FP-25-LV-VSR
Breaker-To-Motor Starter Conversion
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WARNING

IMPROPERLY INSTALLING OR MAINTAINING THESE PRODUCTS CAN RESULT IN DEATH, SERIOUS PERSONAL INJURY, OR PROPERTY DAMAGE

READ AND UNDERSTAND THESE INSTRUCTIONS BEFORE ATTEMPTING ANY UNPACKING, ASSEMBLY, OPERATION, OR MAINTENANCE OF THE VACUUM STARTER REPLACEMENT.

INSTALLATION OR MAINTENANCE SHOULD BE ATTEMPTED ONLY BY QUALIFIED PERSONNEL. THIS INSTRUCTION BOOK SHOULD NOT BE CONSIDERED ALL INCLUSIVE REGARDING INSTALLATION OR MAINTENANCE PROCEDURES. IF FURTHER INFORMATION IS REQUIRED, YOU SHOULD CONSULT EATON'S ELECTRICAL SERVICES & SYSTEMS

THE VACUUM STARTER REPLACEMENTS DESCRIBED IN THIS BOOK ARE DESIGNED AND TESTED TO OPERATE WITHIN THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS MAY CAUSE THE EQUIPMENT TO FAIL, RESULTING IN DEATH, BODILY INJURY, AND PROPERTY DAMAGE.

ALL APPLICABLE SAFETY CODES, SAFETY STANDARDS AND/OR REGULATIONS RELATED TO THIS TYPE OF EQUIPMENT MUST BE STRICTLY FOLLOWED.

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These products were manufactured by Eaton Corporation at the Power Breaker Center: 310 Maxwell Avenue, Greenwood, SC 29646. All possible contingencies that may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation, or maintenance of particular equipment, contact a local Eaton representative.
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SECTION 1: INTRODUCTION

The purpose of this instruction book is to provide instructions for receiving, handling, storage, installation, operation, and maintenance of Type LV-VSR, Low Voltage-Vacuum Starter Replacement Units. These units are horizontal, draw-out type removable Vacuum Starter Replacements for existing LV Metal-Enclosed Switchgear with breakers of the same type and rating. LV-VSRs provide reliable control, protection, and performance, with ease of handling and maintenance.

This booklet is intended to be used in conjunction with the technical information provided with the original equipment order that includes but is not limited to electrical control schematics and wiring diagrams, installation plans, and procedures for installation and maintenance of accessory items.

Satisfactory performance is dependent upon proper application, correct installation, and adequate maintenance. It is strongly recommended that this instruction book be carefully read and followed in order to realize optimum performance and long useful life of the LV-VSR.

The LV-VSR consists of the following components: Current Limiting Fuses, Overload Relay, and V201 Vacuum Contactor.

- The current limiting fuses, class J (sized as required), are primarily used to provide short circuit protection to the vacuum contactor. During High-Power testing, the V201 vacuum contactor was confirmed to properly coordinate with Mersen class J AJT600EIB current limiting fuses. The contactor successfully withstood the let-through energy of each fuse for a 200 kA available symmetrical fault at 600 Vac. Other UL Class J fuses can be specified by the end user, as required, for proper coordination. Their let-through current, however, must be less than the short circuit current rating (SCCR) of the V201 contactor.

- The overload relay provides longtime overload protection and single-phase protection. The solid-state Overload Relay provides high accuracy and enhanced protection through the use of micro-electronic packaging technology. The Overload Relay comes standard with Trip Class 10 and 20 trip characteristics and Manual or Manual/Automatic Reset. An electro-mechanical overload relay, Eaton type C306 may be substituted for the electronic overload relay. This relay is equipped with Class 20 overload relay heaters sized according to the motor full load current (FLC) and service factor. This relay has settings to select a trip threshold closest to the motor FLC; manual and automatic reset modes are selectable.

- The V201 Vacuum Contactor is designed for the control of inductive or non-inductive loads at voltages between 200 and 600, AC.

The fuses have a micro-switch mounted to the body of the fuse that provides blown/open indication. This switch opens the contactor and prevents a close operation in the event of a blown/open fuse. This feature also provides single-phase protection to the motor.

⚠️ WARNING

Mersen Type AOS-S Microswitches and Current Limiting Type AJT Fuses sized as required by the application must be used to retain the IEEE Certification. Selected fuse must have a Let-through less than SCCR of contactor.

1.1 Available FP-25-LV-VSR Motor Starter Replacement

Refer to Table 1.

⚠️ WARNING

Satisfactory performance of these vacuum motor starter replacement units is contingent upon proper application, correct installation, and adequate maintenance. This instruction book must be carefully read and followed in order to obtain optimum performance for long useful life of the vacuum motor starter.

Type LV-VSR vacuum motor starter replacement units are protective devices, as such, they are maximum rated devices. Therefore, they should not under any circumstance be applied outside their nameplate ratings.

All possible contingencies that might arise during installation, operation, or maintenance, and all details and variations of this equipment, are not covered by these instructions. If further information is desired by the purchaser regarding a particular installation, operation, or maintenance of this equipment, the local Eaton’s electrical services & systems representative should be contacted.

Table 1. FP-25-LV-VSR Vacuum Motor Starter Replacement Unit Availability and Interchangeability.

<table>
<thead>
<tr>
<th>Vacuum Starter Replacement Type</th>
<th>Rated Max. Volts (VAC)</th>
<th>Rated Continuous Current At 60Hz (Amps)</th>
<th>Rated Short Circuit kA RMS At Rated Max. Voltage</th>
<th>Rated Withstand ANSI Test Voltage Low Freq. V RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP-25-LV-VSR-425A</td>
<td>600</td>
<td>425</td>
<td>200</td>
<td>2200</td>
</tr>
</tbody>
</table>
### Table 2. FP-25-LV-VSR Dimensions

<table>
<thead>
<tr>
<th>Device Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP-25-LV-VSR</td>
<td>5.55</td>
<td>4.00</td>
<td>8.00</td>
<td>3.63</td>
<td>15.63</td>
<td>13.18</td>
<td>20.09</td>
<td>23.00</td>
</tr>
</tbody>
</table>
SECTION 2: SAFE PRACTICES

Vacuum Starter Replacements are designed with several built-in interlocks and safety features to provide safe and proper operating sequences.

⚠️ WARNING

TO PROTECT THE PERSONNEL ASSOCIATED WITH INSTALLATION, OPERATION, AND MAINTENANCE OF THE LV-VSR, THE FOLLOWING PRACTICES MUST BE FOLLOWED:

- Only qualified persons, as defined in the National Electrical Safety Code, who are familiar with the installation and maintenance of low voltage circuits and equipment, should be permitted to work on the LV-VSR.
- Read these instructions carefully before attempting any installation, operation, or maintenance of the LV-VSR.
- Always remove the LV-VSR from the enclosure before performing any maintenance. Failure to do so could result in electrical shock leading to death, severe personnel injury, or property damage.
- Do not work on a LV-VSR with the secondary test coupler engaged. Failure to disconnect the test coupler could result in an electrical shock leading to death, personnel injury, or property damage.
- Do not use a LV-VSR as the sole means of isolating a circuit. Withdraw the LV-VSR to the DISCONNECT position and follow all lockout and tagging rules of the National Electrical Code and any and all applicable codes, regulations, and work rules.
- Do not leave the LV-VSR in an intermediate position in the cell. Always have the LV-VSR either in the DISCONNECT or CONNECTED position. Failure to do so could result in a flash over and possible death, personnel injury, or property damage.
- LV-VSRs are equipped with safety interlocks. Do not defeat them. This may result in death, bodily injury, or equipment damage.
SECTION 3: RECEIVING, HANDLING, AND STORAGE

Vacuum Starter Replacements are subjected to complete factory production tests and inspection before being packed. They are shipped in packages designed to provide maximum protection to the equipment during shipment and storage and at same time to provide convenient handling. The original racking handle can be used to insert/remove the LV-VSR.

3.1 Receiving

Until the LV-VSR is ready to be delivered to the switchgear site for installation, DO NOT remove it from the shipping crate. If the LV-VSR is to be placed in storage, maximum protection can be obtained by keeping it in its shipping container.

Upon receipt of the equipment, inspect the crates for any signs of damage or rough handling. Open the shipping container carefully to avoid any damage to the contents. Use a nail puller rather than a crow bar when required.

When opening the crates, be careful that any loose items or hardware are not discarded with the packing material. Check the contents of each package against the packing list. Examine the LV-VSR for any signs of shipping damage such as broken, missing, or loose hardware, damaged or deformed insulation and other components. File claims immediately with the carrier if damage or loss is detected and notify the nearest Eaton’s Electrical Services & System office.

3.2 Handling

⚠️ WARNING

DO NOT USE ANY LIFTING DEVICE AS A PLATFORM FOR PERFORMING MAINTENANCE, REPAIR, OR ADJUSTMENT. THE LV-VSR MAY SLIP OR FALL CAUSING SEVERE PERSONAL INJURY. ALWAYS PERFORM MAINTENANCE, REPAIR, AND ADJUSTMENTS ON A WORKBENCH CAPABLE OF SUPPORTING THE LV-VSR TYPE.

LV-VSR shipping containers are designed to be handled by a forklift truck. If containers must be skidded for any distance, it is preferable to use roller conveyors or individual pipe rollers.

Once a LV-VSR has been inspected for shipping damage, it is best to return it to its original shipping crate until it is ready to be installed in the Metal-Enclosed Switchgear.

When a LV-VSR is ready for installation, a lifting harness in conjunction with an overhead lift or portable floor lift can be used to move a LV-VSR. If the LV-VSR is to be lifted, position the lifting device (lifting straps should have at least a 1,600 pound capacity) over the LV-VSR and insert the lifting harness hooks into the LV-VSR side openings and secure. Be sure the hooks are firmly attached before lifting the LV-VSR. Stand a safe distance away from the LV-VSR while lifting and moving.

3.3 Storage

If the LV-VSR is to be placed in storage, maximum protection can be obtained by keeping it in the original shipping crate. Before placing it in storage, checks should be made to make sure that the LV-VSR is free from shipping damage and is in satisfactory operating condition.

Outdoor storage is NOT recommended. If unavoidable, the outdoor location must be well drained and a temporary shelter from sun, rain, snow, corrosive fumes, dust, dirt, falling objects, excessive moisture, etc. must be provided. Containers should be arranged to permit free circulation of air on all sides and temporary heaters should be used to minimize condensation. Moisture can cause rusting of metal parts and deterioration of high voltage insulation. A heat level of approximately 400 watts for each 100 cubic feet of volume is recommended with the heaters distributed uniformly throughout the structure near the floor.

Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same general rule for heat as for outdoor storage should be applied.

### 3.4 FP-25-LV-VSR Approximate Weights

Refer to Table 5.

<table>
<thead>
<tr>
<th>Type</th>
<th>Amperes</th>
<th>Lbs. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP-25-LV-VSR</td>
<td>425A</td>
<td>150 (68.039)</td>
</tr>
</tbody>
</table>

Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same general rule for heat as for outdoor storage should be applied.
Figure 3.2. Front External View of FP-25-LV-VSR

Front External View

1. Trip Button
2. Overload Relay Access
3. Position Indicator
4. Contactor Status Indicator
5. Crank Access Shutter
6. Lock Out / Lock Tag
7. Contactor Operations Counter
8. Lifting Point
9. Guide Roller
10. Racking Arms
Figure 3.3. Rear External View of FP-25-LV-VSR

Front External View

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Secondary Contacts</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Overload Relay Current Transformers</td>
<td>4</td>
</tr>
</tbody>
</table>
SECTION 4: DESCRIPTION AND OPERATION

Vacuum Contactor

Class V201 NEMA vacuum contactors are designed for the control of inductive or non-inductive loads at voltages between 200 and 600 Vac. The vacuum contactor in the LV-VSR is protected against short circuits above its capability by current limiting fuses.

General

The V201 contactor has its main contacts sealed inside ceramic tubes from which all air has been evacuated (i.e.: the contacts are in vacuum). No arc boxes are required, because any arc formed between opening contacts in a vacuum has no ionized air to sustain it. The arc simply stops when the current goes through zero as it alternates at line frequency. The arc usually does not survive beyond the first half cycle after the contacts begin to separate. The ceramic tube with the moving and stationary contacts enclosed is called a vacuum interrupter or a “bottle”. A three-pole contactor has three vacuum bottles. A metal bellows (like a small, circular accordion) allows the moving contact to be closed and pulled open from the outside without letting air into the vacuum chamber of the bottle. Both the bellows and the metal-to-ceramic seals of modern bottles have been improved to the point that loss of vacuum is no longer cause for undue concern.

Figure 4.1. V201 Non-Reversing Contactor.

Contact Force and Altitude

A vacuum contactor is affected by atmospheric pressure on the bellows of the vacuum bottles. Up to an altitude of 3,300 ft (1005.8 m), the contactor is designed to tolerate normal variations in barometric pressure. If the contactor is to be operated over 3,300 ft (1005.8 m) above sea level, consult the factory.

Contact Wear Allowance

Contact material vaporizes from the contact faces during every interruption and condenses inside the bottle. This is normal and is provided for by over-travel, or wear allowance. When the contactor is fully closed, there is a gap underneath the lower bottle nut and the pivot plate (see section 6.3.2 – Contact Wear Allowance). As the contacts wear, this gap decreases. When any gap goes below .020 in., the unit should be replaced. Use the fork-shaped over-travel gauge (Part No.7874A59H01) supplied for this measurement.

⚠️ WARNING

DO NOT RE-ADJUST THE BOTTLE NUTS TO RESET OVER-TRAVEL. ONCE PLACED INTO SERVICE, OVER-TRAVEL SHOULD BE CHECKED BUT NOT ADJUSTED. A STAR-WHEEL LOCK IS INCLUDED FOR LOCKING THE BOTTLE NUTS OF EACH BOTTLE TO PREVENT TAMPERING.

Coil

The operating coil has a “figure eight” shape and is really two coils in series, with a connection at their common point. Both coils are encapsulated in one environment-immune coil shell, which also contains a full-wave bridge rectifier. When AC is connected directly to terminals A and B on the coil shell, the magnet excitation is unfiltered DC. The magnet will not chatter as AC magnets sometimes do, but at less than rated voltage it may hum slightly. A normally-closed Type L63 auxiliary contact, set to open slightly before the armature fully closes, is connected to terminals C and D on the coil shell. When adjusted correctly, this contact allows a relatively high current through the pickup winding, and as the contactor closes, the contact inserts the holding winding, which reduces the coil current to a low value sufficient to hold the magnet closed without overheating. No external resistors are required.

Overload Relay

The overload relay provides longtime overload protection and single phase protection. The solid-state overload relay provides high accuracy and enhanced protection through the use of micro-electronic packaging technology. The overload relay comes standard with trip class 10, 15, and 20 trip characteristics.

Current Limiting Fuses

The current limiting fuses, class J AJT600EIB, are primarily used to provide short circuit protection to the vacuum contactor. During high-power testing, the V201 vacuum contactor was confirmed to properly coordinate with Ferraz Shawmut type class J AJT600EIB current limiting fuses. The contactor successfully withstood the let-through energy of each fuse for a 200 kA available symmetrical fault at 600 Vac.
4.1 Electrical Control

Specific wiring schematics are included with each LV-VSR. A typical wiring schematic is depicted in Figure 4.2.

**Figure 4.2. Typical Wiring Schematic.**

There may be different control voltages or more than one tripping element, but the principle mode of operation is as follows.

If control power is present, and the LV-VSR is in either the TEST or CONNECT position, then the LV-VSR may be closed.

The LV-VSR may be closed by making the control switch close (CS/C) contact. The LV-VSR may be opened at any time by making the control switch (CS/T) contacts.

Note the position switch (PS1) contact in the closing circuit. This contact remains open while the LV-VSR is being levered between the TEST and CONNECT positions. Consequently, it prevents the LV-VSR from closing automatically, even though the control close contact may have been made while the LV-VSR is levered to the CONNECT position.

When the CS/C contact is made, the MR1 closes the LV-VSR. If the CS/C contact remained after the LV-VSR closes, and trip single is sent, the Trelay contact will close and pick up the Yrelay. The Y/a contact will seal in the Yrelay until the CS/C contact is released. Even though the LV-VSR would open, it could not be reclosed before CS/C was released and remade and no trip single was present. This is the anti-pump function.

The LV-VSR will also open if there was an overload condition that the overload relay sensed. The LV-VSR will not close until the overload relay is reset after an overload condition.

The LV-VSR will also open if a fuse blown or opens. The LV-VSR will not close until the blown or open fuses are replaced.
Figure 4.3. V201 Contactor.

Trip Free Operation

The LV-VSR is in a "trip-free" condition when the unit is in between the TEST and CONNECT positions. Also, if the local OPEN push button is depressed and maintained, the LV-VSR is in a "trip free" condition.

4.2 Bushing and Disconnecting Contact Assemblies

The line and load bushing assemblies, which are the primary circuit terminals of the LV-VSR, consist of six silver plated conductors. Multiple finger type primary disconnecting contacts at the ends of the conductors provide means for connecting and disconnecting the LV-VSR to the bus terminals in the switchgear compartment.

4.3 Secondary Connection Block

The LV-VSR control circuit is connected to the switchgear control through a multi-contact block. The movable secondary control contacts mounted on the LV-VSR are self-aligning (See Insertion Procedure), line-contact, slip-type connectors. The multiple finger arrangement on the LV-VSR makes contact with a stationary mounted element. The contact surfaces on the stationary element are recessed to prevent accidental short circuiting of the control circuits. These secondary disconnects mate in both the CONNECT and TEST positions.

4.4 Interlocks

There are several interlocks built into the LV-VSR. Each of these interlocks, though different in form, duplicate or exceed in function that of the original breaker. These interlocks exist to safeguard personnel and equipment. The basic premise behind the interlocking arrangement on the LV-VSR is that the LV-VSR must not be inserted into or removed from the live circuit while the main contacts are closed. Also considered in the interlocking is that the LV-VSR should pose no greater risk than necessary to the operator in or out of the cell.

⚠️ DANGER

INTERLOCKS ARE PROTECTIVE DEVICES FOR PERSONNEL AND EQUIPMENT. DO NOT BYPASS, MODIFY, OR MAKE INOPERATIVE ANY INTERLOCKS. DOING SO COULD CAUSE DEATH, SERIOUS PERSONAL INJURY, AND/OR PROPERTY DAMAGE.
SECTION 5: INSTALLATION & INSPECTION

⚠️ WARNING

BEFORE PLACING THE LV-VSR IN SERVICE, CAREFULLY FOLLOW THE INSTALLATION PROCEDURE BELOW AND THE SAFE PRACTICES SET FORTH IN SECTION 2. NOT FOLLOWING THE PROCEDURE MAY RESULT IN INCORRECT LV-VSR OPERATION LEADING TO DEATH, BODILY INJURY, AND PROPERTY DAMAGE

THIS VACUUM BREAKER / STARTER REPLACEMENT IS NOT DESIGNED TO OPERATE A SEPARATE EXTERNAL AUXILIARY SWITCH (MOC SWITCH).

DO NOT PERFORM MANUAL OR ELECTRICAL OPERATIONAL CHECKS WITH THE LV-VSR IN THE “CONNECT” POSITION BECAUSE OF THE POSSIBILITY OF CONNECTING DE-ENERGIZED LOAD CIRCUITS TO THE ELECTRICAL POWER SOURCE, RESULTING IN DEATH, PERSONAL INJURY, OR EQUIPMENT DAMAGE.

DO NOT ATTEMPT TO INSTALL OR OPERATE A LV-VSR UNTIL A VACUUM INTEGRITY TEST IS PERFORMED.

WHEN THE LV-VSR IS FIRST COMMISSIONED INTO SERVICE AND EACH TIME THE STARTER IS RETURNED TO SERVICE, IT SHOULD BE CAREFULLY EXAMINED AND CHECKED TO MAKE SURE IT IS CLEAN AND OPERATING CORRECTLY.

⚠️ DANGER

LV-VSR UNITS ARE NOT INTERCHANGEABLE WITH CIRCUIT BREAKER. THEY ARE SUPPLIED WITH CELL CODE/REJECTION PLATES. DO NOT ATTEMPT TO MODIFY OR REMOVE THE NEW CELL CODE/REJECTION PLATES. MODIFICATIONS OR OMISSIONS OF THE CELL CODE/REJECTION PLATES MAY RESULT IN INCORRECT LV-VSR OPERATION LEADING TO DEATH, BODILY INJURY, AND PROPERTY DAMAGE

5.1 CELL MODIFICATION INSTRUCTIONS

⚠️ WARNING

THE FP-25-LV-VSR EMPLOYS A REJECTION PIN TO PREVENT INSERTION INTO CELLS INTENDED FOR DEVICES WITH INCOMPATIBLE CAPABILITIES. THE UNIT HAS A REJECTION PIN ON THE LEFT SIDE. ALL NEW INSTALLATIONS WILL REQUIRE CELL MODIFICATIONS. CELL MODIFICATION INSTRUCTIONS ARE PROVIDED WITH THE LV-VSR. THE CELL MUST BE MODIFIED PRIOR TO INSTALLATION.

Use the following procedure to notch the left cell flange for installation of FP-25-LV-VSR. See steps below.

1. Mark 3/4” below existing cell opening. (Figure 5.1 & 5.2)

2. Align straightedge flush with existing opening and scribe line to previous mark. (Figure 5.3)

3. Remove indicated material with appropriate cutter and clean up as necessary. (Figure 5.4 & 5.5)

4. Rejection pin clearing cell modification.
Once the LV-VSR is removed from the switchgear and placed outside of the arc-flash boundary, follow these steps:

1. Place the LV-VSR on a flat, level, and stable surface.
2. Remove four #10-32 x 1/2” fasteners from the top barrier. Figure 5.8.
3. Remove top barrier and set aside.
4. Locate the blown fuse or fuses.
5. Remove the micro-switch from the blown fuse. To remove the switch, use a flat blade screwdriver to gently pry the switch from its mounting base.
6. Remove the two .50-13 fasteners from the blown fuse. Take special notice of the orientation of the fuse.
7. Remove the blown fuse from the LV-VSR.
8. Install the new replacement fuse with the same orientation in place of the removed blown fuse.
9. Insert the .50-13 fasteners with a flat washer into the mounting hole of the fuse; use a retaining nut with a lock washer and flat washer to tighten the fuse with the connecting copper.
10. Tighten the fasteners using a wrench to hold the head of the screw while tightening the retaining nut. DO NOT over tighten.
11. Torque the fasteners to 40 ft-lbs.
12. Replace the micro-switch to the fuse by gently pressing the switch on to the mounting base.
13. Check the connections of the control wiring on the micro-switch. Tighten connections with a Philips head screwdriver.
14. Install the top barrier back onto the LV-VSR.
15. Insert the #10-32 fasteners into the top barrier and tighten until snug.
16. Electrically test the LV-VSR by using a test cabinet device or equivalent. Make sure the LV-VSR will close and open normally.
17. Perform an AC hipot test per section 6 prior to insertion into the switchgear.
18. Check the V201 contactor per section 6.3.2 of this manual prior to insertion.
5.3 ELECTRONIC OVERLOAD RELAY C440

The preferred overload relay provided on Eaton LV-VSR devices is the electronic C440 relay. The relay offers four selections of trip classes:

1. The C440 overload device normally specified for the LV VSR devices is the relay that provides two trip class selections, 10 or 20, plus a switchable ground fault trip system. The ground fault trip threshold is 50% of the full load ampere setting. See Figures 5.9 and 5.10.

2. A second rarely used C440 overload relay is available in a 3-phase and single phase form. The 3-phase and single phase configured device allows four trip class selections: 10, 20, 30, and 10A. Figure 5.11 shows the C440 with four trip class selections.

3. Refer to Figure 5.10 or 5.11. C440 relay features include a push/pull button for trip and test, a push button for reset, and the full load current dial. Adjacent to the FLA dial, the C440 electronic overload relay has ‘dip’ switch selections for trip classes 10 or 20. (Most applications conforming to ANSI guidelines use trip class 20.) The second position enables or disables the built-in ground fault trip system. The third position of the ‘dip’ switch enables or disables the phase unbalance protection of the device. The fourth position of the ‘dip’ switch enables or disables automatic reset of the relay [see special warning about using automatic reset feature]. An indicating light on the face of the relay signals when current is passing through the LV-VSR and when a trip has occurred. Rapid blinking of the indicating light on the C440 indicates that trip is imminent. Make the preferred ‘dip’ switch selections prior to energizing the LV VSR for the first time.

4. A Full Load Current (FLA) dial is provided for selecting the full load current setting, calculated based on the current transformer ratio of the current transformers installed on the LV VSR and the full load current determined from the motor nameplate. When the C440 is set correctly, the relay will provide tripping at 115% of the motor full load rating in less than 10 seconds in accordance with UL 508. The C440 provided has markings 1 through 5 corresponding to the 5 ampere secondary current of the current transformers. These markings designate trip thresholds that correspond to the current passing through the windows of the current transformers mounted on the rear of the LV VSR. Selections are possible over the full range of the dial. The trip setting must be made according to item 6 below prior to energizing the LV VSR for the first time.
5. An electrically separate normally open (NO) contact and an electrically separate normally closed (NC) contact are provided. See Figure 5.14 for operating modes. The C440 may be optionally equipped with various communication modules to allow remote functionality over Modbus, DeviceNet, Profield, and Ethernet IP communication protocols.

6. Eaton LV VSRs are equipped with 300:5 or 600:5 current transformers as required by the continuous current rating shown on the nameplate of the device. The current transformer ratio and motor full load current must be known to determine the proper FLA dial setting on the C440 relay. That setting may be calculated by the following formula:

\[
\text{Set Value} = \text{Equivalent FLA} \times \left(\frac{1}{\text{CT Ratio}}\right)
\]

**Example:**

Motor FLC is 120 amperes

\[
\text{Set Value} = 120 \times \left(\frac{1}{60}\right) = 2.0
\]

The C440 FLA setting may also be determined from Table 6.

**Note:** The overload relay allows trip settings that exceed the 425 ampere continuous current rating of the LV VSR. Therefore, dial settings above 3.5 are not allowed.

7. Figures 5.10 and 5.11 are provided for setting assistance. For the C440, the overload relay settings are the same regardless of motor service factor.

**Note:** The LV VSR is shipped from the Power Breaker Center with its overload relay set at the very lowest setting; the C440 must be properly set before closing the device onto a motor load.

8. Figure 5.13 provides hot motor time-current information for the C440.

**Figure 5.13. Average Hot Trip Curve for Three Phase Motors**

![Average Hot Trip Curve](image)

Consult factory or Eaton website for cold trip curves.

9. Eaton Instructional Leaflet IL04210001E provides additional information on the C440 overload relay.

10. If the C440 overload relay trips after a motor overload condition, access the relay through the removable front clear polycarbonate cover, and press the reset button. The device should only be reset after the condition causing the motor overload is removed.

**Table 6. C440 Overload Relay Dial Settings**

<table>
<thead>
<tr>
<th>Overload Relay Dial Settings</th>
<th>FLA with 300:5 CT</th>
<th>FLA with 600:5 CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>1.25</td>
<td>75</td>
<td>150</td>
</tr>
<tr>
<td>1.50</td>
<td>90</td>
<td>180</td>
</tr>
<tr>
<td>1.75</td>
<td>105</td>
<td>210</td>
</tr>
<tr>
<td>2.00</td>
<td>120</td>
<td>240</td>
</tr>
<tr>
<td>2.25</td>
<td>135</td>
<td>270</td>
</tr>
<tr>
<td>2.50</td>
<td>150</td>
<td>300</td>
</tr>
<tr>
<td>2.75</td>
<td>165</td>
<td>330</td>
</tr>
<tr>
<td>3.00</td>
<td>180</td>
<td>360</td>
</tr>
<tr>
<td>3.25</td>
<td>195</td>
<td>390</td>
</tr>
<tr>
<td>3.50</td>
<td>210</td>
<td>420</td>
</tr>
<tr>
<td>3.75</td>
<td>225</td>
<td>Exceeds VSR Current Rating</td>
</tr>
<tr>
<td>4.00</td>
<td>240</td>
<td>Exceeds VSR Current Rating</td>
</tr>
<tr>
<td>4.25</td>
<td>255</td>
<td>Exceeds VSR Current Rating</td>
</tr>
</tbody>
</table>

**Phase Imbalance Selection for C440**

When a three phase load is powered with a poor quality line, the voltage per phase may be unbalanced.

The effect of this if not protected results in unbalanced voltage which causes large unbalanced currents. It can also lead to motor stator windings being overloaded, causing excessive heating, reduced motor efficiency and reduced insulation life.

If the OL relay is switched to the “ON” position, it will take the starter offline if a phase drops below 50% of the other two phases.

**Figure 5.14. Operating Modes for C440**

![Operating Modes](image)

*Approximately 1 lbf

**5.4 INSERTION PROCEDURE**

**DANGER**

ARC-FLASH INCIDENCES WITH LV SWITCHGEAR CAN OCCUR DURING THE PROCESS OF INSERTING AND REMOVING LV-VSR DEVICES IN SWITCHGEAR CUBICLES. IT IS STRONGLY RECOMMENDED THAT PROPER PPE (PERSONAL PROTECTIVE EQUIPMENT) BE WORN BY PERSONNEL WHO INSERT/REMOVE LV-VSRS.
1. The starter must be in the open position and the racking crank turned fully counter-clockwise to reach a complete stop.

2. Open the cell door and pull out the rails to the fully extended and latched position.

3. Use a lifting device, set the VSR on the rails such that the positioning pins reside in the slots of each track.

4. Remove the lifting device and push the LV-VSR into the cell until the positioning pins reach the end of the slots. An additional positive push will automatically release the two latches (Figure 5.15). This gives the LV-VSR some clearance, when the racking cams stopped against their guides on the cradle. Close the cell door, the LV-VSR is now in the DISCONNECT position.

5. When the starter is in the Disconnect position, an inspection device should be used to ensure that the starter secondary contacts are not in contact with the cell secondaries. If contact is made, the starter will need to be retracted on the rails and the bracket holding the secondary disconnects will need to be adjusted up or down. (Figure 5.16)

6. To enter the TEST position; press the trip push button, lift up the crank shutter, and insert the crank. Turn the crank clockwise until the position indicator on the starter shows “TEST” position. (Figure 5.17).

7. Remove the racking crank; the shutter will automatically be returned. In test position LV-VSR may be electrically closed and opened if there is control power available.

8. To rack the LV-VSR to the CONNECT position; press the trip push button, lift up the crank shutter, and insert the crank, turn the crank clockwise until the position indicator on the starter shows “CONNECT” position. (Figure 5.18)

9. Remove the racking crank; the shutter will automatically be returned. The LV-VSR is now ready to be electrically operated if control power is available.
5.5 REMOVAL PROCEDURE

DANGER

THE LV-VSR MUST BE IN OPEN POSITION PRIOR THE REMOVAL PROCEDURE. FAILURE TO DO SO MAY CAUSE SEVERE INJURY, DEATH, OR EQUIPMENT DAMAGE.

1. Either remotely or locally open the LV-VSR prior to attempting to remove it from the cell.
2. Lift up the crank shutter, and insert the crank, turn the crank counter-clockwise until the position indicator on the starter shows “DISCONNECT” position.
3. Keep turning the crank counter-clockwise until it reaches the stopped position.
4. Remove the racking crank; the shutter will automatically be returned.
5. Open the cell door and pull the LV-VSR forward until the cell tracks are in the fully extended and latched position. The LV-VSR is now ready to be removed from the switchgear area.

5.6 MANUAL OPERATIONAL CHECK

Manual operational checks must be performed before the LV-VSR is connected to a live circuit. The checks can be performed either with the LV-VSR in TEST position in the cell or outside of the cell, as long as secondary power is available.

5.7 VACUUM INTEGRITY TEST

Check the vacuum integrity of the interrupters of the three vacuum bottles by conducting the applied potential test described in Section 6.

5.8 LOW FREQUENCY WITHSTAND TEST

Perform insulation integrity tests as described in Section 6.

5.9 CONTACT INSPECTION

Check all three vacuum interrupter erosion indicator marks as described in Section 6.

5.10 ELECTRICAL OPERATIONAL CHECKS

WARNING

DO NOT PERFORM ELECTRICAL OPERATION CHECKS WITH THE LV-VSR IN THE “CONNECT” POSITION BECAUSE OF THE POSSIBILITY OF CONNECTING DE-ENERGIZED LOAD CIRCUITS TO THE ELECTRICAL POWER SOURCE, RESULTING IN DEATH, PERSONNEL INJURY OR EQUIPMENT DAMAGE

The LV-VSR can only be operated electrically when the following condition are met:

1. Control power is present, either by having the LV-VSR in the TEST position in the cell or by a test cabinet connected to the LV-VSR.
2. The overload relay reset if tripped.
3. The current limiting fuses are not blown.

Having met these conditions, the LV-VSR may be electrically operated. Either depressing the CLOSE pushbutton on the unit or sending the close signal remotely to close the LV-VSR.

To open the LV-VSR, send a remote open signal, press the open pushbutton, or press the test button on the overload relay.

Perform several close/open operations to ensure reliable and constant electrical operation.
Section 6: Inspection and Maintenance

6.1 Introduction

**WARNING**

- DO NOT WORK ON A LV-VSR IN THE "CONNECTED" POSITION.
- DO NOT WORK ON A LV-VSR WITH SECONDARY DISCONNECTS ENGAGED.
- DO NOT WORK ON A LV-VSR WITH THE CONTACTOR CLOSED, UNLESS IT IS REMOVED FROM THE SWITCHGEAR.
- DO NOT DEFEND ANY SAFETY INTERLOCKS.
- FOLLOW ALL PRECAUTIONARY MEASURES WHEN TESTING FOR VACUUM INTEGRITY.
- FAILURE TO FOLLOW ANY OF THESE INSTRUCTIONS MAY CAUSE DEATH, SERIOUS BODILY INJURY, OR PROPERTY DAMAGE. SEE SECTION 2 - SAFE PRACTICES FOR MORE INFORMATION.

6.2 Frequency of Inspection

Inspect the LV-VSR once a year when operating in a clean, non-corrosive environment. For a dusty and/or corrosive environment, inspection should be performed twice a year. Additionally, it is recommended to inspect the LV-VSR every time it interrupts fault current.

The no-load life test value of the LV-VSR is hundreds of thousands of operations. This value will be reduced if proper inspection, maintenance, and cleaning are not performed.

Refer to Section 6.3 for maintenance and inspection check points.

6.3 Inspection and Maintenance Procedures

It is recommended that inspection and maintenance procedures are performed outside of the cell.

**CAUTION**

SOME COMMERCIAL CLEANING AGENTS WILL DAMAGE THE NAMEPLATES OR MOLDED PARTS. MAKE SURE THAT CLEANING AGENTS OR SOLVENTS USED ARE SUITABLE FOR THE JOB.

6.3.1 V201 Contactor

**NOTICE**

THERE ARE NO FIELD SERVICEABLE PARTS ON CONTACTORS.

**WARNING**

THE ONLY WAY TO CLOSE THE CONTACTOR IS TO ENERGIZE THE COIL. IF THE COIL IS ENERGIZED FOR THIS OR OTHER MAINTENANCE, USE ADEQUATE CARE TO GUARD AGAINST ELECTRICAL SHOCK. DO NOT PERFORM ANY MAINTENANCE WITH THE LV-VSR IN THE SWITCHGEAR.

6.3.2 Contact Wear Allowance

Contact material vaporizes from the contact faces during every interruption and condenses inside the bottle. This is normal and is provided for by over-travel or wear allowance. When the contactor is fully closed, there is a gap between the pivot plate and the bottle nuts. As the contacts wear, this gap decreases. When any gap goes below 0.020 in. (0.51 mm), the unit should be replaced. Use the 0.020 in. (0.51 mm) thick fork shaped over-travel gauge (Part Number 7874A59H01) supplied for this measurement.

**WARNING**

DO NOT READJUST THE BOTTLE NUTS TO RESET OVER-TRAVEL AS THE BOTTLES WEAR. ONCE PLACED INTO SERVICE, OVER-TRAVEL SHOULD BE CHECKED BUT NOT ADJUSTED.

6.3.3 Mechanical Checks

**WARNING**

THE MECHANICAL CHECKS MAY ONLY BE PERFORMED OUTSIDE THE SWITCHGEAR CELL.

Use a test cabinet to operate the LV-VSR. Operate the appropriate push buttons to CLOSE and OPEN the contactor. While the contactor is closed, observe the over-travel gap between the pivot plates on the crossbar and the bottle nut on each pole. This over-travel gap should be no less than 0.045 in. (1.14 mm) when the contactor is new. If less, refer to the Contact Wear Allowance section of this manual.

While the contactor is open, attempt to pull the armature forward. The armature should not move because it should already be firmly against the plastic main frame. If it does move, refer to the Kickout Spring Adjustment section in this manual.

6.3.4 Kickout Spring Adjustment

The kickout spring is not disturbed by any maintenance described in this manual and, therefore, should not need any adjustment. However, when the contactor is in the OPEN position, the crossbar should be solidly against the frame, so that it cannot move any further open even when pulled. If kickout spring is out of adjustment, call your closest Eaton representative.
### 6.3.5 Inspection After Short Circuit

The magnitude of a short circuit may exceed the damage threshold of the vacuum bottle on the V201 contactor. After a short circuit, the unit should be examined for any apparent physical damage, or deformation of the conductor bars. If there is any evidence of severe stress, it is recommended that the unit be replaced. If the over-travel has changed significantly (from the last inspection) on one or more bottles, the unit should be replaced.

A dielectric test may be performed at 1760 Vac (80% of factory test level) (see Section 6.6). A dielectric test would not by itself confirm that the unit should be returned to service after a fault. Vacuum Integrity is to be performed at 5.5 kVac RMS per Section 6.4. However, if there is no physical evidence of stress, and if the over-travel exceeds the 0.020 in. (0.51 mm) minimum, the bottles can then be dielectrically tested as outlined in this manual. If physical stress, over-travel, and dielectric are satisfactory, it is reasonable to return the unit to service after a fault and after unit has been properly cleaned.

### 6.4 Vacuum Interrupter Integrity Test

Vacuum interrupters used in the LV-VSR are highly reliable interrupting contactors. Satisfactory performance of these devices is dependent upon the integrity of the vacuum in the interrupter and the internal dielectric strength. Both of these parameters can be readily checked by a one minute AC high potential test. During this test, the following warning must be observed.

#### WARNING

**APPLYING ABNORMALLY HIGH VOLTAGE ACROSS A PAIR OF CONTACTS IN VACUUM MAY PRODUCE X-RADIATION. THE RADIATION MAY INCREASE WITH THE INCREASE IN VOLTAGE AND/OR DECREASE IN CONTACT SPACING. X-RADIATION PRODUCED DURING THIS TEST WITH RECOMMENDED VOLTAGE AND NORMAL CONTACT SPACING IS EXTREMELY LOW AND WELL BELOW THE MAXIMUM PERMITTED BY STANDARDS. HOWEVER, AS A PRECAUTIONARY MEASURE AGAINST THE POSSIBILITY OF APPLICATION OF HIGHER THAN RECOMMENDED VOLTAGE AND/OR BELOW NORMAL CONTACT SPACING, IT IS RECOMMENDED THAT ALL OPERATING PERSONNEL STAND AT LEAST 3.2 FEET (1 METER) AWAY IN FRONT OF THE LV-VSR.**

Only use an AC high potential test set. A DC high potential test may result in inaccurate test results.

1. Conduct the test with the LV-VSR open and securely placed on a workbench or suitable surface.
2. Short the CTs and the secondary block connections to ground.
3. Connect all top primary studs (bars) together and the high potential machine lead.
4. Connect all bottom studs together. Do not ground them to the LV-VSR frame. Connect the high potential ground to the bottom studs.
5. Start the machine at zero potential, then increase to 5.5 kV AC RMS and maintain for one minute.
6. Successful withstand indicates that all interrupters have satisfactory vacuum levels. If there is a breakdown, the contactor should be replaced before placing the LV-VSR in service.
7. After the high potential is removed, discharge any electrical charge that may be retained, particularly from the center shield of vacuum interrupters. To avoid any ambiguity in the AC high potential test due to leakage or displacement (capacitive) current, the test unit should have sufficient volt-ampere capacity. It is recommended that the equipment be capable of delivering 25 milliampères for one minute.
8. Remove ALL shorting wire on CTs and secondary block before placing unit back into service.

### 6.5 Insulation

In LV-VSRs, insulation maintenance primarily consists of keeping all insulating surfaces clean. This can be done by wiping off all insulating surfaces with a dry lint free cloth. In case there is any tightly adhering dirt that will not come off by wiping, it can be removed with a mild solvent or distilled water. Be sure that the surfaces are dry before placing the LV-VSR in service. If a solvent is required to cut dirt, use isopropyl alcohol. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

### 6.6 Insulation Integrity Check

#### Primary Circuit

The integrity of primary insulation may be checked by the AC high potential test. The test voltage is 1760 V RMS, 60 Hz. Conduct the test as follows.

1. Conduct the test with the LV-VSR open and securely placed on a workbench or suitable surface.
2. Ground the LV-VSR frame.
3. Short the CTs connections to ground.
4. Close the contactor on the LV-VSR. Control power will be needed to close the Contactor.
5. Connect the high potential lead of the test machine to one of the phases of the LV-VSR.
6. Connect the remaining two phases and LV-VSR frame to ground.
7. Start the test machine with the output potential at zero and increase to the test voltage. Maintain the test voltage for one minute.
8. Repeat for the remaining phases. Successful withstand indicates satisfactory insulation strength of the primary circuit.
9. Disconnect the control power from the LV-VSR.
10. After the control power has been removed and disconnected from the LV-VSR, short all of the secondary connections together and to the frame.
11. Connect the high potential lead of the test machine to one of the poles of the LV-VSR.
12. Connect the remaining poles and LV-VSR frame to ground.
13. Start the test machine with the output potential at zero and increase to the test voltage. Maintain the test voltage for one minute.
14. Repeat for the remaining poles. Successful withstand indicates satisfactory insulation strength of the primary circuit.
15. Remove ALL shorting wire on the CTs and secondary block before placing unit back in to service.
**WARNING**

FAILURE TO REMOVE ALL SHORTING WIRE FROM CURRENT TRANSFORMERS AND SECONDARY CONNECTIONS MAY CAUSE INJURIES AND EQUIPMENT DAMAGE.

Secondary Circuit

---

**WARNING**

BEFORE PERFORMING SECONDARY INSULATION CHECK, PLACE A JUMPER ON THE CONTACTOR COIL ASSEMBLY POINTS (A) TO (B). FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE SOLID STATE RECTIFIER IN THE COIL ASSEMBLY.

1. Ensure that a jumper is placed on contactor coil assembly points (A) to (B).
2. Connect all points of the secondary disconnect pins with a shorting wire.
3. Connect the CTs with a shorting wire and connect them to the frame.
4. Connect the high potential lead of the test machine to the secondary block.
5. Ground the LV-VSR frame.
6. Starting with zero, increase the voltage to 1200 Vac RMS, 60 Hz. Maintain the voltage for one minute.
7. Successful withstand indicates satisfactory insulation strength of the secondary control circuit.
8. Remove ALL shorting wire on the CTs and secondary block before placing unit back into service.
9. Remove the jumper from the contactor coil assembly points (A) to (B).

---

**WARNING**

FAILURE TO REMOVE ALL SHORTING WIRE FROM CURRENT TRANSFORMERS AND SECONDARY CONNECTIONS MAY CAUSE INJURIES AND EQUIPMENT DAMAGE.

6.8 Mechanism Check

Make a careful visual inspection of the mechanism for any loose parts such as bolts, nuts, pins, rings, etc. Check for excessive wear or damage to the LV-VSR components. Operate the LV-VSR several times electrically to verify operation.

6.9 Lubrication

All parts that require lubrication have been lubricated during the assembly with molybdenum disulphide grease (Eaton No.53701QB). Over a period of time, this lubricant may be pushed out of the way or degrade. Proper lubrication at regular intervals is essential for maintaining the reliable performance of the mechanism. The LV-VSR should be re-lubricated once a year. The locations shown in Figure 30 should be lubricated with a drop of non-synthetic light machine oil. After lubrication, operate the LV-VSR several times manually and electrically.

6.10 Primary Circuit Resistance Check

Since the main contacts are inside the vacuum chamber they remain clean and require no maintenance at any time.

The DC resistance of the primary circuit may be calculated by measuring the voltage drop across the circuit. To check the primary circuit resistance, remove the LV-VSR from the switchgear, close the LV-VSR, and pass at least 10A DC through one of the breaker’s poles. Measure the voltage drop across the primary contacts and calculate the resistance. Repeat for the remaining two poles.

6.11 Magnet Operating Range

If the magnet chatters, look for mechanical interference that prevents the magnet from being aligned. The magnet gap can be seen from the left and right sides with the help of a flashlight. A screwdriver inserted into one of the long slots can be used as a lever to put a corrective set into the mounting plate around the magnet. It should not be necessary to do this unless the contactor has been damaged and it can be seen that the armature does not fit against the magnet. A poor magnet to armature fit usually produces a high dropout voltage and/or chatter.

Mechanical interference can be produced by various incorrect adjustments. Two specific points to check are:

1. Armature travel is incorrect, causing the contact springs to be compressed into a solid, non-resilient “tube” that stops the crossbar rigidly. Refer to Eaton’s Electrical Services and Systems for assistance.
2. The auxiliary contact mounting brackets are mis-adjusted, so that a contact plunger bottoms solidly before the magnet seals. When the contactor is fully sealed closed, there should still be a small amount of travel remaining for the plungers.
L63 Auxiliary Contact Adjustment

The normal 0.34 in. (8.64 mm) pre-travel gap for the L63 auxiliary contact (normally-closed) is important. If the gap is too big, the “hold” winding of the operator coil will not be inserted as the contactor closes, and the pickup winding will burn out because the pickup winding is only intermittently rated. If the gap is too small, the hold winding will be inserted too soon, reducing the force to “hold” before the contactor is closed, and producing an oscillation like a doorbell. In a particular contactor, the gap may need slight adjustment to avoid these problems. The key is not the measurement, but the performance of the magnet.

The auxiliary contacts are not as critical. In the open position, their plungers may rest lightly against the operating arm, or may have a small clearance.

However, neither of the auxiliary contact plungers should bottom solidly in the closed contactor position, as discussed under Magnet Operating Range. If required, the auxiliaries can be adjusted by resetting their mounting brackets in their slotted holes. Adjust the L63 by loosening the two slotted hexagonal washer head screws that hold the L63 mounting bracket, repositioning and tightening them. These bracket mounting screws are accessible from the top side of the contactor and are recognized by the slotted holes under their heads.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Inspection Area</th>
<th>Possible Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fails To Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blown fuse(s)</td>
<td>Fuses</td>
<td>• Unit experienced an overcurrent or short-circuit</td>
</tr>
<tr>
<td>overload relay</td>
<td>Overload relay</td>
<td>• Unit experienced an overcurrent and that exceeded OL relay set point.</td>
</tr>
<tr>
<td></td>
<td>Control circuit</td>
<td>• Fuses blown (control power)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Secondary disconnects</td>
</tr>
<tr>
<td>Undesirably</td>
<td>Control circuit</td>
<td>• Close circuit (CS/C shorted)</td>
</tr>
<tr>
<td>closes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fails To Trip</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control circuit</td>
<td>• Fuses blown (control power)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Secondary disconnects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T-relay</td>
</tr>
<tr>
<td>Undesirably</td>
<td>Control circuit</td>
<td>• Trip circuit (CS/T shorted)</td>
</tr>
<tr>
<td>trips</td>
<td></td>
<td>• OL relay not set correctly</td>
</tr>
<tr>
<td>Fails To Crank</td>
<td>Mechanism</td>
<td>• Dry gear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Worn gear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Broken gear</td>
</tr>
</tbody>
</table>
SECTION 7: REPLACEMENT OF COMPONENTS

7.1 General

In order to minimize production downtime, it is recommended that an adequate quantity of spare parts carried in stock. The quantity will vary from customer to customer, depending upon the service severity and continuity requirements. Each customer should develop his own level based on operating experience.

7.1.1 Ordering Instructions

1. Always specify the LV-VSR rating information and general order number from the nameplate.
2. Describe the item, give the style number, and specify the quantity required.
3. Specify the voltage for electrical components.
4. Specify the method of shipping desired.
5. Send all orders or correspondence to the nearest Eaton Electrical Sector sales office.
6. Include negotiation number with order when applicable.

### Table 10. Common Replacement Parts

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>DESCRIPTIONS</th>
<th>CURRENT EATON STYLE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FUSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuses</td>
<td>AJT600EIB (Mersen Fuse) ¹   AJT600EIB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AOS-S</td>
<td></td>
</tr>
<tr>
<td><strong>RELAYS</strong></td>
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<td></td>
</tr>
<tr>
<td>Relays</td>
<td>Y-Relay</td>
<td>D9P92A-A2</td>
</tr>
<tr>
<td></td>
<td>Y-Relay Base</td>
<td>D9P92A-A2</td>
</tr>
<tr>
<td></td>
<td>T-Relay</td>
<td>D9P92A-A2</td>
</tr>
<tr>
<td></td>
<td>T-Relay Base</td>
<td>D9P92A-A2</td>
</tr>
<tr>
<td>Closing Contact</td>
<td>MR1</td>
<td>D15CR44A1B</td>
</tr>
<tr>
<td></td>
<td>MR2</td>
<td>D15CR40A1B</td>
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<tr>
<td>Auxiliary Contact</td>
<td>J02</td>
<td>9084A17G03</td>
</tr>
<tr>
<td></td>
<td>J20</td>
<td>9084A17G02</td>
</tr>
</tbody>
</table>

¹ Order fuse replacement that matches fuse originally supplied.