Instructions for the Use, Operation and Maintenance of Types T-VAC and T-VACR Vacuum Circuit Breakers

IB131015EN Effective November 2017

T- VACR Fixed (up to 25kA)

T-VAC Draw out (up to 25kA)

T- VACR Fixed (up to 40kA)

T-VAC Draw out (up to 40kA)

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
Moon Township, 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.

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SECTION 1: INTRODUCTION

The purpose of this book is to provide instructions for unpacking, storage, use operation and maintenance of T-VAC draw out type and T-VACR fixed type Vacuum Circuit Breakers. T-VAC and T-VACR are compact vacuum interrupting elements designed for applications such as: mine power centers, portable power substations, fixed breaker or draw out switchgear and portable generators, all without compromising metal clad expectations. T-VAC and T-VACR breakers were specifically designed to provide proven reliable performance in a small package. The circuit breakers are available in voltage classes of 7.2, 12.0 and 17.5 kV. They are tested and certified to IEC62271-100 (Table **1.1).**

1-1 T-VAC and T-VACR Vacuum Breaker Ratings

Refer to Tables 1.1 and 1.2 on pages 2 and 3.

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 T-VAC and T-VACR 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.

T-VAC and T-VACR CIRCUIT BREAKERS ARE PROTECTIVE DEVICES, AS SUCH, THEY ARE MAXIMUM RATED DEVICES. THEREFORE, THEY SHOULD NOT UNDER ANY CIRCUMSTANCES BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS.

Table 1.1 T-VAC and T-VACR Ratings (Certified to IEC62271-1 00) (continued on next page)

Identification	Rated Values						
Circuit Breaker Type	Voltage Class	Insulation Level Withstand Voltage		Normal Current (In)	Short Circuit ` Breaking Current (Isc)	Short Circuit Making Current	Mechanical Endurance C - O
		Power Frequency	Lightning Impulse (Uw)				
	kV rms	kV rms	kV Peak	Amperes	kA rms	kA Peak	Operations
72 T-VAC16 and 72 T-VACR16	7.2	20	60	630 1250 1600③	16	40	10000 10000 10000
72 T-VAC20 and 72 T-VACR20	7.2	20	60	600 1250 1600③	20	50	10000 10000 10000
72 T-VAC25 and 72 T-VACR25	7.2	20	60	630 1250 1600③ 2000 2500③	25	63	10000 10000 10000 10000 10000
72 T-VAC32 and 72 T-VACR32	7.2	20	60	630 1250 2000 2500③	31.5	82	10000 10000 10000 10000
72 T-VAC40 and 72 T-VACR40	7.2	20	60	630 1250 2000 2500③	40	104	10000 10000 10000 10000
120 T-VAC16 and 120 T-VACR16	12	28	75①	630 1250 1600③	16	40	10000 10000 10000
120 T-VAC20 and 120 T-VACR20	12	28	75①	630 1250 1600③	20	50	10000 10000 10000
120 T-VAC25 and 120 T-VACR25	12	28	75①	630 1250 1600③ 2000 2500③	25	63	10000 10000 10000 10000 10000
120 T-VAC32 and 120 T-VACR32	12	28	75①	630 1250 2000 2500③	31.5	82	10000 10000 10000 10000
120 T-VAC40 and 120 T-VACR40	12	28	75①	630 1250 1200 2000 2500③	40	104	10000 10000 10000 10000

① Use 17.5kV Breaker and Cassette when 95kV Impulse Withstand required ② Also 3 Second Short Time Current Rating

③ 1600A and 2500A available as fixed T-VACR circuit breaker only

Table 1.1 T-VAC and T-VACR Ratings (Certified to IEC62271-100) (continued from previous page)

Identification	Rated Values						
Circuit Breaker Type	Voltage Class	Insulation Level Withstand voltage		Normal Current (In)	Short Circuit ` Breaking Current (Isc)	Short Circuit Making Current	Mechanical Endurance C - O
		Power Frequency	Lightning Impulse (Uw)				
	kV rms	kV rms	kV Peak	Amperes	kA rms	kA Peak	Operations
175 T-VAC16 and 175 T-VACR16	17.5	38	95	630 1250 1600③	16	40	10000 10000 10000
175 T-VAC20 and 175 T-VACR20	17.5	38	95	630 1250 1600③	20	50	10000 10000 10000
175 T-VAC25 and 175 T-VACR25	17.5	38	95	630 1250 1600③ 2000④ 2500③④	25	63	10000 10000 10000 10000
175 T-VAC32 and 175 T-VACR32	17.5	38	95	630④ 1250④ 2000④ 2500③④	31.5	82	10000 10000 10000 10000
175 T-VAC40 and 175 T-VACR40	17.5	38	95	630④ 1250④ 2000④ 2500③④	40	104	10000 10000 10000 10000

① *Use 17.5kV Breaker and Cassette when 95kV Impulse Withstand required* ② *Also 3 Second Short Time Current Rating*

③ *1600A and 2500A available as fixed T-VACR circuit breaker only*

④ *Tested for capacitor switching capabilities. Certified Class C2 to IEC 62271-100 (2003). Back-to-back equals 250A and 1000A. Ratings of 250 and 1000A cover capacitor bank applications from 75 to 1000A. Cable charging breaker current 31.5A. Inrush current and frequency rating = 18 kApk at 2.4 kHz.*

1-2 Types T-VAC and T-VACR Outlines and Dimensions (Circuit Breakers and Draw out Cassettes)

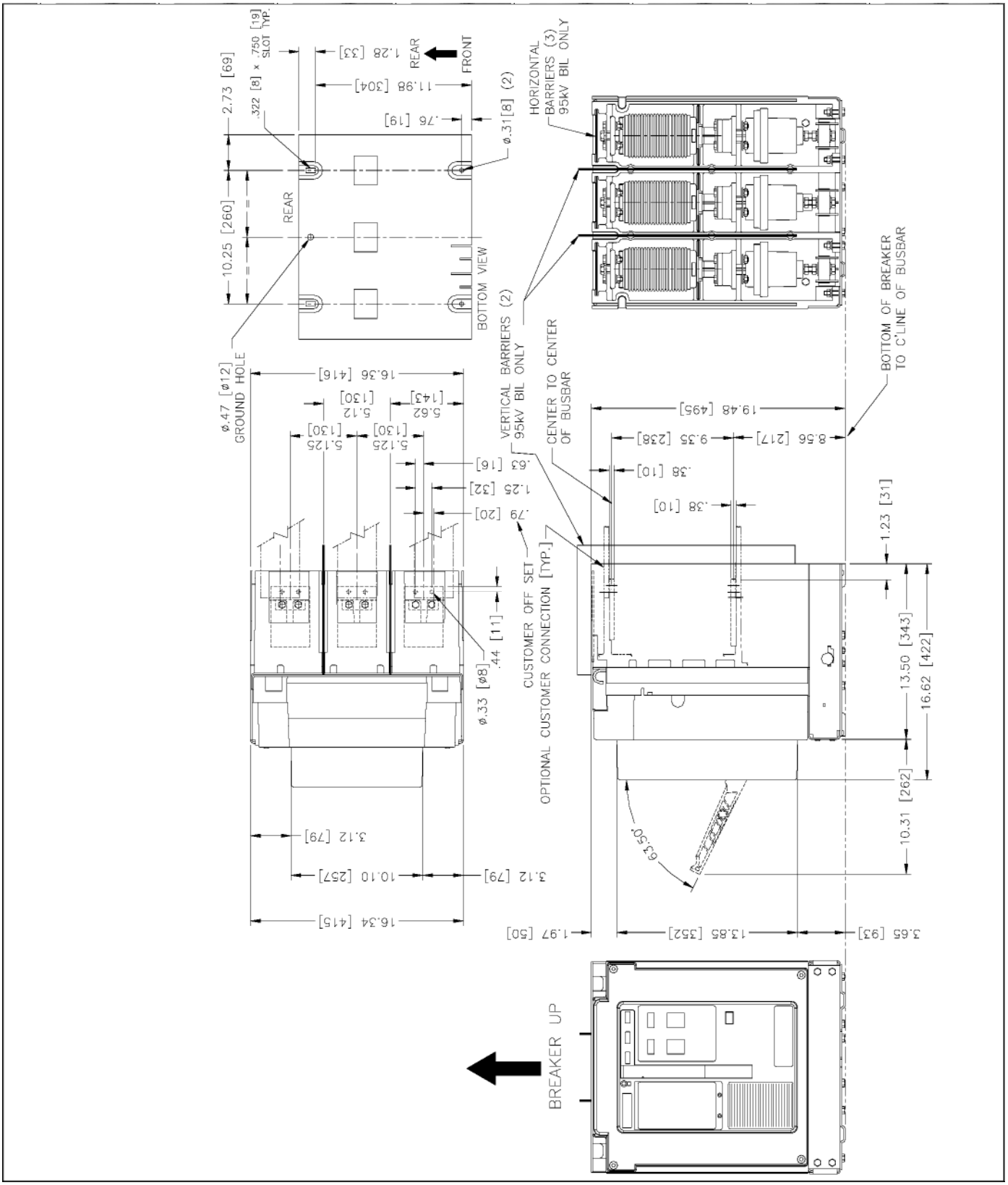


Figure 1-1 T-VACR Fixed Breaker Outlines in inches [mm] (except 25kA, 2000/2500A and all 31.5/40kA)

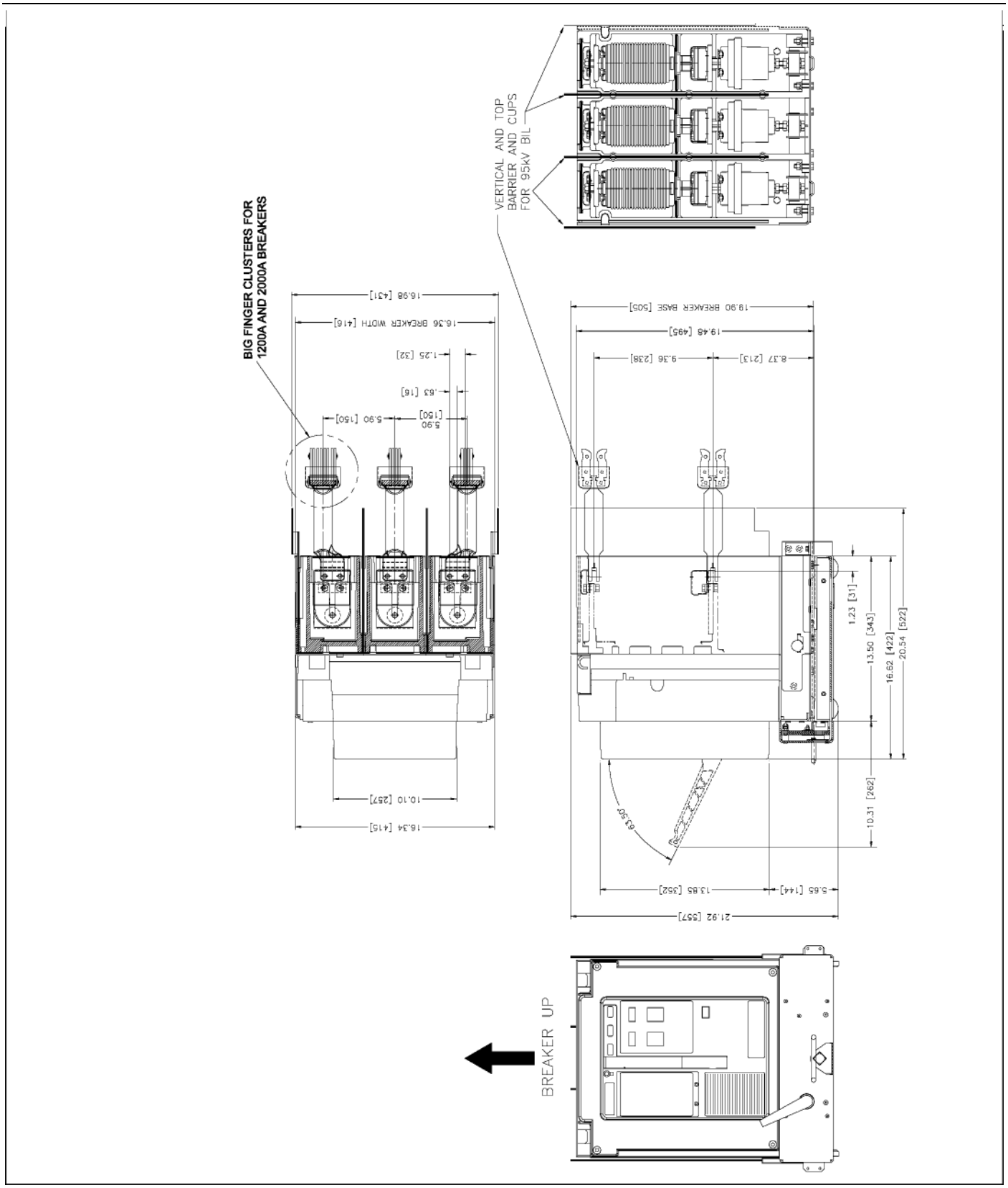


Figure 1-2 T-VAC Draw out Breaker Outlines in inches [mm] (except 25kA, 2000A and all 31.5/40kA)

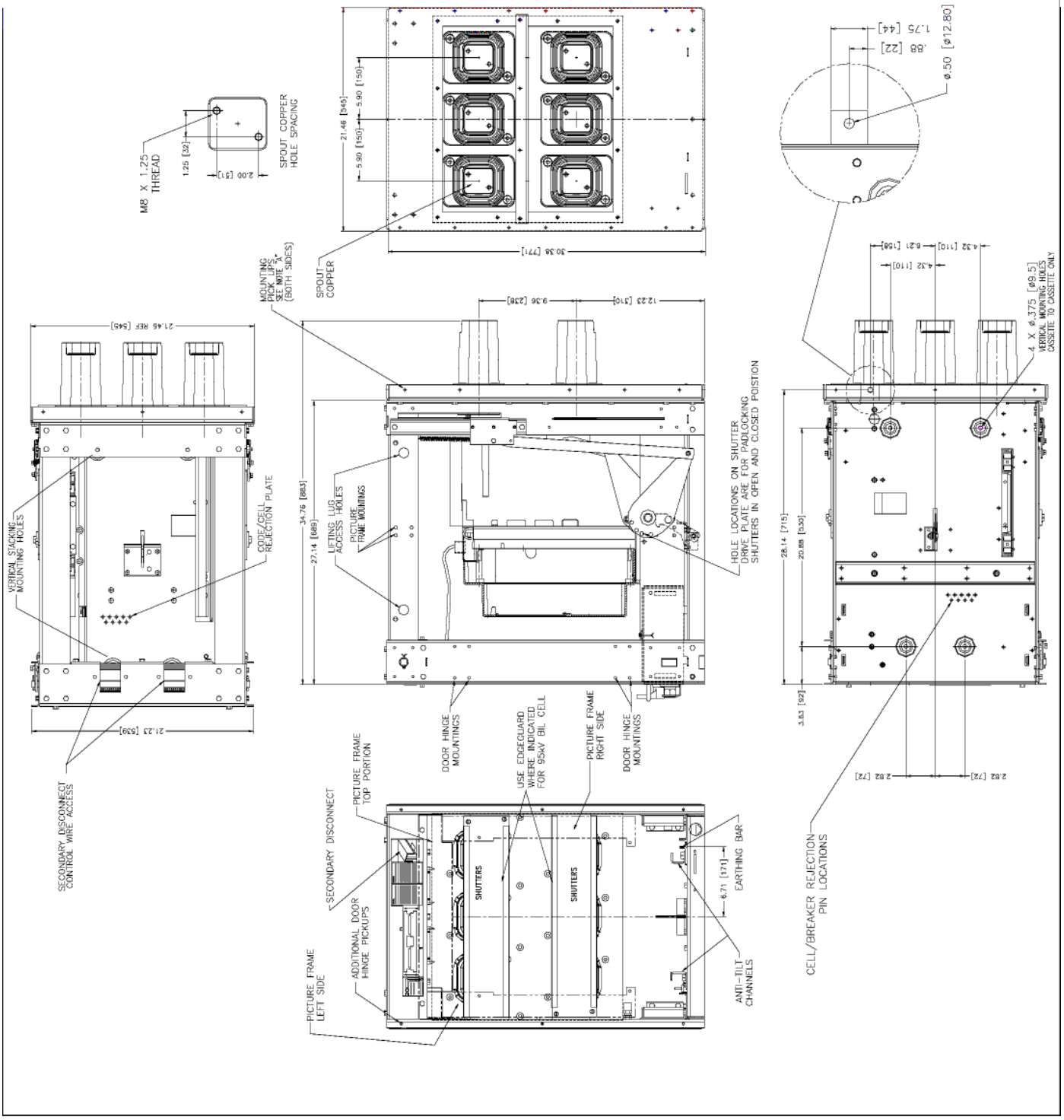
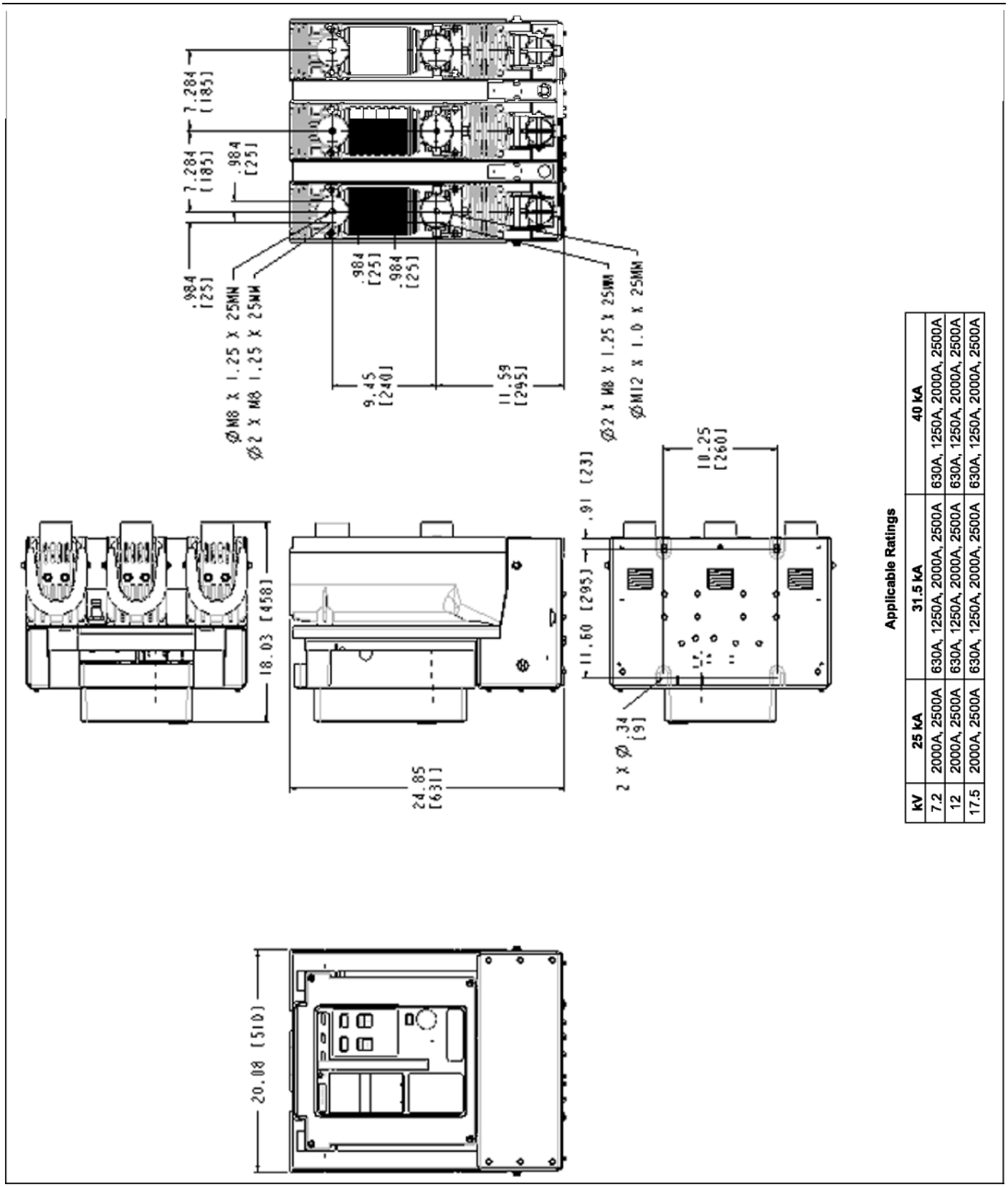


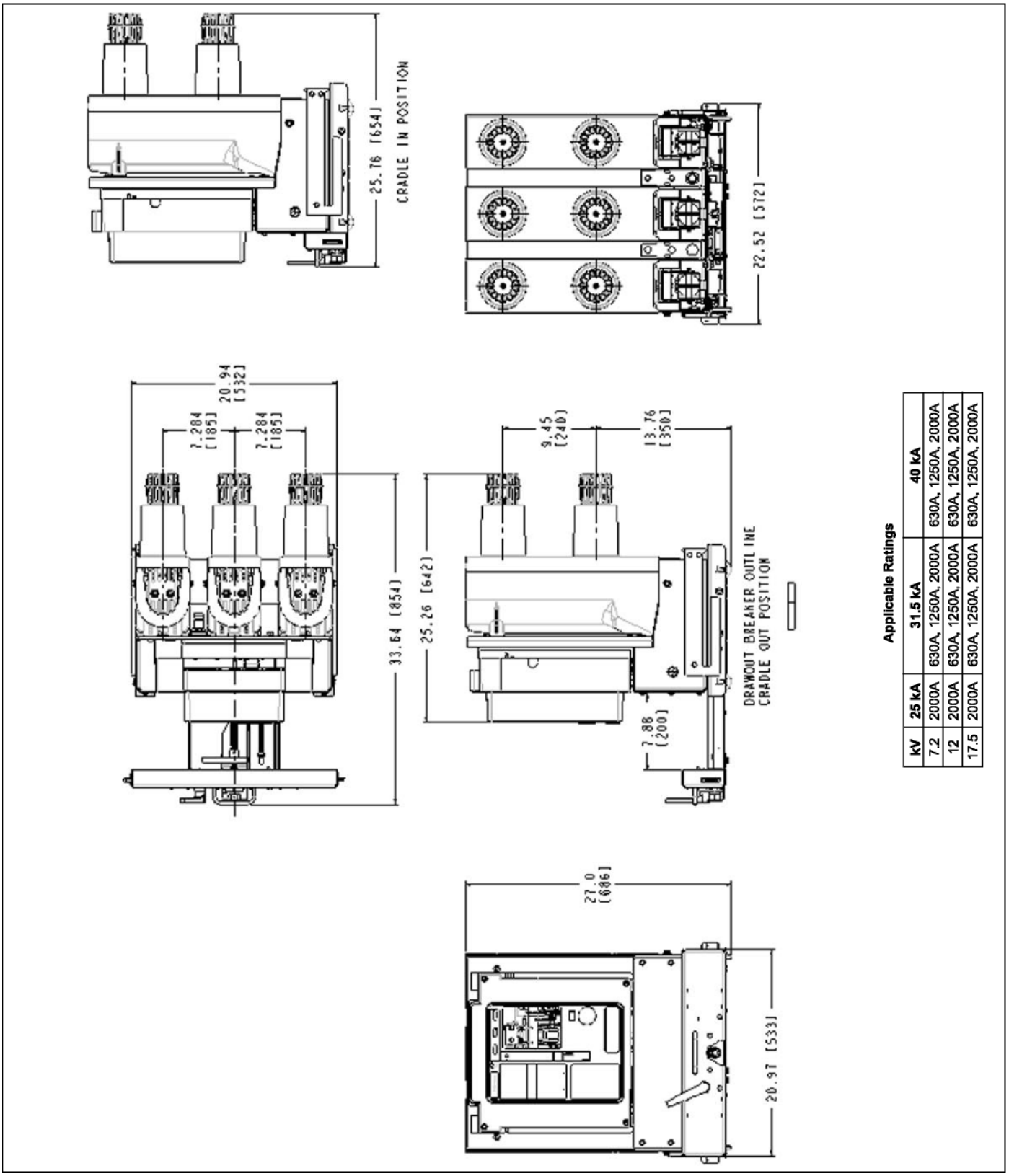
Figure 1-3 T-VAC Breaker Cassette Outlines in inches [mm] (except 25kA, 2000A and all 31.5/40kA)



Applicable Ratings

kV	25 kA	31.5 kA	40 kA
7.2	2000A, 2500A	630A, 1250A, 2000A, 2500A	630A, 1250A, 2000A, 2500A
12	2000A, 2500A	630A, 1250A, 2000A, 2500A	630A, 1250A, 2000A, 2500A
17.5	2000A, 2500A	630A, 1250A, 2000A, 2500A	630A, 1250A, 2000A, 2500A

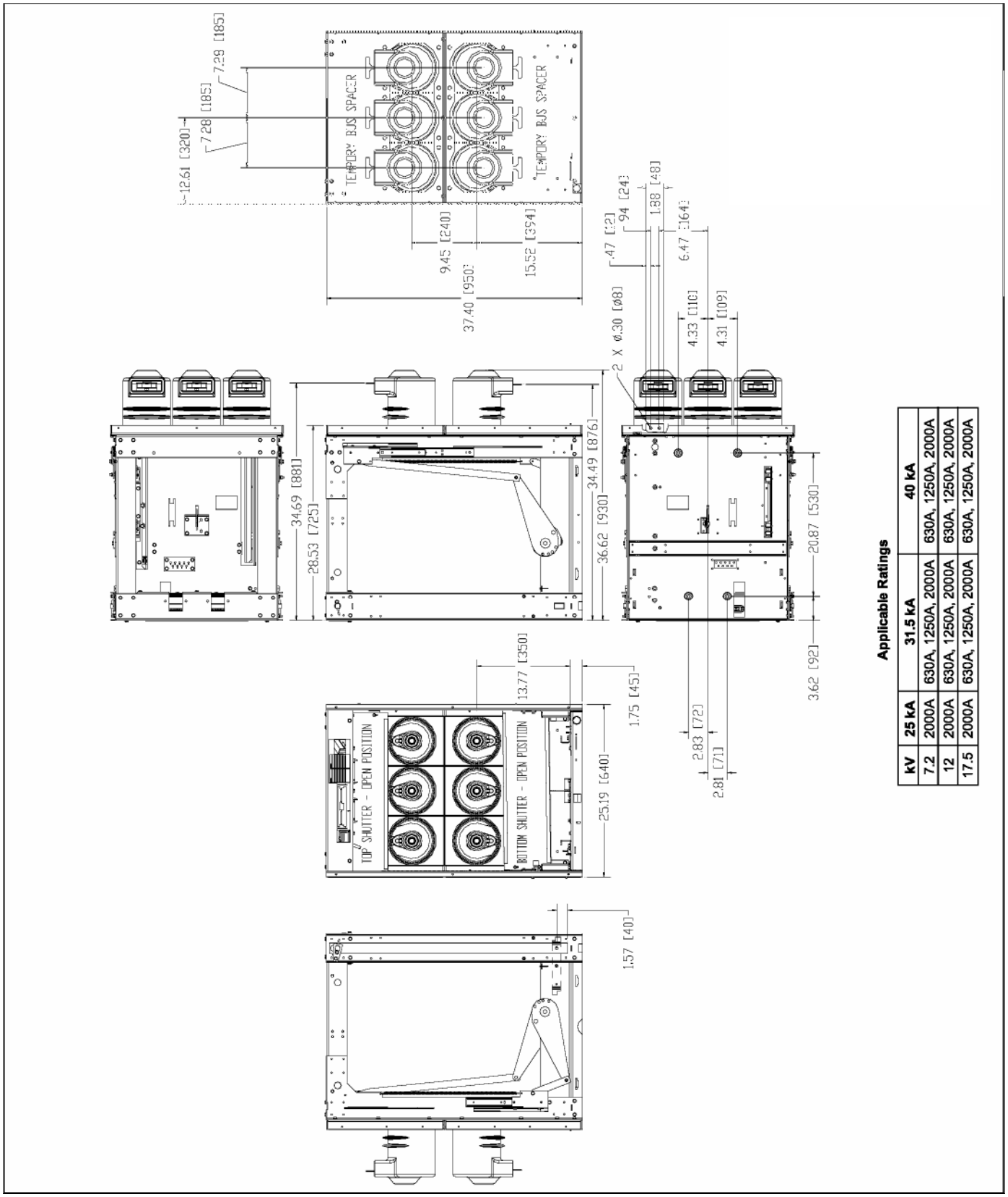
Figure 1-4 T-VACR Fixed Breaker Outlines in inches [mm] (Refer to above Applicable Ratings Table)



Applicable Ratings

kV	25 kA	31.5 kA	40 kA
7.2	2000A	630A, 1250A, 2000A	630A, 1250A, 2000A
12	2000A	630A, 1250A, 2000A	630A, 1250A, 2000A
17.5	2000A	630A, 1250A, 2000A	630A, 1250A, 2000A

Figure 1-5 T-VAC Draw out Breaker Outlines in inches [mm] (Refer to above Applicable Ratings Table)



Applicable Ratings

kV	25 kA	31.5 kA	40 kA
7.2	2000A	630A, 1250A, 2000A	630A, 1250A, 2000A
12	2000A	630A, 1250A, 2000A	630A, 1250A, 2000A
17.5	2000A	630A, 1250A, 2000A	630A, 1250A, 2000A

Figure 1-6 T-VAC Breaker Cassette Outlines in inches [mm] (Refer to above Applicable Ratings Table)

REFER TO IL131031EN FOR:

VCP-T/T-VAC 31.5kA, 40kA 2000A Cassette Bus Bar Assembly Instructions

SECTION 2: SAFE PRACTICES

The circuit breakers are equipped with high speed, high energy 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 draw out 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 are 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 draw out 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

T-VAC and T-VACR 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 PLATFORM 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 SUPPORTING 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 draw out 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 draw out circuit breaker to its shipping pallet.

When ready to inspect and install the circuit breaker, carefully remove any banding straps and lift off the cardboard 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 shipping pallet. Save all shipping hardware and packaging material for any future shipments of the circuit breaker.

Figure 3-1 Fixed Breaker Shown Mounted on Pallet

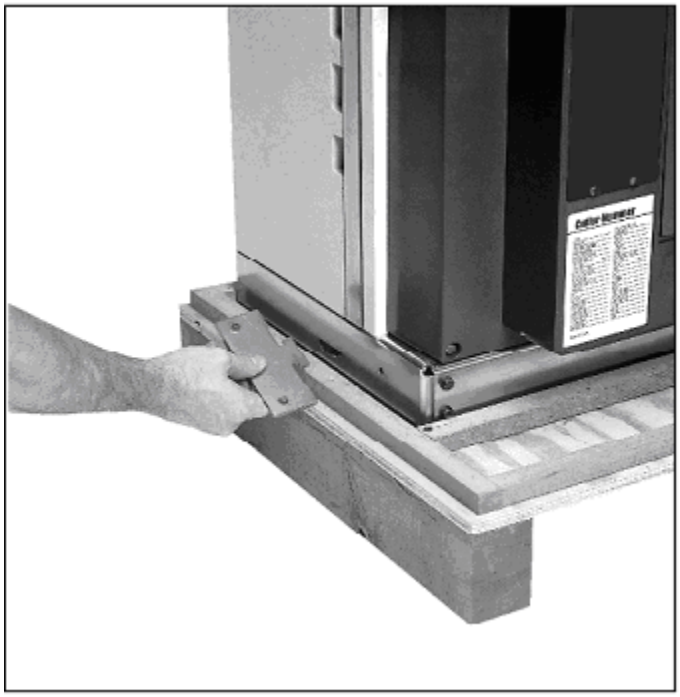


Figure 3-2 Keyed Shipping Clamp Being Removed From Fixed Breaker

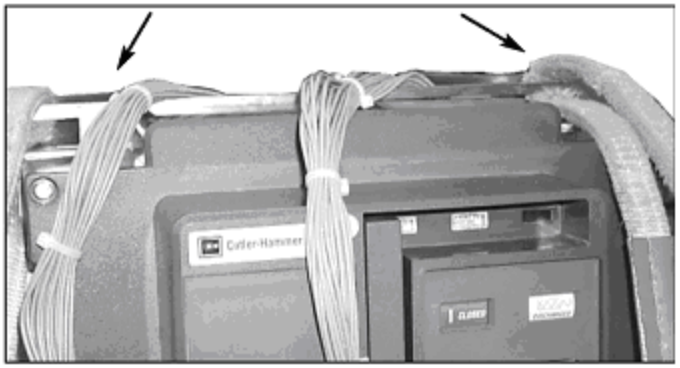


Figure 3-3 Optional Lifting Sling Shown In Each Rectangular Lifting Hole On 40kA Breaker

3-2.2 LIFTING (UP TO 25KA)

To closely examine, install or just become familiar with circuit breakers up to 25Ka, 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 recommended lifting yoke (Style 67A7677H01) or optionally with a sling (Figures **3-1**and **3-4).** Once the yoke or sling are 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.

3-2.3 LIFTING (UP TO 40KA)

To closely examine, install or just become familiar with circuit breakers up to 40Ka, 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 rectangular lifting slots located in the upper breaker frame for use with a recommended lifting yoke (Style 67A7677H01) or two slings (Figures **3-3, 3-3a,** and **3-4a).** Once the yoke or slings are 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.

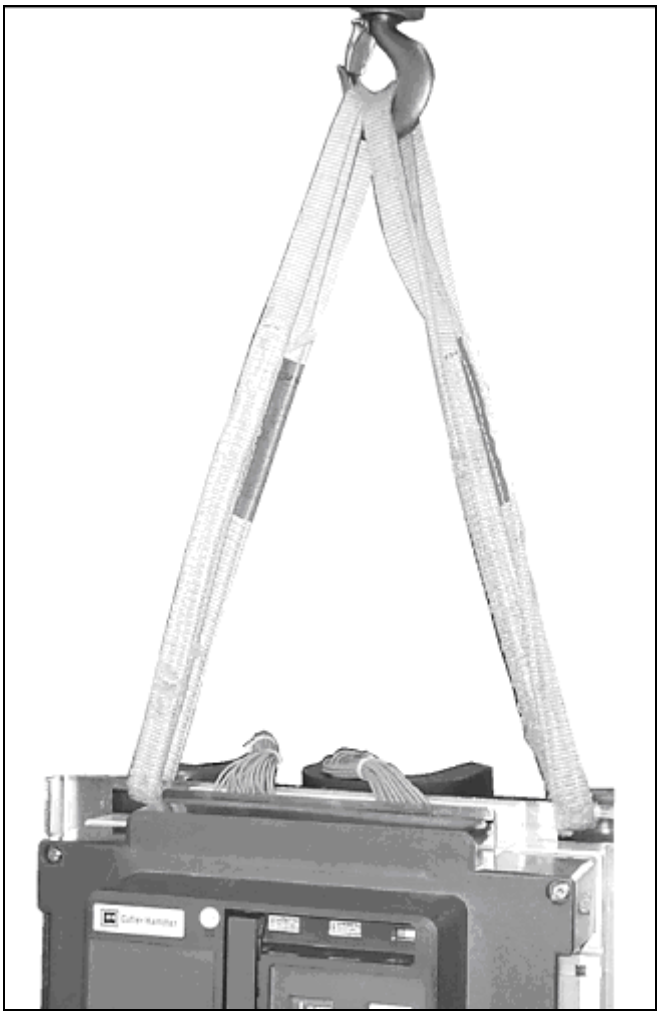


Figure 3-3a 40kA Breaker Shown Being Lifted Using Two Optional Slings And Overhead Lifter

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 T-VAC OR T-VACR 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, maximum 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 shipping damage and is in satisfactory operating condition.

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

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

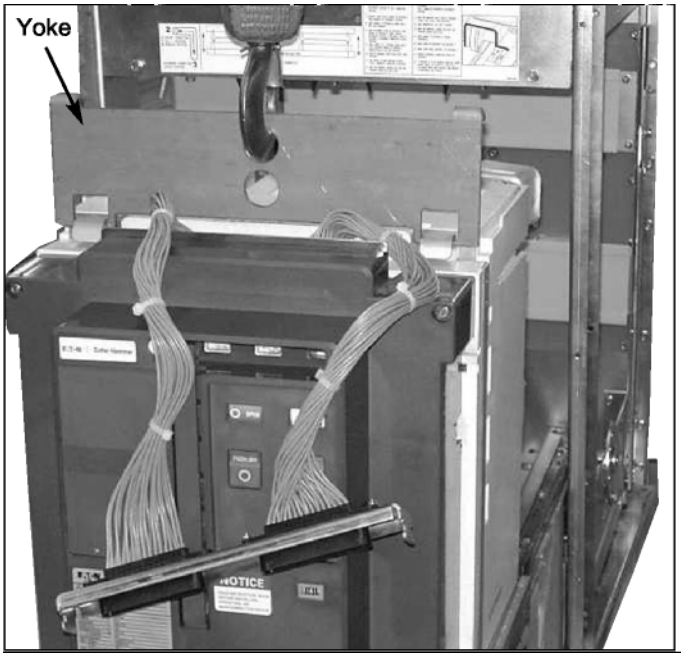


Figure 3-4 Preferred Lifting Method Using Lifting Yoke To Lift 25kA Breaker

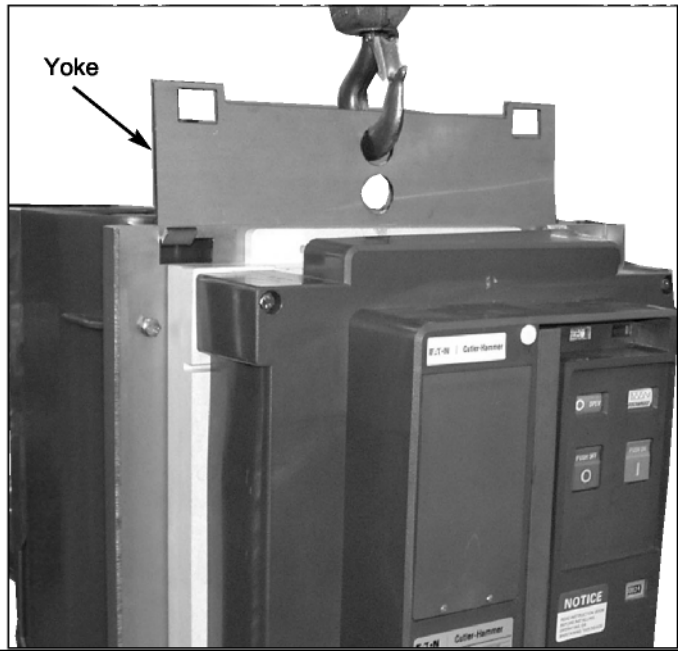


Figure 3-4a Preferred Lifting Method Using Lifting Yoke To Lift 40kA Breaker

3-4 TYPICAL BREAKER AND CASSETTE WEIGHTS

Table 3.1 Circuit Breaker and Cassette Weights

Circuit Breaker Type	Current Rating (Amps)	Approximate Weight (Kg)		
		Fixed	Draw out	Cassette
72 T-VACR16 and 72 T-VAC16	630 1250 1600	71 72 73	108 109 110	73 73 73
72 T-VACR20 and 72 T-VAC20	630 1250 1600	74 75 76	110 111 112	73 73 73
72 T-VACR25 and 72 T-VAC25	630 1250 1600 2000 2500	77 78 79 157 159	113 114 115 199 NA	73 73 73 73 NA
72 T-VACR32 and 72 T-VAC32	630 1250 1600 2000 2500	153 153 155 157 159	195 195 197 199 NA	140 140 140 140 NA
72 T-VACR40 and 72 T-VAC40	630 1250 1600 2000 2500	155 155 157 159 161	197 197 199 201 NA	140 140 140 140 NA
120 T-VACR16 and 120 T-VAC16	630 1250 1600	72 73 74	108 109 110	75 75 75
120 T-VACR20 and 120 T-VAC20	630 1250 1600	75 75 76	111 112 113	75 75 75
120 T-VACR25 and 120 T-VAC25	630 1250 1600 2000 2500	77 78 79 159 161	114 115 116 201 NA	75 75 75 75 NA
120 T-VACR32 and 120 T-VAC32	630 1250 1600 2000 2500	155 155 157 159 161	197 197 199 201 NA	140 140 140 140 NA
120 T-VACR40 and 120 T-VAC40	630 1250 1600 2000 2500	155 155 157 159 161	197 197 199 201 NA	140 140 140 140 NA

Table 3.1 (Continued)

Circuit Breaker Type	Current Rating (Amps)	Approximate Weight (Kg)		
		Fixed	Draw out	Cassette
175 T-VACR16 and 175 T-VAC16	630 1250 1600	72 73 74	109 110 111	75 75 75
175 T-VACR20 and 175 T-VAC20	630 1250 1600	75 76 77	111 112 113	75 75 75
175 T-VACR25 and 175 T-VAC25	630 1250 1600 2000 2500	78 79 80 159 161	114 115 116 201 NA	75 75 75 75 NA
175 T-VACR32 and 175 T-VAC32	630 1250 1600 2000 2500	155 155 157 159 161	197 197 199 201 NA	140 140 140 140 NA
175 T-VACR40 and 175 T-VAC40	630 1250 1600 2000 2500	157 157 159 161 163	199 199 201 203 NA	140 140 140 140 NA

1. Horizontal Phase Barrier (95kV BIL Only)
   68B3016H02
2. Vertical Phase Barrier (95kV BIL Only)
   69C3027G01
3. Integral Lifting Hook
   67A3137H01
4. Front Cover (Figure **3-10** for details)
   69C3056G01
5. 3mm Earthed Steel Barrier
   69C3104H03
6. Pole Unit Molding **70D3001G01**
7. Trip Unit Location (Non-Automatic Breaker Shown)
8. Secondary Disconnect with Protective Hood
9. Vacuum Interrupter (Part of Replacement Pole Unit Assembly - **67A3158** or **67A3159** or **67A3160**, depending on kA and AMP rating.
10. Primary Conductor Interface or Bottom Conductor – **69C3008H03**
11. Drive Insulator with Internal Contact Loading Spring (Wipe Spring)
    16kA – 69C3053G01
    25kA - 69C3053G03
12. Vacuum Interrupter Movable Stem
13. Rear Customer Mounting Holes
    69C3010G01 – Base Plate
14. Customer Earth Connection
    69C3010G01 - Base Plate

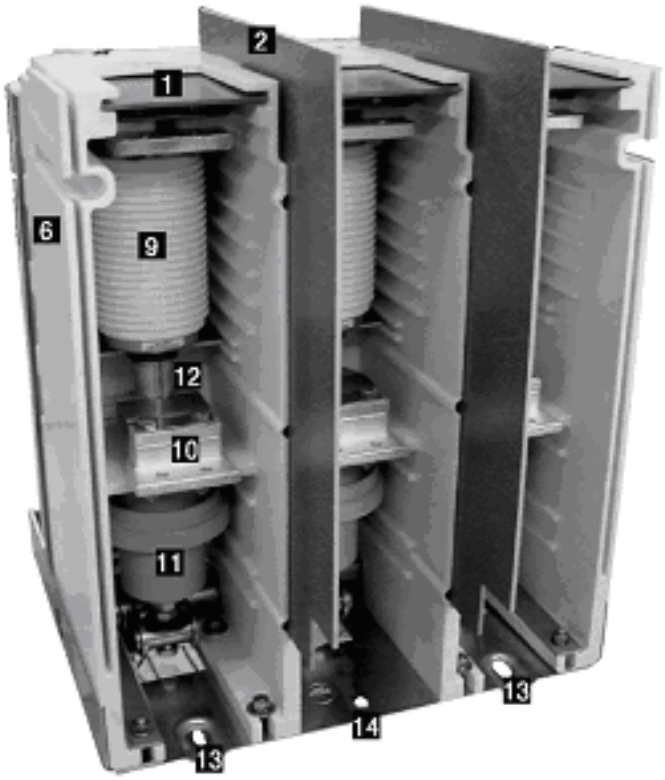
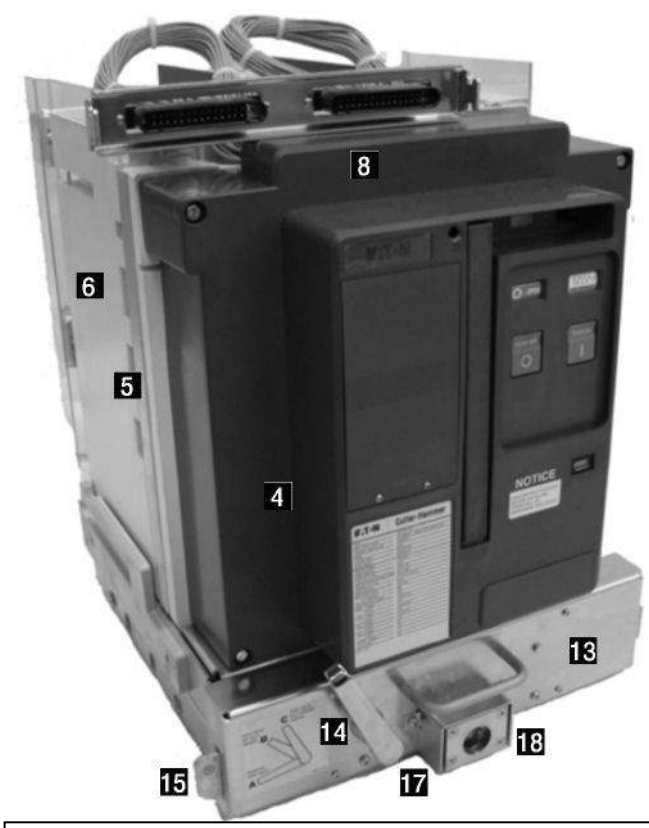
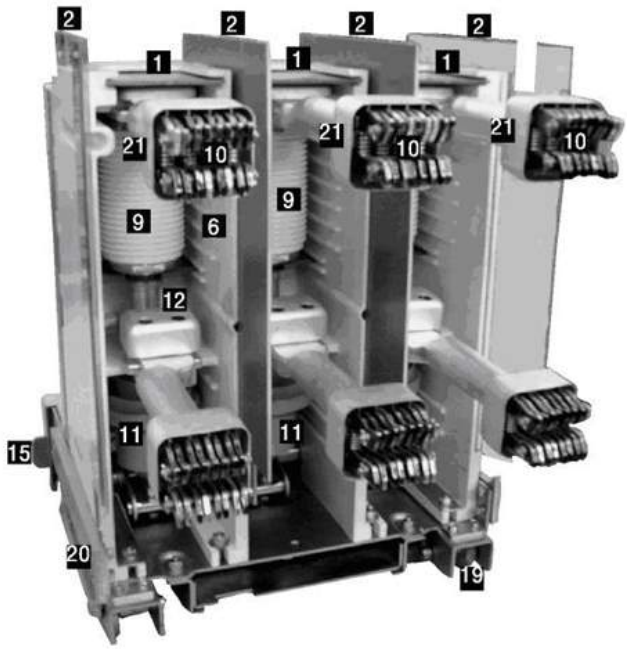


Figure 3-5 Front and Rear Views All T-VACR Fixed (except 25kA, 2000/2500A and all 31.5/40kA)





1. Horizontal Phase Barrier – 95kV BIL Only **68B3106H02**
2. Vertical Phase Barrier – 95kV BIL Only **69C3027G01**
3. Integral Lifting Hook **67A3137H01**
4. Front Cover **69C3056G01**
5. 11 Gauge Grounded Steel Barrier **69C3104H03**
6. Pole Unit Molding **70D3001G01**
8. Secondary Disconnect Protective Hood (Umbilical Cord Shown)
   Umbilical Harness Assembly **69C3261G01**
9. Vacuum Interrupter (This is part of the Pole Unit Assembly)
   67A3158, 67A3159, or 67A3160 (Depending on the kA and AMP Rating)
   (Contact your Eaton Sales or Local Eaton Rep. for more information).
10. Primary Disconnect Finger Cluster (1200/1250A Shown)
    1200/1250A – 68B3031G01 600/630A - 68B3031G02
11. Drive Insulator with Internal Contact Loading Spring (Wipe Spring).
    16kA – 69C3053G01 25kA – 69C3053G03
12. Vacuum Interrupter Movable Stem
13. Cradle with Levering Mechanism **25kA – 69C3305G01 40kA – 69C3305G11**
14. Shoot Bolt Handle – **Part of 69C3305**
15. Shoot Bolt - **Part of 69C3305**
16. Push/Pull Handle – **Part of 69C3305**
17. Racking Screw Lock Plate – **Part of 69C3305**
18. Levering Drive Nut – **Part of 69C3305**
19. Integral Wheel – Wheel **67A3201H01** Wheel Axle (Pin) – **67A3202H02**
20. Shutter Operator – **69C3213H05**
21. Primary Disconnect Cup (95kV BIL Only) – **68B3303H01**

Figure 3-6 Front and Rear Views All T-VAC Draw out (except 25kA, 2000A and all 3 1.5/40kA)

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. Earthing Bar - **69C3266H01**

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 Connection - **69C3266H01**

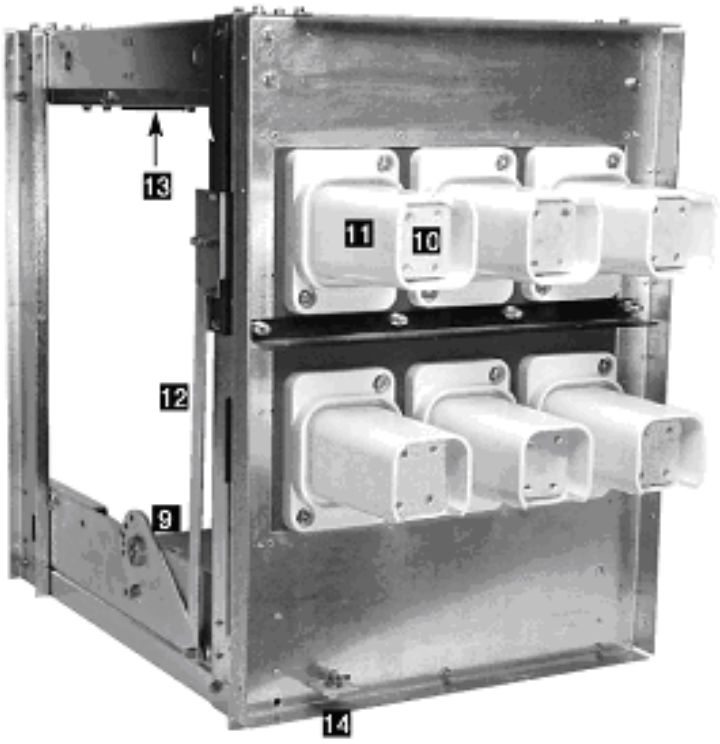
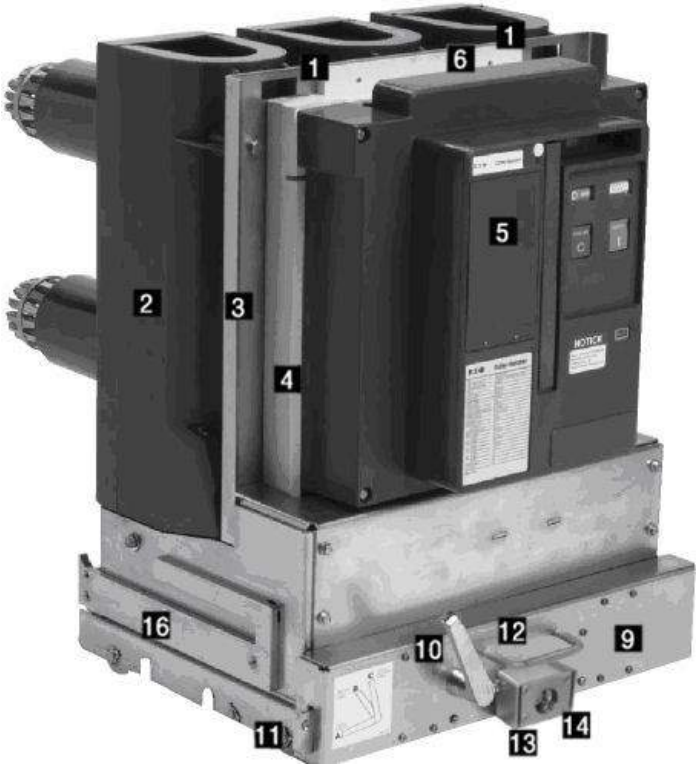


Figure 3-7 Front and Rear Views Draw out Cassette (except 25kA, 2000A and all 31.5/40kA, breaker compartment barrier not shown)



1. Integral Lifting Slots - **67A3137H01**
2. Pole Unit Molding - **70D3250G11**
3. 11 Gauge Grounded Steel Barrier **69C3254G01**
4. Front Cover (Figure **3-10** for details) **69C3056G01**
5. Trip Unit Location (Non-Automatic Breaker Shown)
6. Secondary Disconnect Protective Hood (Umbilical Cord not shown) **Harness 69C3261G01**

7. Pole Unit Molding Removable Cover **70D3251H02**
8. Vacuum Interrupter (Located Behind Removable Back Covers) **Part of Pole Unit**
9. Cradle with Levering Mechanism **69C3305G11**
10. Shoot Bolt Handle - **Part of 69C3305G11**
11. Shoot Bolt - **Part of 69C3305G11**
12. Push/Pull Handle - **Part of 69C3305G11**
13. Racking Screw Lock Plate - **Part of 69C3305G11**
14. Levering Drive Nut - **Part of 69C3305G11**
15. Integral Wheel - **67A3201H01** / Pin - **67A3202H02**
16. Shutter Operator - **69C3213H05**
17. Primary Disconnect Finger Cluster **502A852G02**
18. Contact Wipe Measurement Area

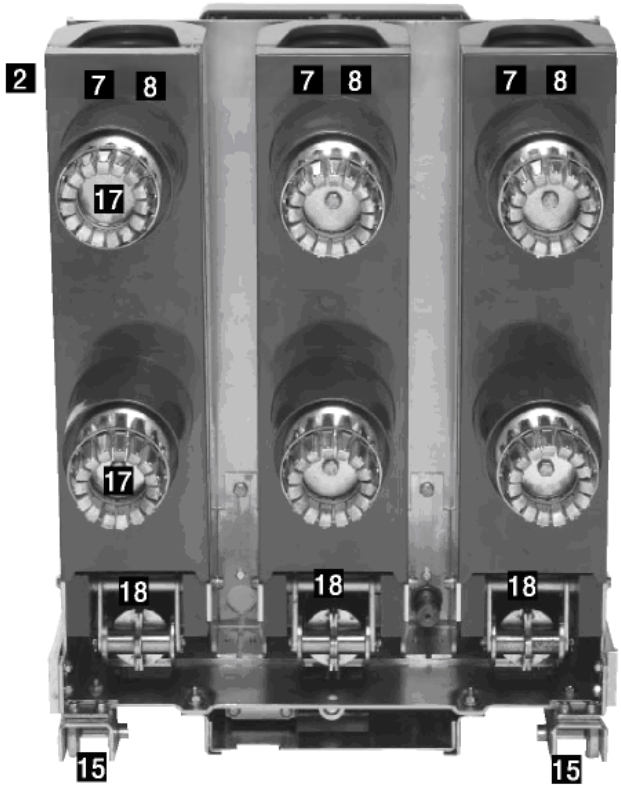
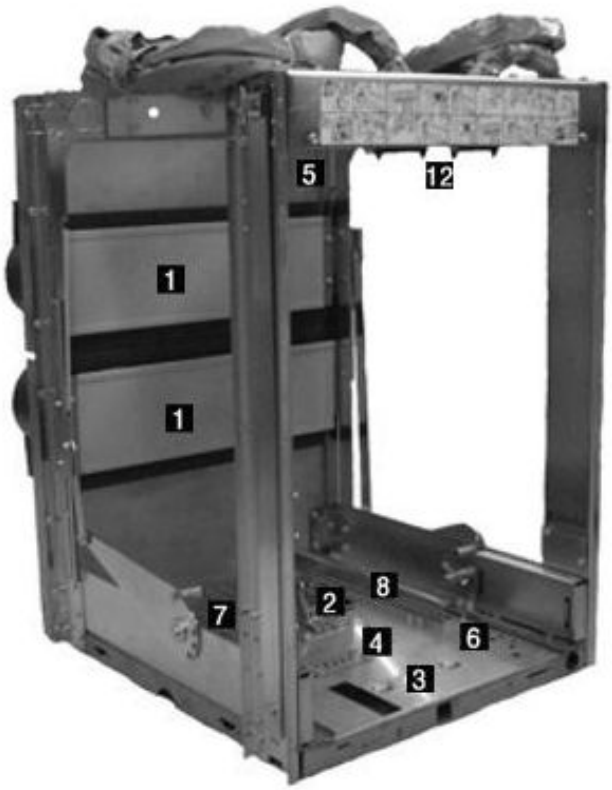


Figure 3-8 Front and Rear Views T-VAC Draw out (25kA, 2000A and all 31.5/40kA)



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

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

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

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

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

13. Customer 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 Bar

7. Position Switches

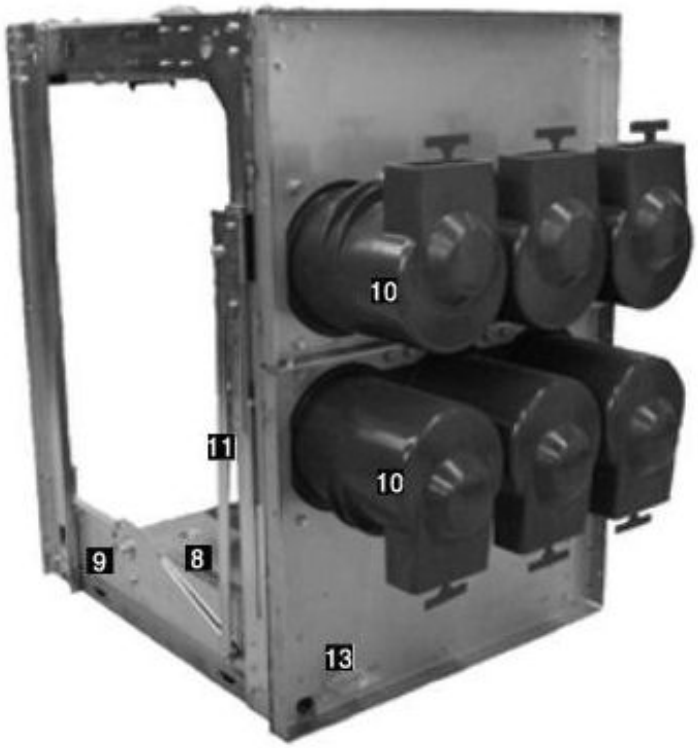
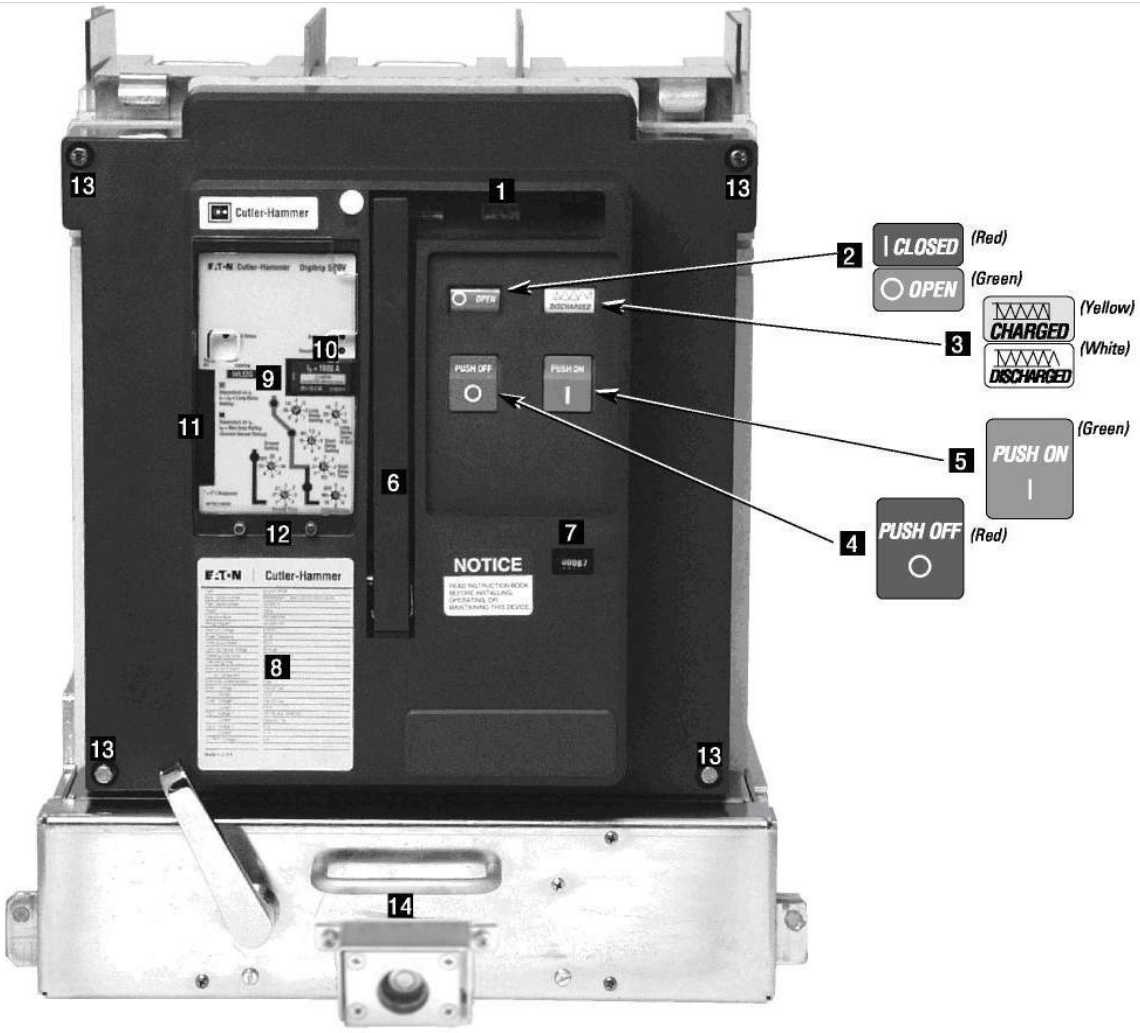


Figure 3-9 Front and Rear Views Draw out Cassette (25kA, 2000A and all 31.5/40kA, breaker compartment barrier not shown)



1. Accessory Window (3)

2. Contact Status (open-Close) - **2A10895G01**

3. Spring Status (Charged-Discharged) - **2A10895G01**

4. Manual “OFF” Button - **2A10895G01**

5. Manual “ON” Button - **2A10895G01**

6. Manual Charging Handle - **2C12297G01**

7. Operations Counter - **592C040H01**

8. Nameplate

9. Trip Unit (Optional) - **67A3153XXX / 67A3154XXX**

10. Rating Plug - **5720B93XXX**

11. Trip Unit Test Port

12. Trip Unit Cover with Two Mounting Screws (Screws Accept Customer Supplied Lead Security Seals)
WTU - **2C12190G01 / 2C12190G02**
W/O - **2C12812H06**

13. Front Cover Mounting Hardware
SPG Washer - **70550AC10R**
Flat Washer - **70540AK10R**
Bolt - **70045BB0BG**
O-Ring - **71070CA009**

14. Drawout Cradle (Drawout Circuit Breaker Only) - **69C3305G01 (25kA)**
69C3305G11 (40kA)

Figure 3-10 Typical T-VAC Front Cover

SECTION 4: INSTALLATION AND WIRING

NOTICE

Refer to the circuit breaker weights in Table 3.1 to ensure 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 interphase barriers installed. To check the electrical operation of a circuit breaker, follow the operational procedures outlined in Section 5.

For draw out 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 “Draw out 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 IEC 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

IEC requires specific dielectric performance. It is the customer's responsibility to insure that all required interphase 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 draw out circuit breakers depends primarily on the circuit breaker rating. Refer to Figures **1-1** to **1-6** for any required 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 T-VAC and T-VACR 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 **3-10).**

4-5 INSTALLING FIXED CIRCUIT BREAKER

The T-VACR fixed type circuit breaker differs from the T-VAC draw out circuit breaker in that it has no levering device, primary disconnects and secondary umbilical disconnect (Figure **4-1).** In addition, a T-VACR 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 T-VACR fixed circuit breaker is properly installed and applied in a fixed configuration. 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 hardware (Figures **1-1, 1-4,** 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 Non-Automatic T-VACR 17.5KV Circuit Breaker

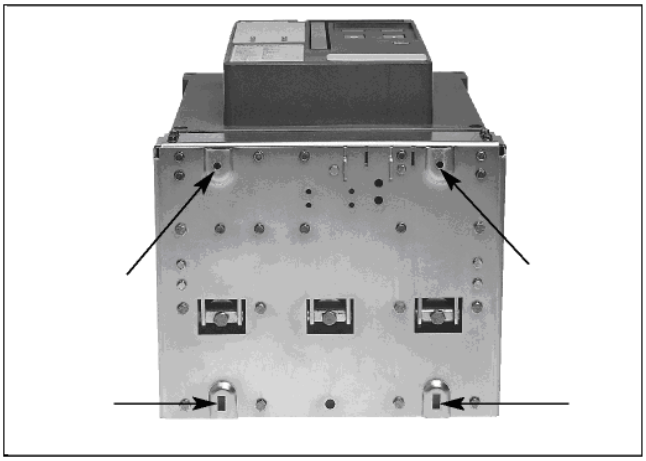


Figure 4-2 Bottom View of T-VACR Circuit Breaker showing Mounting Holes

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

4-6 INSTALLING DRAW OUT CIRCUIT BREAKER

T-VAC circuit breakers are installed in structures equipped for draw out circuit breakers. A bolted-in draw out cassette supports the circuit breaker (Figures **3-7** and **3-9).**

4-6.1 DRAW OUT MECHANICAL INTERFACES

Each draw out 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 draw out 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 draw out 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.

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						
31.5/40	1	1	1						
Current Rating (A)									
630				0	0	0			
1250				1	1	0			
1600/2000/2500				1	1	1			
Rated Voltage (kV)									
7.2							0	0	
12.0							0	1	
17.5							1	1	
Type									
Dummy Element									0
Circuit Breaker									1

① 0 = no pin required, 1 = pin required

Rejection Pin-Kit 68B3049G01

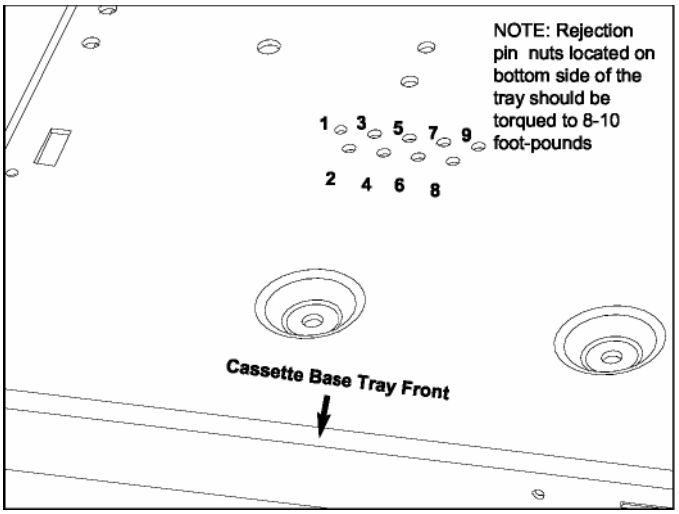


Figure 4-3 Cassette Rejection Interlock Pin Positioning

WARNING

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

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 interfaces 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. However, the closing spring may discharge. Shoot bolt details are provided later.

Anti-Close Interlock

This interlock prevents releasing the closing springs 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. However, the closing spring may discharge.

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 T-VAC draw out 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 connections 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 BREAKER LEVERING DETAILS (FIGURES 4-14 AND 4-15).

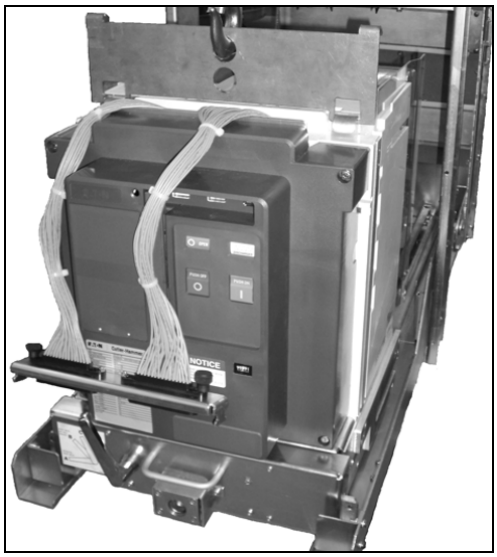


Figure 4-4 Position Circuit Breaker With Lifter On Removable Extension Rails

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, carefully 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** and **3-2.3** (Figure **4-4).** The cradle portion (bottom portion) of the draw out circuit breaker is provided with integrally mounted wheels for rolling on the removable extension rails and 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.

Figure 4-5 Breaker Shoot Bolts Against Cassette

The shoot bolt handle as shown in Figure 4-6 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 draw out 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.

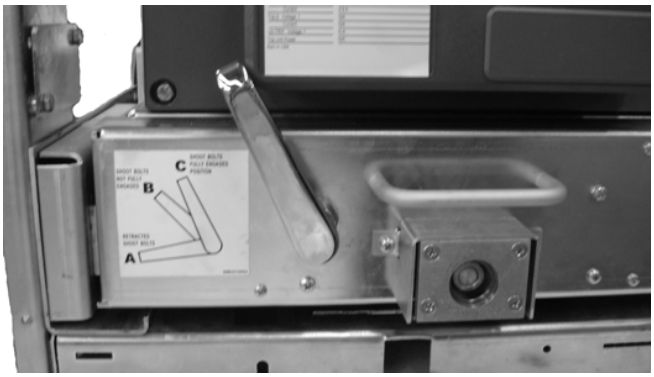


Figure 4-7 Shoot Bolt Handle Shown in Position "C" - Shoot Bolts Protrude Fully From Cradle

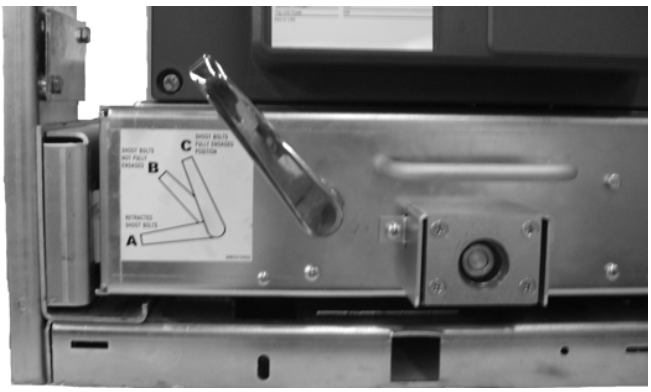


Figure 4-8 Shoot Bolt Handle Shown in Position "B" - Shoot Bolts Protrude Partially From Cradle

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

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).**

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 DRAW OUT 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 connected. 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

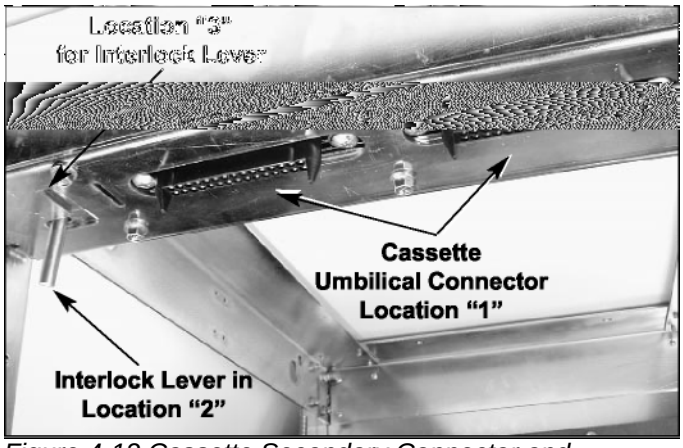


Figure 4-12 Cassette Secondary Connector and Interlock Lever

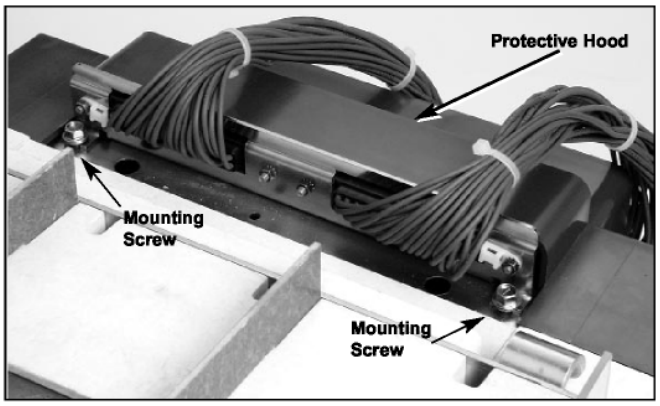


Figure 4-11 Secondary Connector Viewed From Rear of Breaker

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 interlock lever from Location **"2"** to Location **"3"** (right and forward 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 cassette's 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 Draw out Cassette with Primary Safety Shutters Open Showing Fixed Primary Stabs

back of the cassette (Figures **3-7, 3-9** 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 BREAKER POSITIONING DETAILS AND SEE FIGURES 4-14 AND 4-15.

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

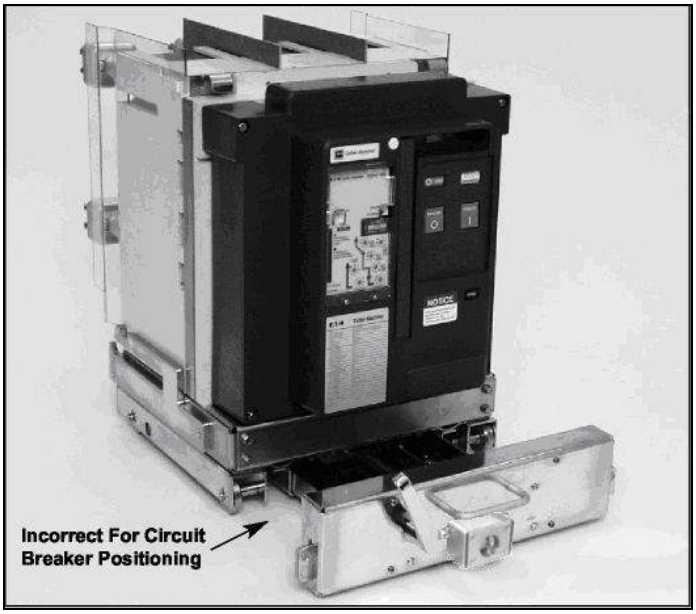


Figure 4-15 Circuit Breaker Shown in Levered In CONNECT Position - Incorrect for Breaker Positioning

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).**

Once the T-VAC 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 a deep (1 inch/25 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.**

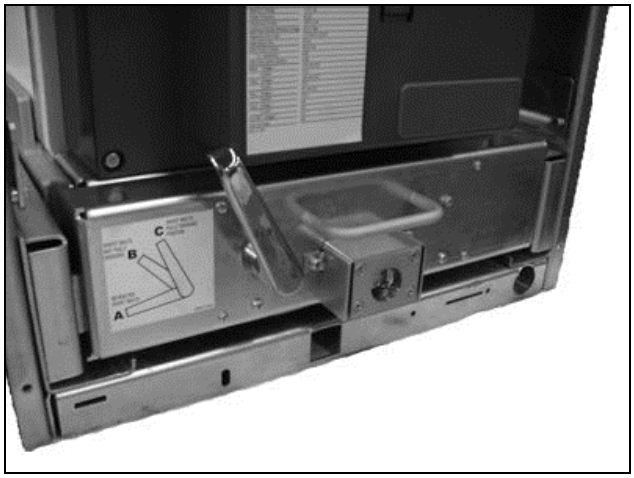


Figure 4-16 Cradle Mounted Levering Mechanism

Figure 4-17 Levering Circuit Breaker

Levering In Crank - 701B601G11

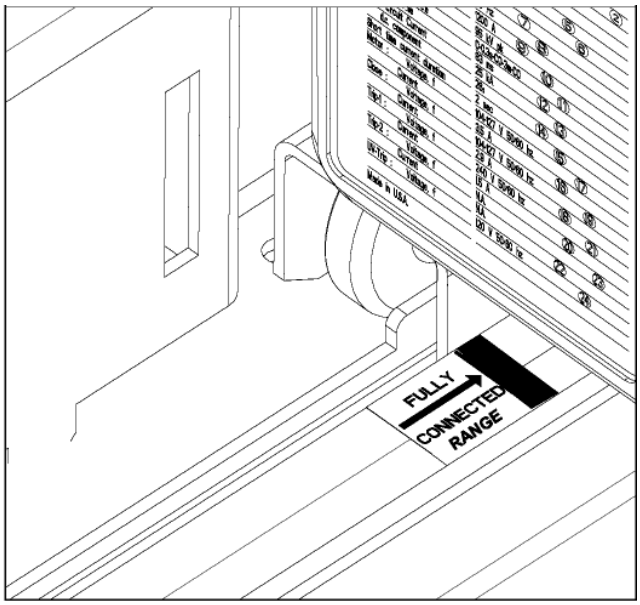


Figure 4-18 Circuit Breaker Connected as Indicated by Fully Connected Position Label

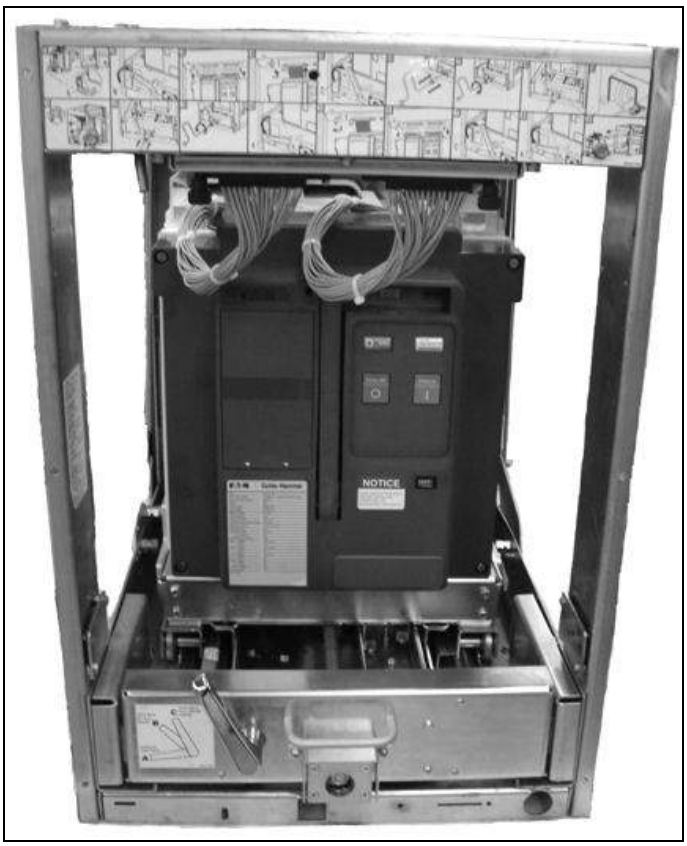


Figure 4-19 Circuit Breaker Shown in CONNECT Position with Secondary Connections Made

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, 3-9** 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

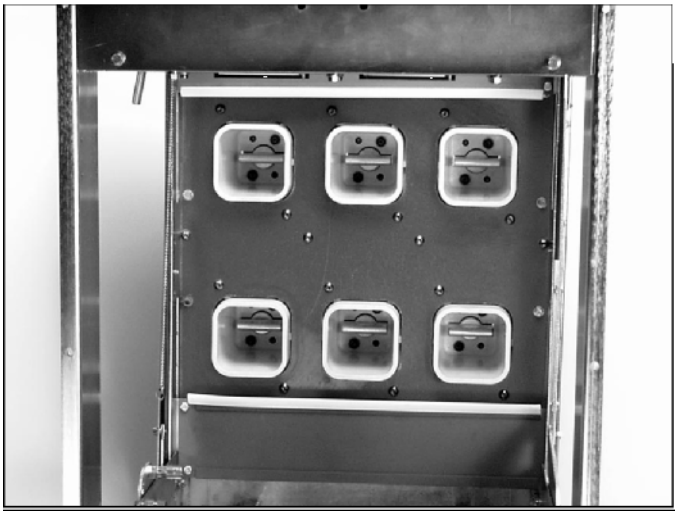


Figure 4-20 Primary Safety Shutters Shown in Open Position with Fixed Primary Stabs Exposed

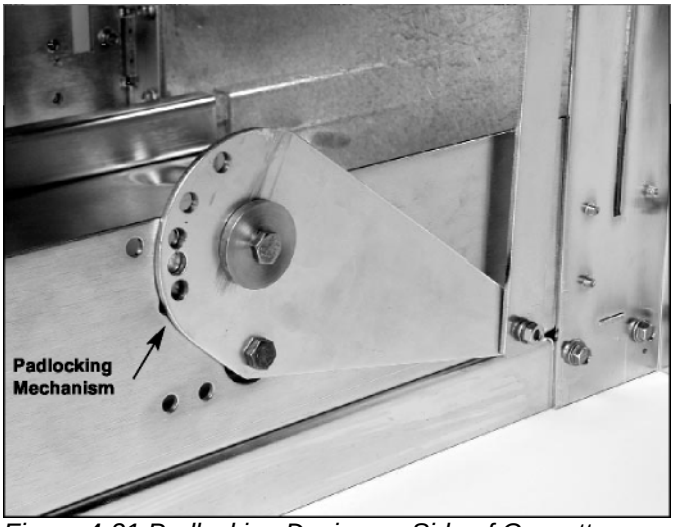


Figure 4-21 Padlocking Device on Side of Cassette

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.

SECTION 5: DESCRIPTION AND OPERATION

5-1 INTRODUCTION

The T-VAC vacuum circuit breaker is a draw out device while the T-VACR circuit breaker is a fixed mounted device. The T-VAC draw out circuit breaker is comprised of two parts. The upper circuit breaker element, much like the fixed T-VACR 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 certified to IEC62271 -100. The ratings are shown in Table **1.1.**

The circuit breakers utilize a proven two step stored energy mechanism, which is available as standard with manually charged closing springs or optionally with electrically charged closing springs. 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: 24, 48, 110, 125, 220 and 250 Vdc, and 110, 120, 220 and 240 Vac.

T-VAC and T-VACR 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
- 3 mm grounded steel safety barrier between primary and mechanism compartments

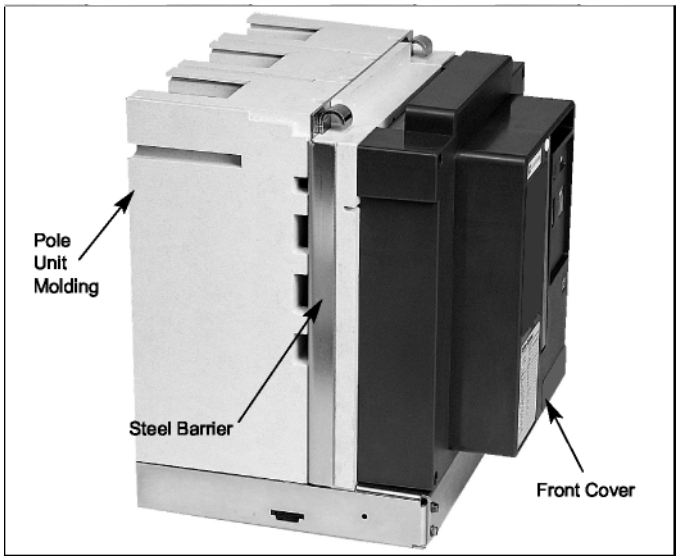


Figure 5-1 Typical Rigid Frame Construction

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 T-VACR 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 draw out T-VAC 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.

T-VAC draw out type and T-VACR 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 type contacts (Figures **5-2** and **5-3).**

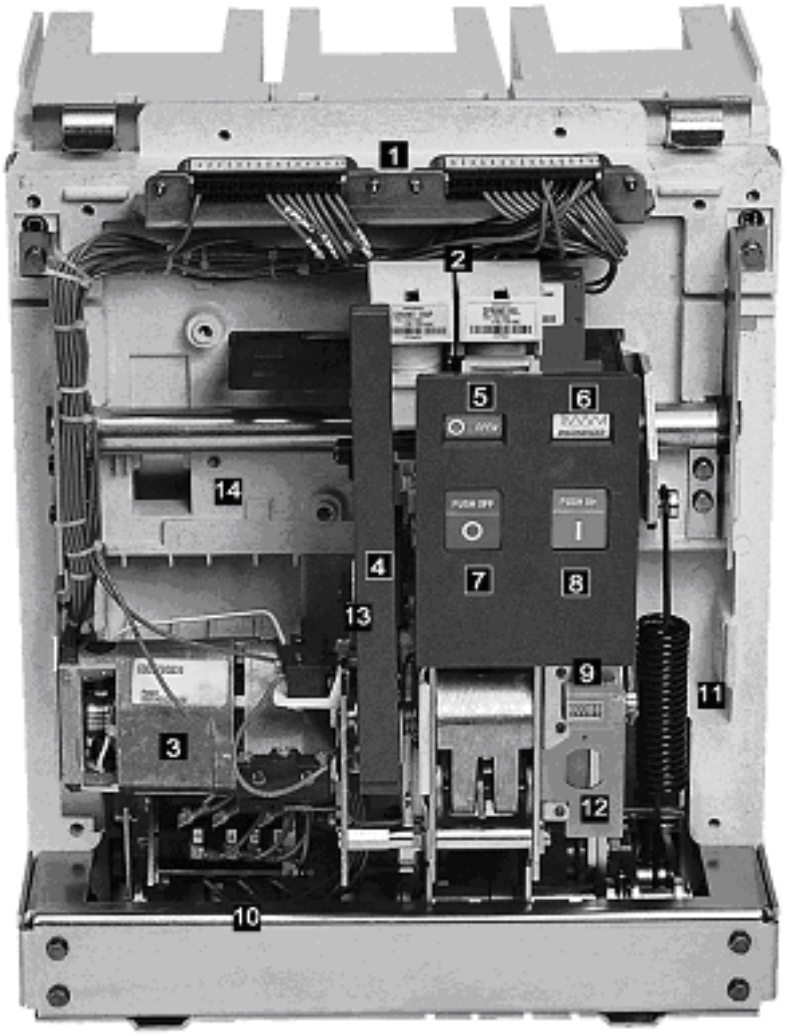
5-2 VACUUM INTERRUPTER ASSEMBLY

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

WARNING

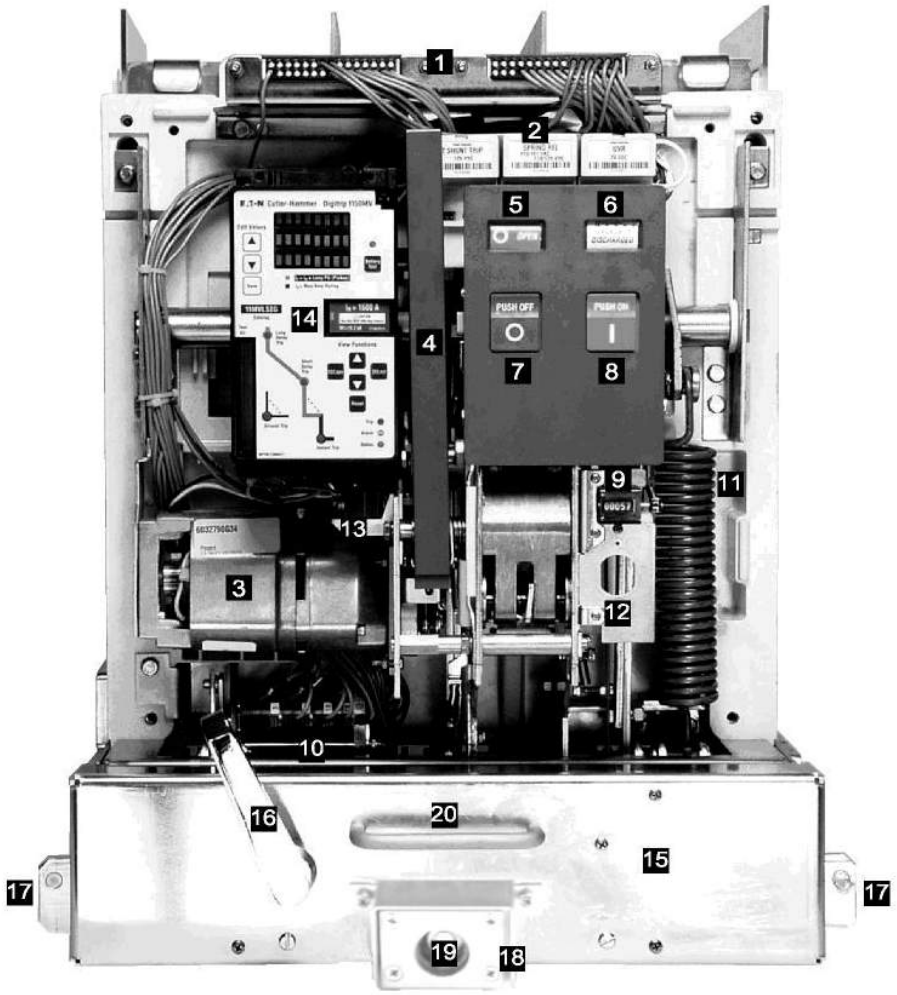
DO NOT PLACE ANY CIRCUIT BREAKER IN SERVICE WITHOUT ITS SUPPLIED HORIZONTAL AND VERTICAL BARRIERS, IF SO SUPPLIED, BEING PROPERLY IN PLACE. FAILURE TO COMPLY WITH THIS WARNING CAN CAUSE A CATASTROPHIC FAILURE RESULTING IN DEATH, SEVERE PERSONAL INJURY AND PROPERTY/EQUIPMENT DAMAGE.

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 up to 25kA and four sides on 31.5 and 40kA breakers providing the required mounting means, insulation, isolation, strength and rigidity. Certain VCP-T and VCP-TR 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



1. Secondary Wiring
2. Through-The-Window Accessories
3. Electric Charging Motor
4. Manual Charging Handle
5. Contact Status (Open-Close)
6. Spring Status (Charged-Discharged)
7. Manual “OFF” Pushbutton
8. Manual “ON” Pushbutton
9. Operations Counter
10. 5A/5B Auxiliary Switch
11. Opening Spring
12. OFF Key Lock Location
13. Motor Cutoff Switch
14. Trip Unit Location

Figure 5-2 Typical T-VACR Fixed Non-Automatic Circuit Breaker (Front Cover Removed)



1. Secondary Wiring
2. Through-The-Window Accessories
3. Electric Charging Motor - **69C3193XXX**
   Complete 10 Digit number depends on Control Voltage
4. Manual Charging Handle - **2C12297G01**
5. Contact Status (Open-Close) - **2A10895G01**
6. Spring Status (Charged-Discharged) **2A10895G01**
7. Manual “OFF” Pushbutton - **2A10895G01**
8. Manual “ON” Pushbutton - **2A10895G01**
9. Operations Counter – **592C040H01**
10. 5A/5B Auxiliary Switch – **698B822H01**
11. Opening Spring – **67A3139H02**
12. OFF Key Lock Location
13. Motor Cutoff Switch - **73430E1A02**
14. Integral Protective Relay (Optional)
15. Cradle with Levering Mechanism
    25kA - 69C3305G01
    40kA - 69C3305G11
16. Shoot Bolt Handle-**Part of 69C3305G11**
17. Shoot Bolt - **Part of 69C3305G11**
18. Racking Screw Lock Plate **Part of 69C3305G11**
19. Levering Drive Nut - **Part of 69C3305G11**
20. Push/Pull Handle – **Part of 69C3305G11**

Figure 5-3 Typical T-VAC Draw out Circuit Breaker (Front Cover Removed)

into service (Figures **3-5** and **3-6).** Other barriers may also be required in keeping with paragraph 4-3.

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

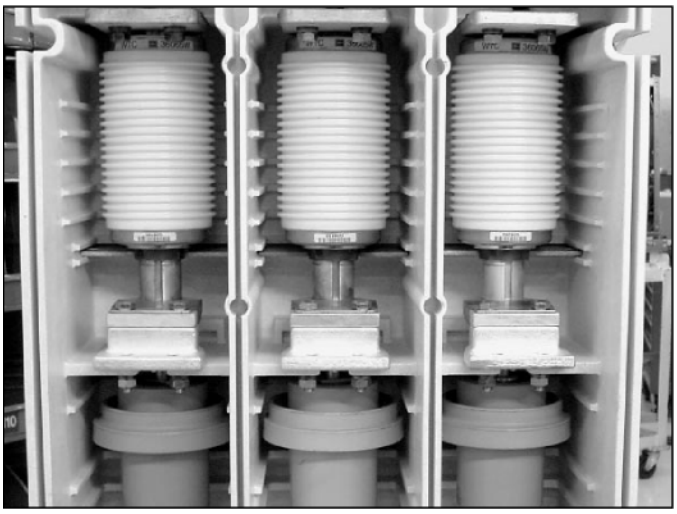


Figure 5-4 Typical Fixed 72 T-VACR Interrupter Assembly

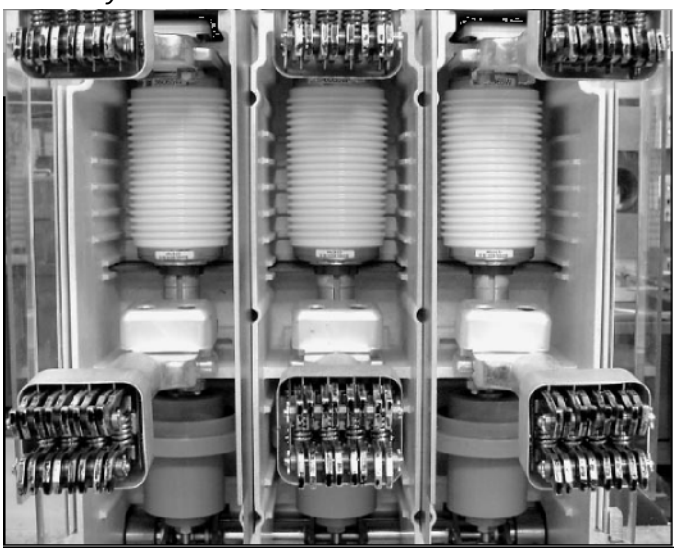


Figure 5-5 Typical Draw out 175 T-VAC Interrupter Assembly

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 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 (Up to 25kA)

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 (Up to 25kA)

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.

5-2.3 CONTACT WIPE AND EROSION (40KA)

Direct reading contact erosion indicators are not provided on 40Ka T-VAC and T-VACR breakers. The contact wipe is measured using a dialed caliper as described in paragraph 6-5.1. Acceptable or unacceptable contact erosion is determined from the contact wipe measurement.

The vacuum interrupters on 40kA breakers are not visible from the rear of the circuit breaker without removing the individual rear covers (Figure **3-8).** The rear covers are held in place by the upper and lower primary conductors which must be removed first to access the

vacuum interrupters. The rear covers do not have to be removed to take the contact wipe measurements. Measurements are taken at the very bottom of each pole unit as described in paragraph 6-5.1 (Figure **3-8).**

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 STORED ENERGY MECHANISM

CAUTION

KEEP HANDS AND FINGERS AWAY FROM THE BREAKER'S INTERNAL PARTS WHILE THE BREAKER CONTACTS ARE CLOSED OR THE CLOSING SPRINGS ARE CHARGED. THE BREAKER CONTACTS MAY OPEN OR THE CLOSING SPRINGS DISCHARGE CAUSING INJURY. DISCHARGE THE SPRINGS AND OPEN THE BREAKER BEFORE PERFORMING ANY MAINTENANCE, INSPECTION OR REPAIR.

The two step stored energy mechanism is arranged vertically in front of the circuit breakers. It is easily accessed by removing four cover screws and the front cover (Figures **3-10, 5-2** and **5-3).** The mechanism is based on a proven cam and spring design.

Figure 5-6 Breaker Closing Springs Being Manually Charged

The stored energy mechanism uses stored potential energy to close the circuit breaker. Sufficient energy to open the circuit breaker becomes available after a closing operation. After closing, springs can be recharged permitting the following operating sequence: open - close - open (O-CO). This feature provides a high degree of service continuity.

Manual controls are front accessible. Motion to close and open the interrupter contacts is provided through operating rods connecting the mechanism to the interrupter assemblies.

5-3.1 MANUAL OPERATION

A standard circuit breaker is a manually operated breaker with one shunt trip. The closing springs can only be charged manually. To manually charge the springs, insert one finger in the recess behind the charging handle and pull out. This permits a hand to grasp the handle and begin charging (Figure **5-6).** It takes a number of down-ward strokes on the charging handle to complete the manual charging process. Keep in mind that it is possible to manually recharge the springs immediately after closing the circuit breaker and before it has been tripped open.

Manually operated circuit breakers are normally closed and opened by hand using the manual "ON" and manual "OFF" buttons respectively. These buttons are conveniently located on the front of the circuit breaker (Figure **3-10).** Performing either operation is accomplished by pressing and releasing the appropriate button. Access to these pushbuttons can be limited by the use of an optional, padlockable cover. In addition, complete access to the "ON" pushbutton can be prevented with an optional prevent close cover. The status of the springs and the primary contacts is always indicated in an indicator window just above the pushbuttons. In addition, the standard shunt trip can also be used to electrically trip (open) the circuit breaker.

Other optional electrically operated devices are available to automatically close or trip manually operated circuit breakers. An electrical spring release is available to close a manually operated circuit breaker. Two other optional devices, a second shunt trip or an undervoltage release, can be used to automatically trip (open) a manually operated circuit breaker. All of these optional devices can be installed in the field. For more details, refer to paragraph 5-5.1 later in this section.

Manually operated circuit breakers are pre-wired to accept the addition of an electrical motor operator. An electrical operator is used to automatically charge the closing springs. Refer to paragraph 5-3.2 for more details.

5-3.2 ELECTRICAL OPERATION

For electrically operated circuit breakers, the springs are normally charged through the use of a rugged electrical motor operator (Figure **5-7).** The springs can, however, be manually charged as just described in the previous section.

Like the manually operated circuit breaker discussed in the previous section, electrically operated circuit breakers can also be manually closed and opened through the use of the front mounted manual "ON" and manual "OFF" pushbuttons. A factory supplied electrically operated circuit breaker is equipped as standard with a spring release to close the circuit breaker electrically and a shunt trip to trip (open) the circuit breaker electrically. A second shunt trip or an undervoltage release are available optional devices. Refer to paragraph 5-5.1 for more details.

5-3.3 TRIP FREE OPERATION

When the manual trip button is held depressed, any attempt to close the circuit breaker will be prevented.

5-3.4 ANTI-PUMP FEATURE

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

5-3.5 LATCH CHECK SWITCH

Any circuit breaker capable of being electrically closed is provided with a latch check switch. The latch check switch insures that all closing conditions are met before the circuit breaker can be electrically closed. If a spring release device is supplied for installation in the field, a latch check switch must also be purchased and used.

5-3.6 MECHANICAL INTERLOCKS

The mechanical interlock function can be provided in two ways:

(1) One is an optional fixed breaker key interlock located on the circuit breaker's front cover (Figure **5-8).** The key interlock can utilize Ronis, Castell or Kirk devices. This mechanical interlock feature prevents the circuit breaker from closing.

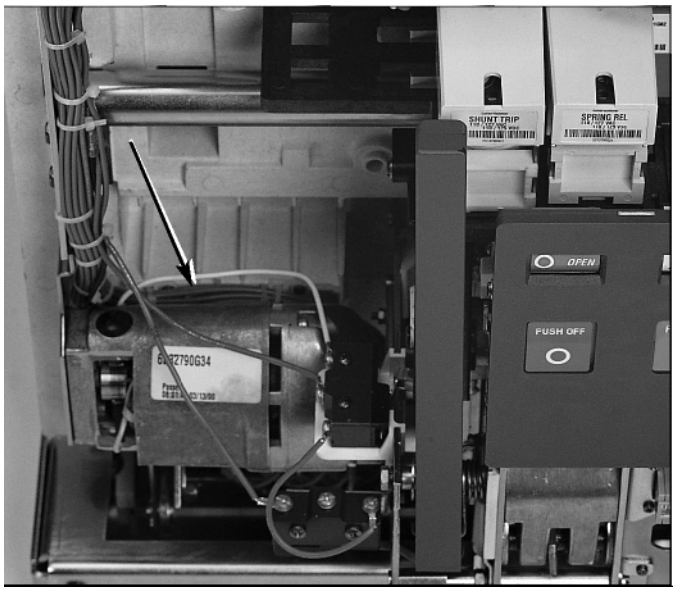


Figure 5-7 Motor Operator Shown Installed

(2) The other means is a family of optional mechanical interlocks (Figure **5-9).** They are used to prevent the closing of two or three circuit breakers. The mechanical interlock holds one or more circuit breakers tripped (prevents closure) when others are closed. The circuit breakers are interconnected with either cables or rods, depending upon the relative orientation of the breakers

Figure 5-8 Typical Cover Mounted Key Interlock

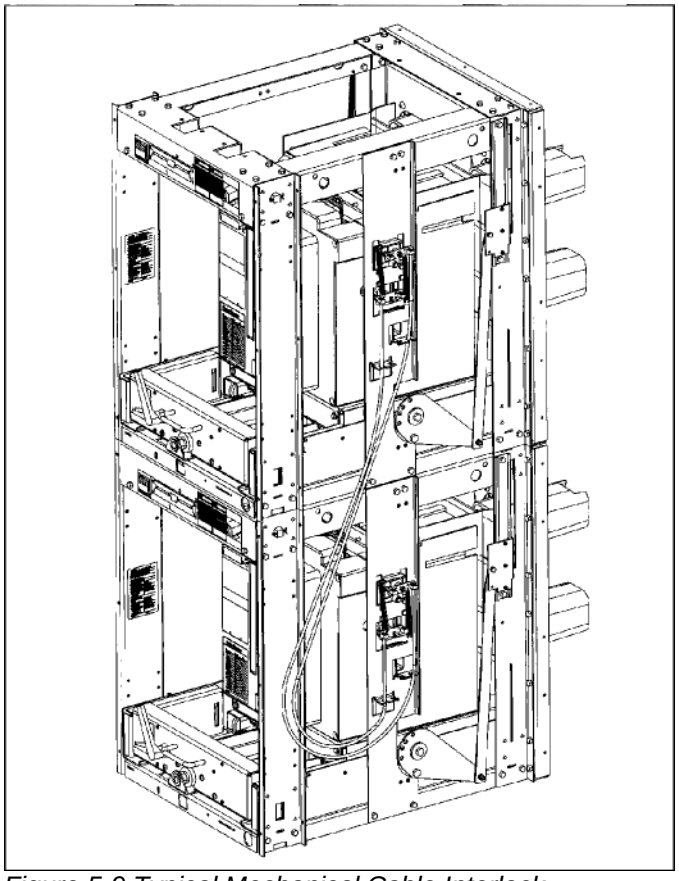


Figure 5-9 Typical Mechanical Cable Interlock

5-4 CONNECTION DIAGRAMS

Connection Diagrams for all circuit breakers are shown in Figure **5-10, 5-11, 5-12** and **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 T-VAC and T-VACR 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

Reclosing 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 (Figures **5-5, 5-6, 5-9** and **5-14).** 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 **5-15).**

There are two secondary connection options for fixed type T-VACR 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 (Figure **5-16).** 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 **5-17).**

Draw out type T-VAC 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 draw out cassette.

A standard tool is available from the plug-in connector manufacturer (AMP) to facilitate the removal of secondary wiring from the plug-in connector (Figure **5-18).** The connector halves must be separated to use this tool.

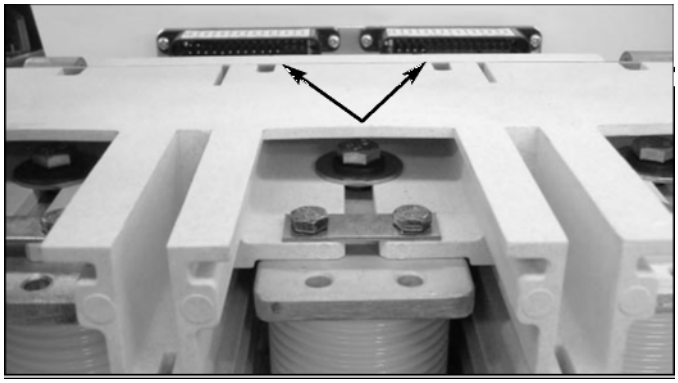


Figure 5-14 Secondary Connectors Shown Mounted without Secondary Protective Hood In Place

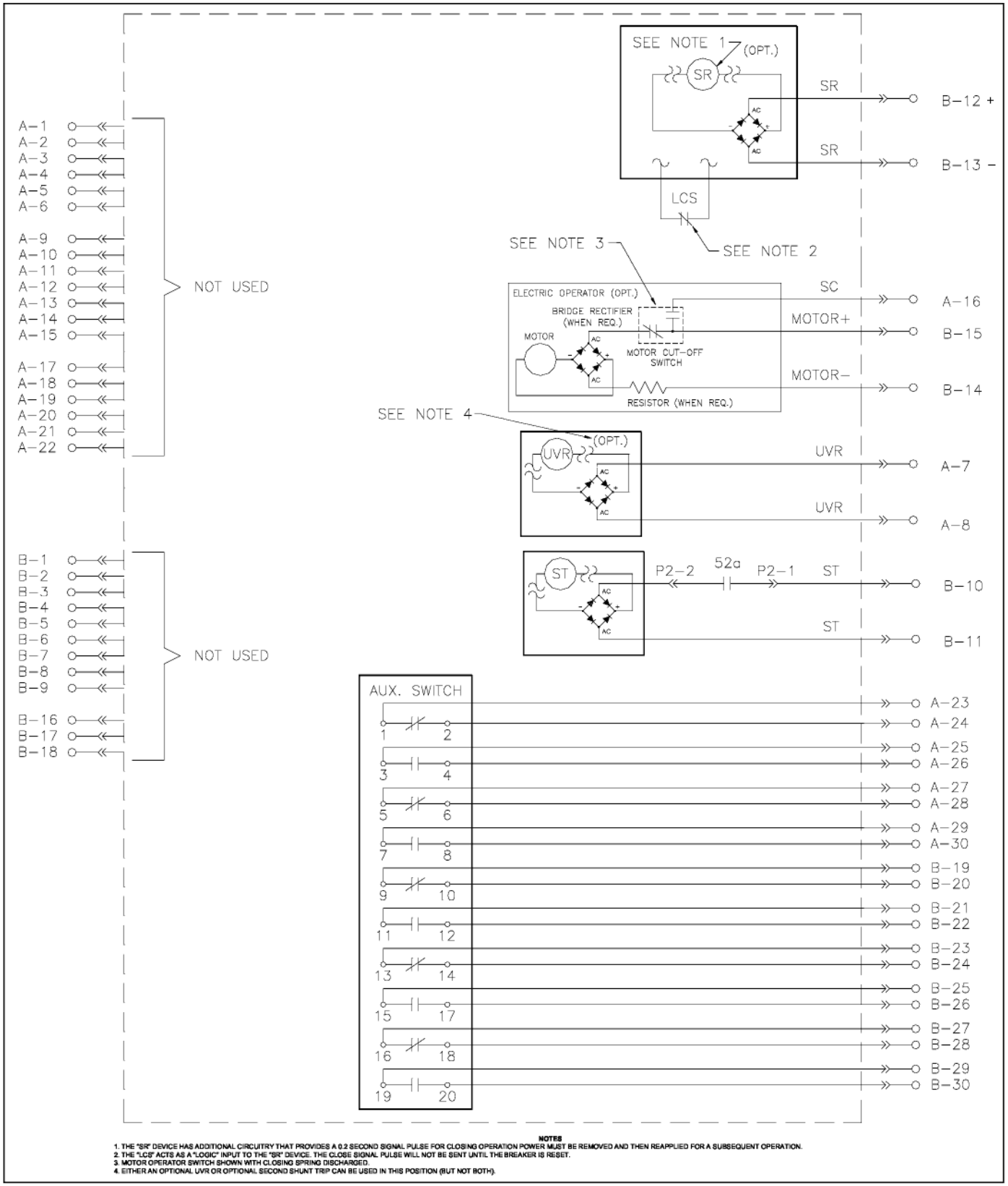


Figure 5-10 T-VAC and T-VACR Non Trip Unit Connection Diagram

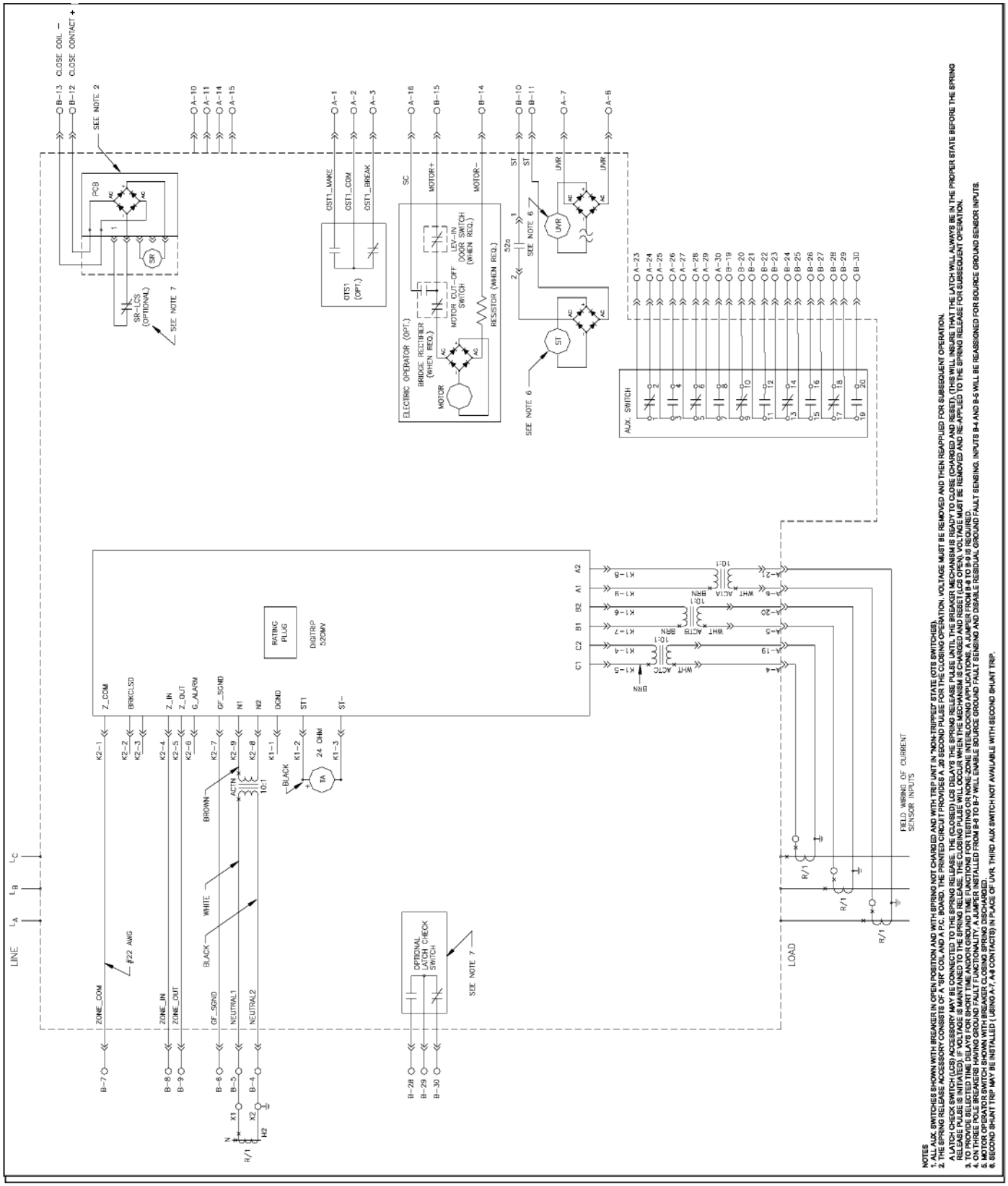


Figure 5-11 T-VAC and T-VACR with 520V Trip Unit Connection Diagram

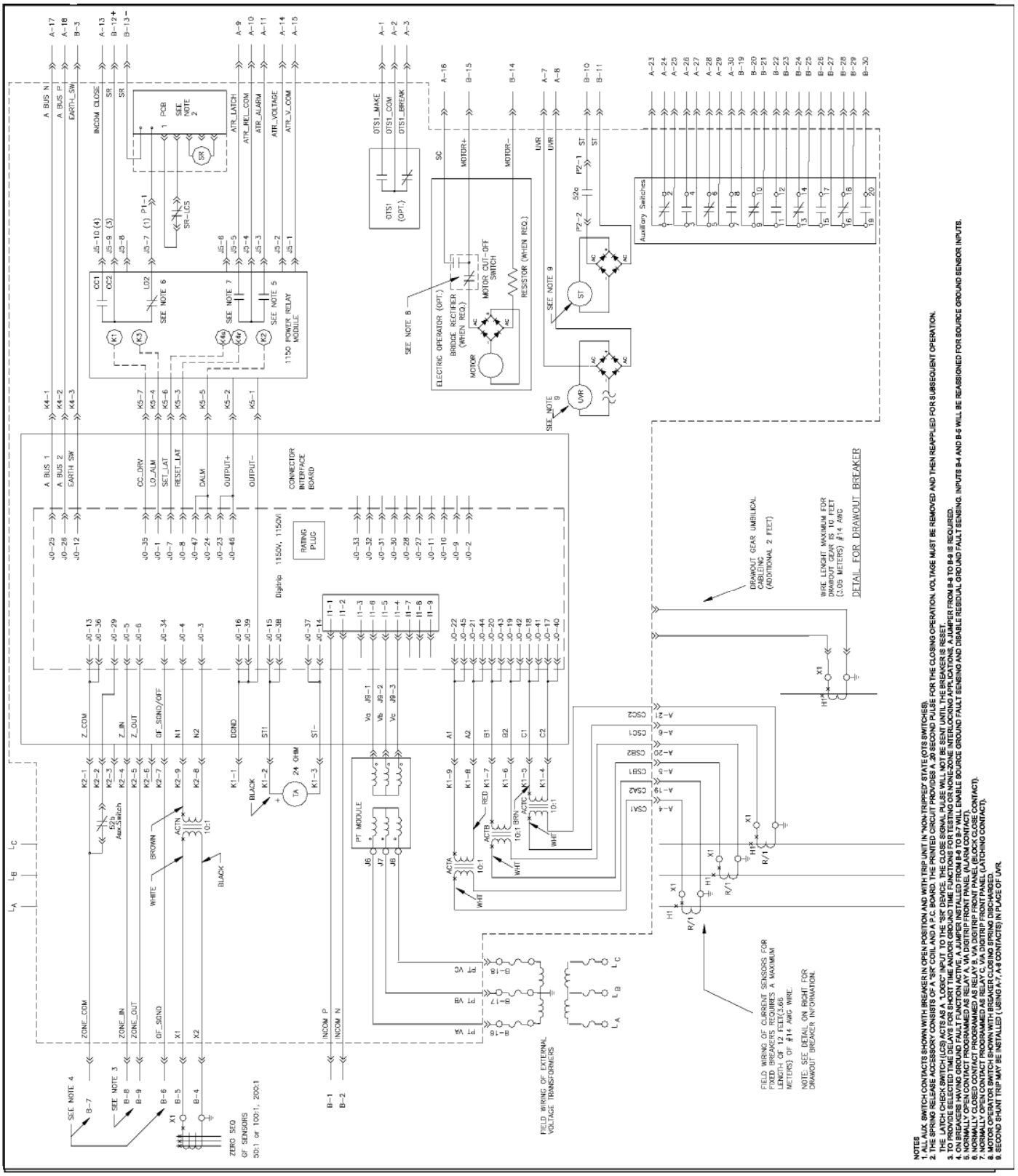


Figure 5-12 T-VAC and T-VACR with 1150Vi Trip Unit Connection Diagram

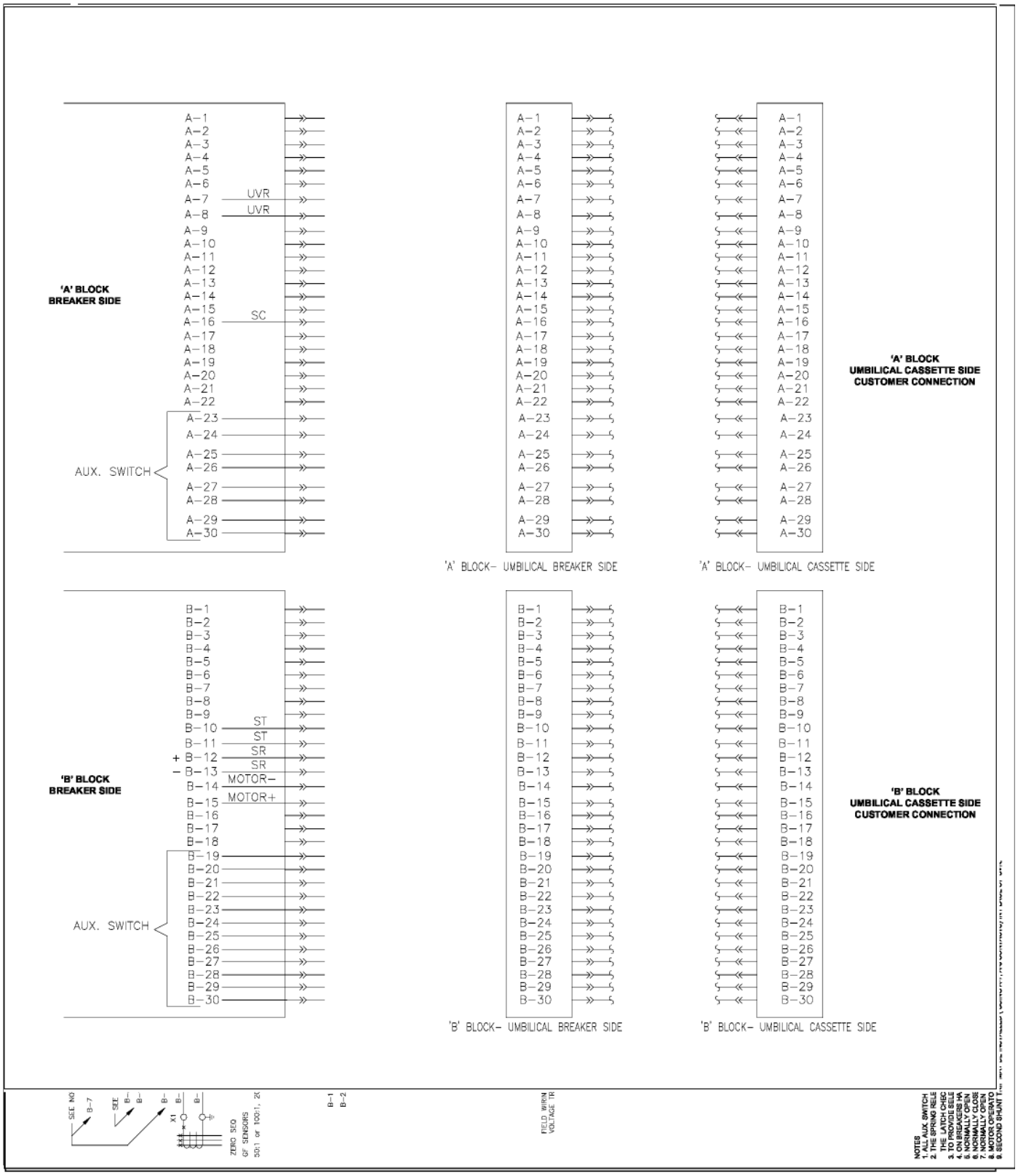


Figure 5-13 T-VAC Draw out Umbilical Cord and Connector Wiring Diagram

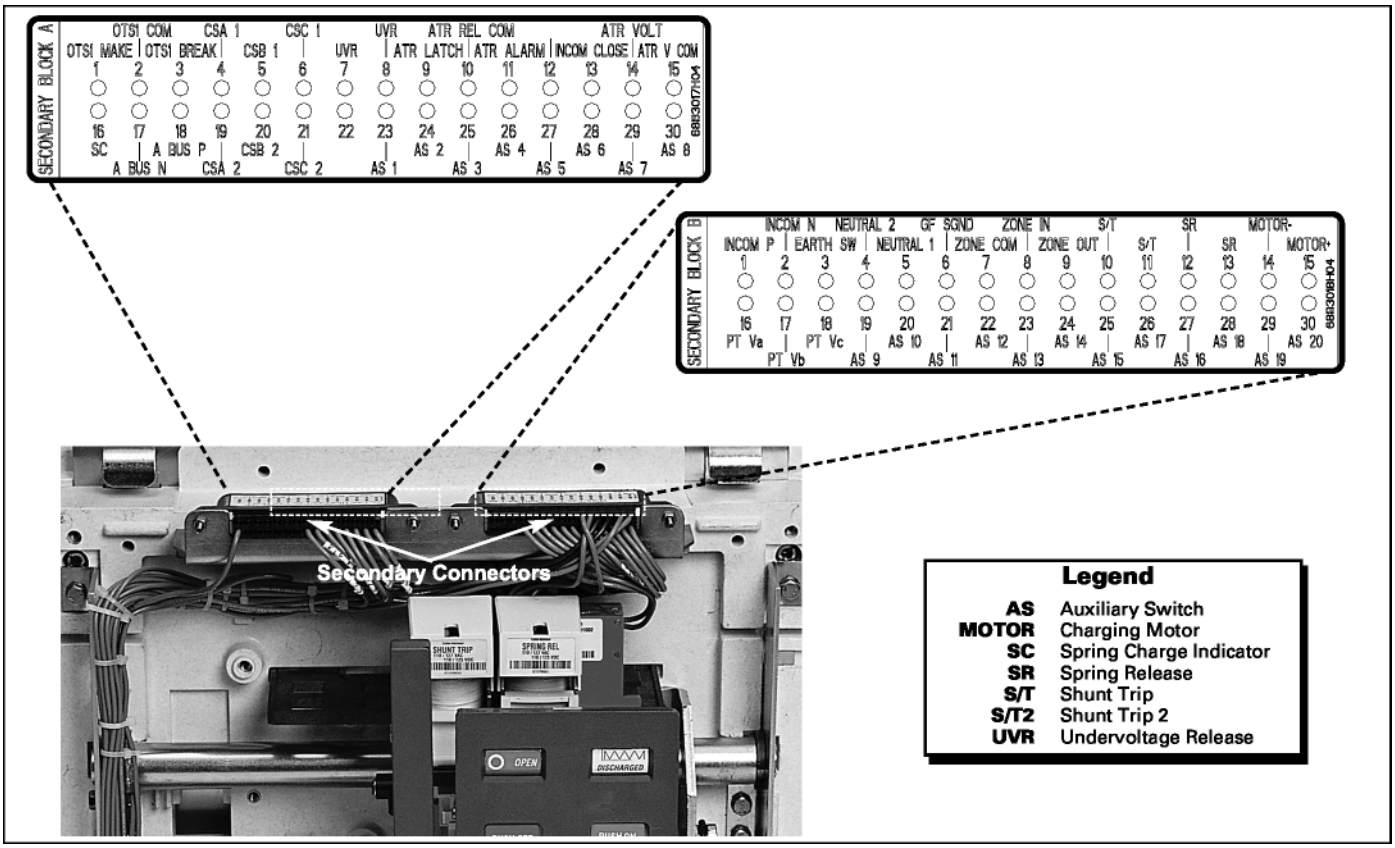


Figure 5-15 Top View Secondary Connectors

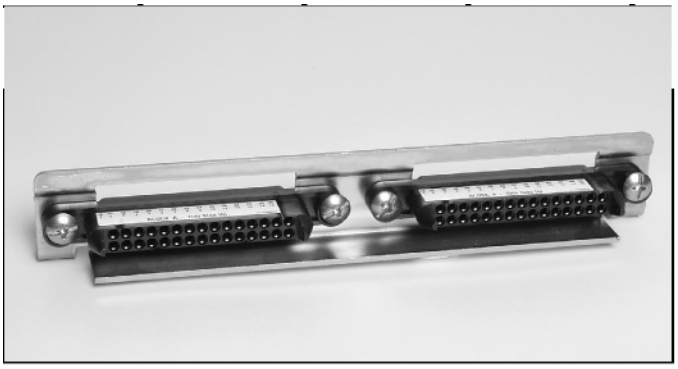


Figure 5-16 Secondary Male Connector with Female Pins

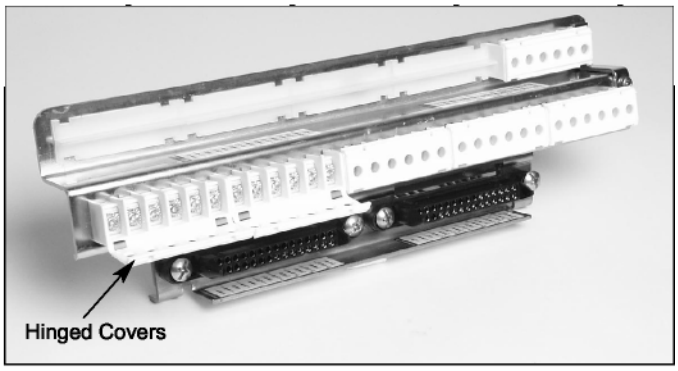


Figure 5-17 Optional Terminal Block

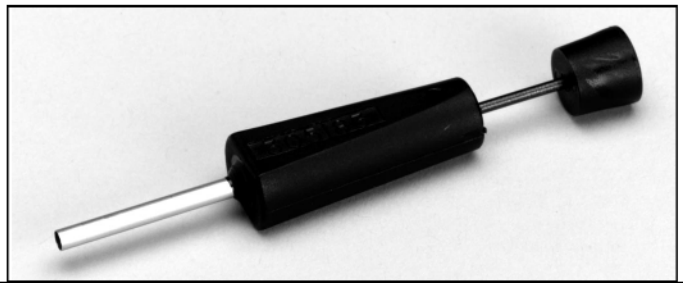


Figure 5-18 AMP Secondary Wiring Removal Tool (AMP#305 183)

5-5 ELECTRONIC TRIPPING SYSTEM

T-VAC and T-VACR circuit breakers utilize a three part tripping system:

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

All three parts of the tripping system are discussed here, except that the trip unit itself is not discussed in detail. 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

T-VAC and T-VACR 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 1150Vi) are not interchangeable in the field. Contact Eaton for upgrading to Model 520V or Model 1150Vi.

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 5-19 Digitrip RMS 1150 Vi Programmable Trip Unit Installed in T-VAC Circuit Breaker

Table 5.1 Digitrip Trip Units

Functions	*520V*	*1150Vi②*
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

①Three-line, (eight characters per line) LED display.
②Available control voltages are 24/48Vdc, 1 20Vac and 240Vac

A functional local test can be performed through the trip unit's test receptacle (Figure **5-19).** A small hand held functional Test Kit is used to check circuitry and mechanical tripping functions (Figure **5-20).**
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 5-20 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 **5-19** 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 0.1 Nm.**

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 pre-selected 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.

5-5.4 TRIP ACTUATOR

The trip actuator is a small cylindrically shaped electromagnetic device which acts mechanically to trip the circuit breaker. In general, it is comprised of a permanent magnet, a coil and a spring loaded rod to produce the mechanical tripping, and a lever for resetting the actuator after tripping occurs. The electronic trip unit provides a pulse which counteracts the effect of the permanent magnet, allowing the spring loaded rod to act mechanically. The device is reset when the circuit breaker opens.

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
2000	2500	----

5-6 ACCESSORY DEVICES

A variety of accessory devices are available for use with T-VAC and T-VACR 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 three categories:

- Plug-in electrical
- Internal electrical
- Mechanical

5-6.1 PLUG-IN ELECTRICAL ACCESSORIES

There are three plug-in electrical accessories. All three can be viewed for identification by name and rating through viewing windows located in the right front of the circuit breaker (Figure **5-21).** These accessories can be factory installed or field installed using a kit. A maximum of three plug-in accessories can be mounted. Two trip devices and one close device can be used. The three plug-in accessories are:

- Shunt Trip (ST)
- Spring Release (SR)
- Undervoltage Release (UVR)

Shunt Trip - The shunt trip opens the circuit breaker instantaneously when its coil is energized by a voltage input (Figure **5-22** and Table **5.3).** One shunt trip is supplied as standard with all manually operated and electrically operated circuit breakers. An optional second shunt trip can be supplied for customer use.

Spring Release - The spring release remotely closes the circuit breaker when the coil is energized by a voltage input (Figure **5-23** and Table **5.4).** A spring release is supplied as standard with all electrically operated circuit breakers. In every other situation, the spring release is an optional device.

Undervoltage Release - The undervoltage release opens the circuit breaker when the supply voltage falls below 70% (Figure **5-24** and Table **5.5).** If the release is not energized to 85% of its supply voltage, the circuit breaker cannot be reclosed electrically or manually. The undervoltage release device is always optional.

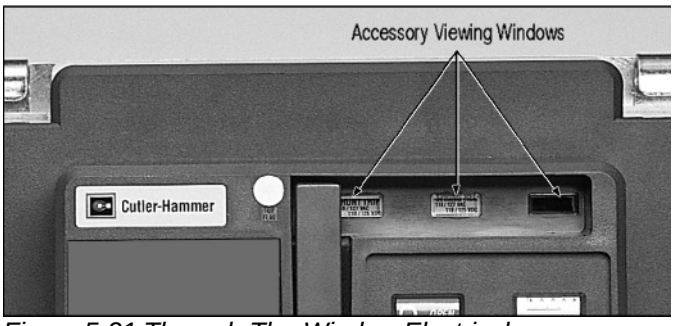


Figure 5-21 Through-The-Window Electrical Accessories

Figure 5-22 Shunt Trip Device

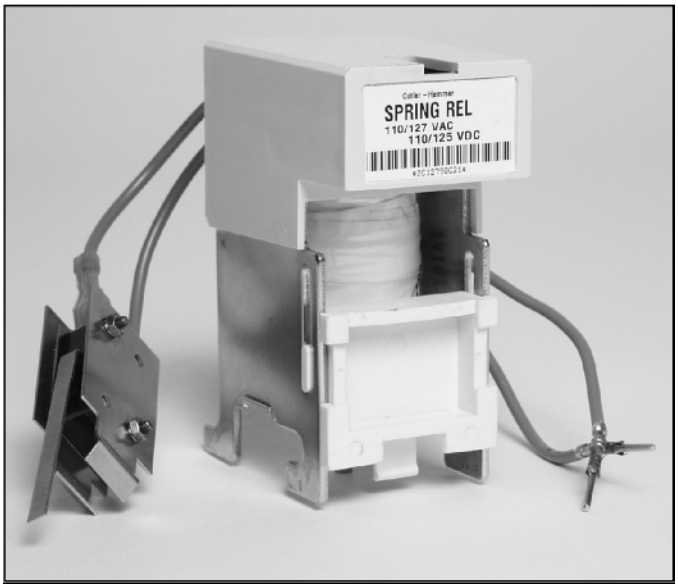


Figure 5-23 Spring Release Device

Table 5.3 Shunt Trp Ratings

Control Voltages	Operational Voltage Range	Inrush Power Consumption	Typical Opening Time
24 Vdc	17-26	250 VA	25 - 38 ms
48 Vdc	34-53	250 VA	25 - 38 ms
110 Vdc	77 - 121	450 VA	25 - 38 ms
125 Vdc	88-138	450 VA	25 - 38 ms
220 Vdc	154-242	450 VA	25 - 38 ms
250 Vdc	175-275	450 VA	25 - 38 ms
110 Vac	77 - 121	Cap. Trip	25 - 38 ms
120 Vac	84-132	Cap. Trip	25 - 38 ms
220 Vac	154 - 242	Cap. Trip	25 - 38 ms
240 Vac	168 - 264	Cap. Trip	25 - 38 ms

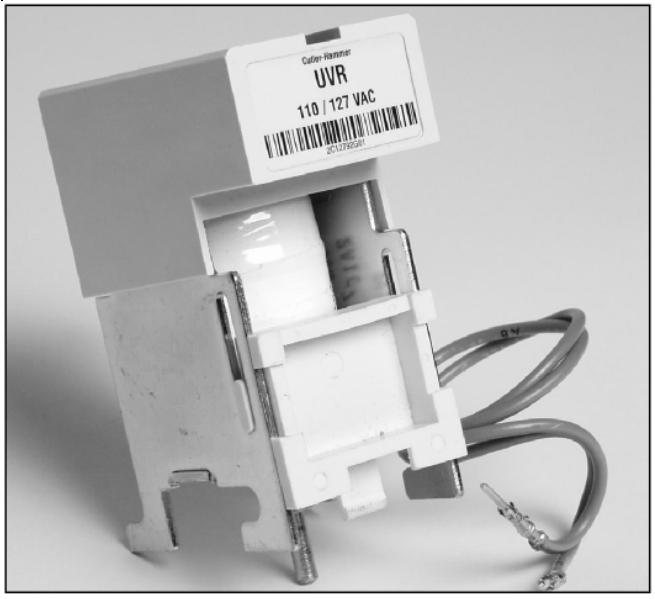


Figure 5-24 Undervoltage Release Device

Table 5.5 Undervoltage Release Rating

Control Voltages	Operational Voltage Range	Dropout Voltage 35-60%	Inrush Power Consumption	Continuous Power Consumption
24 Vdc	20 - 26	8 - 14	250 VA	18 VA
48 Vdc	41 - 53	17 - 29	275 VA	18 VA
110 Vdc	94 - 121	39 - 66	450 VA	10 VA
125 Vdc	106 - 138	44 - 75	450 VA	10 VA
220 Vdc	187 - 242	77 - 132	450 VA	10 VA
250 Vdc	213 - 275	88 - 150	450 VA	10 VA
110 Vac	94 - 121	39 - 66	450 VA	10 VA
120 Vac	102 - 132	42 - 72	450 VA	10 VA
220 Vac	187 - 242	77 - 132	400 VA	10VA
240 Vac	204 - 264	84 - 144	400 VA	10VA

Table 5.4 Spring Release Ratings

Control Voltages	Operational Voltage Range	Inrush Power Consumption	Typical Closing Time
24 Vdc	20-27	250 VA	60 ms
48 Vdc	41-53	250 VA	60 ms
110 Vdc	94 - 121	450 VA	60 ms
125 Vdc	106-138	450 VA	60 ms
220 Vdc	187 - 242	450 VA	60 ms
250 Vdc	213 - 275	450 VA	60 ms
110 Vac	94 - 121	450 VA	60 ms
120 Vac	102 - 132	450 VA	60 ms
220 Vac	187 - 242	450 VA	60 ms
240 Vac	204 - 264	450 VA	60 ms

5-6.2 INTERNAL ELECTRICAL ACCESSORIES

Other electrical accessories are mounted inside the circuit breaker behind the front cover. Access to these devices is gained by simply removing the front cover.

There are three internally mounted electrical accessories:

- Motor Operator
- Auxiliary Switch
- Trip Indicator/Overcurrent Trip Switch

Motor Operator - A motor operator is a rugged electric motor assembly internally mounted in the circuit breaker (Figure **5-25** and Table **5.6).** It charges the closing springs electrically for remote or local operation. The motor operator can be factory or field installed.

Manually operated circuit breakers are pre-wired to accept the addition of an electrical motor operator in the field. A UL listed motor operator kit is available for this conversion.

Auxiliary Switch - A 5a, 5b auxiliary switch is supplied as standard on all circuit breakers for customer use (Figure **5-26** and Table **5.7).** The switch is a heavy duty, double break type switch with wipe type contacts.

Trip Indicator/Overcurrent Trip Switch - The optional trip indicator is supplied on breakers ordered with Digitrip RMS trip units. It provides a visual indication, through a red pop-out plunger mounted above the trip unit, that the electronic trip system has initiated a trip signal. The trip indicator is reset by pushing the plunger back into its normal position. The trip indicator does not have to be reset in order to operate the breaker or the trip unit.

The trip indicator is available with or without a SPST over-current trip switch. This switch only changes state with the trip indicator.

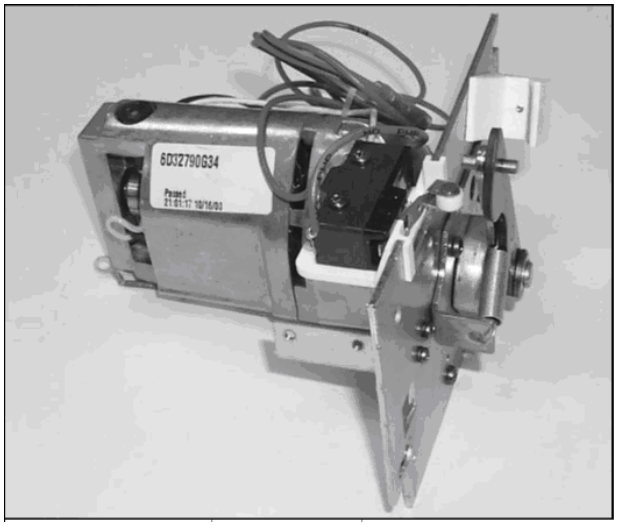


Figure 5-25 Rugged Motor Operator Kit

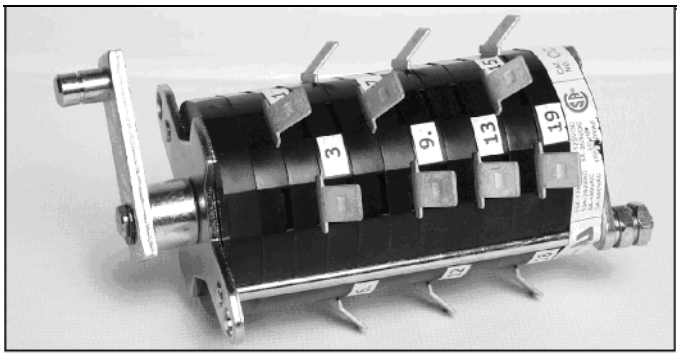


Figure 5-26 Auxiliary Switch

Table 5.6 Motor Operator Ratings

Control Voltages	Operational Voltage Range	Running Current	Inrush Current	Power Consumption	Charging Time
24 Vdc	20-27	8 Amperes	400% of Running	250 VA	5 sec
48 Vdc	41-53	4 Amperes	400% of Running	250 VA	5 sec
110 Vdc	94 - 121	3 Amperes	400% of Running	250 VA	5 sec
125 Vdc	106 - 138	3 Amperes	400% of Running	250 VA	5 sec
220 Vdc	187 - 242	2 Amperes	400% of Running	250 VA	5 sec
250 Vdc	213 - 275	2 Amperes	400% of Running	250 VA	5 sec
110 Vac	94 - 121	3 Amperes	400% of Running	250 VA	5 sec
120 Vac	102- 132	3 Amperes	400% of Running	250 VA	5 sec
220 Vac	187 - 242	2 Amperes	400% of Running	250 VA	5 sec
240 Vac	204 - 264	2 Amperes	400% of Running	250 VA	5 sec

Table 5.7 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

5-6.3 MECHANICAL ACCESSORIES

There are six mechanical type accessories:

- Operations Counter
- Key Interlock
- Mechanical Interlock
- Pushbutton Cover
- Prevent Close Cover
- 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 **3-10).**

OFF Key Lock - The key lock secures the circuit breaker in the "OFF" (open) position. It is an optional device mounted in the lower right portion of the circuit breaker and can be viewed through the front cover (Figure **5-8).** The customer supplies the key lock. The lock choices are Ronis, Castell or Kirk.

Mechanical Interlock - A family of mechanical interlocks are available to interlock the closing of two or three circuit breakers. The mechanical interlock holds one or more circuit breakers tripped (prevents closure) is interconnected with either cables or rods, depending upon the relative orientation of the breakers. Rods can be used only when the circuit breakers to be interlocked are vertically stacked. Cables can be used for any orientation of the breakers. Mechanical interlocks are available for both fixed and draw out circuit breakers and in both 2-way and 3-way versions. An illustration of a 2-way cable interlock mounted on two draw out circuit breakers is shown in Figure **5-9.**

Pushbutton Cover - An optional padlockable cover is available to limit access to the "ON" and "OFF" pushbuttons (Figure **5-27).**

Prevent Close Cover - The optional prevent close cover completely prevents access to the "ON" pushbutton. It must be used in conjunction with the pushbutton cover.

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 **5-28).**

Figure 5-27 Pushbutton Cover Mounted

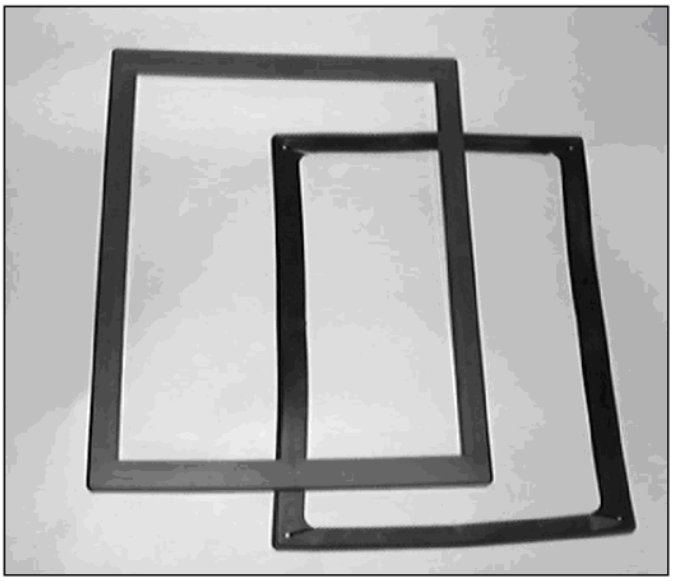


Figure 5-28 Door Escutcheon and Gasket

SECTION 6: INSPECTION AND 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 T-VAC and T-VACR 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	No dirt	Visual Check	Clean with lint-free cloth
	Molded Pole Unit Support	No cracking	Visual Check	Replace cracked unit
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
	Controls Circuit to Ground	Withstand	Hipot Tester	Clean and retest or replace
2. Power Elements	Vacuum Interrupters	Contact Erosion Visibility of Mark (Up to 25Ka)	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 the mark is not visible, replace pole unit assembly
		Contact wipe visible (Up to 25Ka)	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
		Contact wipe/erosion (40Ka)	Refer to 6-5.1 details	Replace pole unit 87mm & >
		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 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	Referr to Figures 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 PRODUCE X-RADIATION. THE RADIATION MAY INCREASE WITH THE INCREASE IN VOLTAGE AND/OR DECREASE IN CONTACT SPACING. X-RADIATION PRODUCED DURING THIS TEST WITH RECOMMENDED VOLTAGE AND NORMAL CONTACT SPACING IS EXTREMELY LOW AND WELL BELOW 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 Interrupter Integrity Test Voltage*	
	at 60 Hz	*dc*
7.2 kV	20 kV	28 kV
12.0 kV	20 kV	28 kV
17.5 kV	27 kV	40 kV

The current delivery capability of 25 ma ac and 5 ma dc apply when all three VIs are tested in parallel. If individual VIs 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 (Up TO 25KA)

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 (Up TO 25KA)

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.

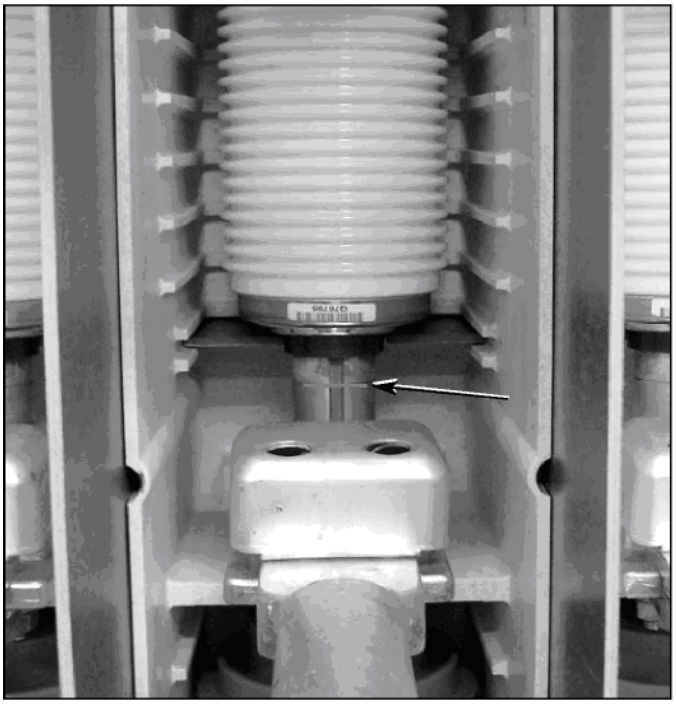


Figure 6-1 Contact Erosion Mark Visible on Stem

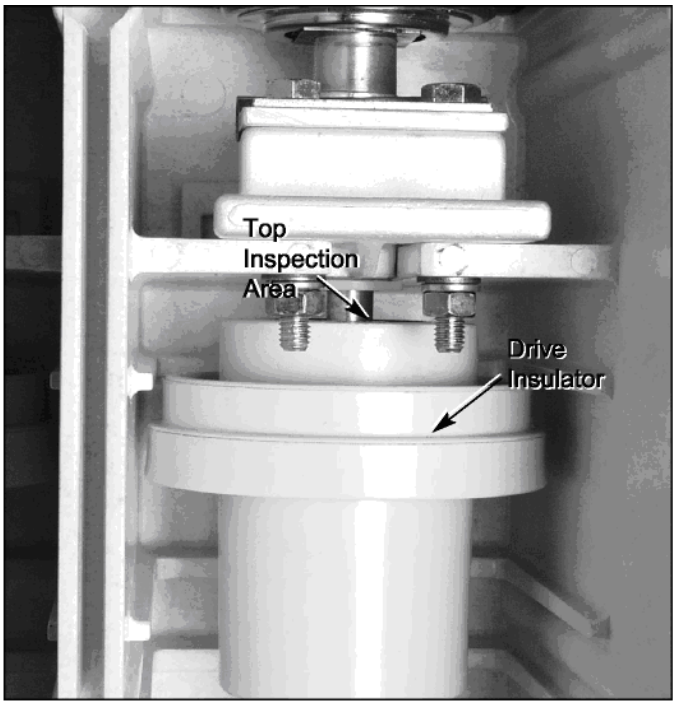


Figure 6-2 Contact Wipe Inspection Area

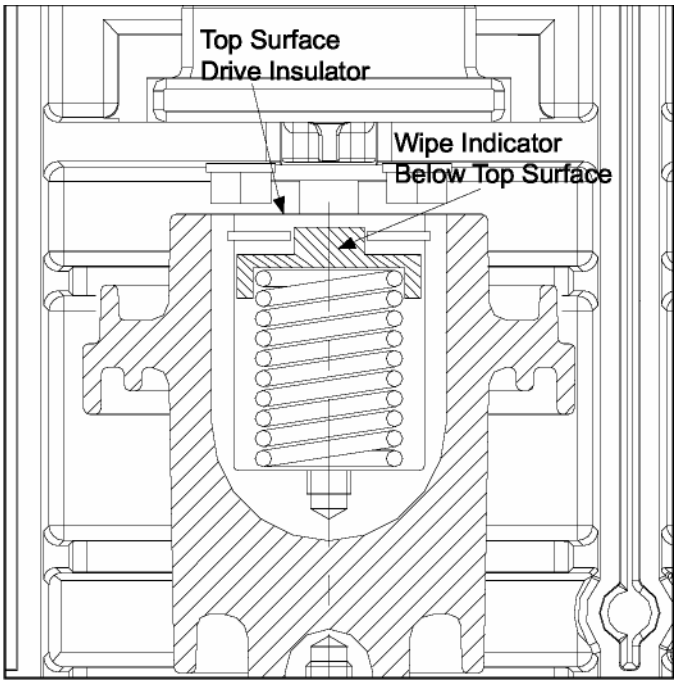


Figure 6-3 Satisfactory Contact Wipe Condition with Breaker Closed

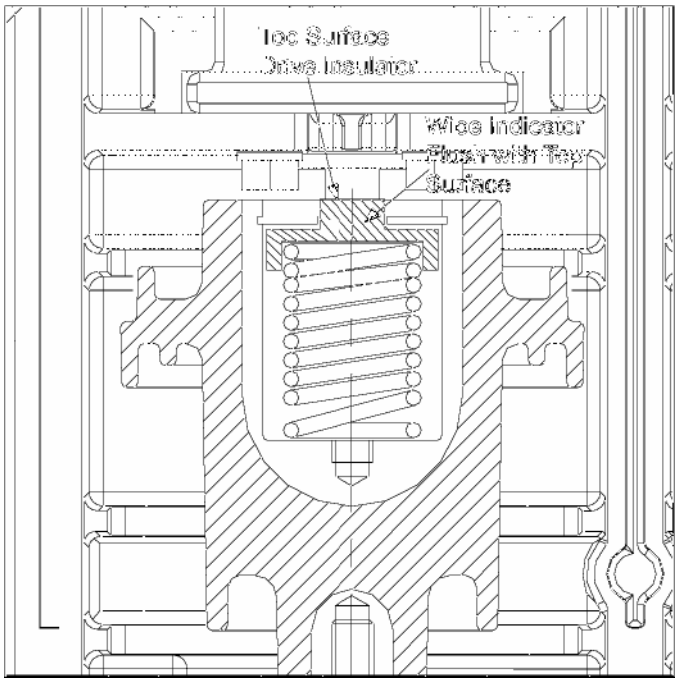


Figure 6-4 Unsatisfactory Contact Wipe Condition with Breaker Closed

6-5.1 CONTACT WIPE MEASUREMENT (40KA)

Direct reading contact erosion indicators are not provided on 31 .5/40kA T-VAC and T-VACR breakers. The contact wipe is measured using a dialed caliper with breaker in the closed position (Figures **6-5** and **6-6).** Acceptable or unacceptable contact erosion is determined from the contact wipe measurement. The measurement is 82mm as supplied from the factory. If a measurement of 87mm or higher is taken, it indicates that the contacts have eroded to an unacceptable performance level. The entire vacuum interrupter assembly must be replaced.

Vacuum interrupters on 31.5/40kA breakers are not visible from the rear of the circuit breaker without removing the individual rear covers (Figure **3-9).** It is not necessary to remove the rear covers to make the wipe measurement. The rear covers are held in place by the upper and lower primary conductors which must be removed first to access the vacuum interrupters. Measurements are taken at the very bottom of each pole unit as shown in Figure **6-5.**

Figure 6-5 Contact Wipe Measurement Being Taken on Middle Pole of Closed 40kA Breaker

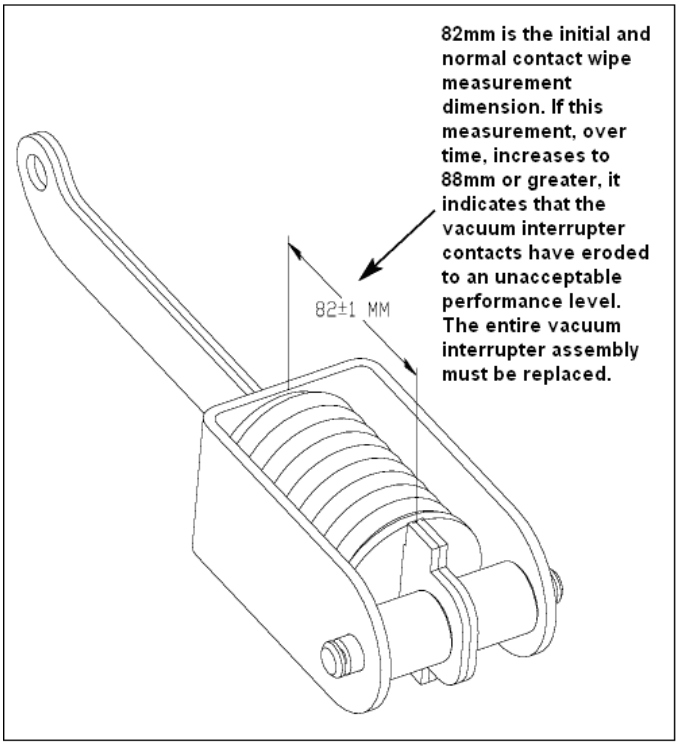


Figure 6-6 Graphical Representation of Exact Contact Wipe Measurement Location

6-6 INSULATION

In T-VAC and T-VACR 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 voltage depends upon the maximum rated voltage of the breaker. For the breakers rated 7.2kV, 12kV and 17.5 kV, the test voltages are 16kV, 23 kV and 31kV 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 voltage 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. T-VAC and T-VACR 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 #53701AI as indicated in Figure **6-5.** As required for smooth operation, lubricate the draw out 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 (µohms)*
630	46
800	44
1250	39
1600	36
2000	25
2500	24

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	Undervoltage release operates; voltage too low or zero.	Check and correct the UVR supply voltage (85-110% rated voltage)
	Shunt Trip operates	Check control signal(s) to shunt trip; correct if necessary
	Trip latch is defective	Inspect latch condition and engagement before closing; consult Eaton service center
Circuit breaker cannot be opened remotely, but can be opened locally	Shunt trip control signal absent or too low	Check supply voltage exceeds minimum of voltage range when signal is applied to shunt trip
	Shunt trip is faulty or improperly installed.	Remove front cover; check voltage supplied to shunt trip; make sure shunt trip is seated and retainer snapped into place. Check for shunt trip motion; replace shunt trip if faulty
	Secondary contact wiring problem	Make sure electrical pin and socket connectors are properly seated in molded plug. Verify proper wiring
Circuit breaker cannot be opened locally	OPEN pushbutton locked	Remove lock
	Faulty mechanism or one or more vacuum interrupter contacts welded	Contact Eaton service center
Circuit breaker makes no attempt to close with either local (manual) or remote controls; springs do not discharge	Closing spring not fully charged (check SPRING CHARGED indicator)	Charge spring manually; check voltage to electrical operator; replace electrical operator if faulty
	If equipped with undervoltage release, undervoltage release is not energized or is faulty	Unplug undervoltage release from mounting deck and retry closing operation; if OK, check voltage supply to undervoltage release (>85%); replace undervoltage release if faulty
	Circuit breaker locked in OPEN position	Check reason for lock
	Circuit breaker interlocked with another circuit breaker or device	Check for presence of an interlocking scheme (cable interlock or key interlock); check to see if interlocked circuit breaker is CLOSED

Table 6.4 Troubleshooting Guide (continued from previous page)

Symptom	Probable Cause	Corrective Actions
Circuit breaker cannot be closed remotely (can be closed locally)	Spring release (closing) coil supply voltage low or spring release faulty	Check power supply voltage; replace spring release if faulty
	Secondary contact wiring problem	Make sure electrical pin and socket connectors are properly seated in molded plug. Verify proper wiring
	Latch check switch open	Bad switch or not reset
Circuit breaker cannot be closed locally (but can be closed remotely)	Opening and/or closing pushbuttons locked	Check reason for lock
Circuit breaker does not recharge electrically but will recharge manually	Charging motor supply voltage absent or too low (< minimum of range)	Check charging motor electrical circuit voltage (check under load)
	Charging motor faulty	Replace charging motor assembly

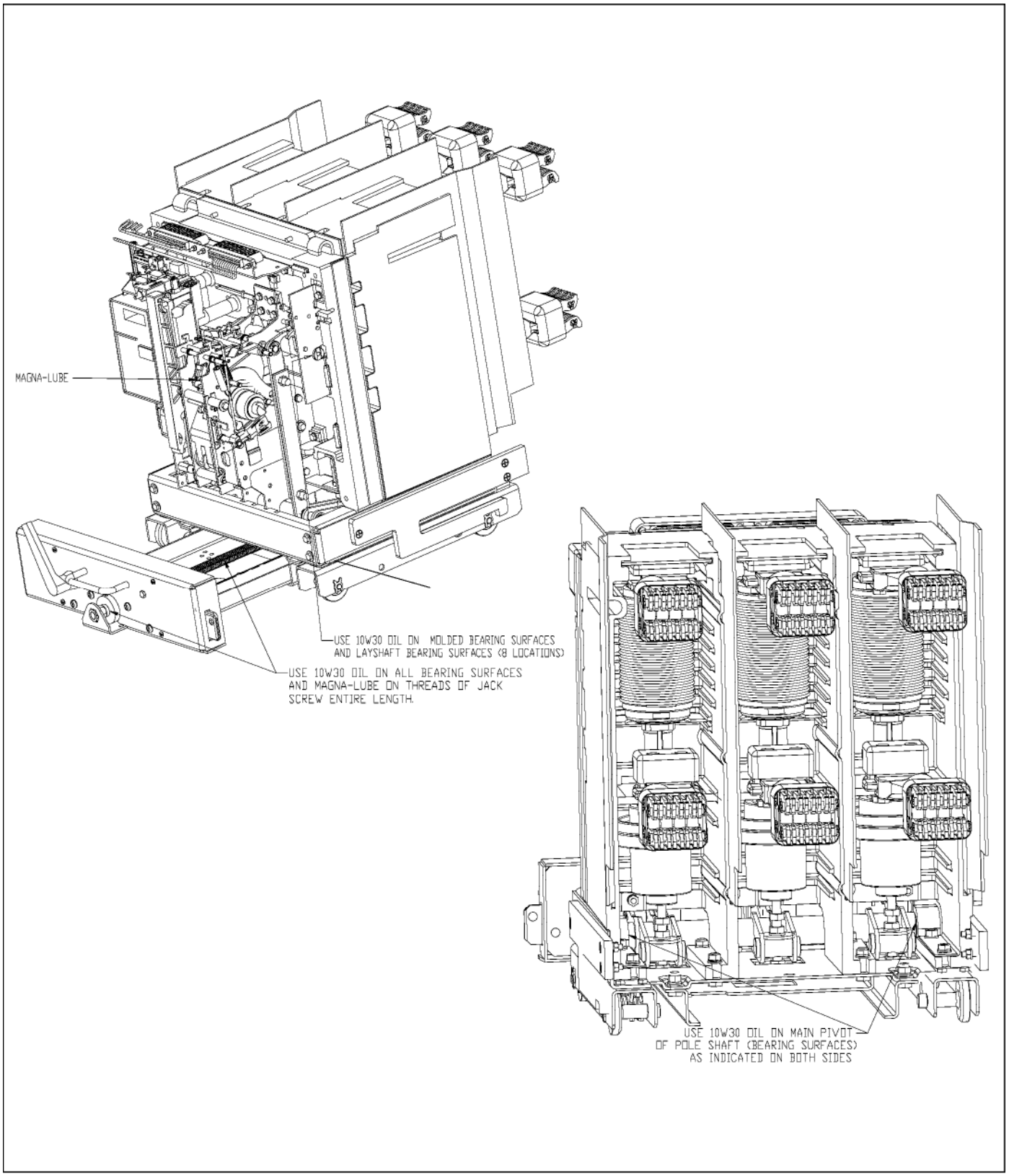


Figure 6-7 Circuit Breaker Lubrication

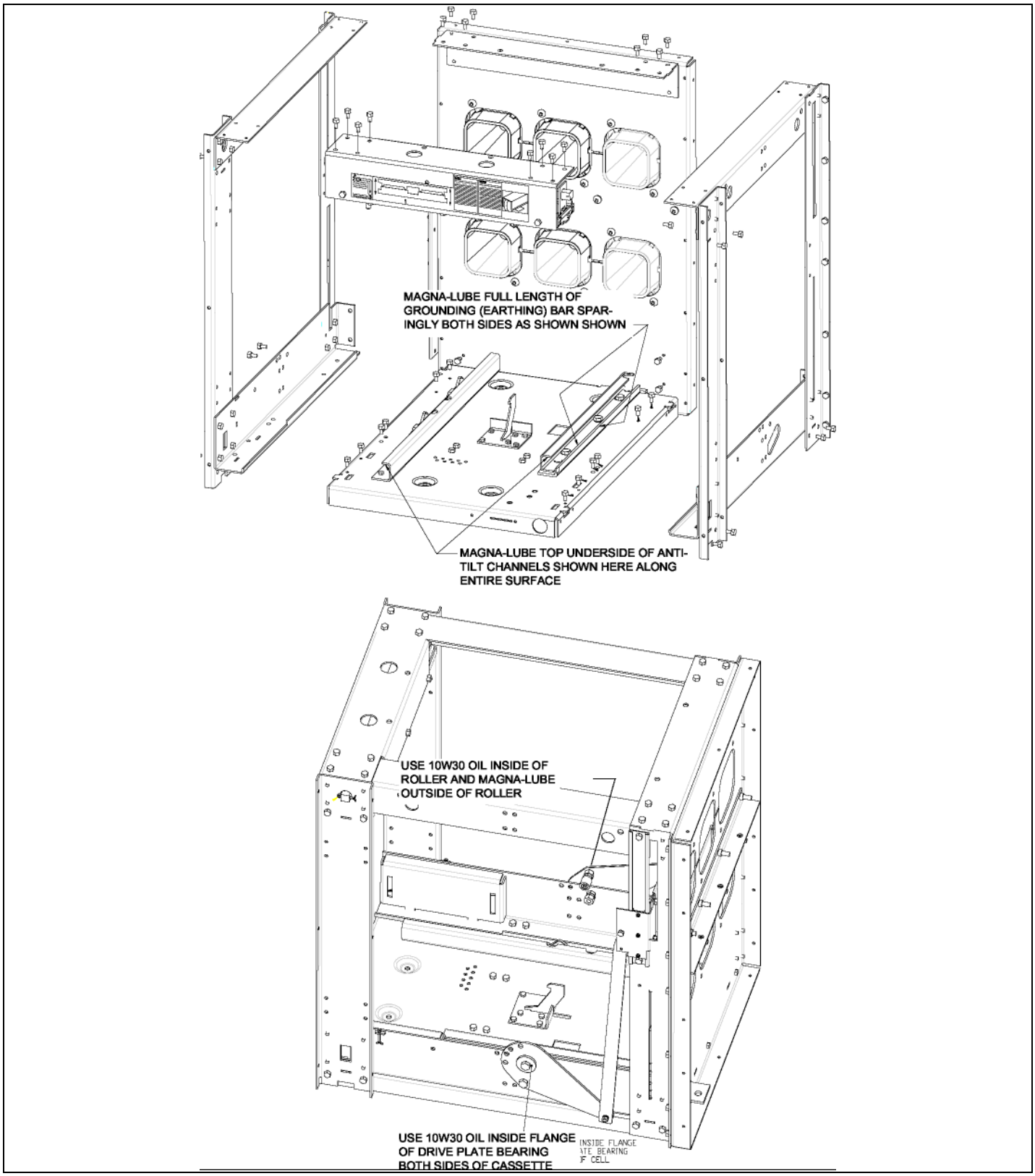


Figure 6-8 Draw out Cassette Lubrication

6-14 END OF LIFE PROCEDURES

This circuit breaker design does not contain SF6, Asbestos or other hazardous materials that require special handling.

On removal from service, the contacts shall be open and the closing spring discharged. The unit can be discarded/destroyed in a similar manner as the switchgear that it is contained within. The breaker raw materials in general are made from Copper, Steel, Aluminum and plastic.

6-15 FAILURE REPORTING

It is important to learn the field failures. To aid in this process, it is recommended the IEEE Std C37.10 (Section A.1) and the reporting form IEEE Std 1325 be considered for reporting the breaker failure event to EATON.

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.

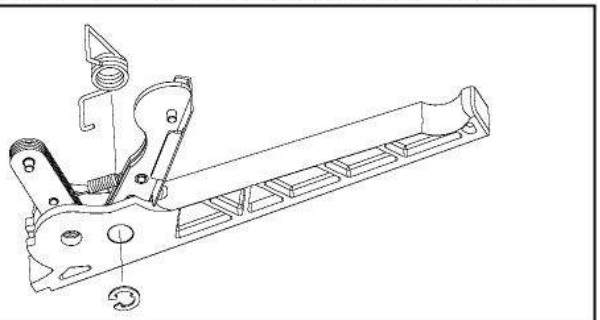
d. Specify the method of shipping desired.

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

7-3 MECHANISM AND RELATED PARTS

(1) Charging Handle with Stop Pawl Assembly

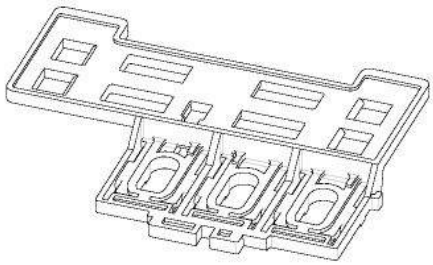
Requires C-HESS (Cutler-Hammer Engineering Services and Systems) Installation



Description	Style#
Handle Includes Stop Pawl Assembly	2A10892G01

(2) Accessories Tray

Customer Field Installable



Description	Style#
Tray where UVR, Shunt Trip, Spring Release, Latch Check Switch and Shunt Trip Switch Mount	2A10891G01

(3) Breaker Key Interlock Provision

Customer Field Installable

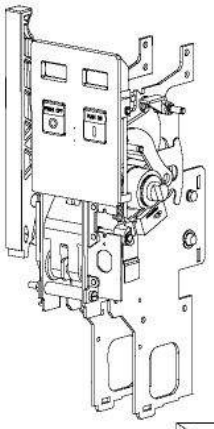
HARDWARE INCLUDED

Ronis			67A3140G01 (Fixed Bkr. Only)
Castell			67A3140G02 (Fixed Bkr. Only)
Kirk			67A3140G03 (Fixed Bkr. Only)
Kirk			69C3333G01 (Draw-Out Bkr. Only)

***Eaton does not supply Lock or Key, only the provision.**

(4) Mechanism*

Requires C-HESS (Cutler-Hammer Engineering Services and Systems) Installation



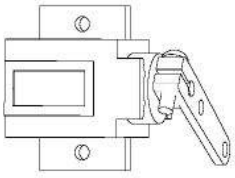
HARDWARE INCLUDED

Circuit Breaker Type	Voltage Class (kV rms)	Style#
50 VCP-T16 and VCP-TR16	4.76	67A3141G01
50 VCP-T20 and VCP-TR20	4.76	67A3141G02
50 VCP-T25 and VCP-TR25	4.76	67A3141G03
75 VCP-T16 and VCP-TR16	8.25	67A3141G04
75 VCP-T20 and VCP-TR20	8.25	67A3141G05
75 VCP-T25 and VCP-TR25	8.25	67A3141G06
150 VCP-T16 and VCP-TR16	15.0	67A3141G07
150 VCP-T20 and VCP-TR20	15.0	67A3141G08
150 VCP-T25 and VCP-TR25	15.0	67A3141G09
75-150 VCP-T/VCP-TR31.5	7.5-15.0	67A3141G10
75-150 VCP-T/VCP-TR 40	7.5-15.0	67A3141G10

* Includes charging handle

(5) Operations Counter

Customer Field Installable

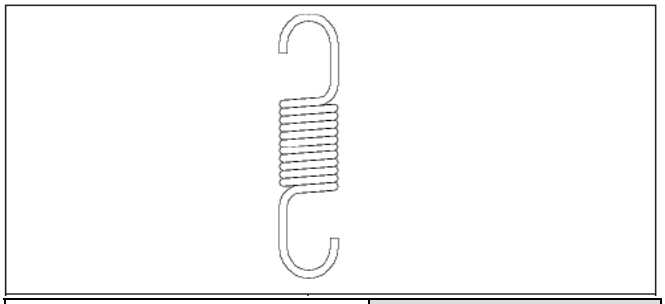


HARDWARE INCLUDED

Description	Cat#
Mechanical Counter	MCOUNT

(6) Opening Spring Guide

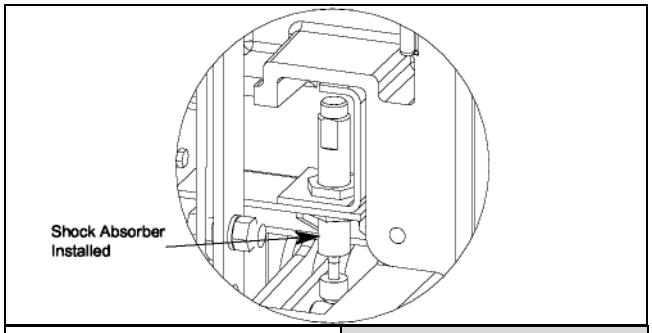
Customer Field Installable



Description	Style#
Black Opening Spring (Low Energy) Blue Opening Spring (High Energy)	67A3142G01 67A3142G02

(8) Shock Absorber

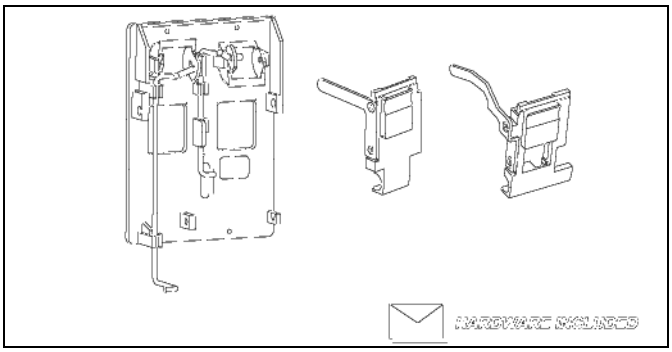
Customer Field Installable



Description	Style#
Shock Absorber All Breakers	67A3143G01

(7) Faceplate, Buttons and Flags

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



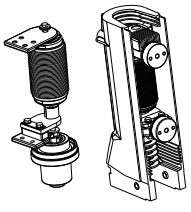
Description	Style#
Faceplate, Buttons and Flags	2A10895G01

7-4 CURRENT PATH

(1) Pole Unit Assembly (T-VAC and T-VACR)

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

Circuit Breaker Type	Normal Current (Amperes) (Includes VI, Flex Connector and Drive Rod Assembly)					
	630	800	1250	1600	2000	2500
	Style#	Style#	Style#	Style#	Style#	Style#
7.2kV/16kA	67A3161G21	67A3161G22	67A3161G24	67A3161G25	67A3161G26	67A3161G27
7.2kV/20kA	67A3161G31	67A3161G32	67A3161G34	67A3161G35	67A3161G36	67A3161G37
7.2kV/25kA	67A3161G41	67A3161G42	67A3161G44	67A3161G45	67A3161G46	67A3161G47
7.2kV/31.5kA	67A3161G51	67A3161G52	67A3161G54	67A3161G55	67A3161G56	67A3161G57
7.2kV/40kA	67A3161G61	67A3161G62	67A3161G64	67A3161G65	67A3161G66	67A3161G67
12kV/16kA	67A3162G21	67A3162G22	67A3162G24	67A3162G25	67A3162G26	67A3162G27
12kV/20kA	67A3162G31	67A3162G32	67A3162G34	67A3162G35	67A3162G36	67A3162G37
12kV/25kA	67A3162G41	67A3162G42	67A3162G44	67A3162G45	67A3162G46	67A3162G47
12kV/31.5kA	67A3162G51	67A3162G52	67A3162G54	67A3162G55	67A3162G56	67A3162G57
12kV/40kA	67A3162G61	67A3162G62	67A3162G64	67A3162G65	67A3162G66	67A3162G67
17.5kV/16kA	67A3164G21	67A3164G22	67A3164G24	67A3164G25	67A3164G26	67A3164G27
17.5kV/20kA	67A3164G31	67A3164G32	67A3164G34	67A3164G35	67A3164G36	67A3164G37
17.5kV/25kA	67A3164G41	67A3164G42	67A3164G44	67A3164G45	67A3164G46	67A3164G47
17.5kV/31 .5kA	67A3164G51	67A3164G52	67A3164G54	67A3164G55	67A3164G56	67A3164G57
17.5kV/40kA	67A3164G61	67A3164G62	67A3164G64	67A3164G65	67A3164G66	67A3164G67

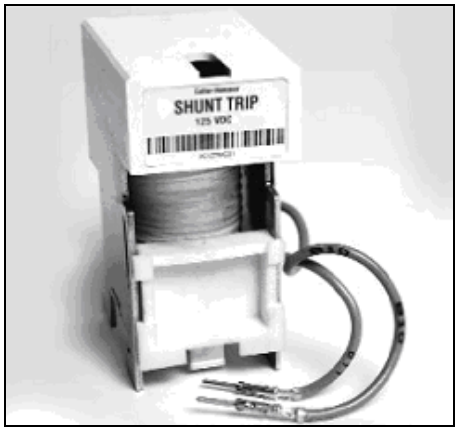


16-25KA 31.5/40kA

7-5 ELECTRICAL ATTACHMENTS

(1) Shunt Trip (Opening Coil)

Customer Field Installable

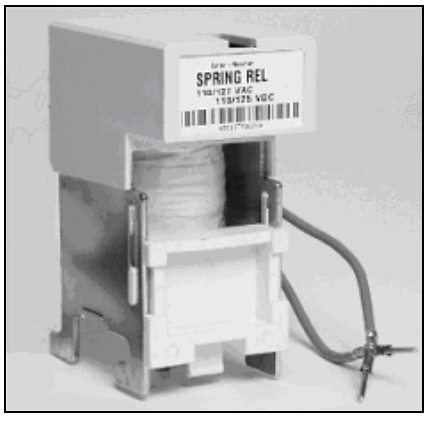


NOTE: For an optional shunt trip capability, both a shunt trip and a shunt trip switch must be ordered and used.

Control Voltage	Style#
24 Vdc	67A3145G11
48 Vdc	67A3145G12
110 Vdc	67A3145G13
125 Vdc	67A3145G13
220 Vdc	67A3145G14
250 Vdc	67A3145G14
110 Vac	67A3145G15
120 Vac	67A3145G15
220 Vac	67A3145G16
240 Vac	67A3145G16

(2) Spring Release (Closing Coil)

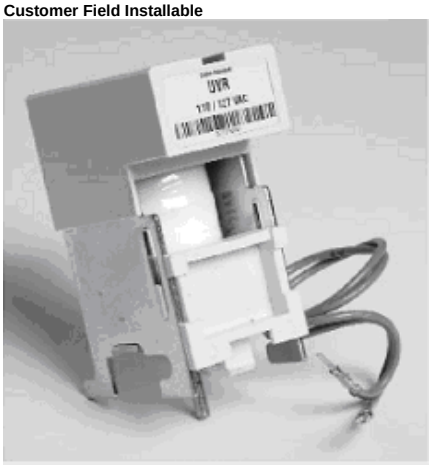
Customer Field Installable



Control Voltage	Cat#
24 Vdc	MSRC
48 Vdc	MSRH
110 Vdc	MSRA
125 Vdc	MSRA
220 Vdc	MSRR
250 Vdc	MSRR
110 Vac	MSRA
120 Vac	MSRA
220 Vac	MSRR
240 Vac	MSRR

(3) Under voltage Release

Customer Field Installable



Control Voltage	Style#
24 Vdc	MUVRC
48 Vdc	MUVRH
110 Vdc	MUVRE
125 Vdc	MUVRE
220 Vdc	MUVRF
250 Vdc	MUVRF
110 Vac	MUVRA
120 Vac	MUVRA
220 Vac	MUVRR
240 Vac	MUVRR

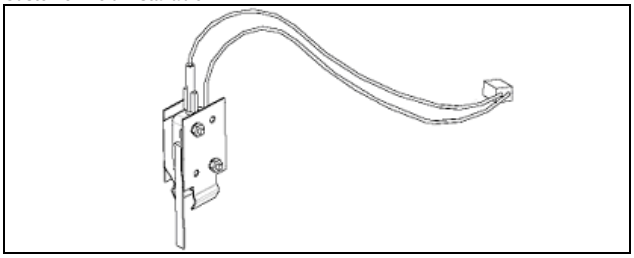
(4) Shunt Trip Switch

Customer Field Installable

Description	Style#
2a/2b Contacts	67A3146G01

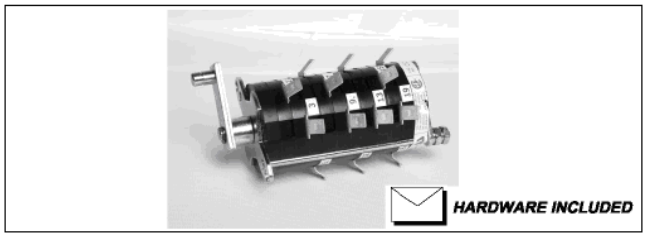
(5) Latch Check Switch

Customer Field Installable



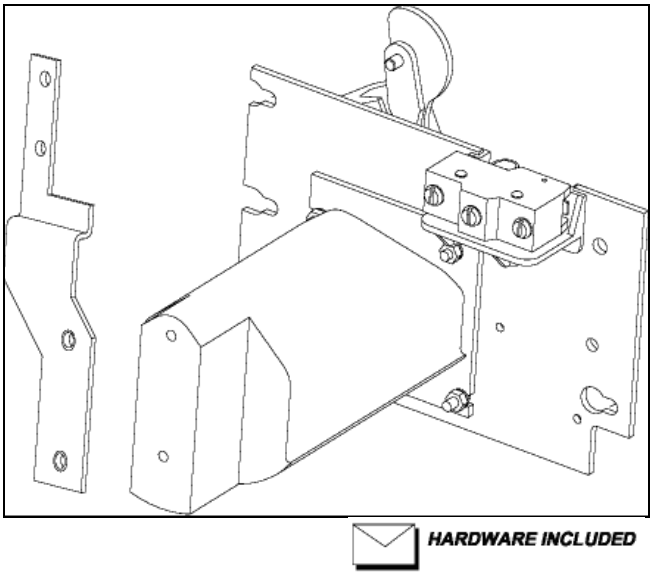
Description	Style#
Single Pole, Single Throw Contact Switch	67A3150G01

6) Auxiliary Switch
Customer Field Installable



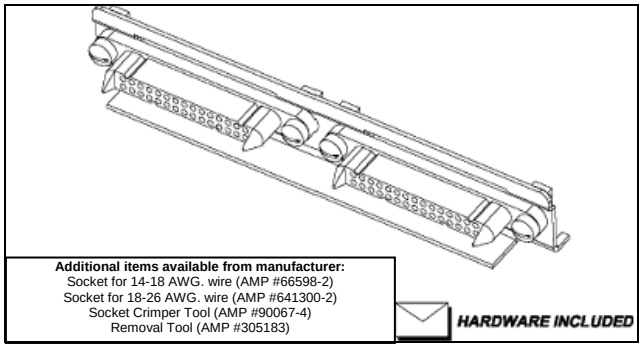
Description	Style#
5a/5b Double Break Type	67A3147G01

7) Motor Operator
Customer Field Installable



Control Voltage	Stylet#
24 Vdc	69C3193G11
48 Vdc	69C3193G01
125 Vdc	69C3193G12
250 Vdc	69C3193G13
120 Vac	69C3193G14
240 Vac	69C3193G15

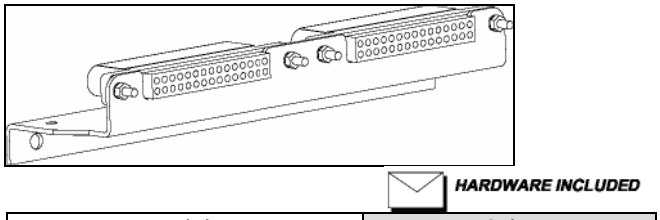
(8) Breaker Secondary Disconnect Block
Customer Field Installable



Description	Style#
2 - 30 Position Connectors Labeled and assembled to Mounting Tray	67A3148G01

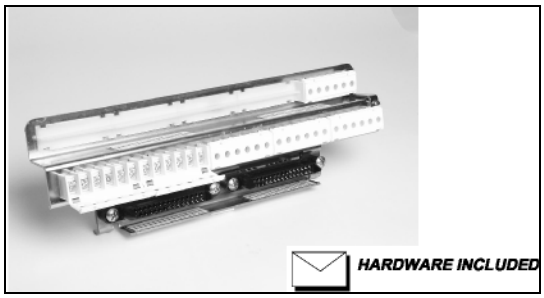
9) Breaker Terminal Block Bracket
Customer Field Installable

Additional items available from manufacturer:
Pin for 14-18 AWG. wire (AMP #66597-2)
Pin for 18-26 AWG. wire (AMP #640545-2)
Pin Crimper Tool (AMP #90067-4)
Removal Tool (AMP #305183)



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

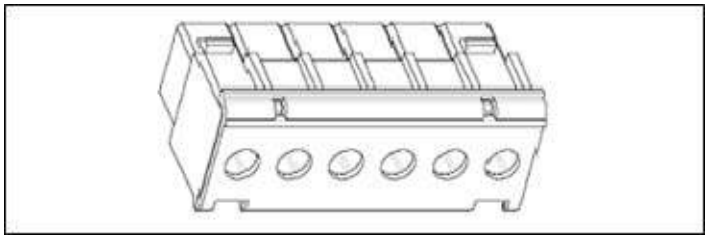
10) Screw Type Terminal Block
Customer Field Installable



Description	Style#
Screw Type Terminal Block with Hinged Covers	
For Breaker without Trip Unit	67A3151G01
For Breaker with Trip Unit	67A3151G02

11) Secondary Terminal Block Kit

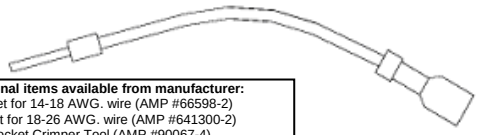
Customer Field Installable



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

12) Secondary Terminal Wire Kit

Customer Field Installable

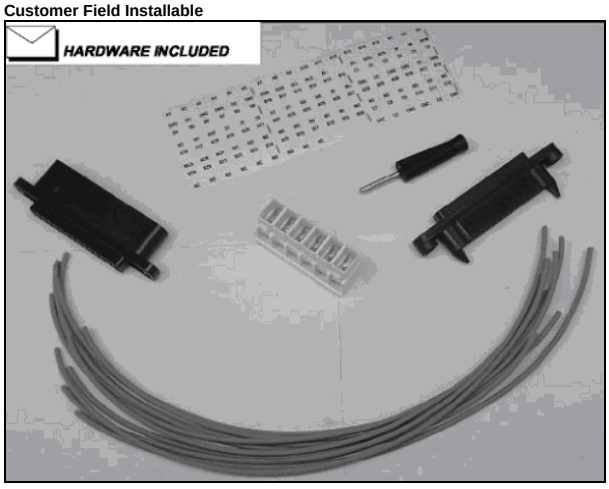


Additional items available from manufacturer:
Socket for 14-18 AWG. wire (AMP #66598-2)
Socket for 18-26 AWG. wire (AMP #641300-2)
Socket Crimper Tool (AMP #90067-4)
Removal Tool (AMP #305183)

Description	Style#
90 Wires with Terminal Connectors (AMP and FastOn on opposite ends)	1B93093G01

13) Secondary Repair Kit

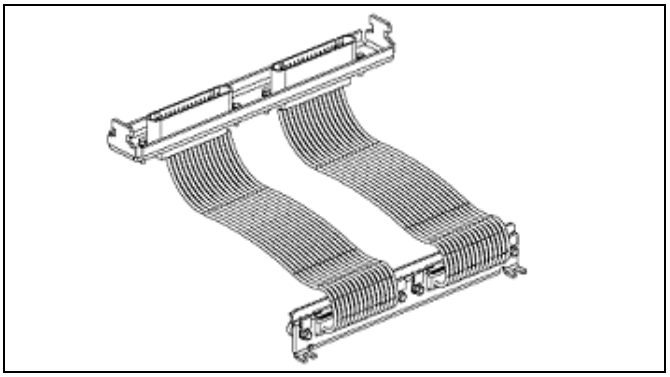
Customer Field Installable



Description	Cat#
Kit Contains: (1) AMP Pin Removal Tool (1) 6 Point Terminal Block (1) 6 Point Blank Label (1) Female 30 Point AMP Connector (1) Male 30 Point AMP Connector (10) Wire Assembly	MSECTOOL

14) Secondary Umbilical Cord

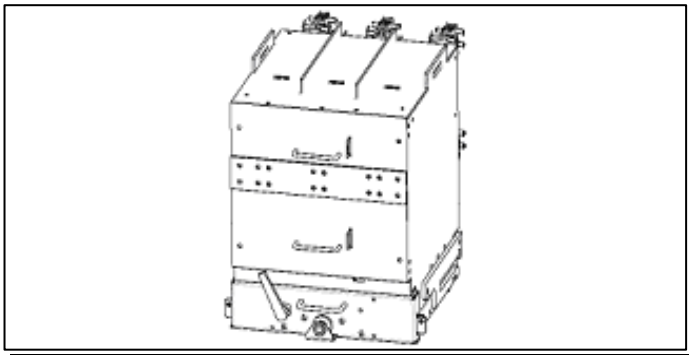
Customer Field Installable



Description	Style#
Secondary Umbilical Cord (Draw out Circuit Breakers Only)	69C3323G01

15) Simple Ground and Test Device (up to 25kA)

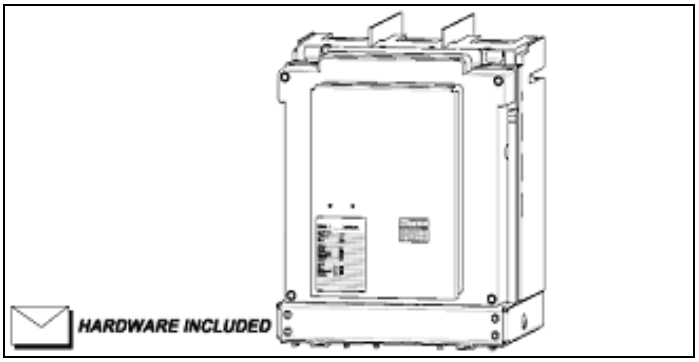
Customer Field Installable



Description	Stylet#
Simple Ground and Test Device	67A3056G01

16) Dummy Element (up to 25kA)

Customer Field Installable

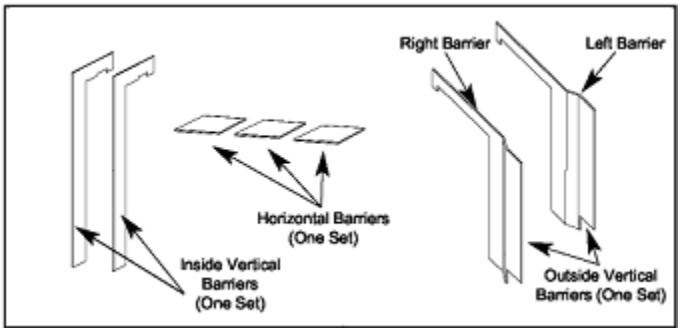


Description	Style#
Dummy Element	67A3055G01

7-6 OTHER BREAKER RELATED PARTS

(1) Phase Barriers

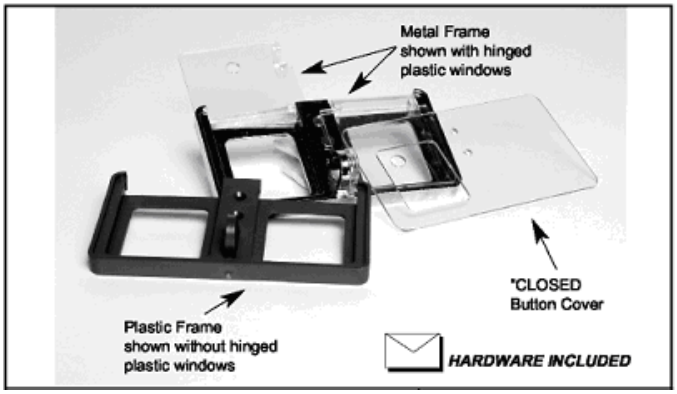
Customer Field Installable



Description	Style#
Horizontal Barriers (All 75 & 95kV BIL) Inside Vertical Barriers (All 95 kV BIL) Outside Vertical Barriers (All 95kV BIL draw out only)	67A3152G01 67A3152G02 67A3152G03

(2) Pushbutton External Lock Cover

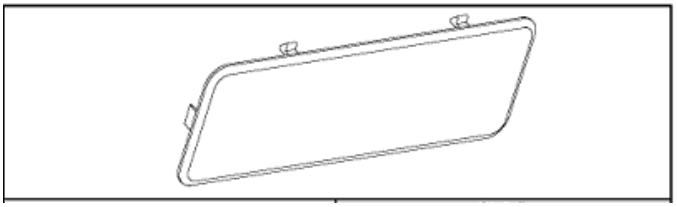
Customer Field Installable



Description	Cat#
Metal Frame (includes hinged plastic windows) Plastic Frame (includes hinged plastic windows) Metal Frame with Blocked Close Button Cover Plastic Frame with Blocked Close Button Cover	MCOVM MCOVP MCOVC MCOVH

(3) Blank Cover for Fixed Breaker

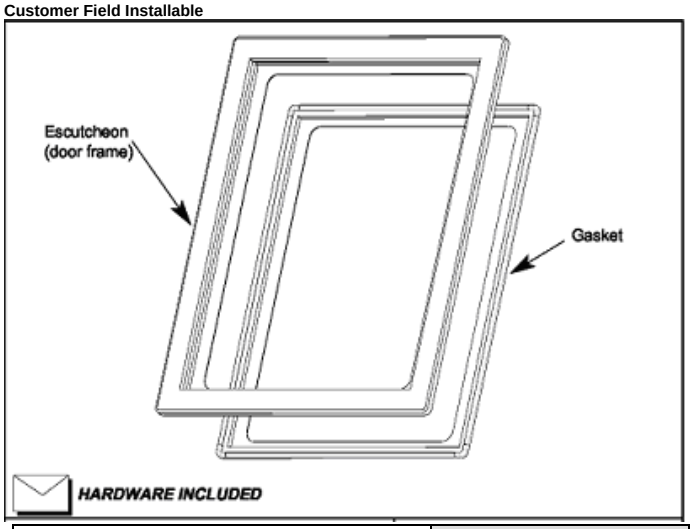
Customer Field Installable



Description	Style#
T-VACR	2C12815H03

(4) Door Escutcheon and Gasket

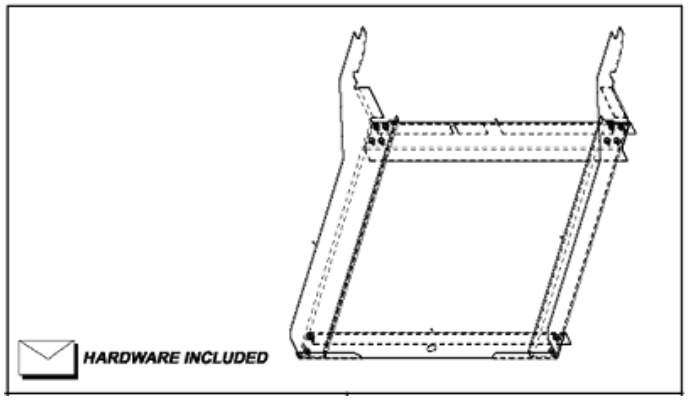
Customer Field Installable



Description	Cat#
Protects Against Dust and Dripping Water by Sealing Space Between Breaker and and Compartment Door Cutout	MDES

(5) Draw out Breaker Extension Rail Kit

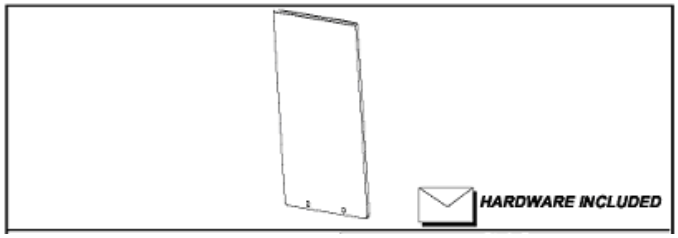
Customer Field Installable



Description	Style#
T-VAC Extension Rail Kit - 25kA (Maximum Breaker Load Capacity 250lbs.)	70D3270G01
T-VAC Extension Rail Kit - 40kA (Maximum Breaker Load Capacity 445lbs.)	70D3271G01

(6) Non-Automatic Trip Unit Cover

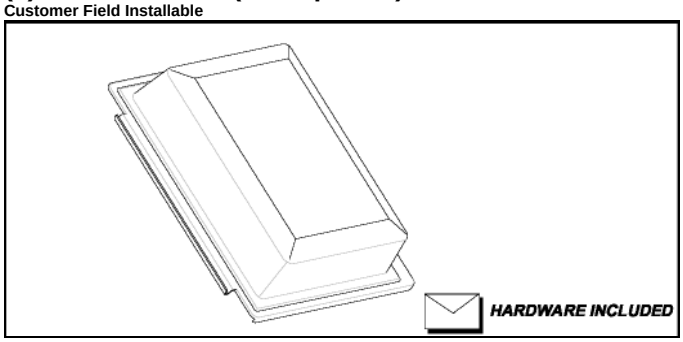
Customer Field Installable



Description	Style#
T-VAC & T-VACR	2C12812H06

(7) IP54 Cover Kit (Transparent)

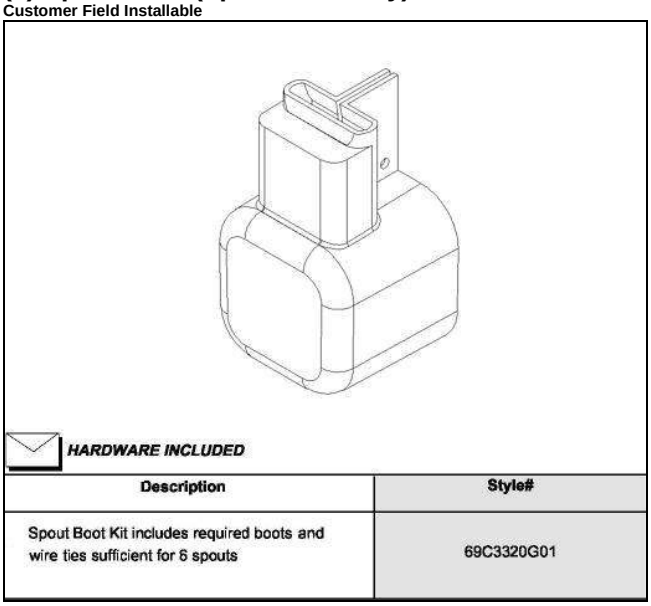
Customer Field Installable



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

(8) Spout Boot (up to 25kA only)

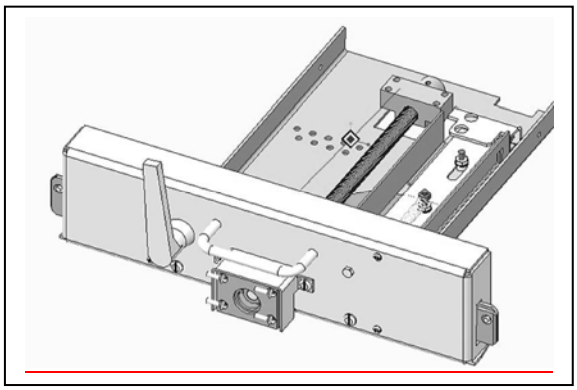
Customer Field Installable



Description	Style#
Spout Boot Kit includes required boots and wire ties sufficient for 6 spouts	69C3320G01

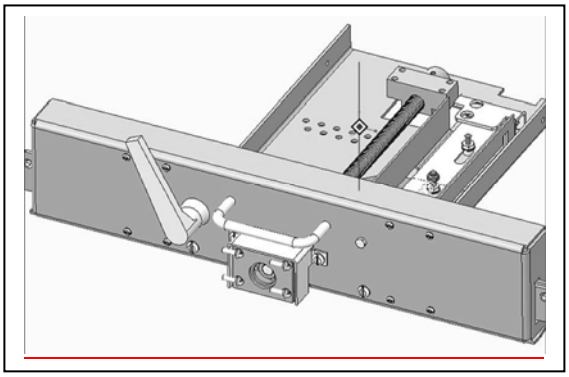
(9) 25kA Racking Cradle – 69C3305G01

Customer Field Installable



(10) 40kA Racking Cradle – 69C3305G11

Customer Field Installable



7-7 TRIP UNIT AND RELATED PARTS

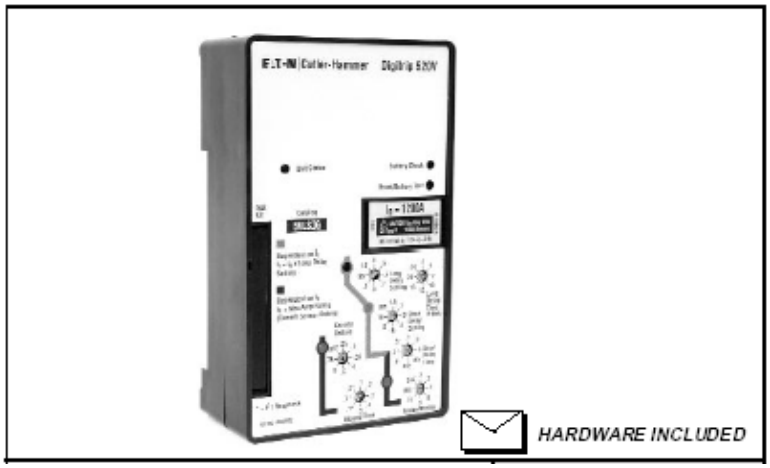
(1) 1150Vi Trip Unit Kit (Trip Unit and Power Supply)

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

Trip Unit Model	Power Supply Voltage	Style#
1150Vi Trip Unit	24 to 48 Vdc	67A3153G11
1150Vi Trip Unit	120 Vac	67A3153G12
1150Vi Trip Unit	240 Vac	67A3153G13

(2) 520V Trip Unit Kit

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



Trip Unit Model	Style#
520V Trip Unit	67A3154G01

(3) Trip Unit Current Sensors and Rating Plug

Customer Field Installable

Current Sensors

Rating Plug and Sensors Must Have Matching Ratings

Rating Plug

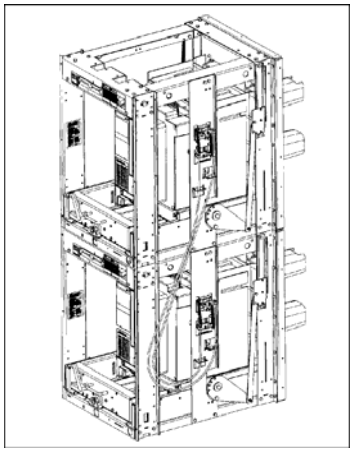
Sensor (Amps)	Style#	Rating Plug (Amps)	Style#
100	69C3011H01	100	5720B93G01
200	69C3011H02	200	5720B93G02
250	69C3011H25	250	5720B93G03
300	69C3011H03	300	5720B93G04
400	69C3011H04	400	5720B93G05
600	69C3011H06	600	5720B93G06
630	69C3011H63	630	5720B93G07
800	69C3011H08	800	5720B93G08
1000	69C3011H10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

(4) 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

5-15Kv T-VAC/T-VACR Front Cover Castell and Kirk Lock Kit	69C3150G01



T-VAC CASSETTE MECHANICAL INTK CABLE KIT – 2 WAY
25kA VERSION - 67A3350G01
40kA VERSION - 67A3348G01

T-VACR BREAKER MECHANICAL INTK CABLE KIT – 2 WAY
25kA VERSION - 67A3349G01

T-VACR BREAKER MECHANICAL INTK CABLE KIT – 3 WAY
25kA VERSION - 69C3179G01

Instruction Book
Effective: November 2017

Instructions for the Use, Operation and Maintenance of Types T-VAC and T-VACR Vacuum Circuit Breakers

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

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