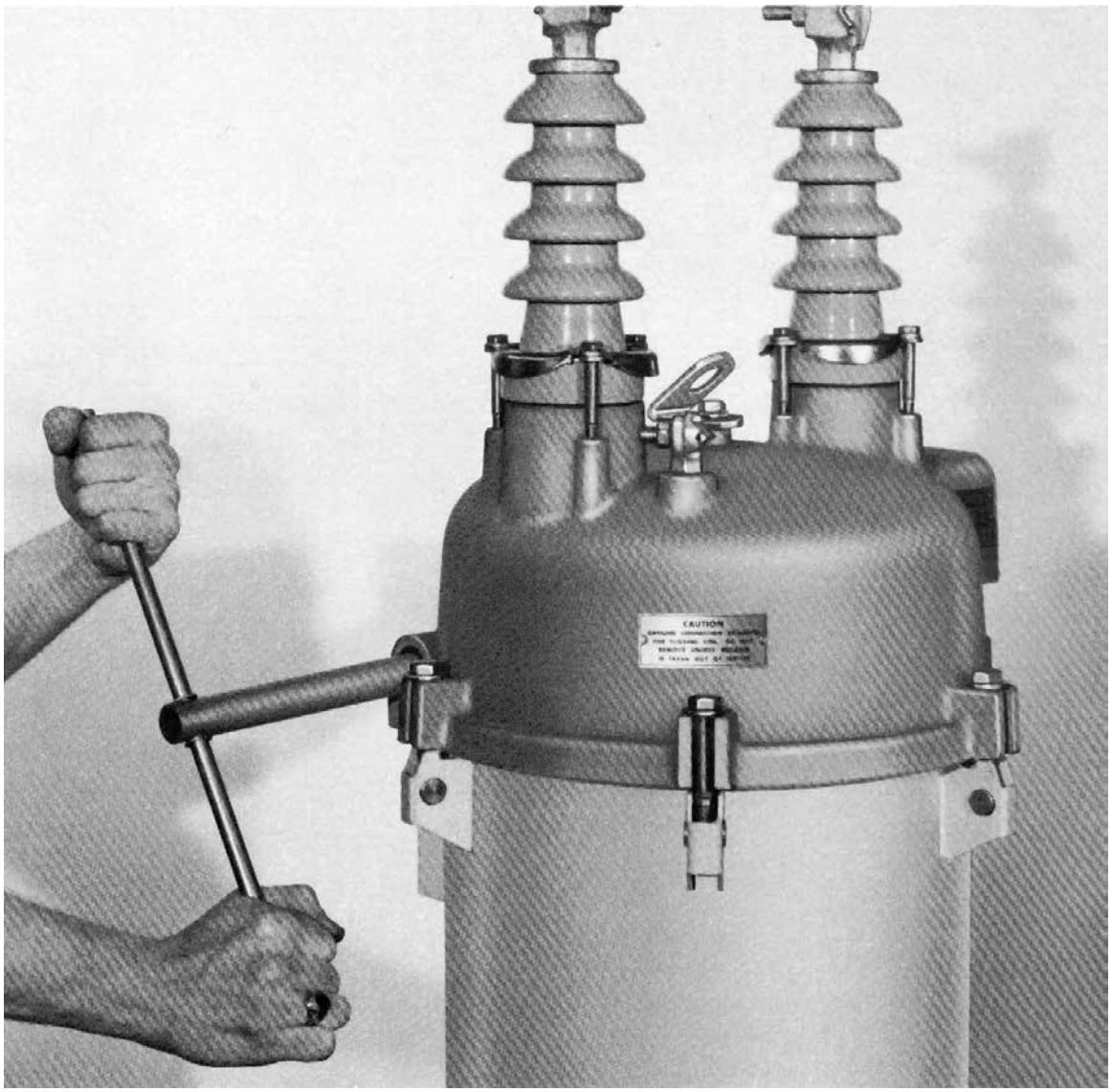



**Figure 12. Manual closing tool of de-energized recloser.**

## Non-reclosing operation

When the non-reclosing lever 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 in the higher load density areas served by the Types D and DV reclosers.

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.

## Testing

Types D and DV reclosers are carefully tested and adjusted at the factory to operate according to the published data. Well equipped test facilities, a detailed testing procedure, and trained personnel assure accurate calibration. Permanent records are kept of each recloser's test performance. Thus, each recloser leaves the factory ready for installation, and preinstallation testing is not necessary.

However, should verification of recloser operation prior to installation be desired, the following characteristics can be checked:

1. Number of operations to lockout.
2. Number of fast openings.
3. Satisfactory operation of closing solenoid.
4. Minimum trip current.
5. Reclosing time.

The test findings should concur with the information shown on the data plates and nameplates located on the sleet hood. The application of the Types D and DV reclosers equipped with high-voltage closing is limited to wye systems with a multi-ground neutral; therefore, the test connections must simulate field application with the phase-to-ground-neutral connection. The recloser can be test tripped with a low voltage AC source but, for automatic closing, a high-voltage AC source is required. For personnel safety, the recloser and high voltage transformer should be enclosed in a test cage to prevent accidental contact, and all grounding precautions should be observed. All metering and measuring equipment should be located outside of the test cage.

### ⚠ WARNING

**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

**Note:** For reclosers equipped with low-voltage closing, the elaborate high-voltage shielding is not required. However, good, sound testing practices and precautions should be followed.

### Test equipment required

A suggested test circuit is shown in Figure 13. The following equipment is required for this circuit:

1. For reclosers equipped with high-voltage closing: At least four standoff insulators with a platform of wood or bakelite to provide isolation so that the tests can be performed with both high- and low-voltage sources connected to a common ground at the source side terminal. Standoff insulator ratings should be above the ratings of the closing coil.
2. **Variable autotransformer**—240 volts, 20 amps.
3. **Low-voltage transformer T2**—Ratio and kVA size depend upon size of recloser trip coil and maximum current to be used.
4. Ammeter—Full-scale deflection should be at least 300% of reclosing rating. Use of current transformer may be required.
5. Cycle counter or other timing device.
6. For high-voltage closing, Transformer T1. Low-side rating should equal voltage of available test source. High-side source equal voltage rating of recloser.

### IMPORTANT

A 50 kVA transformer having an impedance of about three percent will be satisfactory if the source impedance is reasonably low, the recloser may not be able to latch closed is a smaller transformer is used.

Equally important, the transformer supply must be capable of delivering the required power. Be sure that minimum allowable voltages shown in Table 3 can be maintained at recloser terminals during the two- to five-cycle interval the closing solenoid is energized.

7. For low-voltage closing, substitute an appropriate source of power for Transformer T, and connect to the receptacle mounted on the head casting. A 5 kVA source generally is adequate.

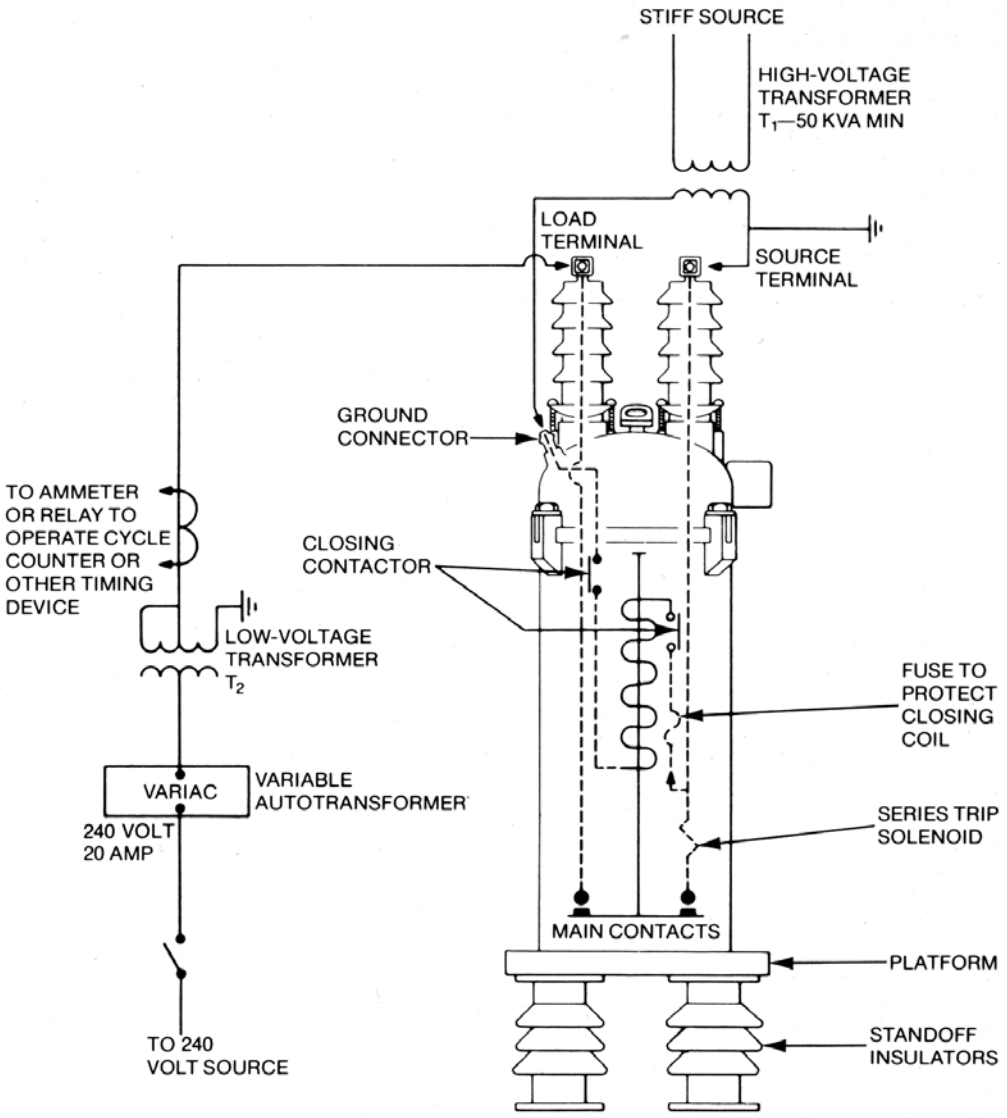



**Figure 13. Suggested test diagram, low-voltage tripping high-voltage closing.**

**Table 3. Closing Solenoid electrical constants and Minimum Voltage**

| Closing Solenoid Rating (kV) | Voltage Code No. | DC Resistance (ohms) | Min. Allowable Voltage at Recloser When Solenoid is Energized (volts) |
|---|---|---|---|
| 2.4 | 21 | 8 | 2040 |
| 4.16-4.8 | 22 | 30 | 3536 |
| 7.2-7.62 | 23 | 83 | 6120 |
| 8-8.32 | 24 | 94 | 6800 |
| 11.5 | 25 | 206 | 9770 |
| 14.4 | 27 | 324 | 12340 |
| 20.0 | 29 | 573 | 17000 |

## Test procedure - electrical closing

### Operation of closing coil

Assemble and connect the equipment as shown in Figure 13. Trip the recloser manually and then move the manual operating handle to the CLOSE position. Energize the closing solenoid (T, or low-voltage source). The recloser should close immediately, indicating correct operation of the closing solenoid.

### Minimum trip current

With the recloser closed, slowly raise the variable autotransformer voltage and note the ammeter reading. As the trip coil plunger starts to move, the trip-coil impedance will rise and cause a decrease in current. The maximum reading before the current decreases is the minimum trip current.

### Operating sequence and reclosing time

With the recloser closed and the variable autotransformer set high enough to cause the recloser to operate readily (300% of rated trip-coil current is suggested), energize the low-voltage tripping circuit. The number of fast operations and the number of operations to lockout can be checked by observing the operation of the red contact position indicator located under the sleet hood. Reclosing time can be read from the timing device arranged to record the period during which current is not flowing.

### Test procedure - manual closing

The closing tool (Figure 12) permits manual closing of the main contacts for test purposes when a high-voltage source for closing is not available. The minimum trip current and operating sequence can be verified in this manner.

To close the recloser manually, remove the pipe plug in the head casting and insert the manual closing tool to engage the main lever-and-shaft assembly of the head mechanism. Turn the tool clockwise to close the contacts. The tool is trip-free operating. Be sure to replace the pipe plug before placing the recloser into service.

### Minimum trip current

Connect the low-voltage tripping source to the recloser as shown in Figure 13. (Since high-voltage closing is not used, the high-voltage isolation and shielding are not required.) Close the recloser with the manual closing tool and slowly raise the voltage of the variable autotransformer while observing the ammeter reading. As the trip-coil plunger starts to move, the trip-coil impedance will rise and cause a decrease in the current. The *maximum* reading before the current decreases is the *minimum trip current*.

### Operating sequence

With the variable autotransformer set high enough to cause the recloser to operate readily (300% of rated trip-coil current is suggested), close the recloser with the manual closing tool. The recloser will trip. In approximately two seconds, the closing solenoid contactor will reclose (indicated by an audible click). *Immediately* close the recloser manually for the next trip operation. When lockout is reached, the yellow operating handle under the sleet hood will drop down and the manual reclosing mechanism will become inoperative.

**Note:** It is important to manually close the recloser *immediately* after the closing solenoid contactor closes. otherwise, the additional time may cause the resetting mechanism to allow one or more extra tripping operations before lockout is reached.

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