Instructions for the Use, Operation and Maintenance of Types VCP-TL and VCP-TRL Linear Magnetic Vacuum Circuit Breakers

IB131017EN Effective May 2016

VCP-TRL Fixed
(shown with optional protective relay installed)

VCP-TL Drawout
(Non-automatic shown)

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 CIRCUIT BREAKERS.

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 CONTACT EATON

WARNING

THE CIRCUIT BREAKER ELEMENTS 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 SAFETY CODES, SAFETY STANDARDS AND/OR REGULATIONS AS THEY MAY BE APPLIED TO THIS TYPE OF EQUIPMENT MUST BE STRICTLY ADHERED TO.

SERIOUS INJURY, INCLUDING DEATH, CAN RESULT FROM FAILURE TO FOLLOW THE PROCEDURES OUTLINED IN THIS MANUAL. THESE CIRCUIT BREAKER ELEMENTS ARE SOLD PURSUANT TO A NON-STANDARD PURCHASING AGREEMENT WHICH LIMITS THE LIABILITY OF THE MANUFACTURER.

Eaton Corporation
Coraopolis, PA. 15108

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do no 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 an EATON representative.

TABLE OF CONTENTS

FIGURES

TABLES

Table **Title** **Page**

SECTION 1: INTRODUCTION

The purpose of this book is to provide instructions for unpacking, storage, use, operation and maintenance of VCP-TL drawout type and VCP-TRL fixed type Vacuum Circuit Breakers with linear actuator mechanisms. VCP-TL and VCP-TRL are compact vacuum interrupting elements designed for applications such as: mine power centers, portable power substations, fixed breaker or drawout switchgear and portable generators, all without compromising metal clad expectations. VCP-TL and VCP-TRL breakers were specifically designed to provide proven reliable performance in a small package. The circuit breakers are available in voltage classes of 4.76, 8.25 and 15.0 kV. They are tested in accordance with ANSI C37.04 and C37.09 (Table **1.1**).

1-1 VCP-TL and VCP-TRL Vacuum Breaker Ratings

Refer to Table 1.1 on page 2.

The circuit breaker's nameplate provides complete rating information. Reliable control and protection for medium voltage equipment and circuits are achieved through the use of VCP-TL and VCP-TRL Vacuum Breakers.

WARNING

SATISFACTORY PERFORMANCE OF THESE BREAKERS 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 CIRCUIT BREAKERS.

VCP-TL and VCP-TRL CIRCUIT BREAKERS ARE PROTECTIVE DEVICES, AS SUCH, THEY ARE MAXI-MUM RATED DEVICES. THEREFORE, THEY SHOULD NOT UNDER ANY CIRCUMSTANCES BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS.

Table 1.1 VCP-TL and VCP-TRL Ratings (ANSI C37.04 and C37.09)

Identification	Rated Values							
Circuit Breaker Type	Voltage Class	Insulation Level		Continuous Current	Shod Circuit ② Breaking Current	Shod Circuit Making Current	Mechanical Endurance Operations	
		Power Frequency	Impulse Withstand					
	kV rms	kV rms	kV Peak	Amperes	kA rms	kA Peak	Vl	Mech.
50 VCP-TL16 and 50 VCP-TRL16	4.76	19	60	600 1200 1600③	16	42	30000 ↓	100000 ↓
50 VCP-TL20 and 50 VCP-TRL20	4.76	19	60	600 1200 1600③	20	52	30000 ↓	100000 ↓
50 VCP-TL25 and 50 VCP-TRL25	4.76	19	60	600 1200 1600③	25	65	30000 ↓	100000 ↓
75 VCP-TL16 and 75 VCP-TRL16	8.25	20	60①	600 1200 1600③	16	42	30000 ↓	100000 ↓
75 VCP-TL20 and 75 VCP-TRL20	8.25	20	60①	600 1200 1600③	20	52	30000 ↓	100000 ↓
75 VCP-TL25 and 75 VCP-TRL25	8.25	20	60①	600 1200 1600③	25	65	30000 ↓	100000 ↓
150 VCP-TL16 and 150 VCP-TRL16	15	36	95	600 1200 1600③	16	42	30000 ↓	100000 ↓
150 VCP-TL20 and 150 VCP-TRL20	15	36	95	600 1200 1600③	20	52	30000 ↓	100000 ↓
150 VCP-TL25 and 150 VCP-TRL25	15	36	95	600 1200 1600③	25	65	30000 ↓	100000 ↓

①Use 15kV Breaker and Cassette when 95kV Impulse Withstand required ② Also 2 Second Short Time Current Rating
Tested for capacitor switching capabilities. "General Purpose" to ANSI C37: Cable charging = 25A. "Definite Purpose" to ANSI C37: Back-to-back equals 250A and 1000A. Ratings of 250 and 1000A cover capacitor bank applications from 75 to 1000A. Inrush current and frequency rating = 18 kApk at 2.4 kHz."
③ 1600A VCP-TL Drawout Breaker not available

1-2 Types VCP-TL and VCP-TRL Outlines and Dimensions (Circuit Breakers and Drawout Cassettes)

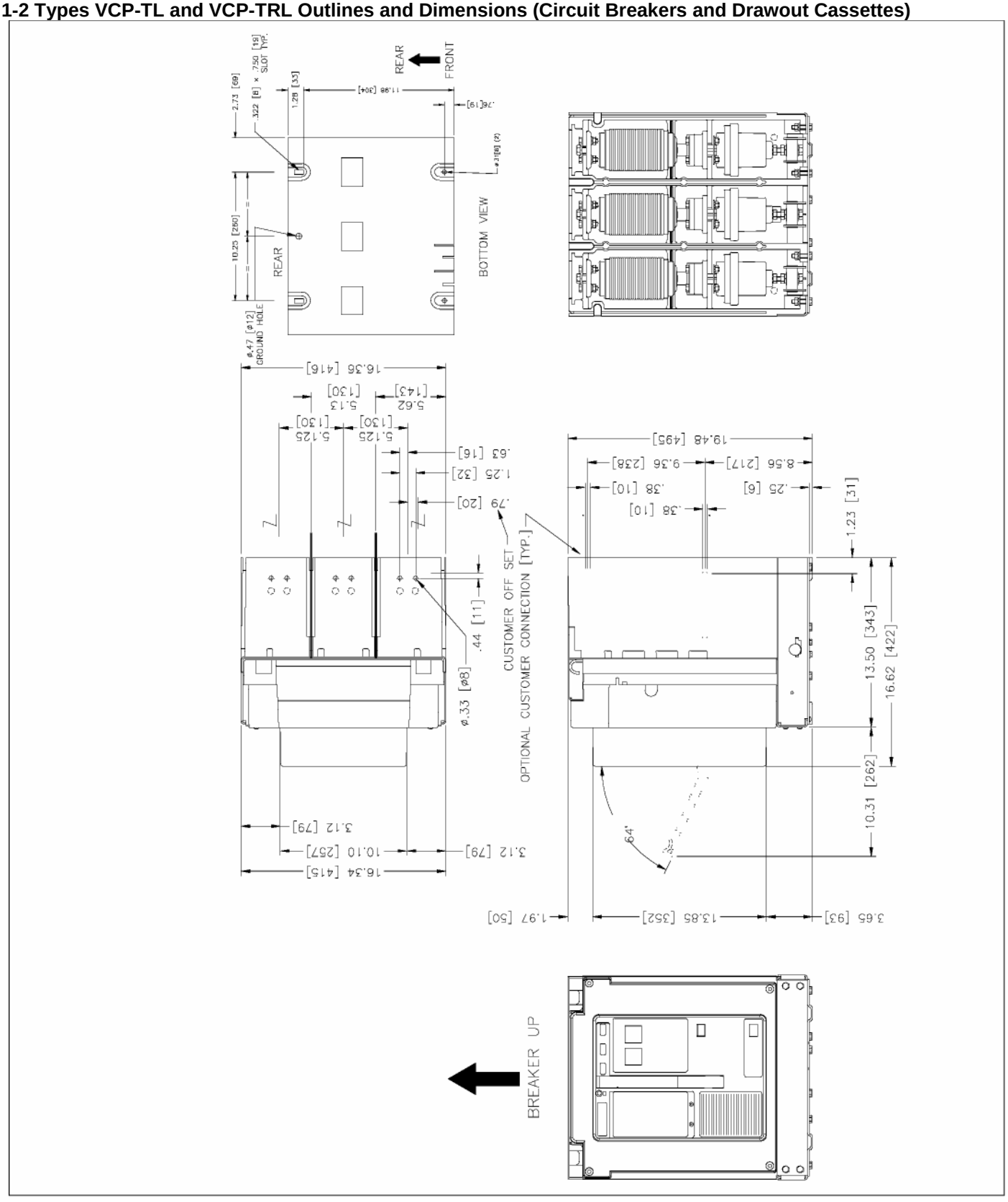


Figure 1-1 VCP-TRL Fixed Breaker 4.76/8.25kV, 600A/800A, 16kA, 60kV BIL Only Outlines in inches (mm)]

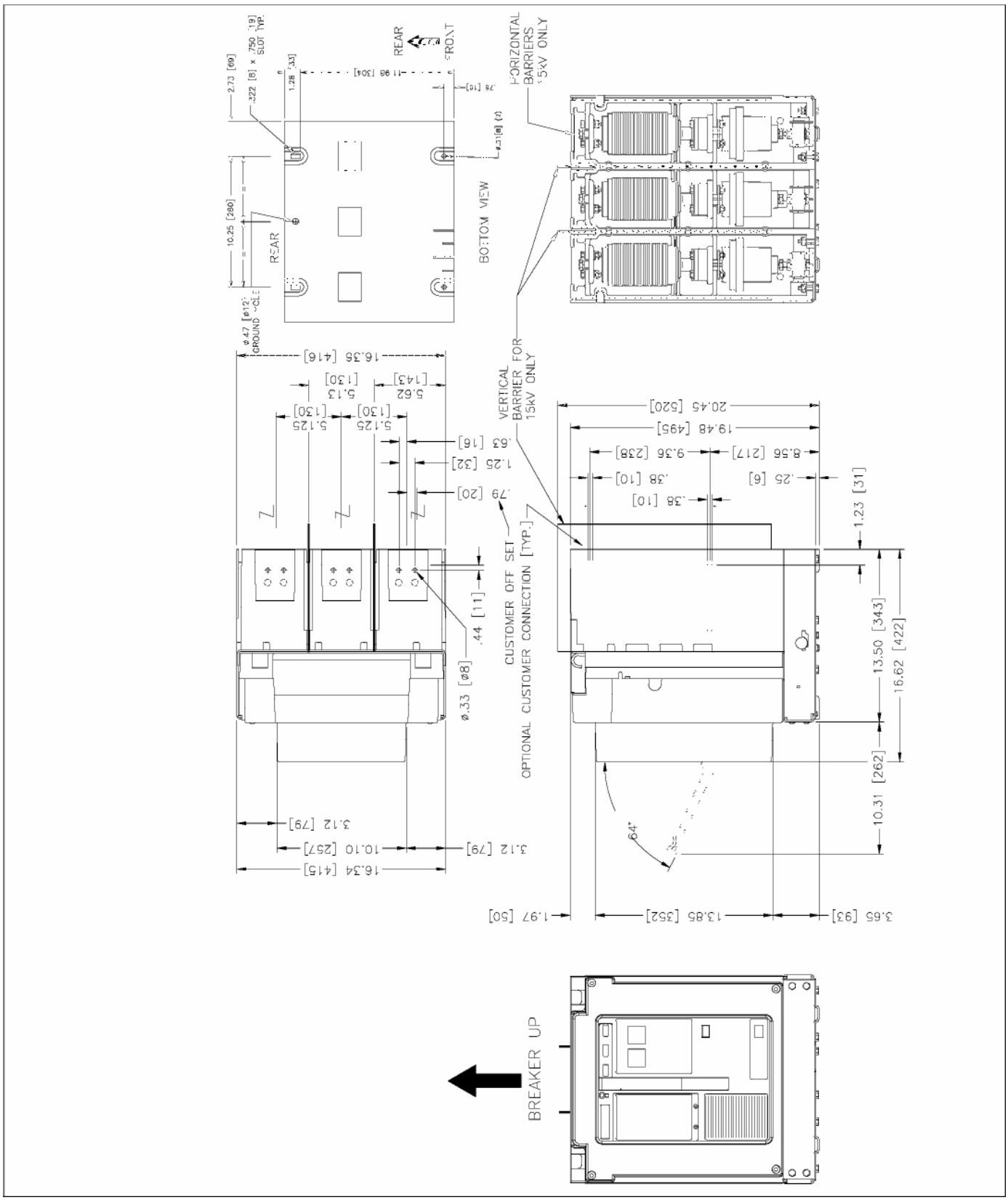


Figure 1-2 All VCP-TR Fixed (except 4.76/8.25kV, 600/800A, 16kA, 60kV BIL see Figure 1-1) Outlines in inches [mm]

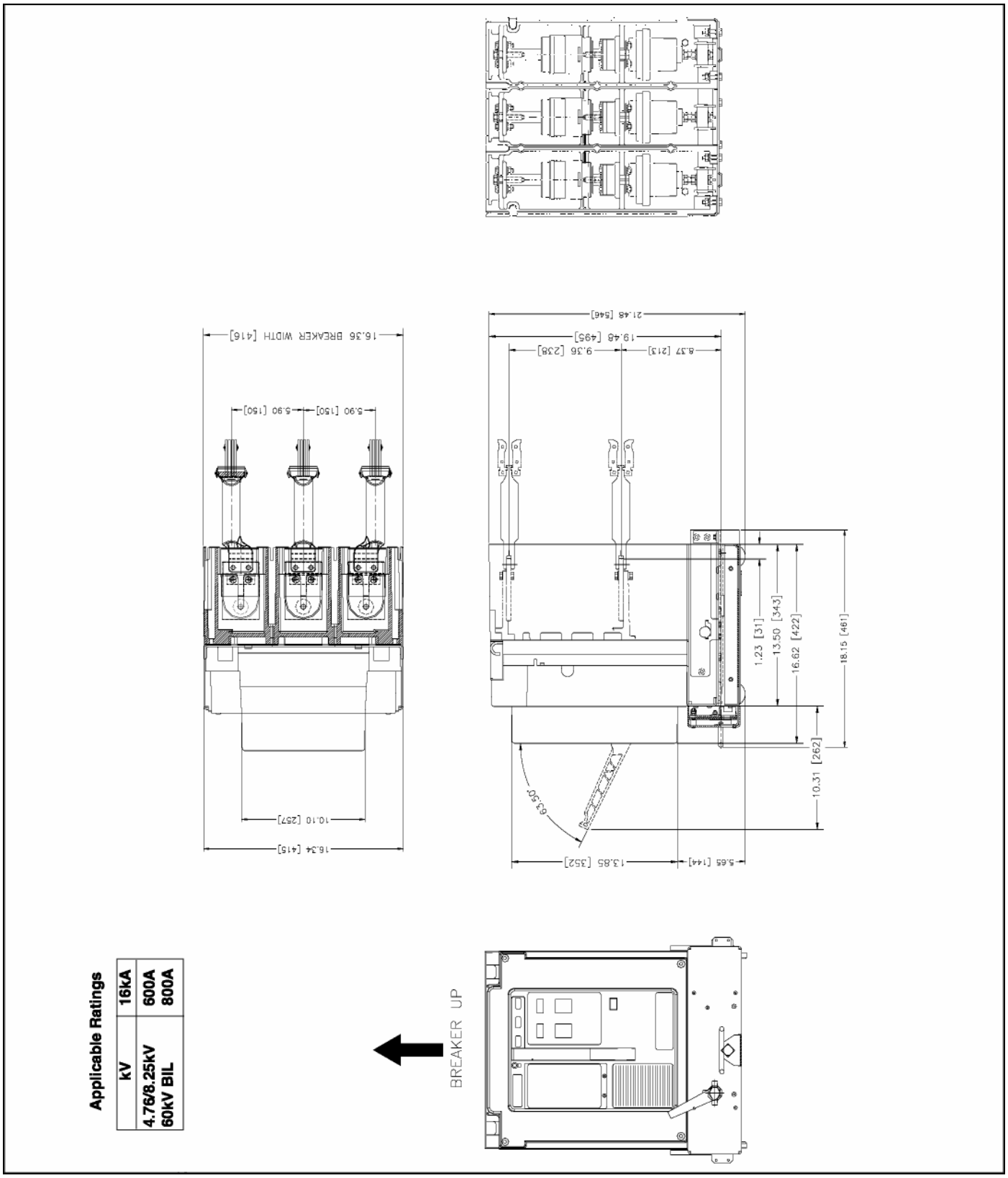


Figure 1-3 VCP-TL Drawout Breaker 4.76/8.25kV Outlines in inches [mm] (Refer to above Applicable Ratings Table)

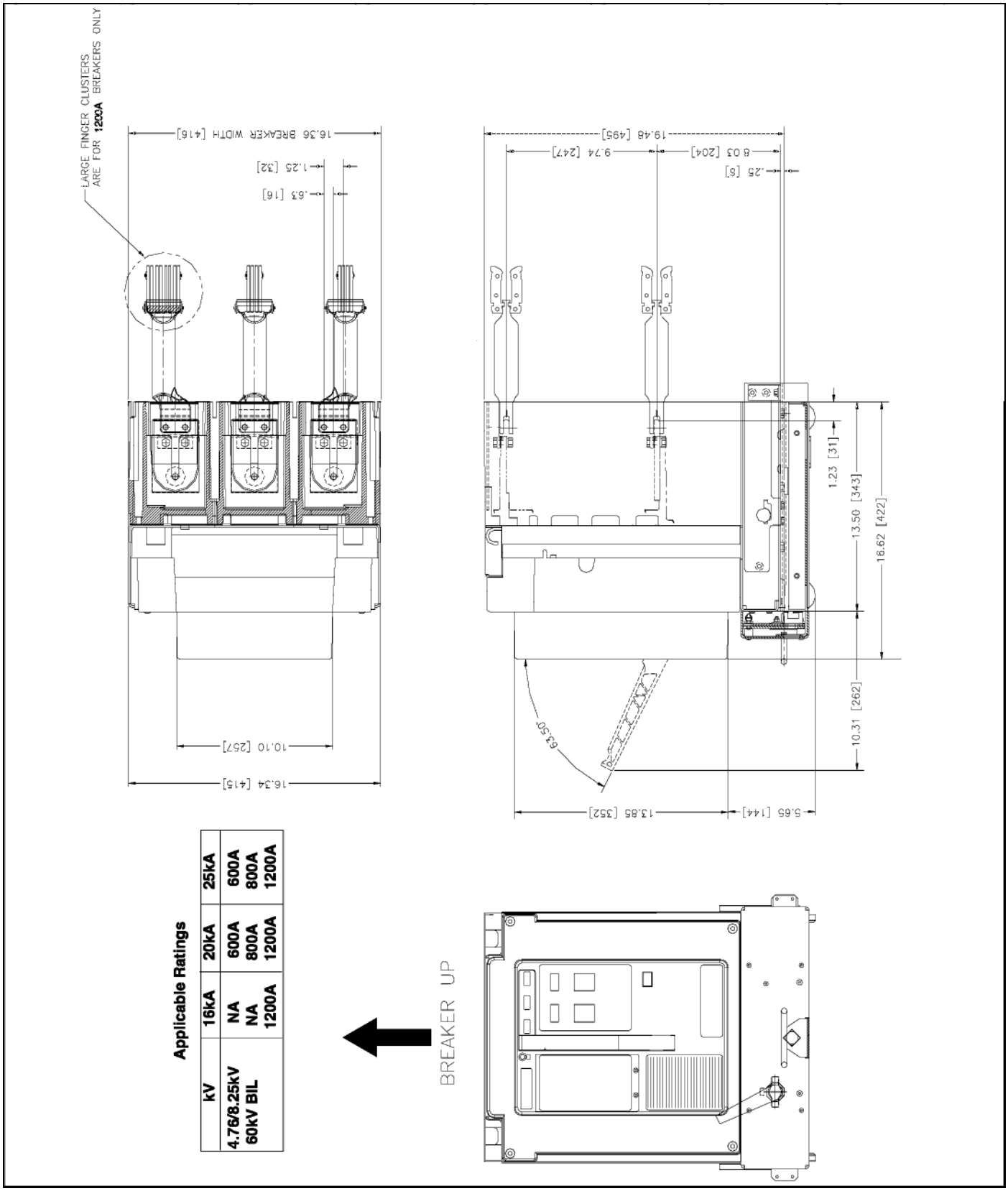
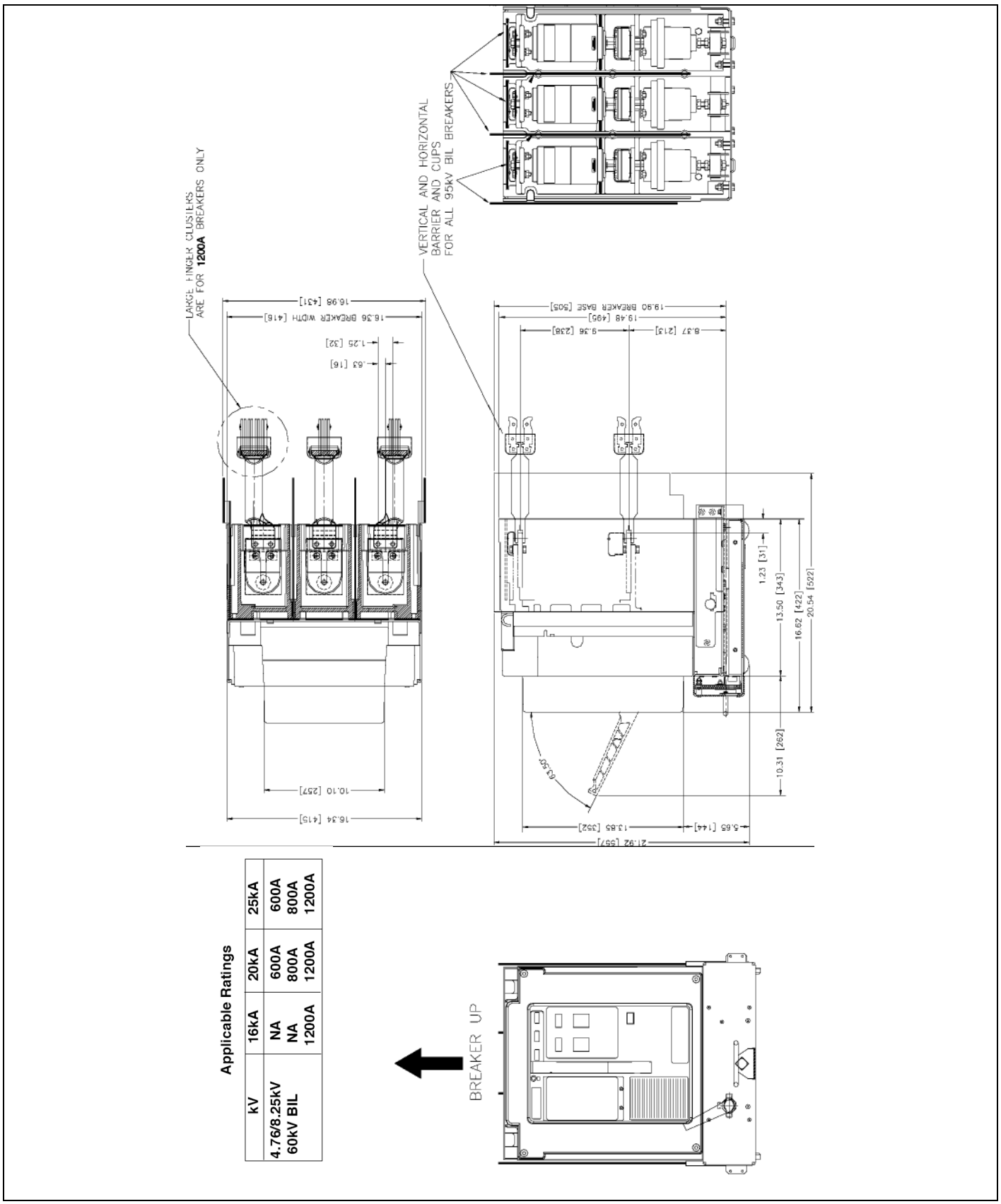


Figure 1-4 VCP-TL Drawout Breaker 4.76/8.25kV Outlines in inches [mm] (Refer to above Applicable Ratings Table)



Applicable Ratings			
kV	16kA	20kA	25kA
4.76/8.25kV 60kV BIL	NA	600A	600A
	NA	800A	800A
	1200A	1200A	1200A

Figure 1-5 VCP-TL Drawout Breaker 8.25/15kV Outlines in inches [mm] (Refer to above Applicable Ratings Table)

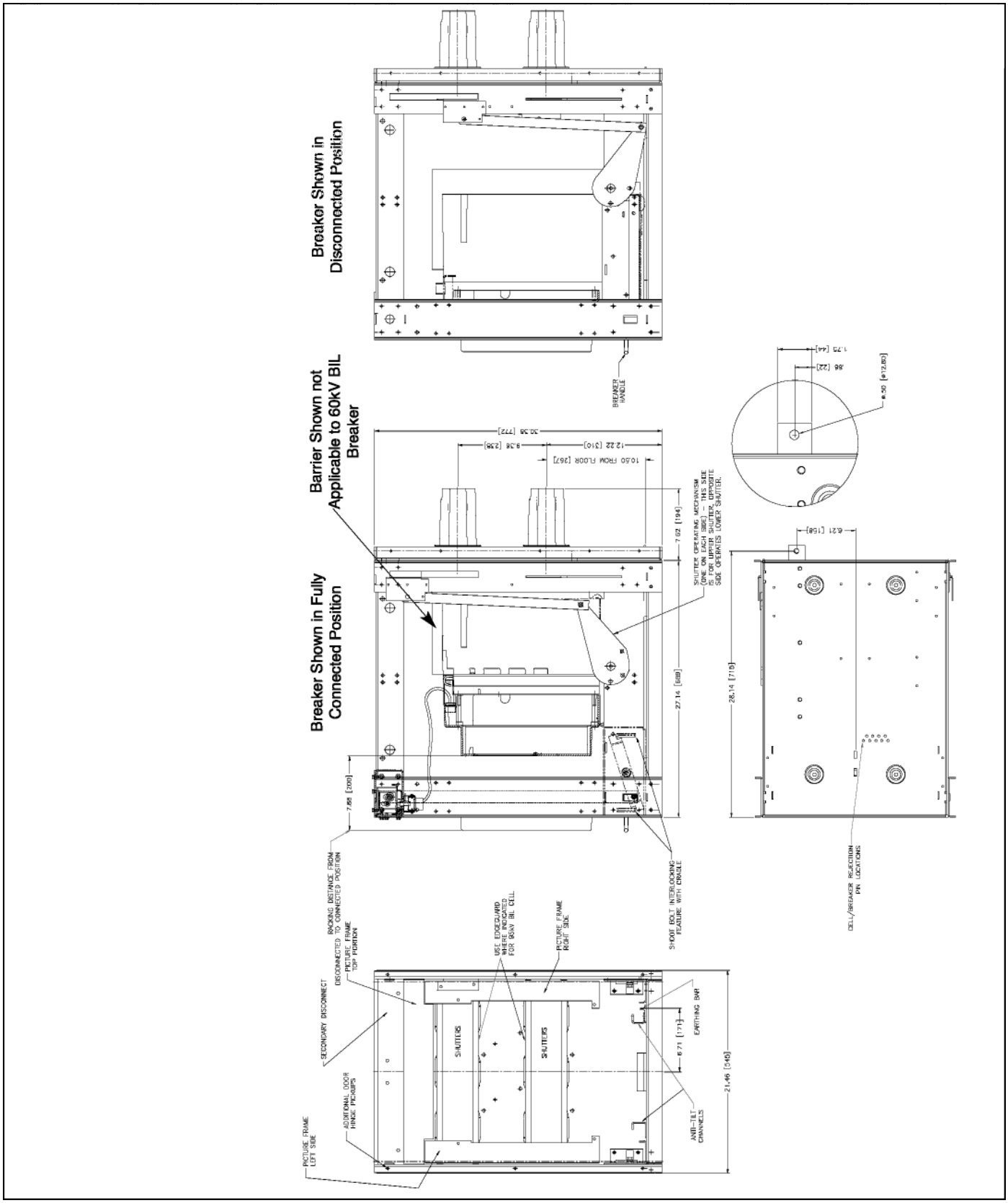


Figure 1-6 VCP-TL Breaker Cassette Up to 95kV BIL Outlines in inches [mm] (Additional Details Figures 1-7 & 1-8)

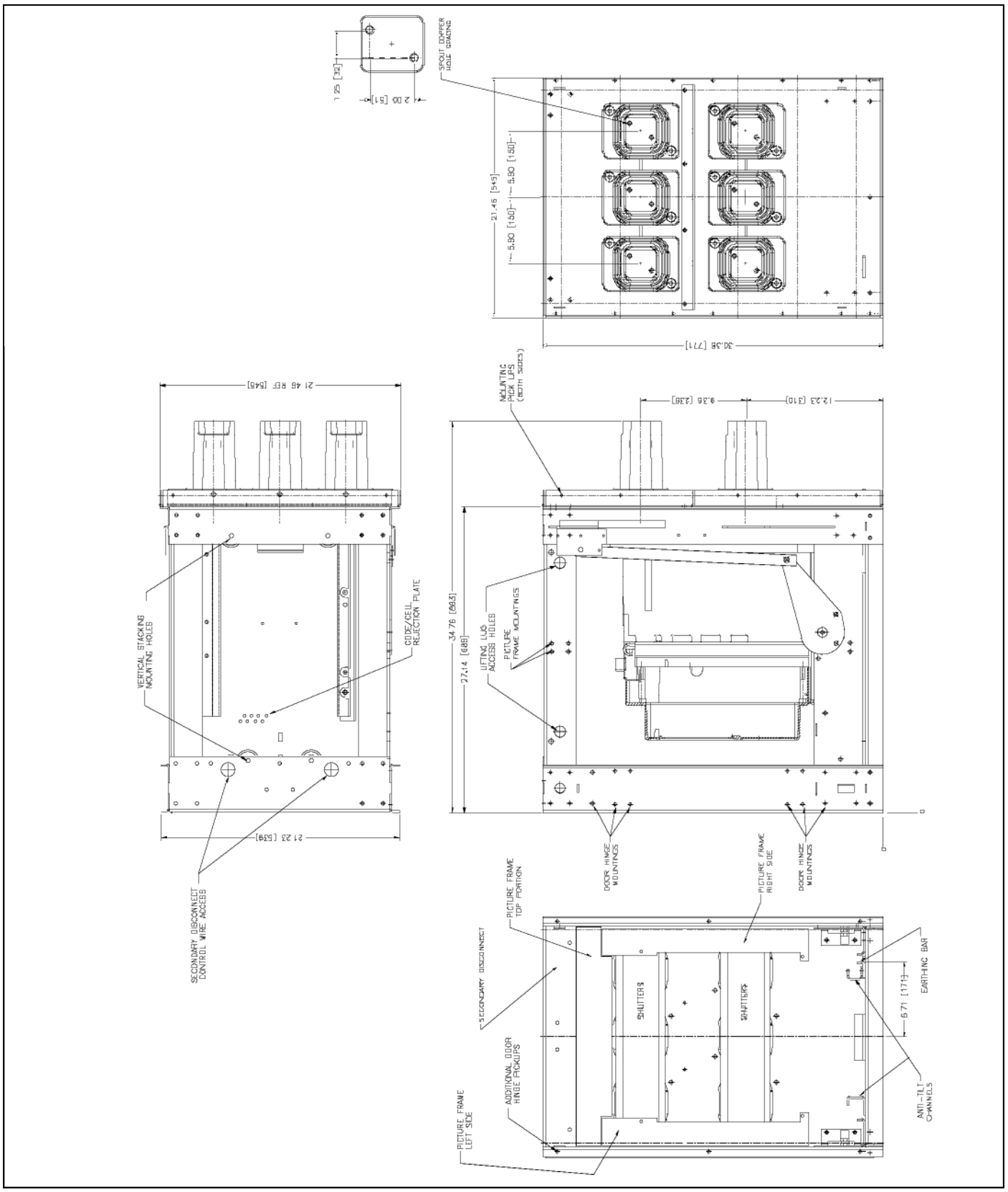


Figure 1-7 VCP-TL Breaker Cassette 60kV BIL Outlines in inches [mm] (Additional Details Figure 1-6)

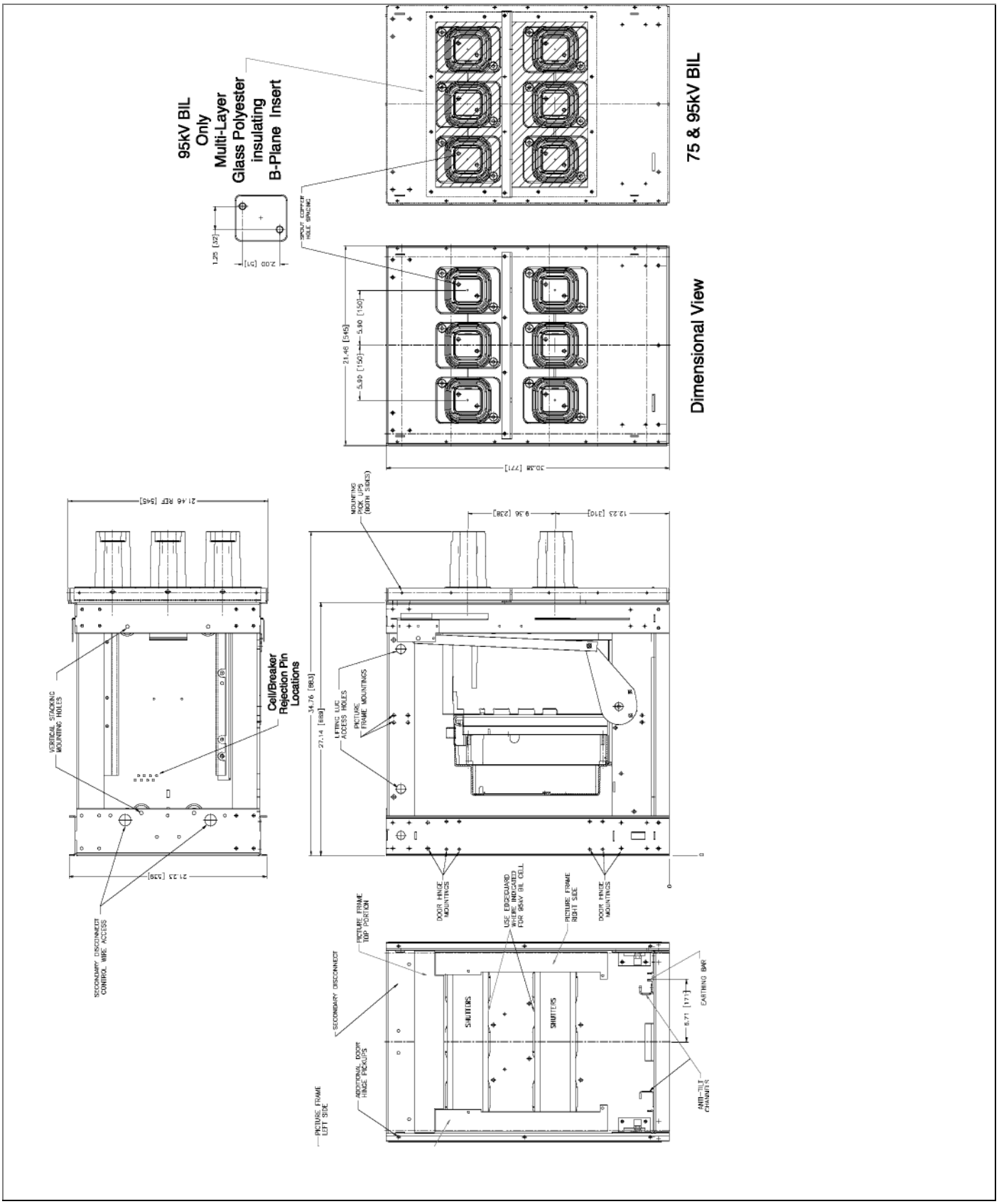


Figure 1-8 VCP-TL Breaker Cassette 95kV BIL Outlines in inches [mm] (Additional Details Figure 1-6)

SECTION 2: SAFE PRACTICES

The circuit breakers are equipped with linear actuator operating mechanisms. They are designed with built-in safety interlocks to provide for safe operation. In addition, other optional interlocks are available depending upon the application. Refer to Section 5 for additional interlock information. It is the customers' responsibility to insure that appropriate interfaces with the breakers are provided and tests conducted to adequately prove proper installation and functioning.

WARNING

TO PROTECT THE PERSONNEL ASSOCIATED WITH INSTALLATION, OPERATION, AND MAINTENANCE OF THESE BREAKERS, THE FOLLOWING PRACTICES MUST BE FOLLOWED:

- Only qualified persons, as defined in the Local Electrical Codes, who are familiar with the installation and maintenance of medium voltage circuits and equipment, should be permitted to work on these breakers.
- Read these instructions carefully before attempting any installation, operation or maintenance of these breakers.
- Always remove drawout type breakers from their enclosure before performing any maintenance. Failure to do so could result in electrical shock leading to death, severe personal injury and/or property damage.
- Always make sure that primary and secondary power is disconnected from a fixed breaker before performing any maintenance. Failure to do so could result in electrical shock leading to death, severe personal injury and/or property damage.
- Do not work on a closed breaker or a breaker with closing springs charged. The closing springs should be discharged and the main contacts open before working on the breaker. Failure to do so could result in cutting or crushing injuries.
- Do not use a circuit breaker by itself as the sole means of isolating a high voltage circuit. As appropriate, use an isolation means and follow all lock-out and tagging rules of the Local Electrical Codes and any and all applicable codes, regulations and work rules.
- Always ensure that drawout circuit breakers are in one of their designed cell positions, such as Connect, Test/Disconnect or Remove. A circuit breaker permitted to remain in an intermediate position could result in control circuits being improperly connected resulting in electrical failures.
- Breakers are equipped with safety interlocks. Do not defeat them. This may result in death, bodily injury and/or equipment damage.
- Do not work on a circuit breaker while suspended from a lifting means. Maintenance work should be performed on a properly supported cart or table.

SECTION 3: RECEIVING, HANDLING AND STORAGE

VCP-TL and VCP-TRL circuit breakers 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 the same time to provide convenient handling.

3-1 RECEIVING

Until the breaker is ready for use, it is best NOT to remove it from its container. If the breaker is to be placed in storage, maximum protection can be obtained by keeping it packed as shipped.

Upon receipt of the equipment, inspect the containers for any signs of damage from rough handling and/or external damage incurred during the transportation phase. Record any observed damage for reporting to the transportation carrier and EATON. All reports should be as specific as possible and include the order number and other applicable nameplate information.

Every effort is made to ensure that circuit breakers arrive at their destination undamaged and ready for installation. Care should be exercised, however, to protect the breakers from impact at all times. Do not remove protective packaging until the circuit breakers are ready for inspection, testing and/or installation.

3-2 HANDLING

WARNING

DO NOT USE ANY LIFTING DEVICE AS A PLAT-FORM FOR PERFORMING MAINTENANCE, REPAIR OR ADJUSTMENT OF THE BREAKER, FOR OPENING OR CLOSING THE CONTACTS OR CHARGING THE SPRINGS. THE BREAKER MAY SLIP OR FALL CAUSING SEVERE PERSONAL INJURY. ALWAYS PERFORM MAINTENANCE, REPAIR AND ADJUSTMENTS ON A WORKBENCH CAPABLE OF SUP-PORTING THE BREAKER.

Shipping containers are designed to be handled either by use of a sufficiently strong rope sling and overhead lifting device or by a fork lift truck. If containers must be skidded for any distance, it is preferable to use roller conveyors or individual pipe rollers.

3-2.1 UNPACKING

Before beginning to unpack new circuit breakers, read and understand the directions. Unpacking a fixed circuit breaker is described in the next paragraph in detail. Unpacking a drawout circuit breaker is also simple to accomplish and is not described here in detail. Just proceed by carefully removing all packing material used for protection during shipment and the fasteners used to secure the drawout circuit breaker to its shipping pallet.

When ready to inspect and install the circuit breaker, carefully remove any banding straps and lift off the card-board box. Remove any additional packing material and internally packed documentation. The circuit breaker is mounted to a wooden shipping pallet. A keyed metal clamp is used on each side of the circuit breaker to hold it to the wooden pallet (Figure 3-1). Remove the screws from the wooden pallet on each side and lift up and out on the keyed metal clamps for removal (Figure 3-2). The circuit breaker is now ready to be removed from its ship-ping pallet. Save all shipping hardware and packaging material for any future shipments of the circuit breaker.

3-2.2 LIFTING

To closely examine, install or just become familiar with the circuit breaker, carefully lift and place the circuit breaker on a solid work surface capable of handling the circuit breaker's weight (Table 3.1). The circuit breaker is provided with two integrally mounted lifting hooks for use with a standard sling (Figure 3-1). Once the sling is properly placed, the breaker can be carefully lifted and moved using an overhead lifter or portable floor lifter. Every effort should be made to minimize circuit breaker swing or tilt.

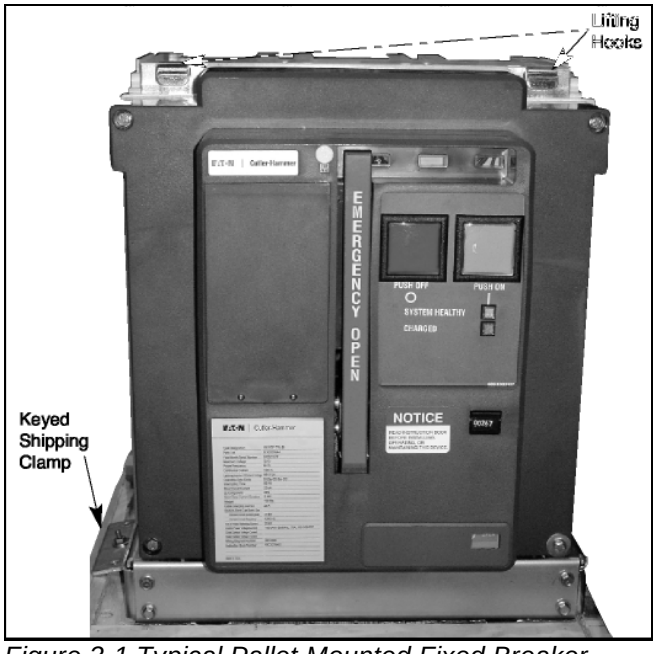


Figure 3-1 Typical Pallet Mounted Fixed Breaker

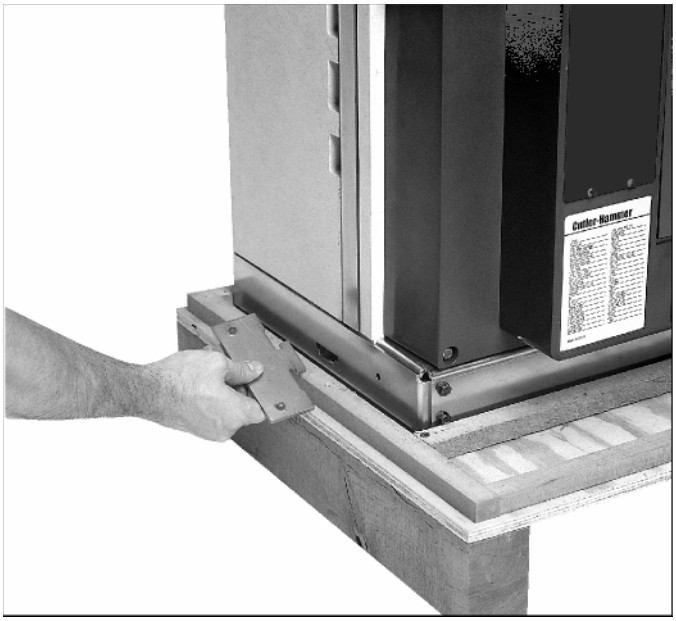


Figure 3-2 Keyed Shipping Clamp Being Removed From Typical Pallet Mounted Fixed Breaker

WARNING

THE CUSTOMER SHOULD READ AND UNDERSTAND THE MATERIAL PRESENTED AND ANY WARNINGS OR CAUTIONS OFFERED IN THE INSTRUCTION BOOK BEFORE ANY ATTEMPT IS MADE TO INTERFACE WITH THIS CIRCUIT BREAKER.

IT IS IMPERATIVE THAT ALL APPLICABLE ANSI STANDARDS BE COMPLIED WITH IN EVERY RESPECT AND THAT NO COMPROMISES ARE MADE WITH RESPECT TO THE ANSI GUIDELINES OR INTENT.

UNDER NO CIRCUMSTANCES SHOULD ALTERATIONS BE MADE TO EATON SUPPLIED VCP-T VCP-TR CIRCUIT BREAKERS UNLESS THE ALTERATION IS SPECIFICALLY ADDRESSED IN AND PERMITTED BY THIS INSTRUCTION BOOK.

3-3 STORAGE

If the circuit breaker is to be placed in storage, maxi-mum protection can be obtained by keeping it packed as shipped. Before placing it in storage, checks should be made to make sure that the breaker is free from ship-ping damage and is in satisfactory operating condition.

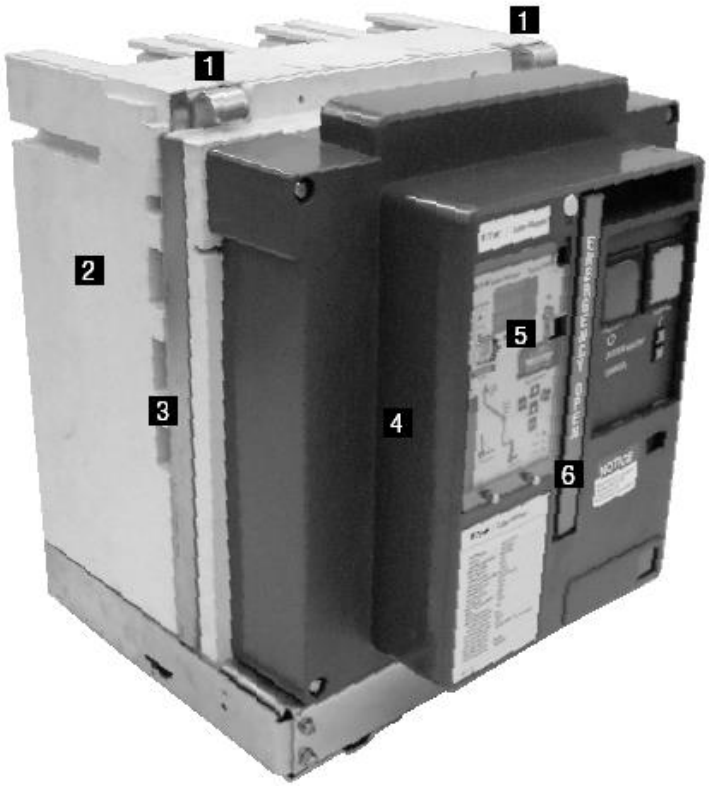
Outdoor storage is NOT recommended. If unavoidable, the outdoor location must be well drained and a temporary shelter from sun, rain, snow, corrosive fumes, dust, dirt, falling objects, excessive moisture, etc. must be provided. Containers should be arranged to permit free circulation of air on all sides 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 TYPICAL BREAKER AND CASSETTE WEIGHTS

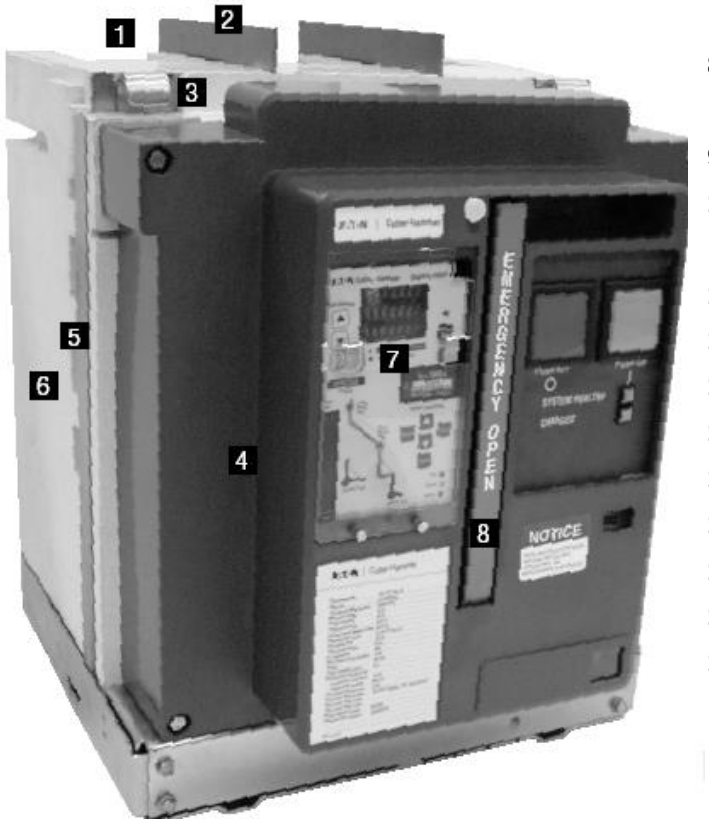
Table 3.1 Circuit Breaker and Cassette Weights

Circuit Breaker Type	Current Rating (Amps)	Approximate Weight (lb)		
		Fixed	Drawout	Cassette
50 VCP-TRL16 and 50 VCP-TL16	600	153	232	157
	800	153	232	157
	1200	155	234	157
	1600	157	NA	NA
50 VCP-TRL20 and 50 VCP-TL20	600	159	237	157
	800	159	237	157
	1200	161	239	157
	1600	163	NA	NA
50 VCP-TRL25 and 50 VCP-TL25	600	166	243	157
	800	166	243	157
	1200	168	245	157
	1600	170	NA	NA
75 VCP-TRL16 and 75 VCP-TL16	600	155	232	161
	800	155	232	161
	1200	157	234	161
	1600	159	NA	NA
75 VCP-TRL20 and 75 VCP-TL20	600	161	239	161
	800	161	239	161
	1200	163	241	161
	1600	165	NA	NA
75 VCP-TRL25 and 75 VCP-TL25	600	166	245	161
	800	166	245	161
	1200	168	247	161
	1600	170	NA	NA
150 VCP-TRL16 and 150 VCP-TL16	600	155	234	161
	800	155	234	161
	1200	157	237	161
	1600	159	NA	NA
150 VCP-TRL20 and 150 VCP-TL20	600	161	239	161
	800	161	239	161
	1200	163	241	161
	1 600	166	NA	NA
150 VCP-TRL25 and 150 VCP-TL25	600	168	245	161
	800	168	245	161
	1200	170	247	161
	1600	172	NA	NA



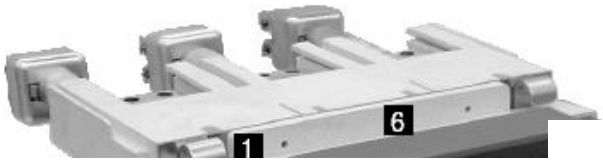
1. Integral Lifting Hook - **67A3137H01**
2. Pole Unit Molding - **70D3001G01**
3. 11 Gauge Grounded (Earth) Steel Barrier **69C3104H03**
4. Front Cover (Figure 3-9 for details) **69C3056G01**
5. Optional Protective Relay
6. Emergency open Handle - **6D33210H11**
7. Secondary Disconnect with Protective Hood
8. Vacuum Interrupter - **67A4558G01**
9. Primary Conductor Interface **69C3008H03**
10. Drive Insulator with Internal Contact Loading Spring (Wipe Spring)
    16kA - 69C3053G01
    25kA - 69C3053G03
11. Vacuum Interrupter Movable Stem
12. Rear Customer Mounting Holes **69C3010G01**
13. Customer Ground (Earth) Connection **69C3010G01**

Figure 3-3 Front and Rear Views VCP-TRL Fixed (4.76 and 8.25kV, 600/800A, 16kA, 60kV BIL)



1. Horizontal Phase Barrier (95kV BIL Only) **68B3106H02**
2. Vertical Phase Barrier (95kV BIL Only) **69C3027G01**
3. Integral Lifting Hook - **67A3137H01**
4. Front Cover (Figure **3-9** for details) **69C3056G01**
5. 11 Gauge Grounded (Earth) Steel Barrier **69C3104H03**
6. Pole Unit Molding - **70D3001G01**
7. Optional Protective Relay
8. Emergency Open Handle - **6D33210H11**
9. Secondary Disconnect with Protective Hood
10. Vacuum Interrupter - **67A4558G01**
11. Primary Conductor Interface **69C3008H03**
12. Drive Insulator with Internal Contact Loading Spring (Wipe Spring) **16kA - 69C3053G01** **25kA - 69C3053G03**
13. Vacuum Interrupter Movable Stem
14. Rear Customer Mounting Holes **69C3010G01**
15. Customer Ground (Earth) Connection **69C3010G01**

Figure 3-4 Front and Rear Views All VCP-TRL Fixed (except 4.76 and 8.25kV, 600/800A, 16kA)



1. Integral Lifting Hook - **67A3137H01**
2. Front Cover (Figure 3-9 for details) **69C3056G01**
3. 11 Gauge Grounded (Earth) Steel Barrier **69C3254G01**
4. Pole Unit Molding - **70D3250G11**
5. Optional Protective Relay Location
6. Secondary Disconnect Protective Hood (Umbilical Cord not shown)
7. Emergency Open Handle - **6D33210H11**

9. Secondary Disconnect Protective Hood (Umbilical Cord not shown)
10. Vacuum Interrupter

Part of Pole Unit Kit - **67A4558G01**

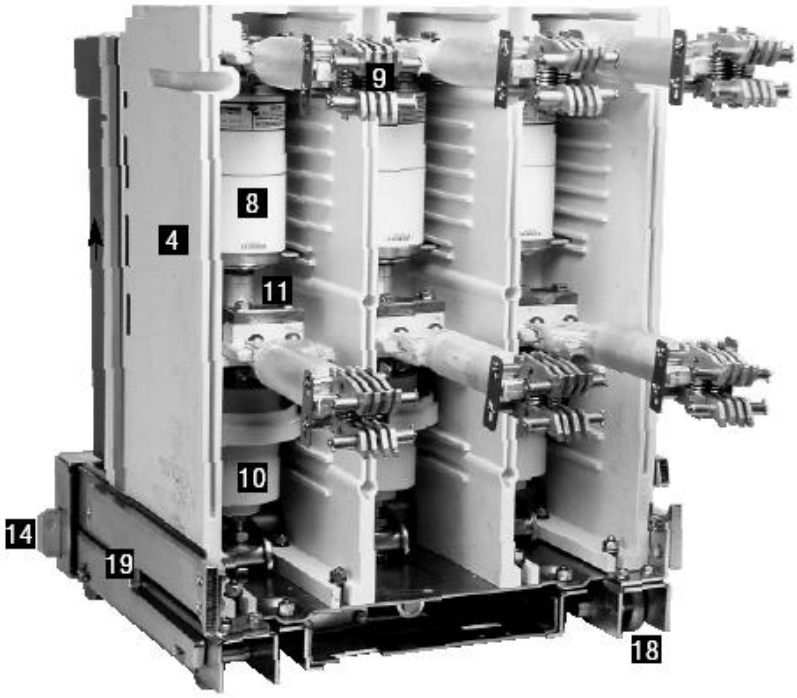
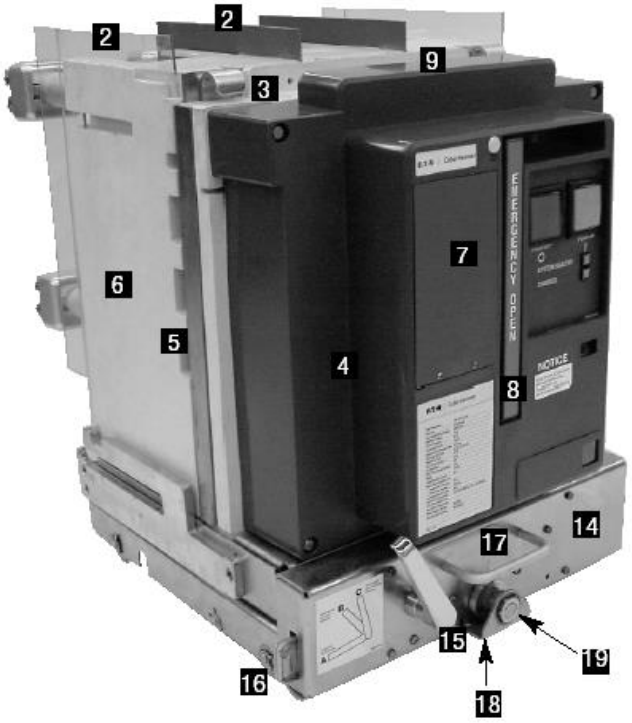


Figure 3-5 Front and Rear Views VCP-TL Drawout (4.76 and 8.25kV, 600/800A, 16kA, 60kV BIL)



1. Horizontal Phase Barrier (95kV BIL Only)
2. Vertical Phase Barrier (95kV BIL Only)
3. Integral Lifting Hook - **67A3137H01**
4. Front Cover (Figure 3-9 for details) **69C3056G01**
5. 11 Gauge Grounded (Earth) Steel Barrier **69C3254G01**
6. Pole Unit Molding - **70D3250G11**
7. Optional Protective Relay Location
8. Emergency Open Handle - **6D33210H11**

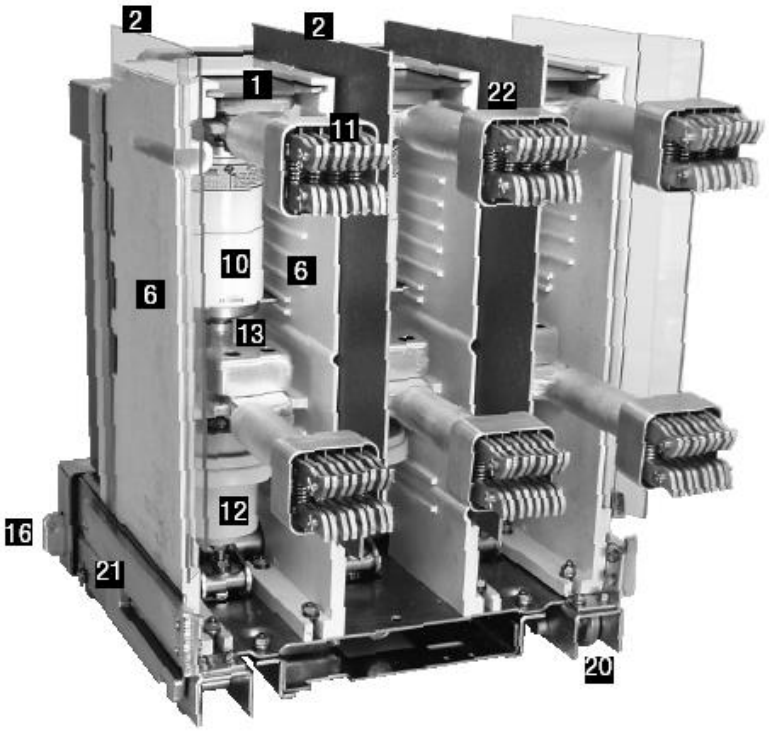
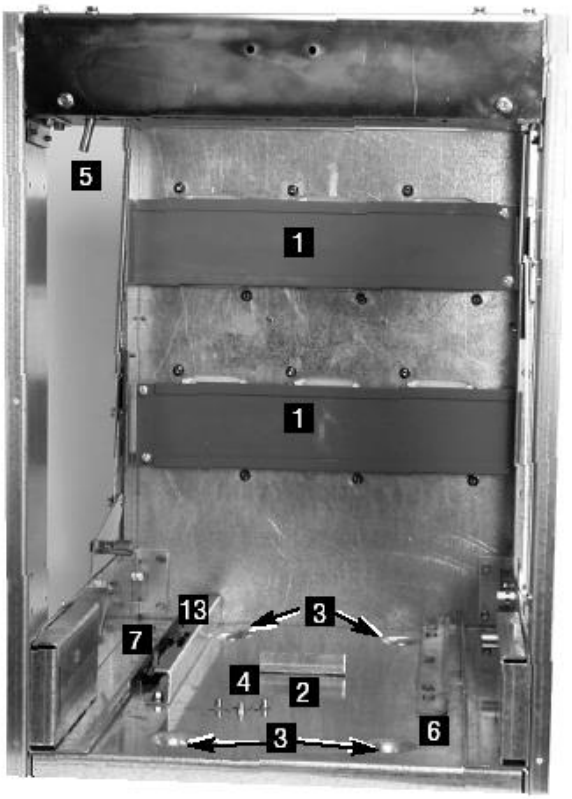


Figure 3-6 Front and Rear Views All VCP-TL Drawout (except 4.76/8.25kV, 600/800A, 16kA, 60kV BIL) See Figure 3-5



8. Breaker Position and Safety Shutter Padlocking Mechanism - **69C3287H02**

9. Primary Connecting Pad

10. Primary Insulating Tube (Spout) - **69C3347G02**

11. Safety Shutter Operating Arm **68B3298H03**

12. Secondary Umbilical Cord Connector Male Connector - **73477JAA01**

13. Anti-tilt Channel - **69C3302H03**

14. Customer Earth (Ground) Connection **69C3266H11**

1. Automatic Primary Safety Shutters (Closed Position) - **69C3288H04**

2. Cradle Stop/Hook Stop - **68B3315G01**

3. Mounting Holes Base Tray Assembly - **70D3328G02**

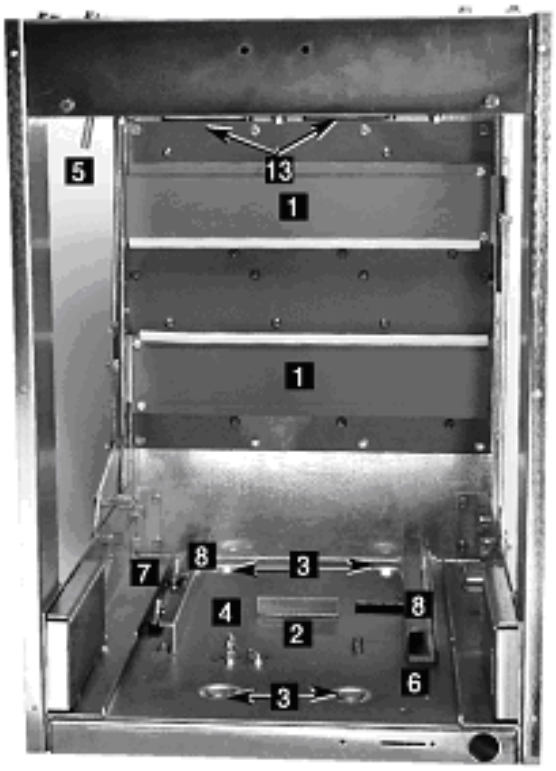
4. Rejection Interlock Pins Rej. Pin Kit - **68B3049G01**

5. Interlock Lever (Secondary Contact) Interlock Lever - **67A3277H23**

6. Grounding (Earthing) Bar

7. Position Switches

Figure 3-7 Front and Rear Views Drawout Cassette (For use with 60kV BIL Drawout Breakers Only)



1. Automatic Primary Safety Shutters (Closed Position) - **69C3219H04**
2. Cradle Stop/Hook Stop - **68B3315G01**
3. Mounting Holes (Base Tray Assembly) - **69C3339G01**
4. Rejection Interlock Pins - **68B3049G01**
5. Interlock Lever (Secondary Contact) **67A3277H23**
6. Grounding (Earthing) Bar - **69C3266H01**
7. Position Switches
8. Anti-tilt Channel - **70D3220H06**
9. Breaker Position and Safety Shutter Padlocking Mechanism - **68B3216H04**
10. Primary Connection Pad - **68B3219H01**
11. Primary Insulating Tube (Spout) - **70D3211H01**
12. Safety Shutter Operating Arm -**68B3332H01**
13. Secondary Umbilical Cord Connector Cell Wiring Harness - **69C3259G01** Male Connector Secondary Block - **73477JAA01**
14. Customer Earth (Ground) Connection - **69C3266H01**

Figure 3-8 Front and Rear Views Drawout Cassette (For use with all 95kV BIL Drawout Breakers)

1. Emergency Open Handle - **68B3210H11**
2. Push OFF Button (RED) - **68B3355G01**
3. Push CLOSE Button (Green) - **68B3355G02**
4. Open Indicator - **68B3353H02**
5. Close Indicator - **68B3353H01**
6. Charged Indicator - **68B3353H04**
7. Operations Counter - **592C040H01**
8. Mechanical OPEN/CLOSE Indicator
9. Nameplate
10. Front Cover Mounting Hardware
    - **70540AK10R** - Flat Washer
    - **70045BB0BG –** Bolt
    - **71070CA009** - O Ring
    - **70045BB0A1**- Screw
    - **70550AC10R** – SPG Washer

Figure 3-9 Typical VCP-TL Drawout Breaker Front Cover Details

SECTION 4: INSTALLATION AND WIRING

NOTICE

Refer to the circuit breaker weights in Table 3.1 to ensue: that any table used for inspections is capable of supporting the circuit breaker.

4 - 1 INITIAL INSPECTION

Before attempting to use or put a circuit breaker into service, examine it for loose or obviously damaged parts. In addition, compare the circuit breaker nameplate with associated drawings, shipping papers and ordering information for compatibility. A circuit breaker should also be operated manually. To check the manual operation of a circuit breaker, follow the operational procedures outlined in Section 5.

For fixed breaker applications, an electrical operations check should be performed after the breaker is appropriately mounted, secondary wiring completed, and any appropriate inter-phase barriers installed. To check the electrical operation of a circuit breaker, follow the operational procedures outlined in Section 5.

For drawout breaker applications, an electrical operations check should be made with the breaker in the TEST position or by using a 'Test Cable" with the breaker out of its cell. Refer to paragraphs later in this section covering "Circuit Breaker Positioning" and "Drawout Electrical Interfaces". Once familiar with this information, refer to Section 5 for electrical operation procedures.

4 - 2 ELECTRICAL CLEARANCES

It is the responsibility of the customer to insure that the proper electrical clearances are maintained on the circuit breaker, in the assembly structure, and between the circuit breaker and its assembly structure. These required electrical clearances must be in keeping with the appropriate ANSI standards and the specific BIL application level. The BIL rating associated with a particular circuit breaker is clearly indicated on its nameplate located on the front cover. Also refer to Table **1.1** for circuit breaker rating details.

4 - 3 INTERPHASE BARRIERS

ANSI requires specific dielectric performance. It is the customer's responsibility to insure that all required inter-phase barriers are in place on the circuit breaker before the circuit breaker is placed in service. Appropriately sized and constructed barriers are supplied with the circuit breaker. The number and types (vertical or horizontal) of barriers used with fixed and drawout circuit breakers depend primarily on the circuit breaker rating. Refer to Figures **1-1** to **1-8** for the barriers used with specific breakers. Any other barriers required to meet ANSI requirements must be supplied by the customer. They must be constructed of an appropriate insulating material, such as thick high strength, track resistant glassmat polyester or polycarbonate of appropriate thickness.

4-4 FRONT COVER

The front cover of VCP-TL and VCP-TRL circuit breakers is designed such that the customer can choose to have a closed door or open door design. If a closed door design is selected, an appropriately sized door cutout can be provided by the customer to permit access to all front mounted circuit breaker controls and devices (Figure **3-9**).

4-5 INSTALLING FIXED CIRCUIT BREAKER

The VCP-TRL fixed type circuit breaker differs from the VCP-TL drawout circuit breaker in that it has no levering device, primary disconnects and secondary umbilical disconnect (Figure **4-1**). In addition, a VCP-TRL fixed circuit breaker does not have a standard feature to hold the breaker in a trip free position. To ensure the proper sequence of operation between two or more circuit breakers, an optional key interlock and/or optional cable interlock can be used.

4-5.1 FIXED MECHANICAL INTERFACES

The customer is responsible for providing all required mechanical interfaces to insure that the VCP-TRL fixed circuit breaker is properly installed and applied in a fixed con-figuration. This responsibility includes but is not limited to the following:

1. The circuit breaker must be securely mounted in an installation capable of supporting the circuit breaker's weight. Mounting holes are provided in the bottom pan of the circuit breaker for use with appropriate mounting hard-ware (Figures **1-1, 1-2** and **4-2).**

2. Appropriately sized, secured, and braced primary connections must be provided, whether the connections take the form of cable or bus bar. Circuit breaker primary terminals have holes for making bolted horizontal primary bus connections. Refer to Figures in Chapter 1 for primary connection details, such as primary spacing and hole patterns.

4-5.2 FIXED ELECTRICAL INTERFACES

Secondary electrical connections can be made through a standard secondary disconnect block or an optional screw type terminal block. Both secondary connection devices are mounted at the top, front of the circuit breaker. Secondary contacts are dedicated and identified. Refer to Figures **5-10** to **5-13** for secondary connection details.

Figure 4-1 Typical Fixed VCP-TRL 15KV Circuit Breaker with Optional Protective Relay

A 5a, 5b auxiliary switch with double break, wipe We contacts is provided as standard for customer use.

4-6 INSTALLING DRAWOUT CIRCUIT BREAKER

VCP-TL circuit breakers are installed in structures equipped for drawout circuit breakers. A bolted-in drawout cassette supports the circuit breaker (Figures 3-7 and 3-8).

4-6.1 DRAWOUT MECHANICAL INTERFACES

Each drawout circuit breaker is supplied with the following interlocks to insure safe and proper operation.

Rejection Interlocks

Rejection interlocks are steel pins mounted at the bottom of the drawout circuit breaker and in the base tray (floor) of the cassette to prevent the insertion of a circuit breaker into a structure with a higher power rating. The pins are factory mounted in the circuit breaker. **It is the customer's responsibility to correctly mount the pins in the drawout cassette.**

WARNING

DO NOT DISABLE REJECTION INTERLOCKS. DOING SO AND USING A CIRCUIT BREAKER IN A STRUCTURE WITH A HIGHER POWER RATING COULD RESULT IN AN ELECTRICAL FAULT WHICH COULD RESULT IN DEATH, BODILY INJURY AND/OR EQUIPMENT DAMAGE.

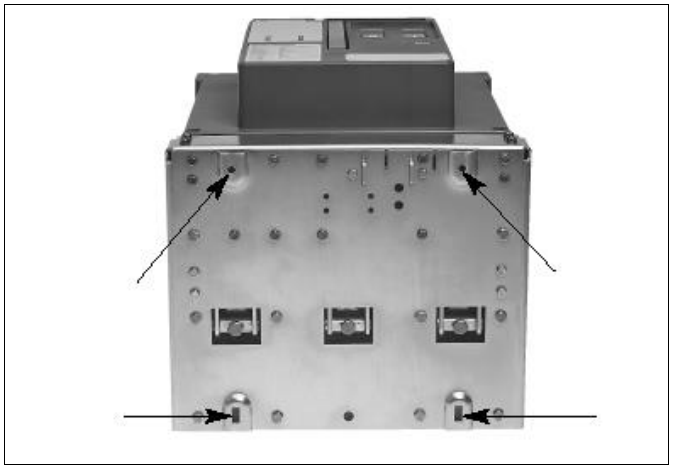


Figure 4-2 Bottom View of VCP-TRL Circuit Breaker showing Mounting Holes

As the circuit breaker is pushed into the structure, the mating pins on the bottom of the circuit breaker move past a set of corresponding pins in the cassette, if the circuit breaker and cassette are compatible. If there is a mismatch between the circuit breaker and the cassette, the rejection pins prevent the circuit breaker from being fully inserted into the cassette.

Before attempting to position the circuit breaker for insertion into its cassette, compare the positioning of the rejection interlock pins in the cassette in keeping with Table **4.1** and Figure **4-3** and ratings information supplied on the circuit breaker's nameplate. Proceed if the circuit breaker and cassette are compatible. If they are not compatible, do not attempt to insert the circuit breaker into the cassette. Contact EATON for assistance if required.

Table 4.1 Cassette Rejection Interlock Pin Locations

Cassette Used For	Pin Locations ①								
	1	2	3	4	5	6	7	8	9
Short Circuit Rating (kA)									
16	0	0	0						
20	0	0	1						
25	0	1	1						
Current Rating (A)									
600				0	0	0			
800				0	1	0			
1200				1	1	0			
Rated Voltage (kV)									
4.76							0	0	
8.25							0	1	
15.0							1	1	
Type									
Dummy Element									0
Circuit Breaker									1

①0 = no pin required, 1 = pin required

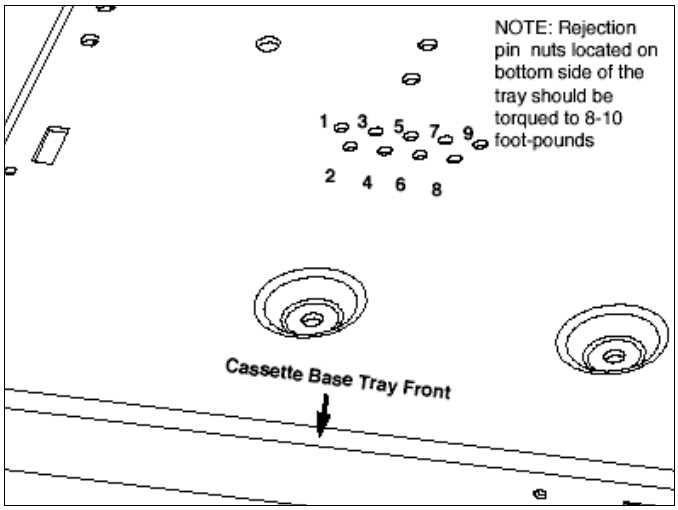


Figure 4-3 Cassette Rejection Interlock Pin Positioning

WARNING

NEVER DISABLE OR DEFEAT ANY INTERLOCKS. HAZARDOUS VOLTAGES WILL CAUSE DEATH, SEVERE PERSONAL INJURY OR PROPERTY DAM-AGE.

Secondary Control Interlock

This interlock insures that the breaker cannot be levered into the CONNECTED position if the cassette end connector of the secondary umbilical cord is not properly engaged with its cassette mounted connector. This interlock inter-faces with the cradle mounted shoot bolt interlock which will prevent secondary disconnection with the breaker connected.

Levering Interlock

The levering crank can only be engaged when the breaker is open and the horizontal shoot bolts located in the breaker cradle are properly engaged (fully extended). The breaker contacts will not close manually or electrically while the levering crank is engaged. Shoot bolt details are provided later.

Anti-Close Interlock

This interlock prevents closing electrically or manually if the breaker is already closed.

Anti-Latch Interlock

This interlock prevents the breaker contacts from being closed between the CONNECTED and TEST positions.

Shutter Drive Interlock

The metallic primary safety shutters are independently operated permitting them to be locked in the closed position for safety when the breaker is disconnected or removed or the open position for servicing the fixed primary disconnects. The locking system is not automatically disabled when the breaker is being connected. Consequently, the lock **must be removed** prior to racking or damage to the shutter drive will result.

Handle Interlock

Prevents racking in or removing a circuit breaker which is closed.

Hook Interlock

Prevents a circuit breaker which is "racked in" from being inserted into a cassette. Refer to the CAUTION below.

4-6.2 CIRCUIT BREAKER POSITIONING

The VCP-TL drawout circuit breaker has three normal positions within the cassette:

- DISCONNECT
- TEST
- CONNECT

In the DISCONNECT position, the circuit breaker is completely inside the cassette in the forward most position. The breaker end of the connector of the secondary umbilical cord is made but the cassette end of the connector of the umbilical cord is not made. The shoot bolts cannot be fully engaged. Primary connect-ions are not made.

In the TEST position, the circuit breaker is also completely inside the cassette in the forward most position. In this position, however, the secondary connections are made on both the breaker end and the cassette end. The shoot bolts are fully engaged and the interlock lever must be locked. The Primary connections are not made.
In the CONNECT position, the circuit breaker is in the cassette as far as possible. The primary connections are fully made and secondary connections remain made and locked in position.

CAUTION

MAKE SURE THE CIRCUIT BREAKER ELEMENT IS IN THE FULLY RACKED OUT POSITION IN THE CRADLE BEFORE ANY ATTEMPT IS MADE TO PUT THE CIRCUIT BREAKER INTO THE CASSETTE. FAILURE TO DO SO COULD RESULT IN EQUIPMENT DAMAGE OR BODILY INJURY DURING LIFTING AND HANDLING. REFER TO PARAGRAPH 4-6.4 FOR CIRCUIT BREAK-ER LEVERING DETAILS (FIGURES 4-14 AND 4-15).

Figure 4-4 Positioning Circuit Breaker With Lifter

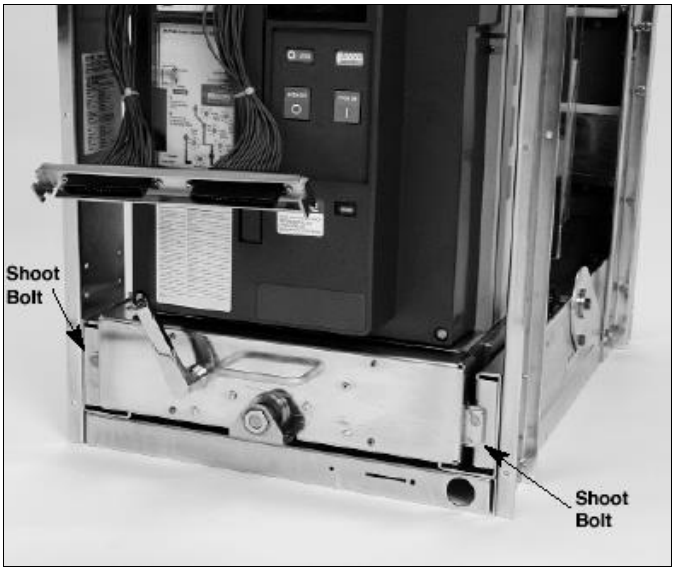


Figure 4-5 Breaker Shoot Bolts Against Cassette

NOTICE

A number of labels have been applied to the circuit breaker and its cassette to facilitate the connection and disconnection of the secondary umbilical cord, inserting the circuit breaker, levering the circuit breaker to the CONNECT position and removal of the circuit breaker. These operations are also described in detail in this instruction book. Become familiar with the labels as they not only provide assistance initially, but provide a good quick reference at a later date when the instruction book may not be readily available.

With secondary connections to the **circuit breaker only made** as supplied from the factory, carfully position the circuit breaker directly in front of its cassette using appropriate slings and an overhead lifter as described earlier in paragragraphs **3-2.2** (Figure **4-4**). The cradle portion (bottom portion) of the drawout circuit breaker is provided with integrally mounted wheels for rolling on the floor of the cassette in a guided manner.

Position the circuit breaker so that the two rear wheels begin to roll on the cassette's floor and then firmly push the circuit breaker into the cassette until the horizontal shoot bolts on either side of the breaker cradle contact the front of the cassette (Figure **4-5**). **Care should be taken not to bind the secondary umbilical cord between the circuit breaker and cassette as the circuit breaker is pushed into its cassette.** At this point the breaker cannot be inserted any further until the shoot bolts are retracted using the spring loaded shoot bolt handle on the lower left side of the cradle (Figure **4-6**). The lifting slings can now be removed from the circuit breaker.

The shoot bolt handle as shown in Figure 46 has three labeled positions

Position "A" - Full down position causing the shoot bolts to retract fully inside the breaker cradle (not engaged)

Position "B" - Partially up position causing the shoot bolts to only protrude partially (partially engaged).

Position "C" - Full up position which causes the shoot bolts to protrude completely (fully engaged).

These three handle positions are important and play a critical role while connecting and disconnecting the secondary umbilical cord to and from the drawout cassette as well as during insertion and removal of the circuit breaker from the cassette.

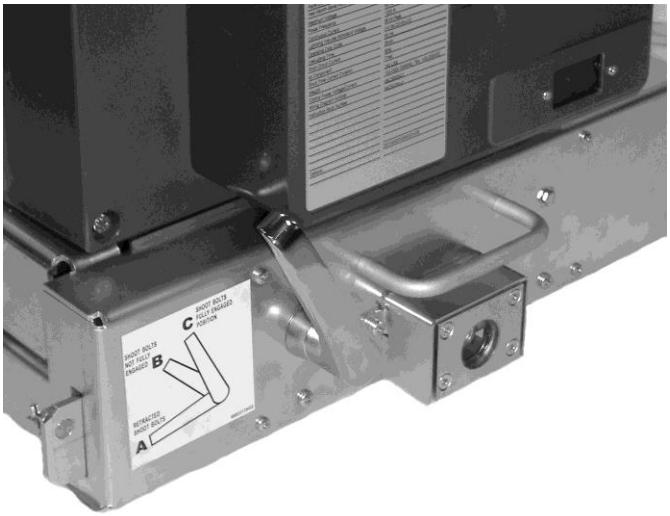


Figure 4-6 Shoot Bolt Handle in Up (Locked) Position

The circuit breaker and cassette are designed such that the lower portion of the circuit breaker (the cradle) is held in the DISCONNECT/TEST position by two shoot bolts which fit into the rectangular slots of interlock plates located on each side of the cassette's frame. The shoot bolt handle can be in either Position "B" (partially engaged) or Position "A" (not engaged) for the breaker to be in the DISCONNECT position. The shoot bolt handle **must,** however, be in Position "C" (fully engaged) to be the TEST position and before the circuit breaker can be levered to the CONNECTED position as dictated by the design's mechanical interlocking system. Levering of the circuit breaker is discussed in paragraph **4-6.4.** The three shoot bolt handle positions (A, B and C) are shown Figures **4-7, 4 - 8** and **4-9**).

Figure 4-7 Shoot Bolt Handle Shown in Position "C" - Shoot Bolts Protrude Fully From Cradle

Figure 4-8 Shoot Bolt Handle Shown in Position "B" - Shoot Bolts Protrude Partially From Cradle

Figure 4-9 Shoot Bolt Handle Shown in Position "A" - Shoot Bolts Retracted Fully Inside Cradle

Retract the shoot bolts by pushing the shoot bolt handle down to Position "A" (Figure **4-9**) and push the circuit breaker the rest of the way into the cassette against the stop. At this point, the front of the cradle will be flush with the front of the cassette. Rotate the shoot bolt handle up to Position "B" (Figure **4-8**) permitting the shoot bolts to protrude partially into the rectangular slots of the interlock plates on each side of the cassette. The circuit breaker is now held in the DISCONNECT position.

For the circuit breaker to be in the TEST position, the secondary connection must be made between the breaker and the cassette. Refer to paragraph **4-6.3** for details on making secondary connections to the cassette.

Once the secondary connection is made and the shoot bolt handle is in Position "C" (fully engaged), the circuit breaker can be levered from the TEST position to the CONNECTED position. For the circuit breaker to reach its CONNECTED position, it must be manually levered to that position as described in paragraph **4-6.4.** When the circuit breaker is levered to the CONNECTED position, the lower cradle portion remains locked in the position dictated by the shoot bolts. The upper portion of the circuit breaker moves into the structure to the CONNECTED position.

4-6.3 DRAWOUT ELECTRICAL INTERFACES

Circuit Breaker Secondary Connections

Secondary connections are made through the use of an umbilical cord (Figure **4-10).** The secondary connector on the breaker end of the cord is connected to its compatible secondary connector located under a protective hood on the upper front portion of the circuit breaker (Figure **4-11**). **This connection is already made when the breaker is shipped from the factory.** If there is a need to make this connection in the field, it can be simply accomplished as follows: Connect the breaker side connector of the umbilical cord to the circuit breaker's connector. Once the push-in connection is made, the breaker end of the umbilical cord is secured in place with two self threading screws that screw into two mounting holes in the top of the breaker's secondary mounting hardware. With the breaker end of the umbilical cord securely in place, take the cassette end of the umbilical cord and carefully lay it over the front of the circuit breaker in preparation for movement of the breaker into the cassette (Figure **4-10**). At this point, the circuit breaker is ready to be inserted into its cassette. Refer to paragraph **4-6.2** for details on positioning of the circuit breaker for insertion into its cassette.

Figure 4-10 Secondary Umbilical Cord Shown Connected to Breaker Prior to Breaker Insertion

Cassette Secondary Connections

Once the circuit breaker is in position in the cassette as described in paragraph **4-6.2** with the breaker end of the umbilical cord properly connected to the breaker, the cassette end connector of the umbilical cord can be connect-ed. Once this connection is made, the circuit breaker will be in its operable TEST position.

To make the cassette's secondary connection, make sure the shoot bolt handle is in Position **"B"** (Figure **4-8**). With the interlock lever in Location **"2"** (back and to left) (Figure **4-12**)**,** take the unconnected cassette end connector of the umbilical cord (making certain that the connector is oriented correctly before insertion) and firmly insert it into its compatible

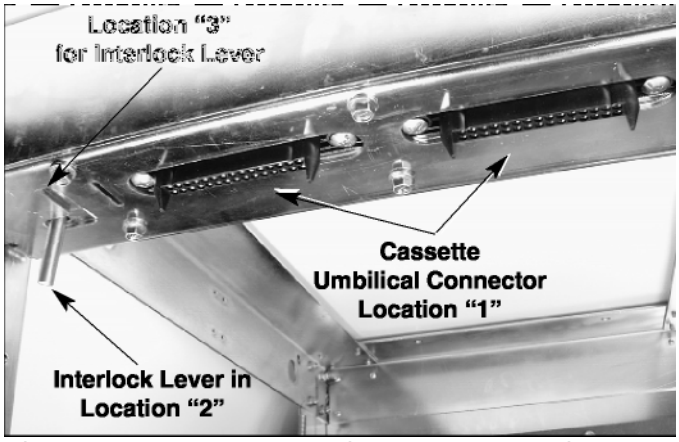


Figure 4-12 Cassette Secondary Connector and Interlock Lever

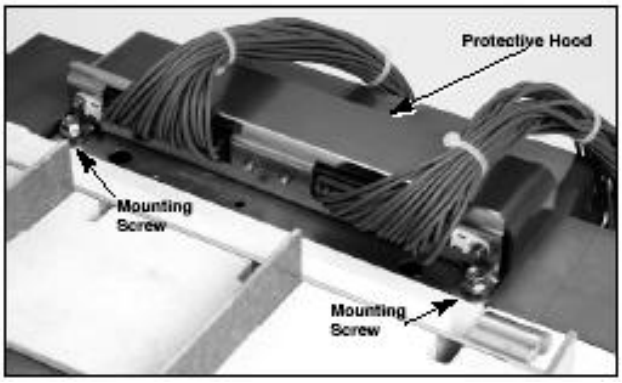


Figure 4-11 Secondary Connector Viewed From Rear of Breaker

secondary connector at Location "1" on the top front underside of the cassette (Figure **4-12). Make certain that the connector on the umbilical cord is completely inserted into the cassette's connector.** Hold the connector firmly in place and flush against the underside of the cassette on all sides with one hand while pulling the inter-lock lever from Location **"2"** to Location **"3"** (right and for-ward in keyed slot) (Figure **4-12).** This will lock the secondary connector of the umbilical cord and the cassette's secondary connector together.

The shoot bolt handle can now be rotated to its full up position, Position "C" (Figure **4-7**). In this position the shoot bolts engage the cassettes interlock plates completely and the interlock lever cannot be moved back to Location "2". Since the interlock lever cannot be moved, the umbilical cord cannot be disconnected from the cassette. The circuit breaker is now in the TEST position and ready to be tested mechanically or with secondary control voltage or ready to be levered to the CONNECTED position. Refer to paragraph **4-6.4** for levering details.

To disconnect the umbilical cord from the cassette, the breaker must be levered to the TEST position and the shoot bolt handle must be rotated down to Position **"A"** (Figure **4-9**). The interlock lever is once again moved to Location **"2"** which unlocks the secondary connector (Figure **4-12).** The cassette end of the umbilical cord can now be removed from the cassette's connector in Location **"1"** (Figure **4-12).** Since the shoot bolt handle is in Position **"A"** (shoot bolts fully retracted) and the umbilical cord is disconnected from the cassette, the circuit breaker is in the DISCONNECT position and can be removed from the cassette.

Primary Connections

Primary connections are made when the spring loaded finger clusters (disconnects) mounted on the rear of the circuit breaker automatically engage the horizontal stabs rigidly mounted inside the insulating spouts) at the

Figure 4-13 Drawout Cassette with Primary Safety Shutters Open Showing Fixed Primary Stabs

back of the cassette (Figures **3-5, 3-6** and **4-13**)**.** Proper engagement (fully engaged) of the finger clusters (disconnects) and the cassette stabs takes place as the circuit breaker is levered into the fully CONNECTED position, as described next in paragraph **4-6.4.** The primary safety shutters automatically move out of the way as the circuit breaker is levered toward the CONNECT position exposing the fixed primary stabs in the cassette. The primary safety shutters also close automatically as the circuit breaker is levered toward the TEST position. Refer to the next paragraph **4-6.4** levering details and additional safety shutter information.

4-6.4 LEVERING CIRCUIT BREAKER

CAUTION

MAKE SURE THE CIRCUIT BREAKER ELEMENT IS IN THE FULLY RACKED OUT POSITION IN THE CRADLE BEFORE ANY ATTEMPT IS MADE TO PUT THE CIRCUIT BREAKER INTO THE CASSETTE. FAILURE TO DO SO COULD RESULT IN EQUIPMENT DAMAGE OR BODILY INJURY DURING LIFTING AND HANDLING. REFER TO PARAGRAPH 4-6.2 FOR CIRCUIT BREAK-ER POSITIONING DETAILS AND SEE FIGURES 4-14 AND 4-15.

Once the VCP-TL circuit breaker is in the TEST position with the secondary umbilical cord properly connected, it is ready to be levered into the CONNECTED position. Using

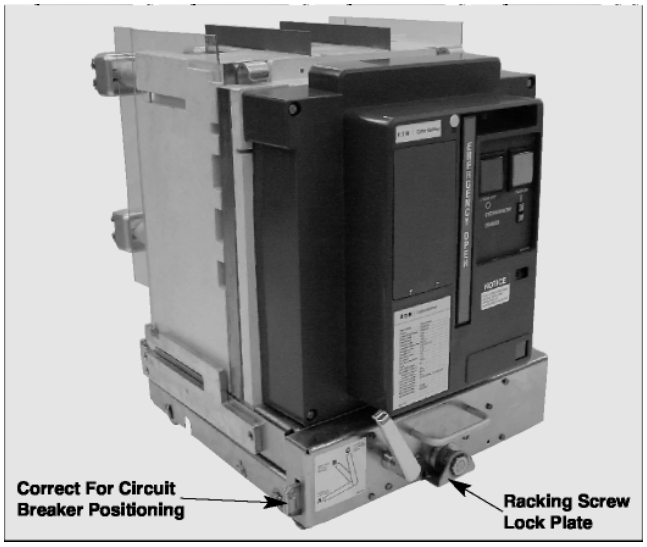


Figure 4-14 VCP-TL Breaker Shown in Levered Out DISCONNECT Position - Correct for Breaker Positioning

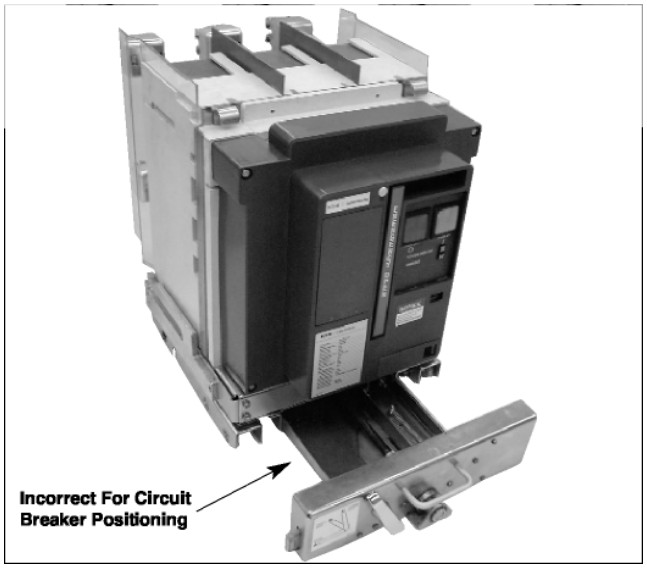


Figure 4-15 VCP-TL Breaker Shown in Levered In CONNECT Position - Incorrect for Breaker Positioning

The purpose of the levering device is to move the circuit breaker from the TEST position to the CONNECT position and from the CONNECT position to the TEST position. The mechanism is comprised of a drive screw and nut, and is part of the lower cradle assembly (Figure **4-16**)**.**

a deep (1 inch 5 mm) socket and levering crank, engage the large drive nut on the front of the breaker cradle. Note that a racking screw lock plate surrounds the drive nut and must be pushed back before the drive nut can be engaged (Figures **4-14** and **4-16**).

NOTICE

If the shoot bolt handle is not in its proper full up Position "C" with the shoot bolts protruding fully into the cassette's side interlock plates or if the circuit breaker is closed while the breaker is in the CONNECT position, the racking screw lock plate cannot be recessed to begin the levering process. If the breaker is closed and in the TEST position, it will trip when the screw lock plate is pushed. In addition, the circuit breaker will not close with the locking plate recessed.

To connect the circuit breaker, lever it in a clockwise direction (Figure **4-17**). The upper circuit breaker portion moves into the cassette, while the lower cradle portion remains stationary in the front portion of the cassette. Continue levering the circuit breaker until it comes to a definite stop position where the primary connections will have been automatically made. This fully connected position range is also indicated when the circuit breaker front wheel well edge lines up with the fully connected position label on the lower center portion of the cassette floor (Figure **4-18**). The circuit breaker is shown in the CONNECTED position in Figure **4-19.**

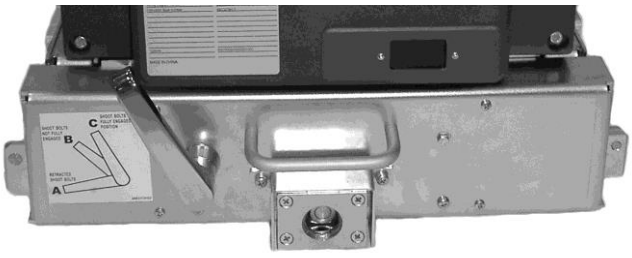


Figure 4-16 Cradle Mounted Levering Mechanism

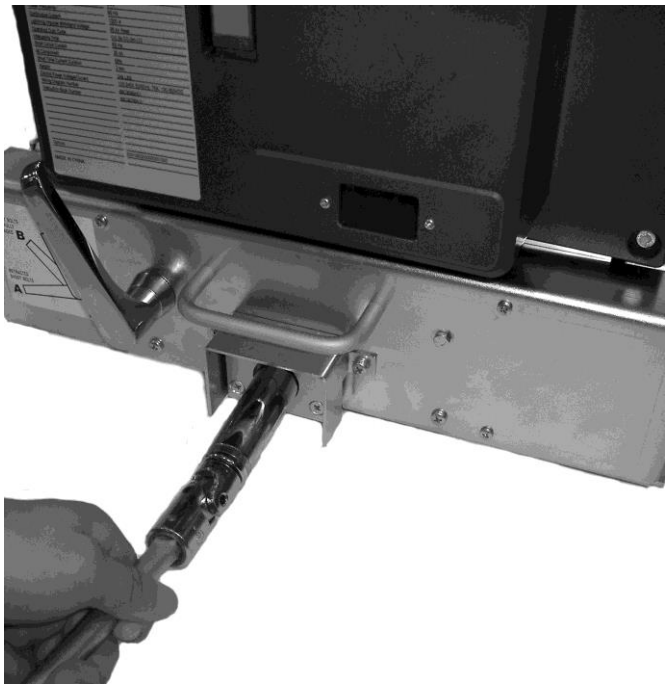


Figure 4-17 Levering Typical Circuit Breaker

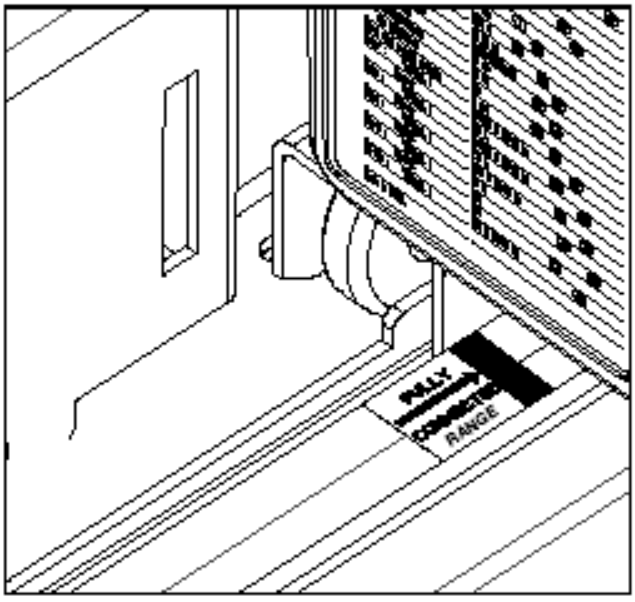


Figure 4-18 Circuit Breaker Connected as Indicated by Fully Connected Position Label

Figure 4-19 Typical Circuit Breaker Shown in CONNECT Position with Secondary Connections Made

During the levering process, the metallic primary safety shutters in the cassette automatically move out of the way exposing the fixed cassette stabs, thus permitting the circuit breaker to make its primary connection (Figure **4-20**)**.** When the circuit breaker is levered from the CONNECT position to the TEST position, the safety shutters automatically close over the fixed primary stabs. A padlocking device is provided on the side of the cassette to permit padlocking the primary safety shutters in an open position for inspection or in the closed position to prevent inadvertent contact with the fixed primary stabs. Padlocks must be removed before the circuit breaker is levered in either direction to prevent shutter system damage (Figures **3-7**, **3-8** and **4-21**)**.**

To lever the circuit breaker out of the CONNECT position, reverse the process just described for levering the circuit breaker to the CONNECT position. Remember that the circuit breaker must be open before the racking screw lock plate can be recessed to gain access to the large drive nut (Figure **4-16**)**.** Once the drive nut is accessible, engage it with the socket and levering crank. Begin levering the circuit breaker out of the CONNECT position by turning the crank in a counterclockwise direction. As the breaker approaches the TEST position, the primary safety shutters automatically cover the fixed stabs. Continue levering the breaker to the TEST position where it will once again mate with the front of its cradle. Refer to paragraph **4-6.3** for instructions on how to disconnect the secondary umbilical cord from the cassette if the breaker is to be removed from its cassette. Disconnecting the umbilical cord will put the breaker in the DISCONNECT position which is necessary before removing it from the cassette.

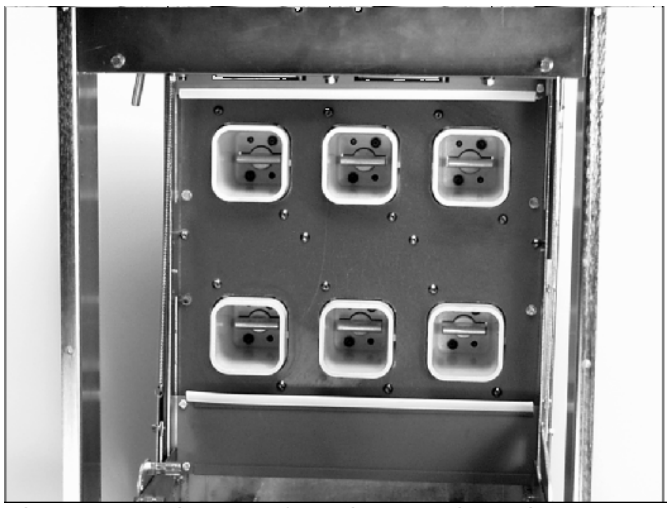


Figure 4-20 Primary Safety Shutters Shown in Open Position with Fixed Primary Stabs Exposed

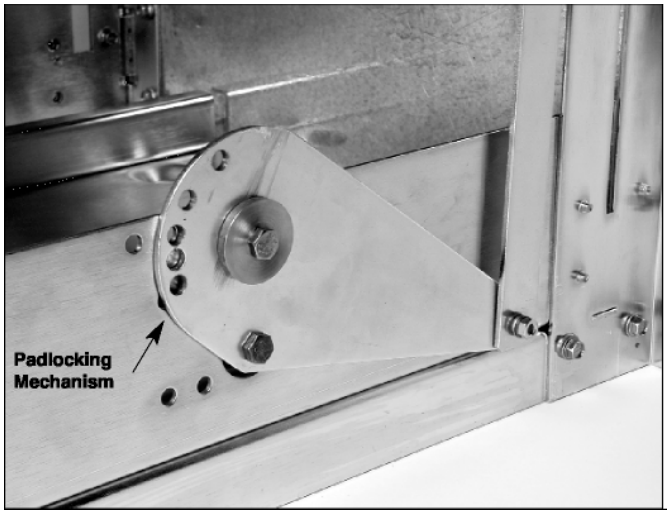


Figure 4-21 Padlocking Device on Side of Cassette

SECTION 5: DESCRIPTION AND OPERATION

5-1 INTRODUCTION

The VCP-TL vacuum circuit breaker is a drawout device while the VCP-TRL circuit breaker is a fixed mounted device. The VCP-TL drawout circuit breaker is comprised of two parts. The upper circuit breaker element, much like the fixed VCP-TRL circuit breaker element and a lower portion called the cradle. The cradle primarily provides the levering mechanism for moving the circuit breaker into and out of the CONNECTED position. They are designed, tested and in accordance with ANSI Standards C37.04, C37.09 and C37.20.2. The ratings are shown in Table **1.1.**

The circuit breakers utilize a linear actuator mechanism, capable of up to 100,000 operations due to the small number of moving parts. A high degree of service continuity is provided by the open-close open (O-CO) circuit breaker duty cycle. A wide range of AC and DC control voltages are available: Low 36-60 Vac, 36-72 Vdc and High 100-240 Vac, 100-353Vdc (Figure **5-2**).

VCP-TL and VCP-TRL circuit breakers are true metal-clad circuit breakers encompassing all the features normally associated with a true metal-clad design, such as:

- Insulation and isolation of compartments
- 11 gauge grounded steel safety barrier between primary and mechanism compartments

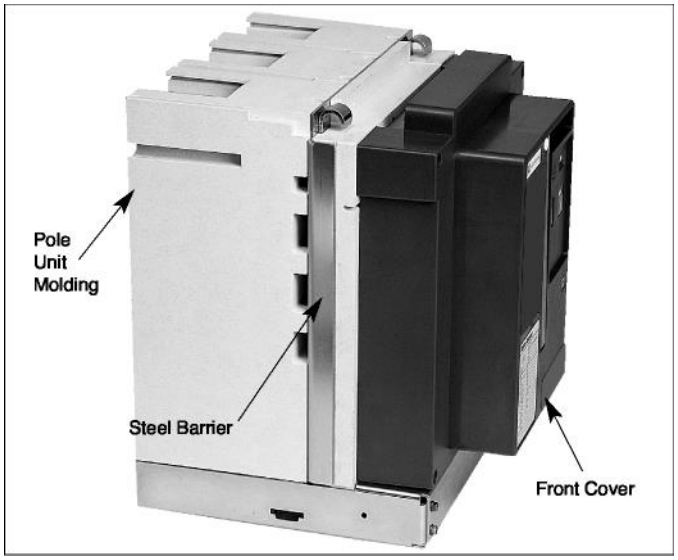


Figure 5-1 Typical Rigid Frame Construction

The circuit breakers utilize a rigid frame construction of engineered thermoset composite resins with a patented pole unit molding. In addition to high strength structural properties, the material used has excellent dielectric characteristics and resists tracking (Figure **5-1**).

The fixed type VCP-TRL circuit breaker element uses copper primary conductors with silver plated joints. Upper and lower conductors have two holes for making bolted horizontal bus or cable connections. Secondary connections can be made through a standard secondary disconnect block or an optional screw type terminal block supplied in kit form.

The drawout VCP-TL circuit breakers utilize spring loaded finger disconnects to make its primary connection. The number of individual silver plated fingers that make up a finger cluster depends upon the current rating of the circuit breaker. The circuit breaker finger disconnects mate with rigidly mounted, silver plated stabs mounted in the rear portion of the cassette.

Controls and indicators, common to all ratings, are functionally grouped on the front of the circuit breaker. The front escutcheon (faceplate) is also common for all voltage and current ratings. A mechanical operations counter is provided as standard on all circuit breakers.

VCP-TL drawout type and VCP-TRL fixed type circuit breakers are supplied as standard with a front mounted 5a, 5b auxiliary switch for customer use. The switch is a heavy duty, double break type switch with wipe We contacts.

5-2 VACUUM INTERRUPTER ASSEMBLY

All VCP-TL and VCP-TRL circuit breakers utilize vacuum interrupters for interruption and switching functions (Figures **5-3** and **5-4**). Vacuum interruption offers the advantages of enclosed interrupters, reduced size and weight, short interrupting time, long life, reduced maintenance, and environmental compatibility.

WARNING

DO NOT PLACE ANY CIRCUIT BREAKER IN SERVICE WITHOUT ITS SUPPLIED HORIZONTAL AND VERTICAL BARRIERS, IF SO SUPPLIED, BEING PROPERLY IN PLACE. FAILURE TO COMPLY WITH THIS WARNING CAN CAUSE A CATASTROPHIC FAILURE RESULTING IN DEATH, SEVERE PERSONAL INJURY AND PROPERTY/EQUIPMENT DAMAGE.

The vacuum interrupters are mounted vertically and supported from the fixed stem connected to the top conductor. A patented pole unit molding encloses each of the vacuum interrupter assemblies on three sides and provides the required mounting means, insulation, isolation, strength and rigidity. Certain VCP−TL and VCP−TRL circuit breakers are supplied with vertical and horizontal barriers already in place and are required to be in place before the circuit breaker is put into service (Figures **3-4** and **3-6**). Other barriers may also be required in keeping with paragraph **4-3.**

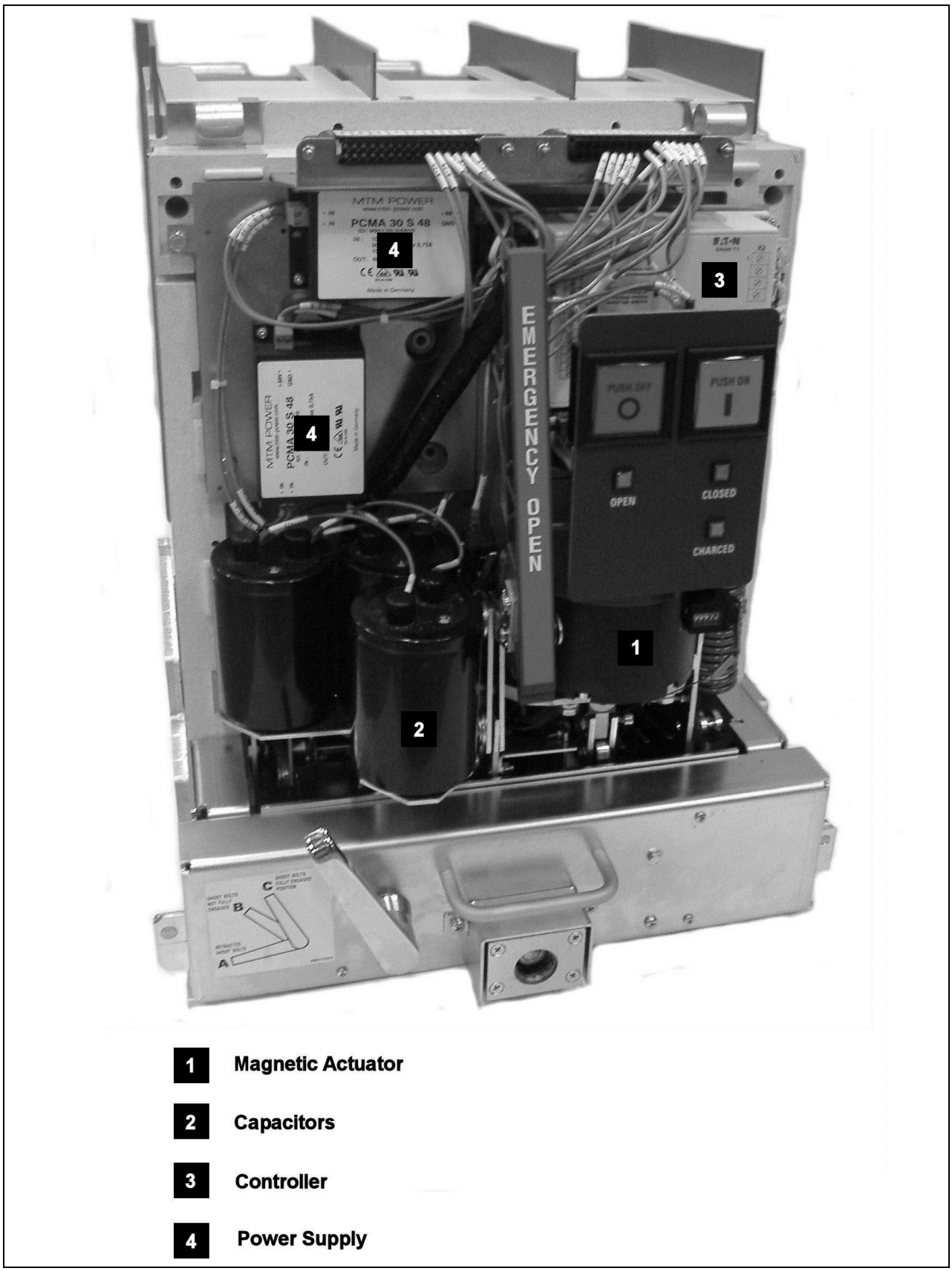


*Figure **5-2** Typical VCP-TL Drawout Breaker Shown (Front Cover Removed)*

The current transfer system consists of a unique flexible connector attached to the movable stem of the vacuum interrupter. The flexible connector consists of a large number of flexible leaf conductors that are pressure welded on both ends. One end of the flexible connector is attached to the movable vacuum interrupter stem and

Figure 5-3 Fixed 50 VCP-TRL Interrupter Assembly (600/800A, 16kA shown)

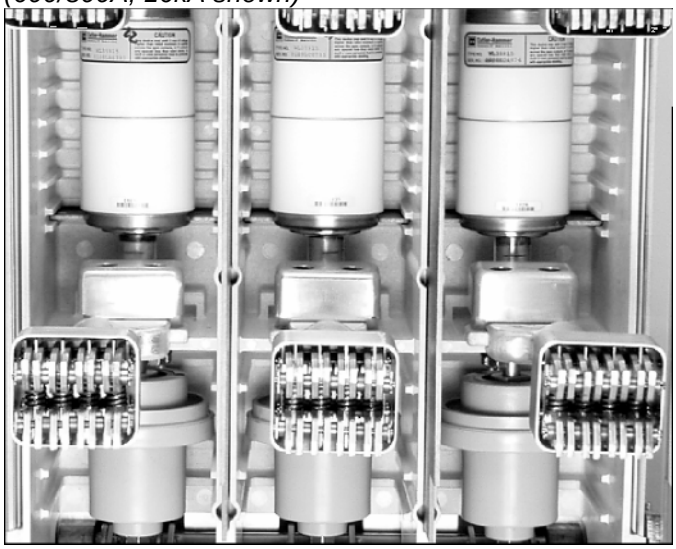


Figure 5-4 Drawout 150 VCP-TL Interrupter Assemblies (1200A, 25kA shown)

the other end to the circuit breaker's lower conductor. As the vacuum interrupter stem moves and the flexible connector flexes, current is safely and efficiently transferred between the stem and lower conductor.

5-2.1 CONTACT EROSION INDICATOR

The purpose of the contact erosion indicator is to monitor any erosion of the vacuum interrupter contacts. Contact erosion is, however, very minimal over time with EATON vacuum interrupters. A contact erosion indicator mark is located on the moving stem of the interrupter (Figure **6-1**). The erosion mark can be observed from the rear of the circuit breaker, and should be done with the circuit breaker closed. If the erosion mark is no longer visible with the circuit breaker closed, the entire vacuum interrupter assembly must be replaced.

5-2.2 CONTACT WIPE AND STROKE

Contact wipe is the indication of (1) the force holding the vacuum interrupter contacts closed and (2) the energy available to hammer the contacts open with sufficient speed for interruption.

Stroke is the gap between fixed and moving contacts of a vacuum interrupter with the breaker open.

The circuit breaker mechanism provides a fixed amount of motion to the drive insulators. The first portion of the motion is used to close the contacts (i.e. stroke) and the remainder is used to further compress the preloaded contact spring. This additional compression is called wipe.

Wipe and stroke are thus related to each other. As the stroke increases due to the erosion of contacts, the wipe decreases. A great deal of effort has been spent in the design of all EATON vacuum circuit breakers, in order to eliminate the need for field adjustments of wipe or stroke. Refer to paragraph 6-7 for details on visually inspecting contact wipe.

CAUTION

THERE IS NO PROVISION FOR IN SERVICE ADJUSTMENTS OF CONTACT WIPE AND STROKE. ALL SUCH ADJUSTMENTS ARE FACTORY SET AND SHOULD NOT BE ATTEMPTED IN THE FIELD.

5-3 LINEAR ACTUATOR MECHANISM

WARNING

KEEP HANDS AND FINGERS AWAY FROM THE BREAKER'S INTERNAL PARTS WHILE THE BREAKER CONTACTS ARE CLOSED. OPEN THE CIRCUIT BREAKER BEFORE PERFORMING ANY MAINTENANCE, INSPECTIONS OR REPAIR. DO NOT TRY TO REMOVE THE CAPACITORS UNLESS THE CAPACITORS ARE FULLY DISCHARGED.

Interior components of the linear actuator mechanism can be easily accessed by removing the four cover bolts securing the breaker's front cover (Figures **3-9** and **5-2**). **The circuit breaker must be in the open position to remove the front cover.**

The linear actuator mechanism is comprised primarily of the linear actuator, the controller and three closing capacitors (Figure **5-2**). The mechanism allows for a circuit breaker OOCO duty cycle. Once the capacitors discharge to accomplish the close action, they immediately begin to recharge which takes approximately 15 seconds.

5-3.1 MANUAL OPERATION

While the circuit breaker powered on, it can be manually closed and opened through the use of the front mounted green "ON" and red "OFF" pushbuttons (Figure 5-5). In the event that control power is lost, the circuit breaker is capable of performing a manual OPEN operation up to 48 hours after the loss of control power. If the control power loss lasts longer than 48 hours, the circuit breaker can be opened utilizing the integral "EMERGENCY OPEN" handle located on the front of the circuit breaker. (Figure 5-5). The circuit breaker is manually opened by inserting one finger in the recess behind the "EMERGENCY OPEN" handle, grasping firmly and pulling down to open the circuit breaker.

5-3.2 ELECTRICAL OPERATION

While the circuit breaker is powered on, it can be electrically closed and opened. In the event that control power is lost, the circuit breaker is capable of performing an electrical OPEN operation up to 48 hours after the loss of control power. The linear actuator circuit breaker does not accept an exterior voltage source to open or close the circuit breaker. A dry contact must be used to open or close the circuit breaker remotely. An optional undervolt age release device is available and mounted separately from the circuit breaker.

Figure 5-5 Manual Operation Features

5-3.3 TRIP FREE OPERATION

When the emergency open handle is pulled, any attempt to close the circuit breaker will be prevented.

5-3.4 ANTI-PUMP FEATURE

All circuit breakers have a standard anti-pump feature. If the circuit breaker is open, it only accepts one attempt to re-close when the close command continues uninterrupted.

5-4 CONNECTION DIAGRAMS

Connection Diagrams for all circuit breakers are shown in Figures **5-7** through **5-13.**

5-4.1 TIMING

The opening and closing times for the circuit breakers vary depending upon the control voltage and the power rating. Typical values for VCP-TL and VCP-TRL breakers are given below:

Closing Time (from initiation of close signal to contact make) - 60 milliseconds

Opening Time (from initiation of trip signal to contact break) - 25 to 38 milliseconds

Re-closing Time (from initiation of trip signal to contact make) - 250 milliseconds

5-4.2 SECONDARY CONNECTIONS

Each secondary wiring point is identified and dedicated to a specific function. The wiring points are finger safe with no more than two wires per terminal. Two male type secondary plug-in connectors are mounted on the top rear portion of the circuit breaker. The plug-in connectors are protected by a molded hood. When the front cover of the circuit breaker is removed, the top of each plug-in connector is exposed. A label on each connector identifies the wiring points (Figure **5-14**).

There are two secondary connection options for fixed type VCP-TRL circuit breakers:

(1) Standard Secondary Disconnect Block - The secondary disconnect block is a female connector with male pins compatible with a male connector with female pins mounted under the protective hood (Figures **5-6** and **5-15**)**.** The customer plugs secondary wiring with crimp-on connectors into the back of the female plug-in connector.

(2)Optional Screw Type Terminal Block - For those customers preferring to wire to a terminal block, an optional screw type terminal block is available for terminating the secondary wiring leaving the female secondary disconnect block. The terminal block is available in kit form (Figure **5-16**)**.**

Drawout type VCP-TL circuit breakers utilize an umbilical cord utilizing a male connector with female pins on the breaker end and a female connector with male pins on the cassette end. One end plugs into its matching connector mounted under a protective hood on the front. top portion of the circuit breaker. The other end plugs into its matching connector mounted under the front top portion of the drawout cassette.
A standard tool is available from the plug-in connector manufacturer (AMP) to facilitate the removal of secondary wring from the plug-in connector (Figure 5-17). The connector halves must be separated to use this tool.

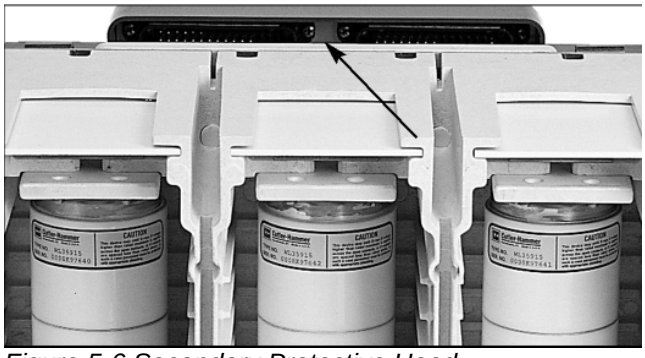


Figure 5-6 Secondary Protective Hood

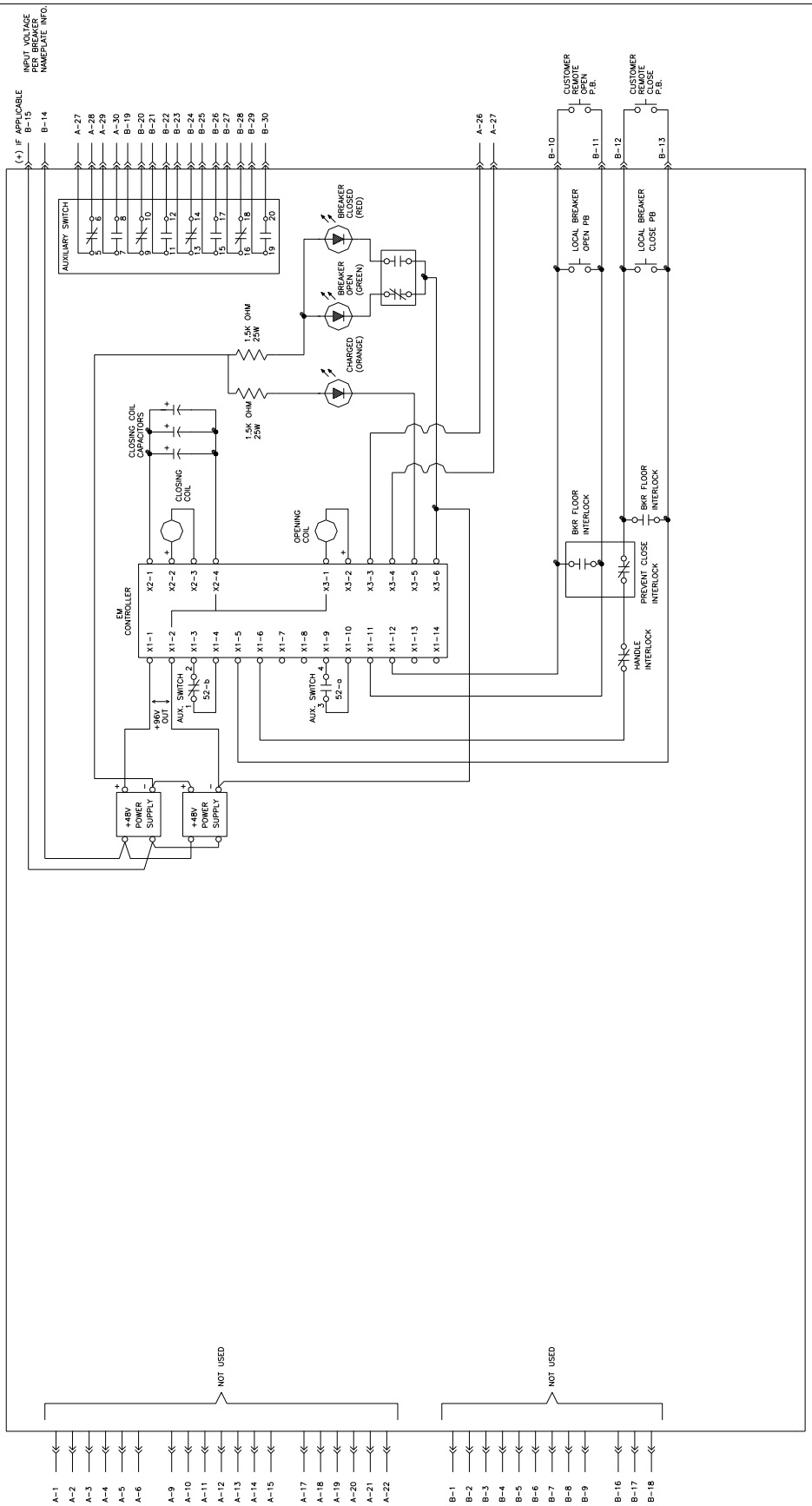


Figure 5-7 VCP-TRL Non Automatic Connection Diagram

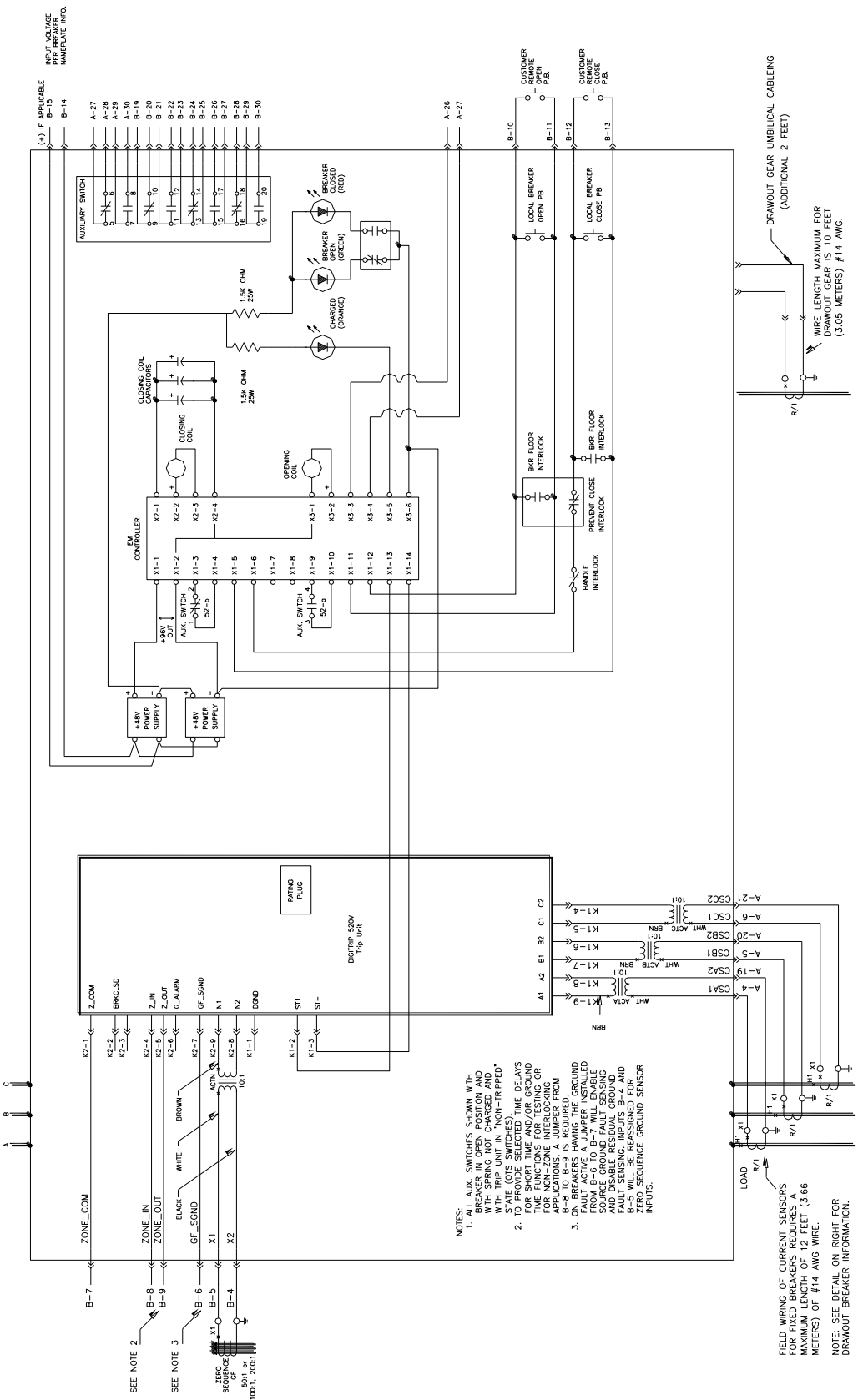


Figure 5-8 VCP-TRL with 520V Trip Unit Connection Diagram

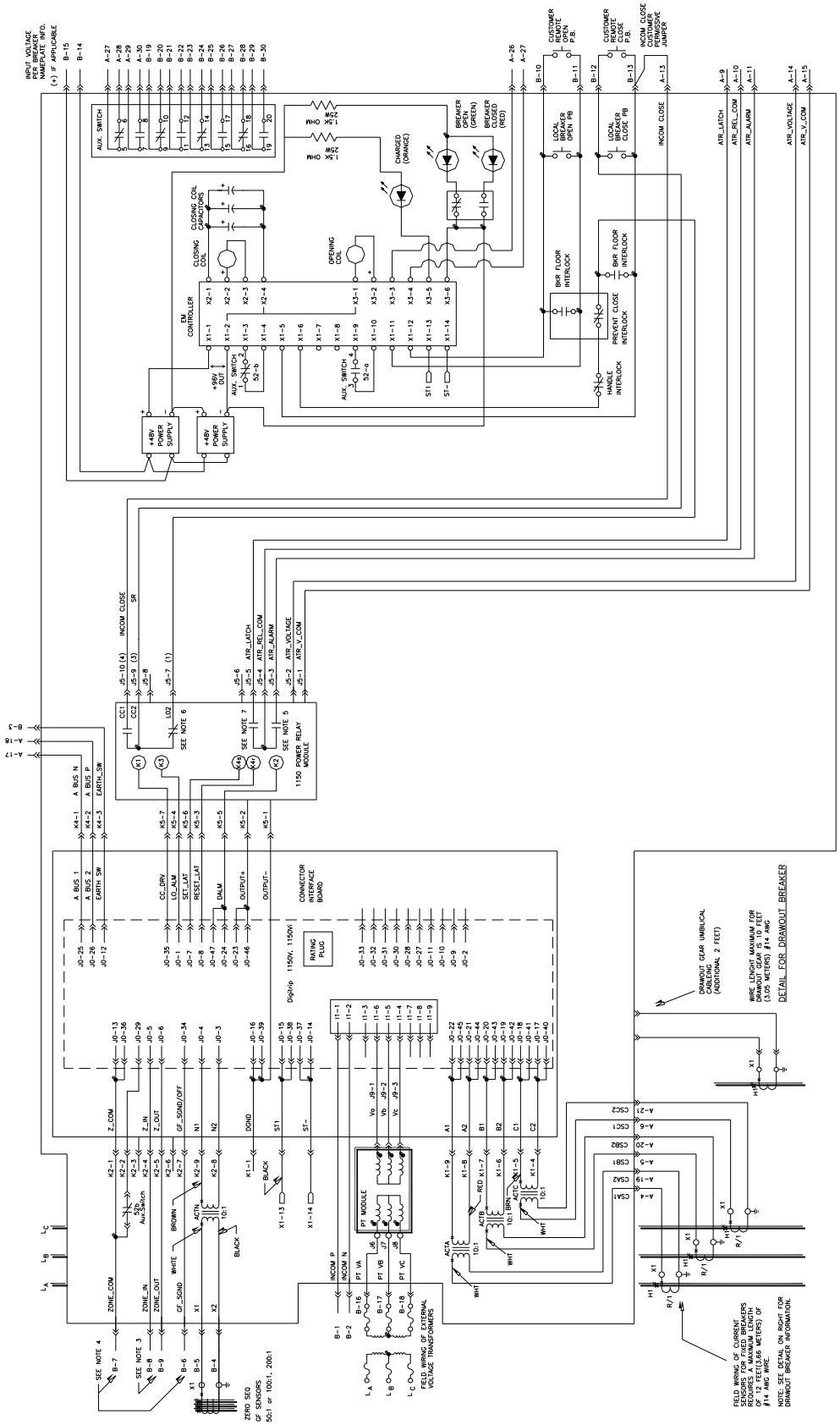


Figure 5-9 VCP-TRL with 1150V Trip Unit Connection Diagram

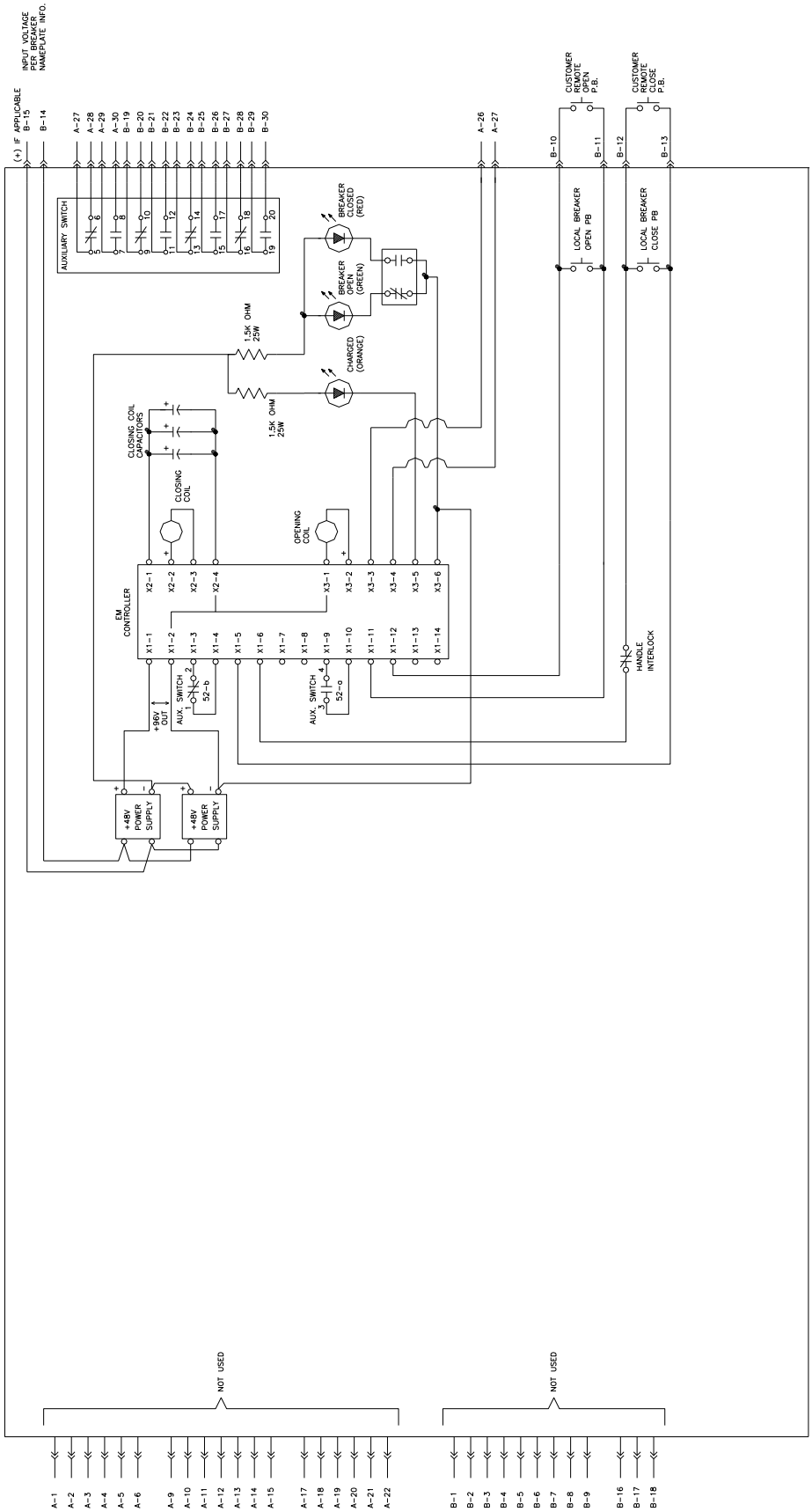


Figure 5-10 VCP-TL Non Automatic Connection Diagram

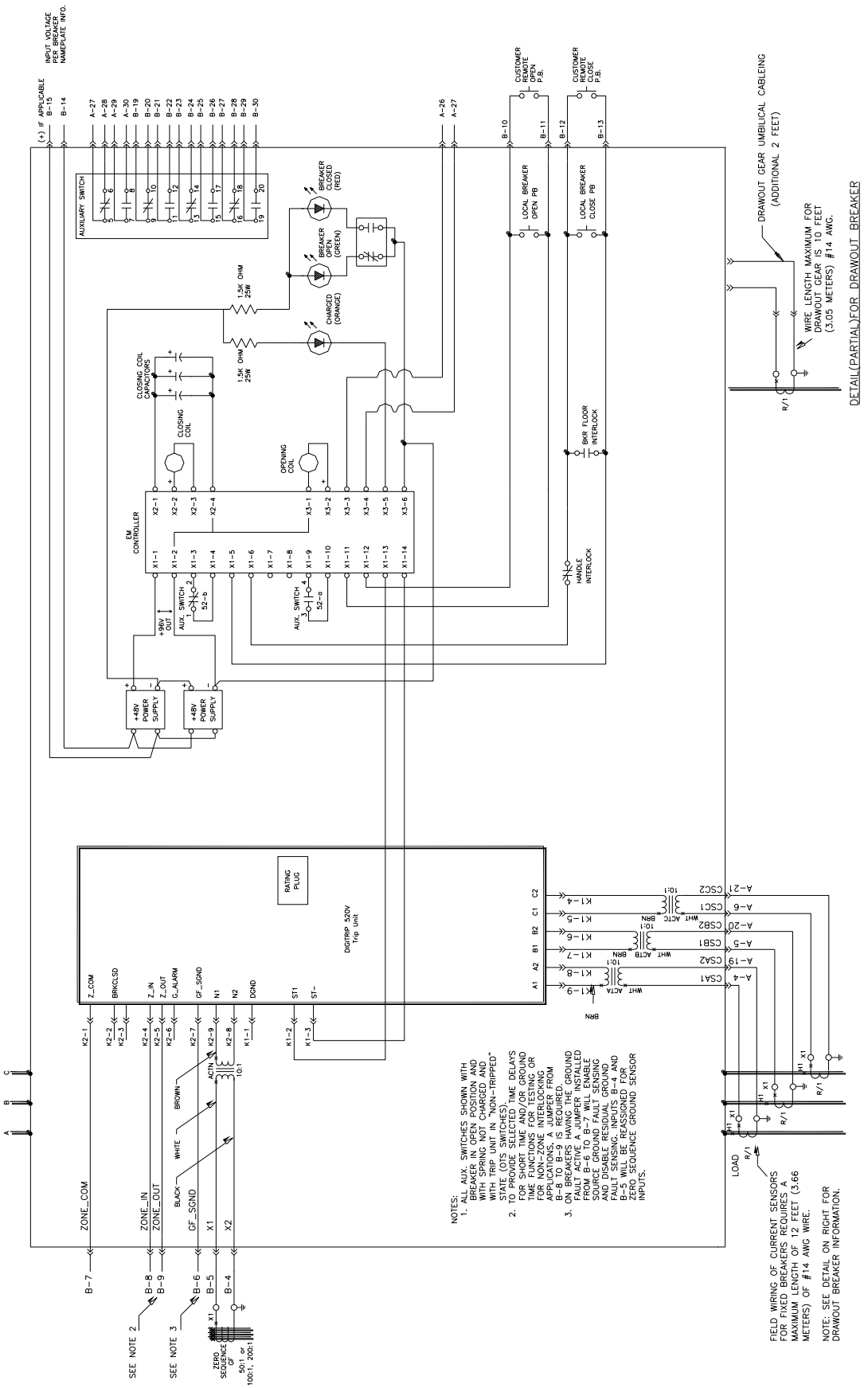


Figure 5-11 VCP-TL with 520V Trip Unit Connection Diagram

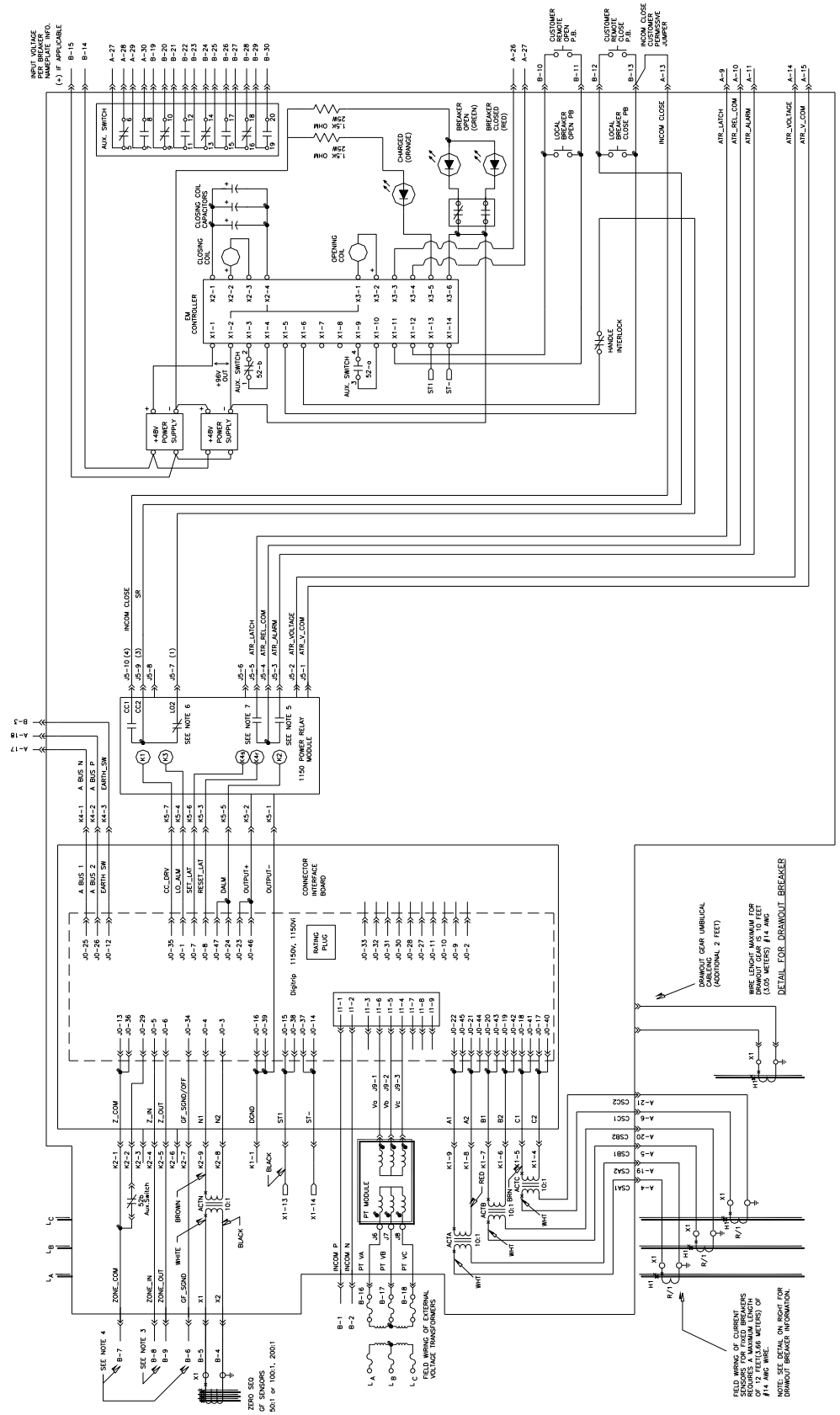


Figure 5-12 VCP-TL with 1150V Trip Unit Connection Diagram

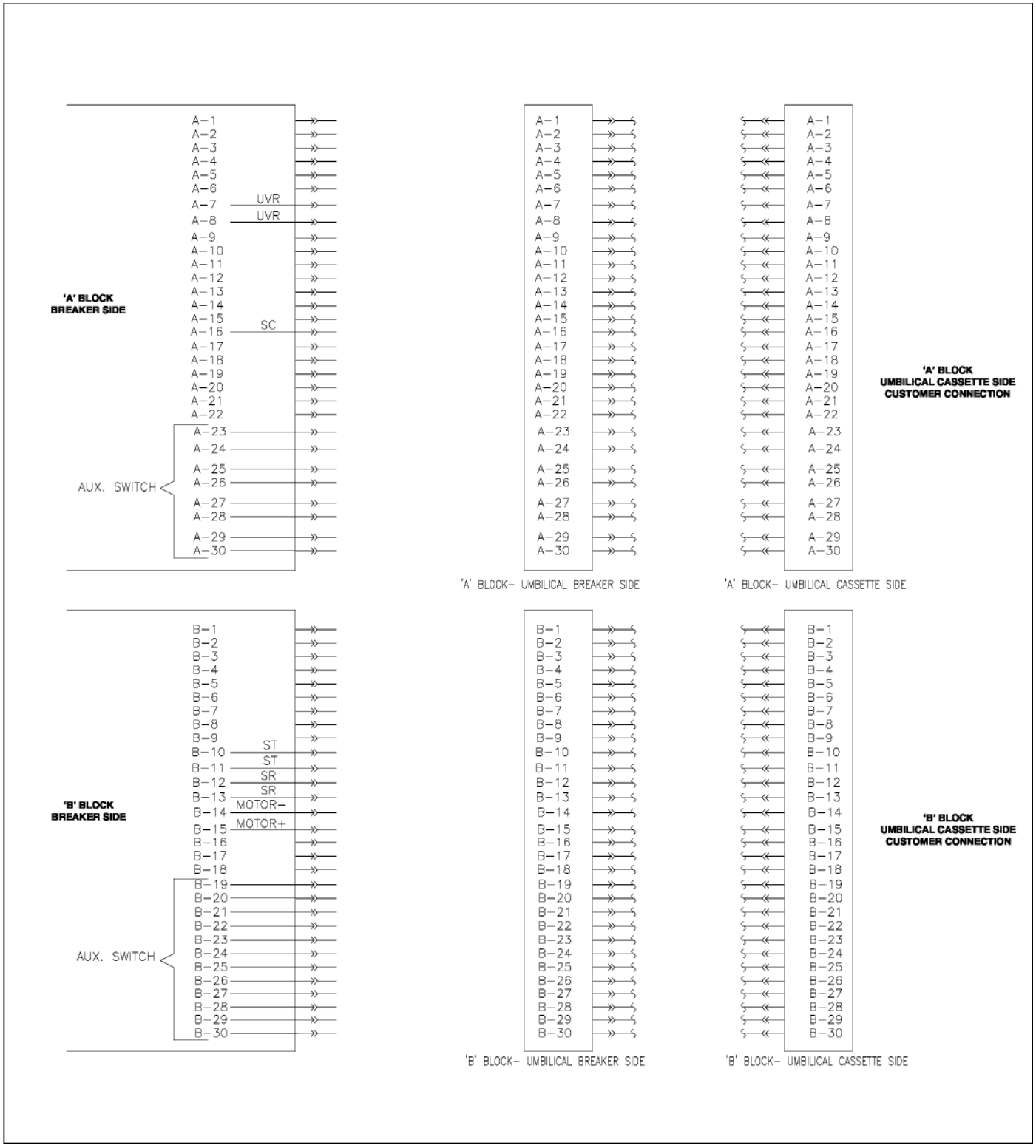


Figure 5-13 VCP-TL Drawout Umbilical Cord and Connector Wiring Diagram

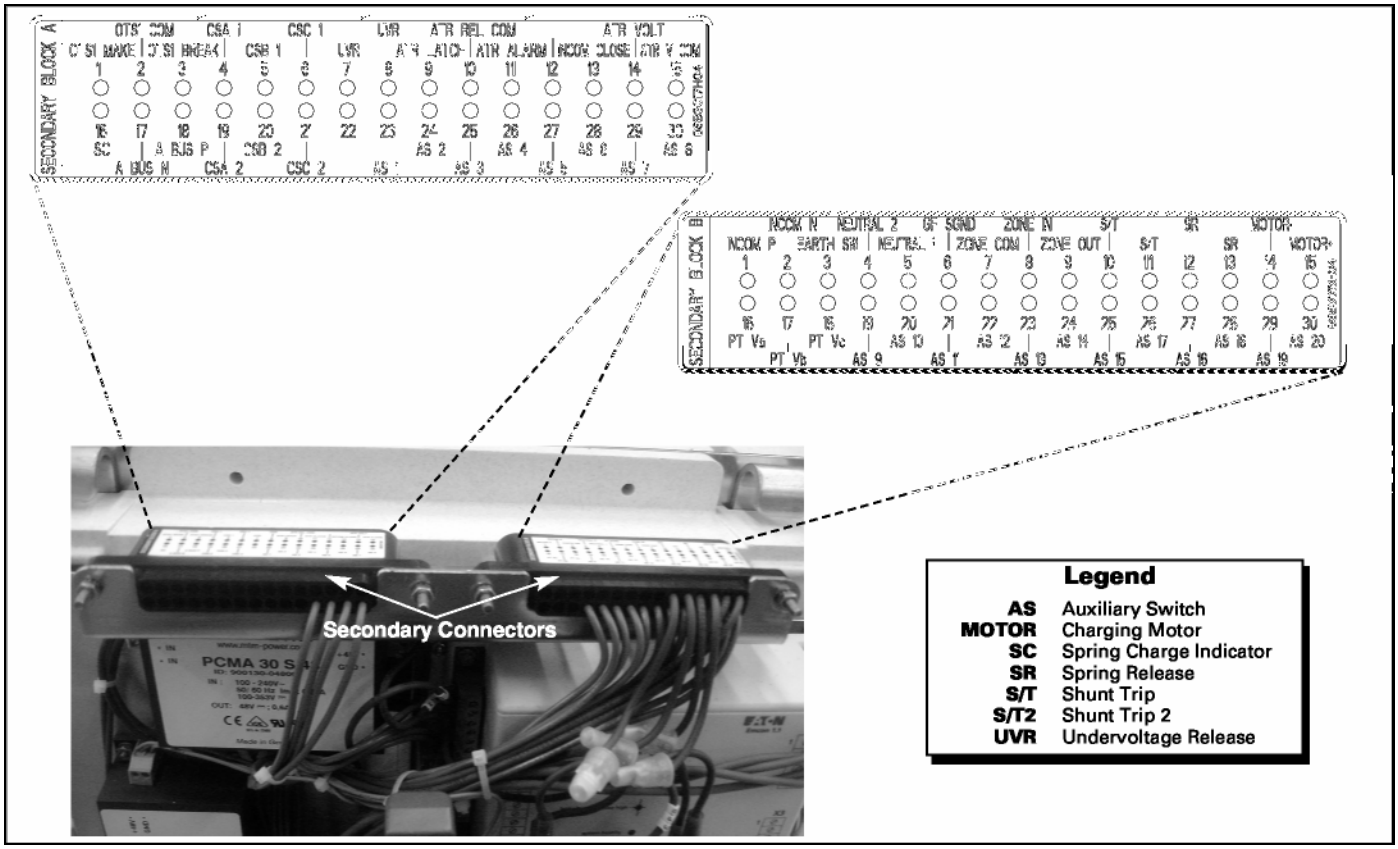


Figure 5-14 Top View Secondary Connectors

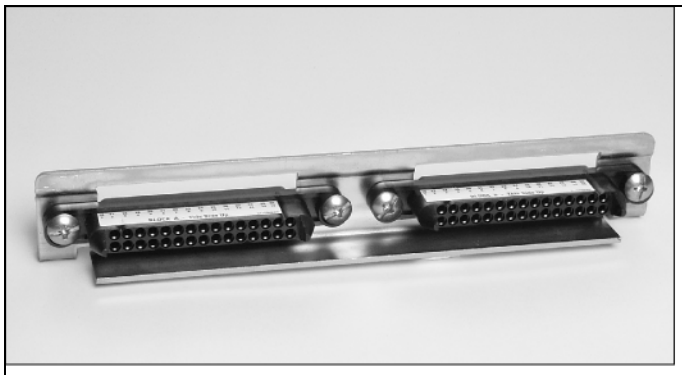


Figure 5-15 Secondary Male Connector with Female Pins

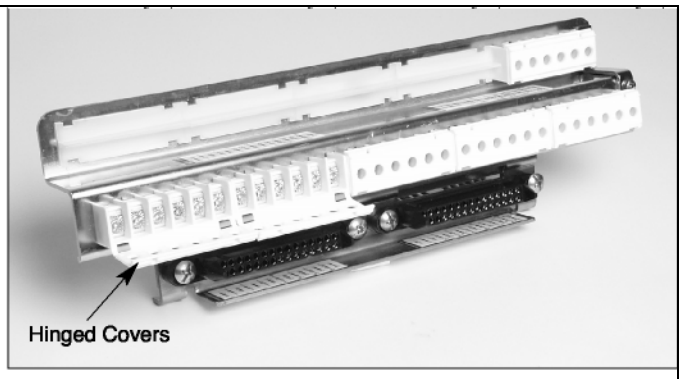


Figure 5-16 Optional Terminal Block

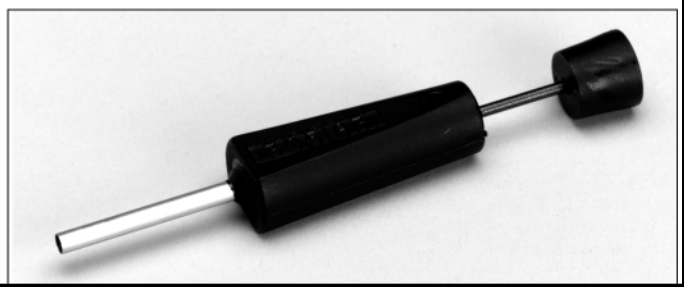


Figure 5-17 AMP Secondary Wiring Removal Tool (AMP#305183) (C-H#MAMPSEC)

5-5 ELECTRONIC TRIPPING SYSTEM

VCP-TL and VCP-TRL circuit breakers can utilize an optional three part tripping system:

- Microprocessor-based trip unit
- Current Sensors
- Trip Actuator

For detailed information pertaining to the different trip unit models available with these circuit breakers, refer to the specific instruction leaflet dedicated to the trip units.

5-5.1 MICROPROCESSOR-BASED TRIP UNIT

VCP-TL and VCP-TRL circuit breakers can use either of two Digitrip RMS trip units whose main features are summarized in Table **5.1**. The two models (Model 520V and Model 1150V) are not interchangeable in the field. Contact EATON for upgrading to Model 520V or Model 1150V.

The electronic trip units are self-powered. When the circuit breaker is closed, no external power is required to operate their protective systems. Current signal levels and the control power are derived from the current sensors mounted behind the cassette.

Figure 5-18 Digitrip RMS 1150V Programmable Trip Unit Installed in Typical Circuit Breaker

Table 5.1 Digitrip Trip Units

Functions	520V	1150V②
LSIG Protection	Yes	Yes
Disable (I)	Yes	Yes
GF Protection	Yes	Yes
GF Alarm	No	Yes
Display	No	Yes①
Programmable	No	Yes
Metering	No	Yes
Power and Energy Values	No	Yes
Power Quality	No	Yes
Communication	No	Yes

① Three-line, (eight characters per line) LED display.
② Available control voltages are 24/48Vdc, 12OVac and 24OVac

A functional local test can be performed through the trip unit's test receptacle (Figure **5-18**). A small hand held functional Test Kit is used to check circuitry and mechanical tripping functions (Figure **5-19**).

When the circuit breaker is shipped from the factory, the trip unit's protective functions are normally set at minimum values. For specific overload tripping characteristics and time/current curves to coordinate with a load or system, refer to the trip unit instruction book.

Figure 5-19 Hand Held Tester

5-5.2 RATING PLUG

All trip units use a fixed type rating plug. The current rating of the rating plug must match the current rating of the current sensors (Figure **3-9**, **5-18** and Table **5.2**). The rating plug performs several functions:

1. It tells the trip unit what the rating is of the current sensors. A label on the front of the rating plug clearly indicates that the rating plug and sensors must have the same rating.

2. It determines the maximum instantaneous setting which is a function of the current sensor rating.

If the rating plug is removed from the trip unit, the circuit breaker will trip if it is carrying current. Make certain the rating plug is secured in position with its retaining screw. **Do not torque the retaining screw beyond 15 In-Oz.**

Refer to Table **5.2** for a tabulation of the available rating plugs.

5-5.3 CURRENT SENSORS

Three current sensors are installed at the rear of the cassette on the lower terminals. The sensors produce an output current proportional to the load current. Under preselected conditions of current magnitude and time, the sensors furnish the trip unit with a signal and the energy required to trip the circuit breaker.

Neutral current sensors are available for customer installation. The additional sensor is not supplied with the circuit breaker and must be ordered separately. They are wired to the trip unit through the secondary contacts of the circuit breaker.

Zero sequence transformers (vectorial summation) are available with a 100:1 and 200:1 tap ratio.

Refer to Table **5.2** for a tabulation of the available current sensor ratings.

Table 5.2 Current Sensors and Matching Rating Plugs

Current Rating in Amperes		
100	200	250
300	400	600
630	800	1000
1200	1250	1600

5-5.4 CIRCUIT BREAKER CONTROLLER

The trip unit is wired to the circuit breaker's controller. Under pre-selected conditions, the controller receives a pulse from the trip unit and the controller trips the circuit breaker.

5-6 ACCESSORY DEVICES

Accessory devices are available for use with VCP-TL and VCP-TRL circuit breakers. Unless otherwise stated, they should be considered optional devices in the sense that they are not provided as standard on a manually operated circuit breaker.

Circuit breaker accessories are common to all circuit breaker ratings. The accessories fall into one of two categories:

•Internal electrical
•Mechanical

5-6.1 INTERNAL ELECTRICAL ACCESSORY

One electrical accessory is mounted inside the circuit breaker behind the front cover. This device is the auxiliary switch and access to the device is gained by simply removing the front cover.

Auxiliary Switch - A 5a, 5b auxiliary switch is supplied as standard on all circuit breakers for customer use (Figure **5-20** and Table **5.3**). The switch is a heavy duty, double break type switch with wipe type contacts.

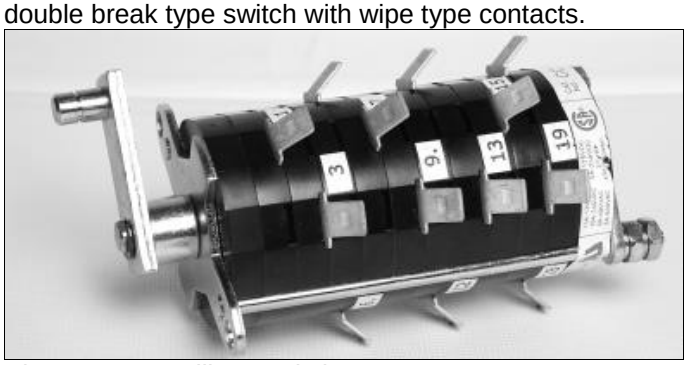


Figure 5-20 Auxiliary Switch

5-6.2 MECHANICAL ACCESSORIES

There are two mechanical type accessories:

•Operations Counter
•Door Escutcheon

Operations Counter - The operations counter is a standard mechanical device used to provide a record of the number of circuit breaker operations. It is mounted on the right side of the circuit breaker and can be viewed through the front cover (Figure **5-5**).

Door Escutcheon - The door escutcheon is an optional molded frame used to seal space between the circuit breaker and a compartment door cutout, should the customer choose to have a through the door type mounting configuration. It is supplied with a mounting gasket (Figure **5-21**).

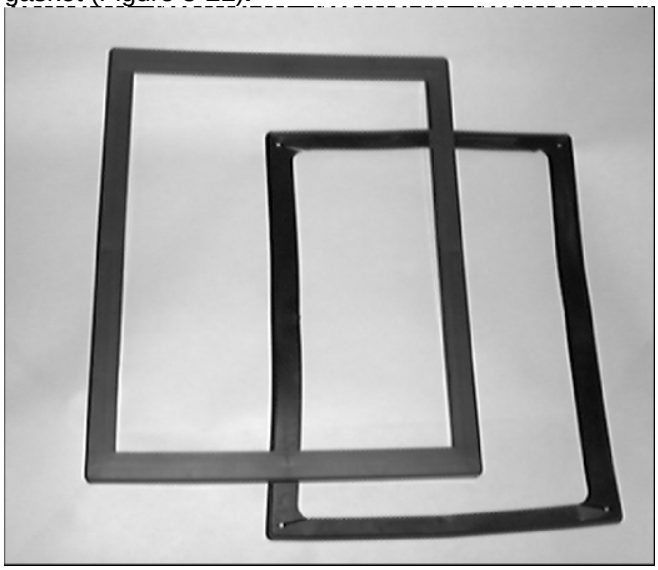


Figure 5-21 Door Escutcheon and Gasket

Table 5.3 Auxiliary Switch Contacts Interrupting Capacities

Continuous Current (amperes)	Control Circuit Voltage					
	120 Vac	240 Vac	24 Vdc	48 Vdc	125 Vdc	250 Vdc
20	**Non-inductive Circuit Interrupting Capacity in Amperes**					
	15	10	16	16	10	5
20	**Inductive Circuit Interrupting Capacity In Amperes**					
	15	10	16	16	10	5

SECTION 6: INSPECTION AN MAINTENANCE

6-1 INTRODUCTION

WARNING

FAILURE TO INSPECT, CLEAN AND MAINTAIN CIRCUIT BREAKERS CAN REDUCE EQUIPMENT LIFE OR CAUSE THE EQUIPMENT NOT TO OPERATE PROPERLY UNDER FAULT CONDITIONS. THIS COULD RESULT IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

WARNING

ONLY PERSONNEL FAMILIAR WITH THE HAZARDS ASSOCIATED WITH WORKING ON POWER CIRCUIT BREAKERS SHOULD CARRY OUT INSPECTION AND MAINTENANCE PROCEDURES.

- **INSPECTION AND MAINTENANCE PERSONNEL SHOULD BE FAMILIAR WITH THE SPECIFICS ASSOCIATED WITH THE CIRCUIT BREAKERS AS PRESENTED IN THIS INSTRUCTION BOOK.**
- **DO NOT WORK ON A CIRCUIT BREAKER IN THE CONNECTED POSITION.**

  DO NOT WORK ON A CIRCUIT BREAKER WITH SECONDARY DISCONNECTS ENGAGED

  DO NOT WORK ON A CIRCUIT BREAKER WITH SPRINGS CHARGED OR CONTACTS CLOSED.
- **DO NOT DEFEAT ANY SAFETY INTERLOCKS.**
- **DO NOT STAND LESS THAN ONE METER AWAY FROM THE CIRCUIT BREAKER WHEN TESTING FOR VACUUM INTEGRITY.**

FAILURE TO FOLLOW ANY OF THESE INSTRUCTIONS MAY CAUSE DEATH, SERIOUS BODILY INJURY, OR PROPERTY DAMAGE.

6-2 FREQUENCY OF INSPECTION AND MAINTENANCE

Periodic inspections and associated maintenance are essential for the safe and reliable operation of VCP-TL and VCP-TRL circuit breakers. The inspection frequency and associated maintenance recommended are intended to insure the best possible ongoing service. It is imperative that an established schedule be followed. To establish an exact schedule for a specific installation, use the following guidelines:

1. In a clean, non-corrosive environment, inspect and maintain each breaker every 2000 operations or 3 years, whichever comes first.

2. For special conditions such as frequent breaker operation, contaminated environments, and/or high temperature/humidity conditions, the inspection frequency should be more frequent.

3. Inspect a breaker every time it interrupts fault current.

4. Follow the steps outlined in Table **6.1** entitled "Inspection and Maintenance Procedures".

5. Create and maintain a dated permanent record of all inspections, maintenance performed, actions taken, observations made, and measurements taken. Not only will this provide valuable historical information, it can help to establish whether or not the present schedule needs to be adjusted.

6. Perform ongoing visual inspections, when possible, of all equipment on a regular basis. Be alert for an accumulation of dirt in and around the breaker, loose hard-ware or discolored insulation.

6-3 VACUUM INTERRUPTER INTEGRITY TEST

Vacuum interrupters used in these circuit breakers are highly reliable interrupting elements. 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. (See Table **6.2** for appropriate test voltage.) During this test, the following warning must be observed:

Table 6.1 inspection and maintenance procedures

No./Section	Inspection Item	Criteria	Inspection Method	Corrective Action
1. Insulation	Drive Insulator And Molded pole unit support	No dirt	Visual Check	Clean with lint-free cloth
		No cracking	Visual Check	Replace cracked piece
Insulation Integrity	Main Circuit to Ground	Withstand	Hipot Tester	Clean and retest or replace
	Between Main Circuit Terminals	Withstand	Hipot Tester	Clean and retest or replace
	Control Circuit to Ground	Withstand	Hipot Tester	Clean and retest or replace
2. Power Elements	Vacuum Interrupters	Contact erosion Visibility of Marks	Visual: Close the breaker And look for the mark on Moving stem from the Rear of the breaker (See figures **6-1** & **6-2**)	If a mark is not visible, Replace pole unit assembly.
		Contact wipe visible	Visual: Close the breaker and Look for indicator (see Figures **6-2** ,**6-3** ,**6-4**)	Replace pole unit assembly If the indicator is visible.
		Adequate vacuum	See section 6-5.	Replace pole unit assembly.
		Dirt on ceramic body	Visual Check	Clean with dry lint-free cloth.
3. Control Circuit	Closing and Tripping Device	Smooth and correct operation by control power	Test closing and tripping of the circuit breaker twice	Replace any defective device. Identify per trouble-shooting Chart in this section.
	Wiring	Securely tied in proper place	Visual Check	Repair or tie as necessary
	Terminals	Tight	Visual Check	Tighten or replace if necessary
	Motor	If required	Functional Test	Replace as necessary.
	Tightness of Hardware	No loose or missing parts	Visual and tighten with Appropriate tools	Tighten or reinstate if Necessary.
4. Operating Mechanism	Dust or Foreign Matter	No dust or foreign matter	Visual Check	Clean as necessary
	Lubrication	Smooth operation and no excessive wear	Sight and feel	Refer to Figure 6-5,6-6 And paragraph 6-10.
	Deformation or Excessive Wear	No excessive deformation or wear	Visual and operational	Remove cause and replace parts
	Manual Operation	Smooth operation	Manual charging, closing and tripping	Correct per troubleshooting chart (Table **6.4**) if necessary.

WARNING

APPLYING ABNORMALLY HIGH VOLTAGE ACROSS A PAIR OF OPEN CONTACTS IN VACUUM MAY PRO-DUCE 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 MAXIMUM PERMITTED BY STANDARDS. HOWEVER, AS A PRECAUTIONARY MEASURE AGAINST POSSIBILITY OF APPLICATION OF HIGHER THAN RECOMMENDED VOLTAGE AND/OR BELOW NORMAL CONTACT SPACING, IT IS RECOMMENDED THAT ALL OPERATING PERSONNEL STAND AT LEAST ONE METER AWAY IN FRONT OF THE BREAKER.

With the circuit breaker open and securely sitting on the floor or secured in a fixed position, connect all top primary studs (bars) together and to the high potential machine lead. Connect all bottom studs together and ground them along with the breaker frame. Start the machine at zero potential, increase to appropriate test voltage and maintain for one minute.

Successful withstand indicates that all interrupters have satisfactory vacuum level. If there is a breakdown, the defective interrupter or interrupters should be identified by an individual test and replaced before placing the circuit breaker in service.

WARNING

AFTER THE HIGH POTENTIAL IS REMOVED, AN ELECTRICAL CHARGE MAY BE RETAINED BY THE VACUUM INTERRUPTERS. FAILURE TO DISCHARGE THIS RESIDUAL ELECTROSTATIC CHARGE COULD RESULT IN AN ELECTRICAL SHOCK. ALL SIX PRIMARY TERMINALS AND THE CENTER RING OF EACH VACUUM INTERRUPTER OF THE CIRCUIT BREAKER SHOULD BE GROUNDED TO REDUCE THIS ELECTRICAL CHARGE BEFORE COMING IN CONTACT WITH THE PRIMARY CIRCUIT.

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 milliamperes for one minute.

Although an ac high potential test is recommended, a dc test may be performed if only a dc test unit is available. In this case the equipment must be capable of delivering 5 milliamperes for one minute to avoid ambiguity due to field emission or leakage currents and the test voltage shall be as shown in Table **6.2**

Table 6.2 Test Voltage

Breaker Rated Maximum Voltage	Vacuum IMenupter IMegrIty Test Voltage	
	at 6o Hz	dc
4.76 kV	20 kV	28 kV
8.25 kV	20 kV	28 kV
15.0 kV	27 kV	40 kV

The current delivery capability of 25 ma ac and 5 ma dc apply when all three Vls are tested in parallel. If individual Vls are tested, current capability may be one third of these values.

WARNING

SOME DC HIGH POTENTIAL UNITS, OPERATING AS UNFILTERED HALF-WAVE RECTIFIERS, ARE NOT SUITABLE FOR USE TO TEST VACUUM INTERRUPTERS BECAUSE THE PEAK VOLTAGE APPEARING ACROSS THE INTERRUPTERS CAN BE SUBSTANTIALLY GREATER THAN THE VALUE READ ON THE METER.

6-4 CONTACT EROSION

Since the contacts are contained inside the interrupter, they remain clean and require no maintenance. However, during high current interruptions there may be a minimum amount of erosion from the contact surfaces. Maximum permitted erosion is 3 mm. To determine contact erosion, close the breaker and observe the vacuum interrupter moving stem from the rear of the breaker. If the mark on each stem is visible, erosion has not reached maximum value thus indicating satisfactory contact surface of the interrupter. If the mark is not visible, the pole unit assembly must be replaced (Figure **6-1**).

6-5 CONTACT WIPE

To check contact wipe, close the breaker and observe the drive insulators from the rear of the breaker (Figure **6-2**). Since the indicator to be observed is in the lower rear portion of each pole unit assembly, a flashlight should be used. Refer to Figures **6-3** and **6-4** for graphical representations of satisfactory and unsatisfactory contact wipe conditions. If the identified wipe indicator is observed to be below the top surface of the drive insulator as shown in Figure **6-3,** the contact wipe is satisfactory. If the wipe indicator is observed to be flush with or protruding out past the top surface of the drive insulator as shown in Figure **6-4,** the contact wipe is unsatisfactory. The pole unit assembly must be replaced when an unsatisfactory wipe condition is observed.

Figure 6-1 Contact Erosion Mark Visible on Stem

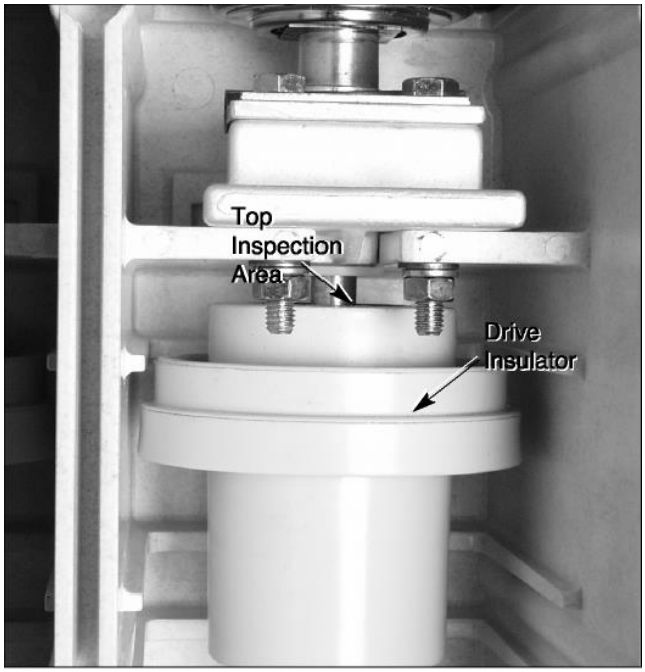


Figure 6-2 Contact Wipe Inspection Area

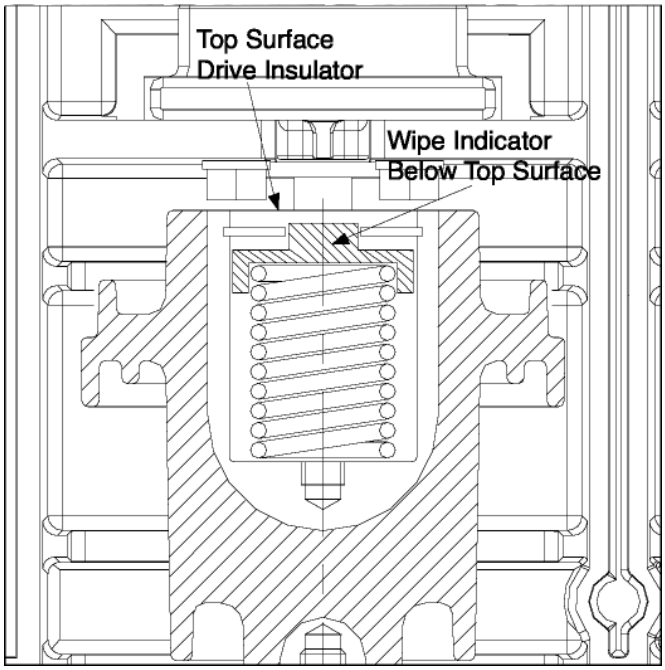


Figure 6-3 Satisfactory Contact Wipe Condition with Breaker Closed

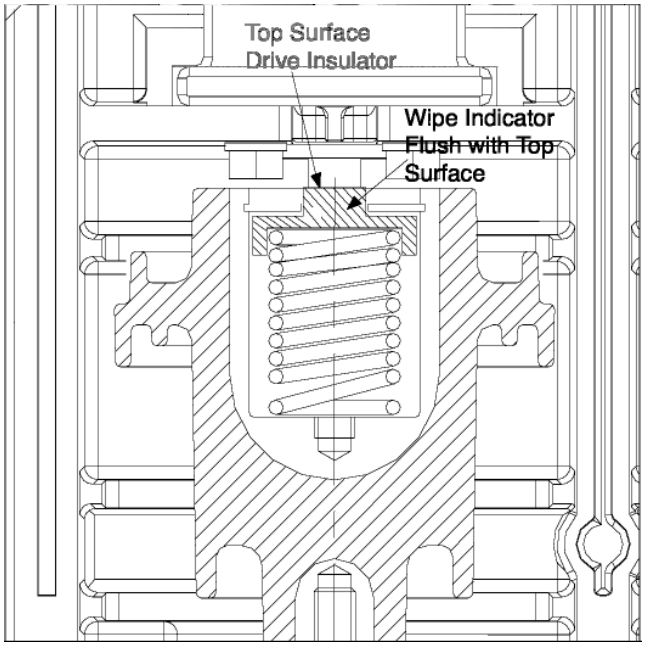


Figure 6-4 Unsatisfactory Contact Wipe Condition with Breaker Closed

6-6 INSULATION

In VCP-TL and VCP-TRL circuit breakers, 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 or dry paper towel. 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 breaker in service. If a solvent is required to cut dirt, use Stoddard's Solvent (EATON 55812CA) or commercial equivalent. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

6-7 INSULATION INTEGRITY CHECK

Primary Circuit: The integrity of primary insulation may be checked by the AC high potential test. The test volt-age depends upon the maximum rated voltage of the breaker. For the breakers rated 5.0kV, 12kV and 15.0 kV, the test voltages are 15kV, 21 kV and 27 kV rms respectively. Conduct the test as follows:

Close the breaker. Connect the high potential lead of the test machine to one of the poles of the breaker. Connect the remaining poles and breaker frame to ground. Start the machine with output potential at zero and increase to the test voltage. Maintain the test volt-age for one minute. Repeat for the remaining poles. Successful withstand indicates satisfactory insulation strength of the primary circuit.

If a DC high potential machine is used, make certain that the peak voltage does not exceed the peak of the corresponding AC RMS test voltage.

Secondary Circuit: Isolate the motor by pulling apart the two insulated quick disconnecting terminals in the two motor leads provided for this purpose. Connect all points of the secondary disconnect pins with a shooting wire. Connect this wire to the high potential lead of the test machine. Ground the breaker frame. Starting with zero, increase the voltage to 1500 volts rms. Maintain the voltage for one minute. Successful withstand indicates satisfactory insulation strength of the secondary control circuit. Remove the shooting wire and reconnect the motor leads.

6-8 PRIMARY CIRCUIT RESISTANCE CHECK

Since the main contacts are inside the vacuum chamber, they remain clean and require no maintenance at any time. If desired, the DC resistance of the primary circuit may be measured as follows: close the breaker, pass at least 100 amps DC current through the breaker. With the low resistance instrument, measure resistance across the studs on the breaker side of the disconnect for each pole. The resistance should not exceed the values shown in Table **6.3.**

6-9 MECHANISM CHECK

Make a careful visual inspection of the mechanism for any loose parts such as bolts, nuts, pins and rings. Check for excessive wear or damage to the breaker components. Operate the breaker several times manually and electrically. Check the closing and opening times to verify that they are in accordance with the limits in paragraph 5-4.1.

6-10 LUBRICATION

Maintenance of these circuit breakers and cassettes consists mainly of keeping them clean with a minimal amount of lubrication recommended. VCP-T and VCPTR circuit breakers should be lubricated every 3 years or 2000 operations with a high quality 10W30 motor oil and/or magna-lube G Teflon grease C-H #53701 AI as indicated in Figure **6-5.** As required for smooth operation, lubricate the drawout cassette also with a high quality 10W30 motor oil and/or magna-lube G Teflon grease C-H #53701AI as indicated in Figure **6-6.**

Table 6.3 Typical Resistance Measurements

Rated Continuous Current (amperes)	Resistance (microohms)
600	46
800	44
1200	39
1600	36

6-11 TROUBLESHOOTING

Refer to Table **6.4** for troubleshooting suggestions. It will help to determine the probable causes of simple circuit breaker problems and possible corrective actions. If the problem cannot be resolved with the aid of this guide, contact the EATON service center for more in-depth assistance.

Table 6.4 Troubleshooting Guide (continued on next page)

Symptom	Probable Cause	Corrective Actions
Circuit breaker undesirably opens	Opening coil is energized	Check control signal to circuit breaker for proper connection
	Interlock switch is closed (drawout only)	Check that interlocks are in correct positions and free from obstructions
Circuit breaker undesirably closes	Closing coil is energized	Check control signal to circuit breaker for proper connection
	Interlock switch is closed (drawout only)	Check that interlocks are in correct positions and free from obstructions
When attempting to close, the circuit breaker opens immediately	The vacuum interrupter contact wipe is incorrectly adjusted	Contact EATON Service Center
	Interlock switch is closed (drawout only)	Check that interlocks are in correct positions and free from obstructions
Circuit breaker cannot be opened remotely, but can be opened locally	Secondary contact wiring problem	Check for correct installation of pins and sockets and that the plug us properly connected
	A voltage is being supplied to the open circuit	A dry contact must be used to open the circuit breaker remotely
	Controller wiring problem	Inspect for loose wires into controller
Circuit breaker cannot be opened locally, but can be opened remotely	Controller or pushbutton switch wiring problem	Inspect for loose wires into controller or open pushbutton switch
Circuit breaker makes no attempt to open with either local (manual) or remote controls	Opening spring broken or one or more vacuum interrupter contacts welded	Contact EATON Service Center
	Controller or pushbutton switch wiring problem	Inspect for loose wires into controller or open pushbutton switch
	Damaged auxiliary switch or open coil	Contact EATON Service Center
Circuit breaker cannot be closed remotely, but can be closed locally	Secondary contact wiring problem	Check for correct installation of pins and sockets and that plug is properly connected
	Controller wiring problem	Inspect for loose wires into controller
	A voltage is being supplied to close circuit	A dry contact must be used to close the circuit breaker remotely

Table 6.4 Troubleshooting Guide (continued from previous page)

Symptom	Probable Cause	Corrective Actions
Circuit breaker cannot be closed locally, but can be closed remotely	Controller or pushbutton switch wiring problem	Inspect for loose wires into controller or open pushbutton switch
Circuit breaker makes no attempt to close with either local (manual) or remote controls	Circuit breaker interlock is preventing close	Make sure circuit breaker is fully racked in or out on enclosure (drawout only) Verify that emergency open handle is in a vertical position Check all interlock switches for obstructions
	Controller wiring problem	Inspect for loose wires into controller
	Damaged auxiliary switch or close coil	Contact EATON Service Center

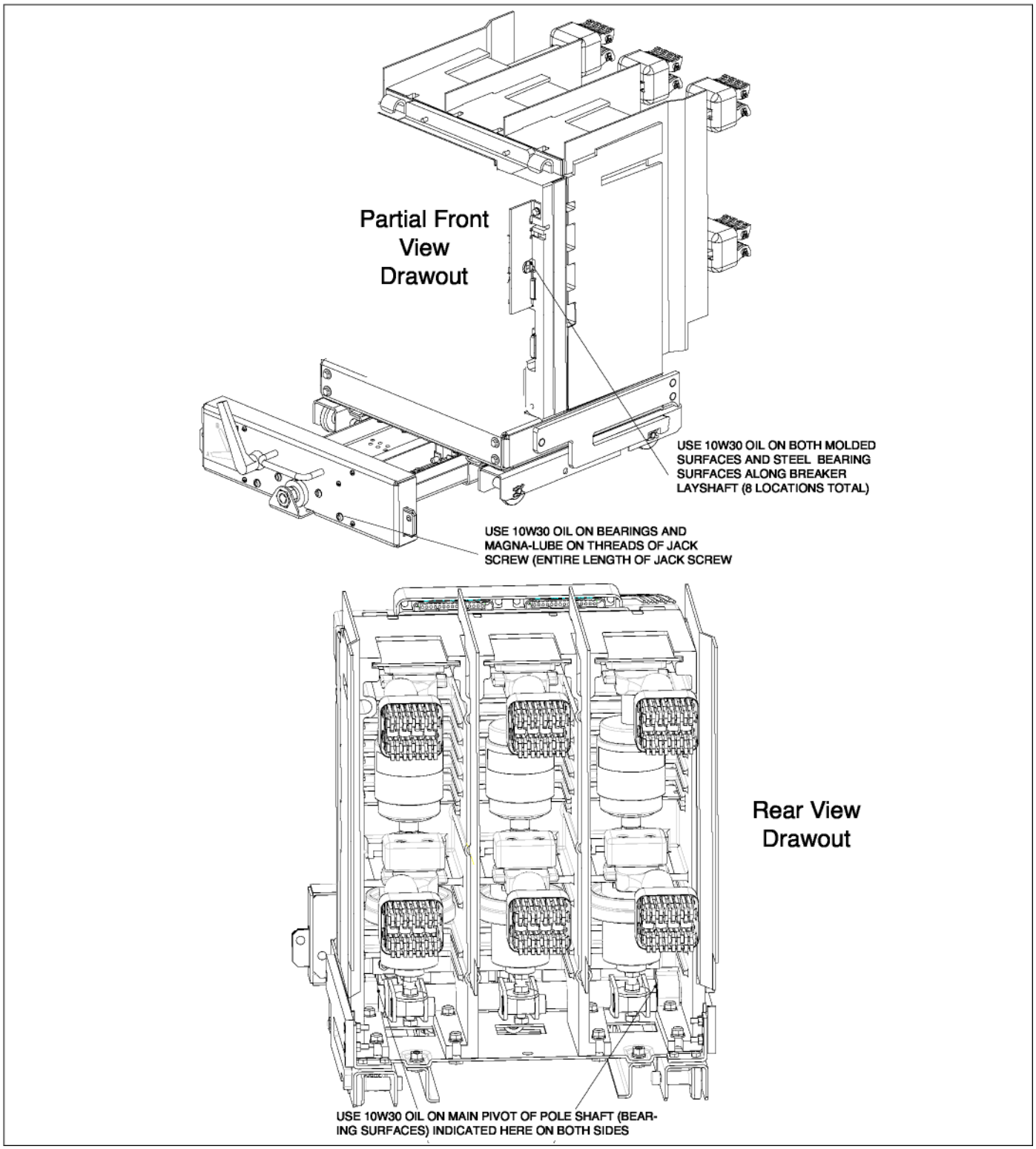


Figure 6-5 Circuit Breaker Lubrication

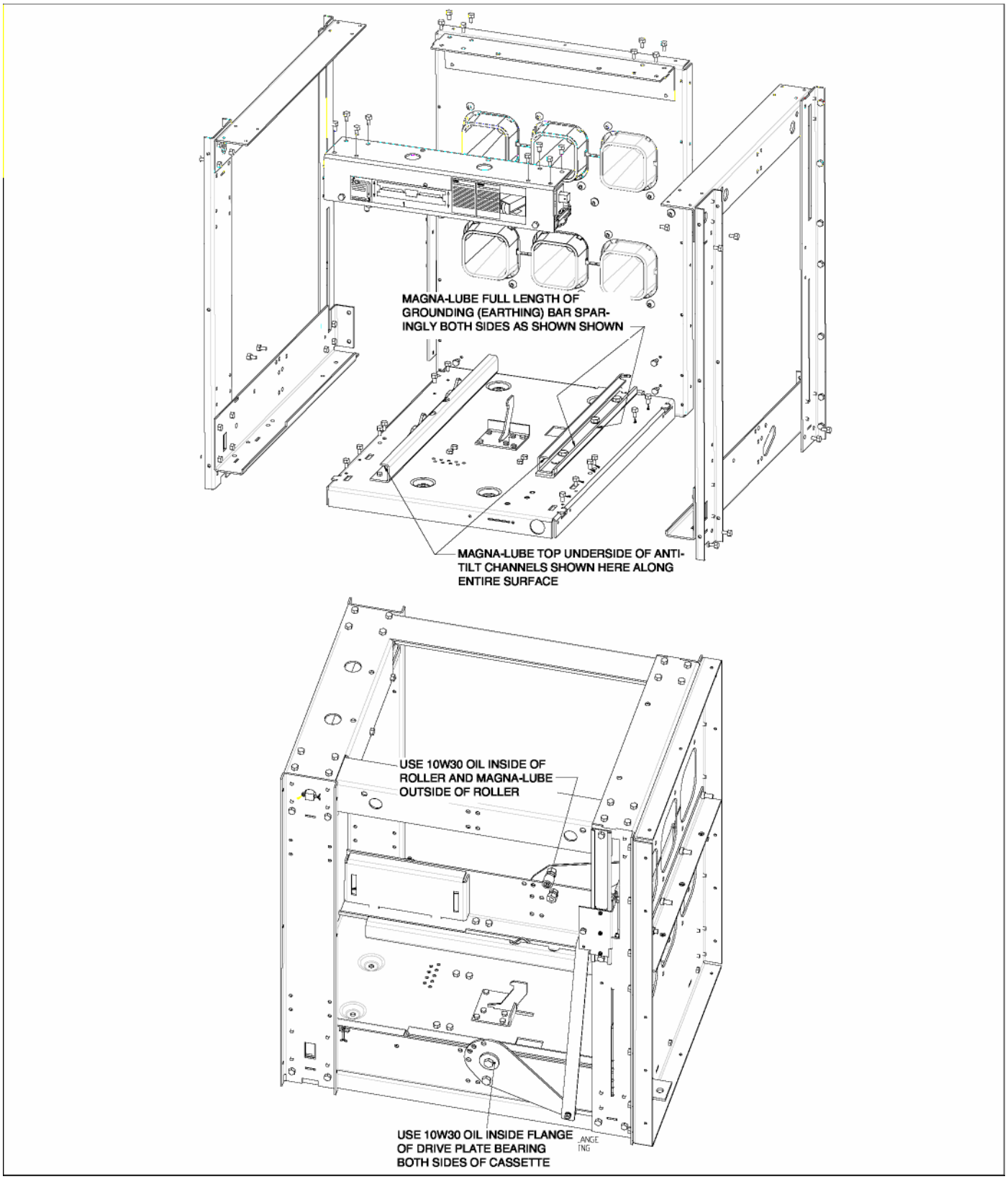


Figure 6-6 Drawout Cassette Lubrication

SECTION 7: RENEWAL PARTS

7-1 GENERAL

In order to minimize production downtime, it is recommended that an adequate quantity of spare parts be 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 stock level based on operating experience.

7-2 ORDERING INSTRUCTIONS

a. Always specify the breaker rating information and shop order number.

b. Describe the item, give the style number, and specify the quantity required.

c. Specify the voltage for electrical components.

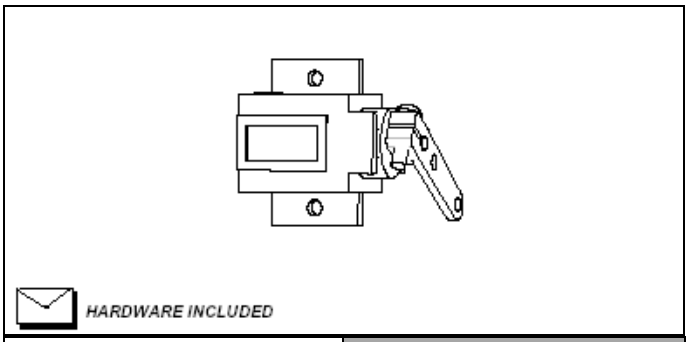
d. Specify the method of shipping desired.

e. Send all orders or correspondence to the nearest EATON sales office.

7-3 MECHANISM AND RELATED PARTS

(1) Operations Counter

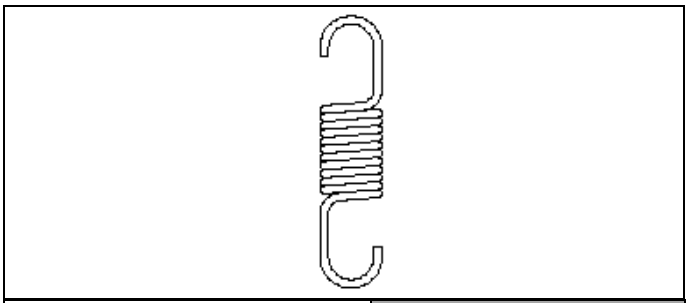
Customer Field Installable



Description	Cat#
Mechanical counter	MCOUNT

(2) Opening Spring and Guide

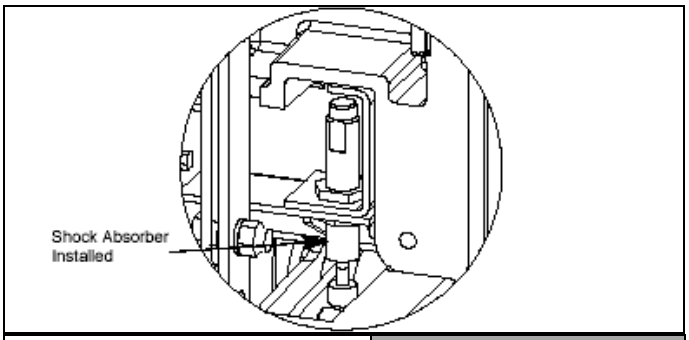
Customer Field Installable



Description	Style#
Blue Opening Spring (High Energy)	67A3142G02

(3) Shock Absorber

Customer Field Installable3



Description	Style#
Shock Absorbor all Breakers	67A3142G01

7-4 CURRENT PATH

(1) Pole Unit Assembly (VCP-TL and VCP-TRL)

Requires C-HESS (EATON Engineering Services and Systems) Installation

Breaker Type	Normal Current (Amperes) (Includes VI, Flex Connector and Drive Rod Assembly)			
	600	800	1200	1600
	Style#	Style#	Style#	Style#
5KV/16KA	67A4558G01	67A4658G01	67A4558G01	67A4558G01
5KV/20KA	67A4558G01	67A4558G01	67A4558G01	67A4558G01
5KA/25KA	67A4558G01	67A4558G01	67A4558G01	67A4558G01
7.5kV/16kA	67A4558G01	67A4558G01	67A4558G01	67A4558G01
7.5kV/20kA	67A4558G01	67A4558G01	67A4558G01	67A4558G01
7.5kV/25kA	67A4558G01	67A4558G01	67A4558G01	67A4558G01
15KV/16KA	67A4558G01	67A4558G01	67A4558G01	67A4558G01
15KV/20KA	67A4558G01	67A4558G01	67A4558G01	67A4558G01
15KV/25KA	67A4558G01	67A4558G01	67A4558G01	67A4558G01

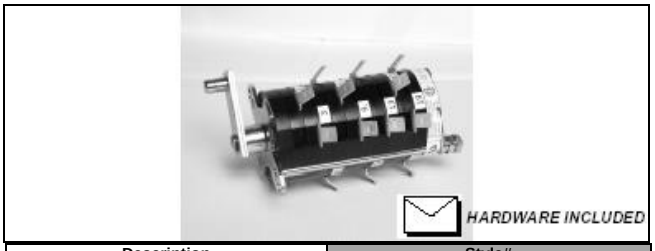
(2) 30,000 Operations Maintenance Kit

Description	Style#
Maintenance Kit for use when 30,000 operations reached	67A4559G01

7-5 ELECTRICAL ATTACHMENTS

(1) Auxiliary Switch

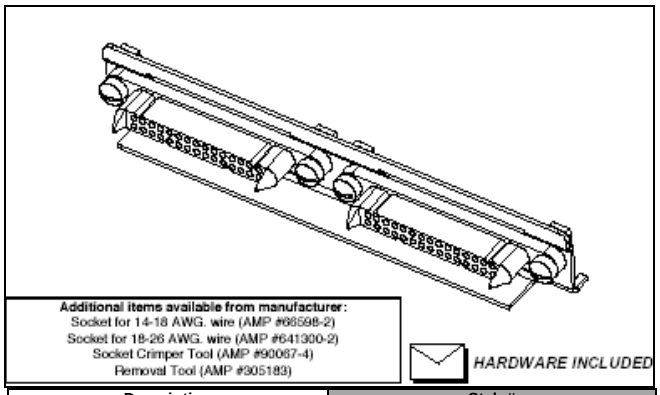
Customer Field Installable



Description	Style#
5a/5b double break type	67A3147G01

(2) Breaker Secondary Disconnect Block

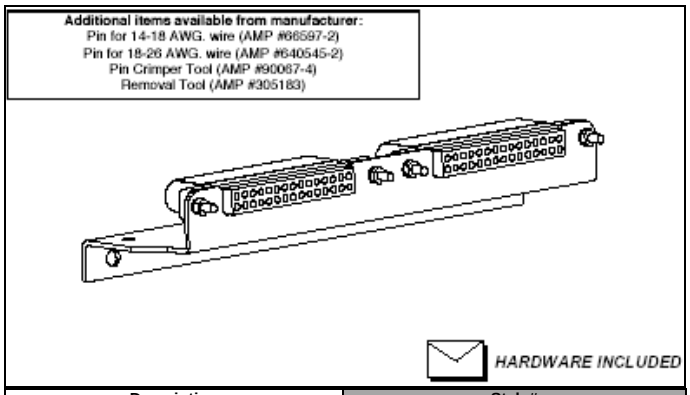
Customer Field Installable



Description	Style#
2-30 position connectors labeled and assembled To mounting tray	67A3148G01

(3) Breaker Terminal Block Bracket

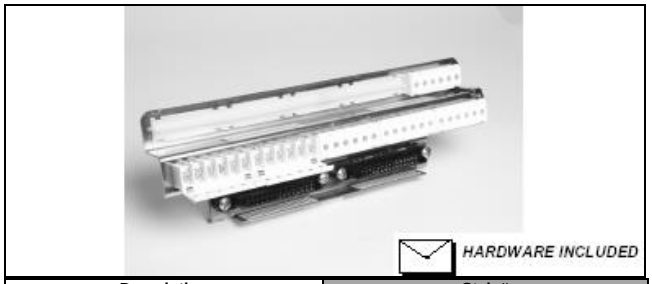
Customer Field Installable



Description	Style#
2-30 Position Connectors Labeled for External Wiring	67A3149G01

(4) Screw Type Terminal Block

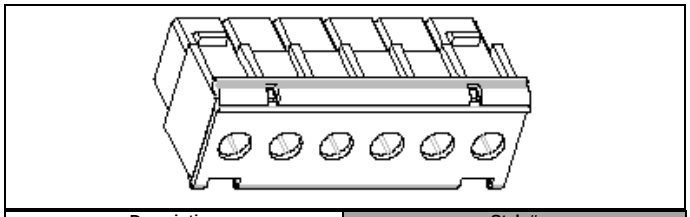
Customer Field Installable



Description	Style#
Screw Type Terminal Block With Hinged Covers	67A3151G01

(5) Secondary Terminal Block Kit

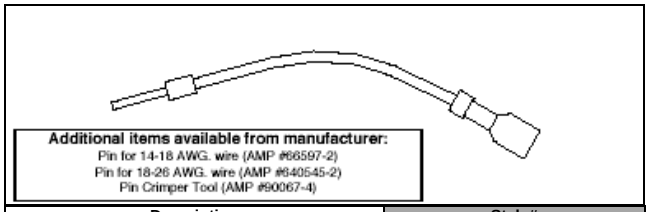
Customer Field Installable



Description	Style#
15 (6 point) Terminal Blocks And Labels	1B93092G01

(6) Secondary Terminal Wire Kit

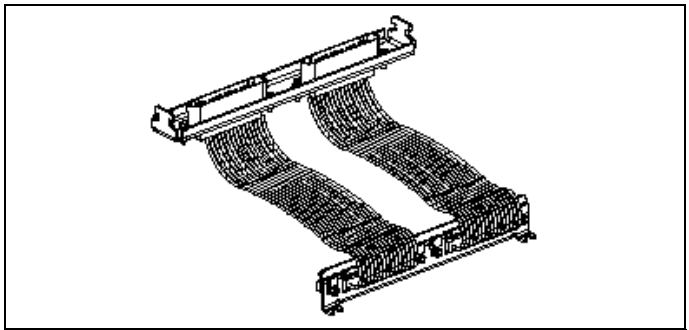
Customer Field Installable



Description	Style#
90 wires with terminal connectors (Amp And Fast ON Opposite Ends)	1B93093G01

(7) Secondary Umbilical Cord

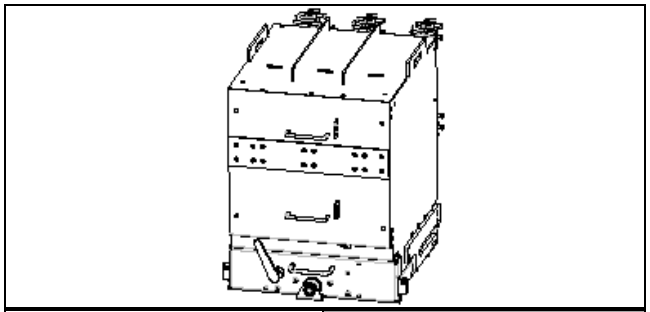
Customer Field Installable



Description	Style#
Secondary umbilical cord (Drawn Out circuit breakers only)	69C3323G01

(8) Simple Ground and Test Device

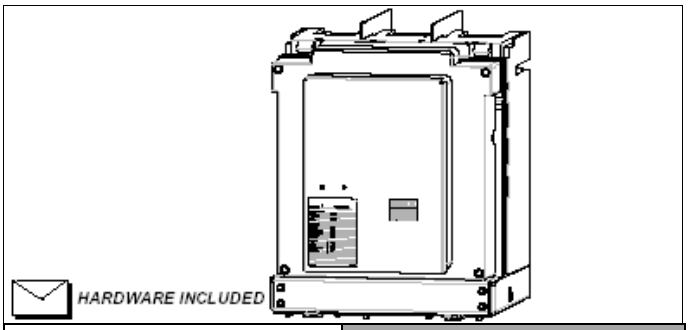
Customer Field Installable



Description	Style#
Simple Ground And Test Device	67A3056G01

(9) Dummy Element

Customer Field Installable

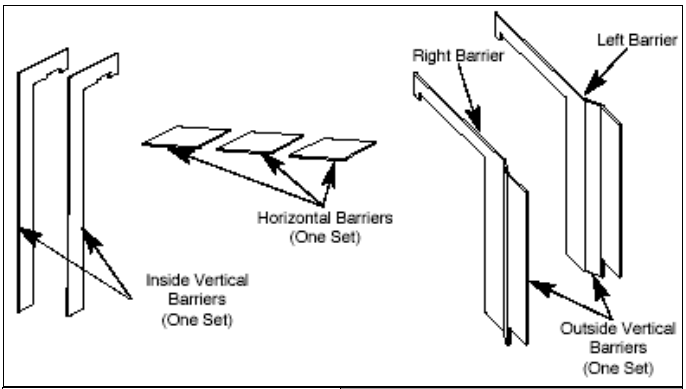


Description	Style
Dummy Element	**67A3055G01**

7-6 OTHER BREAKER RELATED PARTS

(1) Phase Barriers

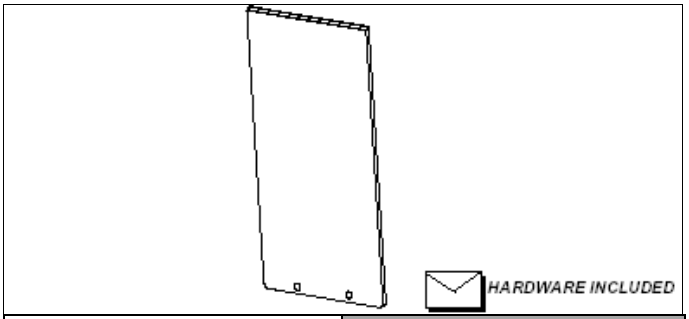
Customer Field Installable



Description	Style
Horizontal Barriers (All 95kV BIL) Inside Vertical Barriers (All 95 kV BIL) Outside Vertical Barriers (Al 95kV BIL drawout only)	**67A3152G01** **67A3152G02** **67A3152G03**

(4) Non-Automatic Trip Unit Cover

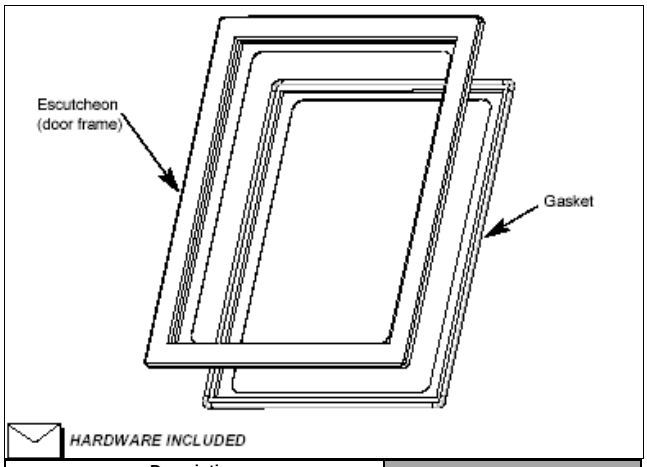
Customer Field Installable



Description	Style
VCP-T & VCP-TR	2C12812H06

(2) Door Escutcheon and Gasket

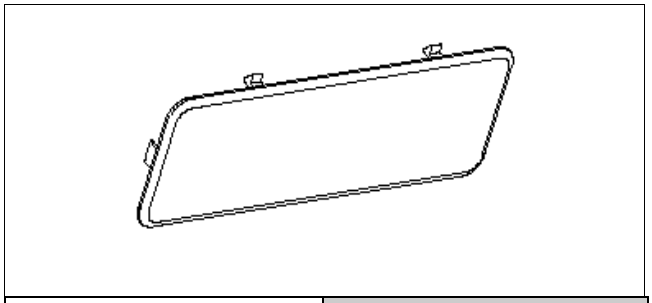
Customer Field Installable



Description	Cat#
Protects against dust and dripping water by Sealing Space **Between** Breaker and Compartment door cutout	MDES

(3) Blank Cover for Fixed Breaker

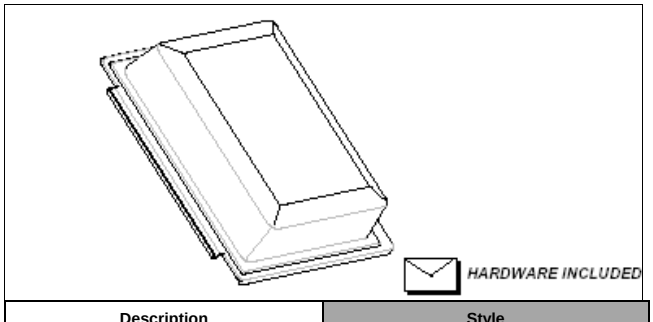
Customer Field Installable



Description	Style
VCP-TRL	**2C12815H03**

(5) IP54 Cover Kit (Transparent)

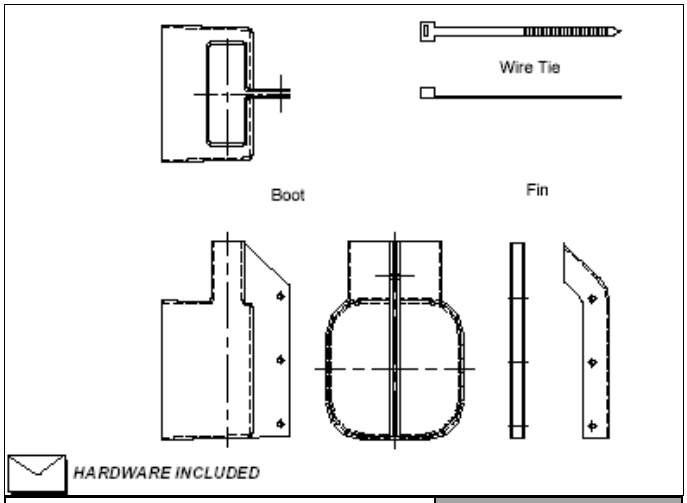
Customer Field Installable



Description	Style
Provides protection against dust and dripping water (IP54)	2C14892G01

(6) Spout Boot

Customer Field Installable



Description	Style
Spout Boot Kit includes required boots, fins and wire ties sufficient for 6 spouts (6 boots, 6 fins and 18 wire ties)	69C3320G01

7-7 TRIP UNIT AND RELATED PARTS

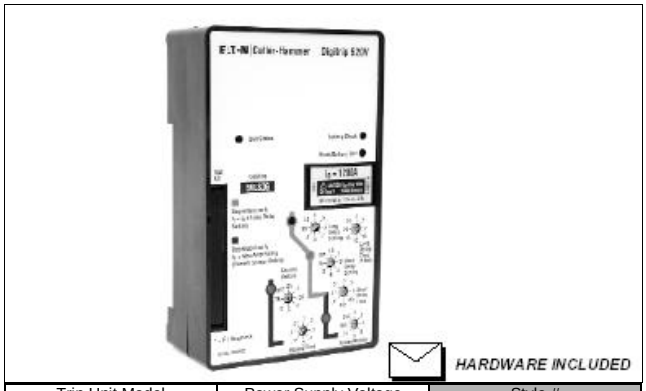
(1) 1150V Trip Unit Kit (Trip Unit and Power Supply)

Requires C-HESS (EATON Engineering Services and Systems) Installation

Trip unit model	Power supply voltage	Style#
1150V Trip Unit	24 to 48 Vdc	67A3153G01
1150V Trip Unit	120Vdc	67A3153G02
1150V Trip Unit	240 Vac	67A3153G03
1150V Trip Unit	125 Vdc	67A3153G04

(2) 520V Trip Unit Kit

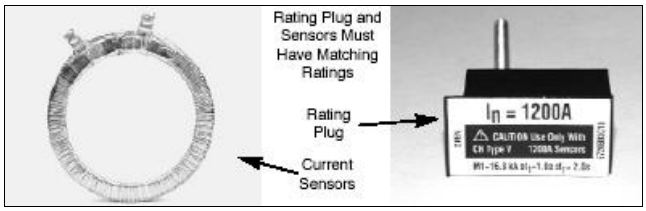
Requires C-HESS (EATON Engineering Services and Systems) Installation



Trip Unit Model	Power Supply Voltage	Style #
520V Trip Unit	NA	67A3154G01
520MCV Trip Unit	24 to 48 Vdc	67A3154G21
520MCV Trip Unit	120 Vac	67A3154G22
520MCV Trip Unit	240 Vac	67A3154G23
520MCV Trip Unit	125 Vdc	67A3154G24

(3) Trip Unit Current Sensors and Rating Plug

Customer Field Installable



Sensor (amps)	Style#	Rating plug (amps)	Style #
100	69C3011H01	100	5720B93G01
200	69C3011H02	200	5720B93G02
250	69C3011H25	250	5720B93G03
300	69C3011H03	300	5720B93G04
400	69C3011H04	400	5720B93G05
600	69C3011H06	600	5720B93G06
630	69C3011H63	630	5720B93G07
800	69C3011H08	800	5720B93G08
1000	69C3011H10	1000	5720B93G09
1200	69C3011H12	1200	5720B93G10
1250	69C3011H13	1250	5720B93G11
1600	69C3011H16	1600	5720B93G12
2000	69C3011H20	2000	5720B93G13
2500	69C3011H30	2500	5720B93G14

(6) Zero Sequence Current Transformer

Customer Field Installable

Description	Style
Zero sequence current transformer (100:1 and 200:1 tap ratio) (50:1 tap ratio)	69C3016G01 69C3016G02

Instruction Book

Effective: January 2005

Instructions for the Use, Operation and Maintenance of Types VCP-TL and VCP-TRL Linear Magnetic Vacuum Circuit Breakers

Eaton Corporation Cutler-Hammer business unit 1000 Cherrington Parkway Moon Township, PA 15108-4312 USA
tel: 1 -800-525-2000
www.EatonElectrical.com

Cutler-Hammer

Printed in USA
Publication No. IB69C3076H01 (ISI)
January 2005