



Instructions for Installation, Operation and Maintenance of Magnum DS Low Voltage Power Circuit Breakers



PURPOSE

This instruction manual is expressly intended to cover the installation, operation and maintenance of Magnum DS Power Circuit Breakers. These circuit breakers are usually supplied as part of low voltage metal-enclosed drawout switchgear. This manual applies only to the circuit breakers and their details. Magnum DS circuit breakers may also be supplied as fixed mounted devices. In the case of fixed versions of Magnum DS circuit breakers, certain sections of this manual, referring to such items as position interlocks and the drawout mechanism, will not apply.

Trip units associated with Magnum DS Power Circuit Breakers will be addressed in a general manner in this manual. Specific trip unit details and time-current characteristic curves are covered in separate documents specific to the trip units.

Magnum DS circuit breaker accessory items are discussed in this manual. Field installation instructions for such items, however, are covered in individual instruction leaflets specific to the accessory. This information is also available from the Cutler-Hammer website at www.cutlerhammer.eaton.com

For application information, consult Cutler-Hammer Inc., see applicable Product Guides, Technical Documents, Application Publications and/or Industry Standards.

SAFETY

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and maintenance of this equipment.



WARNING

THE WARNINGS AND CAUTIONS INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS MANUAL ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE TO FAMILIARIZE PERSONNEL WITH THE STYLE OF PRESENTATION. THIS WILL HELP TO INSURE THAT PERSONNEL ARE ALERT TO WARNINGS. IN ADDITION, CAUTIONS ARE ALL UPPER CASE AND BOLDFACE.

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 the local Cutler-Hammer Inc. representative.

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SECTION 1: INTRODUCTION

1-1 GENERAL INFORMATION

The Magnum DS Power Circuit Breaker is a fixed or drawout air circuit breaker design utilizing an electronic tripping system. It is designed for use in both switchboard and metal-enclosed switchgear assemblies having maximum voltages of 635 volts ac. Magnum DS circuit breakers are available in six continuous currents and frame sizes from 800 through 5000 amperes. These frame sizes are covered by two physical sizes with the same heights and depths (Figure 1-1, Table 1.1). The circuit breaker nameplate provides complete rating information. All Magnum DS circuit breakers are 100 percent rated, UL listed, and are built and tested in an ISO 9000 certified facility to applicable NEMA, ANSI, IEEE and UL standards (Table 1.1, Figures 1-2 and 1-3).

Magnum DS circuit breakers use a rigid frame housing of engineered thermoset composite resins which has high strength structural properties, excellent dielectric characteristics and arc tracking resistance.

The drawout Magnum DS circuit breaker is a through-the-door design having three breaker positions with the compartment door closed (CONNECT, TEST, DISCONNECT) and one position out of its compartment on extension rails (REMOVE). The operating mechanism is a two-step stored energy mechanism, either manually or electrically operated.

When withdrawn on captive compartment cassette extension rails, Magnum DS circuit breakers can be inspected, accessory items added, and minor maintenance performed. The inside of the compartment can also be inspected with the circuit breaker on its extension rails (Figure 1-4).

NOTICE

Please read and understand these instructions before attempting to unpack, install, operate or maintain this equipment. Study the breaker and its mechanism carefully before attempting to operate it on an energized circuit.



Figure 1-1 Magnum DS Family of Low Voltage Power Circuit Breakers (800-5000 Amperes)

**WARNING**

MAGNUM DS CIRCUIT BREAKERS SHOULD NOT UNDER ANY CIRCUMSTANCES BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS COULD RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

1-2 SAFETY FEATURES

Magnum DS circuit breakers and associated draw-out equipment are manufactured with built-in interlocks and safety related features. They are provided to reduce hazards to operating personnel and provide proper operating sequences.

Table 1.1 Magnum DS Ratings at 240, 480, 600 volts

Maximum Amperes	Breaker Designation	Interrupting Rating	Short Time Rating
800	MDS-408	42 kA	42 kA
	MDS-608	65 kA	65 kA
	MDS-808	85 kA	85 kA
	MDS-C08	100 kA	85 kA
1600	MDS-616	65 kA	65 kA
	MDS-816	85 kA	85 kA
	MDS-C16	100 kA	85 kA
2000	MDS-620	65 kA	65 kA
	MDS-820	85 kA	85 kA
	MDS-C20	100 kA	85 kA
3200	MDS-632	65 kA	65 kA
	MDS-832	85 kA	85 kA
	MDS-C32	100 kA	85 kA
4000	MDS-640	65kA	65kA
	MDS-840	85 kA	85 kA
	MDS-C40	100 kA	100 kA
	MDS-E40	130kA	130kA
5000	MDS-850	85 kA	85 kA
	MDS-C50	100 kA	100 kA
	MDS-E50	130kA	130kA

A**Magnum DS****B****MDSC32****Low Voltage AC Power Circuit Breaker****C****3200 Amp Frame 3 Pole 50/60 Hz**

Interrupting Ratings in Amps*

Max Volts	Inst Trip	Short Delay
635	100,000A	85,000A
508	100,000A	85,000A
254	100,000A	85,000A

D

Accessories

E
Motor Operator 120VAC
OTS Reset 2A 2B
Trip Unit Power Supply 120VAC

G.O. #

Cust. P.O.

IT:

Code

06/16/98 115002

Cat.#

MDS8323WEA 32MUA AA6N NNNXX

Enclosure Requirements Dwg: 2C13090

Installation and Operating Instructions: 2C12060

A**Low voltage power circuit breaker family name****B****Breaker family designation number****C****Breaker frame size in amperes****D****Interrupting capacity rating****E****Accessories**

Figure 1-2 Typical Magnum DS Nameplate

**WARNING**

TYPE MAGNUM DS CIRCUIT BREAKERS ARE ROBUST AND ARE PROVIDED WITH SAFETY FEATURES. NEVERTHELESS, THE VOLTAGES, CURRENTS AND POWER LEVELS AVAILABLE IN AND AROUND THIS EQUIPMENT WHEN IT IS IN OPERATION ARE EXTREMELY DANGEROUS AND COULD BE FATAL. UNDER NO CIRCUMSTANCES SHOULD INTERLOCKS AND OTHER SAFETY FEATURES BE MADE INOPERATIVE, AS THIS MAY RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

1-3 SAFETY PRACTICES

To protect personnel associated with the installation, operation and maintenance of this equipment, the following practices must be followed:

1. Only qualified electrical personnel familiar with the equipment, its operation and the associated hazards should be permitted to work on the equipment. Additionally, only qualified personnel should be permitted to install or operate the equipment.
2. Always be certain that the primary and secondary circuits are de-energized or the circuit breaker is removed to a safe work location before attempting any maintenance.
3. For maximum safety, only insert a completely assembled breaker into an energized cell.
4. Always ensure that drawout circuit breakers are in one of their designed cell positions, such as Connect, Test, Disconnect or Remove. A circuit breaker permitted to remain in an intermediate position could result in control circuits being improperly connected resulting in electrical failures.

1-4 QUALIFIED PERSONNEL

For the purpose of operating and maintaining low voltage power circuit breakers, a person should not be considered qualified if the individual is not thoroughly trained in the operation of the circuit breaker and how it interfaces with the assembly in which it is used. In addition, the individual should have knowledge of the connected loads.

For the purpose of installing and inspecting circuit breakers and their associated assembly, a qualified person should also be trained with respect to the hazards inherent to working with electricity and the proper way to perform such work. The individual should be able to de-energize, clear and tag circuits in accordance with established safety practices.

1-5 OTHER PUBLICATIONS AND DOCUMENTATION

In addition to this instruction manual, other printed information and documentation is available and supplied as appropriate. This additional information can include, but not necessarily be limited to, an instruction manual for a specific electronic trip unit, instruction leaflets for accessory items, renewal parts information, and necessary dimensional drawings.

<div style="display: flex; justify-content: space-between; align-items: center;"> MDS C32 </div>		
Circuit Breaker Type	Interrupting Capacity	Frame Size
<i>MDS - Magnum DS</i>	4 - 42,000 6 - 65,000 8 - 85,000 C - 100,000 E - 130,000	08 - 800 Amps 16 - 1600 Amps 20 - 2000 Amps 32 - 3200 Amps 40 - 4000 Amps 50 - 5000 Amps

Figure 1-3 Sample Magnum DS Identification



Figure 1-4 Magnum DS Drawout Circuit Breaker Shown on Integral Cassette Extension Rails

SECTION 2: RECEIVING, HANDLING AND INSTALLATION

2-1 GENERAL INFORMATION

Magnum DS Power Circuit Breakers, when supplied as part of an assembly, may be shipped already installed in their respective breaker compartments. Receiving and handling of this equipment is addressed in an assembly instruction manual supplied with the assembled equipment. This instruction manual applies to only the circuit breakers.

2-2 SUGGESTED TOOLS

A large number of different tools are not required to properly install and maintain Magnum DS circuit breakers. The following tools are, however, suggested:

- Flat bed screw driver
- Phillips head screw driver
- 3/8" socket (ratchet) wrench
- 6" socket extension with 3/8" square drive
- 10mm socket
- 17mm socket
- Secondary wiring removal tool

2-3 UNPACKING CIRCUIT BREAKER

Before beginning to unpack new Magnum DS circuit breakers, read and understand these directions. Following the directions will ensure that no damage is caused.

Shipping containers should be inspected for obvious signs of rough handling and/or external damage incurred during the transportation phase. Record any observed damage for reporting to the transportation carrier and Cutler-Hammer, once the inspection is completed. All reports and claims should be as specific as possible and include the order number and other applicable nameplate information.

Every effort is made to ensure that Magnum DS 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 breakers are ready for inspection, testing and/or installation.

When ready to inspect and install the Magnum DS circuit breaker, carefully remove the banding straps and lift off the cardboard box (Figure 2-1). Remove any additional packing material and internally packed documentation. The circuit breaker is mounted to a wooden shipping pallet.

If it is a drawout type circuit breaker, clamps hook into the circuit breaker on both sides and are screwed to the wooden pallet. Remove the screws first and then the clamps (Figure 2-1). Save the clamps for any future shipments of the circuit breaker.

If it is a fixed type circuit breaker, screws through the circuit breaker's mounting feet into the wooden pallet are used to hold the circuit breaker securely to the pallet. Remove the screws to free the circuit breaker from the pallet.

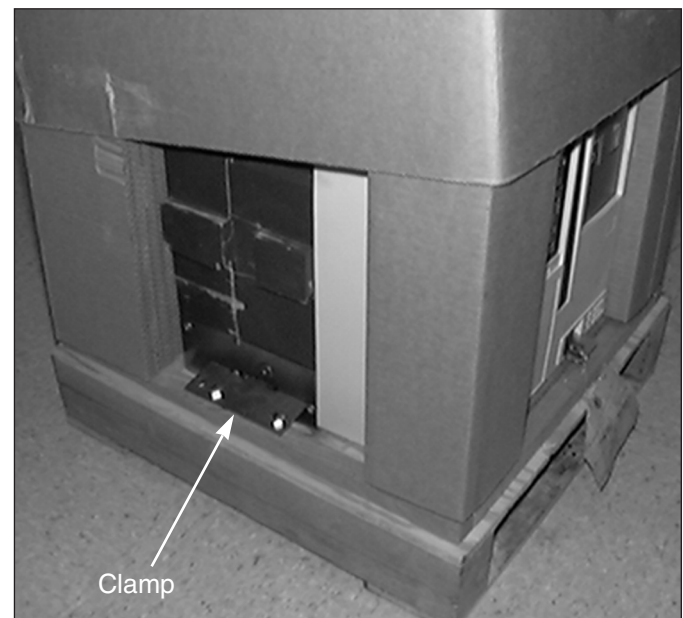


Figure 2-1 Shipping Carton Being Partially Lifted from Circuit Breaker Revealing Shipping Clamp

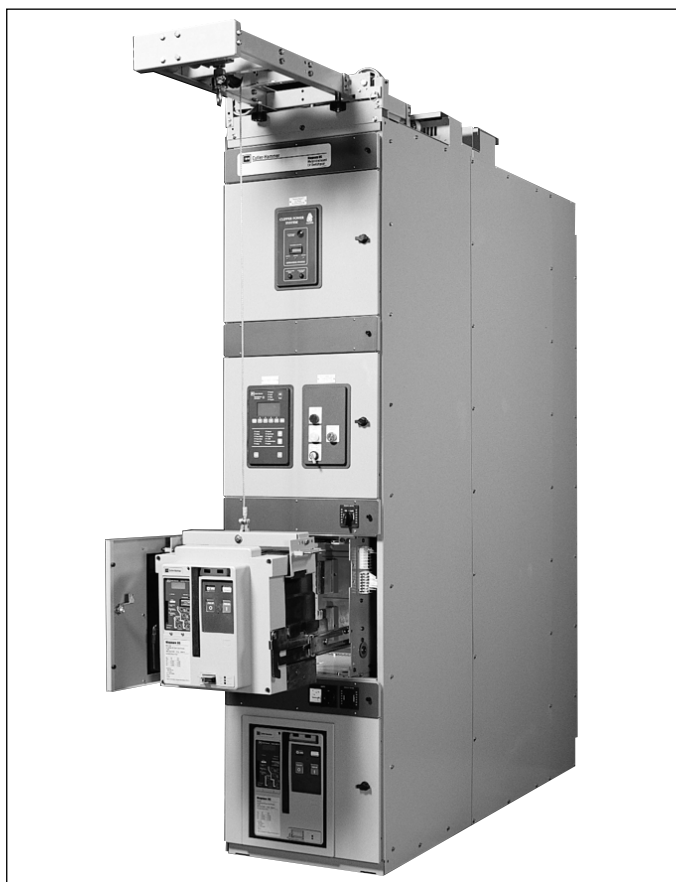


Figure 2-2 Magnum DS Circuit Breaker with Lifting Yoke Attached

Circuit breakers are designed to be easily lifted from the wooden pallet using an appropriate lifting yoke and overhead or portable lifting device (Figure 2-2).

2-3.1 STORING CIRCUIT BREAKER

If it is necessary to store a circuit breaker before installation, do so in its original shipping container. Keep the circuit breaker in a clean dry place. Ensure there is ample air circulation and heat, if necessary, to prevent condensation. It is very important that the circuit breaker not be exposed to dirt or moisture.

NOTICE

A circuit breaker that has been stored for any length of time should be operated a minimum of five times before it is placed in service.

2-4 LIFTING CIRCUIT BREAKER



CAUTION

DO NOT ATTEMPT TO LIFT CIRCUIT BREAKERS WITH ORDINARY CRANE HOOKS, ROPES, CHAINS OR OTHER SUCH DEVICES. FAILURE TO FOLLOW THIS CAUTION COULD RESULT IN DAMAGE TO VITAL PARTS SUCH AS ARC CHUTES, BARRIERS AND WIRING OR THE ENTIRE CIRCUIT BREAKER.

To closely examine, install or just become more familiar with the circuit breaker, carefully lift and place the circuit breaker on a solid work surface capable of handling the circuit breaker's weight (Table 2.1) or on the captive drawout extension rails of the breaker compartment (Figure 1-4 and 2-2). This is accomplished by using the appropriate lifting yoke and lifter. The lifting yoke consists of two steel hooks specially shaped to hook under the integral molded lifting handles on both sides of the circuit breaker (Figures 2-2 and 3-1). Every effort should be made during lifting to minimize circuit breaker swing and tilt.

Table 2.1 Circuit Breaker Weights

Maximum Amperes	Breaker Designation	Weights (lbs)	
		Fixed	Drawout
800	MDS-408	116	138
	MDS-608	116	138
	MDS-808	127	138
	MDS-C08	127	138
1600	MDS-616	116	138
	MDS-816	127	149
	MDS-C16	127	149
2000	MDS-620	135	157
	MDS-820	135	157
	MDS-C20	135	157
3200	MDS-632	163	200
	MDS-832	163	200
	MDS-C32	163	200
4000	MDS-640	248	303
	MDS-840	248	303
	MDS-C40	248	303
	MDS-E40	248	303
5000	MDS-850	293	359
	MDS-C50	293	359
	MDS-E50	293	359

If the circuit breaker is to be lifted onto compartment extension rails, follow the instructions in paragraph 2-6 entitled “Installing Drawout Circuit Breaker.”

2-5 CIRCUIT BREAKER INSPECTION

All circuit breakers, once removed from their shipping containers, should be visually inspected for any obvious damage.

The current rating of the rating plug installed in the trip unit should match the current rating of the sensors mounted on the lower primary stabs of the circuit breaker. Check to make sure that this match exists. The rating plug rating can be viewed from the front of the circuit breaker (Figure 3-4). The sensor rating can be viewed through the viewing windows at the rear of the circuit breaker (Figures 2-3 and 3-1). Sensors and rating plugs can be easily changed as described in Section 6.

If the circuit breaker is drawout, inspect the rejection interlocks on the floor of the cassette to make sure the circuit breaker and cassette are compatible. This is done by following the instructions outlined in paragraph 2-6.1.

2-6 INSTALLING DRAWOUT CIRCUIT BREAKER

In structures equipped for drawout circuit breakers, a bolted-in cassette with movable extension rails supports the circuit breaker (Figures 1-4 and 2-2). The extension rails must first be pulled all the way out using the small black flag shaped handle on the end of each rail. Once

the rails are fully extended, the circuit breaker can be carefully placed on the extension rails.



CAUTION

IT IS IMPORTANT TO TAKE GREAT CARE WHEN PLACING A DRAWOUT CIRCUIT BREAKER ON ITS EXTENSION RAILS. IF THE CIRCUIT BREAKER IS NOT PROPERLY SEATED ON THE EXTENSION RAILS, IT COULD FALL FROM THE RAILS CAUSING EQUIPMENT DAMAGE AND/OR BODILY INJURY.

Carefully lower the circuit breaker down onto the extension rails. Be certain that the circuit breaker's four molded drawout rail supports are fully seated in the extension rail cutouts on both sides (Figures 2-4 and 3-1). **Do not remove the lifting yoke from the circuit breaker until it is properly seated on the rails.**

Once the circuit breaker is on the extension rails and the lifting yoke is removed, proceed with the rest of the circuit breaker installation.

2-6.1 REJECTION INTERLOCKS

Magnum DS 800, 1600, 2000 and 3200 ampere circuit breakers have the same dimensions. To prevent the insertion of drawout circuit breakers into incompatible cassettes because of insufficient interrupting capabilities or incorrect frame sizes, rejection interlocks are provided.



Figure 2-3 Closeup Rear View of Current Sensor Rating Viewing Window

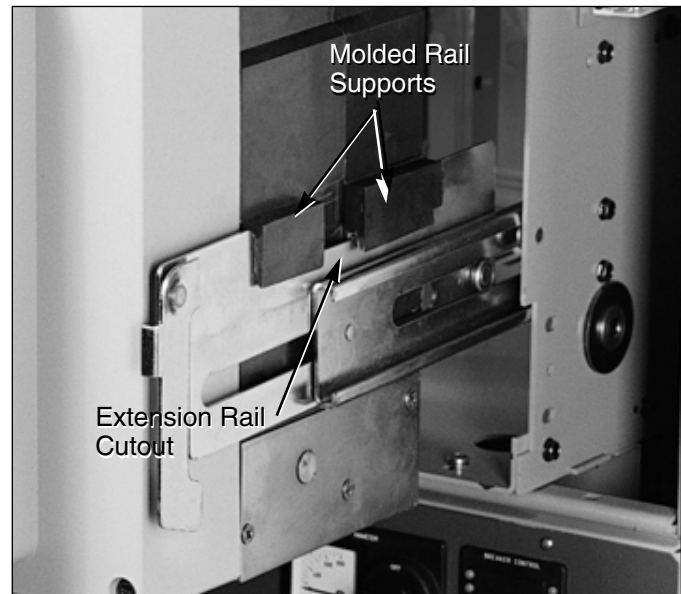


Figure 2-4 Closeup of One Side of Drawout Circuit Breaker Properly Seated on Extension Rail

**CAUTION**

DO NOT DISABLE REJECTION INTERLOCKS. DOING SO AND USING A LOWER CAPACITY CIRCUIT BREAKER IN AN INCOMPATIBLE CASSETTE COULD RESULT IN AN ELECTRICAL FAULT WHICH COULD RESULT IN DEATH, BODILY INJURY AND/OR EQUIPMENT DAMAGE.

The rejection interlocks are steel pins in the floor of the circuit breaker cassette. 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 the circuit breaker and the cassette are a mismatch, the rejection pins will prevent the circuit breaker from being fully inserted into the cassette.

Before attempting to push the circuit breaker into the DISCONNECT position, compare the positioning of rejection interlock pins in the cassette in keeping with Table 2.2 and Figure 2-5 and the information supplied on the circuit breaker's nameplate. Proceed if the circuit breaker and cassette are compatible.

2-6.2 CIRCUIT BREAKER POSITIONING

The Magnum DS drawout circuit breaker has four normal positions:

- REMOVE (Withdrawn) (Figure 2-6)
- DISCONNECT (Figure 2-7)
- TEST (Figure 2-8)
- CONNECT (Figure 2-9)

From Table 2.2, make a pin location comparison. Stop nuts should be torqued to 8-10 Ft.-Lb.

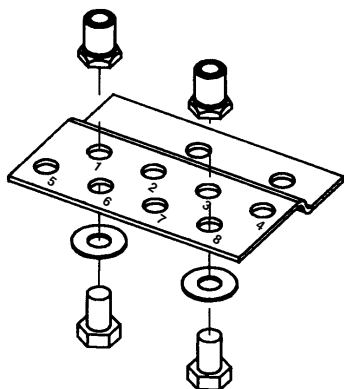


Figure 2-5 Rejection Interlock Pin Positioning/Installation

Table 2.2 Rejection Interlock Pin Locations

Cell For:	Stab Size (in)	I.C. @600 VAC	Pin Locations							
			1	2	3	4	5	6	7	8
MDS-408	.50	42	X	X						
MDS-608, 616, 620	.50	65	X	X			X	X		
MDS-808, 816, 820	.50	85	X	X			X	X	X	
MDS-C08, C16, C20	.50	100	X	X			X	X	X	X
MDS-632	.75	65	X		X		X	X		
MDS-832	.75	85	X		X		X	X	X	
MDS-C32	.75	100	X		X		X	X	X	X
MDS-640	.50	65	X	X				X		
MDS-840	.50	85	X	X				X		
MDS-C40	.50	100	X	X				X	X	
MDS-E40	.50	130	X	X				X	X	X
MDS-850	.75	85	X		X			X		
MDS-C50	.75	100	X		X			X	X	
MDS-E50	.75	130	X		X			X	X	X

The REMOVE position is a position outside the compartment on the cassette's drawout rails and is not part of the levering mechanism. The DISCONNECT, TEST, and CONNECT, position are reached by means of the levering mechanism.

With the breaker solidly positioned on the cassette's extension rails, carefully and firmly push the circuit breaker into the compartment as far as it will go. The rear portion of the circuit breaker's faceplate and the forward front edge of the cassette should be flush when the circuit breaker is completely pushed into position (Figure 2-10).

**CAUTION**

MAKE CERTAIN THAT THE CIRCUIT BREAKER IS FULLY INSERTED INTO ITS COMPARTMENT BEFORE ANY ATTEMPT IS MADE TO LEVER THE CIRCUIT BREAKER. ATTEMPTING TO LEVER THE CIRCUIT BREAKER IN BEFORE IT IS FULLY POSITIONED INSIDE ITS COMPARTMENT CAN RESULT IN DAMAGE TO BOTH THE CIRCUIT BREAKER AND THE COMPARTMENT.

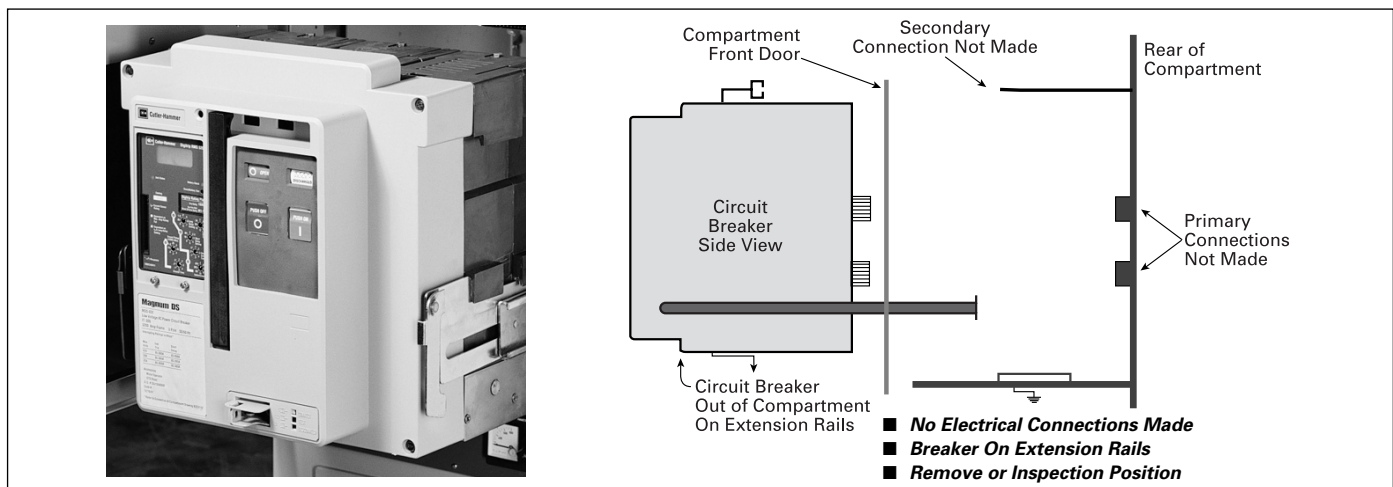


Figure 2-6 Remove Position

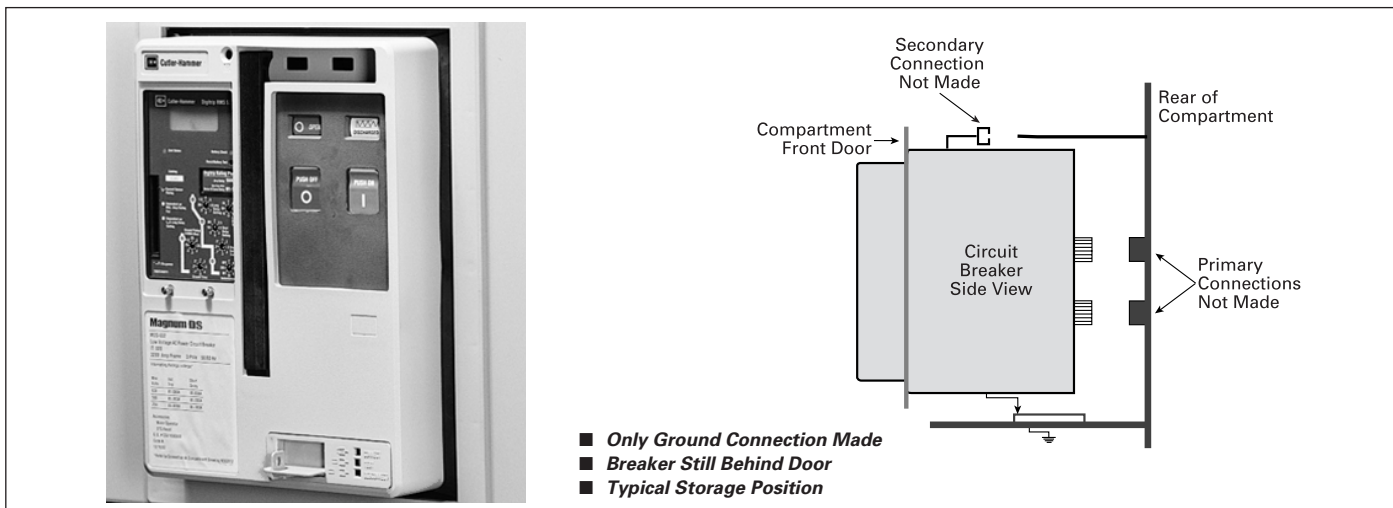


Figure 2-7 Disconnect Position

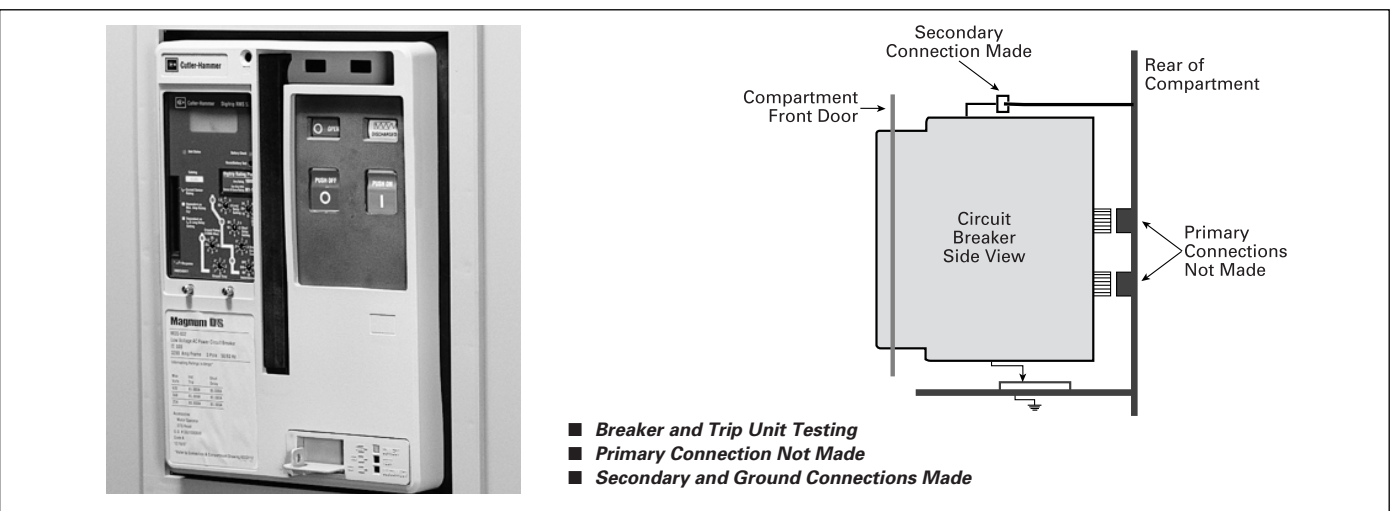


Figure 2-8 Test Position

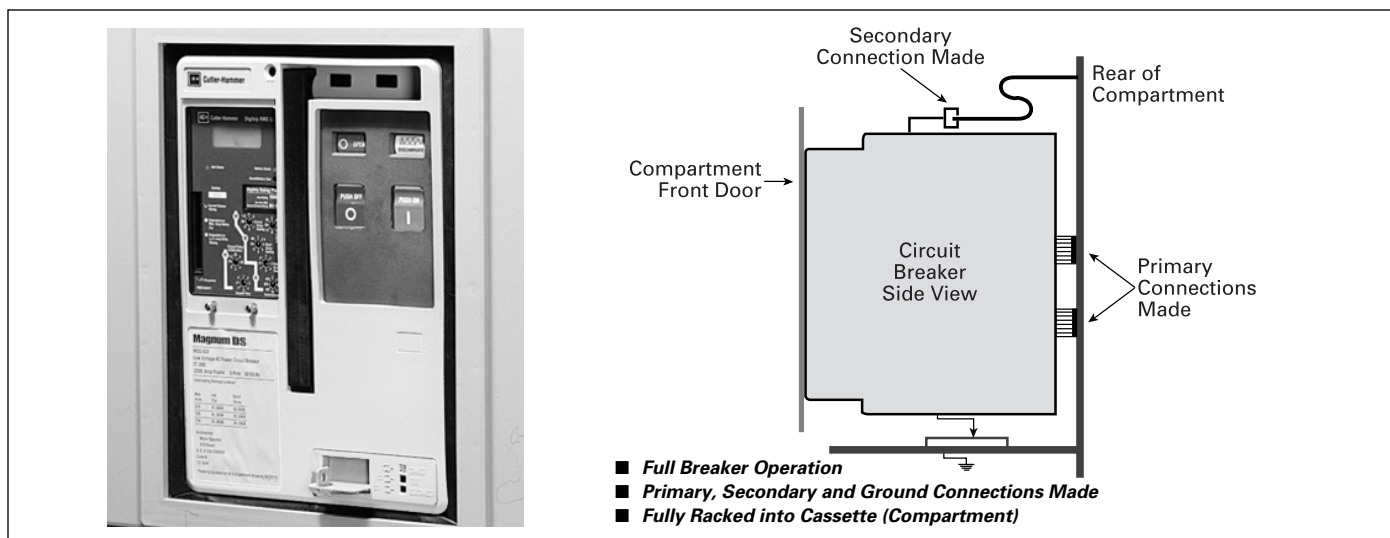


Figure 2-9 Connect Position

2-6.3 LEVERING CIRCUIT BREAKER

The circuit breaker is now ready to be levered. With the circuit breaker OPEN, the levering device access door can be raised (Figure 2-10). The levering device is hand operated using a standard 3/8" square drive and ratchet, which is not provided (Figure 2-11). As long as the access door is raised, the circuit breaker is held trip free. Begin by rotating the levering-in screw to the full counterclockwise (DISCONNECT) position.

Close the compartment door and begin levering the breaker into its different positions using a clockwise ratcheting motion. When levering the circuit breaker into the CONNECT position, do not exceed 25 ft.lb. of torque. **The circuit breaker can be levered with the compartment door open or closed, but it is advisable to close the door prior to levering.** The position of the circuit breaker within its compartment is indicated by color coded position indicators (Red = Connect, Yellow = Test, Green = Disconnect) (Figures 2-11 and 3-4). To remove the circuit breaker from its compartment, follow the procedure just described using a counterclockwise ratcheting motion.



Figure 2-10 Fully Inserted Circuit Breaker



Figure 2-11 Circuit Breaker Being Levered



Figure 2-12 Typical Fixed Type Magnum DS Circuit Breaker

NOTICE

The circuit breaker mechanism is interlocked such that charged closing springs are automatically discharged if the circuit breaker is levered into or out of the CONNECT position.

2-7 FIXED CIRCUIT BREAKER

The Magnum DS fixed type circuit breaker differs from the drawout version in that it has no levering device, primary disconnects and secondary disconnects (Figure 2-12). In addition, a 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 is mounted through the front panel (Figure 3-4).

Circuit breaker terminals have holes for making bolted horizontal primary bus connections. Adapters are available for making vertical primary bus connections. Secondary connections can be made through standard terminal blocks or a special connector compatible with the drawout circuit breaker's type secondary connector. Both secondary connection devices are mounted at the top, front of the circuit breaker.

The fixed circuit breaker frame has two mounting feet, one on each side, to permit the fixed circuit breaker to be securely mounted. Each mounting foot has two slotted mounting holes which are used to bolt the circuit breaker securely in place. Use either M10 or 3/8" bolts for this purpose. Refer to the dimensional drawings presented in Section 5 (Fixed Circuit Breaker) for circuit breaker and bus stab dimensions.

NOTICE

Refer to the circuit breaker weights in Table 2.1 to ensure that the panel on which a fixed circuit breaker is to be mounted is capable of supporting the weight.

2-8 CIRCUIT BREAKER OPERATION

Circuit breakers should be operated manually and/or electrically before they are put into service. This can be done during the installation process or some later date prior to start-up. To check circuit breaker operation, follow the operational procedures outlined in Section 3 for both manually operated and electrically operated circuit breakers.

SECTION 3: CIRCUIT BREAKER DESCRIPTION AND OPERATION

3-1 INTRODUCTION

Magnum DS circuit breakers are available in both drawout and fixed mounting configurations (Figures 3-1 and 3-2). A majority of features are common to both configurations, and will be discussed in this section. The mounting features unique to the drawout and fixed configurations will be covered individually in Sections 4 and 5 respectively.

Controls and indicators for both drawout and fixed circuit breakers are functionally grouped on the front of the circuit breaker. The front escutcheon (faceplate) is common for the two frame sizes that cover all continuous current ratings through 5000 amperes (Figure 3-4).

The larger frame circuit breakers, 4000 and 5000 amperes, utilize six sets of rear primary connections (Figure 3-3). Facing the rear of the larger frame circuit breaker, the standard phase sequencing is AA-BB-CC starting at the right and moving left. For optional phase sequencing A-B-C-A-B-C, contact Cutler-Hammer.

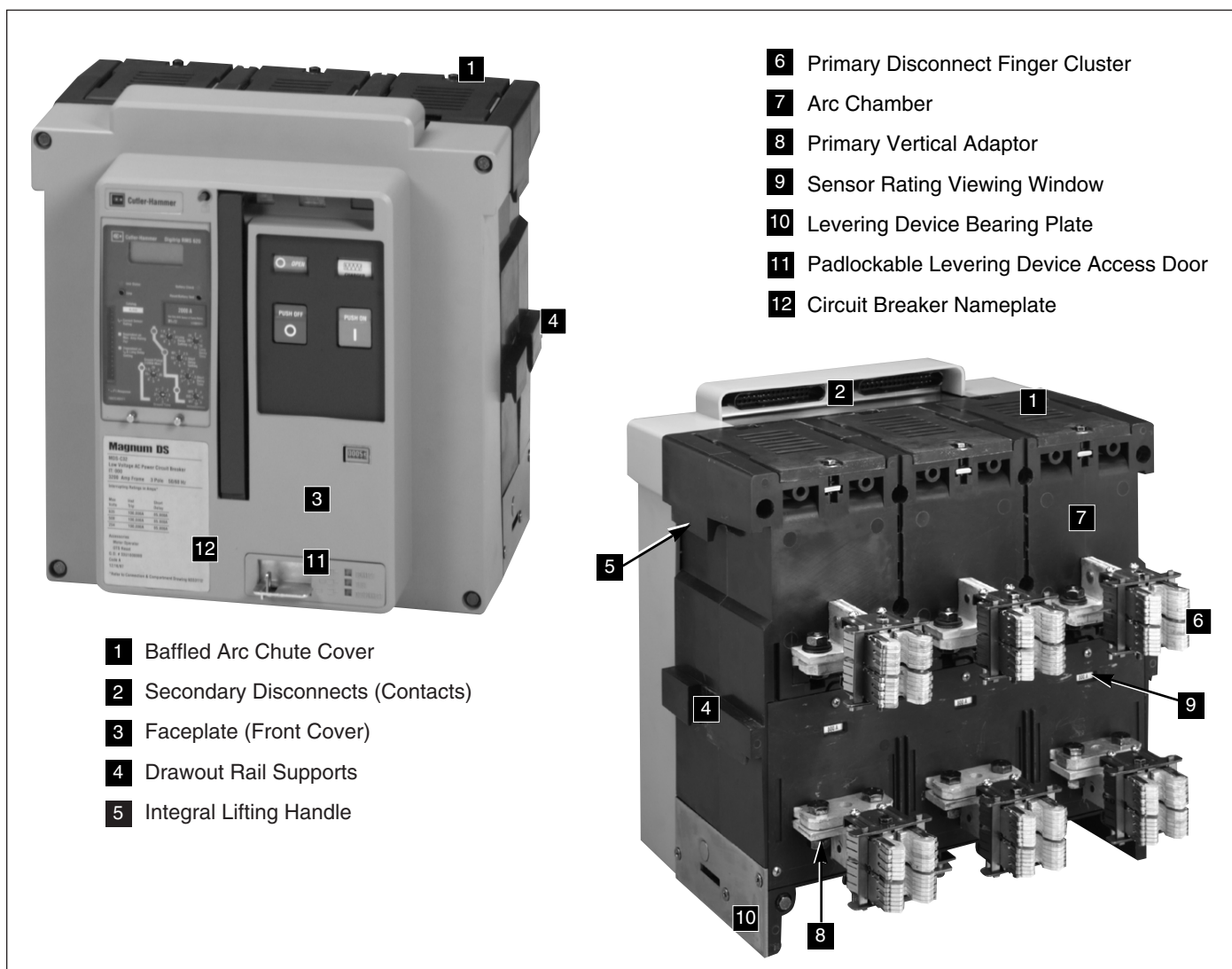


Figure 3-1 Magnum DS Drawout 800-3200A Size (Front and Rear Views) - See Figure 3-4 for More Details

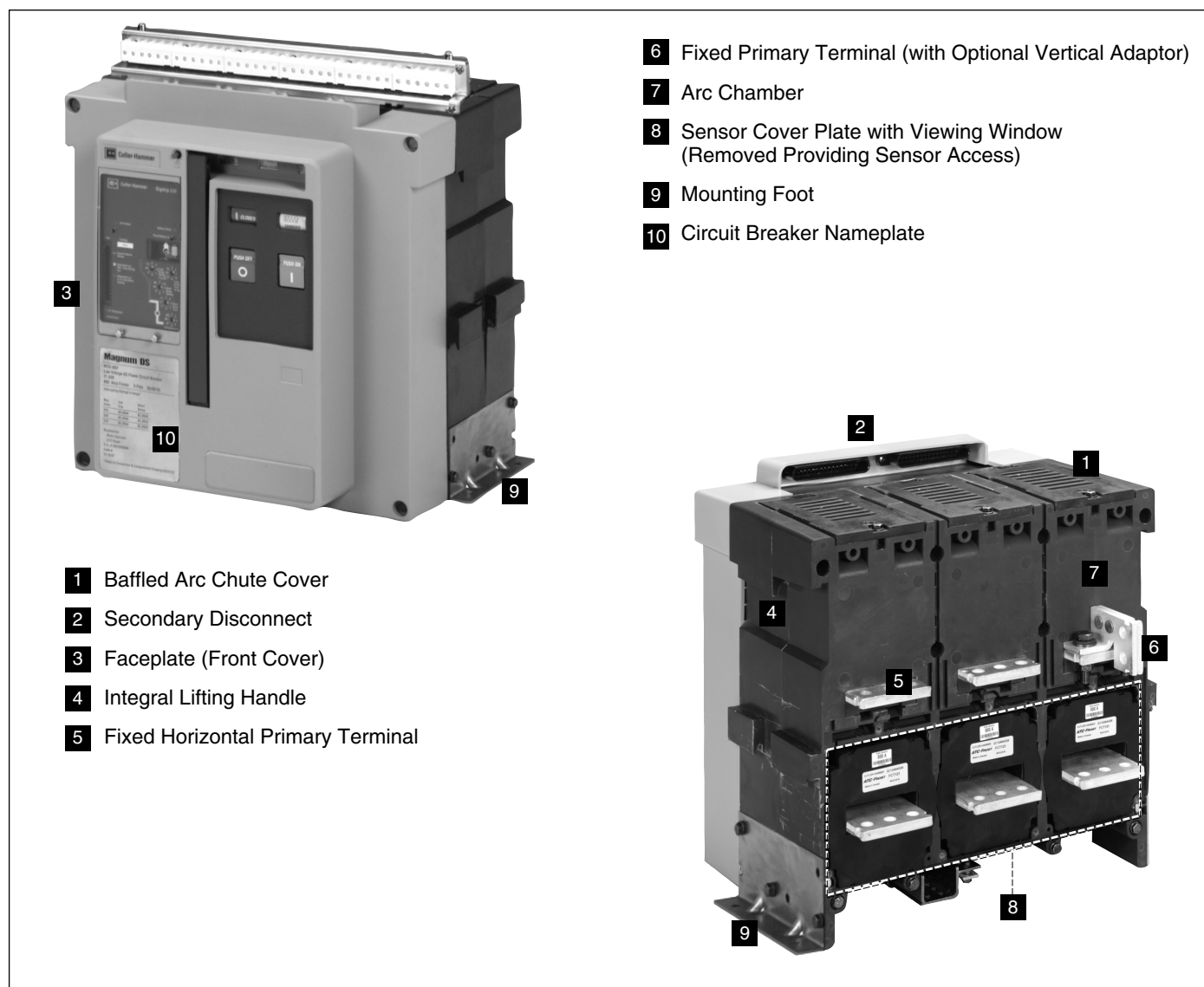


Figure 3-2 Magnum DS Fixed 800-3200A Size (Front and Rear Views) - See Figure 3-4 for More Details



- 1 Baffled Arc Chute Cover
- 2 Secondary Disconnect
- 3 Faceplate (Front Cover)
- 4 Integral Lifting Handle

- 5 Fixed Horizontal Primary Terminals
(shown with Optional Vertical Adaptors)
- 6 Arc Chamber
- 7 Mounting Foot
- 8 Circuit Breaker Nameplate

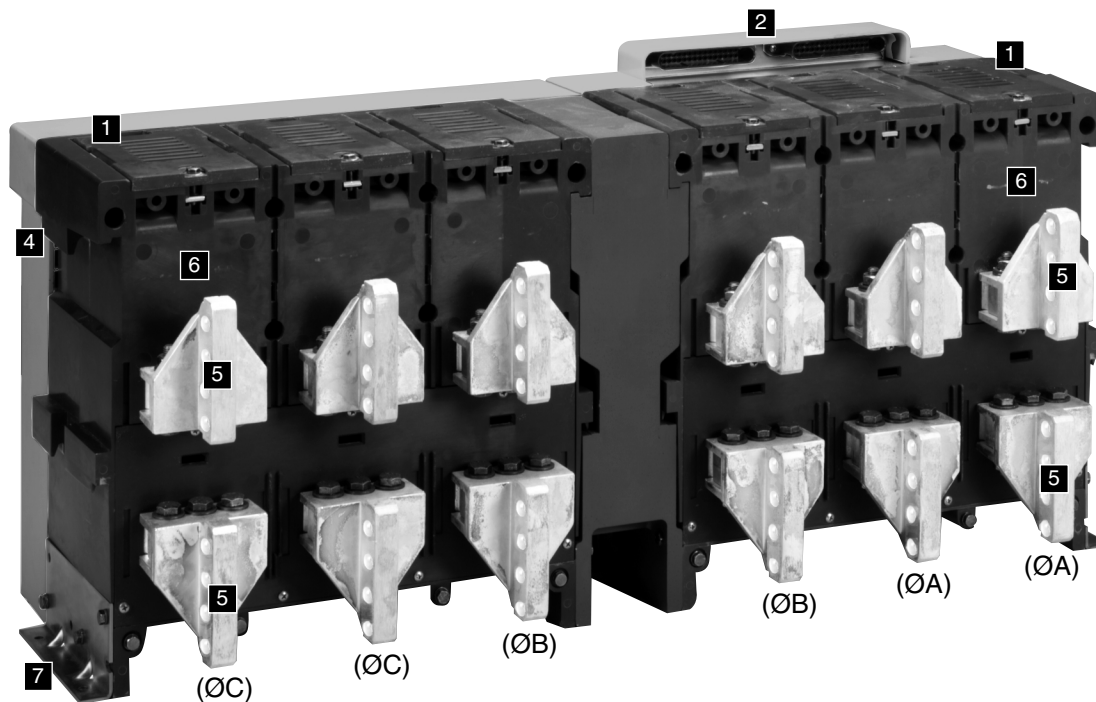


Figure 3-3 Magnum DS Fixed 4000A and 5000A Size (Front and Rear Views) - See Figure 3-4 for More Details

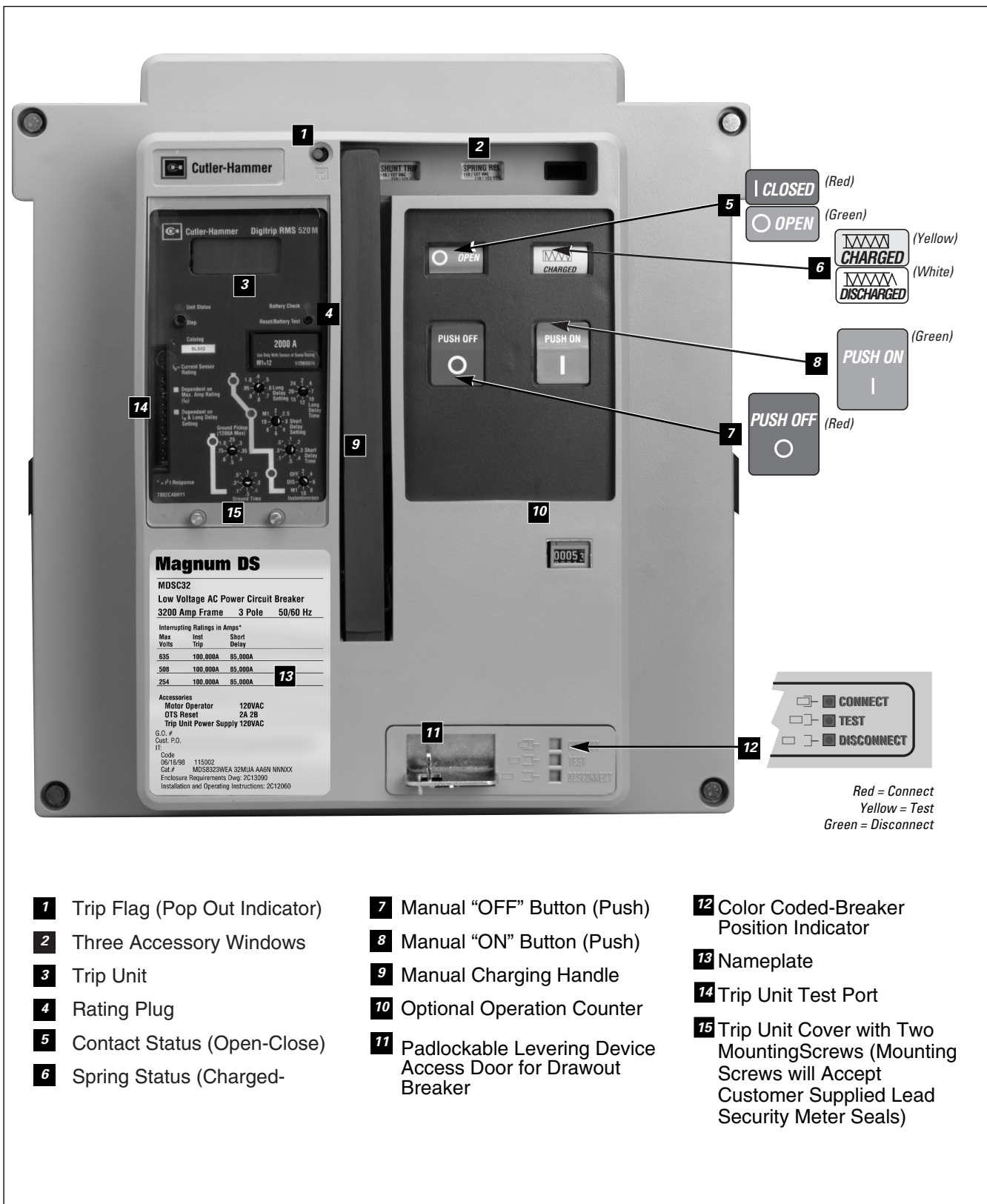


Figure 3-4 Typical Magnum DS Drawout Circuit Breaker Front Cover

3-2 BASIC CIRCUIT BREAKER ASSEMBLY

Magnum DS circuit breakers use a rigid frame housing construction of engineered thermoset composite resins. This construction provides high strength structural properties, excellent dielectric characteristics and resistance to arc tracking.

The 3-piece construction approach provides support while isolating and insulating power conductors (Figure 3-5):

- ❶ A 2-piece engineered thermoset composite resin case encloses current paths and arc chambers. The chambers act to channel arc gases up and out of the circuit breaker during interruption.
- ❷ The operating mechanism sits on the front of the case and is electrically isolated and insulated from current contact structures. It is covered by an insulating front cover.

3-3 POLE UNITS

A current carrying pole unit is individually enclosed and rigidly supported by the case. The individual chambers

provide for pole unit isolation and insulation from one another. Each pole unit has one primary contact assembly, which consists of a moving portion and a fixed portion. The exact design configuration depends upon the breaker's frame size. Circuit breakers with frame sizes of 4000 amperes and higher use two pole units and arc chute assemblies connected mechanically and electrically in parallel to form one phase.

3-3.1 PRIMARY MOVING CONTACTS

Depending upon the frame size, each primary moving contact assembly is comprised of multiple individual copper contact fingers connected to the load conductor through flexible braided connectors (Figure 3-6). Two flexible connectors are used to connect each finger to the load conductor. The number of fingers used depends upon the circuit breaker's continuous and short-circuit current ratings (Table 3.1 and Figure 3-7).

Each contact finger performs both the main and arcing contact functions on different parts of the same finger (Figure 3-8). A highly conductive alloy pad is part of the contact finger and functions as the moving main contact, and is called the "Heel." The tip of the same contact fin-

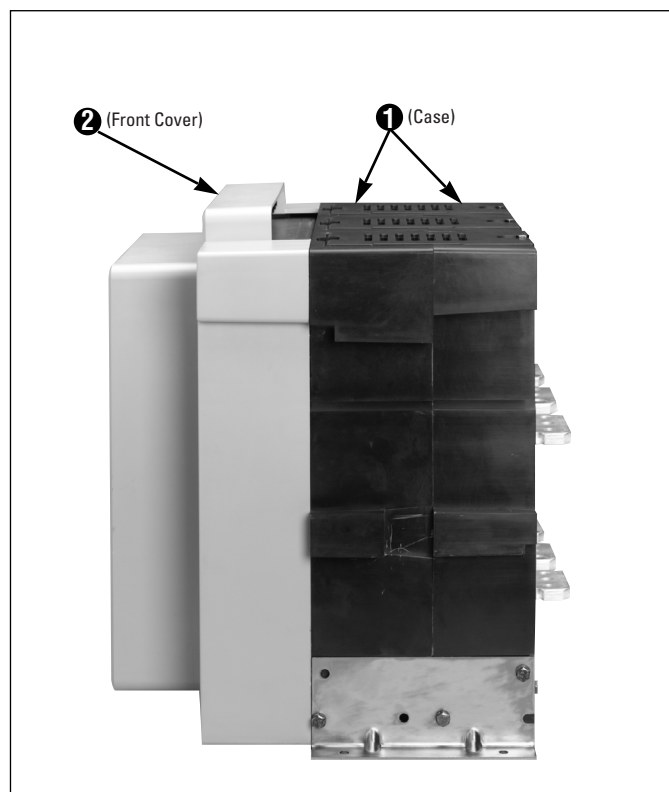


Figure 3-5 Magnum DS Rigid Frame Construction (Right Side View)

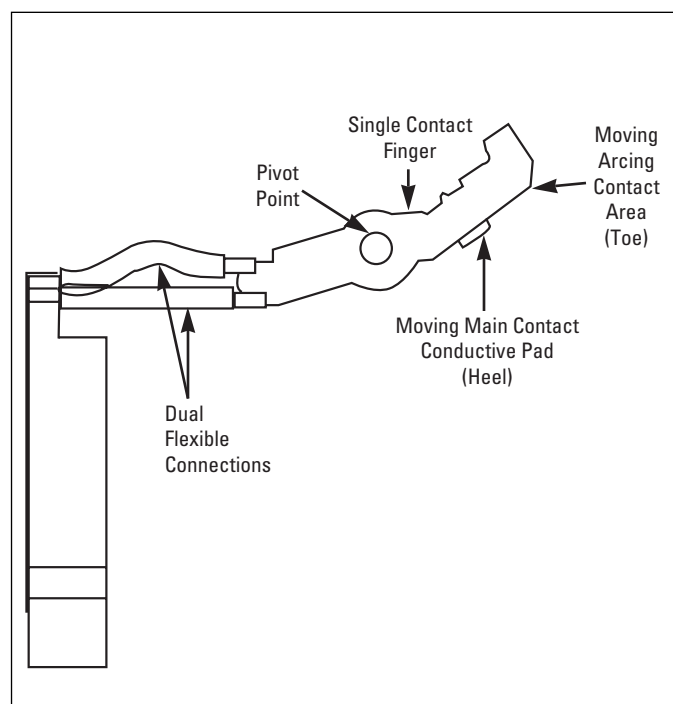


Figure 3-6 Single Magnum DS Contact Finger

ger functions as the moving arcing contact, and is called the “Toe.”

3-3.2 PRIMARY STATIONARY CONTACTS

The primary stationary contact is a combination of two items (Figure 3-9). One is a conductive pad mounted on the line conductor which functions as the stationary main contact. The other is an arc runner, also connected to the line conductor. The integral arc runner serves a dual purpose:

- Fixed arcing contact
- Part of the arc chute

Table 3.1 Line/Load Conductors

Breaker Frame (Amperes)	Line/Load Conductor Thickness (Inches)
800	3/8
1600	3/8
2000	3/8
3000/3200	1.0
4000	3/8
5000	1.0

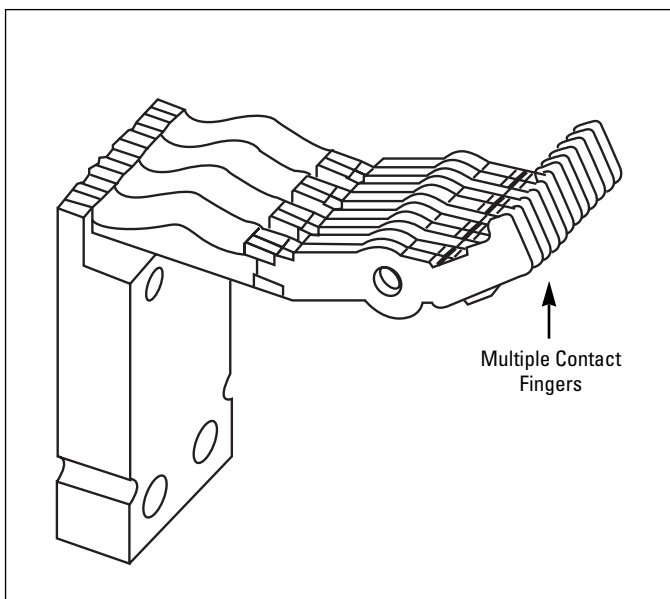


Figure 3-7 Magnum DS Multi-Finger Configuration

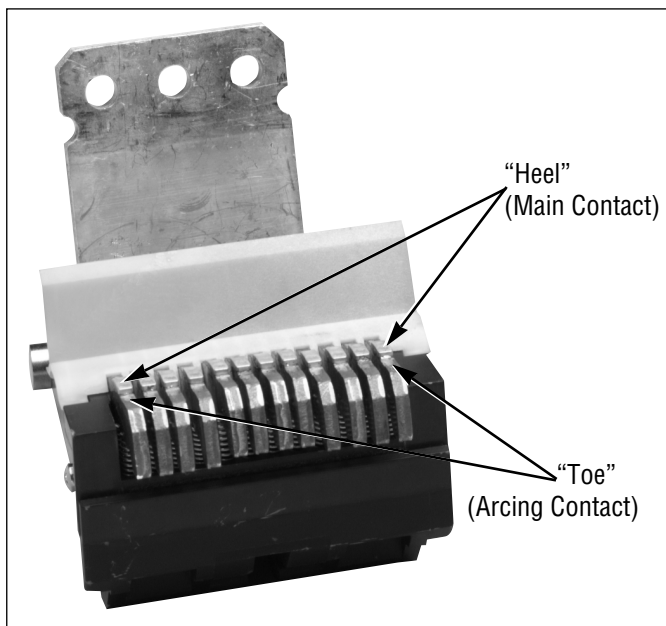


Figure 3-8 Magnum DS 12-Finger Contact Assembly

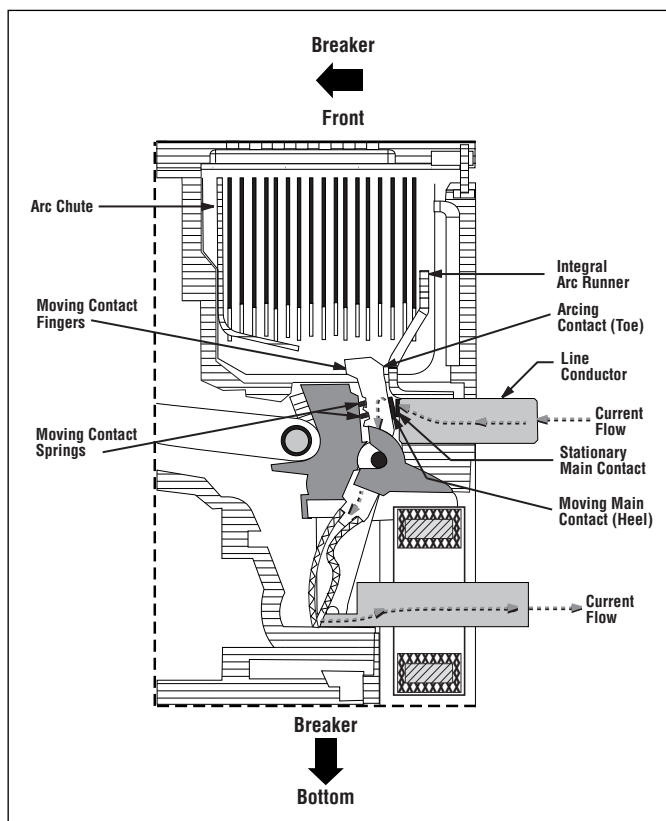


Figure 3-9 Partial Cross-Sectional View of Magnum DS (Shown in Closed Position)

3-4 OPERATING MECHANISM

The Magnum DS operating mechanism is based on the proven cam and spring design of the DSII power circuit breaker. It is easily accessed by removing four cover screws and the front cover (Figure 3-10). The mechanism is a two-step stored energy mechanism. Potential energy is stored to close the circuit breaker. Sufficient energy to open the circuit breaker remains available after a closing operation.

3-4.1 MANUAL OPERATION

On manually operated circuit breakers, the closing spring can only be charged manually. To manually charge the spring, insert one finger in the recess behind the charging handle and pull out. This permits a gloved hand to grasp the handle and begin charging (Figure 3-11). It takes from 5 to 7 downward strokes on the charging handle to complete the manual charging process. It is possible to manually recharge the spring immediately after closing the circuit breaker and before it has been tripped open.

Standard manually operated circuit breakers are closed and opened by hand using the Manual “ON” and Manual

“OFF” buttons respectively located on the front of the circuit breaker (Figure 3-4). 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” button can be prevented with an optional prevent close cover. The status of the springs and the primary contacts are always indicated in an indicator window just above the pushbuttons.

Electrically operated optional devices are available to automatically close or trip a manually operated circuit breaker. An electrical spring release is available to close a manually operated circuit breaker. Two optional devices, a shunt trip and an undervoltage release, are available to automatically trip (open) a manually operated circuit breaker. All of these UL listed optional devices can be installed easily in the field. For more details on these devices, refer to paragraph 3-8 in this manual.

An electrical operator which is used to charge the closing spring automatically can be added to a manually operated circuit breaker in the field (Figure 3-12). Manually operated circuit breakers are pre-wired to accept this addition.

- 1 Secondary Wiring Points
- 2 Through-The-Window Accessories (3 maximum)
- 3 Trip Unit
- 4 Motor Operator
- 5 Manual Charge Handle
- 6 Operations Counter (optional)
- 7 Padlockable Levering Device Access Door
- 8 Breaker Position Indicator

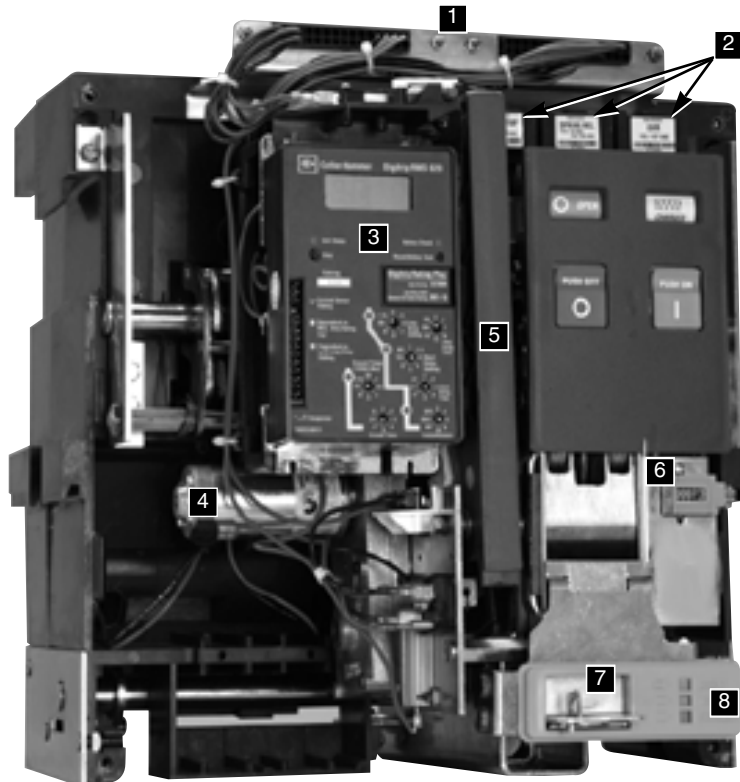


Figure 3-10 Magnum DS Electrically Operated Drawout Circuit Breaker with Front Cover Removed



Figure 3-11 Magnum DS Circuit Breaker Closing Springs Being Manually Charged

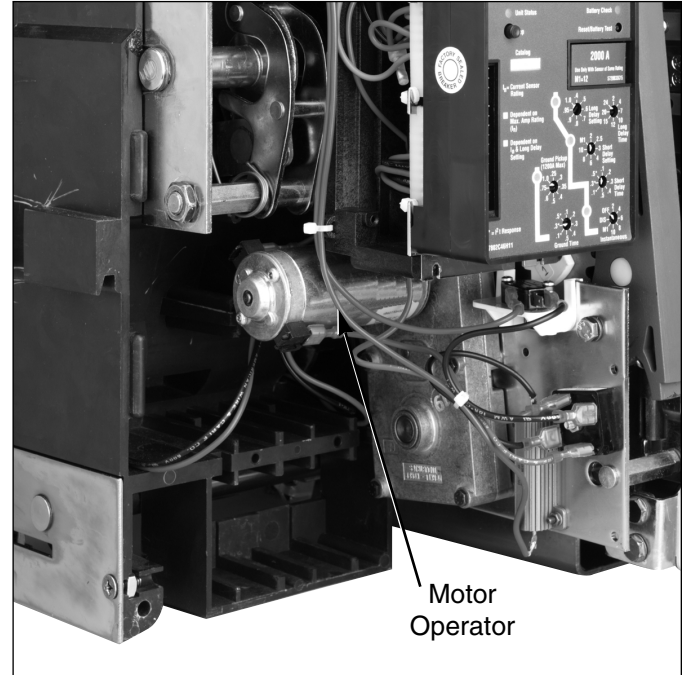


Figure 3-12 Field Installable Motor Operator Shown Mounted

3-4.2 ELECTRICAL OPERATION

For electrically operated circuit breakers, the springs are normally charged through the use of an electrical operator (Figure 3-12). The springs can, however, be charged manually as just described in the previous paragraph (Figure 3-11).

Like the manually operated circuit breaker in the previous paragraph, electrically operated circuit breakers can also be manually closed and opened through the use of the front mounted Manual "ON" and Manual "OFF" buttons.

An electrically operated circuit breaker from the factory is also equipped as standard with a spring release to close the circuit breaker electrically. An optional shunt trip and undervoltage release are also available to trip (open) an electrically operated circuit breaker. Refer to paragraph 3-8 for more details on both standard and optional devices.

3-4.3 ANTI-PUMP FEATURE

The Magnum DS circuit breaker has a mechanical type anti-pump feature. If the circuit breaker is open, it only accepts one attempt to reclose when the close command continues uninterrupted.

3-5 ARC CHAMBERS

The Magnum DS circuit breaker utilizes arc chambers to insulate and isolate individual poles from one another, from the rest of the circuit breaker, and from operating personnel (Figures 2-2 and 3-1). Arc chambers are molded and integral parts of the circuit breaker frame. Enclosed within each arc chamber is an arc chute which mounts over each set of primary contacts.

After the main contacts part, any remaining current is driven to the arcing contacts (Figure 3-13). Magnetic action draws the arc to the arc chute. As the arcing contacts separate, the moving arcing contacts discharge into the arc chute plates while the integral arc runner also helps to draw the arc into the arc chute.

3-5.1 ARC CHUTE

The Magnum DS arc chute mounts down over the arcing contact. Alternating V-shaped arc chute plates attract the arc and interrupt it. The top arc plate, which is a part of the arc chute itself, also helps to attract the arc away from the moving arcing contact and up into the arc chute's V-shaped plates (Figures 3-13 and 3-14).

Arc chute components are assembled in an insulating jacket which is removable from the top of the circuit breaker, as previously described in paragraph 2-4. Each arc chute has a baffled top cover.

3-6 ELECTRONIC TRIPPING SYSTEM

The Magnum DS circuit breaker utilizes a three part tripping system (Figure 3-16):

- 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 Magnum DS circuit breakers, refer to the specific instruction leaflet dedicated to the trip units (I.L. 70C1307).

3-6.1 MICROPROCESSOR-BASED TRIP UNIT

A Magnum DS circuit breaker can use any one of a family of four UL and CSA listed Digitrip RMS electronic and programmable trip units (Figure 3-17):

- Digitrip 220
- Digitrip 520
- Digitrip 520M
- Digitrip 1150

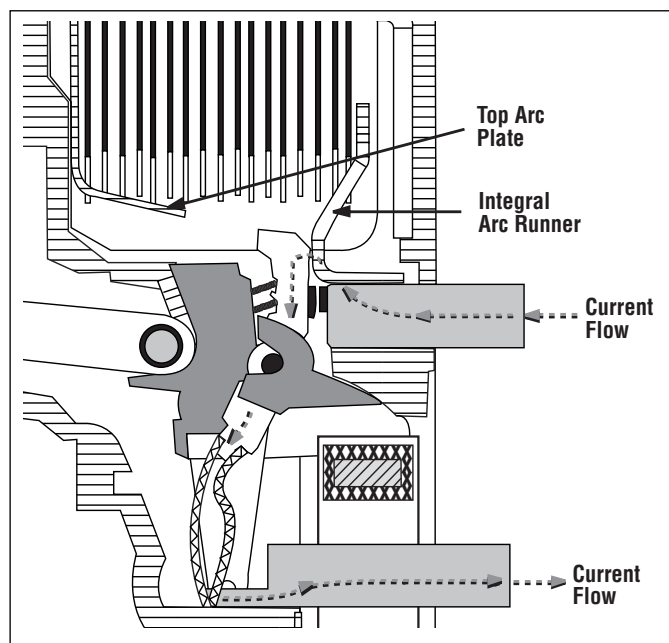


Figure 3-13 Magnum DS Arc Running System

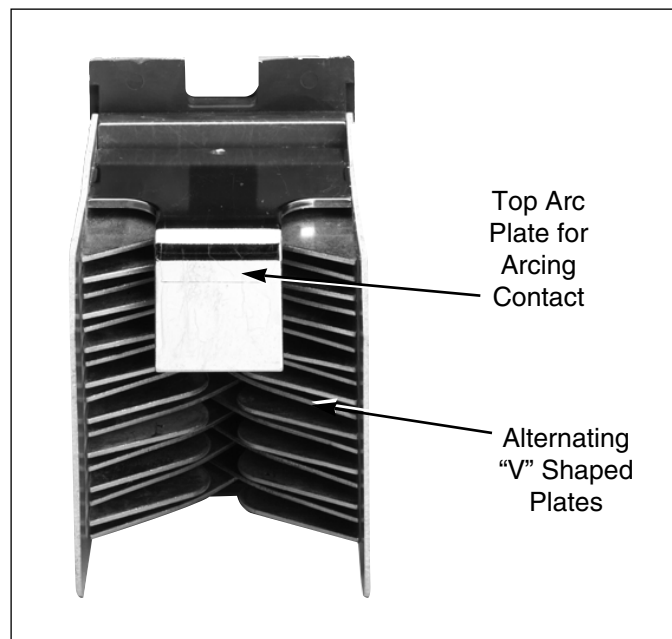


Figure 3-14 Bottom View Magnum DS Arc Chute



Figure 3-15 Integral Arc Runner as Viewed From Top of Arc Chamber (Arc Chute Removed and Circuit Breaker Closed)

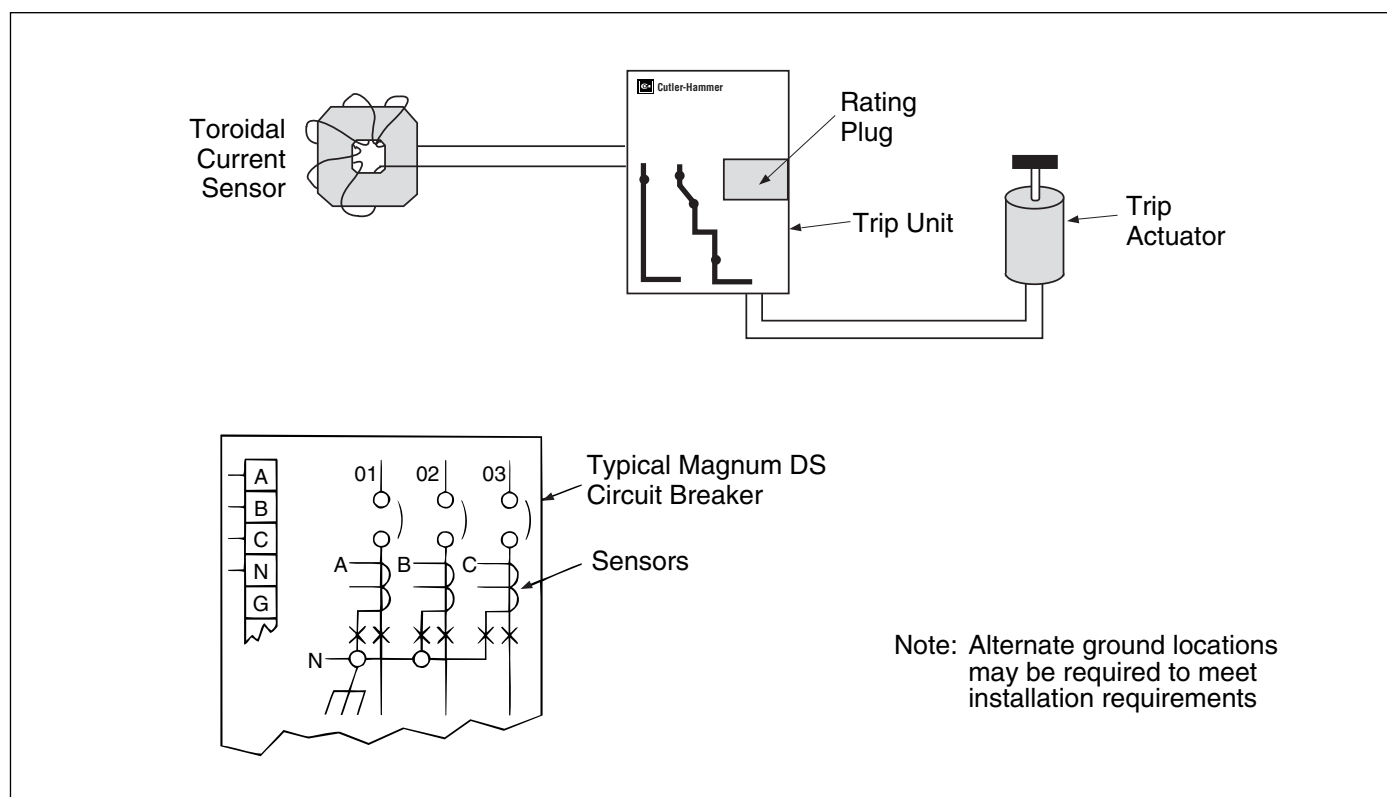


Figure 3-16 Typical Magnum DS Tripping System Diagram

A general summary of the features associated with the four different Digitrip RMS trip units is shown in Table 3.2.

Digitrip RMS trip unit models 220, 520 and 520M are interchangeable in the field. For model 1150 interchangeability, refer to Cutler-Hammer. Refer to Section 6 of this manual entitled "Inspection and Maintenance" for field replacement details.

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 integrally mounted in the circuit breaker.

A functional local test of a major portion of the trip unit's electronic circuitry and the circuit breaker's mechanical tripping action can be verified through the trip unit's test receptacle (Figure 3-17). This is accomplished using a Digitrip (DS Type) Test Kit which provides a secondary injection test that simulates the current sensors. A small hand held Magnum functional Test Kit can also be used to check circuitry and mechanical tripping functions (Figure 3-18).

Table 3.2 Magnum DS Digitrip Trip Units

Functions	220	520	520M ^⑤	1150 ^⑤
LSIG Protection	Yes ①	Yes	Yes	Yes
Disable (I)	No	Yes	Yes	Yes
GF Protection	No	Yes	Yes	Yes
GF Alarm	No	No	Yes	Yes
Display	No	No	Yes ②	Yes ③
Programmable	No	No	No	Yes
Metering	No	No	Yes ④	Yes
Power and Energy Values	No	No	No	Yes
Power Quality	No	No	No	Yes
Communication	No	No	No	Yes

① Long and Instantaneous only.

② One-line, (four characters per line) LCD display.

③ Three-line, (eight characters per line) LED display.

④ Phase, neutral, ground, and high load current only.

⑤ Available control voltages are 24/48Vdc, 120 Vac and 240 Vac.

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.

3-6.2 RATING PLUG

All Magnum DS circuit breaker trip units use a fixed type rating plug. The current rating of the rating plug must match the current rating of the integrally mounted current sensors (Figure 2-4, 3-17 and Table 3.3). The rating plug performs a number of 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.
- 3) The National Electrical Code (NEC) requires that the maximum ground fault pickup value not exceed 1200 amperes. A properly matched rating plug accomplishes this requirement for higher ampere sensors by incorporating circuitry to identify that level by sensor rating.

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

Refer to Table 3.3 for a tabulation of the available rating plugs.

3-6.3 CURRENT SENSORS

Three toroidally wound current sensors are installed at the rear of the circuit breaker on the lower terminals (Figure 3-19). The sensors produce an output current proportional to the load current. Under preselected conditions of current magnitude and time, the sensors furnish the trip unit with a signal and the energy required to open (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.

Refer to Table 3.3 for a tabulation of the available current sensor ratings.



Figure 3-17 Digitrip RMS 1150 Programmable Trip Unit Installed in Magnum DS Circuit Breaker



Figure 3-18 Hand Held Tester

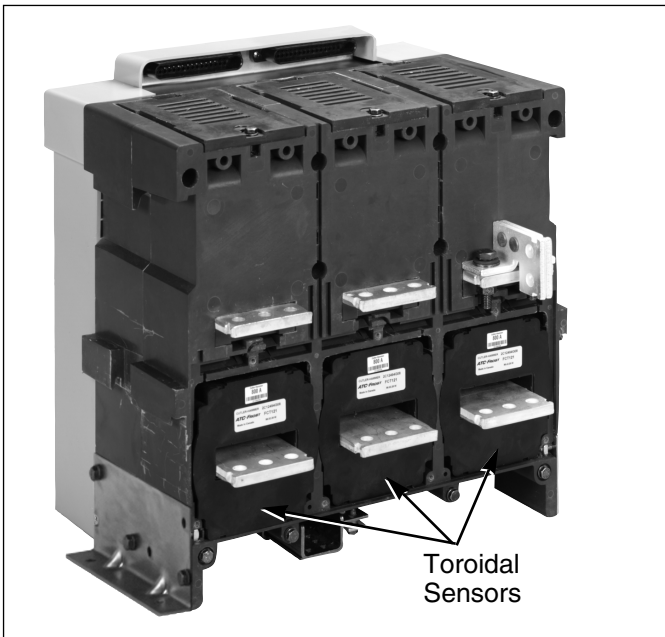


Figure 3-19 Current Sensors Shown Mounted (Sensor Cover Plate Removed for Clarity)

Table 3.3 Magnum DS Current Sensors and Matching Rating Plugs

Breaker Frame (Amperes)	Ratings (Amperes)
800	200, 250, 300, 400, 600, 630, 800
1600	200, 250, 300, 400, 600, 630, 800, 1000, 1200, 1250, 1600
2000	200, 250, 300, 400, 600, 630, 800, 1000, 1200, 1250, 1600, 2000
3200	200, 250, 300, 400, 600, 630, 800, 1000, 1200, 1250, 1600, 2000, 2500, 3000, 3150, 3200
4000	2000, 2500, 3200, 4000
5000	2000, 2500, 3200, 4000, 5000

3-6.4 TRIP ACTUATOR

The trip actuator is a small cylindrically shaped electromagnetic device which acts mechanically to trip the circuit breaker (Figure 3-16). In general, it is comprised of a permanent magnet, 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.

3-6.5 MECHANICAL TRIP FLAG

A red, pop out mechanical trip flag is an additional Magnum DS tripping system feature. It is standard and located above the trip unit on the circuit breaker's front faceplate (Figure 3-17). It operates by popping out to indicate that the circuit breaker opened in response to an overcurrent condition. The flag must be manually reset by pushing it back into position. The circuit breaker can be re-closed, even if the trip flag is not reset.

If an overcurrent trip switch/bell alarm is installed, it is reset when the mechanical trip flag is reset.

3-6.6 MAKING CURRENT RELEASE

All Magnum DS circuit breaker trip units have a making current release function. This safety feature prevents the circuit breaker from being closed and latched on a faulted circuit. The non-adjustable release is preset at a peak instantaneous current of $25 \times I_n$; this corresponds to an rms current of $11 \times I_n$ with maximum asymmetry.

The making current release is enabled only for the first 2 cycles following a circuit breaker closing operation. The making current release will trip the circuit breaker instantaneously and flash the instantaneous LED on the trip unit.

3-6.7 HIGH INSTANTANEOUS TRIP OPTION

The high instantaneous trip option is installed in 800 to 3200 ampere Magnum DS circuit breakers with a 100 kA interrupting capacity. In general, the high instantaneous trip is comprised of three small air core sensors, one in each phase, which produce a signal and transmit it back to the trip unit when the 85 kA withstand rating of the circuit breaker is exceeded. The result is an instantaneous trip by the circuit breaker. This high instantaneous trip option permits the 800-3200 ampere Magnum DS circuit breakers to be applied where a 100 kA fault is possible, while selectivity up to 85 kA is maintained.

3-7 SECONDARY CONTACTS AND CONNECTION DIAGRAMS

A maximum of sixty secondary wiring points are available on the circuit breaker, each dedicated to a specific function (Figure 3-21). The wiring points are finger safe with no more than two wires per terminal.

Up to two secondary contact plug-in connectors (AMP), each with 30 secondary points, can be mounted on the top rear portion of the circuit breaker (Figure 3-1). The plug-in connectors are protected by a molded hood (Figure 3-21). How many connectors are mounted

depends upon a number of considerations, such as whether the circuit breaker is electrically or manually operated and how many features are required. 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.

Drawout type circuit breakers: Compatible secondary plug-in connectors are mounted on the top front portion of the drawout cassette (Figure 3-22). These connectors match and plug into the circuit breaker mounted connectors. Contact points are wired from the cassette's plug-in connectors to cassette mounted terminal blocks. The terminal blocks are also mounted on the top front portion of the cassette. The secondary terminals have finger-proof hinged covers with small holes for probe testing.

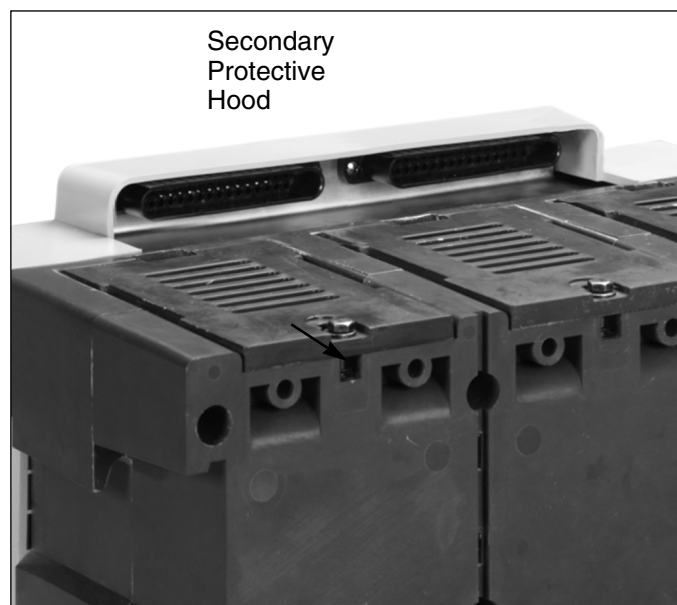


Figure 3-21 Close-up of Protective Secondary Hood

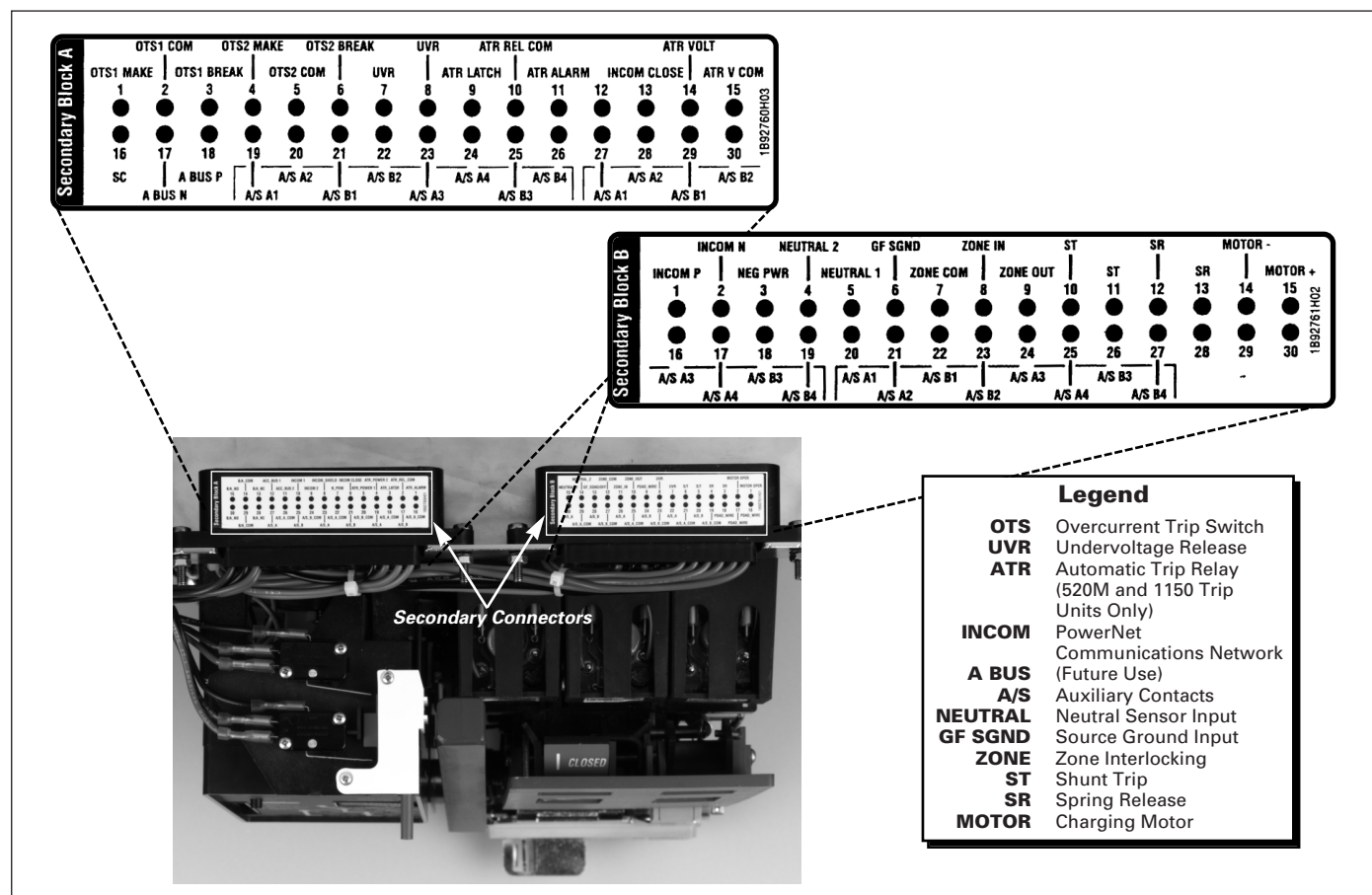


Figure 3-20 Top View Secondary Connectors

Fixed type circuit breakers: There are two secondary connection options:

(1) Without Terminal Block

(2) With Terminal Block

1. Without Terminal Block - If a terminal block for customer use is not required, the circuit breaker is supplied with both plug-in connectors (male and female) just described in the two previous paragraphs. The plug-in connectors are joined and attached to the top portion of the circuit breaker. The customer can plug secondary wiring with crimp-on connectors into back of the plug-in connectors.

2. With Terminal Block - For those customers preferring to wire to a terminal block, terminal blocks with finger-proof hinged covers are added to the secondary configuration just described for a fixed circuit breaker “without a terminal block.” The terminal blocks are wired to the plug-in connectors and also permanently attached to the upper rear portion of the circuit breaker (Figures 3-2 and 3-3).

A standard tool is available from the plug-in connector manufacturer (AMP) to facilitate the removal of secondary wiring from a plug-in connector, or contact Cutler-Hammer for assistance (Figure 3-23). The connector halves must be separated to use this tool.

3-7.1 CONNECTION DIAGRAMS

The connection diagram for all Magnum DS circuit breakers using Digitrip RMS trip units is shown in Figures 3-24 and 3-25.

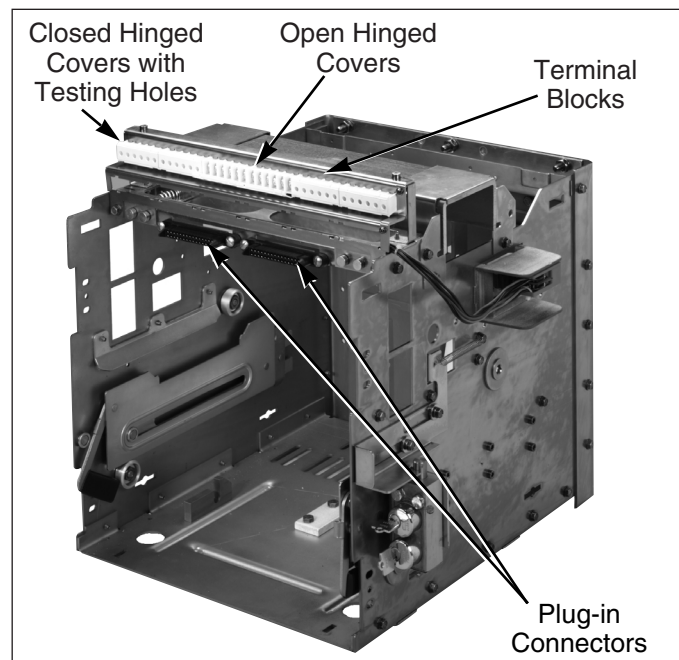


Figure 3-22 Cassette Mounted Secondary Wiring

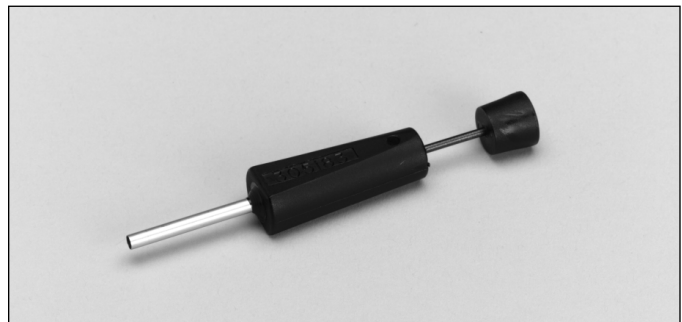
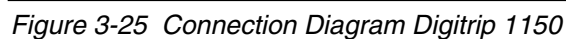


Figure 3-23 AMP Secondary Wiring Removal Tool (AMP #305 183) (C-H #MAMPSEC)





3-8 ACCESSORY DEVICES

A variety of accessory devices are available for use with Magnum DS circuit breakers. Unless otherwise stated, they are all considered optional devices in the sense that they are not provided as standard on a manually operated circuit breaker. Available accessories are identified here and discussed in general terms. For more detailed information and/or installation instructions, refer to individual instruction leaflets dedicated to the accessories.

Magnum DS circuit breaker accessories are designed to fit all frame sizes. The accessories fall into one of three categories:

- Plug-In electrical
- Internal electrical
- Mechanical

3-8.1 PLUG-IN ELECTRICAL ACCESSORIES

There are four Magnum DS Plug-In electrical accessories. Three can be viewed for identification by name and rating through viewing windows located in the right front of the circuit breaker (Figure 3-26). All four are plug-in type and can be factory installed or field installed using a UL listed kit.

The four Plug-In accessories are:

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

Shunt Trip - The shunt trip is an optional device (Figure 3-27). It opens the circuit breaker instantaneously when its coil is energized by a voltage input (Table 3.4). A total of two shunt trips can be mounted on a Magnum DS circuit breaker.



Figure 3-26 Through-the-Window Electrical Accessories

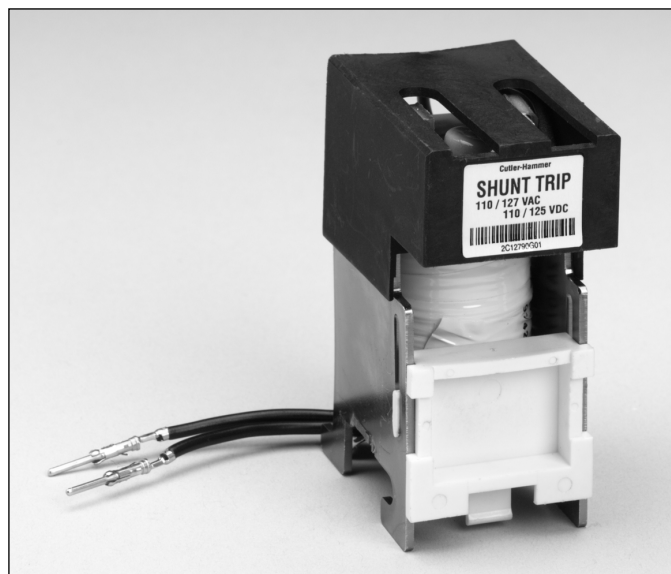


Figure 3-27 Shunt Trip Device

Table 3.4 Shunt Trip Ratings^①

Control Voltages	Operational Voltage Range	Inrush Power Consumption	Closing Time
24 Vdc	70% - 110%	200 VA	35 msec
48 Vdc	70% - 110%	200 VA	35 msec
110/125 Vdc	77 - 138	200 VA	35 msec
220/250 Vdc		154 - 275	200 VA
110/127 Vac	77 - 140	200 VA	35 msec
208/240 Vac	146 - 264	200 VA	35 msec

^①Dielectric Withstand = larger of $(2 \times U_e + 1000 \text{ volts})$ or (1500 volts) for 1 minute.

Table 3.5 Spring Release Ratings^①

Control Voltages	Operational Voltage Range	Inrush Power Consumption	Closing Time
24 Vdc	70% - 110%	200 VA	40 msec
48 Vdc	70% - 110%	200 VA	40 msec
110/125 Vdc	77 - 138	200 VA	40 msec
220/250 Vdc	154 - 275	200 VA	40 msec
110/127 Vac	77 - 140	200 VA	40 msec
208/240 Vac	146 - 264	200 VA	40 msec

^①Dielectric Withstand = larger of $(2 \times U_e + 1000 \text{ volts})$ or (1500 volts) for 1 minute.

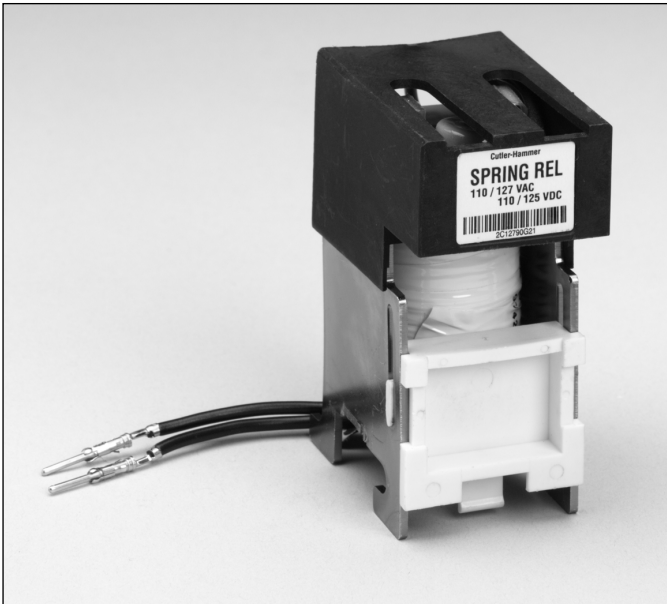


Figure 3-28 Spring Release Device

Spring Release - The spring release is an optional device (Figure 3-28). It remotely closes the circuit breaker when the coil is energized by a voltage input (Table 3.5). The closing spring must already be charged for the device to work.

Undervoltage Release - The undervoltage release is an optional device (Figure 3-29). It opens the circuit breaker when its supply voltage falls below 70%. If the

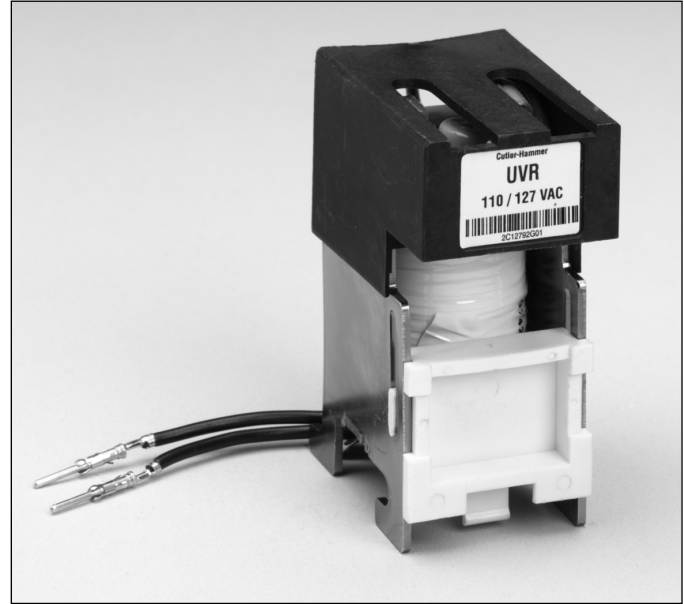


Figure 3-29 Undervoltage Release Device

release is not energized to 85% of its supply voltage, the circuit breaker cannot be reclosed electrically or manually (Table 3.6).

Auxiliary Switch - An auxiliary switch is an optional device providing remote electrical indication if the circuit breaker is open or closed (Figure 3-30). Up to 3 auxiliary switches can be mounted in the circuit breaker. Each switch has 2 normally open (“a”) and 2 normally closed (“b”) contacts for a total of 12 available contacts (Table 3.7).

Table 3.6 Undervoltage Release^①

Control Voltages	Operational Voltage Range	Dropout Voltage	Inrush Power Consumption	Continuous Power Consumption	Opening Time
24 Vdc	85% - 110%	30% - 60%	220 VA	15 VA	70 msec
32 Vdc	85% - 110%	30% - 60%	220 VA	15 VA	70 msec
48 Vdc	85% - 110%	30% - 60%	220 VA	15 VA	70 msec
110/125 Vdc	94 - 138	33 - 75	220 VA	15 VA	70 msec
220/250 Vdc	187 - 275	66 - 150	220 VA	15 VA	70 msec
110/127 Vac	94 - 140	33 - 76	220 VA	15 VA	70 msec
208/240 Vac	177 - 264	62 - 114	220 VA	15 VA	70 msec
380/415 Vac	323 - 457	114 - 249	220 VA	15 VA	70 msec
480 Vac	85% - 110%	30% - 60%	220 VA	15 VA	70 msec
600 Vac	85% - 110%	30% - 60%	220 VA	15 VA	70 msec

^①Dielectric Withstand = larger of (2 x U_e + 1000 volts) or (1500 volts) for 1 minute.

Table 3.7 Auxiliary Switch, Overcurrent Trip Switch and Cell Switch Contact Ratings

Control Voltages	Contact Rating Inductive Load (amperes)
250 Vac	10
125 Vdc	0.5
250 Vdc	0.25

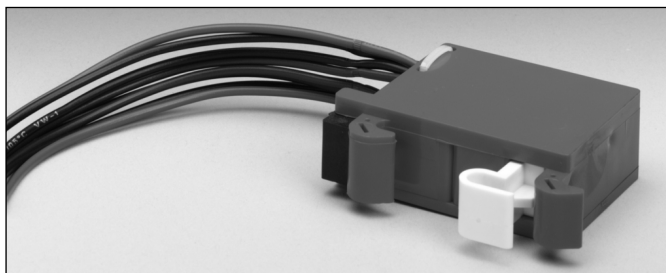


Figure 3-30 Auxiliary Switch

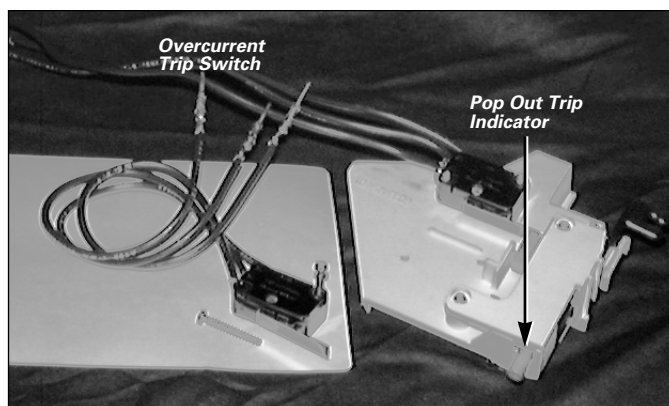


Figure 3-31 Overcurrent Trip Switch and Mechanical Trip Indicator

3-8.2 INTERNAL ELECTRICAL ACCESSORIES

Other electrical accessories are mounted inside the circuit breaker. They can be factory or site installed.

There are two different internally mounted electrical accessories:

- Overcurrent Trip Switch (Bell Alarm)
- Motor Operator

Table 3.8 Motor Operator^{①③}

Control Voltages	Operational Voltage Range	Running Current	Inrush Current	Power ^② Consumption	Charging Time
24 Vdc	85-110%	8 Amperes	400% of Running	250/350	5 sec
48 Vdc	85-110%	4 Amperes	400% of Running	250/350	5 sec
110/125 Vdc	94-138	3 Amperes	400% of Running	250/350	5 sec
220/250 Vdc	187-275	3 Amperes	400% of Running	250/350	5 sec
110/127 Vac	94-140	3 Amperes	400% of Running	250/350	5 sec
208/240 Vac	177-264	3 Amperes	400% of Running	250/350	5 sec

^①For 9 second charging time availability, consult Cutler-Hammer

^②3200 Frame and below/4000A frame and above in watts

^③Motor operators with an AC control voltage are 50/60 Hz

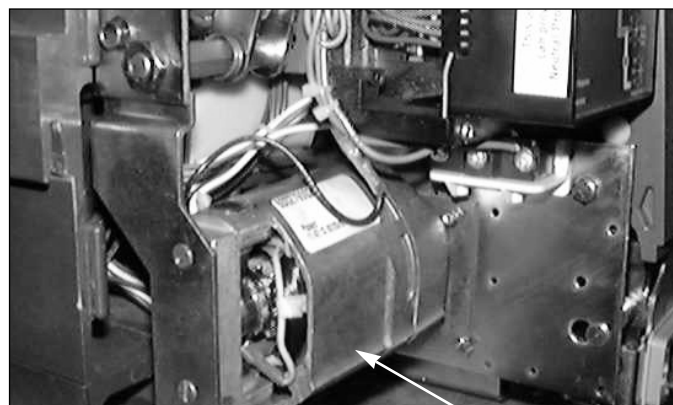


Figure 3-32 Motor Operator Mounted

Overcurrent Trip Switch (Bell Alarm) - An overcurrent trip switch (bell alarm) is an optional device (Figure 3-31). It provides an electrical indication when a circuit breaker trips as a result of the trip unit reacting to an overcurrent condition. Opening as a result of a circuit breaker's manual open button, shunt trip or undervoltage release does not cause the overcurrent trip switch to operate. The overcurrent trip switch has (2a 2b) Form C contacts (Table 3.7).

The status of the contacts changes when the trip indicator pops out. This permits the switch to be used as an alarm or in conjunction with a spring release to block a subsequent remote electrical closing signal.

Motor Operator - A Motor operator is an electric motor assembly internally mounted in the circuit breaker (Figure 3-32). It charges the closing springs electrically for remote or local operation. The motor operator can be factory or site installed (Table 3.8).

To convert a manually operated circuit breaker to an electrically operated circuit breaker, a UL listed motor operator kit is available.



Figure 3-33 Non-Electrical Optional Accessories in Circuit Breaker Front Cover

3-8.3 MECHANICAL ACCESSORIES

There are seven optional mechanical type accessories:

- Operations Counter
- Off Key Lock
- Cassette Lock
- Pushbutton Cover
- Prevent Close Cover
- Cassette Safety Shutters
- Cassette Cell Switch
- Door Escutcheon

Operations Counter - The operations counter is a mechanical device used to provide a record of the number of circuit operations. It is mounted in the lower right portion of the circuit breaker and can be viewed through the front cover (Figure 3-33).



Figure 3-34 Cassette Lock Mounted

Off Key Lock - The off key lock secures the circuit breaker in the "OFF" position. It is mounted in the lower right portion of the circuit breaker and can be viewed through the front cover (Figure 3-33). The customer supplies the key lock. The provisions available are for Kirk, Castell or Ronis.

Cassette Lock - A cassette mounted lock can be used in conjunction with different transfer schemes, such as main-tie-main or automatic transfer (Figure 3-34).

- Hold breaker trip-free in "Connected" Position
- Preventing circuit breaker from being energized

Up to three locks can be installed on one cassette. Cutler-Hammer supplies the lock provisions only. The customer is responsible for the locks, which can be Kirk or Castell.

Pushbutton Cover - A padlockable cover is available to limit access to the “ON” and “OFF” pushbuttons (Figure 3-35).

Prevent Close Cover - Complete access to the “ON” pushbutton can be prevented by adding the prevent close cover to the pushbutton cover.

Cassette Safety Shutters - Automatically operated insulating type safety shutters are available for use with the drawout cassette. When the drawout circuit breaker is levered from the CONNECT position, the shutters automatically close to cover the fixed primary contacts (Figure 3-36). When the circuit breaker is levered into the cassette, the shutters automatically open permitting primary connections to be made (Figure 3-37).

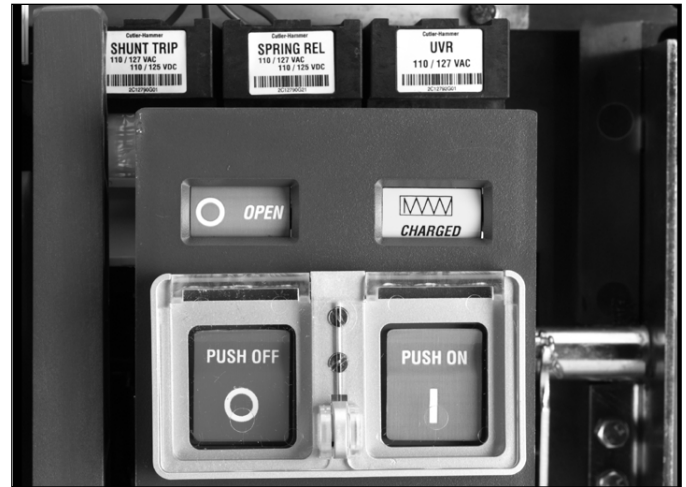


Figure 3-35 Pushbutton Cover Mounted

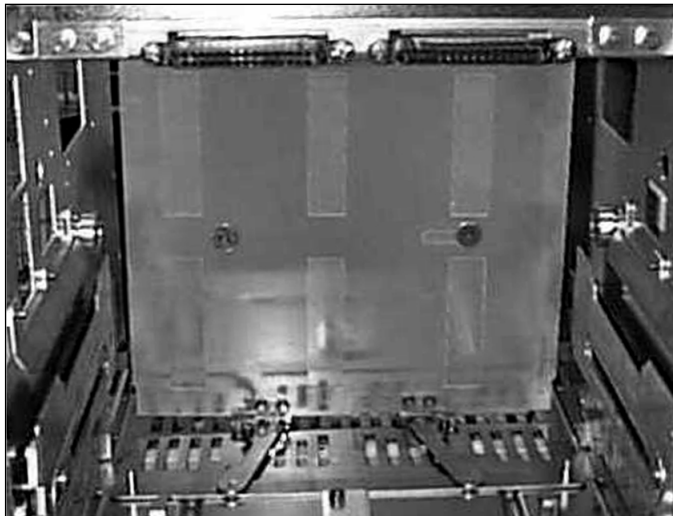


Figure 3-36 Safety Shutters in Closed Position

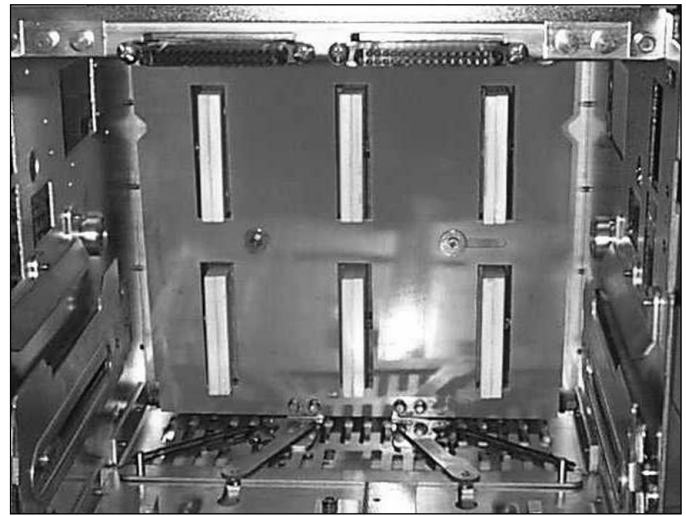


Figure 3-37 Safety Shutters in Open Position

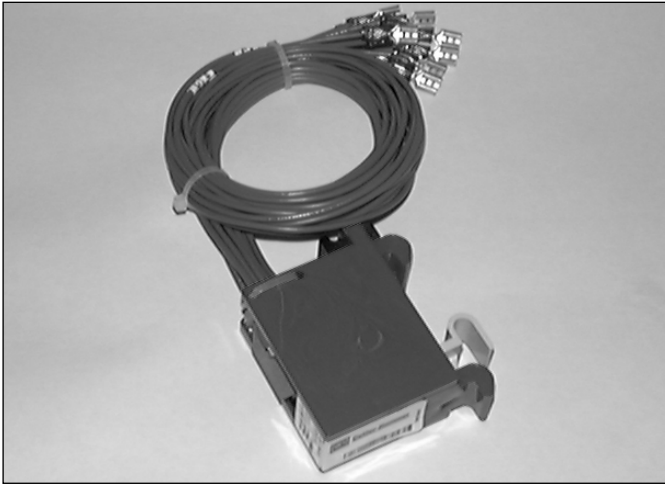


Figure 3-38 Cell Switch Unmounted

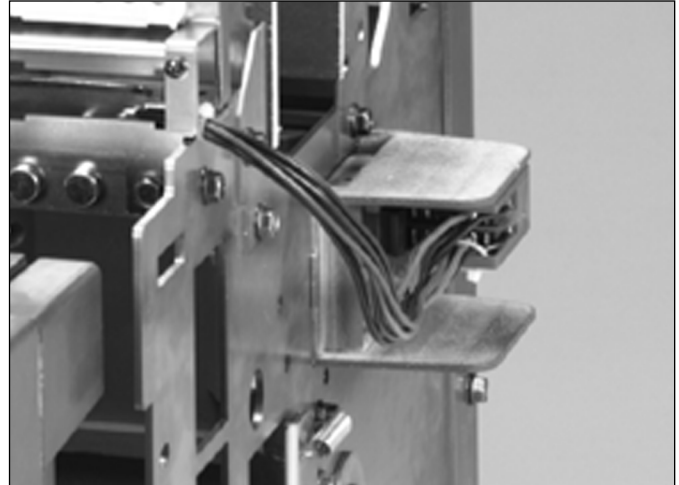


Figure 3-39 Cell Switch Mounted

Cassette Cell Switch - The cassette cell switch is a compartment position switch for drawout circuit breakers. It is available in a 4a4b, 8a8b or 12a12b contact configuration, and mounts on the right side of the cassette (Figures 3-38 and 3-39). Refer to Table 3.7 for cell switch contact information. Each cell switch consists of four SPDT switches and can be mounted in any of the three available positions (Withdrawn, Test, Connected).

Door Escutcheon - The door escutcheon is a molded frame used to seal space between the circuit breaker and the compartment door cutout. It is supplied with a mounting gasket (Figure 3-40).

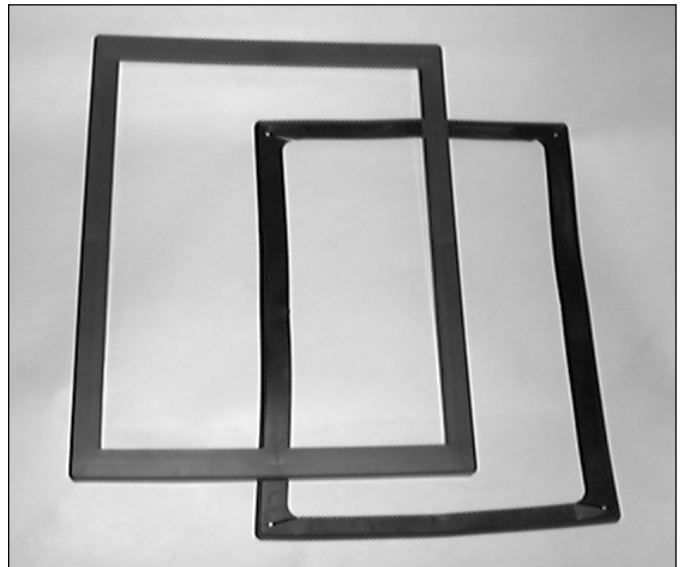


Figure 3-40 Door Escutcheon and Gasket

SECTION 4: DRAWOUT CIRCUIT BREAKER AND CASSETTE

4-1 GENERAL

Section 3 discussed topics and features common to all Magnum DS circuit breakers, no matter what the mounting configuration. In this section, features unique to the drawout configuration not covered elsewhere, including the drawout cassette, are covered. Drawings and dimensions associated with all drawout circuit breakers, their associated drawout cassettes, and any appropriate primary bus connections are included. The installation and levering of a drawout circuit breaker were discussed in Section 2. If necessary, review that information, since it will not be repeated here.

4-1.1 DRAWOUT CASSETTE

A drawout circuit breaker is used in combination with a fixed drawout cassette (Figure 4-1). The cassette provides for all the required fixed drawout features as well as fixed primary and secondary connections. Two types of cassette are available. The basic cassette is supplied without line/load stabs and the standard cassette is supplied with stabs. Mounting locations for cell (TOC) switches, safety shutters and key interlocks are part of the cassette's design (Figure 4-2).

The cassette's drawout extension rails can be pad-locked to prevent a circuit breaker from being inserted during maintenance periods. In addition, the cassette includes all required safety interlocks which function with the circuit breaker's interlock system to insure safe operation of the equipment. An arc hood is positioned above where the circuit breaker's arc chutes will be allowing for zero clearance mounting when circuit breakers are vertically stacked in an assembly.

4-2 DRAWOUT CIRCUIT BREAKER DIMENSIONS

The Magnum DS drawout circuit breaker connects to the fixed primary stabs of the drawout cassette through the primary finger clusters attached to the rear of the circuit breaker. Although two different frame sizes cover all Magnum DS circuit breakers from an overall dimensional standpoint, other dimensions relating to primary connection sizes and spacing can vary. Review the drawings related to a specific circuit breaker size (Figures 4-3 - 4-5).

4-3 DRAWOUT CASSETTE DIMENSIONS

A number of cassette drawings are presented here to provide all the dimensional information required for all mounting configurations and/or the use of optional cassette mounted devices (Figures 4-6 - 4-14). Review carefully for a specific installation.

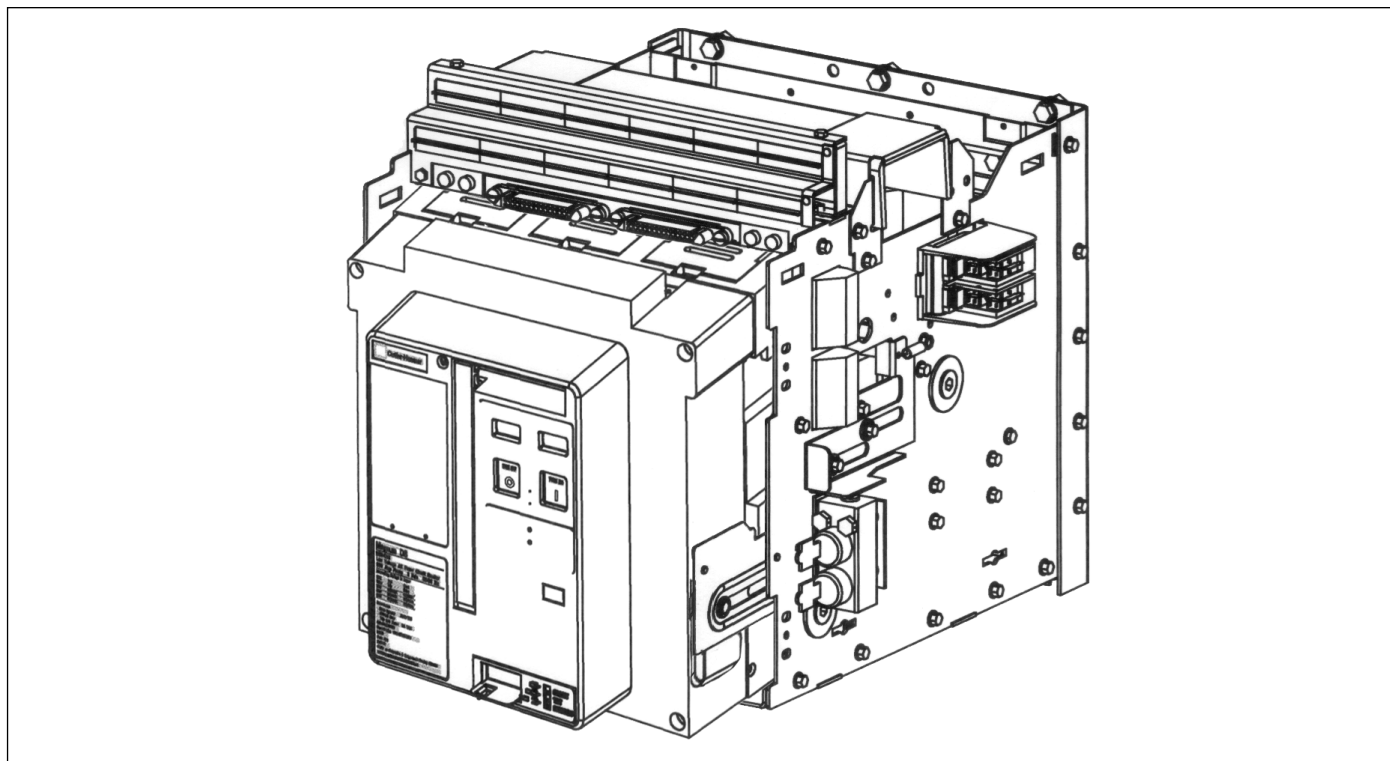
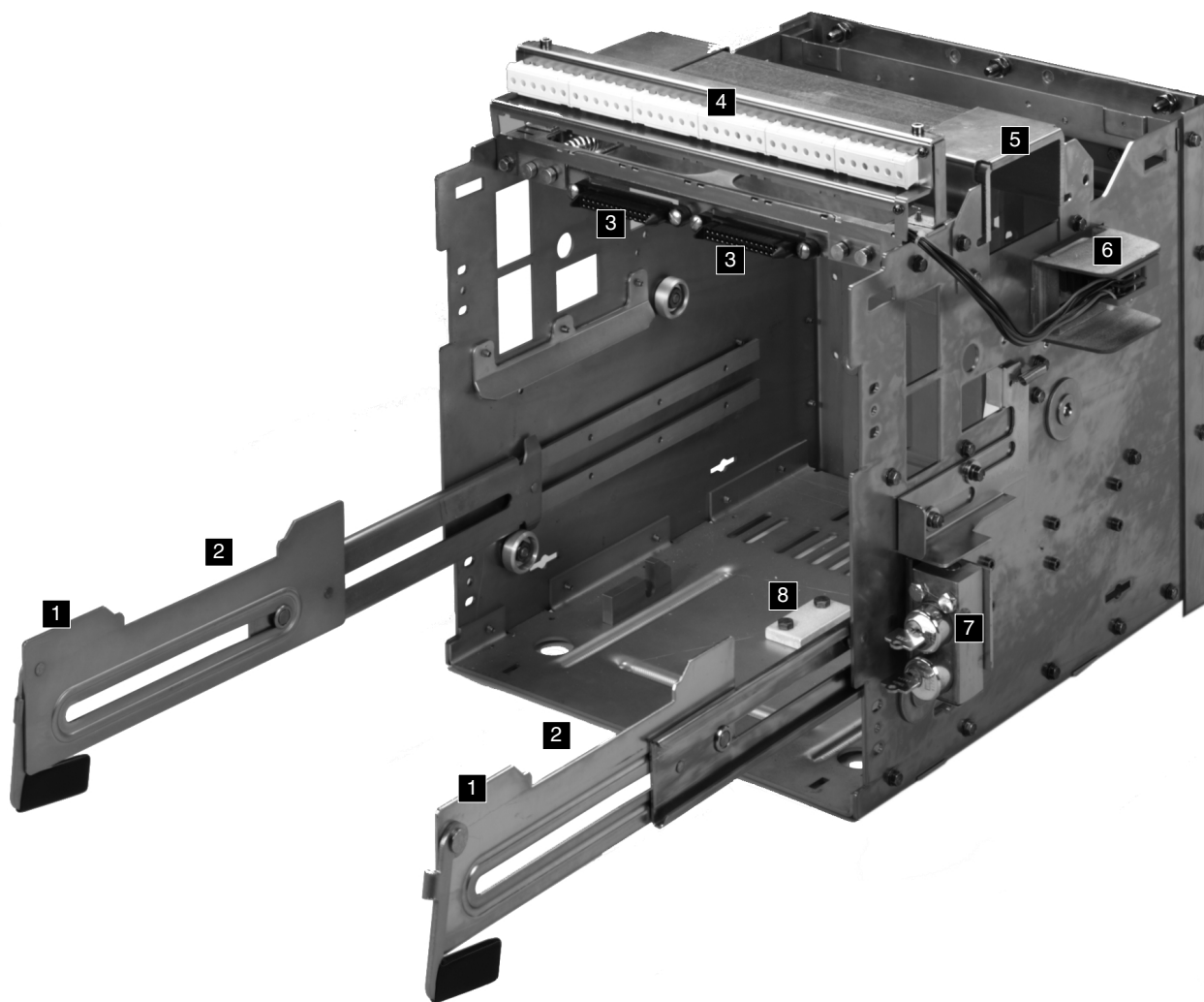


Figure 4-1 Drawout Circuit Breaker and Cassette Isometric



- | | |
|---------------------------------------|---|
| 1 Extension Rails | 5 Arc Hood |
| 2 Extension Rail Cutout | 6 Optional Cell (TOC) Switch Mounting Location |
| 3 Secondary Plug-in Connectors | 7 Optional Key Interlock Mounting Location |
| 4 Secondary Terminal Blocks | 8 Grounding Bar |

Figure 4-2 Drawout Cassette Shown with Extension Rails Fully Extended

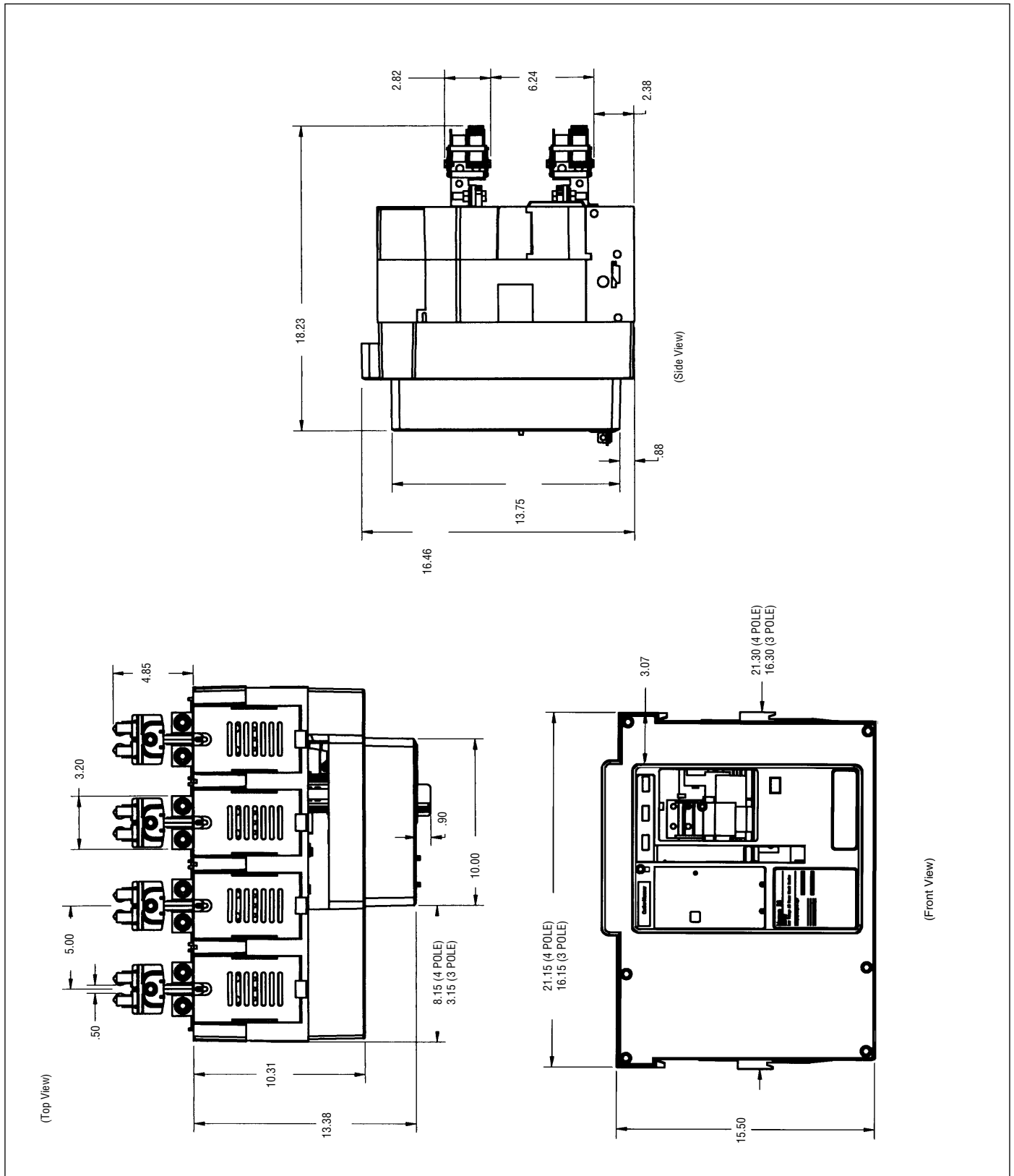


Figure 4-3 Drawout 800/1600 Amp Magnum DS Circuit Breaker (Inches)

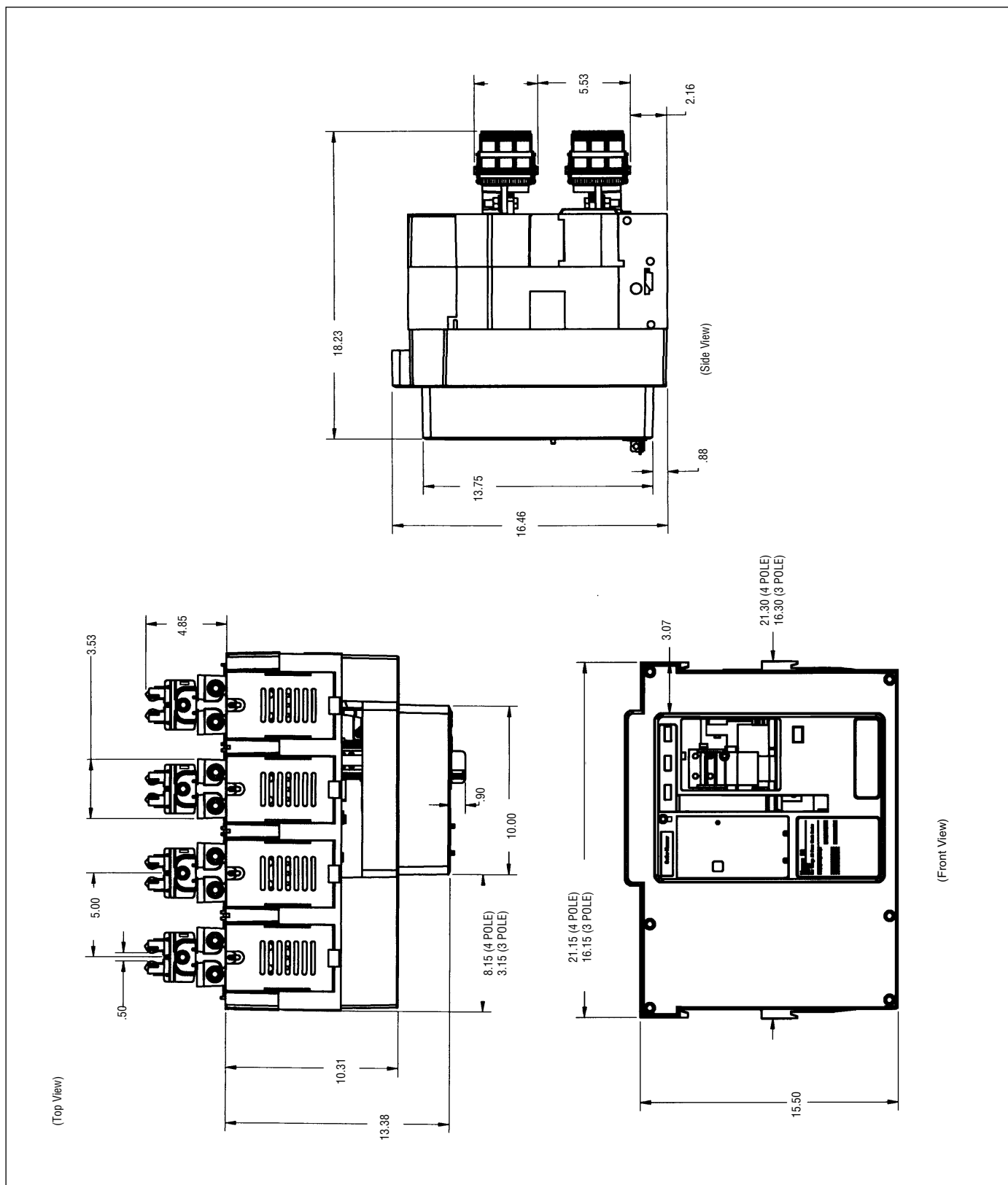


Figure 4-4 Drawout 2000 Amp Magnum DS Circuit Breaker (Inches)

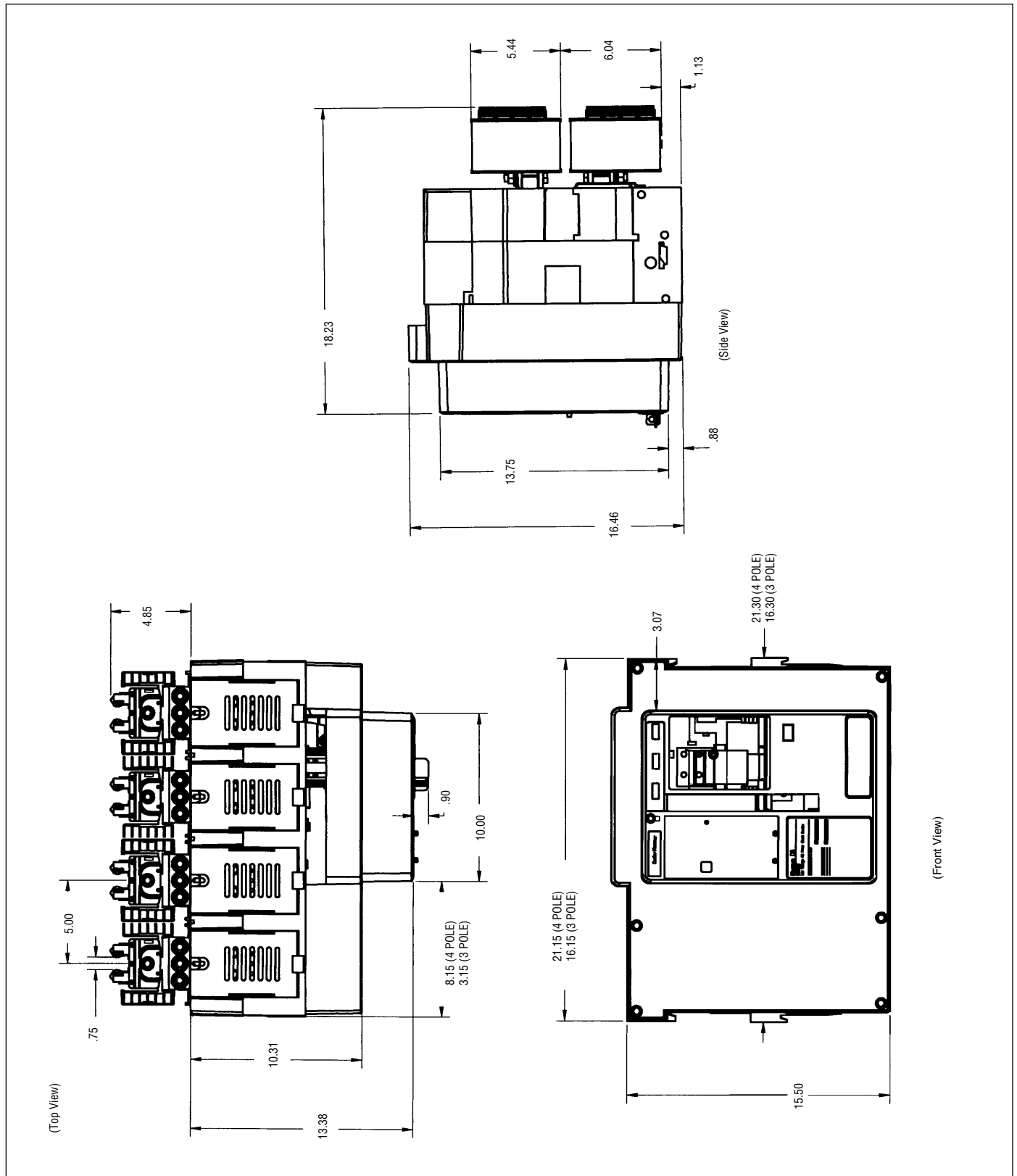


Figure 4-5 Drawout 3200 Amp Magnum DS Circuit Breaker (Inches)

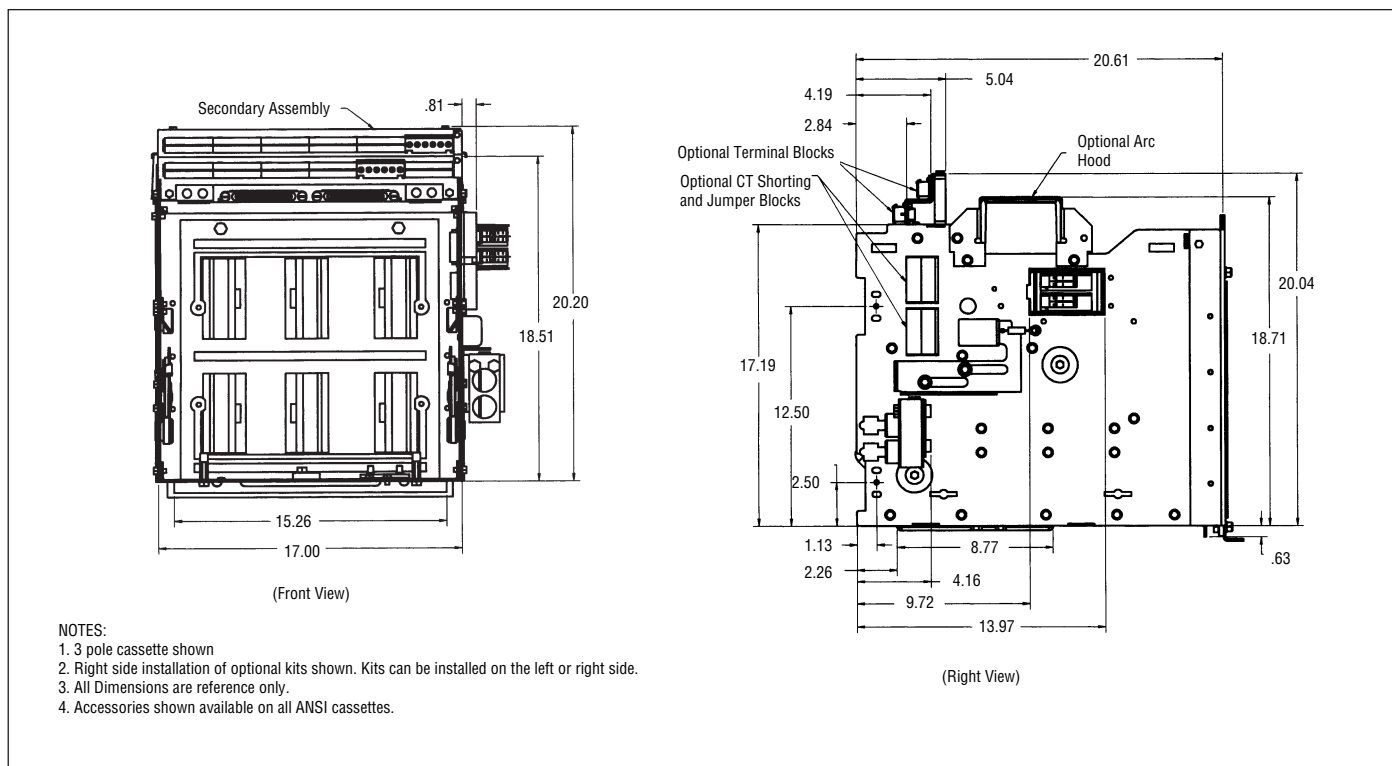


Figure 4-6 Drawout Magnum DS Cassette Front /Right Views 800-3200 Amp (Inches)

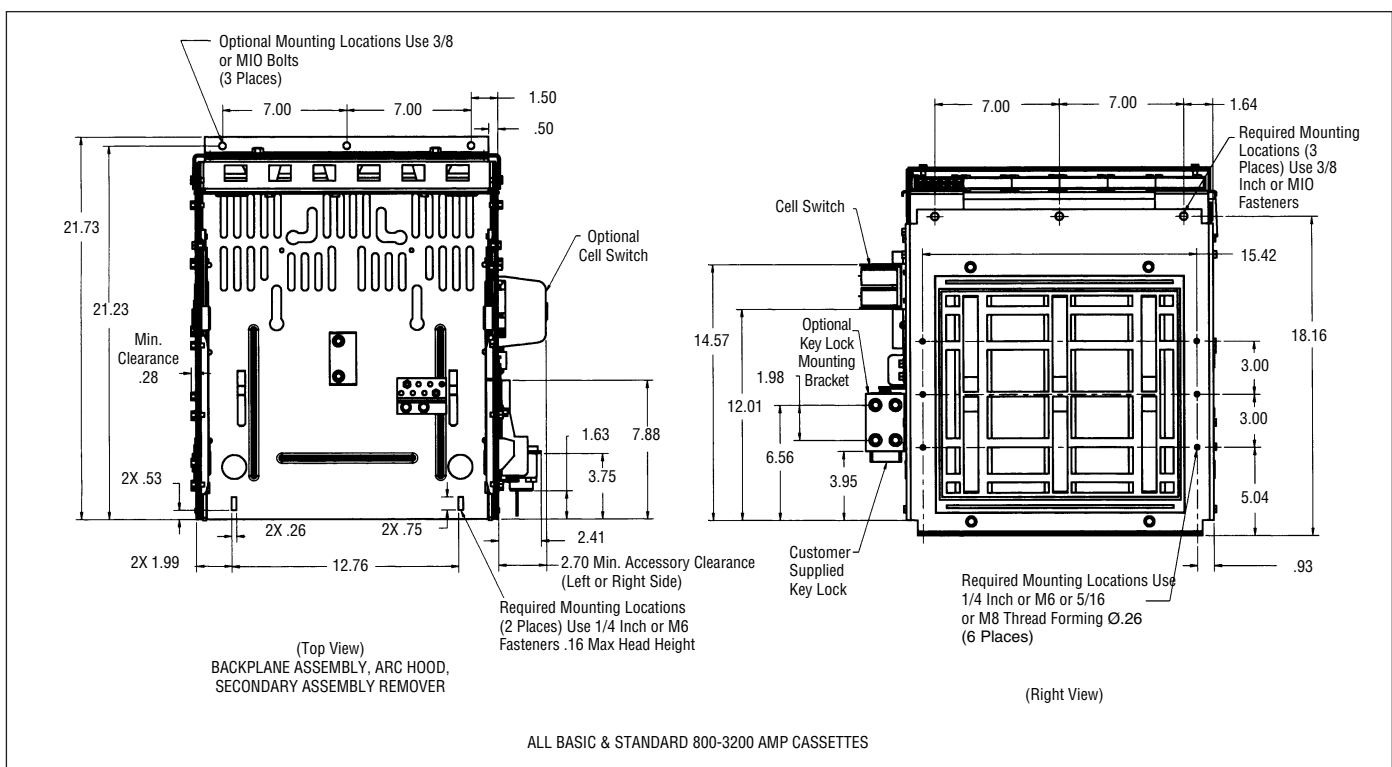


Figure 4-7 Drawout Magnum DS Cassette Top/Right Views 800-3200 Amp (Inches)

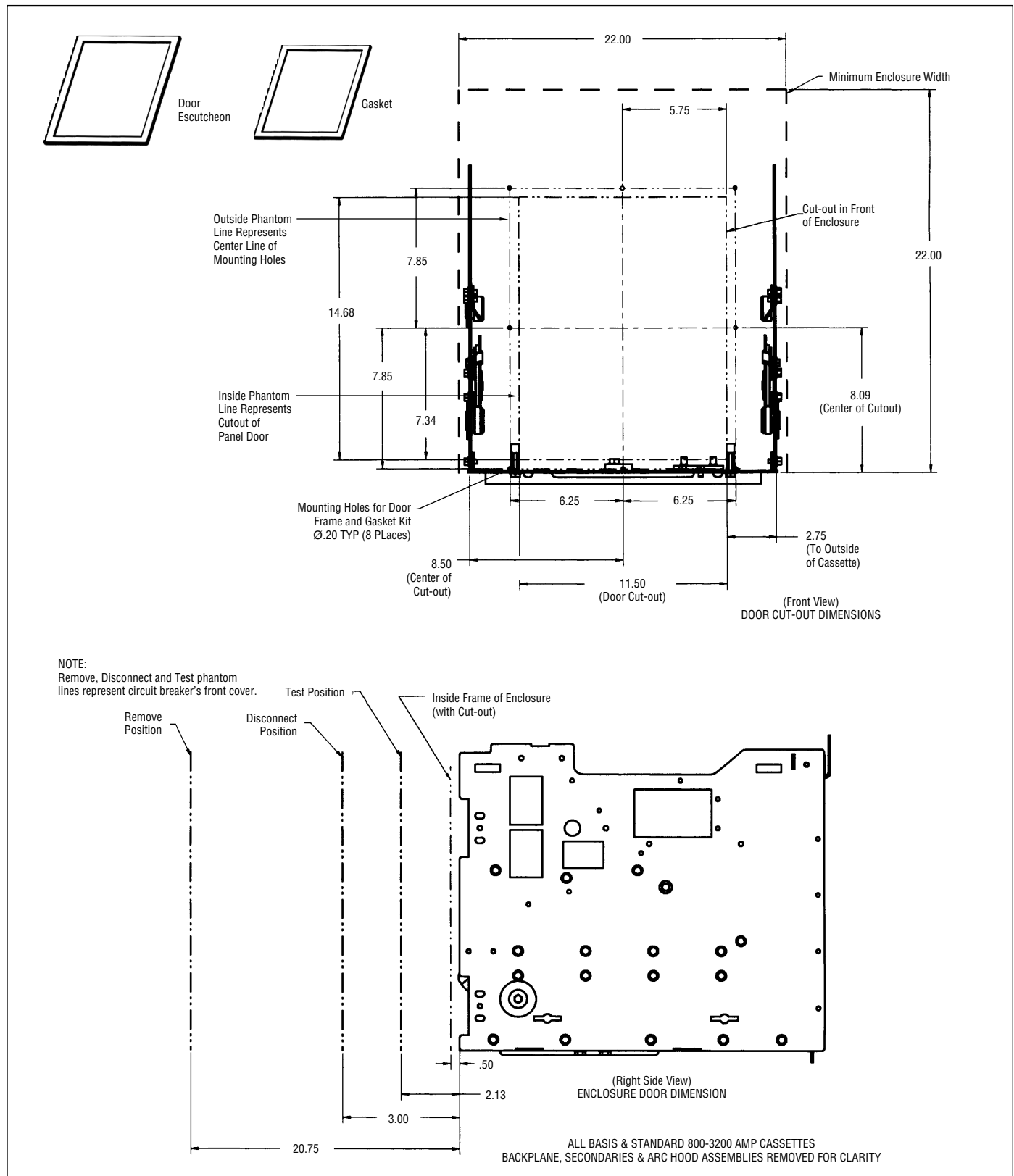


Figure 4-8 Compartment Door Cutout 800-3200A Dimensions (Inches)

NOTES:

1. Copper stab location - 3-pole cassette shown.
2. Dimensions of backplane cutouts shown.
3. Dimensions apply to .50 inch stabs except bracketed dimensions apply here and to .75 inch stab on next page.

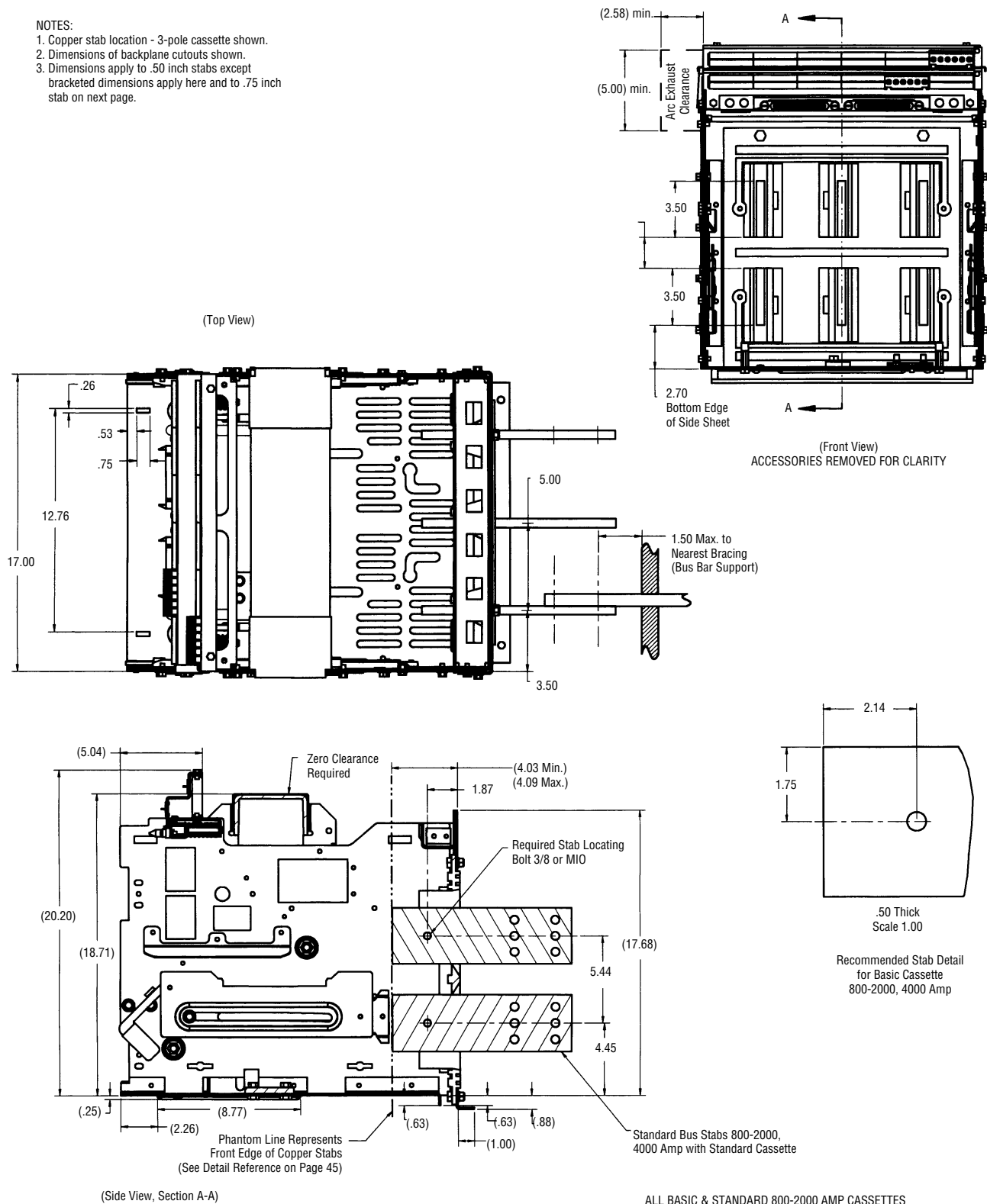


Figure 4-9 Drawout Magnum DS Cassette 800-2000 Amp (Inches)

NOTES:

1. Copper stab location - 3-pole cassette shown.
2. Dimensions of backplane cutouts shown.
3. Dimensions apply to .75 inch stabs except bracketed dimensions on previous page also apply.

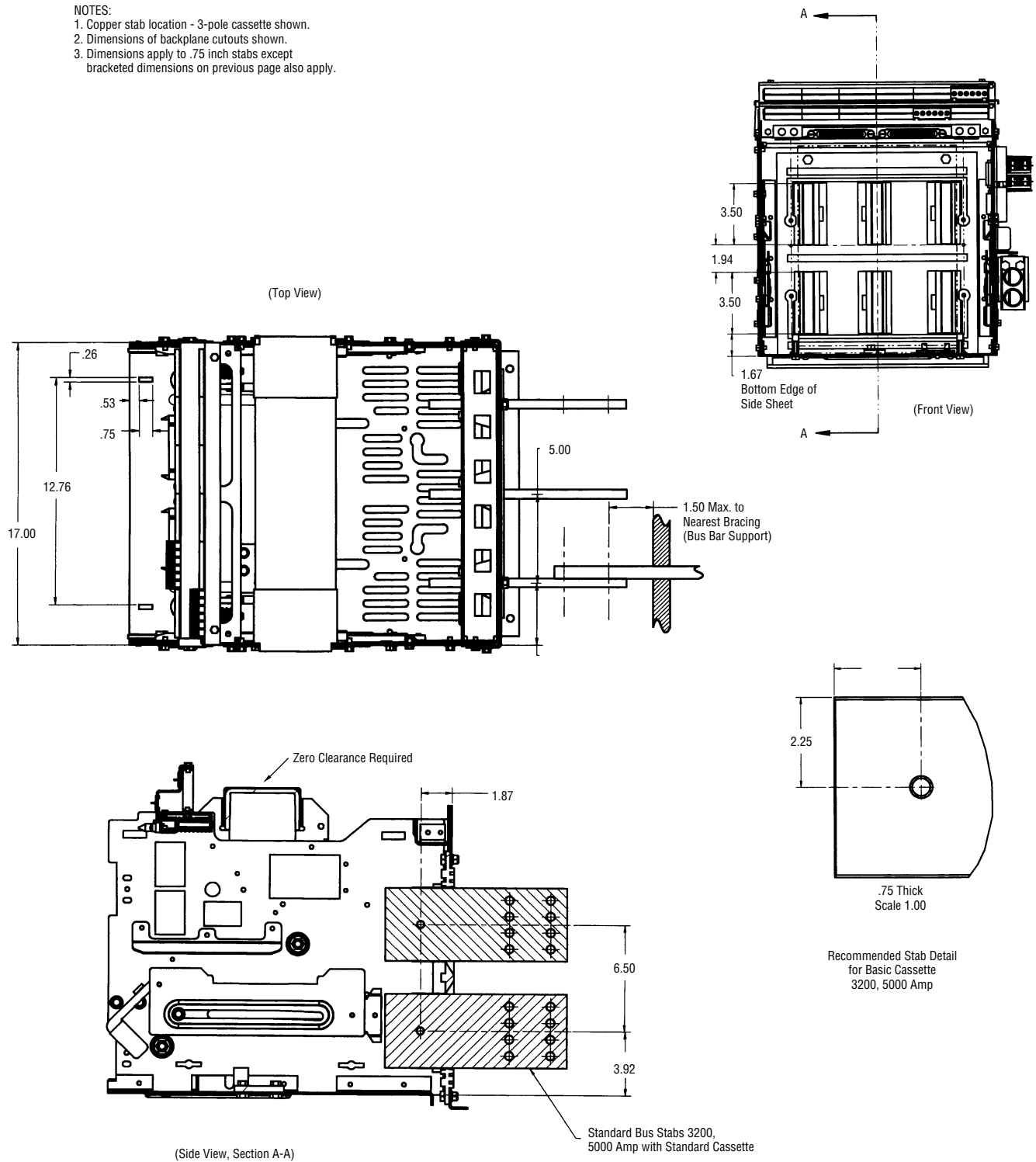


Figure 4-10 Drawout Magnum DS Cassette 3200 Amp (Inches)

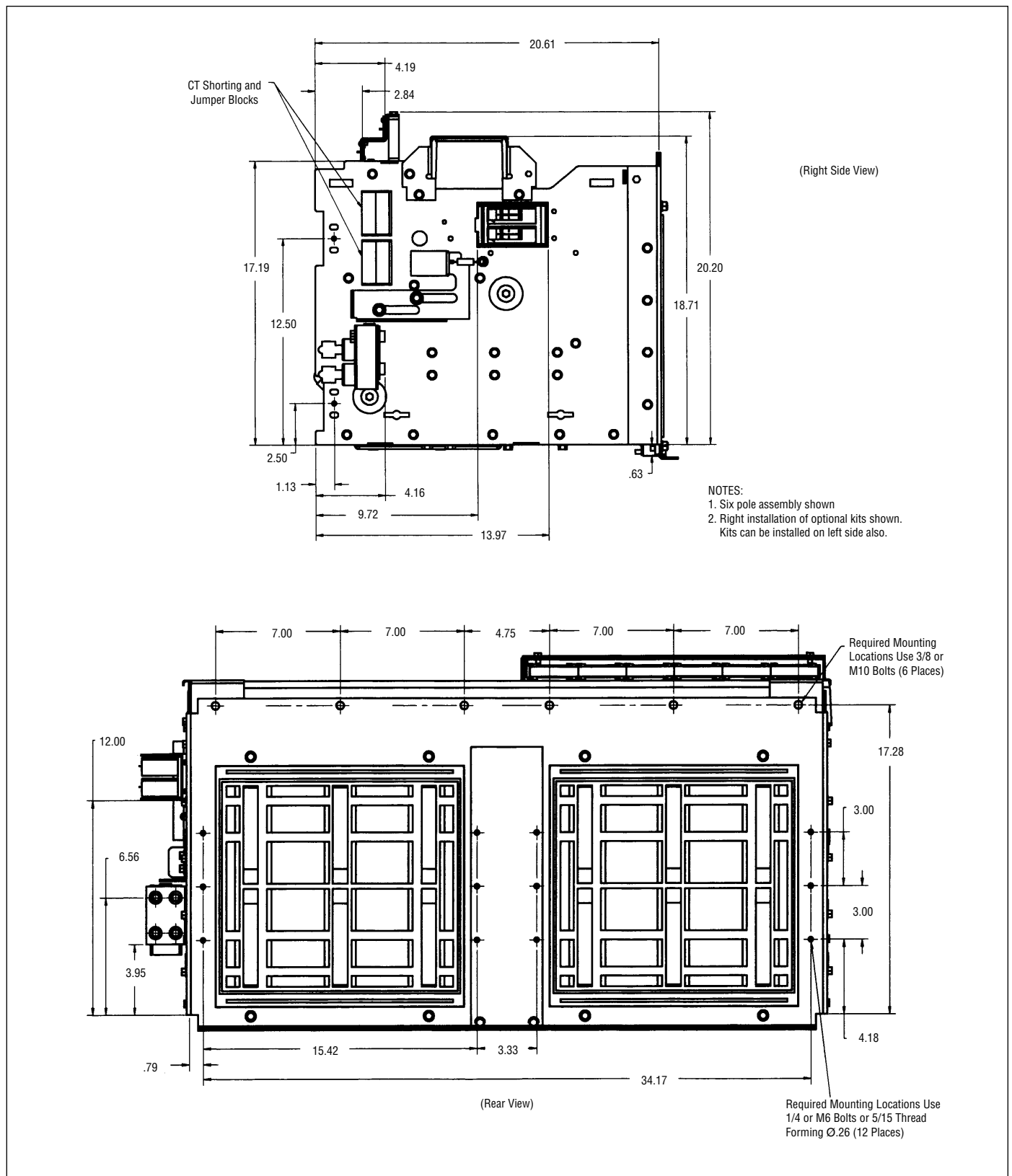
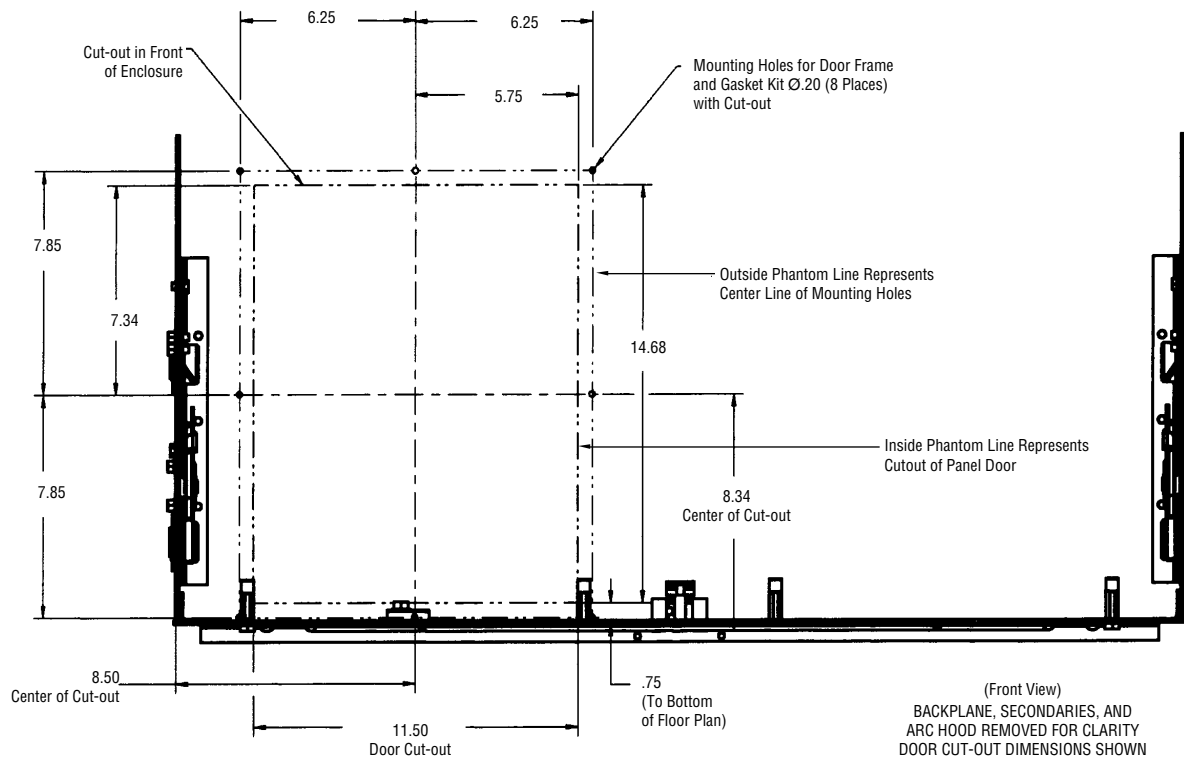


Figure 4-12 Drawout Magnum DS Cassette Side/Rear Views 4000/5000 Amp (Inches)



NOTE:
Remove, Disconnect and Test phantom
lines represent circuit breaker's front cover.

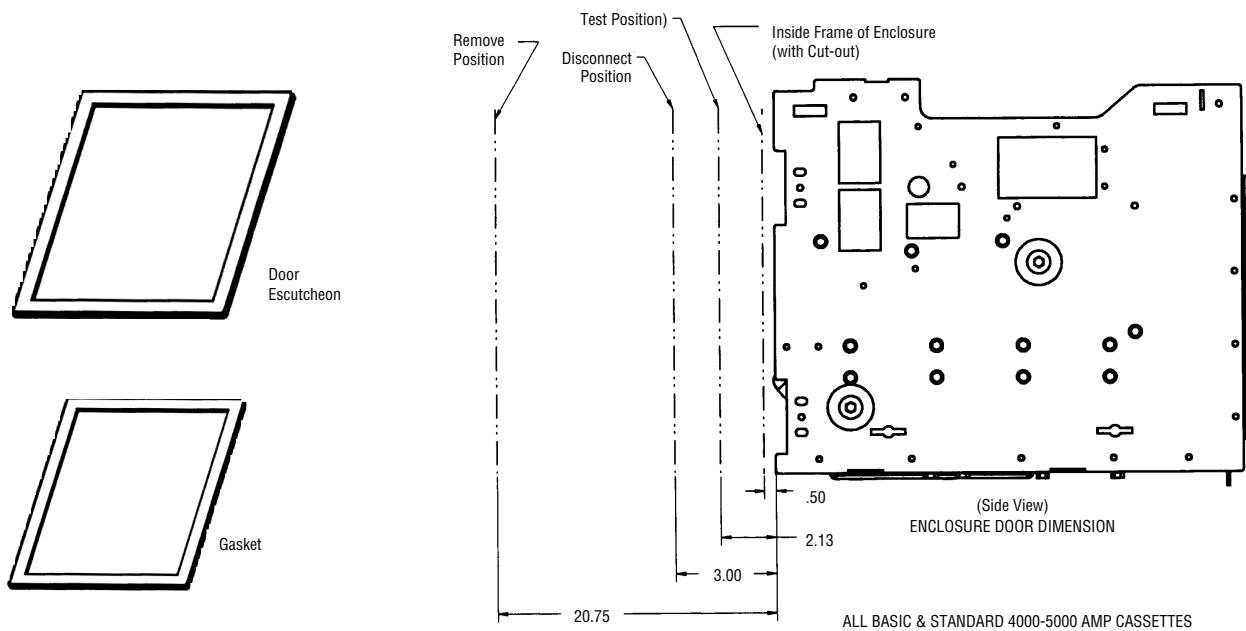
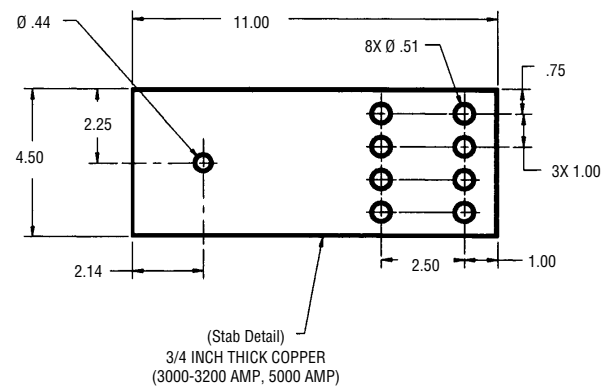
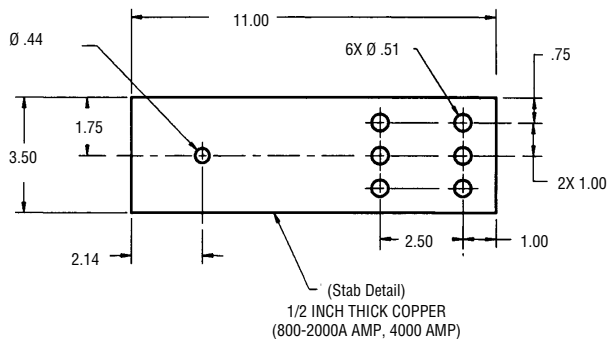
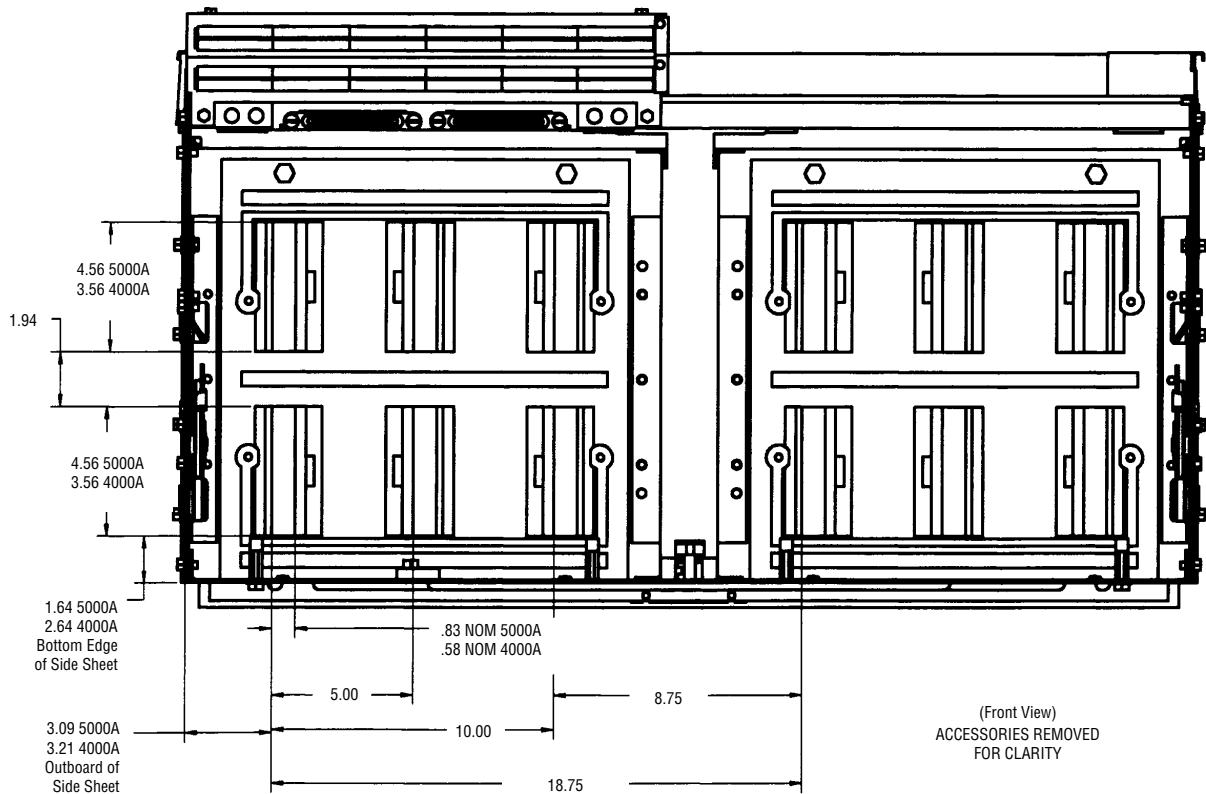


Figure 4-13 Compartment Door Cutout Dimensions 4000/5000 Amp (Inches)

- NOTES:
1. Six Pole Cassette Shown
 2. Dimensions of Backplane Cutouts Shown
 3. Dimensions Apply to .50 Inch and .75 Inch Stabs



ALL BASIC & STANDARD 4000-5000 AMP CASSETTES

Figure 4-14 Drawout Magnum DS Cassette Primary Stabs 4000/5000 Amp (Inches)

SECTION 5: FIXED CIRCUIT BREAKER

5-1 GENERAL

Section 3 discussed topics and features common to all Magnum DS circuit breakers, no matter what the mounting configuration. In this section, features unique to the fixed configuration not covered elsewhere are covered. Drawings and dimensions associated with all fixed circuit breakers and any appropriate primary bus connections are included. The installation of a fixed circuit breaker was discussed in Section 2. If necessary, review that information, since it will not be repeated here.

5-2 FIXED CIRCUIT BREAKER DIMENSIONS

The standard fixed circuit breaker is supplied with horizontally mounted primary connections (Figure 5-1). Optional vertical primary adaptors are available for different bus configurations. Refer to Figures 5-2 through 5-11 for fixed circuit breaker dimensions, vertical adaptor dimensions and vertical adaptor assembly details.

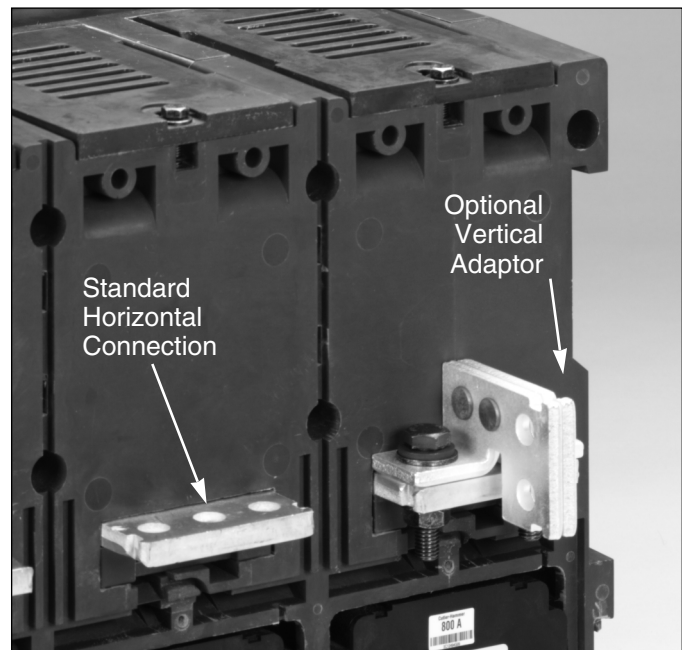


Figure 5-1 Closeup of Fixed Circuit Breaker's Connection Possibilities

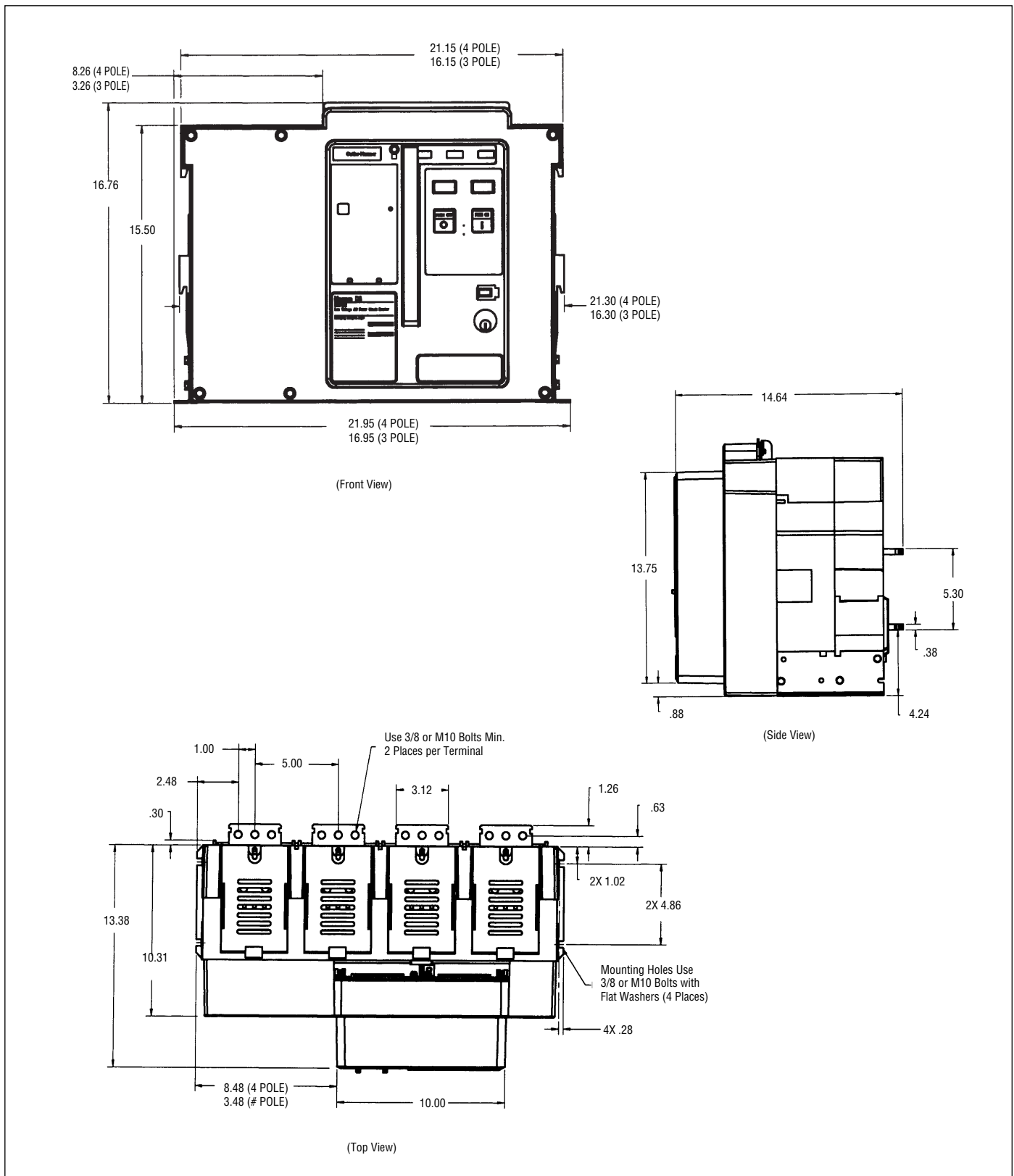


Figure 5-2 Fixed 800, 1600 and 2000 Amp Magnum DS Circuit Breaker (Horizontal Primary Connection) (Inches)

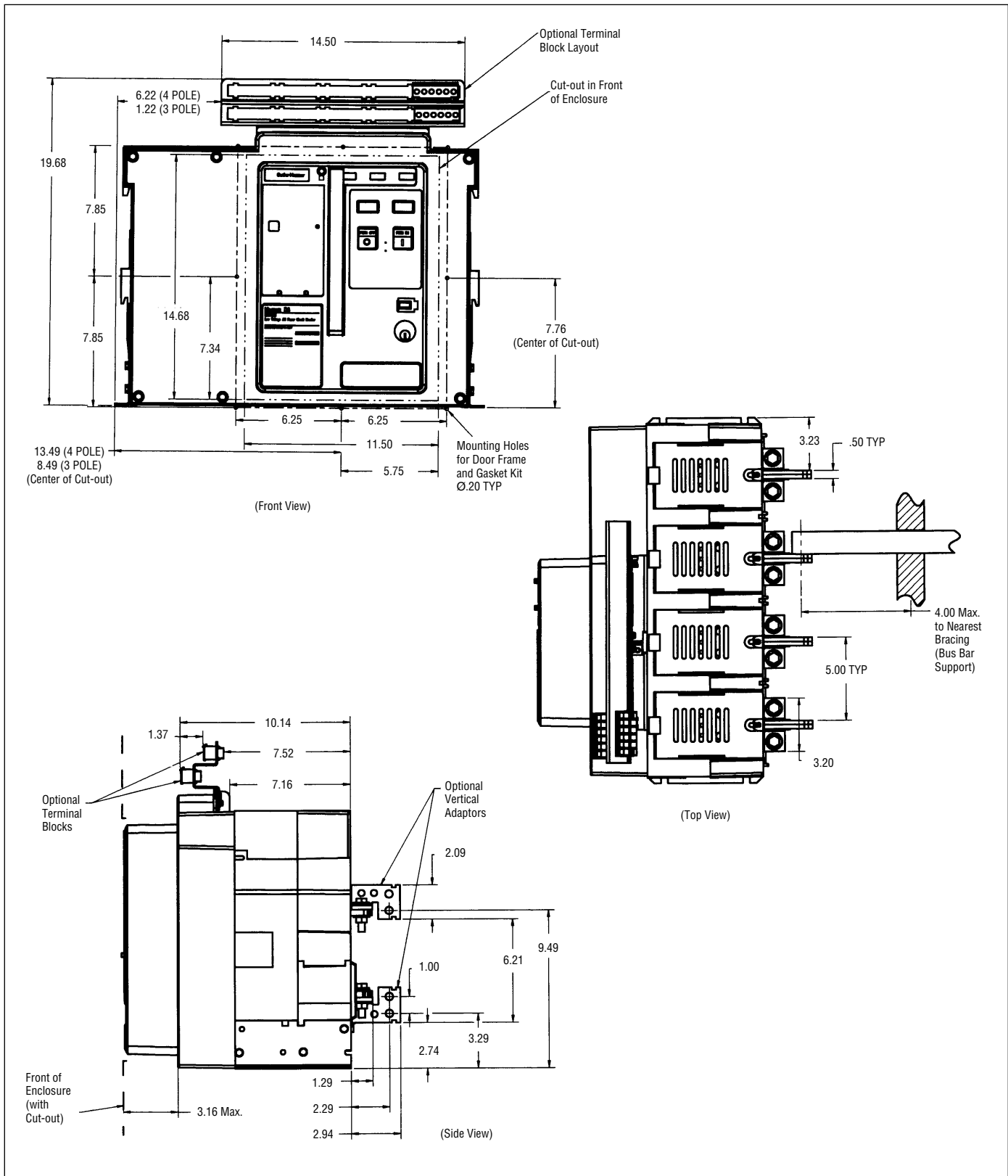


Figure 5-3 Fixed 800 and 1600 Amp Magnum DS Circuit Breaker (Vertical Primary Connection) (Inches)

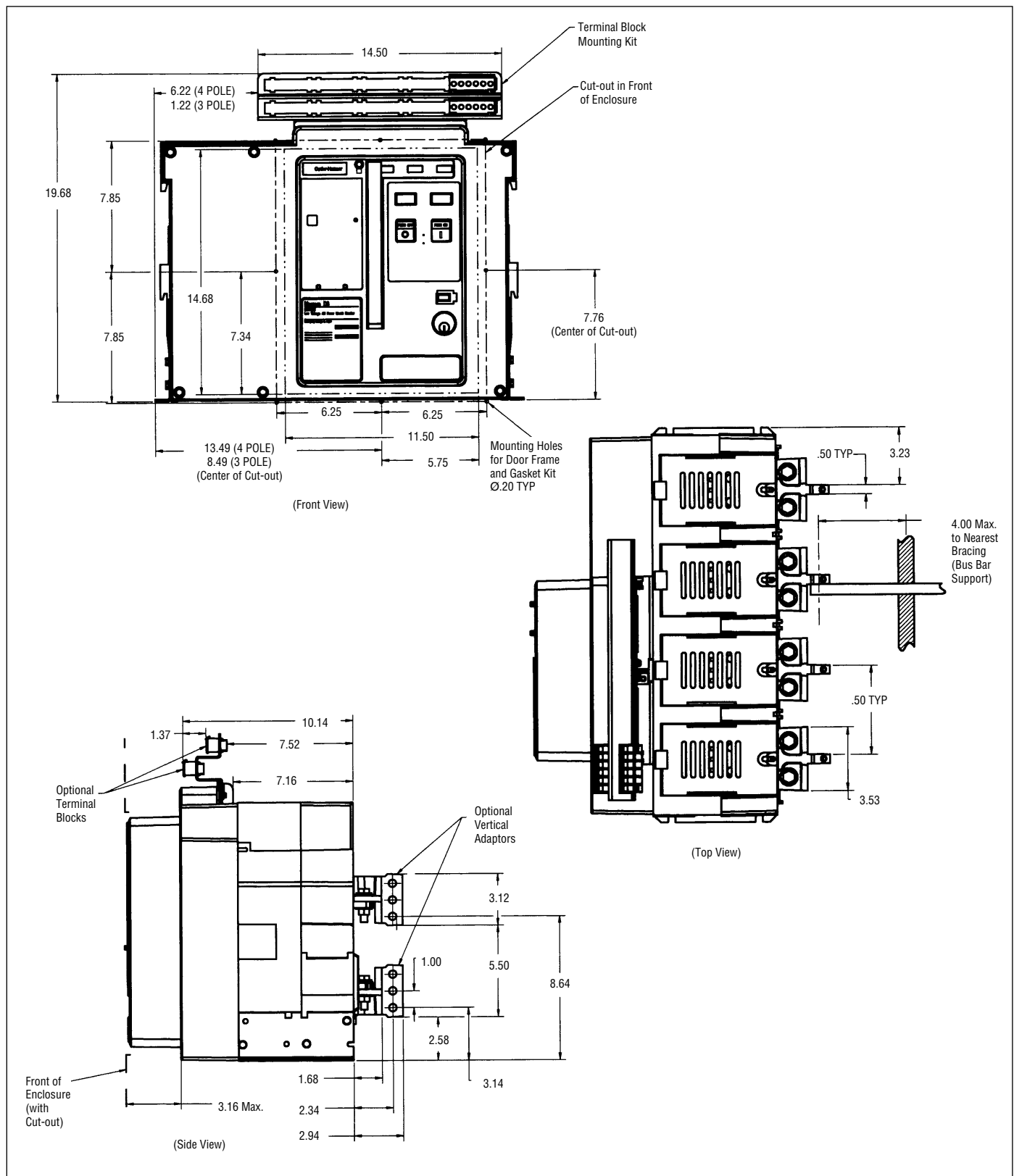


Figure 5-4 Fixed 2000 Amp Magnum DS Circuit Breaker (Vertical Primary Connection) (Inches)

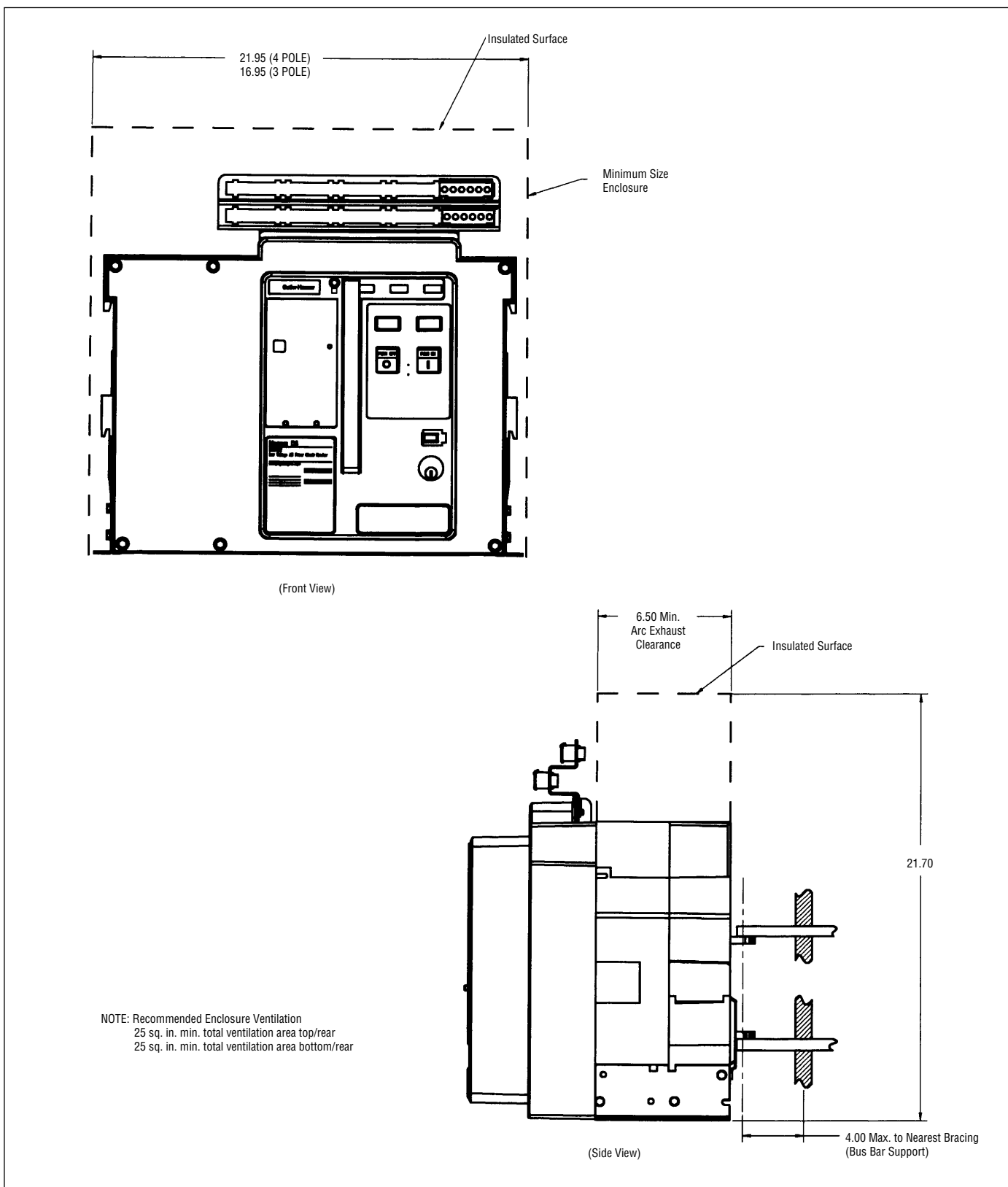


Figure 5-5 Fixed 800, 1600 and 2000 Amp Magnum DS Circuit Breaker (Enclosure/Ventilation) (Inches)

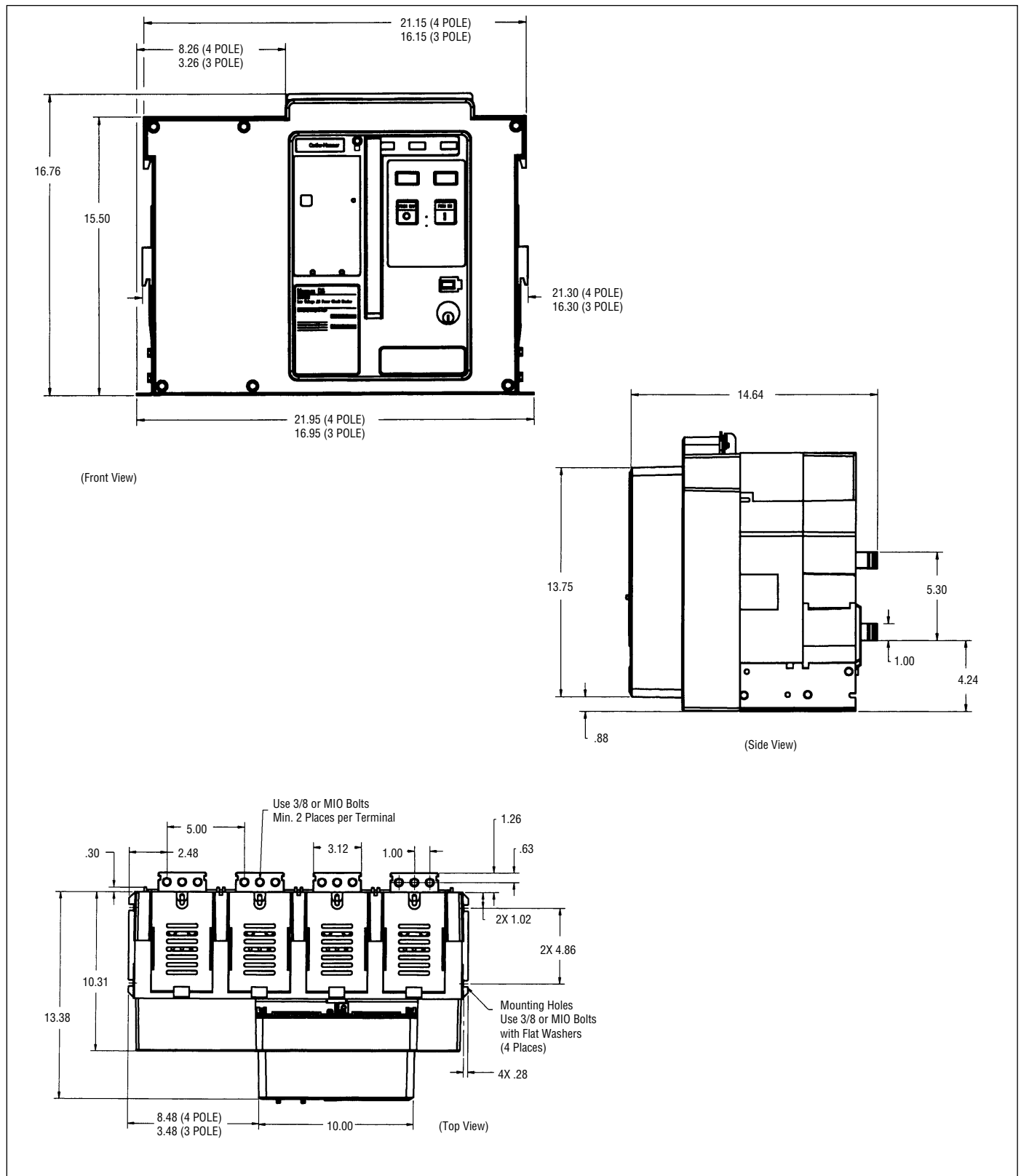


Figure 5-6 Fixed 3200 Amp Magnum DS Circuit Breaker (Horizontal Primary Connection) (Inches)

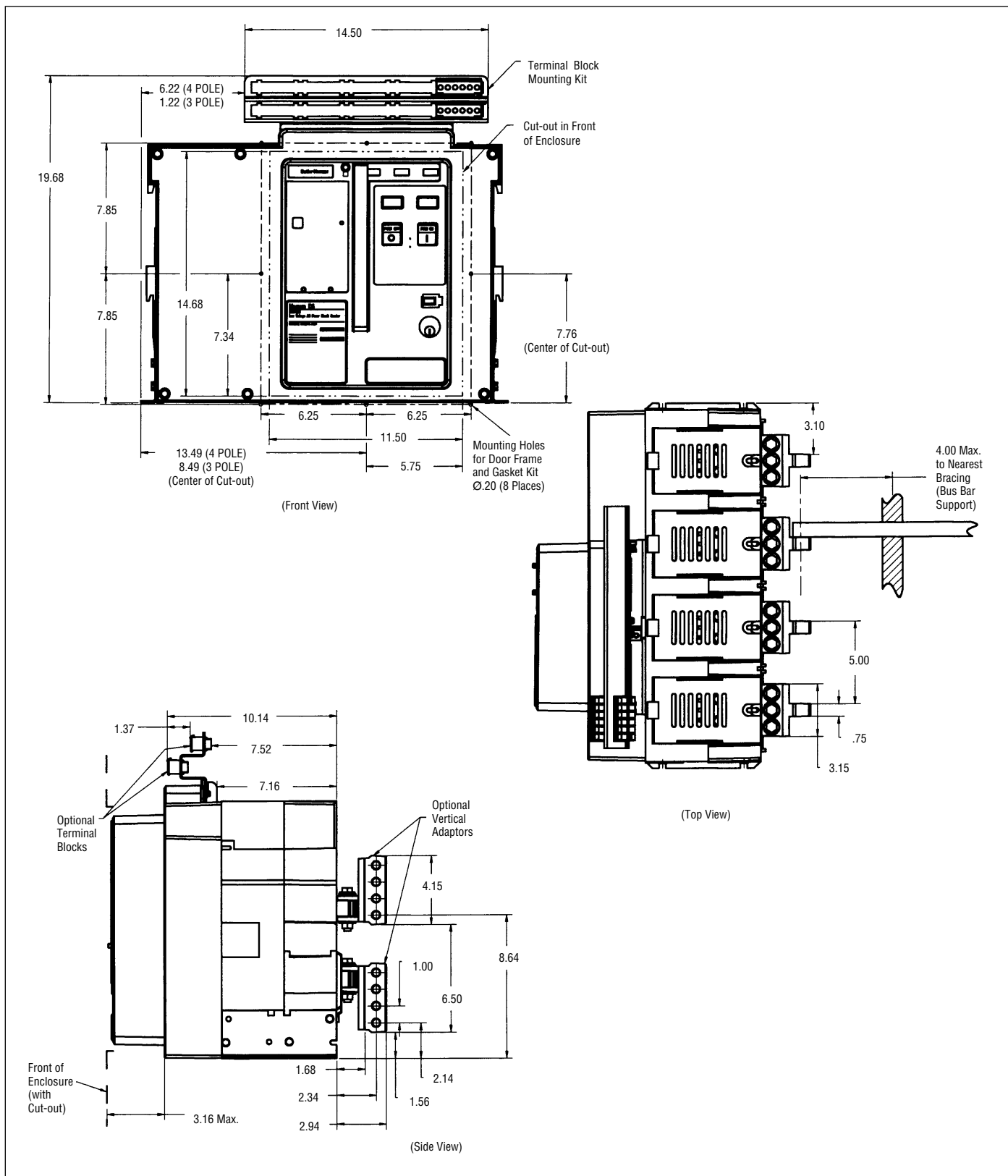


Figure 5-7 Fixed 3200 Amp Magnum DS Circuit Breaker (Vertical Primary Connection) (Inches)

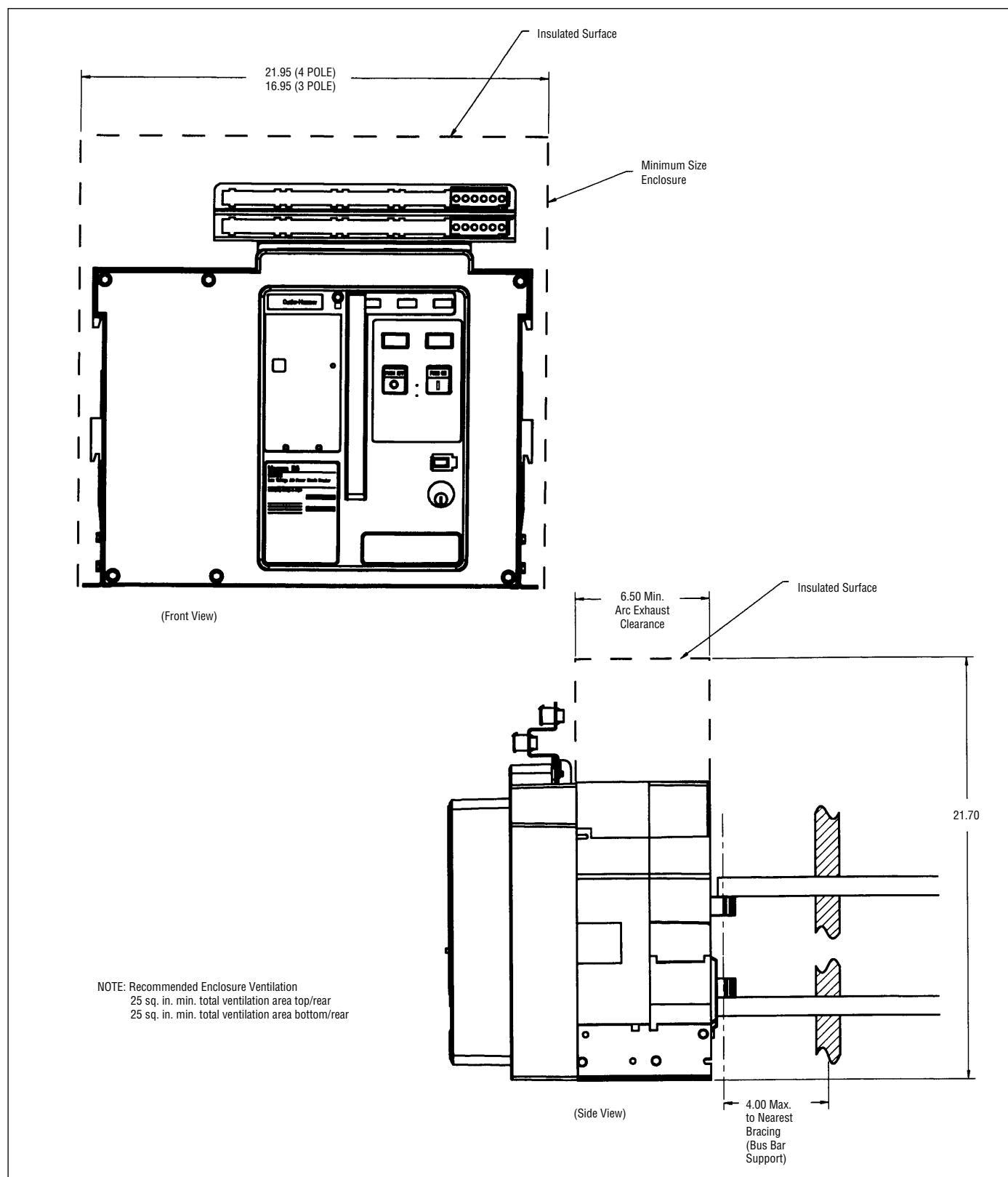


Figure 5-8 Fixed 3200 Amp Magnum DS Circuit Breaker (Enclosure/Ventilation) (Inches)

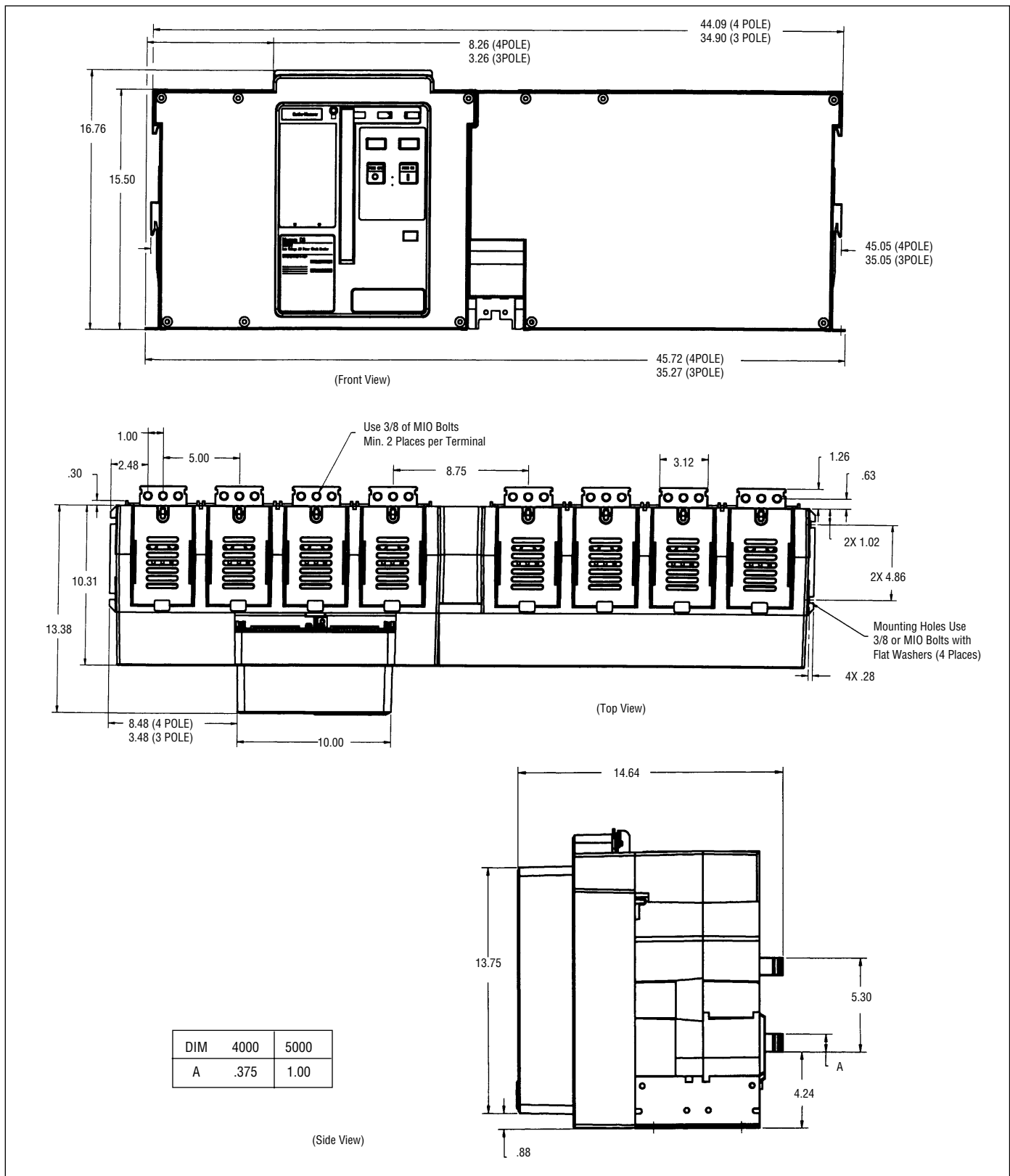


Figure 5-9 Fixed 4000/5000 Amp Magnum DS Circuit Breaker (Horizontal Primary Connection) (Inches)

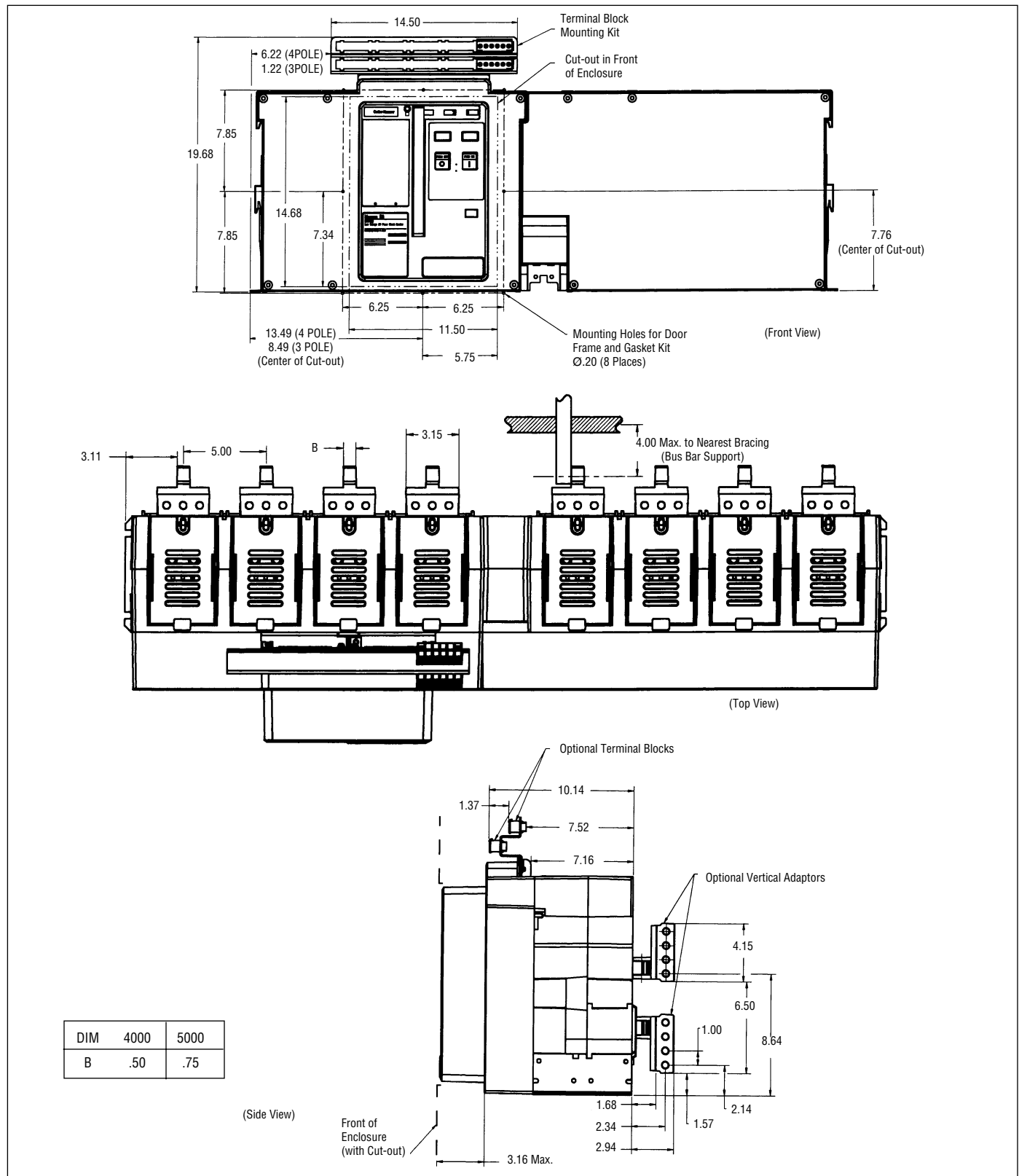


Figure 5-10 Fixed 4000/5000 Amp Magnum DS Circuit Breaker (Vertical Primary Connection) (Inches)

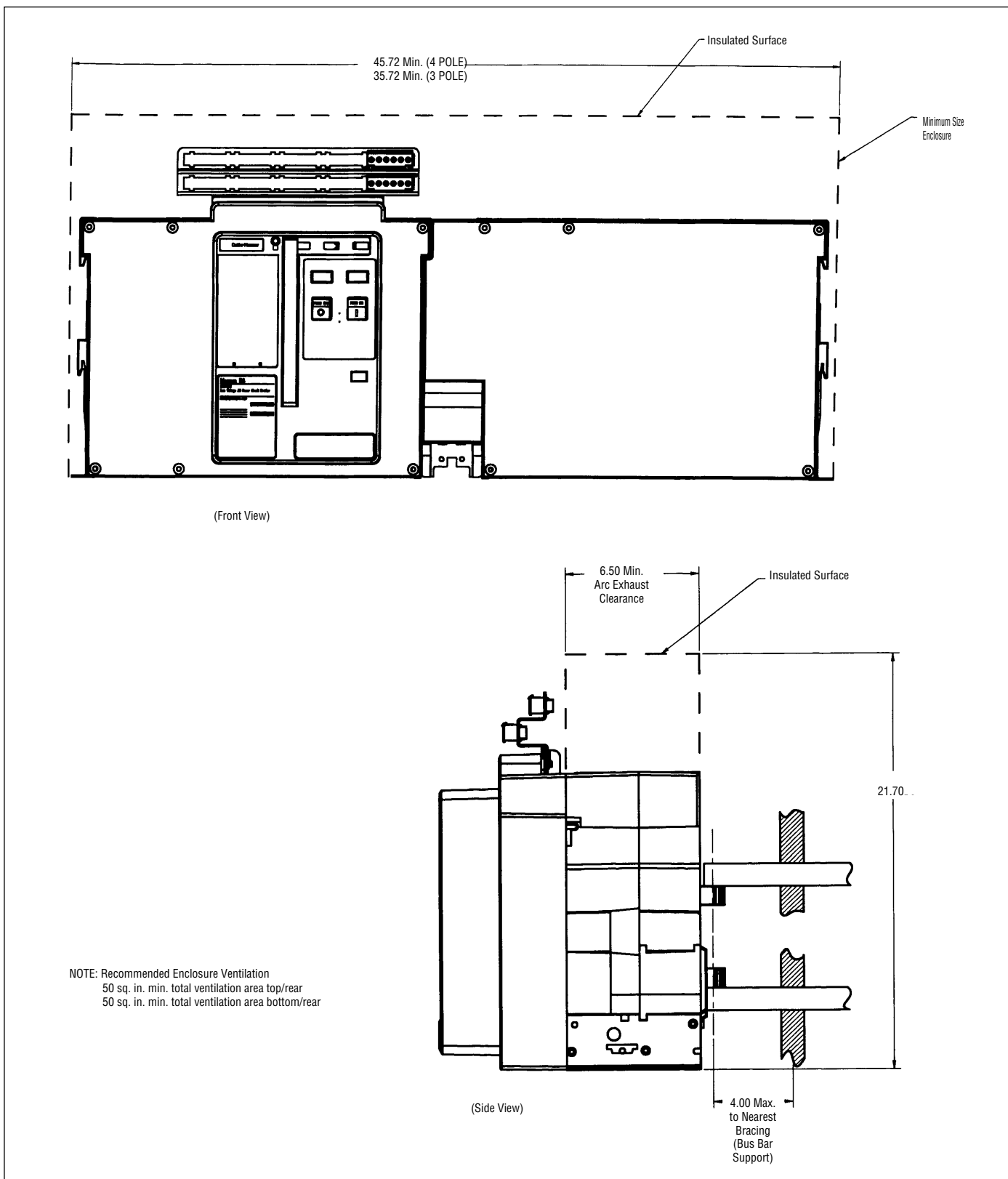


Figure 5-11 Fixed 4000/5000 Amp Magnum DS Circuit Breaker (Enclosure/Ventilation) (Inches)

Section 6: INSPECTION AND MAINTENANCE

6-1 GENERAL



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.



CAUTION

INSPECTION AND MAINTENANCE PROCEDURES SHOULD BE CARRIED OUT ONLY BY PERSONNEL FAMILIAR WITH THE HAZARDS ASSOCIATED WITH WORKING ON POWER CIRCUIT BREAKERS. ADDITIONALLY, THEY SHOULD BECOME FAMILIAR WITH THE SPECIFICS ASSOCIATED WITH TYPE MAGNUM DS CIRCUIT BREAKERS AS PRESENTED IN THIS INSTRUCTION BOOK.

Magnum 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 and with a high degree of tooling for accuracy and parts interchangeability. Design tests and actual installation experience show them to have durability well beyond minimum standards requirements. However, because of the variability of application conditions and the great dependence placed upon these circuit breakers for protection and the assurance of service continuity, inspection and maintenance activities should take place on a regularly scheduled basis.

Since maintenance of these circuit breakers consists mainly of keeping them clean, the frequency of scheduled inspection and maintenance depends to some degree on the cleanliness of the surroundings. Cleaning and preventive measures are a part of any good maintenance program. Plant operating and local conditions can vary to such an extent that the actual schedule should be tailored to the conditions. When the equipment is subject to a clean and dry environment, cleaning is not required as frequently as when the environment is humid with a significant amount of dust and other foreign matter.

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

6-2 GENERAL CLEANING RECOMMENDATIONS

Circuit breaker cleaning activities should be a 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, since dirt or foreign objects can be driven into areas, such as the breaker mechanism, where additional friction sources could create problems. Never use a wire brush to clean any part of the circuit breaker.

6-3 WHEN TO INSPECT

Do not wait for specific scheduled periods to visually inspect the equipment, if there are earlier opportunities. If possible, make a visual inspection each time a circuit breaker compartment door is opened, and especially when a circuit breaker is withdrawn on its compartment extension rails. This preventive measure could help to avoid future problems.

Industry standards for this type of equipment recommend a general inspection and lubrication after the number of operations listed in Table 6.1 of this section. This should also be conducted at the end of the first six months of service, if the number of operations has not been reached.

Table 6.1 Inspection Frequency

Breaker Frame Size	Interval ^① (Breaker Cycles)
800 amperes and below	1750
Between 800 and 3000 amperes	500
3000 amperes and above	250

① Breaker Cycle = one no load open/close operation

After the first inspection, inspect at least once a year. If these recommended inspections show no maintenance requirements, the period may be extended to a more economical point. Conversely, if the recommended inspection shows, for instance, a heavy accumulation of dirt or other foreign matter that might cause mechanical, insulation or other electrical damage, the inspection and maintenance interval should be decreased.

6-4 WHAT TO INSPECT

What to inspect and to what extent is dictated by the nature of the maintenance function. Routine inspections require one type of observation. Inspections following a known high level fault require more detailed inspections.

A drawout type circuit breaker should first be withdrawn from its compartment onto the compartment's extension rails. When the inspection is complete, the circuit breaker can be levered to the TEST position to check the electrical operations of the circuit breaker. During the levering out and levering in of the circuit breaker, be aware for any signs that would indicate that this process is not working properly.

During the inspection of fixed type circuit breakers, bus systems supplying the fixed circuit breakers **should be de-energized** for convenience and safety.

For functional testing of the trip unit, refer to the separate detailed instruction book dedicated to the trip unit.

Once the circuit breaker has been cleaned as described in paragraph 6-2, visually inspect it for any signs of damage, missing or loose parts and unusual wear. Be especially alert for foreign matter that must be removed. On drawout circuit breakers, inspect the primary disconnect finger clusters for signs of wear and erosion. Make appropriate corrections to anything found out of order.

6-4.1 ARC CHUTE INSPECTION

When a circuit breaker experiences a high level fault or during regularly scheduled maintenance periods, the circuit breaker's arc chutes and arc chambers should be inspected for any kind of damage or dirt. Be especially alert for signs of significant erosion of the V-shaped plates inside the arc chute.

Arc chutes fit inside the arc chambers and down over a the primary contacts. Each arc chute is held in place by one top inserted screw (Figure 6-1). Begin by removing the arc chute screws and all three arc chutes.

Turn each arc chute upside down to visually inspect the inside (Figure 6-2).

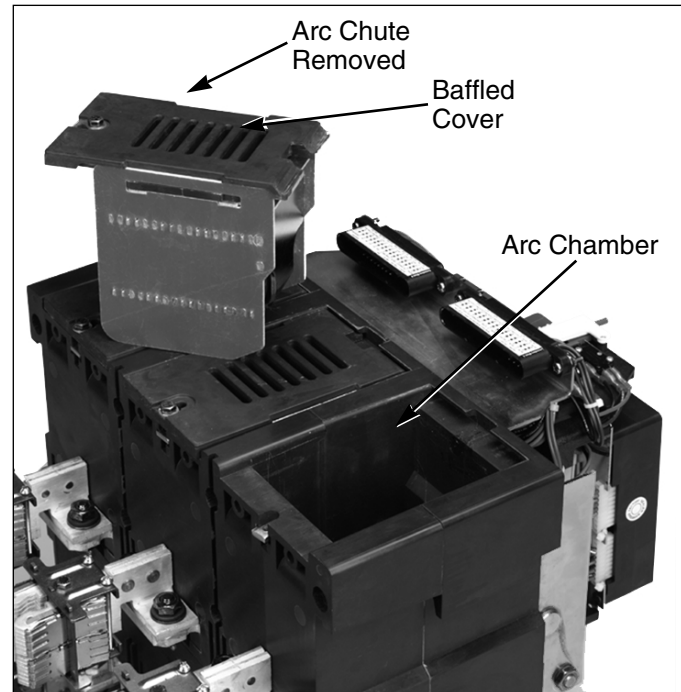


Figure 6-1 Top Rear View of Circuit Breaker with One Arc Chute Removed



Figure 6-2 Bottom View of Arc Chute

Since the arc chutes are removed, this is an ideal time to inspect primary contacts for wear using the circuit breaker's contact wear indicators. The details associated with primary contact inspection are presented in the next paragraph.

**WARNING**

ARC CHUTES MUST ALWAYS BE SECURED PROPERLY IN PLACE BEFORE A CIRCUIT BREAKER IS INSTALLED IN A CIRCUIT BREAKER COMPARTMENT. FAILURE TO DO THIS COULD RESULT IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

When the inspections are complete, position each arc chute down over its respective set of primary contacts, and secure in place with the screw removed earlier. Torque the arc chute screws to 35 to 45 in-lb.

6-4.2 PRIMARY CONTACT INSPECTION

With the arc chutes removed, visually inspect each primary contact structure for signs of wear and/or damage. The primary contacts with the circuit breaker open can be viewed by looking directly down into the arc chamber (Figure 6-3 and 6-4).

A contact wear indicator is provided for each primary contact and indicates whether or not the contact should be replaced. Inspection of the contacts using the contact wear indicators is conducted **only with the circuit breaker closed** (Figure 6-5).

NOTICE

When making a contact wear inspection, always make the inspection by looking straight down into the arc chamber for the proper perspective. Viewing the contact wear area from an angle could distort the view.

The contact wear indicator is the relative position of the individual contact fingers to a narrow, side-to-side ledge inside the arc chamber. The ledge is actually part of the arc chamber. When the circuit breaker is closed and the contacts are in good condition, the narrow ledge is covered by the back end of the contacts (Figure 6-5). If the back end of the contacts do not totally cover the ledge, the contacts should be replaced.



Figure 6-3 Primary Contacts with Circuit Breaker Open (Not Used for Contact Wear Inspection)

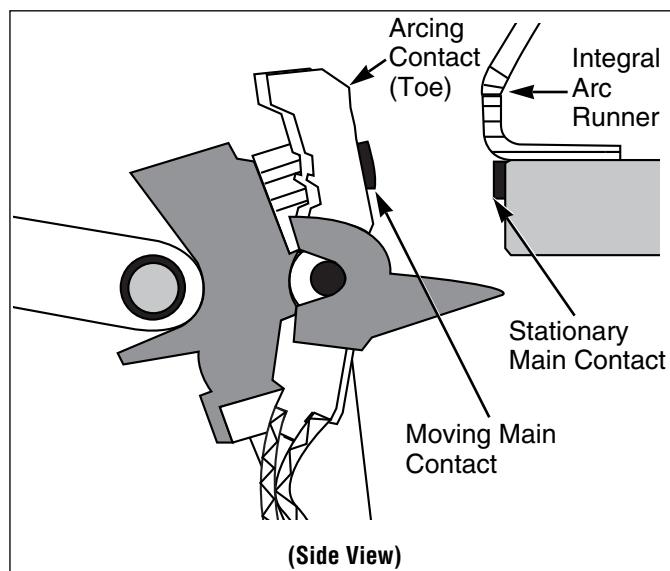


Figure 6-4 Contact Inspection Area with Circuit Breaker Open



WARNING

ARC CHUTES MUST ALWAYS BE SECURED PROPERLY BEFORE A CIRCUIT BREAKER IS INSTALLED IN A CIRCUIT BREAKER COMPARTMENT. FAILURE TO DO THIS COULD RESULT IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

Once the inspection is complete, be sure the arc chutes are properly replaced as previously described in paragraph 6-4.1.

6-5 CIRCUIT BREAKER MODIFICATIONS AND CHANGES

The topics discussed here will relate to those actions that can be taken in the field to change, update, maintain or repair a Magnum DS circuit breaker. This information does not, however, include most accessory devices. Their installation is covered by separate instruction leaflets dedicated to the individual devices. The tasks described here do not, under ordinary circumstances, require any assistance beyond the appropriate instructional material. If further assistance is required, however, contact your Cutler-Hammer representative.

6-5.1 RATING PLUG REPLACEMENT

NOTICE

If a rating plug is not installed in the trip unit, the trip unit will trip when energized. Also remember that the trip unit's rating plug and the circuit breaker's current sensors must have matching ratings.

To remove the rating plug from the trip, open the small rating plug door located on the right side of the trip unit (Figure 6-6). The trip unit's battery cavity is also located behind this door. Use a 1/8" wide screwdriver to remove the M4 screw holding the rating plug in position. Pull the door to release the rating plug from the trip unit.

To install a new rating plug, insert the rating plug into the cavity where the other rating plug was removed. Make sure the three pins on the rating plug are aligned with the sockets in the cavity. The rating plug should fit with a slight insertion force.

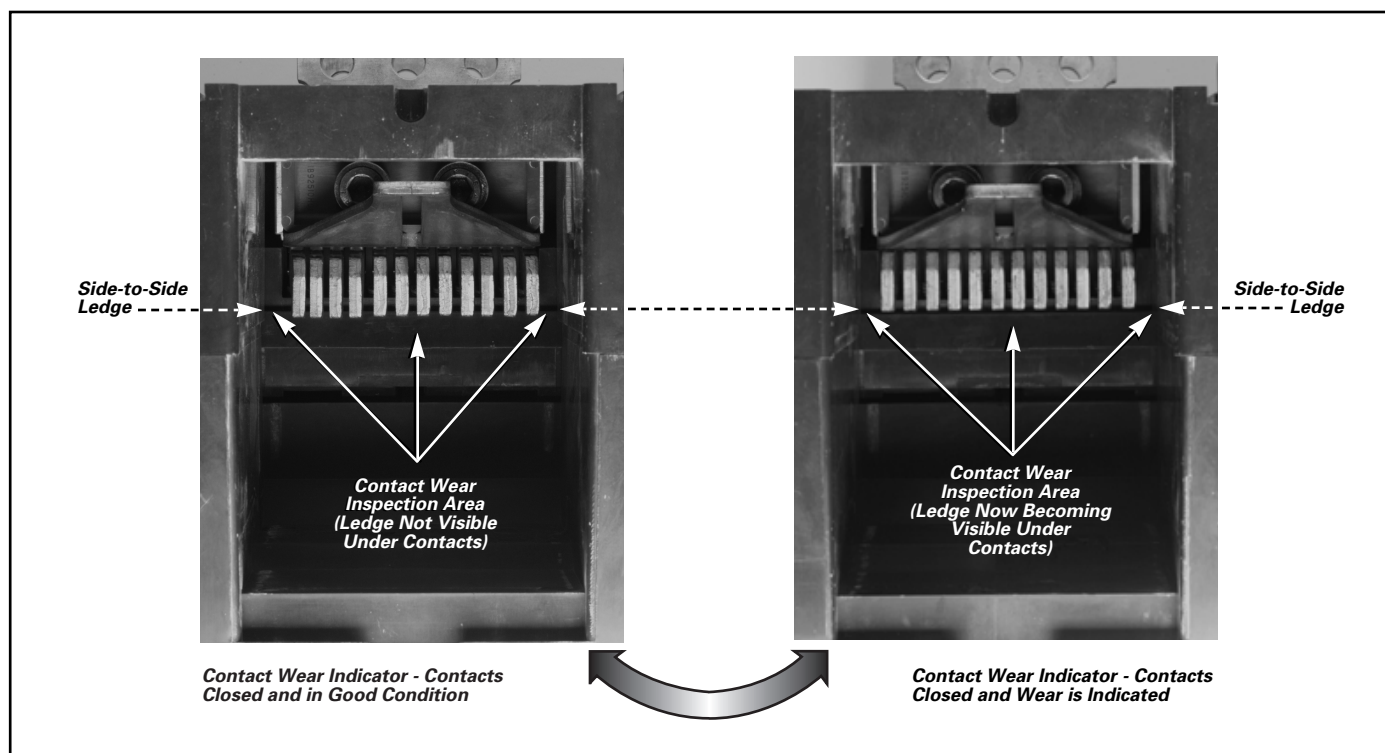


Figure 6-5 Use of Contact Wear Indicator with Circuit Breaker Closed



Figure 6-6 Trip Unit Rating Plug Location

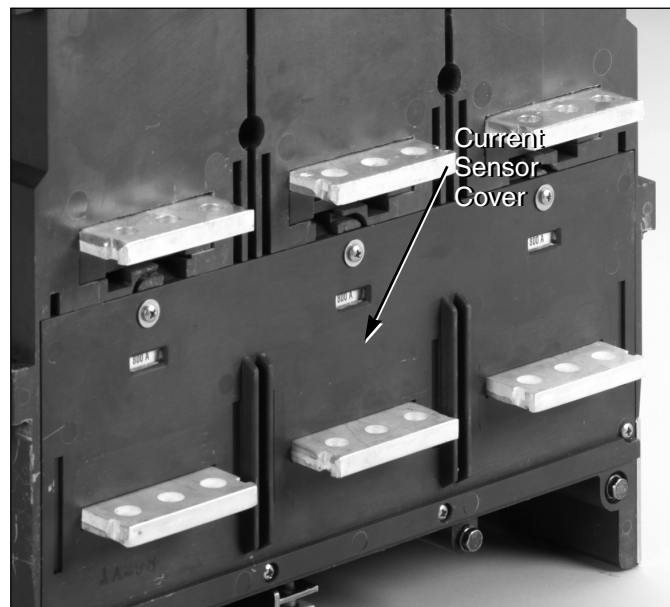


Figure 6-7 Current Sensor Cover in Place Over Sensors

**CAUTION**

TO PREVENT DAMAGE TO THE RATING PLUG, DO NOT FORCE IT INTO THE MOUNTING CAVITY.

Use the same 1/8" screwdriver to tighten the M4 screw and secure the rating plug in the trip unit. The maximum torque on the mounting screw is 15 in-oz. Close the rating plug door.

6-5.2 CURRENT SENSOR REPLACEMENT**NOTICE**

Remember that the trip unit's rating plug and the circuit breaker's current sensors must have matching ratings.

The three current sensors are installed at the rear of the circuit breaker on the lower terminals. A cover with sensor rating viewing windows covers the sensors and is held in place with screws (Figure 6-7). Remove the cover by removing the screws.

If the circuit breaker is a drawout configuration, the lower primary disconnect finger clusters and the vertical adaptors must first be removed from frame sizes up to 3000/3200A. On the 3000/3200A frame, both the upper

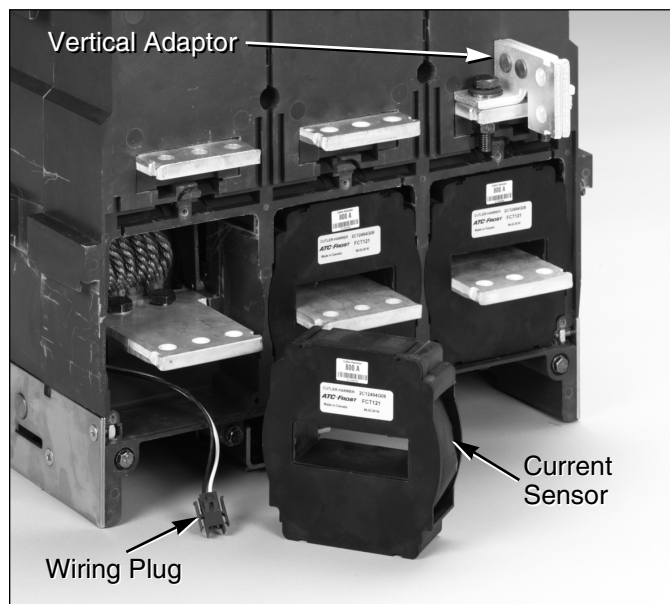


Figure 6-8 One Current Sensor Shown Removed and Disconnected

and lower primary disconnects and vertical adaptors must be removed. Each primary disconnect finger cluster is removed by loosening the two hex-head bolts with a 10 mm wrench (Figure 3-1). These bolts do not have to be completely removed to slide the primary disconnects off of the terminals. Remove the vertical adaptors next from the circuit breaker terminals by removing the two or three 10 mm bolts holding them in place (Figure 6-8).

The current sensors are removed by pulling them off of the terminals and unplugging the wiring plugs from the sensors (Figure 6-8).

Install new current sensors by connecting the wiring plugs to the sensors and sliding the sensors over the terminals. Reinstall the cover over the sensors and secure in place with the screws previously removed.

Reinstall the previously removed vertical adaptors to the terminals using the removed hardware and 40 ft-lb of tightening torque. Make sure the vertical adaptors are square to the rear housing. Slip the primary disconnects on to the vertical adaptors. Make sure the primary disconnects are fully inserted on to the vertical adaptors. Tighten the two retention bolts to 40 in-oz of torque. Properly engaged and secured retention bolts should engage the slots or holes in the vertical adaptors.

SECTION 7: TROUBLESHOOTING

7-1 INTRODUCTION

Table 7.1 will help to determine the probable causes of simple circuit breaker problems and possible corrective actions. Possible problems associated with the electronic trip unit are covered in a companion publication, I.L. 70C10337H01. If the problem cannot be resolved with the aid of one or both of these guides, contact the Cutler-Hammer service center for more in-depth assistance.

Table 7.1 Circuit Breaker Troubleshooting Guide (continued on next page)

Symptom	Probable Cause	Corrective Actions
The circuit breaker <i>trips</i> open (red fault trip indicator button is <i>out</i> and/or fault indicator LED is <i>lighted</i>) when closed on a load current	Rating plug not installed and load current through the breaker	Install rating plug that corresponds to current sensors
	Repeated closing on transient (in-rush) current with thermal memory active	Wait for circuit breaker (and loads) to cool before re-closing
	An overload or fault current condition	Use status and fault indicators to help locate and remove overload or fault condition
Circuit breaker <i>opens</i> (fault trip indicator button is <i>not</i> out)	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 Cutler-Hammer service center

Table 7.1 Circuit Breaker Troubleshooting Guide (continued from previous page)

Symptom	Probable Cause	Corrective Actions
Circuit breaker cannot be opened remotely, but can be opened locally	Shunt trip control signal absent or too low	Check supply voltage exceeds 70% of rated voltage 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 main contacts welded	Contact Cutler-Hammer 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
	Drawout position interlock is operating; levering screw	Make sure that circuit breaker is at a position that permits closure; door is <i>open</i> check that shutter (door) over the levering screw is fully closed
	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 7.1 Circuit Breaker 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
	Spring release closing coil signal blocked	Clear Digitrip 1150 relay contact
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 (<85%)	Check charging motor electrical circuit voltage (check under load)
	Charging motor faulty	Replace charging motor assembly
Drawout circuit breaker will not lever-in	Circuit breaker will not fully enter cell (cell rejection code plate)	Circuit breaker ratings do not correspond to the cassette requirements
	Levering-in screw not in fully DISCONNECT position at insertion	Rotate levering-in screw counterclockwise to DISCONNECT position, then insert breaker fully into cassette
	Levering-in screw in DISCONNECT position but not pushed in far enough	Push circuit breaker in as far it will go, cover should be flush with front of cassette side plate
	Protective boots covering stationary disconnects	Remove boots
	Shutter jammed or locked	Clear problem

SECTION 8: RENEWAL PARTS

8-1 GENERAL

All renewal parts and/or spare parts recommendations for Type Magnum DS Circuit Breakers are supplied in separate Renewal Parts Documentation, not this instruction manual. Refer to the most recent version of this documentation for specific assistance.

When ordering parts, always specify, if known, the part name and style number. If the style number is not known, it would help to refer to a pictorial and/or graphic reference. Also include the circuit breaker type, General Order number and other information as shown on the nameplate on the front cover of the circuit breaker (Figures 1-2 and 3-4).

Some detailed parts shown in the figures in this manual may only be available as a part of a sub-assembly. Certain parts may not be available at all for field installation. Some parts in the figures are illustrated just to show their function and location in the assembly. The Renewal Parts Documentation indicates which parts are available and in what form. For additional information, visit the Cutler-Hammer website at www.cutlerhammer.eaton.com

This instruction booklet is published solely for information purposes and should not be considered all inclusive. If further information is required, you should consult Cutler-Hammer.

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