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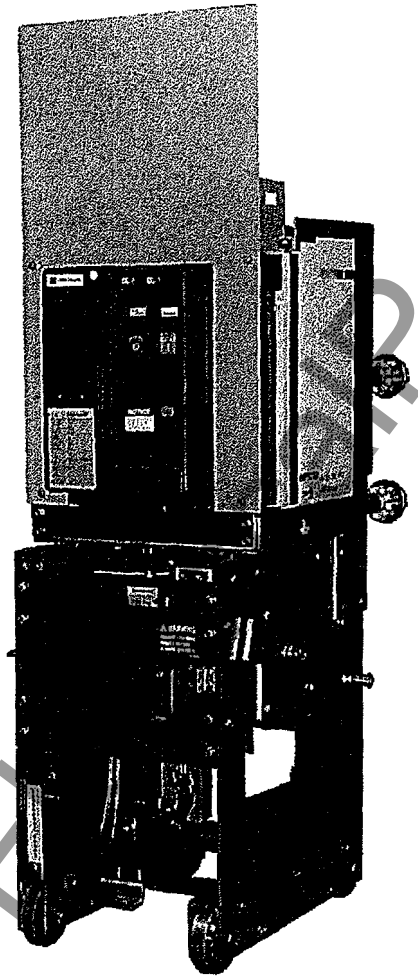
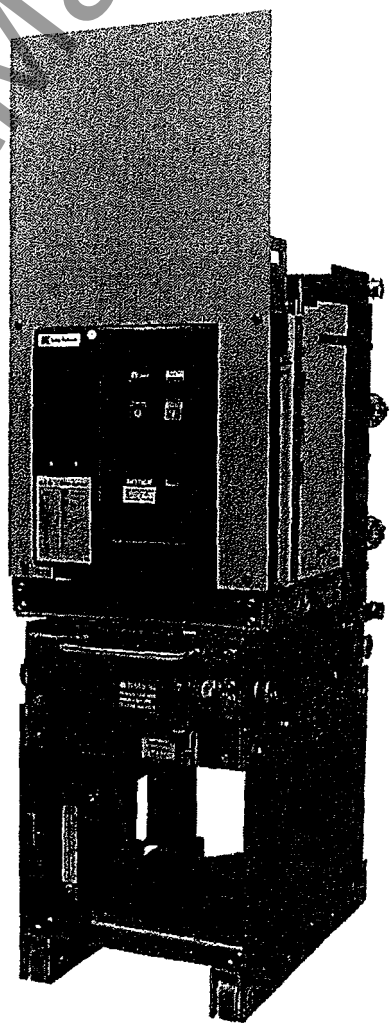
I.B. 94A1991R01

Instructions for VR-Series Replacement Breakers for Westinghouse Type 50DH-VR-50AXU / 50XU / 75U / 75ARU - 600 / 1200A



50DH-VR-50AXU / 75U - 1200A (Front Racking)



50DH-VR-50XU / 75ARU - 1200A (Rear Racking)

Instructions for VR-Series Replacement Breakers for Westinghouse 50DH-VR

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 CONSULT CUTLER-HAMMER.

THE CIRCUIT BREAKERS 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.

WARNING

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

THESE CIRCUIT BREAKER ELEMENTS ARE DESIGNED TO BE INSTALLED PURSUANT TO THE AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI). 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.

Cutler-Hammer
Power Breaker Center
310 Maxwell Avenue
Greenwood, SC 29646

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of particular equipment, contact a Cutler-Hammer representative.

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SECTION 1: INTRODUCTION

The purpose of this book is to provide instructions for receiving and handling, storage, installation, operation and maintenance of DH Type Vacuum Replacement Circuit Breakers (also referred to as VR-Series). The vacuum unit replacement breakers are designed to be used in existing Westinghouse type DH metal-enclosed switchgear. VR-Series Circuit Breakers provide reliable control, protection and performance, with ease of handling and maintenance. Like ratings are interchangeable with each other.

WARNING

SATISFACTORY PERFORMANCE OFTHESE 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 OFTHE CIRCUIT BREAKERS.

VR-SERIES BREAKERS ARE PROTECTIVE DEVICES, AS SUCH, THEY ARE MAXIMUM RATED DEVICES. THEREFORE, THEY SHOULD NOT UNDER ANY CIRCUMSTANCE BE APPLIED OUTSIDETHEIR NAMEPLATE RATINGS.

1.1 AVAILABLE DH-VR BREAKERS

Refer to Table 1.1.

Nominal Voltage Class (kV)	Existing MVA Rating	Rated Continuous Current at 60Hz (Amps)	MVA Designation of VR-Series Breaker	Rated Voltage Factor K	Rated Withstand ANSI Test Voltage		Rated Short-Circuit kA RMS at Rated Max kV	Closing and Latching / Momentary Capabilities
					Low Freq. kV RMS	Impulse kV Crest	kA RMS	kA Peak
4.16	50	600 1200	150	1.0	19	60	20	52
4.16	75	600 1200	150	1.0	19	60	20	52

Table 1.1 - DH-VR Vacuum Circuit Breaker Availability and Interchangeability

Table 1.2 - DH-VR Dimensions in Inches

Ratings	A	B	C	D	E	F	G	H	I	J	K	L	M
50DH-VR50AXU/75U 1200A	20.38	15.44	16.50	5.00	9.00	26.81	58.33	16.44	8.44	8.50	5.25	17.00	5.88

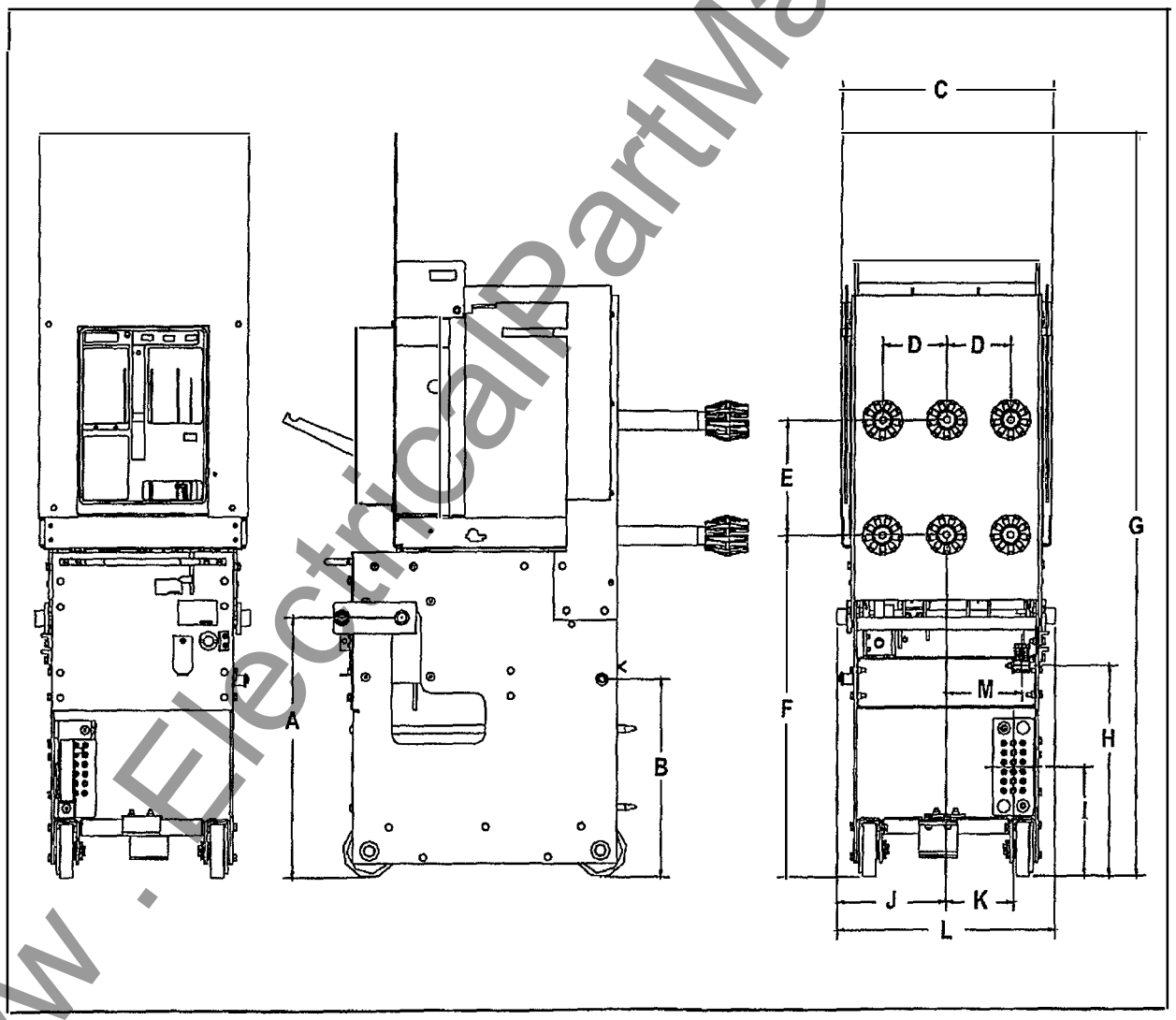


Figure 1-1 Outline and Dimensions (inches) - Type 50-DH-VR-50AXU/75U Front Racking Shown

Table 1.3 - DH-VR Dimensions in Inches

Ratings	A	B	C	D	E	F	G	H	I	J
50DH-VR50XU/75ARU 1200A	5.00	31.53	44.00	9.00	26.62	21.81	17.26	8.25	23.50	58.01

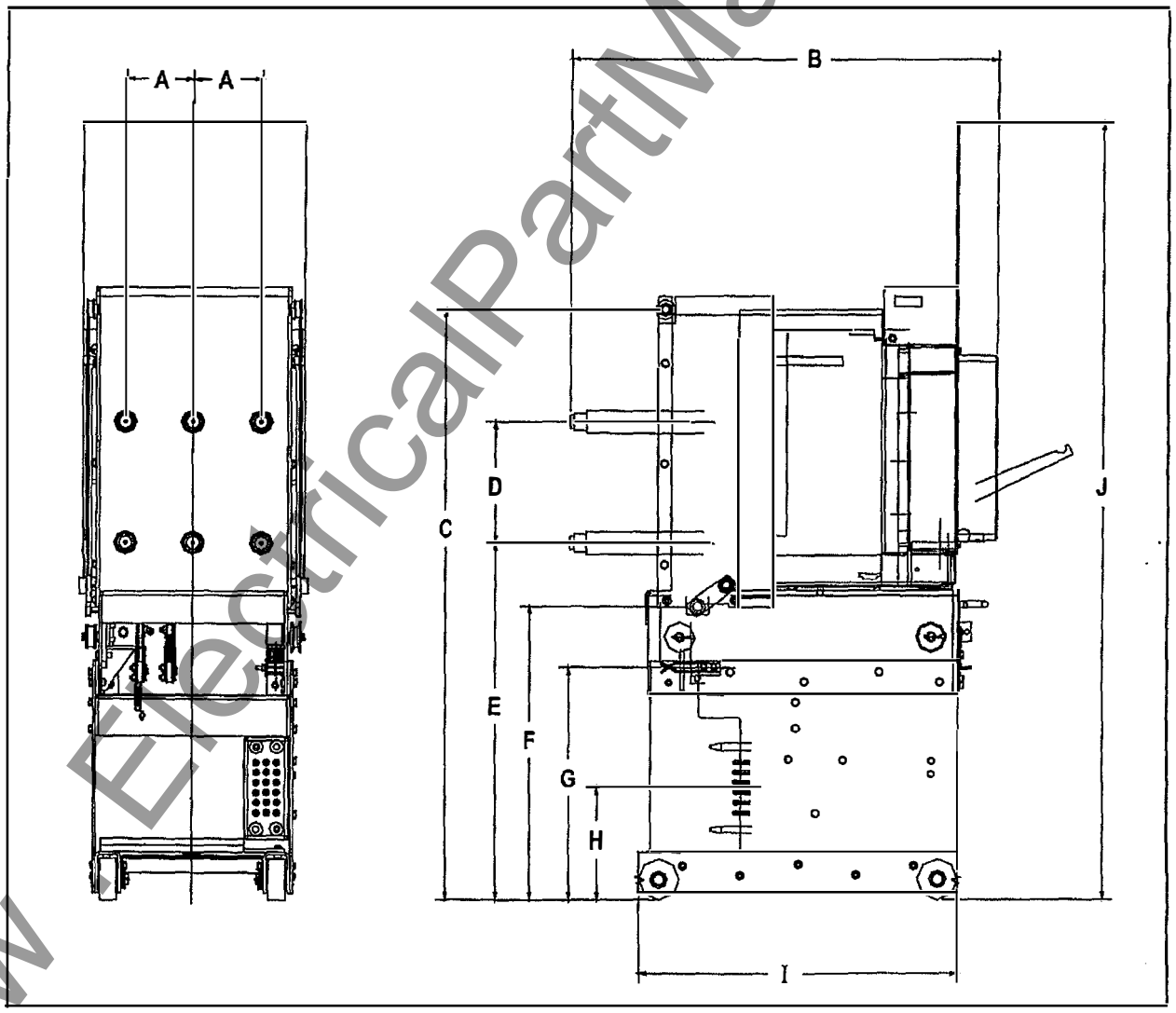


Figure 1-2 Outline and Dimensions (inches) - Type 50-DH-VR-50XU/75ARU Rear Racking Shown

SECTION 2: SAFE PRACTICES

VR-Series breakers are equipped with high speed, high energy operating mechanisms. They are designed with several built-in interlocks and safety features to provide safe and proper operating sequences.

WARNING

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

- **Only qualified persons, as defined in the National Electrical Safety Code, who are familiar with the installation and maintenance of 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 the breaker from the enclosure before performing any maintenance. Failure to do so could result in electrical shock leading to death, severe personnel injury or property damage.**
- **Do not work on a breaker with the secondary test coupler engaged. Failure to disconnect the test coupler could result in an electrical shock leading to death, personnel injury or property damage.**
- **Do not work on a closed breaker or a breaker with closing springs charged. The closing spring 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. Remove the breaker to the Disconnect position and follow all lockout and tagging rules of the National Electrical Code and any and all applicable codes, regulations and work rules.**
- **Do not leave the breaker in an intermediate position in the cell. Always have the breaker either in the Test or Connected position. Failure to do so could result in a flash over and possible death, personnel injury or property damage.**
- **Always remove the maintenance tool from the breaker after charging the closing springs.**
- **Breakers are equipped with safety interlocks. Do not defeat them. This may result in death, bodily injury or equipment damage.**

SECTION 3: RECEIVING, HANDLING, AND STORAGE

Type DH-VR 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. Accessories such as the maintenance tool, etc. are shipped with the breaker (Figure 3-1).

3.1 RECEIVING

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

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

When opening the crates, be careful that any loose items or hardware are not discarded with the packing material. Check the contents of each package against the packing list.

Examine the breaker for any signs of shipping damage such as broken, missing or loose hardware, damaged or deformed insulation and other components. File claims immediately with the carrier if damaged or loss is detected and notify the nearest Cutler-Hammer Office.

Tools and Accessories

Racking Handle: The racking handle is used to drive the racking mechanism which moves the circuit breaker into and out of the cell. This crank type handle is the same as the one provided with the original DH breaker racking mechanism and is therefore not normally provided as part of the vacuum replacement breaker. The 50 DH breaker with front racking did not originally incorporate a gear driven racking mechanism. The new VR replacement breaker does incorporate a gear driven racking mechanism and therefore a racking handle will be provided with each order.

Secondary Connection Block Extension Cable: The extension cable can be used to connect the circuit breaker to a "test cabinet" or to the switchgear cell's secondary receptacle block so that the breaker can be electrically operated while not installed in the switchgear cell. This extension cable is the same one provided with the original DH breaker and is therefore not included as part of the vacuum replacement breaker.

Dolly: Used to easily move and turn breaker. The dolly interfaces with the tow hitch shown in Figure (3-3). This will be provided with orders containing rear racking breakers. Do not turn or move breakers using primary bushing connections.

3.2 HANDLING

⚠ WARNING

DO NOT USE ANY LIFTING DEVICE AS A PLATFORM FOR PERFORMING MAINTENANCE, REPAIR OR ADJUSTMENT OF THE BREAKER OR FOR OPENING, CLOSING THE CONTACTS OR CHANGING THE SPRINGS. THE BREAKER MAY SLIP OR FALL CAUSING SEVERE PERSONNEL INJURY. ALWAYS PERFORM MAINTENANCE, REPAIR AND ADJUSTMENTS ON A WORKBENCH CAPABLE OF SUPPORTING THE BREAKER TYPE.

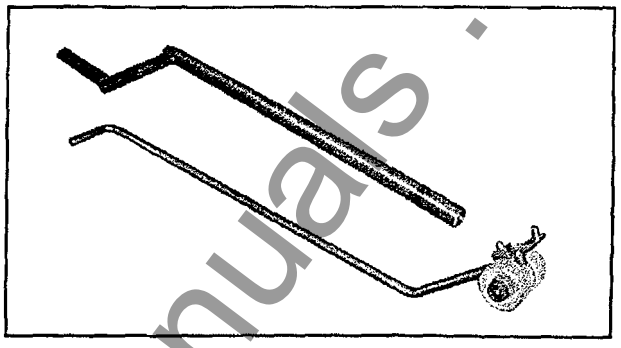


Figure 3-1 Typical Vacuum Replacement Tools and Accessories

DH-VR breaker shipping containers are designed to be handled either by use of a 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.

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

When a breaker is ready for installation, a lifting harness in conjunction with an overhead lifter or portable floor lifter can be used to move a breaker, if this is preferable to rolling the breaker on the floor using self contained wheels. If the breaker is to be lifted, position the lifting device (lifting straps should have at least a 1600 pound capacity) over the breaker side openings and secure in a similar fashion as shown in Figure 3-2. Be sure the hooks are firmly attached before lifting the breaker. Stand a safe distance away from the breaker while lifting and moving.

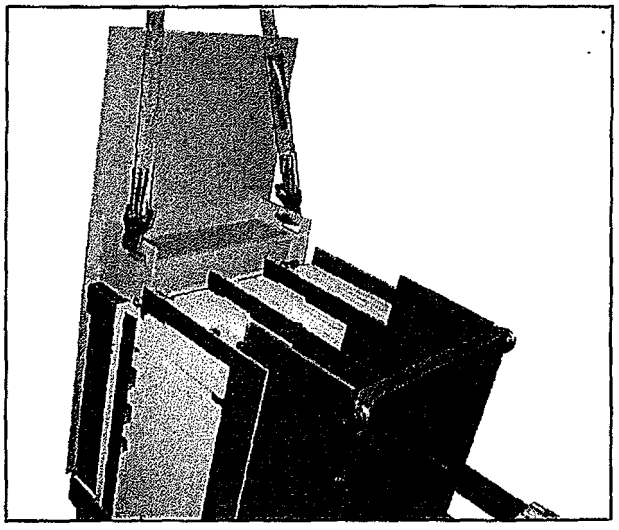


Figure 3-2 Overhead Lifting of DH-VR (50DH-VR shown)

3.3 STORAGE

If the circuit breaker is to be placed in storage, maximum protection can be obtained by keeping it in the original shipping crate. Before placing it in storage, checks should be made to make sure that the 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.

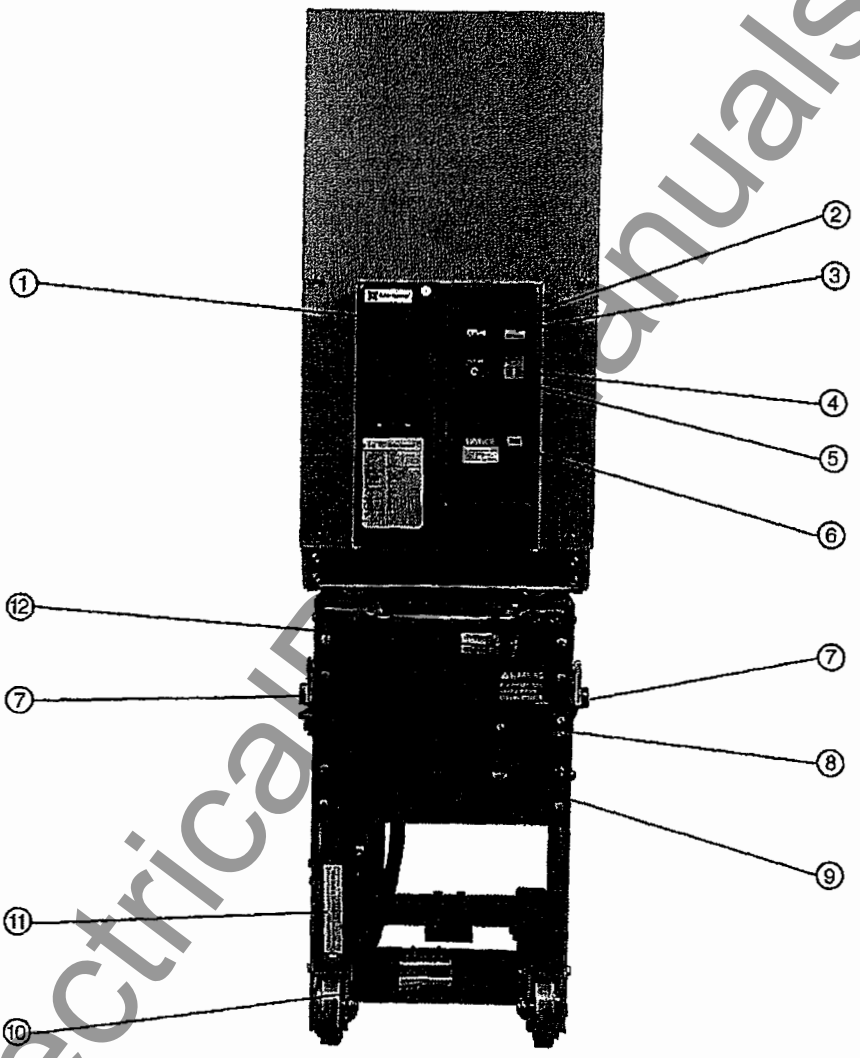
Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same general rule for heat as for outdoor storage should be applied.

3.4 DH-VR APPROXIMATE WEIGHTS

Refer to Table 3.1

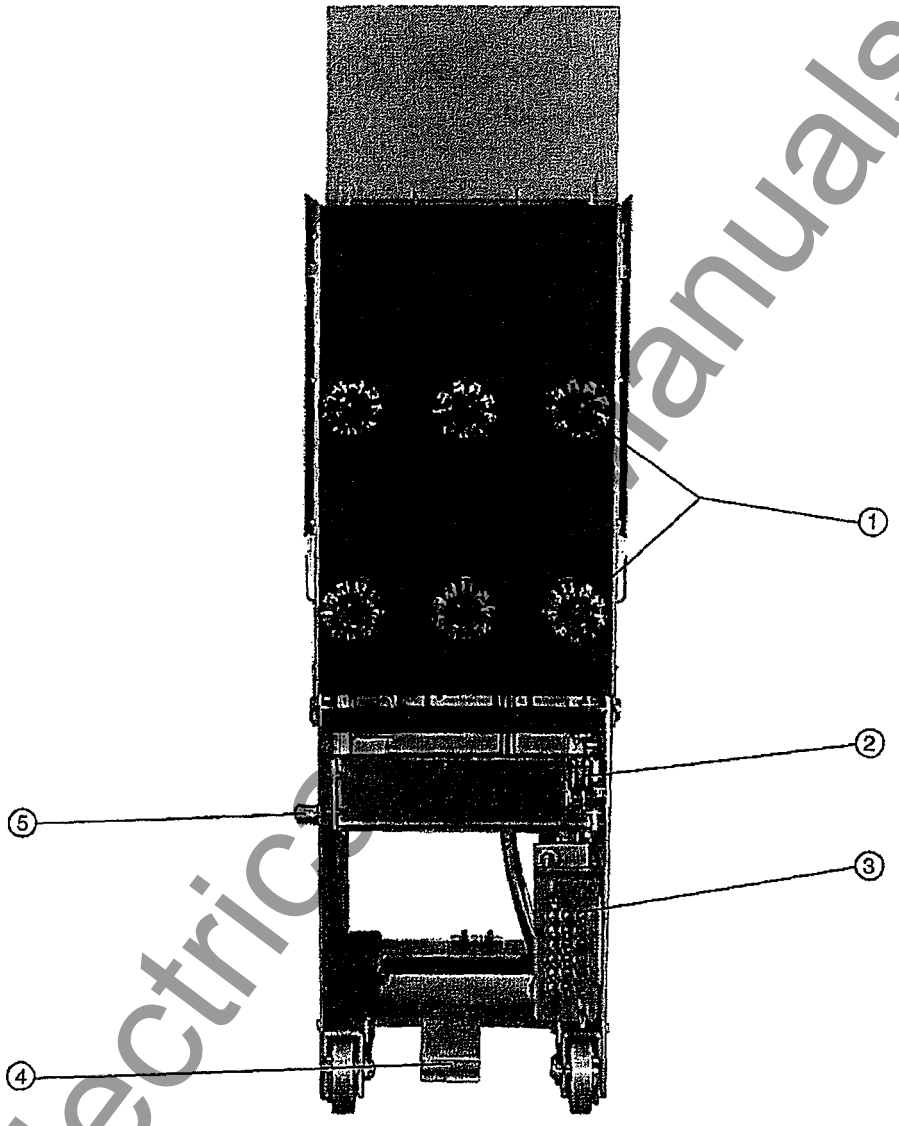
Table 3.1 - Weight by Breaker Type

Circuit Breaker Type	*Amperes*	*LBs.*
50DH-50AXU/75U	600	410
	1200	425
50DH-50XU/75ARU	600	420
	1200	435



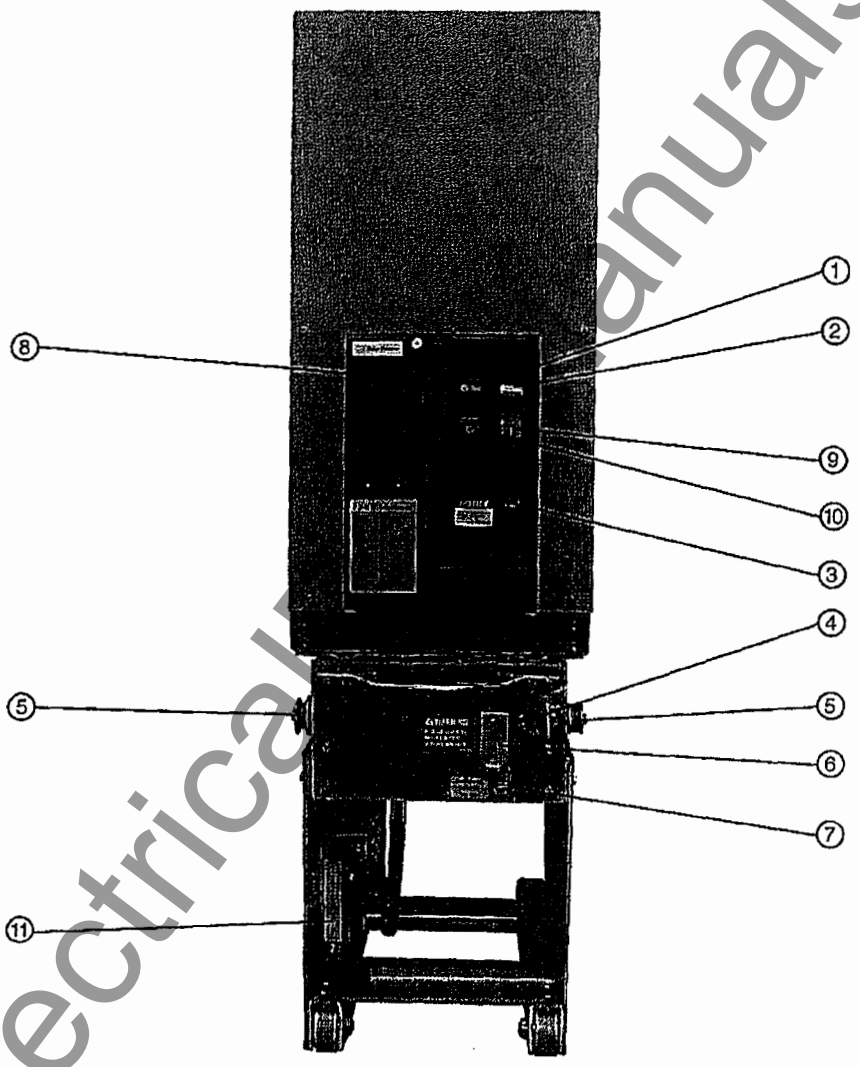
1. Manual Charging Handle
2. Contact Status Indicator
3. Closing Spring Status Indicator
4. Push to Close Button
5. Push to Open Button
6. Operations Counter
7. Racking Mech Arm
8. Levering-In Shaft
9. Lock Out Flag
10. Tow Hitch
11. Secondary Slide
12. Position Indicator

Figure 3-3 Front External View of 50DH-VR Breaker (Front Racking)



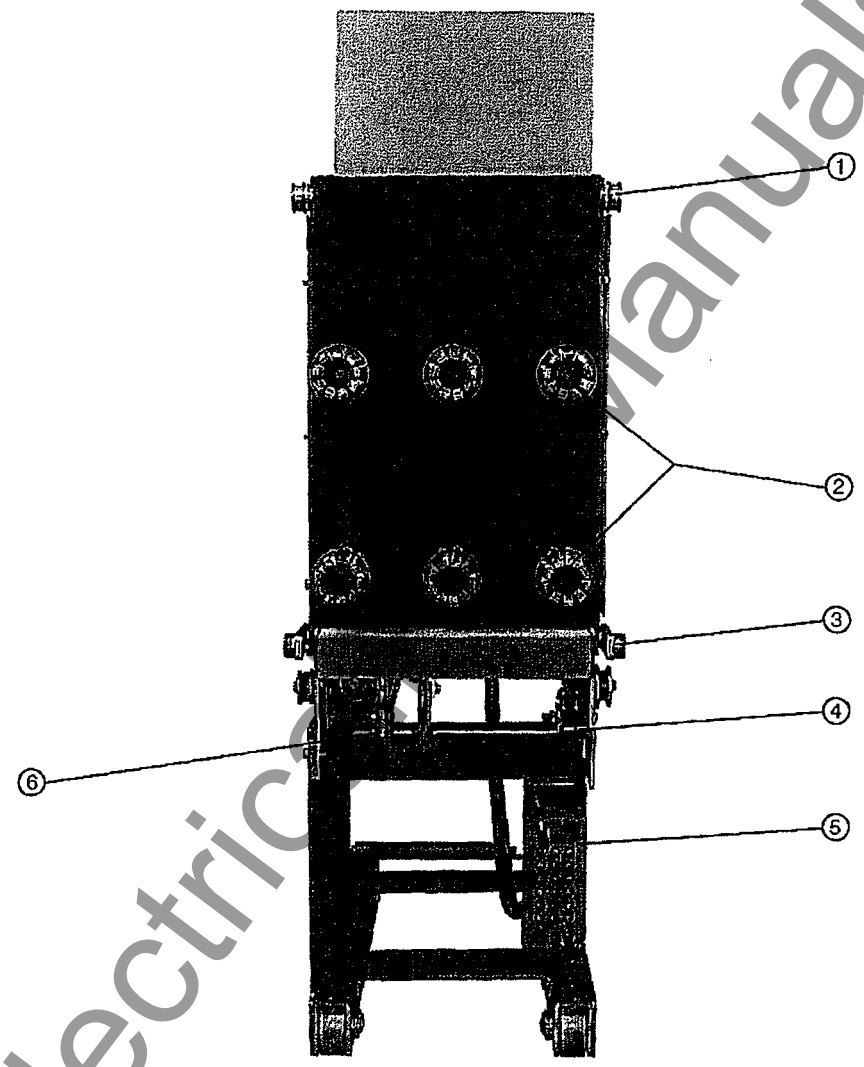
① Primary Disconnects
② Ground
③ Secondary Block
④ Anti-Rotation Bracket
⑤ Shutter Roller

Figure 3-4 Back External View of 50DH-VR Breaker (Front Racking)



① Contacts Status Indicator
② Closing Spring Status Indicator
③ Operations Counter
④ Levering-In Shaft
⑥ Guide Wheels
⑥ Lock-Out Flag
⑦ Position Indicator
⑧ Manual Charging Handle
⑨ Push to Close Button
⑩ Push to Open Button
⑪ Secondary Slide

Figure 3-5 Front External View of 50DH-VR Breaker (Rear Racking)



1. Shutter Rollers
2. Primary Disconnects
3. Racking Mech Arm
4. Ground
5. Secondary Block
6. Interlock Linkage

Figure 3-6 Back External View of 50DH-VR Breaker (Rear Racking)

SECTION 4: INSTALLATION AND INSPECTION

WARNING

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

When the breaker is first commissioned into service and each time the breaker is returned to service, it should be carefully examined and checked to make sure it is operating correctly.

4.1 EXAMINATION FOR DAMAGE

Examine the breaker for loose or obviously damaged parts. Never attempt to install nor operate a damaged breaker.

4.1.1 NAMEPLATE VERIFICATION

Verify the information on the new VR-series nameplate matches the information on the purchase order. If any discrepancies exist, notify Cutler-Hammer for resolution prior to proceeding.

4.2 CELL MODIFICATIONS

4.2.1 50-DH-VR-50AXU/75U (FRONT RACKING)

WARNING

BEFORE ANY MODIFICATIONS ARE PERFORMED, THE SWITCHGEAR MUST BE DE-ENERGIZED. FAILURE TO VERIFY THIS COULD RESULT IN EQUIPMENT DAMAGE, PERSONNEL INJURY, OR DEATH.

Since the width of the VCP-TR element is wider than the original Air Circuit Breaker (ACB), modifications are required to be performed on each switchgear cubicle used in conjunction with a Cutler-Hammer 50-DH-VR-50AXU/75U breaker. These modifications will not affect the operation of the ACB if reinserted in the cell after the changes are complete.

Verify that the switchgear is de-energized. Protect all objects used for conducting electricity (primary and secondary disconnects) from metallic dust produced during the cutting procedure. This could be done using a drop cloth, tarp, or other similar product. Make sure the edges are sealed with duct tape or other equivalent means.

The modifications are to be completed on the frame that, along with the breaker front cover, makes up the "dead front" barrier. Figure 4-5 shows the dimensions of the material to be removed from the switchgear cubicle.

With a marking device, outline the material to be removed. Using a saw with a blade capable of cutting steel, remove the material within the outline. Grinding may be necessary to remove any sharp edges that result.

WARNING

FAILURE TO COMPLETELY REMOVE METALLIC DUST COULD NEGATIVELY AFFECT THE OPERATION OF THE BREAKER AND / OR SWITCHGEAR CELL. THIS COULD RESULT IN EQUIPMENT DAMAGE, PERSONNEL INJURY, OR DEATH.

With an industrial vacuum cleaner, remove all metallic dust from inside the cell. Any remaining dust could negatively affect the operation of the breaker and / or switchgear cubicle. Remove the material used to protect the high voltage and control voltage components. Carefully inspect these areas to ensure no metallic dust penetrated the seal and settled around the components. If dust is observed, thoroughly remove it with an industrial vacuum cleaner. Any remaining dust could negatively affect the operation of the breaker and / or switchgear cubicle.

Once cleanup is complete, insert the breaker into the test position to determine if the correct amount of material was removed. If not, follow the above procedures to remove any material preventing the insertion. See Figure 4-1 for completed modifications.

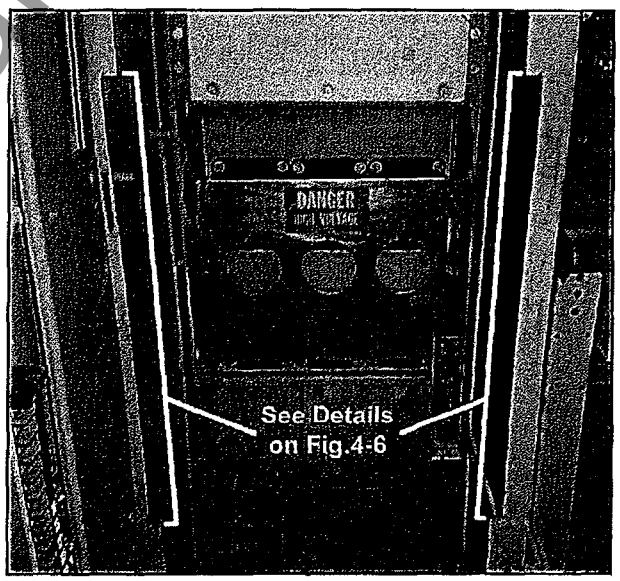


Figure 4-1 Completed Cell Modification (Front Racking)

4.2.2 50-DH-VR-50XU / 75ARU (REAR RACKING)

WARNING

BEFORE ANY MODIFICATIONS ARE PERFORMED, THE SWITCHGEAR MUST BE DE-ENERGIZED. FAILURE TO VERIFY THIS COULD RESULT IN EQUIPMENT DAMAGE, PERSONNEL INJURY, OR DEATH.

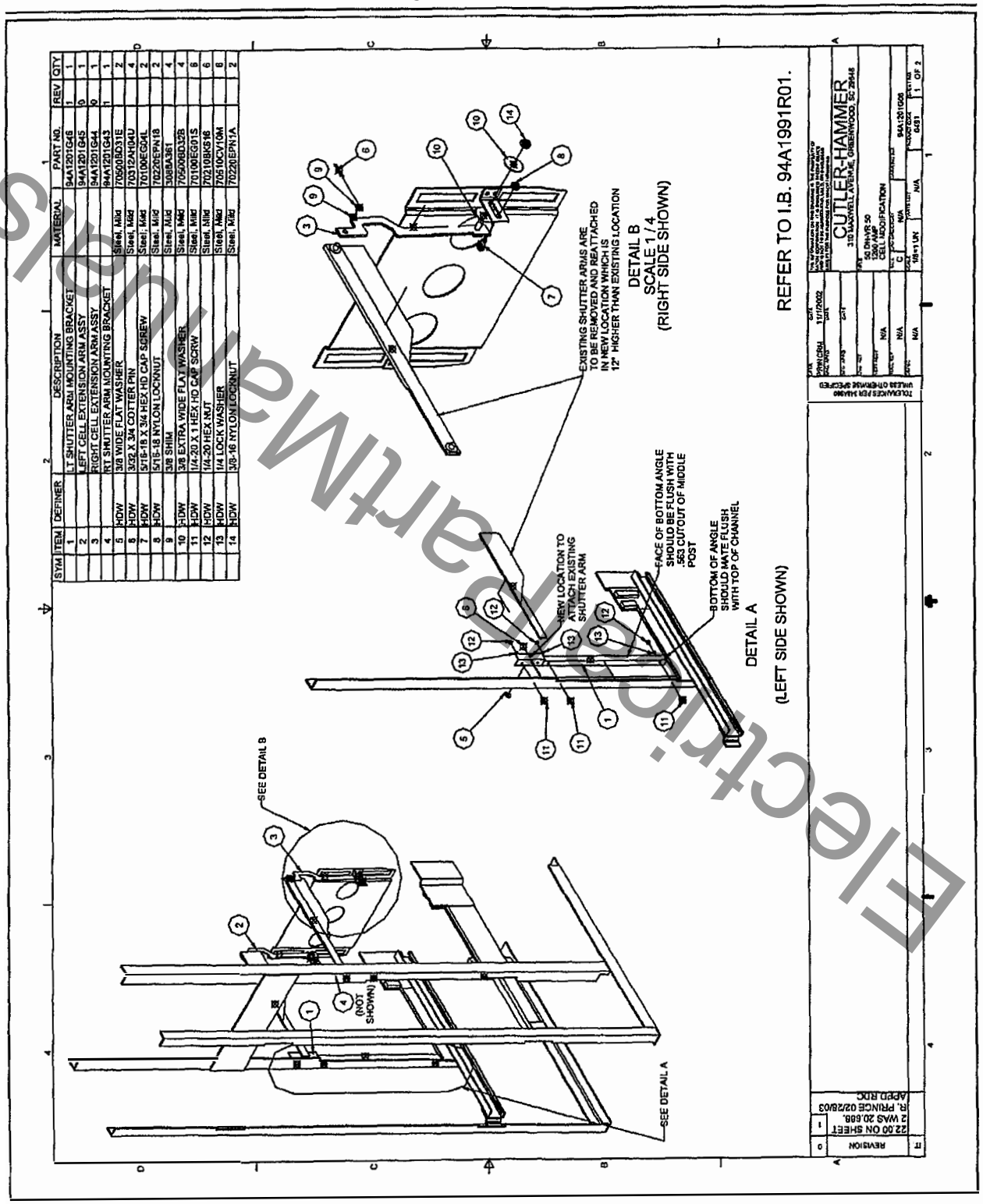


Figure 4-2 Detailed Schematic of Cell Modification

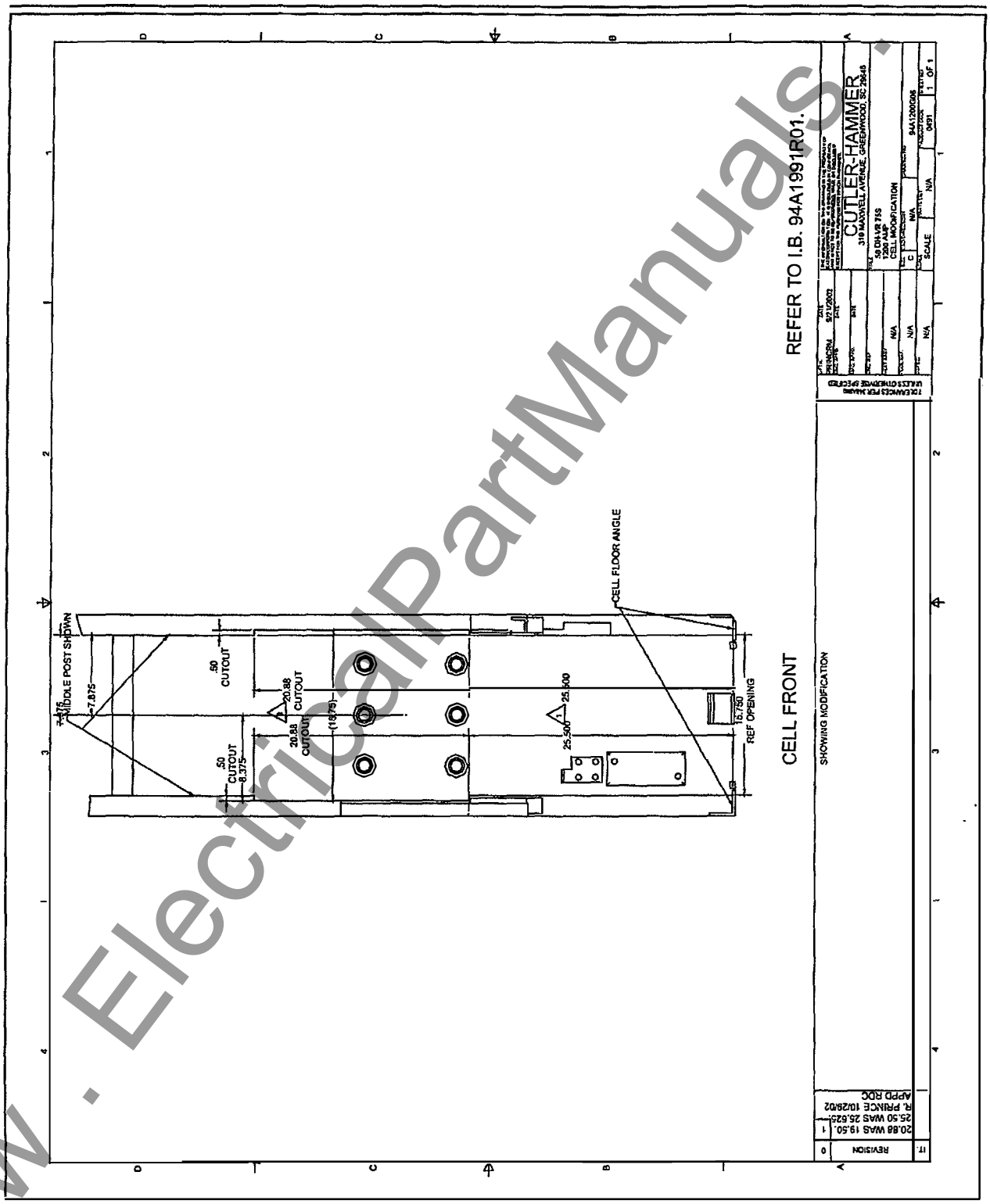


Figure 4-3 Detailed Schematic Of Dimensions To Be Removed (Front Racking)

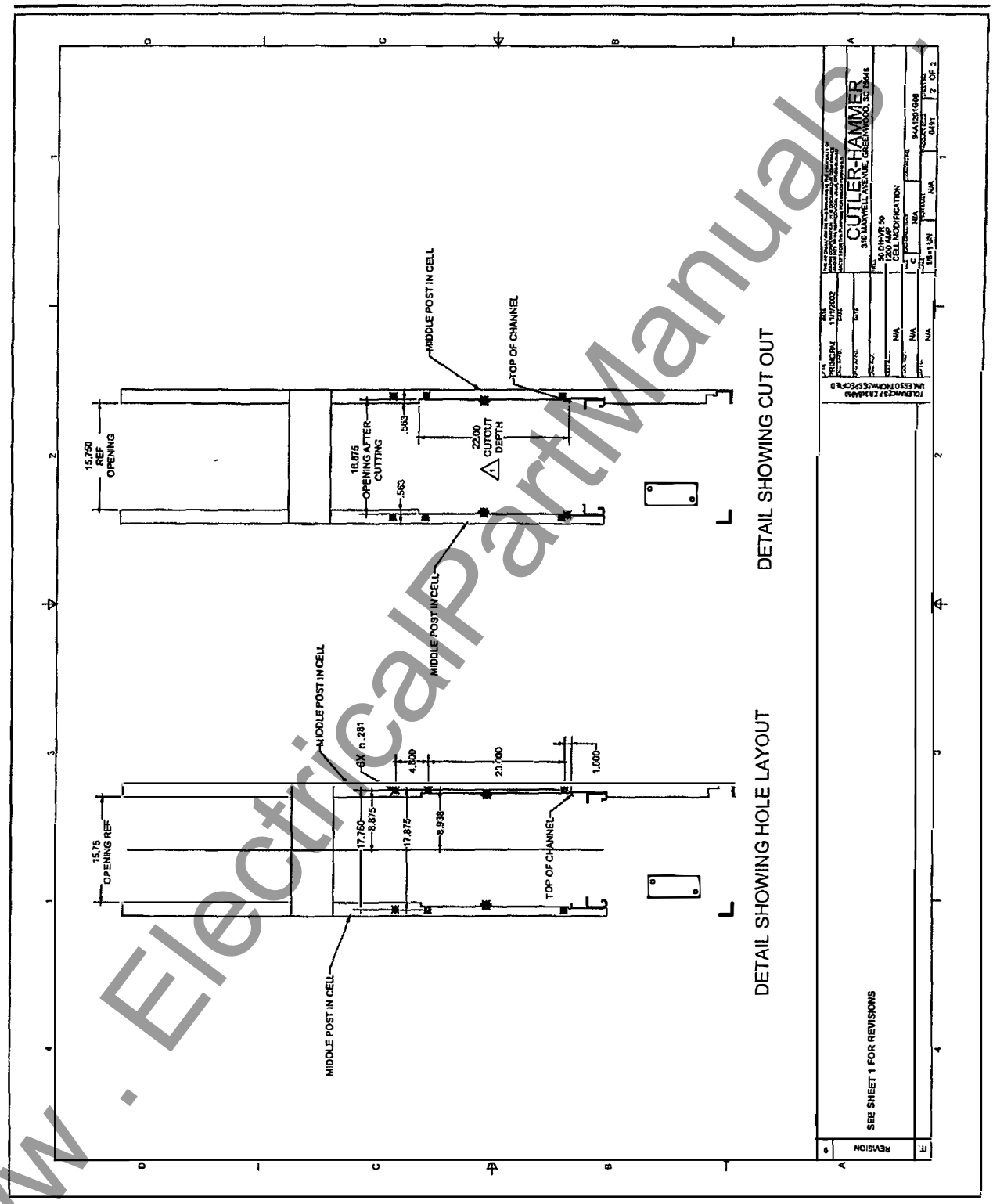


Figure 4-4 Detailed Schematic Of Dimensions To Be Removed (Rear Racking)

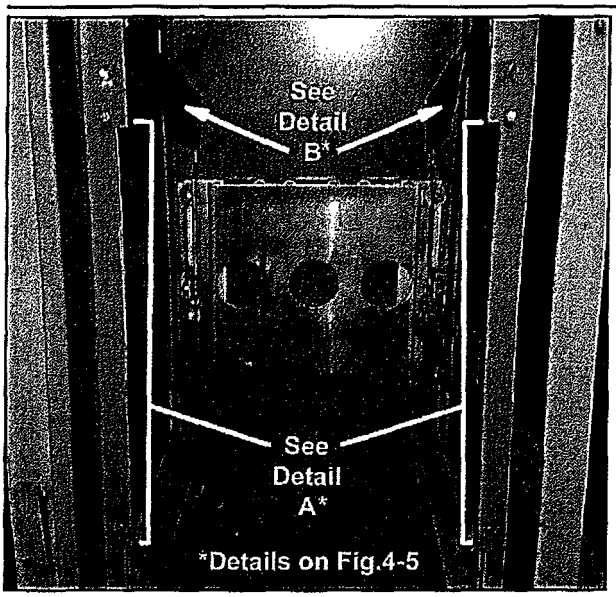


Figure 4-5 Completed Cell Modification (Rear Racking)

Since the width of the VCP-TP element is wider than the original Air Circuit Breaker (ACB), modifications are required to be performed on each switchgear cubicle used in conjunction with a Cutler-Hammer 50-DH-VR-50XU/75ARU breaker. The ACB will no longer operate the shutter mechanism and cannot be used in its original condition. The shutter operators on the breaker can be moved up on the bushing support frame one foot (12") if desired to correctly operate the shutter mechanism.

Verify the switchgear de-energized. To remove the shutter operators in the cell, you must first remove the hardware used to attach them to the cell frame and the shutter. Keep shutter arms for later use. New hardware will be provided.

The brackets used to attach the shutter operators to the middle frame need to be removed. Protect all objects used for conducting electricity (primary and secondary disconnects) from metallic dust produced during the cutting procedure. This could be done using a drop cloth, tarp, or other similar product. Make sure the edges are sealed with duct tape or other equivalent means. The brackets are welded to the frame, therefore they need to be cut away before any more modifications can be performed.

The modifications are to be completed on the frame that, along with the breaker front cover, makes up the "dead front" barrier. Figure 4-4 shows the dimensions of the material to be removed from the switchgear cubicle.

With a marking device, outline the material to be removed. Using a saw with a blade capable of cutting steel, remove the material within the outline. Grinding may be necessary to remove any sharp edges that result. Next, holes need to be drilled to install new shutter arm mounting brackets. Refer to Figure 4-4 for dimensions.

⚠ WARNING ⚡

FAILURE TO COMPLETELY REMOVE METALLIC DUST COULD NEGATIVELY AFFECT THE OPERATION OF THE BREAKER AND/OR SWITCHGEAR CELL. THIS COULD RESULT IN EQUIPMENT DAMAGE, PERSONNEL INJURY, OR DEATH.

With an industrial vacuum cleaner, remove all metallic dust from inside the cell. Any remaining dust could negatively affect the operation of the breaker and/or switchgear cubicle. Remove the material used to protect the high voltage and control voltage components. Carefully inspect these areas to ensure no metallic dust penetrated the seal and settled around the components. If dust is observed, thoroughly remove it with an industrial vacuum cleaner. Any remaining dust could negatively affect the operation of the breaker and/or switchgear cubicle.

Attach supplied left shutter arm mounting bracket and right shutter arm mounting bracket per Figure 4-2 (Detail A) using supplied hardware. Attach left cell extension arm assembly and right cell extension arm assembly per Figure 4-2 (Detail B) using supplied hardware. Once these parts are installed, the shutter arms can be reassembled in the cubicle per Figure 4-2 (Details A and B) using supplied hardware.

Once cleanup and installation of new parts are complete, insert the breaker into the test position to determine if the correct amount of material was removed. If not, follow the above procedures to remove any material preventing the insertion. See Figure 4-5 for completed modifications.

4.3 INSERTION PROCEDURES

4.3.1 50-DH-VR-50 AXU/75U (FRONT RACKING)

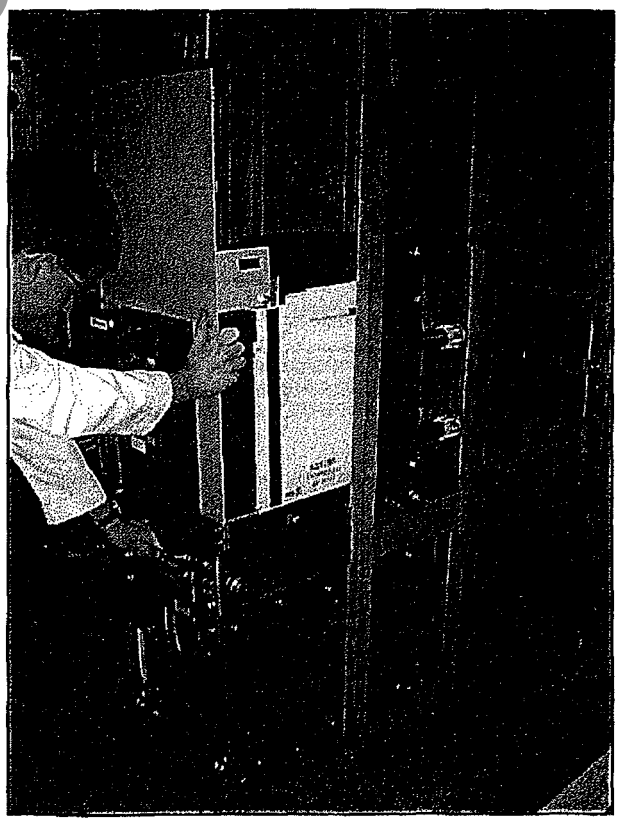


Figure 4-6 Alignment of 50DH-VR

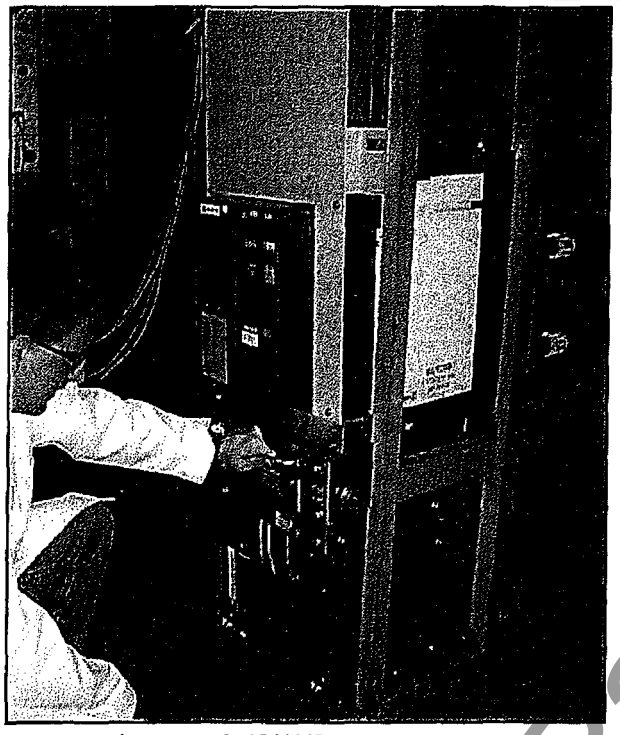


Figure 4-7 Insertion of 50DH-VR

a. Place the breaker in the withdrawn position out of the cell. The racking handle is not required for this position and the levering system interlocks are not automatic outside the cell. The breaker can be mechanically operated in this position if the position mode indicator reads "TEST/OPERATE". Extreme care should be exercised to avoid inadvertent operation and possible injury or equipment damage.

WARNING

THE BREAKER CAN BE OPERATED WHEN WITHDRAWN FROM THE CELL AND EXTREME CARE SHOULD BE EXERCISED TO AVOID INADVERTENT OPERATION AND POSSIBLE INJURY OR EQUIPMENT DAMAGE.

b. From the withdrawn position, insure the breaker is open and the mechanism is completely discharged. Engage the racking crank and rotate the racking handle counterclockwise as far as possible and align the breaker wheel rails with the guide rails of the cell. (See Figure 4-6)

c. Check that the closing spring status indicator reads "DISCHARGED" and that the main contact status indicator reads "OPEN". Manually trip, close, and trip the breaker as needed to obtain this status.

d. Push the circuit breaker into the cell until all the wheels are on the cell floor and the breaker halts as the racking arm rollers meet the guide slots of the cell (Figure 4-7).

e. Engage the racking handle (Figure 3-1) and crank the handle clockwise operate 1/2 turn until the "disconnect" position is reached and the breaker will now be held captive in the compartment. The breaker can not be operated because of the racking mechanism trip cam interface with the breaker trip linkage.

f. To rack the breaker further into the cell, rotate the racking handle clockwise. In approximately 1 - 1/2 clockwise turns of the racking handle, the position indicator (Figure 3-3) will reflect "TEST / OPERATE". In the "TEST" position, the breaker can be closed and tripped manually and electrically, thus allowing maintenance test or checks. To operate the breaker electrically, the secondary control block must be engaged at this time. Release the secondary connection block slider by pulling the catch pin and pushing the slider toward the rear several inches. The slider is located on the lower left hand area of the circuit breaker frame. Push on the front side flat surface of the slider until the contact block can be felt to be fully engaged in the secondary block's socket.

NOTICE

Once the secondary disconnect block is engaged in the "test" position, it will remain connected throughout further inward movement as the breaker advances from the "test" to the "connect" position.

The spring charging motor will begin to run and charge the closing spring as the secondary connection is made as long as control power is available. The breaker is now in the "test" position, with control voltage applied and ready for electrical or manual testing.

g. To advance from the test position, continue turning the racking handle clockwise. The breaker will travel approximately 9 inches. Towards the end of travel, the rack-in torque will increase due to the additional resistance of the contact fingers engaging the cell copper. The breaker will be considered in the "CONNECT" position when the position indicator reads "TEST/OPERATE." This indicates that the trip linkage is released and the breaker is now ready for service.

4.3.2 50-DH-VR-50XU/75ARU (REAR RACKING)

a. Place the breaker in the withdrawn position out of the cell. The racking handle is not required for this position and the levering system interlocks are not automatic outside the cell. The breaker can be mechanically operated in this position if the position mode indicator reads "TEST/OPERATE". Extreme care should be exercised to avoid inadvertent operation and possible injury or equipment damage.

WARNING

THE BREAKER CAN BE OPERATED WHEN WITHDRAWN FROM THE CELL AND EXTREME CARE SHOULD BE EXERCISED TO AVOID INADVERTENT OPERATION AND POSSIBLE INJURY OR EQUIPMENT DAMAGE.

b. From the withdrawn position, insure the breaker is open and the mechanism is completely discharged. Engage the racking crank and rotate the racking handle counter-clockwise as far as possible and align the breaker wheels with the guide rails of the cell. (Figure 4-6)

c. Check that the closing spring status indicator reads "OPEN". Manually trip, close, and trip the breaker as needed to obtain this status.

d. Push the circuit breaker into the cell until all the wheels are on the cell floor. The racking arm rollers will not meet the guide slots and the shutters have not begun to open. This is the "DISCONNECT" position.

WARNING

THE SHUTTER WILL RISE POSSIBLY EXPOSING HIGH VOLTAGE BEFORE THE RACKING ARM ROLLERS ENGAGE THE GUIDE SLOTS. EXTREME CARE SHOULD BE EXERCISED TO AVOID POSSIBLE INJURY OR EQUIPMENT DAMAGE.

e. Continue pushing the breaker into the cell. The shutters will start to rise. The breaker will travel approximately eight (8) inches from the "DISCONNECT" before the racking arm rollers meet the guide slots.

f. To rack the breaker farther into the cell, engage the levering-in handle. Rotate the handle approximately one (1) turn. The position mode indicator will reflect "TEST/OPERATE". In the "TEST" position, the breaker can be closed and tripped manually and electrically, thus allowing maintenance test or checks. To operate the breaker electrically, the secondary control block must be engaged at this time. Release the secondary connection block slider by pulling the catch pin and pushing the slider toward the rear several inches. The slider is located on the lower left hand area of the circuit breaker frame. Push on the front side flat surface of the slider until the contact block can be felt to be fully engaged in the secondary block's socket.

g. To advance from the test position, continue turning the racking handle clockwise. The breaker will travel approximately 4.25 inches. Towards the end of travel, the rack-in torque will increase due to the additional resistance of the contact fingers engaging the cell copper. The breaker will be considered in the "CONNECT" position when the position indicator reads "TEST/OPERATE". This indicates that the trip linkage is released and the breaker is now ready for service.

4.4 REMOVAL PROCEDURE

4.4.1 50-DH-VR-50AXU/75U (FRONT RACKING)

To remove the breaker from the cell it must be in the open position. Insure the breaker is open and engage the levering crank. Move the breaker out by rotating the levering crank counter-clockwise. The breaker will start coming out of the cell before the main stabs or secondary control block are disconnected. The breaker will be in a non-operable mode and will be prevented from closing if any attempt to close it is made in the intermediate position. The shutters will close after the main stabs have cleared, isolating the breaker from its source. Continue racking out until the position mode indicator shows "test/operate" and the shutter indicator shows closed. The breaker is in the test position and the trip mechanism is released, allowing the breaker to be operated either electrically or mechanically. If you desire to electrically open or close the breaker in the test position, the secondary control block must be reengaged and the levering crank removed.

To remove the breaker from the test position to the disconnect position, the breaker must be tripped if closed, the levering crank reinserted, and the secondary contact block should be disengaged. Rotate the levering crank counter-clockwise until the racking mechanism movement is halted by the racking mechanism stop. When moving out of the test position, a close signal will combine with a trip signal from the interlock cam to force a trip-free condition. This will cause the charging springs to discharge leaving the breaker in the open position. The levering crank should be removed at this point. The breaker is ready to be removed from the cell.

To remove the breaker from the disconnected to the withdrawn position, the breaker is pulled manually by the pull handle located immediately above the position mode indicator. The levering crank is not required between the withdrawn and disconnected positions.

If it is desired to leave the breaker in the cell instead of moving it from the test position to the completely withdrawn position, rotate the racking handle counter-clockwise one rotation. This will place the breaker in a "trip-free" mode but will not discharge the closing springs. This prevents unnecessary wear to the breaker mechanism.

4.4.2 50-DH-VR-50XU/75ARU (REAR RACKING)

a. To remove the breaker from the cell, it must be in the open position. Insure the breaker is open and engage the levering crank. Move the breaker out by rotating the levering crank counter-clockwise. The breaker will start coming out of the cell before the main stabs or secondary control block are disconnected. The breaker will be in a non-operable mode and will be prevented from closing if any attempt to close it is made in the intermediate position. Continue racking out the breaker until the position mode indicator reads "TEST/OPERATE". The breaker is in the "TEST" position and the trip mechanism is released, allowing the breaker to be operated either electrically or mechanically. If you desire to electrically open or close the breaker in the secondary control block must be reengaged and the levering crank removed.

WARNING

THE SHUTTERS ARE OPEN IN THE "TEST" POSITION. CARE SHOULD BE EXERCISED WHEN OPERATING THE BREAKER MECHANICALLY OR ELECTRICALLY OR POSSIBLE PERSONAL INJURY EQUIPMENT DAMAGE COULD RESULT.

b. To remove the breaker from the "TEST" position, continue turning the racking handle in a counter-clockwise direction until a mechanical stop is achieved. Using the handle located above the position mode indicator, pull the breaker towards the front of the cell until the shutters fully close isolating the breaker from its source. This is the "DISCONNECTED" position.

c. To remove the breaker from the cell, continue pulling the breaker towards the front of the cell using the handle provided. The breaker will encounter no stops and will be able to be pulled completely clear of the cell. The levering crank is not required.

4.5 MANUAL OPERATIONAL CHECKS

Perform manual operational checks. To make these checks, the breaker must be set in the "TEST" position. 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. It takes a number of downward 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.

Close and trip the breaker by pushing the manual close button "on" then the manual open button "off".

Repeat the charge, close, and trip procedure several times to confirm that the mechanism operates consistently and reliably.

WARNING

DO NOT ATTEMPT TO INSTALL OR OPERATE A VACUUM CIRCUIT BREAKER UNTIL A VACUUM INTEGRITY TEST IS PERFORMED.

Remove the breaker from the cell and move to an area with adequate room for the following tests:

4.6 VACUUM INTEGRITY CHECKS

Check the vacuum integrity of the interrupters of three pole units by conducting the applied potential test described in Section 6.3 of this book.

4.7 APPLIED POTENTIAL TEST

Perform insulation integrity tests as described in Section 6.7.

4.8 CONTACT EROSION, CONTACT WIPE AND STROKE

Close the breaker. Check all three vacuum interrupter erosion indicator marks as described in Section 6.5 and shown in Figures 6-2 and 6-3 to verify that contact erosion is not greater than the service limit. Check contact wipe and stroke (Section 5.1.3).

4.9 PRIMARY CIRCUIT RESISTANCE TESTS

Check the primary circuit resistance of the three pole units as described in Section 6.8. The resistance should not exceed the values specified. Record the values for future reference.

4.10 ELECTRICAL OPERATIONAL CHECKS

Perform electrical operations checks. Close and trip the circuit breaker electrically several times to verify that the operation is reliable and consistent. Check that the operation of the spring charging motor is reasonably prompt and that the motor makes no unusual noise. These checks can be performed by placing the breaker into the "test" position in the switchgear cell, or by connecting the breaker to a "test cabinet" or the switchgear cell's secondary receptacle using the special extension cable designed for this purpose.

WARNING

WHILE CHECKS ARE PERFORMED IN THE BREAKER COMPARTMENT, CARE MUST BE EXERCISED TO MAKE CERTAIN THAT PRIMARY CIRCUIT IS NOT ENERGIZED.

DO NOT PERFORM ELECTRICAL OPERATION CHECKS WITH THE BREAKER IN THE "CONNECT" POSITION BECAUSE OF THE POSSIBILITY OF CONNECTING DE-ENERGIZED LOAD CIRCUITS

SECTION 5: DESCRIPTION AND OPERATION

5.1 VCP-TR Vacuum Circuit Breaker Element

The Cutler-Hammer Type VCP-TR vacuum circuit breaker is a fixed mounted device. It is designed and tested in accordance with ANSI Standards C37.04 and C37.09.

The VCP-TR circuit breaker is a true metal-clad circuit breaker encompassing all the features normally associated with a true metal-clad design, such as:

- Insulation and isolation of compartments
- 11 gauge steel barriers between primary and mechanism compartments

VCP-TR uses 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.

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

VCP-TR circuit breakers utilize vacuum interrupters for interruption and switching functions (Figure 5-1). Vacuum interruption offers the advantages of enclosed interrupters, reduced size and weight, short interrupting time, long life, reduced maintenance, and environmental compatibility.

The vacuum interrupters are mounted vertically and supported from the fixed stem connected to the top conductor. The patented pole unit molding encloses each of the vacuum interrupter assemblies on three sides and provides the required mounting means, insulation, isolation, strength and rigidity.

The current transfer system consists of a unique flexible connector attached to the movable stem of the vacuum interrupter. The flexible connector consists of a large number of flexible leaf conductors that are pressure welded on both ends. One end of the flexible connector is attached to the movable vacuum interrupter stem and the other end to the circuit breaker's lower conductor. As the vacuum interrupter stem moves and the flexible connector flexes, current is safely and efficiently transferred between the stem and lower conductor.

5.2.1 CONTACT EROSION INDICATOR

The purpose of the contact erosion indicator is to monitor any erosion of the vacuum interrupter contacts. Contact erosion is, however, very minimal over time with Cutler-Hammer 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.

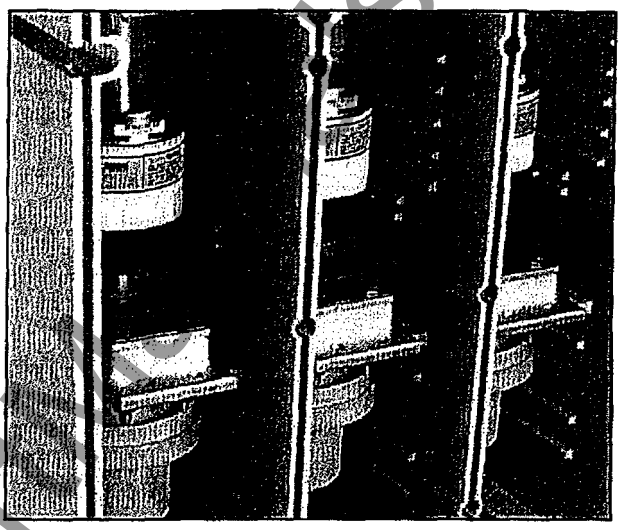


Figure 5-1 50 VCP-TR and 75 VCP-TR Interrupter Assemblies (600A, 16kA shown)

WARNING

FAILURE TO REPLACE THE INTERRUPTER ASSEMBLY WHEN INDICATED BY THE CONTACT EROSION INDICATOR COULD CAUSE THE BREAKER TO FAIL, LEADING TO DEATH, PERSONNEL INJURY OR PROPERTY DAMAGE.

5.2.2 CONTACT WIPE AND STROKE

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

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

The circuit breaker mechanism provides a fixed amount of motion to the drive insulators. The first portion of the motion is used to close the contacts (i.e. stroke) and the remainder is used to further compress the preloaded wipe 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 Cutler-Hammer vacuum circuit breakers, in order to eliminate the need for field adjustments of wipe or stroke. Refer to Section 6.7 for details on visually inspecting contact wipe.

5.3 PHASE BARRIERS

Phase Barriers are flat sheets of insulation placed between each interrupter assembly. They are held in place by slots molded into the element housing. To remove the barriers, lift straight up, no hardware needs to be taken out.

WARNING

ALL FOUR PHASE BARRIERS MUST BE IN PLACE BEFORE PLACING THE CIRCUIT BREAKER INTO SERVICE. FAILURE TO HAVE THEM IN POSITION CAN CAUSE DEATH, SERIOUS PERSONNEL INJURY AND/OR PROPERTY DAMAGE

5.4 BUSHINGS AND DISCONNECTING CONTACT ASSEMBLIES

The upper and lower bushings which are the primary circuit terminals of the circuit breaker consists of silver plated conductors insulated with fluidized epoxy. Multiple finger type primary disconnecting contacts at the ends of the conductors provide means for connecting and disconnecting the breaker to the bus terminals in the switchgear compartment.

5.5 STORED ENERGY MECHANISM

The spring-type stored energy operating mechanism is mounted above the breaker frame and in the front of the breaker. Manual closing and opening controls are at the front panel (Figure 3-3) so that they are accessible while the breaker is in any of its four basic positions. (See Section 4.2)

The mechanism stores the closing energy by charging the closing springs. When released, the stored energy closes the breaker, charges the wipe and resets springs. The mechanism may rest in any one of the four positions shown in Figure 5-5 as follows:

a. Breaker open, closing springs discharged.

b. Breaker open, closing springs charged.

c. Breaker closed, closing springs discharged.

d. Breaker closed, closing springs charged.

The mechanism is a mechanically "trip-free" type. This means that if an electrical or mechanical trip signal is present at the same time as a close signal, the mechanism is prevented from discharging the springs.

In normal operation the closing spring is charged by the spring charging motor, and the breaker is closed electrically by the switchgear control circuit signal to energize the spring release coil. Tripping is caused by energizing the trip coil through the control circuit.

For maintenance inspection purposes the closing springs can be charged manually by using the handle located at the front of the mechanism and the breaker can be closed and tripped by pushing the "ON" and "OFF" buttons on the front panel.

WARNING

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 CRUSHING INJURY. DISCHARGE THE SPRINGS AND OPEN THE BREAKER BEFORE PERFORMING ANY MAINTENANCE, INSPECTION, OR REPAIR ON THE BREAKER.

THE DESIGN OF THIS CIRCUIT BREAKER ALLOWS MECHANICAL CLOSING AND TRIPPING OF THE BREAKER WHILE IT IS IN THE "CONNECT" POSITION. HOWEVER, THE BREAKER SHOULD BE CLOSED MECHANICALLY ONLY IF THERE IS POSITIVE VERIFICATION THAT LOAD SIDE CONDITIONS PERMIT. IT IS RECOMMENDED THAT CLOSING THE BREAKER IN THE "CONNECT" POSITION ALWAYS BE DONE WITH THE CUBICLE DOOR CLOSED. FAILURE TO FOLLOW THESE DIRECTIONS MAY CAUSE DEATH, PERSONNEL INJURY, OR PROPERTY DAMAGE.

ELECTRICAL TRIPPING CAN BE VERIFIED WHEN THE BREAKER IS IN THE "TEST" POSITION.

5.6 ELECTRICAL POSITION

For electrically operated circuit breakers, the springs are normally charged through the use of a rugged electrical motor operator (Figure 5-5). The springs can, however, be manually charged. 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. It takes a number of downward 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.

Electrically operated circuit breakers can also be manually closed and opened through the use of the front mounted manual "ON" and manual "OFF" push-buttons. 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 Section 5.5.1 for more details.

The electrical motor operator can be installed in the field. Manually operated circuit breakers are pre-wired to readily accept this change.

5.7 TRIP-FREE OPERATION

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

5.8 ANTI-PUMP FEATURE

The VCP-TR circuit breaker has 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.

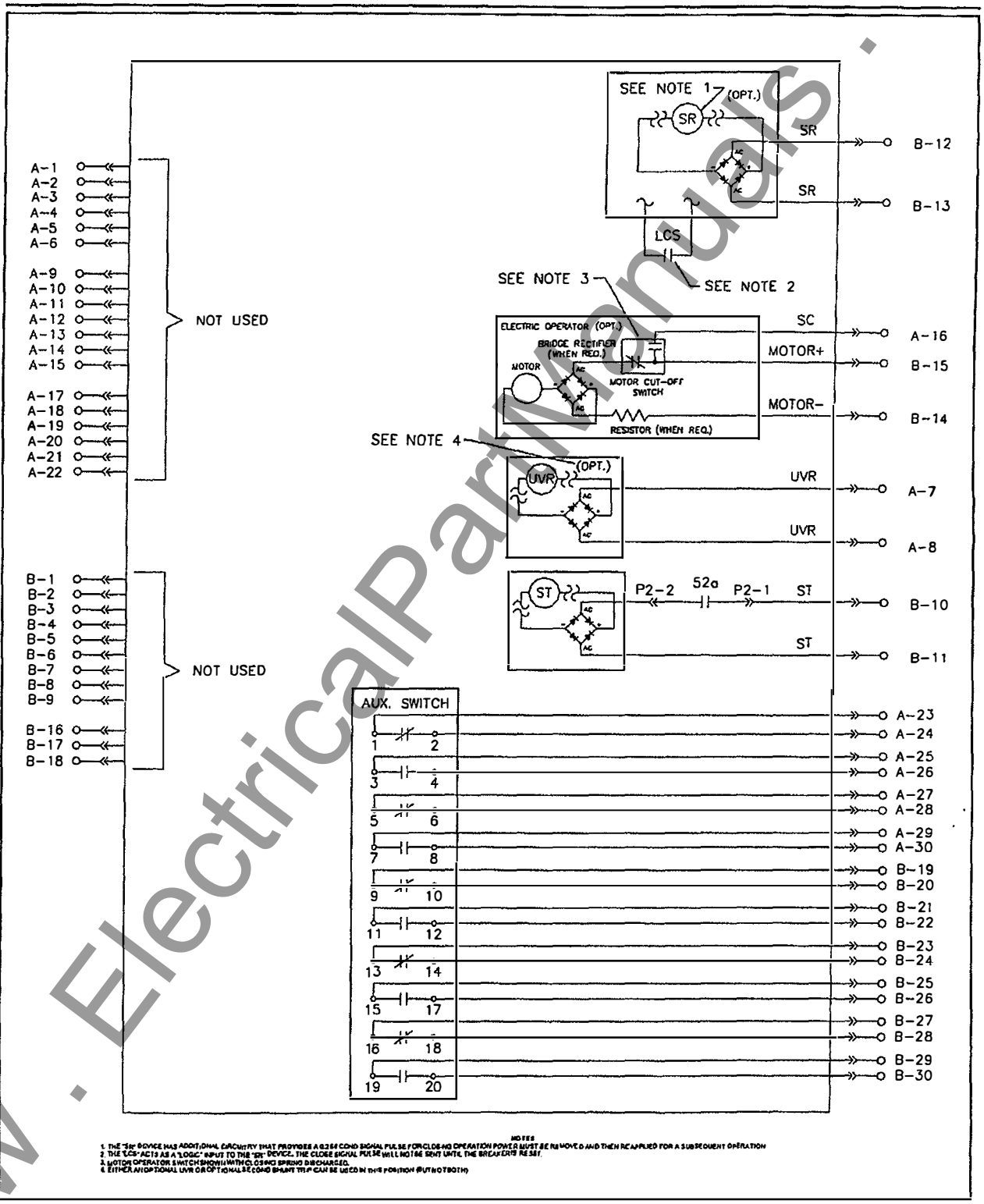


Figure 5-2 Typical AC/DC Schematic

5.9 LATCH CHECK SWITCH

Any VCP-TR 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.

5.10 TIMING

The opening and closing times for the circuit breakers vary depending upon the control voltage and the power rating. Typical values for VCP-TR 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) - 60 to 73 milliseconds

Reclosing Time (from initiation to trip signal to contact make) - 250 milliseconds

5.11 SECONDARY CONNECTION BLOCK

The breaker control circuit is connected to the switchgear control through an 18-point secondary connection block (See Section 3 for component location). The movable slide arrangement is provided to allow for block extension during operational checks with the breaker in the "TEST" position. The contacts engage automatically when the breaker is racked into the "CONNECT" position, or it can be engaged while the breaker is in the "TEST" position by releasing the latch pin and pushing forward on the slider located at the lower left hand of the breaker frame. The socket half of the connection is located in the cubicle and a jumper of multi-conductor cable, which should have been included with the cubicle, can complete with control connections (for testing) when the breaker is in the "WITHDRAWN" position as described in Section 3. The latch pin causes the secondary connection block to disengage whenever the breaker is levered out of the "CONNECT" position.

5.12 INTERLOCKS

There are several interlocks built into the Cutler-Hammer vacuum unit replacement breakers. Each of these interlocks performs exactly the same function it did on the original breaker. These interlocks exist to safeguard personnel and equipment. The basic premise behind the interlocking arrangement on the vacuum unit replacement breakers is that the breaker must not be inserted into or removed from a live circuit while the main contacts are closed. In addition to the original interlocks, the Cutler-Hammer type VCP-TR element provides an anti-close interlock.

WARNING

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

5.13 LEVERING SYSTEM TRIP AND SPRING RELEASE INTERLOCKS

The levering system tripping and spring release interlocks perform the following:

a. Sets the breaker mechanically trip-free whenever the breaker is in the "WITHDRAWN" position or between the "TEST" and "CONNECT" positions.

b. Set the breaker in a safe condition (breaker open, springs discharged) when removed from the cell.

c. Inserts a mechanical trip signal to open a position switch preventing the spring charging motor to operate whenever the breaker is in the "WITHDRAWN" or "DISCONNECT," or between "TEST" or "CONNECT" positions.

d. Prevent inadvertent cycling (pumping) of the breaker between the "TEST" or "CONNECT" positions.

e. Prevent insertion of a closed and/or charged breaker into a cell.

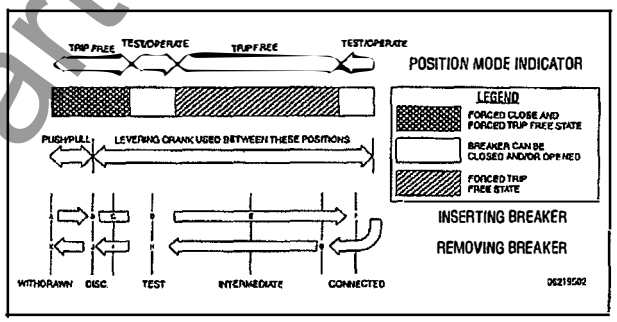


Figure 5-3 Cell Position Description (Front and Rear Racking)

5.14 CELL POSITION DESCRIPTION - Front Racking (See Figure 5-3)

Position A: This is the "WITHDRAWN" position. In the "WITHDRAWN" position the breaker is out of the cell. The racking handle is not required for this position and the levering system interlocks are not automatic outside the cell. The breaker is in a trip-free state and cannot be operated.

Position B: (Figure 5-4) As the breaker is pushed into the cell it will reach a mechanical stop. This is the "DISCONNECT" position and the breaker is still in the trip-free state and cannot be operated. Although it is possible to engage the control block in this position, it SHOULD NOT BE engaged at this time.

Position C: The levering crank is inserted is inserted on the levering shaft and turned in a clockwise direction. The breaker starts advancing into the cell. The breaker remains in the trip-free state until position "D" is reached.

Position D: (Figure 5-5) Continue turning the levering crank in the clockwise direction for a total of about 2 turns. At this time, note that the breaker position mode indicator status will change from "TRIP-FREE" to "TEST/OPERATE". There is no click, stop or

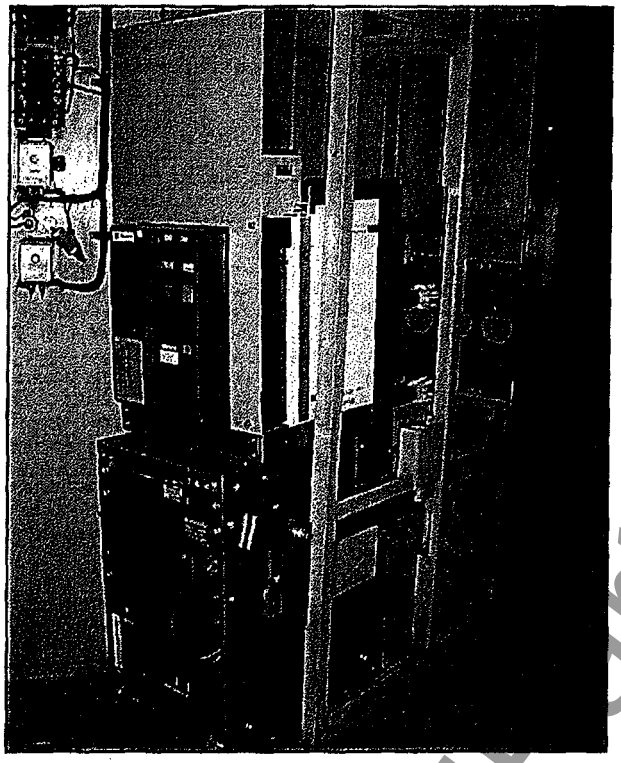


Figure 5-4 Front Racking - Position "B" (Disconnect)

different feel to the levering crank at this point. Observe the shutter position indicator which is located inside of the cell structure. Continue turning the crank until the shutter indicator begins to move downward. Stop clockwise rotation at this point. Turn the levering crank counter-clockwise to return the shutter to its fully closed position. The breaker is now in its "TEST" position. After reaching the test position, REMOVE the crank. In the "TEST" position, the breaker can be closed and tripped manually and electrically, thus allowing maintenance tests or checks. To operate the breaker electrically, the secondary control block must be engaged at this time. Release the secondary control block slider by pulling the release pin and pushing the slider toward the rear several inches. The slider is located on the lower left hand area of the circuit breaker frame. Push on the front side flat surface of the slider until the contact block can be felt to be fully engaged in the secondary block's socket. The spring charging motor will begin to run and charge the closing spring as the contact block engages. The breaker is now in the "TEST" position, with control voltage applied, and ready for testing. The breaker is held captive in the cell via the levering system.

Position E: To continue installing the breaker to the connected position the lever crank will have to be reinserted onto the levering shaft (the breaker MUST be in the open position). Continue turning the levering crank in the clockwise direction and the breaker will continue advancing into the cell. The position mode indicator will change from "TEST/OPERATE" to "TRIP-FREE". The levering system cam will engage the trip release mechanism. The breaker will not be able to mechanically close in this position. As you continue to advance the breaker into the cell the primary voltage source shutters will open allowing the breaker stabs to engage with the source.

Position F: (Figure 5-6) Continue clockwise cranking until a mechanical stop is reached. This is the fully engaged or connected position. At this position you will note the position mode indicator is again on "TEST/OPERATE," the trip and close cams have released the trip and close mechanisms, and the breaker can be operated. The breaker is now ready for service.

⚠ WARNING ⚠

DO NOT USE ANY TOOL TO LEVER THE BREAKER TO OR FROM THE CONNECTED POSITION OTHER THAN THE RACKING HANDLE.

Position G: Insert the levering crank onto the levering shaft. Turn the crank in the counterclockwise direction. The breaker will start coming out of the cell but before the main stabs are disconnected, the levering cam will ralse the trip mechanism, putting the breaker into the trip-free state. Also, the secondary controls stabs will disengage automatically. The position mode indicator will change from "TEST/OPERATE" to "TRIP-FREE". The breaker is in a non-operable mode and will go through a trip-free operation if an attempt to close it were made.

Position H: Continue cranking in the counterclockwise direction, and the shutters will close after the main stabs have cleared, isolating the breaker from its source. Continue cranking until the position mode indicator re-centers on "TEST/OPERATE". At this time the breaker is in the test position and the trip mechanism is

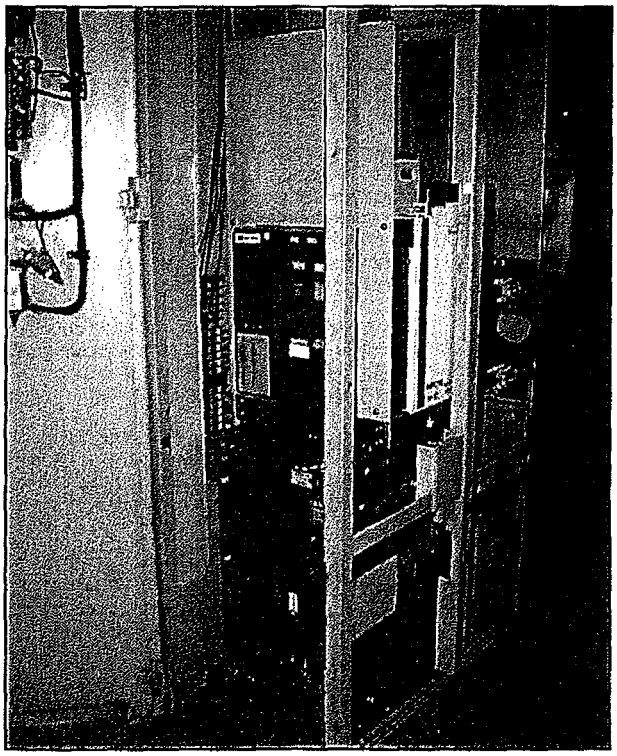


Figure 5-5 Front Racking - Position "D" (Test)

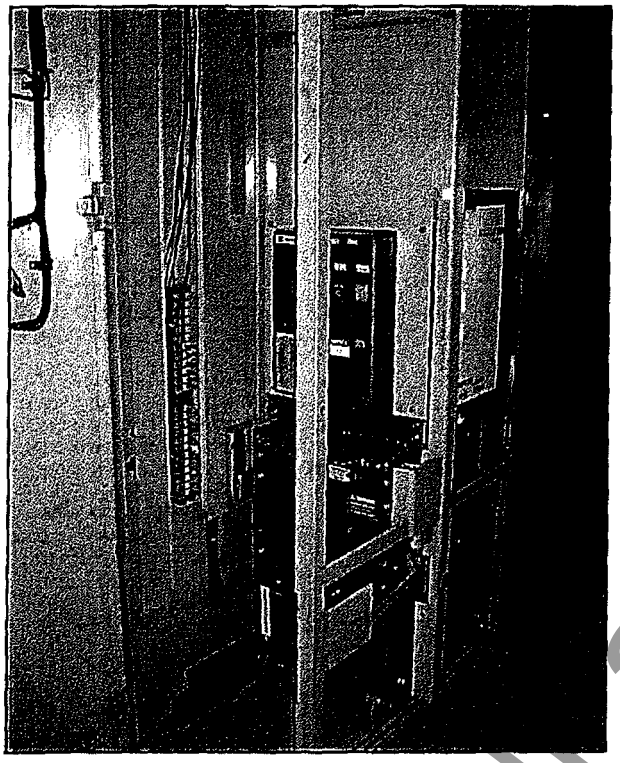


Figure 5-6 Front Racking - Position "F" (Connect)

released, allowing the breaker to be operated either electrically or mechanically. To operate electrically, the secondary control block must be re-engaged.

Position I: To remove the breaker from the test position to the disconnect, the breaker must be tripped if closed, and the secondary contact block should be disengaged and the manual open and close buttons cycled to render the breaker open and discharged. Continued cranking will force a trip-free condition leaving the breaker in the open position if the breaker were left closed in the test position. The breaker is in a non-operable state.

Position J: Once the racking mechanism is cranked counterclockwise until a mechanical stop is reached it is in the disconnected position. The levering crank should be removed at this point. The breaker is ready to be removed from the cell if desired.

Position K: The breaker is removed from the cell by manually pulling on the handle located immediately below the position mode indicator. The levering system is in the "DISCONNECT" orientation. The breaker is in a trip-free status and in a non-operable state in the withdrawn position.

5.15 CELL POSITION DESCRIPTION - Rear Racking

Position A: This is the "WITHDRAWN" position. In the "WITHDRAWN" position the breaker is out of the cell. The racking handle is not required for this position and the levering system interlocks are not automatic outside the cell. The breaker is in a trip-free state and cannot be operated.

Position B: (Figure 5-7) As the breaker is pushed into the cell, all four wheels will be on the cell floor. The racking arm rollers will NOT meet the guide slots and the shutters have not begun to open. This is the "DISCONNECT" position.

Position C: Continue to push the breaker into the cell until the racking arm rollers engage the guide slots. The shutters will start to rise. The breaker remains in the trip-free state until position "D" is reached.

Position D: (Figure 5-8) Insert the levering crank and rotate clockwise approximately (1) one turn. At this time, note that the breaker position mode indicator status will change from "TRIP-FREE" to "TEST/OPERATE". There is no click, stop or different feel to the levering crank at this point. The breaker is now in the "TEST" position. After reaching the test position, REMOVE the crank. In the "TEST" position, the breaker can be closed and tripped manually and electrically, thus allowing maintenance tests or checks. To operate the breaker electrically, the secondary control block must be engaged at this time. Release the secondary control block slider by pulling the release pin and pushing the slider toward the rear several inches. The slider is located on the lower left hand area of the circuit breaker frame. Push on the front side flat surface of the slider until the contact block can be felt to be fully engaged in the secondary block's socket. The spring charging motor will begin to run and charge the closing spring as the contact block engages. The breaker is now in the "TEST" position, with control voltage applied, and ready for testing. The breaker is held captive in the cell via the levering system.

Position E: To continue installing the breaker to the connected position the lever crank will have to be reinserted onto the levering shaft (the breaker MUST be in the open position). Continue turning the levering crank in the clockwise direction and the breaker will continue advancing into the cell. The position mode indicator will

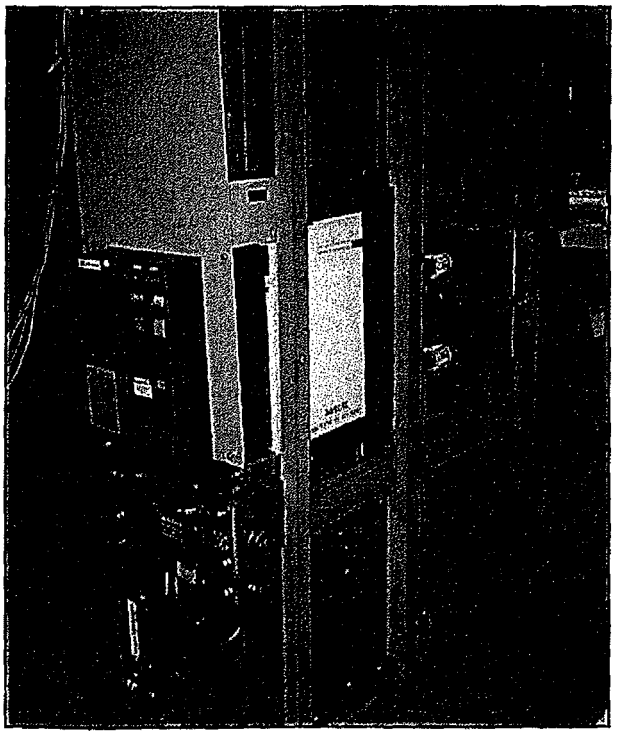


Figure 5-7 Rear Racking - Position "B" (Disconnect)

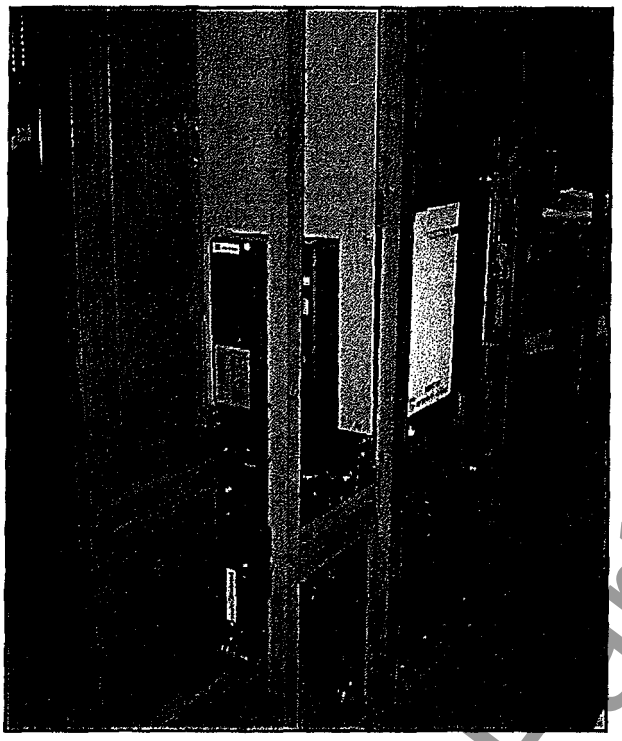


Figure 5-8 Rear Racking - Position "D" (Test)

change from "TEST/OPERATE" to "TRIP-FREE". The levering system cam will engage the trip release mechanism. The breaker will not be able to mechanically close in this position. As you continue to advance the breaker into the cell the primary voltage source shutters will open allowing the breaker stabs to engage with the source.

Position F: (Figure 5-9) Continue clockwise cranking until a mechanical stop is reached. This is the fully engaged or connected position. At this position you will note the position mode indicator is again on "TEST/OPERATE," the trip and close cams have released the trip and close mechanisms, and the breaker can be operated. The breaker is now ready for service.

WARNING

DO NOT USE ANY TOOL TO LEVER THE BREAKER TO OR FROM THE CONNECTED POSITION OTHER THAN THE RACKING HANDLE.

Position G: Insert the levering crank onto the levering shaft. Turn the crank in the counterclockwise direction. The breaker will start coming out of the cell but before the main stabs are disconnected, the levering cam will raise the trip mechanism, putting the breaker into the trip-free state. Also, the secondary controls stabs will disengage automatically. The position mode indicator will change from "TEST/OPERATE" to "TRIP-FREE". The breaker is in a non-operable mode and will go through a trip-free operation if an attempt to close it were made.

Position H: Continue cranking in the counter-clockwise directional until the position mode indicator re-centers on "TEST/OPERATE". At this time the breaker is in the test position and the trip mechanism is released, allowing the breaker to be operated either electrically or mechanically. To operate electrically, the secondary control block must be re-engaged.

Position I: To remove the breaker from the test position to the disconnect, the breaker must be tripped if closed, and the secondary contact block should be disengaged and the manual open and close buttons cycled to render the breaker open and discharged. Continued cranking will force a trip-free condition leaving the breaker in the open position if the breaker were left closed in the test position. The breaker is in a non-operable state.

Position J: Once the racking mechanism is cranked counter-clockwise until a mechanical stop is reached it can be moved to the disconnect position. The levering crank can be removed at this point. Using the handle provided on the lower front cover pull the breaker towards the front of the cell until the shutters are fully closed.

Position K: The breaker is removed from the cell by manually pulling on the handle located immediately below the position mode indicator. The levering system is in the "DISCONNECT" orientation. The breaker is in a trip-free status and in a non-operable state in the withdrawn position.

5.16 GROUNDING CONTACT

The grounding contact is an assembly of spring loaded fingers which ground the breaker frame by engaging the switchgear cell grounding bus when the breaker is levered into the "connect" position. The ground contact is located at the rear of the breaker.

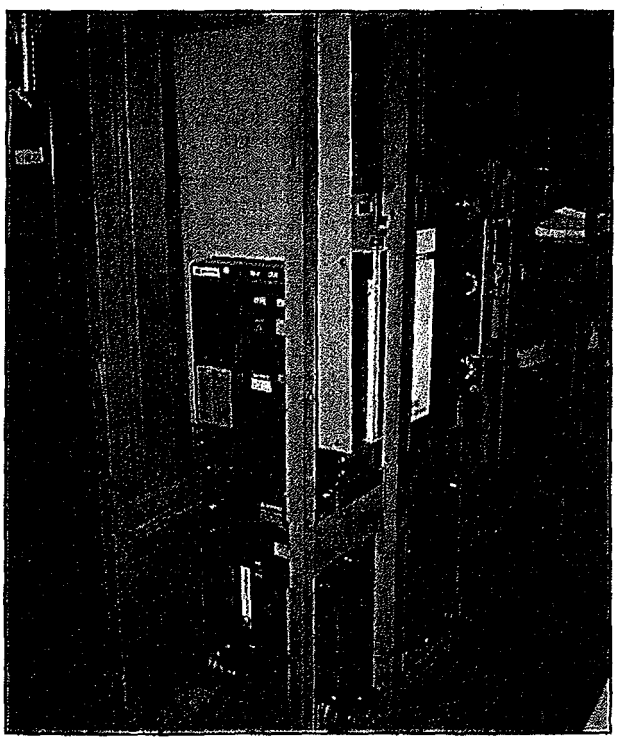


Figure 5-9 Rear Racking - Position "F" (Connect)

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 TO NOT 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 VCP-TR CIRCUIT BREAKERS AS PRESENTED IN THIS INSTRUCTION BOOK.**
- **DO NOT WORK ON A CIRCUIT BREAKER IN THE CONNECT 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.

VCP-TR circuit breakers are "Top of the Line" equipment. This means they are manufactured under a high degree of quality control, with the best available materials, with a high degree of tooling for accuracy and parts interchangeability. Design tests and installation experience show them to have durability beyond minimum requirements. However, because of variations in application conditions and the dependence placed upon these circuit breakers for protection and the assurance of service continuity, inspection and maintenance activities should take place on a regular basis.

It is recommended that maintenance record sheets be completed for the equipment. Careful and accurate documentation of all maintenance activities provide a valuable historical reference on equipment over time.

6.2 GENERAL CLEANING RECOMMENDATIONS

Cleaning and preventive measures are part of any good maintenance program. Circuit breaker cleaning activities should be part of an overall activity that includes the assembly in which the circuit breaker is installed. Loose dust and dirt can be removed from external surfaces using an industrial quality vacuum cleaner and/or lint free cloth. Unless otherwise indicated, never use high pressure blowing air. This could drive dirt or foreign objects into areas, such as the circuit breaker mechanism, where friction sources could cause problems. Never use a wire brush to clean any part of the circuit breaker.

6.3 FREQUENCY OF INSPECTION

Inspect the circuit breaker once a year when operating in a clean, non-corrosive environment. For a dusty and corrosive environment, an inspection should be performed twice a year. Additionally, it is recommended that a circuit breaker be inspected every time it interrupts a fault.

6.4 WHAT TO INSPECT

What to inspect and to what extent is dictated by the nature of the maintenance function. Once the circuit breaker has been cleaned as described in Section 6.2, visually inspect it for signs of damage, missing or loose parts and unusual wear. Make appropriate corrections to anything found out of order. Refer to Table 6.1 for inspection and maintenance procedures.

6.5 VACUUM INTERRUPTER INTEGRITY TEST

Vacuum interrupters used in Type VCP-TR circuit breakers are highly reliable interrupting elements. Satisfactory performance of these devices is dependant 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:

WARNING

APPLYING ABNORMALLY HIGH VOLTAGE ACROSS A PAIR OF CONTACTS IN VACUUM MAY PRODUCE X-RADIATION. THE RADIATION MAY INCREASE WITH THE INCREASE IN VOLTAGE AND/OR DECREASE IN CONTACT SPACING. X-RADIATION PRODUCED DURING THIS TEST WITH RECOMMENDED VOLTAGE AND NORMAL CONTACT SPACING IS EXTREMELY LOW AND WELL BELOW 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.

Table 6.1 - Inspection and Maintenance Procedures

No./ Section	Inspection Item	Criteria	Inspection Method	Corrective Action if Necessary
1. Insulation	Drive Insulator and Molded Pole Unit Support	No dirt	Visual Check	Clean with lint-free cloth
		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
	Control Circuit to Ground	Withstand	Hipot Tester	Clean and retest or replace
2. Power Element	Vacuum Interrupters	Contact Erosion Visibility of mark	Visual: Close the breaker and look for green mark on movingstem from the rear of the breaker (See Figure 6-1 and 6-2)	If mark is not visible, replace interrupter assembly.
		Contact wipe visible	Visual: Close the breaker and look for indicator (See Figures 6-2, 6-3, 6-4)	Replace pole unit assembly if the indicator is visible
		Adequate Vacuum	See Section 6.5	Replace pole unit assembly
		Dirt on ceramic body	Visual Check	Clean with dry lint-free cloth
3. Control Circuit Parts	Closing and tripping devices	Smooth and correct operation by control power	Test closing and tripping of the breaker twice	Replace any defective device, Identify per trouble-shooting chart
	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 tightening 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	Lubricate charging ratchet with magna-lube G teflon grease C-H #53701AI
	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 trouble-shooting chart if necessary

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 the high potential machine lead. Connect all bottom studs together and ground them. 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 6.1.

Breaker Rated Maximum Voltage	Vacuum Interrupter Integrity Test Voltage	
	AC 60Hz	DC
4.76 kV 8.25, 15.0 kV	20 kV	28 kV

Table 6.2 - Test Voltages

The current delivery capability of 25 mAAC 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.

6.6 CONTACT EROSION

Since the contacts are contained inside the interrupter, they remain clean and require no maintenance. However, during high current interruptions there may be a minimum amount of erosion from the contacts 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 satisfactory contact surface of the interrupter. If the mark is not visible, the pole unit assembly must be replaced (Figure 6-1).

6.7 CONTACT WIPE

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

6.8 INSULATION

In VCP-TR 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 Stodard's Solvent Cutler-Hammer 55812CA or commercial equivalent. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

6.9 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.

MAX RATED VOLTAGE	TEST VOLTAGE
5 kV	15 kV

Table 6.3 - Maximum Rated Voltages

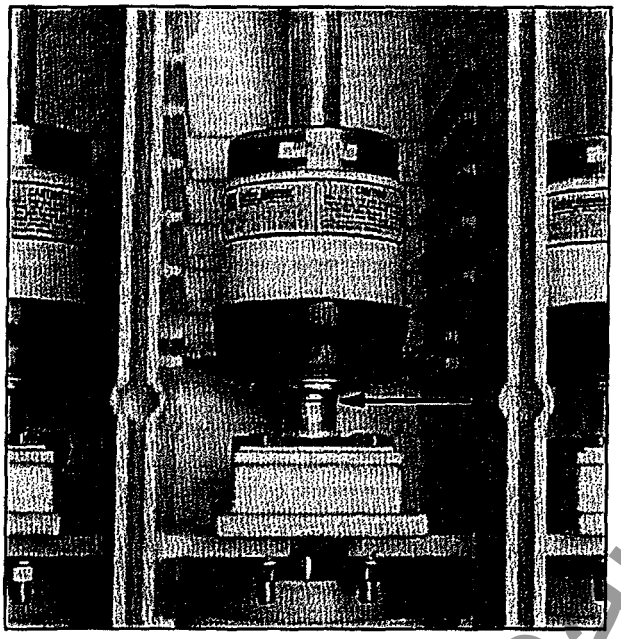


Figure 6-1 Contact Erosion Mark Visible on Stem

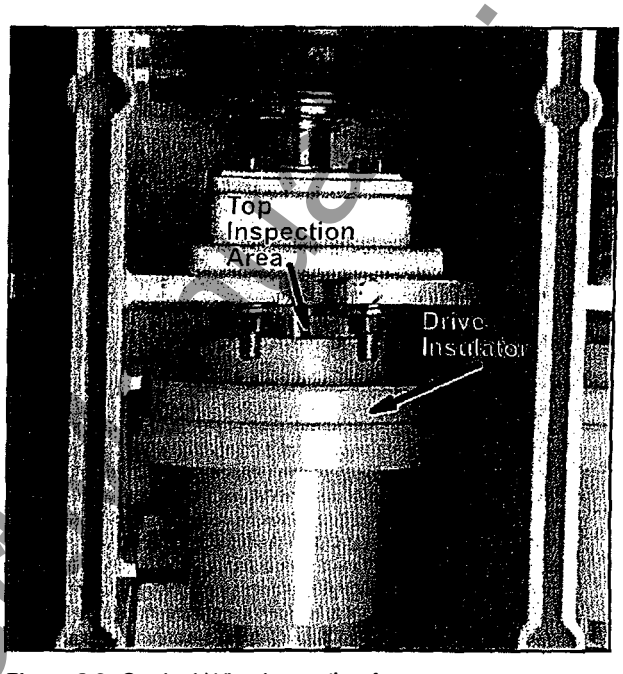


Figure 6-2 Contact Wipe Inspection Area

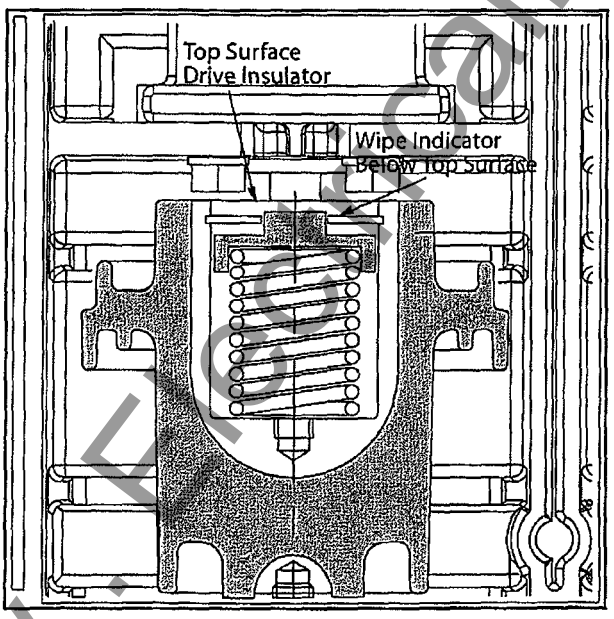


Figure 6-3 Satisfactory Contact Wipe Condition with Breaker Closed

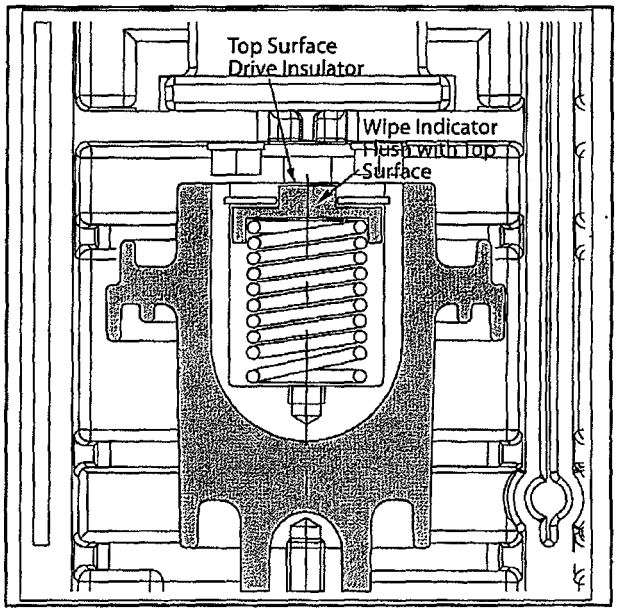


Figure 6-4 Unsatisfactory Contact Wipe Condition with Breaker Closed

Conduct the test as follows:

Close the breaker. Connect the high potential lead of the test machine to one of the poles and 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 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.

6.10 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.

Rated Continuous Current (Amperes)	Resistance (microohms)
600	50
1200	45

Table 6.4 - Typical Resistance Measurements

6.11 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 section 5.4.1.

6.12 LUBRICATION

Maintenance of these circuit breakers consists mainly of keeping them clean, with a very minimal amount of lubrication recommended. As required for smooth operation, lubricate the charging ratchet with magna-lube G teflon grease C-H #53701AI. No other lubrication in this mechanism is required. For smooth racking operation, lubricate the gears of the racking mechanism with Texclad II grease.

6.13 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 Cutler-Hammer service center for more in-depth assistance.

Table 6.5 - Troubleshooting Chart (Continued on next page)

SYMPTOM	INSPECTION AREA	PROBABLE DEFECTS
FAILS TO CLOSE		
• Closing Springs not charged	• Control Circuit	• Control Power (Fuse blown or switch off) • Secondary Disconnects • Motor Cut-off Switch (Poor or burned contacts. Lever not operational.) • Terminals and connectors (Poor or burned contacts) • Motor (Brushes worn or commutator segment open)
	• Mechanism	• Pawls (Slipping or broken) • Ratchet Wheel (Teeth worn or broken) • Cam Shaft Assy. (Sluggish or jammed) • Oscillator (Reset spring off or broken)
Closing Springs not charged breaker does not close	• Control Circuit (Close Coil does not pick up)	• Control Power (Fuse blown or switch off) • Secondary Disconnects • Anti Pump Relay (Y relay N.C. contact open or burned or relay picks up) • Close Coil (Open or burned) • Latch Check Switch (Contact open - Bad switch or trip bar not reset) • Auxiliary Switch (b contact open or burned) • Motor Cut-Off (Contacts open or burned) • Trip Coil Assy. (Clapper fails to reset)

SYMPTOM	INSPECTION AREA	PROBABLE DEFECTS
FAILS TO CLOSE		
• Closing Springs not charged breaker does not close	• Closing Sound But no Close	• Pole Shaft (Not open fully) • Trip Latch Reset Spring (Damaged or missing) • Trip Bar-D Shaft (Fail to remain reset) • Trip Latch-Hatchet (Fails to remain reset) • Trip Floor Tripper (Fails to remain reset) • Close Latch (Binding) • Close Latch Roller (Binding) • Trip Circuit Energized
UNDESIRABLY CLOSES		
	• Control Circuit	• Close Circuit (CS/C Getting shorted)
	• Mechanism	• Close Release Latch (Fails to reset) • Close Floor Tripper (Fails to reset)
FAILS TO CLOSE		
• No Trip Sound	• Control Circuit	• Control Power (Fuse blown or switch off) • Secondary Disconnects • Auxiliary Switch (a contact not making poor or burned) • Trip Coil (Burned or open) • Terminals and Connections (poor or burned or open)
	• Trip Mechanism	• Trip Clapper (Jammed)

SYMPTOM	INSPECTION AREA	PROBABLE DEFECTS
FAILS TO CLOSE		
• Trip Sound But no Trip	• Trip Mechanism	• Trip Bar, Trip Latch (Jammed) • Pole Shaft (Jammed) • Operating Rod Assembly (Broken or pins out)
	• Vacuum Interrupter (One or more Welded)	
UNDESIRABLY TRIPS		
	• Control Circuit	• Control Power (CS/T Switch, remains made)
	• Mechanism	• Trip Coil Clapper (Not resetting) • Trip Bar or Trip Latch (Poor engagement of mating or worm surfaces) • Trip Bar Reset Sprint (Loss of torque)

SECTION 7: REPLACEMENT 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 level based on operating experience. A replacement parts data sheet (RPD) is included with each breaker.

7.1.1 ORDERING INSTRUCTIONS

a. Always specify the breaker rating information and general order number, from the nameplate.

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 Cutler-Hammer sales office.

f. Include negotiation number with order when applicable.

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