

# Three-Phase Switches

Service Information

## Automated M-Force Switch Installation and Operation Instructions

# S260-80-1



Figure 1.  
Automated M-Force switch.

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## SAFETY FOR LIFE



Cooper Power Systems products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cooper Power Systems employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment and support our “Safety For Life” mission.

## SAFETY INFORMATION

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

### Hazard Statement Definitions

This manual may contain four types of hazard statements:

**DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

**WARNING:** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**CAUTION:** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

**CAUTION:** Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

### Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

**DANGER:** Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment. G103.3

**WARNING:** Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage. G101.0

**WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage. G102.1

**WARNING:** Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install, or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage. G122.3

## PRODUCT INFORMATION

### Introduction

Service Information S260-80-1 provides installation and operation instructions for the Automated M-Force three-phase overhead loadbreak switch.

### Read This Manual First

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment.

For additional reference information on the Automated M-Force switch, refer to the following document:

*S260-80-2 iMC Switch Control Installation Instructions*

### Additional Information

These instructions cannot cover all details or variations in the equipment, procedures, or processes described, nor provide directions for meeting every possible contingency during installation, operation or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, contact your Cooper Power Systems sales representative

### Quality Standards

ISO 9001:2000-Certified Quality Management System

### Acceptance and Initial Inspection

Each switch is completely assembled, inspected, tested, and adjusted at the factory. It is in good condition when accepted by the carrier for shipment. Upon receipt of a switch, inspect the switch thoroughly for damage and loss of parts incurred during shipment. If damage or loss is discovered, file a claim with the carrier immediately.

### Handling and Storage

Be careful during handling and storage of the switch to minimize the possibility of damage.

If the switch is to be stored for an appreciable time before installation, provide a clean, dry storage area. Locate the switch so as to minimize the possibility of mechanical damage.

### Description of Operation

The Automated M-Force switch is a distribution class, gang operated, and factory unitized three-phase overhead loadbreak switch, offered in distribution voltage classifications of 15kV and 27kV. The Automated M-Force Switch may be used for line sectionalizing, paralleling, by-passing, and isolating or as a remote system when used in conjunction with a motor operator. M-Force stands for "magnetic force." Cooper Power Systems has reverse loop contacts found on distribution class sidebreak switches; a contact usually reserved for transmission switches. The reverse loop contacts utilize high current magnetic forces for added reliability. The reverse loop design allows for high contact pressure to be maintained during fault conditions. This feature prevents pitting and distorting of the switch blade and contacts even under momentary overload.

## RATINGS AND SPECIFICATIONS

### Check Switch Ratings Prior to Installation

The switch must be applied within its specified ratings. Check nameplate ratings and compare with the system characteristics at the point of application prior to installation.

**TABLE 1**  
Electrical Characteristics

	Max	BIL	Cont. Current	Loadbreak	Momentary**	3 Second	Fault Close (Asm)
15 kV	17 kV	110 kV	600 A*	50 @ 600 A, 10 @ 900 A	40 kA Asy. rms	25 kA Sym. rms	1 @ 20 kA, 3 @ 15 kA
27 kV	29 kV	150 kV	600 A*	50 @ 600 A, 10 @ 900 A	40 kA Asy. rms	25 kA Sym. rms	1 @ 20 kA, 3 @ 15 kA

\* 900 A optional.

\*\* Momentary peak current is 65 kA.

## DIMENSIONS AND WEIGHTS

### Shipping Weights and Dimensions

The shipping weights as specified in Table 2 include the 2.25" bolt hole circle cycloaliphatic epoxy insulators for 15 and 27 kV ratings. For alternate silicone or porcelain insulators, refer to Table 3 for change in weight.

**TABLE 2**  
Automated M-Force Switch Shipping Weights and Dimensions

	Voltage Class	15 kV		27 kV	
	Crossarm	Steel	Fiberglass	Steel	Fiberglass
Horizontal Upright	Crate L" x W" x H"	94" x 27" x 34"	94" x 27" x 34"	104" x 30" x 38"	104" x 30" x 38"
	Weight	510 lbs.	476 lbs.	548 lbs.	514 lbs.
Horizontal Pole Top	Crate L" x W" x H"	94" x 27" x 34"	94" x 27" x 34"	94" x 27" x 34"	94" x 27" x 34"
	Weight	506 lbs.	472 lbs.	544 lbs.	510 lbs.
Triangular	Crate L" x W" x H"	93" x 27" x 73"	94" x 27" x 73"	93" x 30" x 73"	93" x 30" x 73"
	Weight	600 lbs.	566 lbs.	638 lbs.	604 lbs.

Note: G095 spacing and special switch options will cause slight variations.

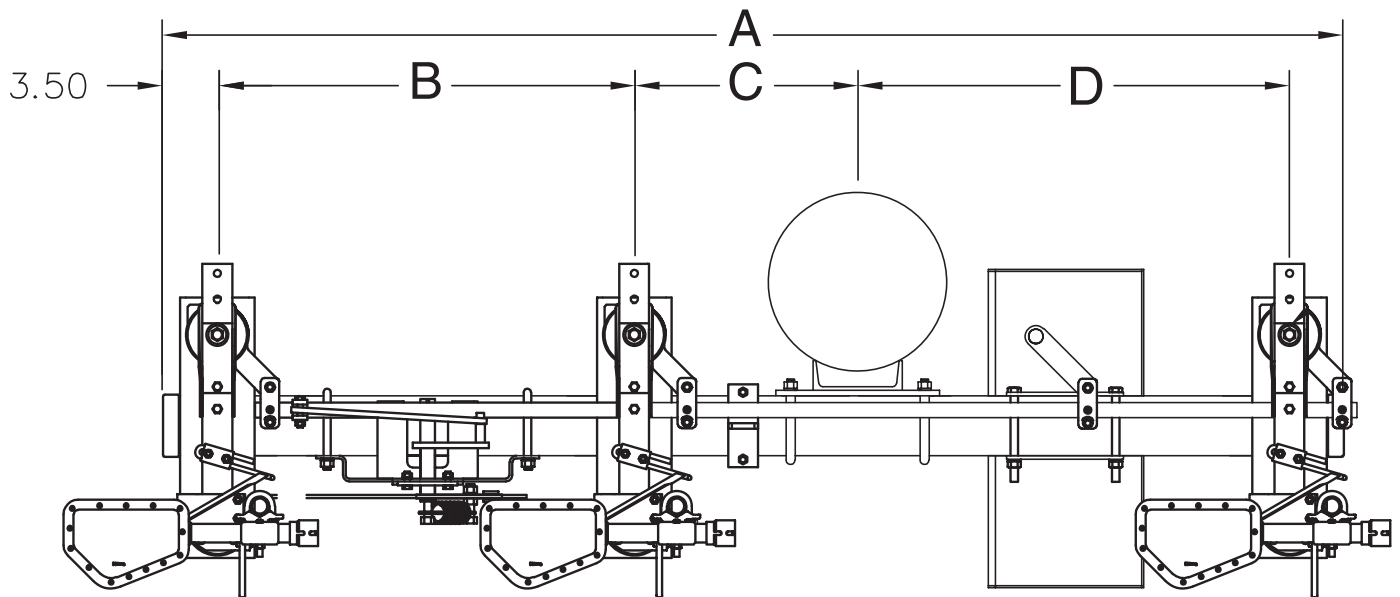
**TABLE 3**  
Insulator Material Weight Adders

	15 kV		27 kV	
	2.25" B.C.	3.00" B.C.	2.25" B.C.	3.00" B.C.
Epoxy Insulators	Standard	32 lbs.	Standard	0 lbs.
Silicone Insulators	N/A	5 lbs.	N/A	(0 lbs.)*
Porcelain Insulators	45 lbs.	105 lbs.	0 lbs.	0 lbs.

\* ( ) Brackets denote reduction in weight from standard.

## Automated M-Force Switch Configurations

The Automated M-Force switch configurations include horizontal, horizontal pole-top or triangular. Refer to the corresponding Figures 2 through 5 for a specific configuration and refer to the Table below for dimensional information.



### Dimensional information

Dim.	Horizontal Upright			
	Standard		GO-95	
	15kV	27kV	15kV	27kV
A	2007 mm (79")	2235 mm (88")	2464 mm (97")	2742 mm (108")
B	711 mm (28")	838 mm (33")	711 mm (28")	838 mm (33")
C	381 mm (15")	381 mm (15")	610 mm (24")	610 mm (24")
D	737 mm (29")	838 mm (33")	965 mm (38")	1105 mm (43.5")
E	N/A	N/A	N/A	N/A
F	324 mm (12.75")	390 mm (15.37")	324 mm (12.75")	390 mm (15.37")
G	762 mm (30")	828 mm (32.6")	762 mm (30")	828 mm (32.6")

Note: Dimensions, given in mm (in), are approximate.

**Figure 2.**  
Horizontal switch configuration (top view).

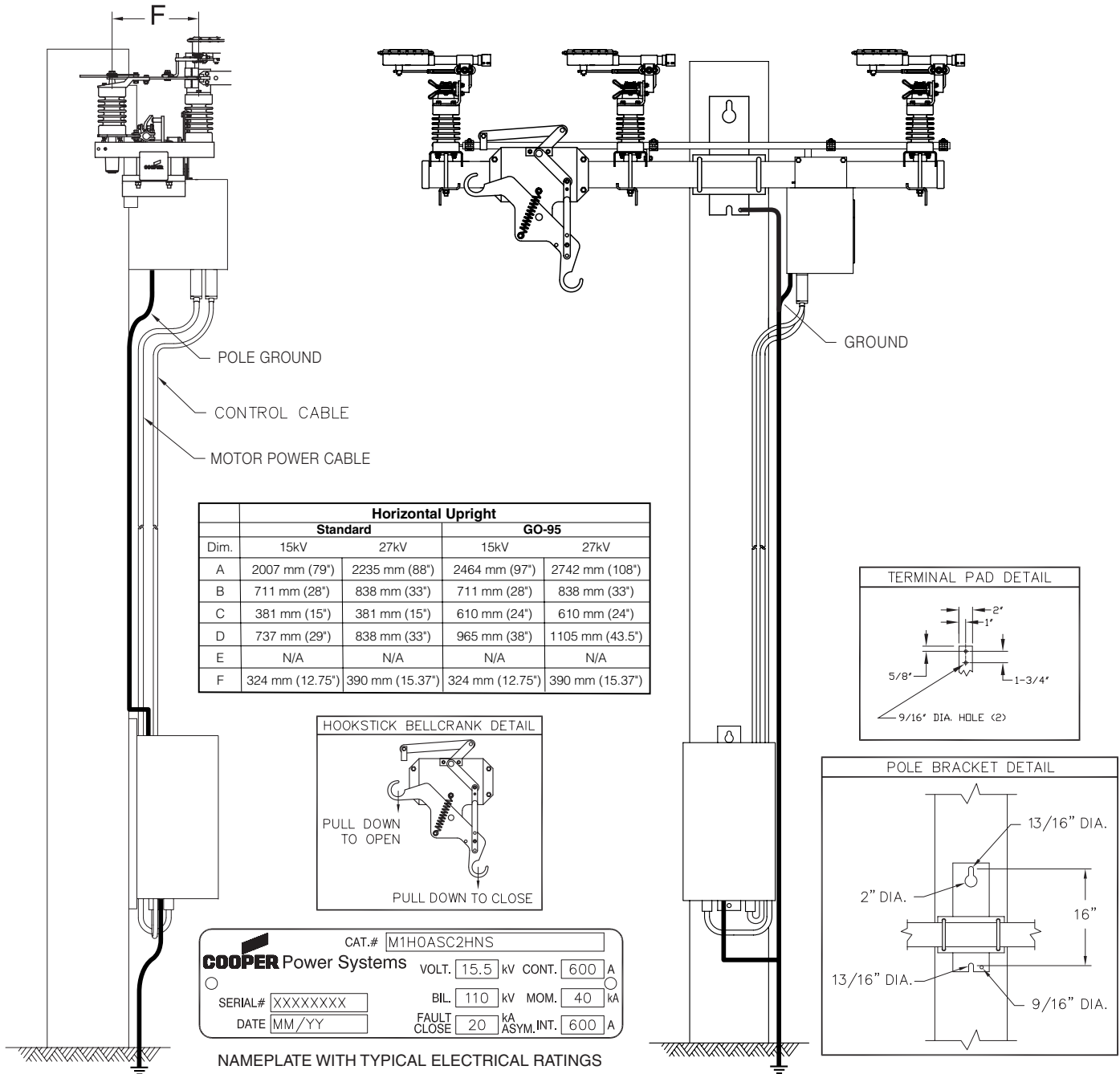
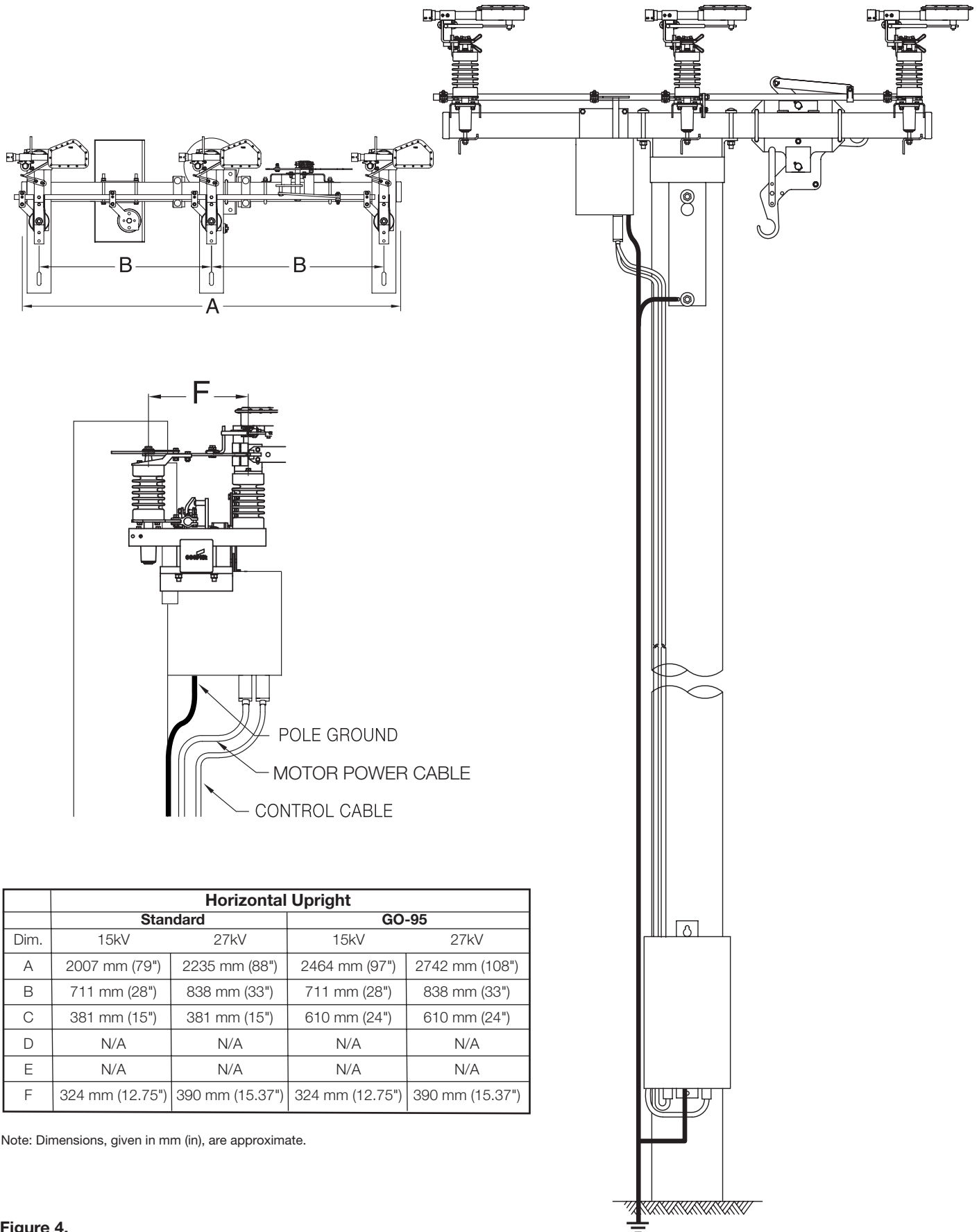


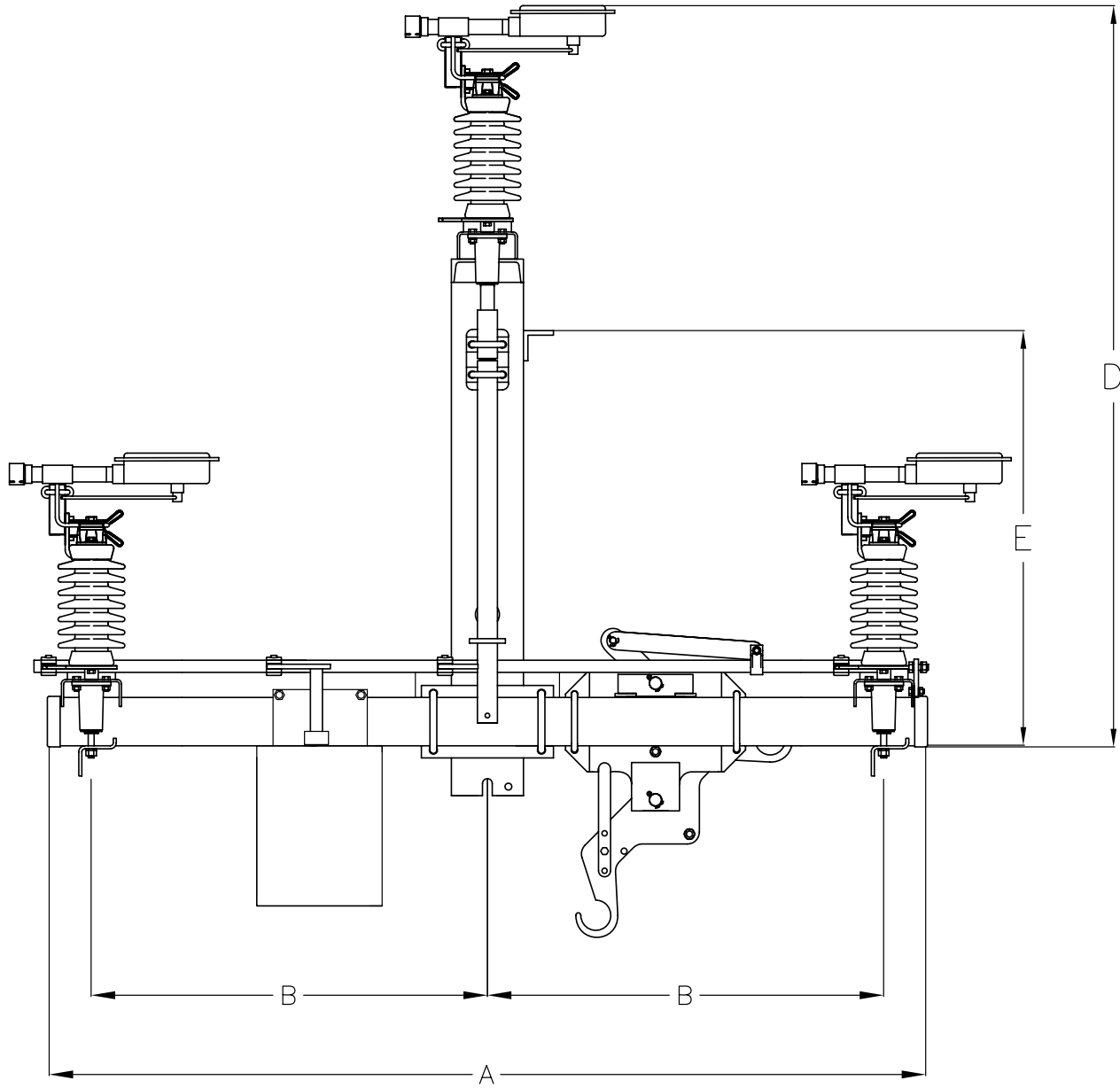
Figure 3. Horizontal upright switch configuration with detailed view.



Dim.	Horizontal Upright			
	Standard		GO-95	
	15kV	27kV	15kV	27kV
A	2007 mm (79")	2235 mm (88")	2464 mm (97")	2742 mm (108")
B	711 mm (28")	838 mm (33")	711 mm (28")	838 mm (33")
C	381 mm (15")	381 mm (15")	610 mm (24")	610 mm (24")
D	N/A	N/A	N/A	N/A
E	N/A	N/A	N/A	N/A
F	324 mm (12.75")	390 mm (15.37")	324 mm (12.75")	390 mm (15.37")

Note: Dimensions, given in mm (in), are approximate.

**Figure 4.**  
Horizontal pole-top switch configuration.



**Dimensional information**

Dim.	Triangular	
	15kV	27kV
A	1549 mm (61")	1854 mm (73")
B	686 mm (27")	838 mm (33")
C	N/A	N/A
D	1473 mm (58")	1549 mm (61")
E	864 mm (34")	864 mm (34")
F	324 mm (12.57")	390 mm (15.37")

Note: Dimensions, given in mm (in), are approximate.

**Figure 5.**  
**Triangular switch configuration.**



### Phase Units

Each phase unit shall be secured to the crossarm with locking spacers to eliminate distortion of the phase unit base. Dead-end brackets shall incorporate locking tabs that will eliminate movement under side forces present when conductor is dead-ended at an angle.

Refer to Figure 6, and Table 4 for Phase Unit dimensions. The switch shall be capable of opening or closing under a 3/8" ice layer without ice shields. The switch shall be capable of opening or closing under a 3/4" ice layer with ice shields.

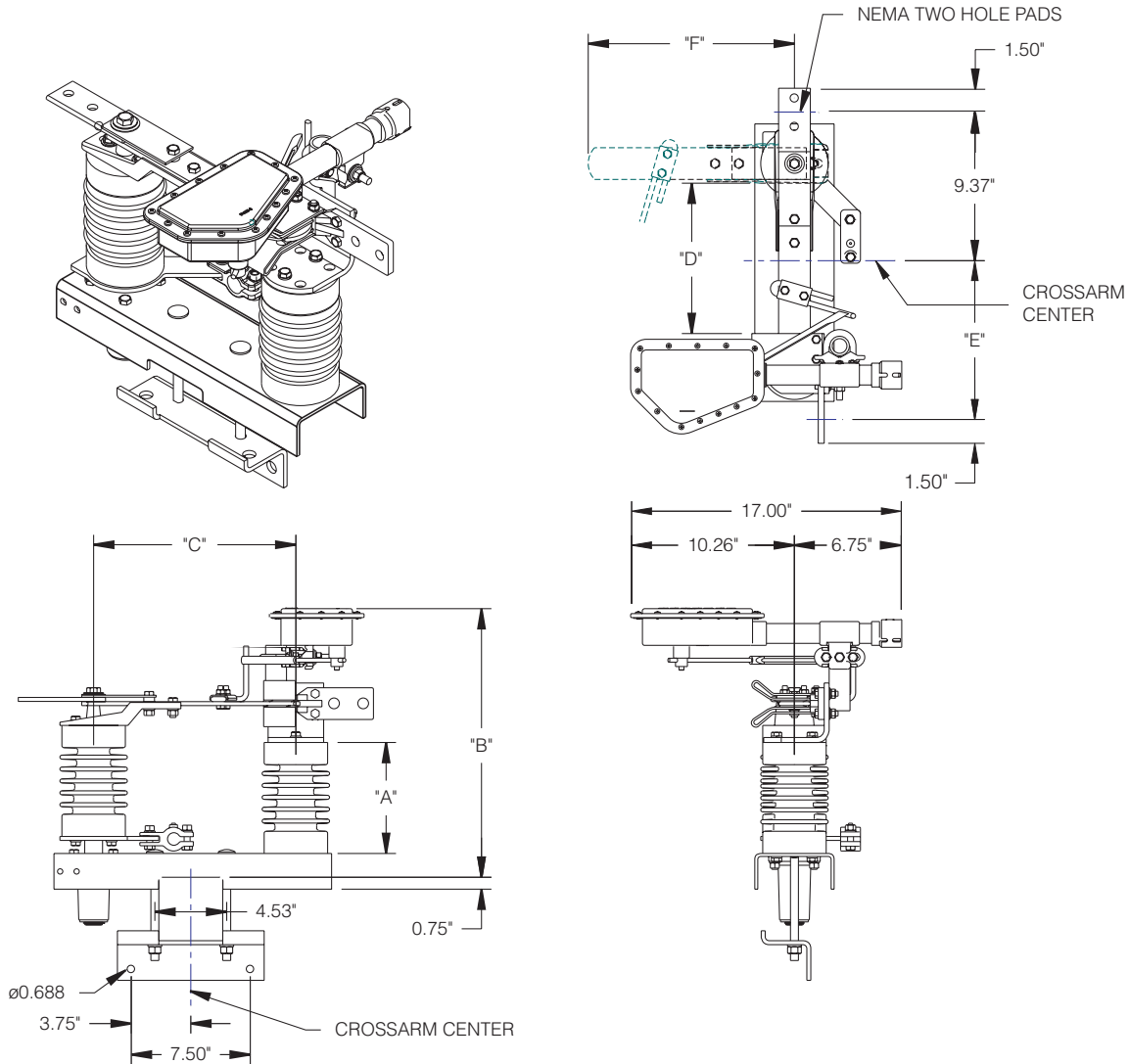


Figure 6. Phase unit for the Automated M-Force switch.

TABLE 4 Phase Unit Dimensions

Dim.	Voltage Class Insulator Material	15 kV		27 kV	
		57 mm (2.25") B.C.	76 mm (3.00") B.C.	57 mm (2.25") B.C.	76 mm (3.00") B.C.
A	Cycloaliphatic	178 mm (7.00")	216 mm (8.50")	254 mm (10")	254 mm (10")
	Porcelain	205 mm (8.00")	254 mm (10.00")	254 mm (10")	356 mm (14")
	Silicone Rubber	N/A	254 mm (10.00")	N/A	356 mm (14")
B	B = A + 254 mm (10.00")				
C		324 mm (12.75")		390 mm (15.37")	
D		241 mm (9.48")		310 mm (12.19")	
E		254 mm (10.01")		321 mm (12.63")	
F		330 mm (13.00")		397 mm (15.62")	

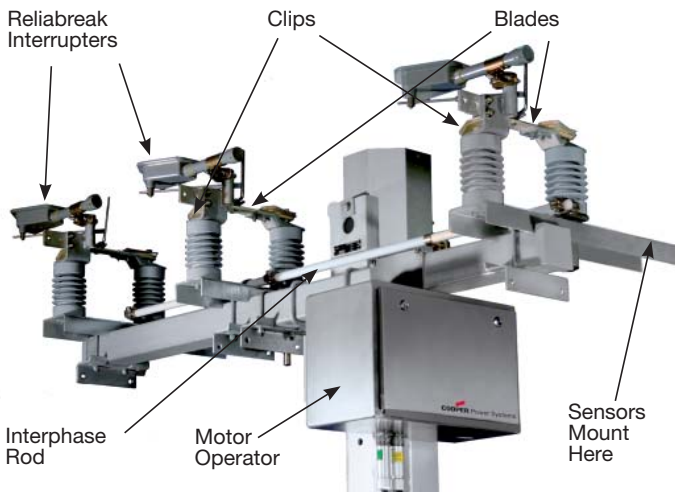
Note: Dimensions, given in mm (in), are approximate.

## INSTALLATION PROCEDURE

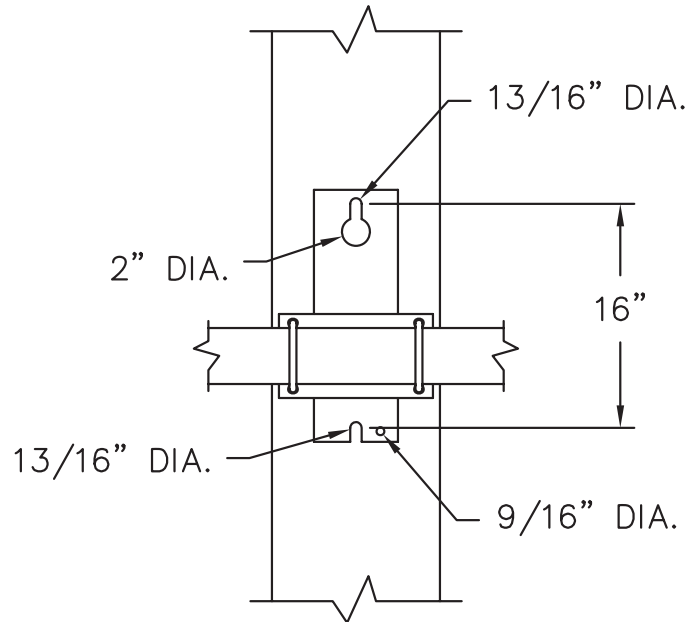
**IMPORTANT:** Do not remove factory installed wire ties holding blade to clips until switch is fully erected.

**WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage.

G102.1



**Figure 7.**  
Horizontal Automated M-Force switch.



**Figure 8.**  
Pole bracket detail.

### Mounting Instructions

1. Do not hoist by or allow lifting slings to contact switch phase unit parts.
2. Mount unitized switch to pole with  $\frac{3}{4}$ " bolts at the desired location. Refer to Figure 11 for pole bracket detail. Remove lifting straps.
3. Remove factory installed contact tie wires from phase units.
4. Slowly operate the crossarm bellcrank, inspecting for operational difficulties.
5. Ensure that there is adequate travel for the switch blades to completely engage.
6. Check all phases for full closure of all main contacts.

#### 7. Adjustment:

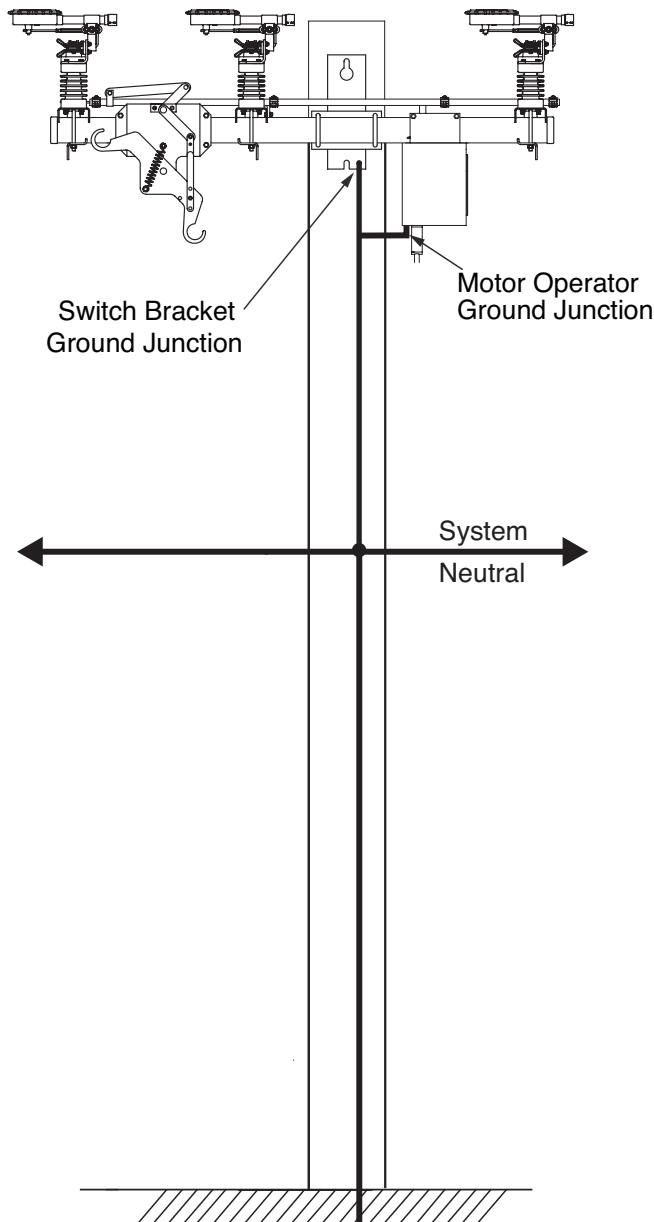
- A. If all phases require equal adjustment, loosen clamp on hotstick bellcrank extension. Adjust the inter-phase rod as required.
- B. To adjust individual phases, close the switch using a vigorous stroke and loosen the individual clamp on the rotating insulator. Fully close the subject phase and tighten the clamp to the inter-phase rod.

#### 8. Repeat Steps 6 and 7 until the following conditions exist:

- A. When the switch is closed and the hotstick operator is in the locked position, all contacts are fully closed.
- B. When the switch is opened and the hotstick operator is in the locked position, all switch contacts are parallel with the crossarm.

## Grounding the Automated M-Force Switch

Use your local operating practices when installing the M-Force Switch. The Pole Mounting bracket has a hole at the bottom of the bracket for the purpose of attaching a ground lug. The M-Force Switch may be ordered with a grounding lug, option "T".



**Figure 9.** Illustrates the recommended grounding method for the Automated M-Force Switch and Motor Operator.

## Grounding the Motor Operator

The motor operator must be grounded. A grounding connector is provided on the underside of the motor operator cabinet and will accommodate No. 14 solid through No. 4 stranded conductors.

**WARNING:** Hazardous voltage. Switch and control must be solidly grounded. Follow all locally approved procedures and safety practices when grounding this equipment. Improper grounding can result in contact with high voltage, which will cause death or severe personal injury.

G155.0

## Grounding the Control

The control must be grounded. For additional information on grounding the iMC switch control, refer to *S260-80-2 iMC Switch Control Installation Instructions*.

## SWITCH OPERATION

### Electrical Switch Operation

Refer to the Switch Operation section of Service Information S260-80-2 iMC Switch Control Instructions prior to attempting an electrical operation of the automated M-Force switch.

**WARNING:** Equipment misoperation. Never attempt to open an energized M-Force switch giving indication of a partial close operation. In this state the M-Force switch may not safely interrupt. Failure to comply can result in equipment damage and serious injury.

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### Manual Switch Operation

**WARNING:** Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury.

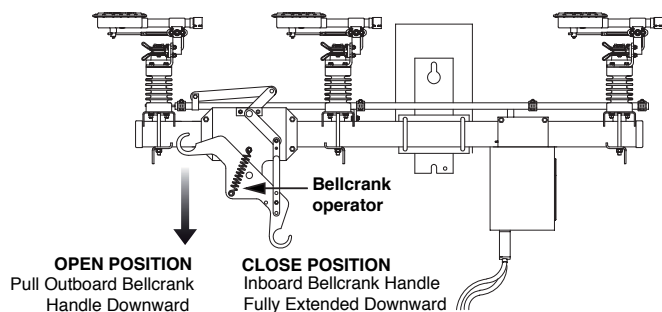
G108.1

**IMPORTANT:** The hotstick tip must be placed in the groove under the eyelet of the manual operating handle when closing the switch.

The Automated M-Force switch is opened and closed by applying downward force upon the pivoting bellcrank operator. A hotstick must always be used to operate the bellcrank operator. Follow these steps to manually open and close the Automated M-Force switch. Refer to Figure 10.

**WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage.

G102.1



**Figure 10.**  
Open and Close positions of Automated M-Force switch manual operation handles.

**WARNING:** Hazardous voltage. Do not rely on the open position of the hotstick-operated bellcrank; it does not ensure that the line has been de-energized. Always establish a visible disconnect and observe the position of the switch blades. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury.

G156.0

### Opening Switch:

- Using a hotstick, quickly and forcefully pull the outboard handle of the manual bellcrank operator downward to open the switch.

### Closing Switch:

- Using a hotstick, quickly and forcefully pull the inboard handle of the manual bellcrank operator to close the switch.

### Returning Switch to Service

**WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage.

G102.1

The following procedure must be followed to return the switch to service upon completion of in-shop service or maintenance operations.

1. Verify that any clamps loosened during the out of service period are tight.
2. Verify that ground connections to the switch, operator, and control are secure.
3. Connect control cables to the motor operator.
4. Conduct a Motor Battery Test and complete the Returning the Control to Service procedure. Refer to service information *S260-80-2 iMC Switch Control Installation Instructions*.
5. Remove any padlock or locking device that may have been attached to the hookstick operator.
6. Verify that the switch is fully open and that the OPEN SWITCH LED on the Control is illuminated.
7. Complete any procedures normally performed as part of any local Return to Service practices.
8. The switch may be returned to normal service conditions. Return control panel settings (SCADA On/Off) to desired positions.

### Motor Battery Test

The motor battery test more closely duplicates the expected load placed upon the battery. During a motor battery test, the Automated M-Force switch motor is operated for approximately one second while the motor clutch is disengaged, preventing operation of the switch blades. If the batteries are found to be at a level of health too poor to operate the motor operator, the motor inhibit function will assert accompanied by illumination of the ALARM, LOW BATTERY VOLTAGE, and MOTOR INHIBIT LEDs. The control will become inoperable until normal battery health is restored.

**Note:** To conduct a motor battery test the Automated M-Force switch control must be connected to an Automated M-Force switch or M-Force bench motor operator.

1. Press the Battery Test hot key on the front panel.
2. Using the navigational arrows keypad, navigate down to the MOTOR BATTERY TEST menu displayed in the LCD screen and press ENTER.
3. Press the F4 LCD Menu Function Key for 1 second to test the battery. The battery test results will display in the battery metering menu.

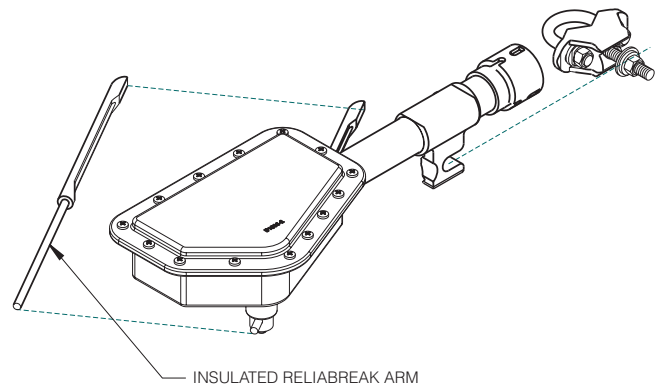
**Note:** Voltage should be between 25–31 V dc with the higher voltage at warmer temperatures.

Under normal conditions, with ac connected and a fully charged battery, the charging current should be less than 20 mA.

With ac connected and a discharged battery the current range should be 20–450 mA.

### Reliabreak Arm

The Reliabreak Pick-up Arm, as shown in Figure 11, is insulated on one side, which isolates the interrupter from the current path during a close operation. This feature allows for a wide range of adjustments between the Reliabreak Arm and the blade catch finger. This increased tolerance removes the possibility of misalignment during operation, which ensures proper load interruption.



**Figure 11.** Exploded view of Phase Unit including insulated Reliabreak Arm.

### Reliabreak Arm Adjustment

**IMPORTANT:** Whatever adjustments are done to the Reliabreak, there must be at least a 0.125 inch (3 mm) gap between the Reliabreak arm and the edge of the trip rod. When properly adjusted, a 0.125 gap is typical. (See detail in Figure 12).

1. Adjustments may be made by moving the Reliabreak arm in and out.

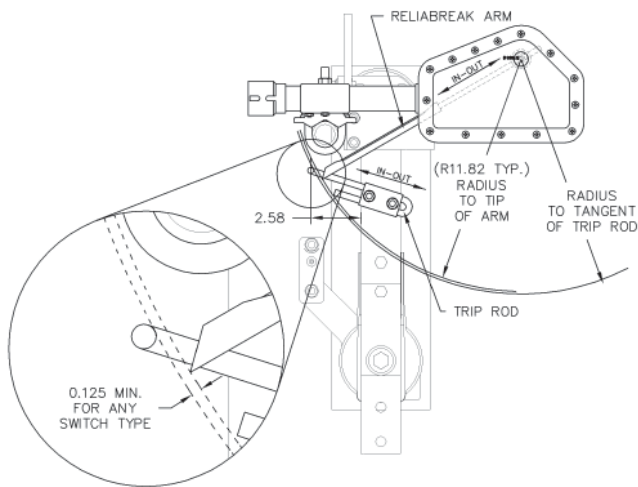
**IMPORTANT:** Do not bend Reliabreak arm. A 0.125 inch (3 mm) minimum clearance gap must be maintained.

2. When properly adjusted, the distance from the radius to the tip of the Reliabreak arm is typically 300 mm (11.82").
3. Adjustments may be made by moving the trip rod in and out.

4. When properly adjusted, the distance from the edge of the blade to the center of the trip rod is typically 66 mm (2.58").
5. The Reliabreak housing may be rotated about the mounting pipe by a maximum of 127 mm (5.0") on the Automated M-Force switch. The housing is typically perpendicular to the blade on 15 kV and 27 kV M-Force switches.

**CAUTION:** Equipment damage. Verify the Reliabreak arm is fully engaged with the trip rod during an equipment OPEN operation. Failure to comply may result in equipment damage.

T352.0



**Figure 12.**  
Reliabreak adjustment on a 15 kV M-Force switch.

## Insulators

The Automated M-Force switch comes standard with 57 mm (2.25") bolt hole circle cycloaliphatic epoxy insulators. These non-porcelain insulators offer exceptional dielectric and mechanical characteristics adding to the reliability of the Automated M-Force switch, while lowering the weight. The switch can also be provided with a 76 mm (3") bolt hole circle insulators and with alternate porcelain or silicone rubber designs.





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