



VERTICAL EXPRESS

Hollister-Whitney Rope Gripper™



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Safety Precautions

IMPORTANT!

Read this page before any work is performed on elevator equipment. The procedures contained in this manual are intended for the use of qualified elevator personnel. In the interest of your personal safety and the safety of others, do not attempt any procedure that you are not qualified to perform.

All procedures must be accomplished in accordance with the applicable rules in the latest edition of the National Electrical Code, the latest edition of ASME A17.1, and any governing local codes.

Terms in This Manual

! CAUTION

CAUTION statements identify conditions that may result in damage to the equipment or other property if improper procedures are followed.

! WARNING

WARNING statements identify conditions that may result in personal injury if improper procedures are followed.

General Safety

! CAUTION

Before applying power to the controller, check that all manufacturing wire connections are tight on relays, contactors, fuse blocks, resistors, and terminals on cards and DIN rail terminals. Connections loosened during shipment may cause damage or intermittent operation.

Other specific warnings and cautions are found where applicable and do not appear in this summary. See the *Elevator Employee Safety and Accident Prevention Program Manual* and the *Elevator Industry Field Employees' Safety Handbook* for electrical equipment safety information on installation and service.

Electrical Safety

All wiring must be in accordance with the National Electrical Code and be consistent with all state and local codes.

Use the Proper Fuse

To avoid fire hazards, use only a fuse of the correct type, voltage, and current rating. See the job specific drawings sheet (Power Supplies) for fusing information.

Electric shocks can cause personal injury or loss of life. Circuit breakers, switches, and fuses may not disconnect all power to the equipment. Always refer to the wiring diagrams. Whether the AC supply is grounded or not, high voltage will be present at many points.

Printed Circuit Cards

Printed circuit boards may be damaged if removed or installed in the circuit while applying power. Before installation and/or removing printed circuit boards, secure all power. Always store and ship printed circuit cards in separate static bags.

Mainline Disconnect

Unless otherwise directed, always Turn OFF, Lockout, and Tagout the mainline disconnect to remove power from elevator equipment. Before proceeding, confirm that the equipment is de-energized with a volt meter. Refer to the *Elevator Employees' Safety and Accident Prevention Program Manual* for the required procedure.

Electrical Safety

(continued)

- | | |
|-----------------------|---|
| Test Equipment Safety | Always refer to manufacturers' instruction book for proper test equipment operation and adjustments.

Megger or buzzer-type continuity testers can damage electronic components. Connection of devices such as voltmeters on certain low level analog circuits may degrade electronic system performance. Always use a voltmeter with a minimum impedance of 1M Ohm/Volt. A digital voltmeter is recommended. |
| When Power Is On | To avoid personal injury, do not touch exposed electrical connections or components while power is ON. |

Mechanical Safety

See the *Elevator Employees' Safety and Accident Prevention Program Manual* and the *Elevator Industry Field Employees' Safety Handbook* for mechanical equipment safety information on installation and service.

Arrival of Equipment

- | | |
|-----------|--|
| Receiving | Upon arrival of the equipment, inspect it for damage. Promptly report all visible damage to the carrier. All shipping damage claims must be filed with the carrier. |
| Storing | During storage in a warehouse or on the elevator job site, precautions should be taken to protect the equipment from dust, dirt, moisture, and temperature extremes. |

Asbestos Compliance

Vertical Express elevator personnel will no longer drill or modify any doors with asbestos containing materials (ACM) or possible asbestos containing materials (PACM). All elevator doors manufactured or installed 1980 and earlier will be treated as having ACM/PACM.

Doors with ACM/PACM should be replaced rather than modified. If replacement is not feasible, abatement modifications shall be done by a licensed asbestos abatement company. Vertical Express mechanics will safely stage the equipment for the abatement team, or remove the doors and seal them with plastic for delivery or pick up by the asbestos abatement company.

Doors manufactured or installed 1980 and earlier may be modified by Vertical Express employees if a test is conducted by a licensed asbestos company prior to work showing zero evidence of ACM/PACM.

All employees that risk exposure to asbestos will complete Vertical Express safety department approved asbestos awareness training.

All employees will stop any work that could expose them to ACM/PACM, and immediately contact their supervisor and their safety manager. All exceptions must be approved by the Director of Health and Safety.

Static Protection Guidelines

IMPORTANT!

Read this page before working with electronic circuit boards.

Elevator control systems use a number of electronic cards to control various functions of the elevator. These cards have components that are extremely sensitive to static electricity and are susceptible to damage by static discharge.

Immediate and long-term operation of an electronic-based system depends upon the proper handling and shipping of its cards. For this reason, Manufacturing bases warranty decisions on the guidelines below.

Handling

- Cards shipped from Manufacturing in separate static bags must remain in the bags until time for installation.
- Anti-static protection devices, such as wrist straps with ground wire, are required when handling circuit boards.
- Cards must not be placed on any surface without adequate static protection.
- Only handle circuit cards by their edges, and only after discharging personal static electricity to a grounding source. Do NOT touch the components or traces on the circuit card.
- Extra care must be taken when handling individual, discrete components such as EPROMS (which do not have circuit card traces and components for suppression).

Shipping

- Complete the included board discrepancy sheet.
- Any card returned to Manufacturing must be packaged in a static bag designed for the card.
- Any card returned to Manufacturing must be packaged in a shipping carton designed for the card.
- “Peanuts” and Styrofoam are unacceptable packing materials.

Failure to adhere to the above guidelines will void the card warranty!

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Overview

- Manufactured by Hollister-Whitney (HW).
- Mechanically activated, hydraulically reset.
- Grabs the elevator suspension ropes to stop the elevator in the event of a mechanical or electrical failure.
- Does not cause damage or undue stress to the ropes, machine, or traction sheave.
- Consists of two components. See Figure 1.
 - Pump Unit - Compresses the springs and opens the movable shoe on the brake unit to accommodate the elevator ropes and put the rope gripper into the ready or running position.
 - Brake Unit - Clamps the elevator ropes to stop elevator movement. A solenoid assembly holds the movable shoe in the ready position and applies the movable shoe when it receives a fault signal from the elevator controller.

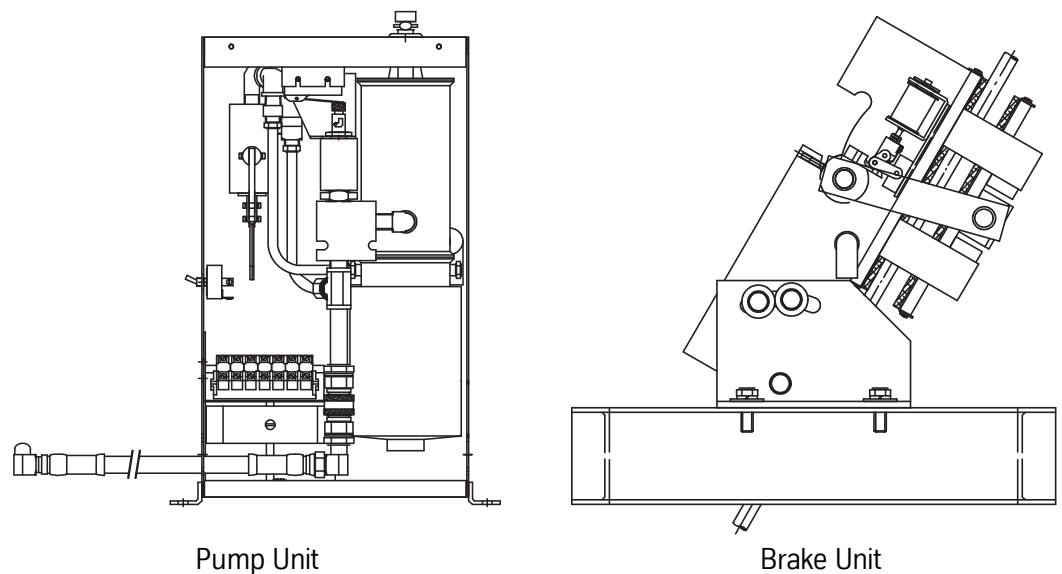


Figure 1 - Rope Gripper Components

Overview

(continued)

Hollister-Whitney (HW) recommends the following rope gripper operations:

1. Activate the rope gripper:
 - when an overspeed occurs.
 - when the car leaves the door zone with the doors open (hoistway door unlocked and car gate switch open).
 - when a power loss occurs.
2. Do not activate the rope gripper if the doors open when the car is between floors.
3. Reset the rope gripper:
 - if the car is in the door zone when power returns.
 - if the car is between floors when power returns.
 - if switching from Inspection Operation to Automatic Operation, when the car gate switch or door interlock makes contact.

Specifications

Models 8000AC1 and 8000AC2 (620 and 622)

- Pumping units may be mounted on either side of the rope gripper.
- Four $\frac{1}{2}$ " bolts are required to mount the rope gripper, and four $\frac{1}{4}$ "-20 N.C. bolts are required to mount the pumping unit.

Models 8000AC3, 8000AC4, and 8000AC5 (624, 625, and 626)

- Model 626 has one more spring and cylinder than models 624 and 625.
- Pumping units may be mounted on either side of the rope gripper.
- Four $\frac{5}{8}$ " bolts are required to mount the rope gripper, and four $\frac{1}{4}$ "-20 N.C. bolts are required to mount the pumping unit.

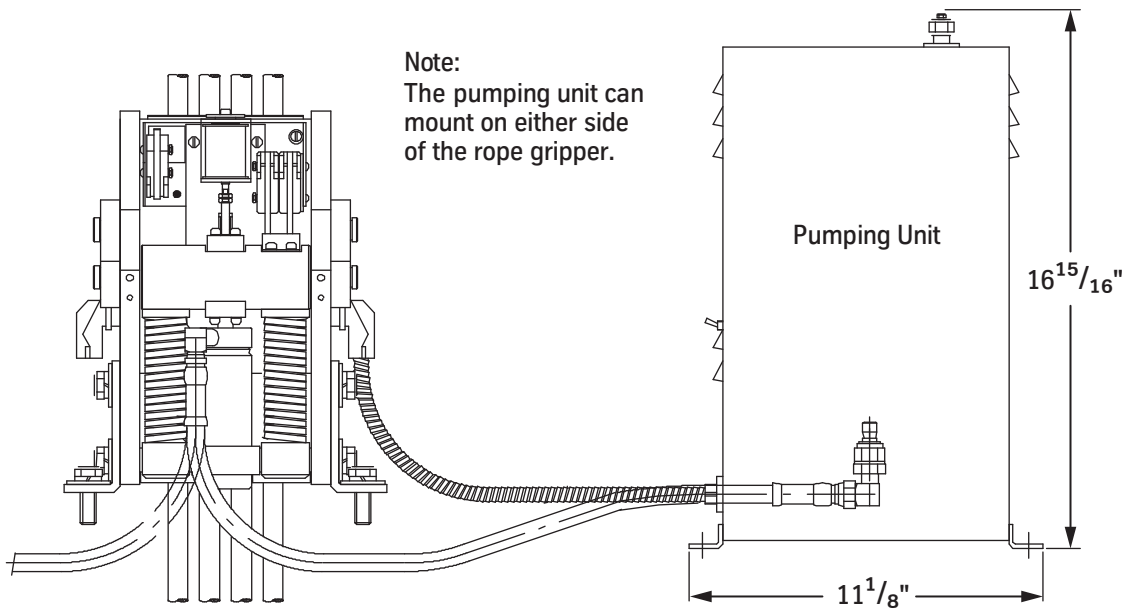
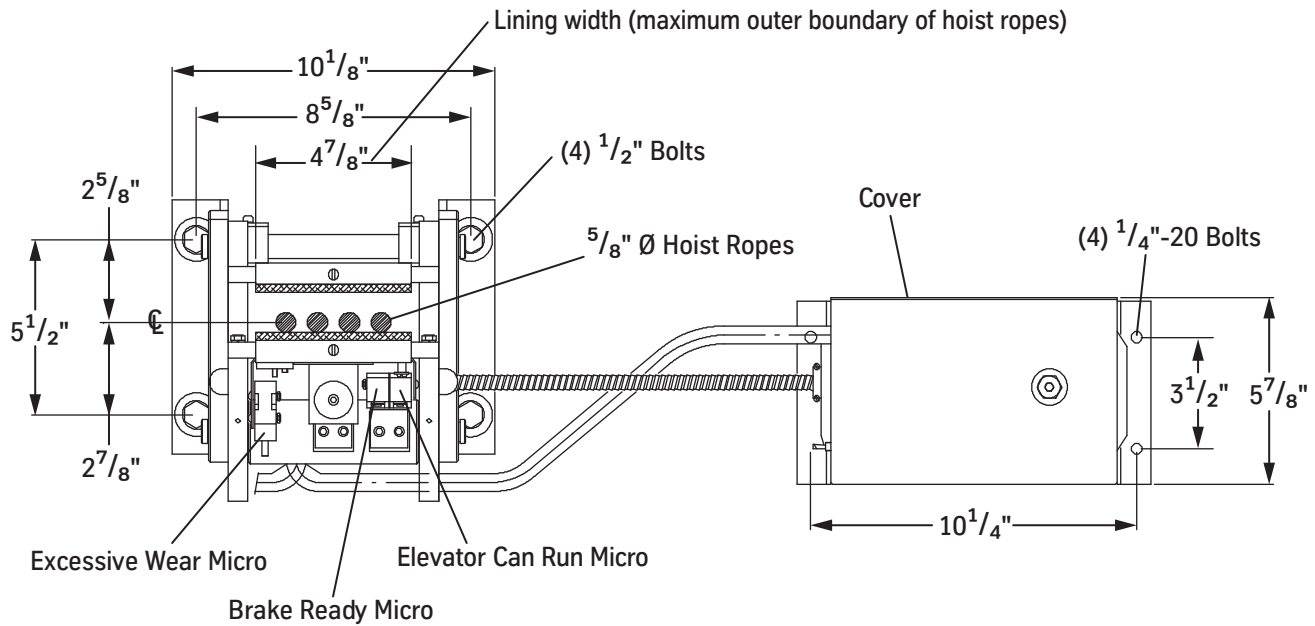
			ROPE GRIPPER MODEL NUMBER						
			8000AC1 (620)	8000AC2 (622)	8000AC3 (624)	8000AC4 (625)	8000AC5 (626)	8000AC6 (622) See Note 1	8000AC7 (622) See Note 2
		Maximum Out to Cables	4 ⁷ / ₈ "	6"	10"	11 ¹ / ₂ "	10"	6"	6"
		Power Supply	6A, 120V ac, 1 PH, 60Hz.						
		Contact Ratings	6A, 250V ac, 0.15A, 250V dc						
1:1 ROPING	MAXIMUM RATINGS	Rated Speed	350 fpm	600 fpm	1,200 fpm		600 fpm		
		Rope Gripper Tripping Speed	402 fpm	690 fpm	1,368 fpm		690 fpm		
		Car Rated Load (with 40% to 50% counterweights)	2,500 lbs	5,000 lbs		10,000 lbs	5,000 lbs		
		Car, Car Load, Counterweight, Hoist, & Compensation Rope Mass	11,500 lbs	18,600 lbs		38,000 lbs	18,600 lbs		
		Door Zone	10 inches ±						
	MINIMUM	Car Rated Load	600 lbs	1,500 lbs		2,500 lbs	—		
		Car & Counterweight Mass	2,280 lbs	6,000 lbs		8,000 lbs	—		
2:1 ROPING	MAXIMUM RATINGS	Rated Speed	250 fpm	400 fpm	800 fpm		400 fpm		
		Rope Gripper Tripping Speed	303 fpm	459 fpm	921 fpm		459 fpm		
		Car Rated Load (with 40% to 50% counterweights)	5,000 lbs	10,000 lbs		20,000 lbs	10,000 lbs		
		Car, Car Load, Counterweight, Hoist, & Compensation Rope Mass	18,600 lbs	38,000 lbs		76,000 lbs	38,000 lbs		
		Door Zone	10 inches ±						
	MINIMUM	Car Rated Load	1,500 lbs	2,500 lbs		5,000 lbs	2,500 lbs		
		Car & Counterweight Mass	6,000 lbs	8,000 lbs		16,000 lbs	8,000 lbs		
		Shipping Weight	100 lbs	180 lbs	300 lbs		335 lbs	180 lbs	

Note 1: 8000AC6 requires setup for 10 mm diameter hoist ropes.

Note 2: 8000AC7 requires setup for 8 mm diameter hoist ropes.

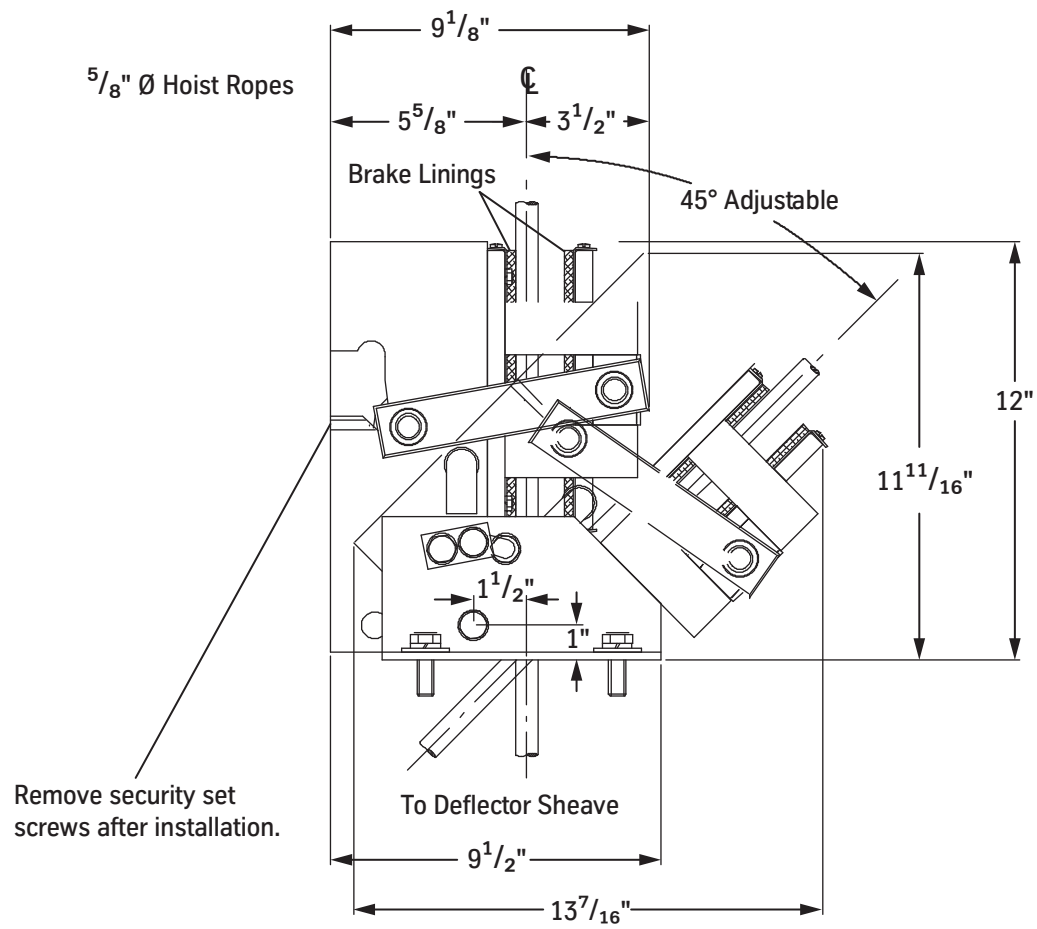
Dimensions

8000AC1 (HW 620)

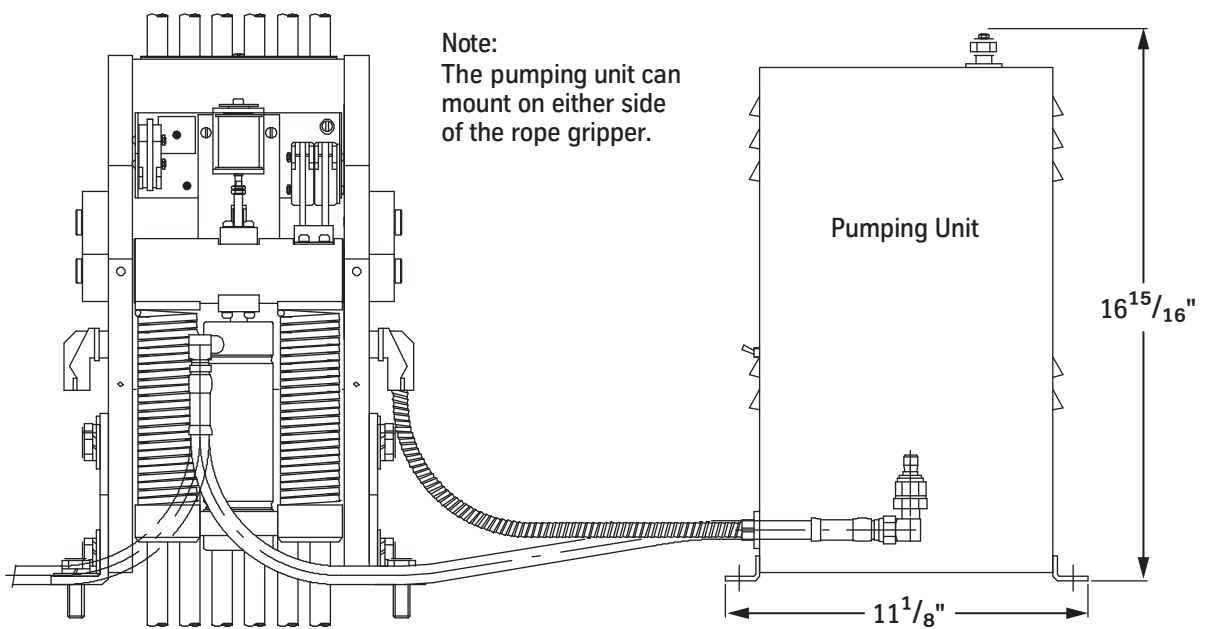
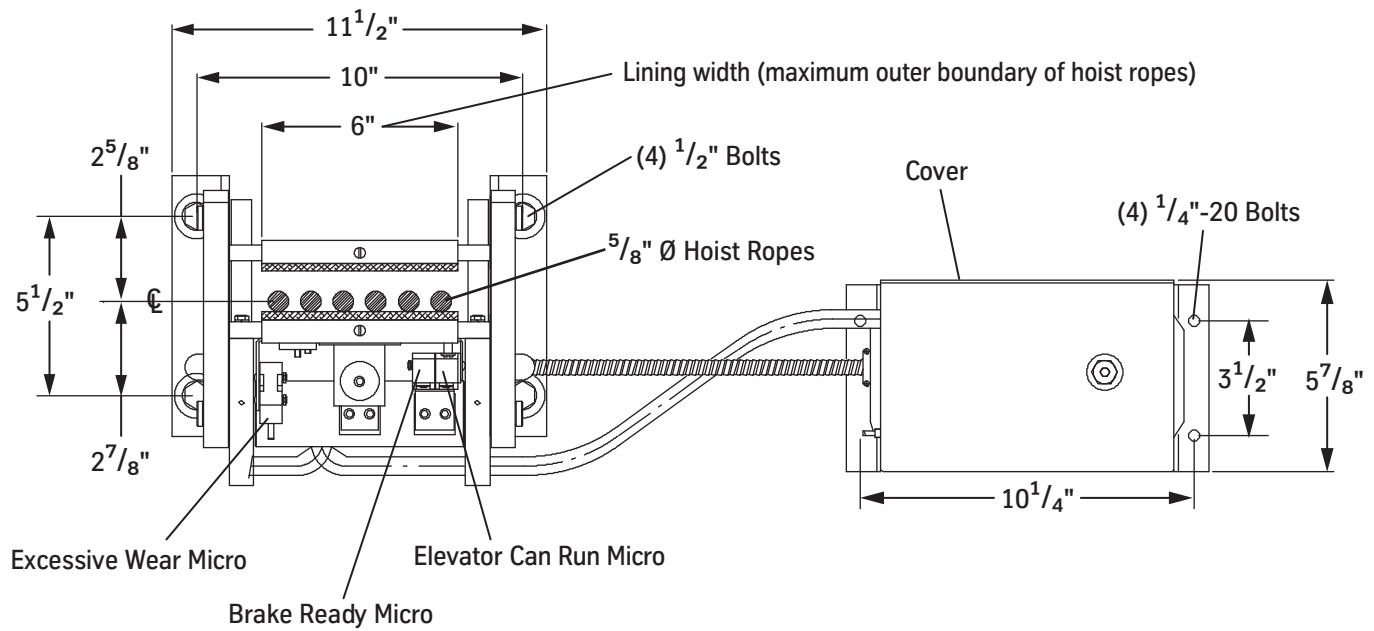


8000AC1 (HW 620)

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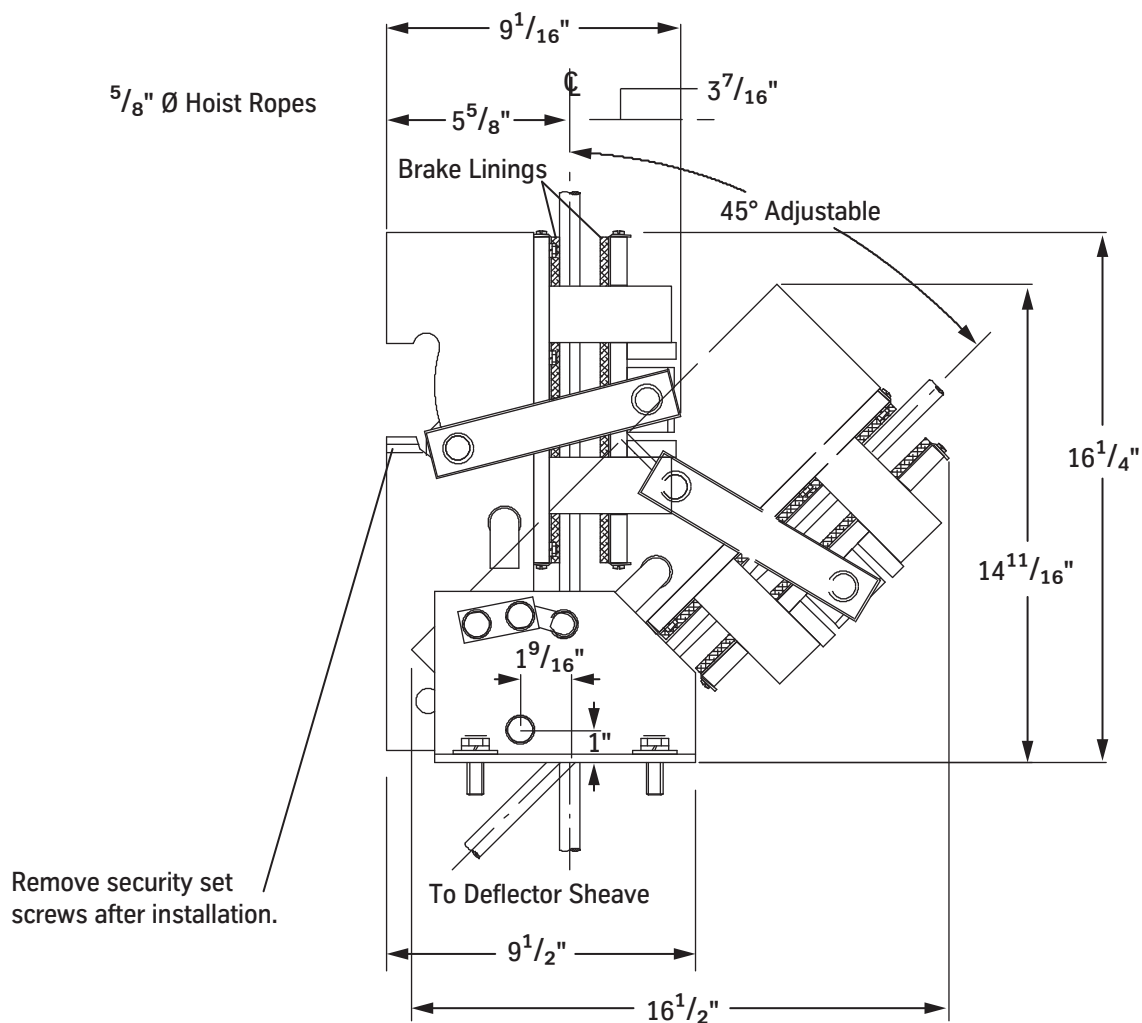


8000AC2 (HW 622)

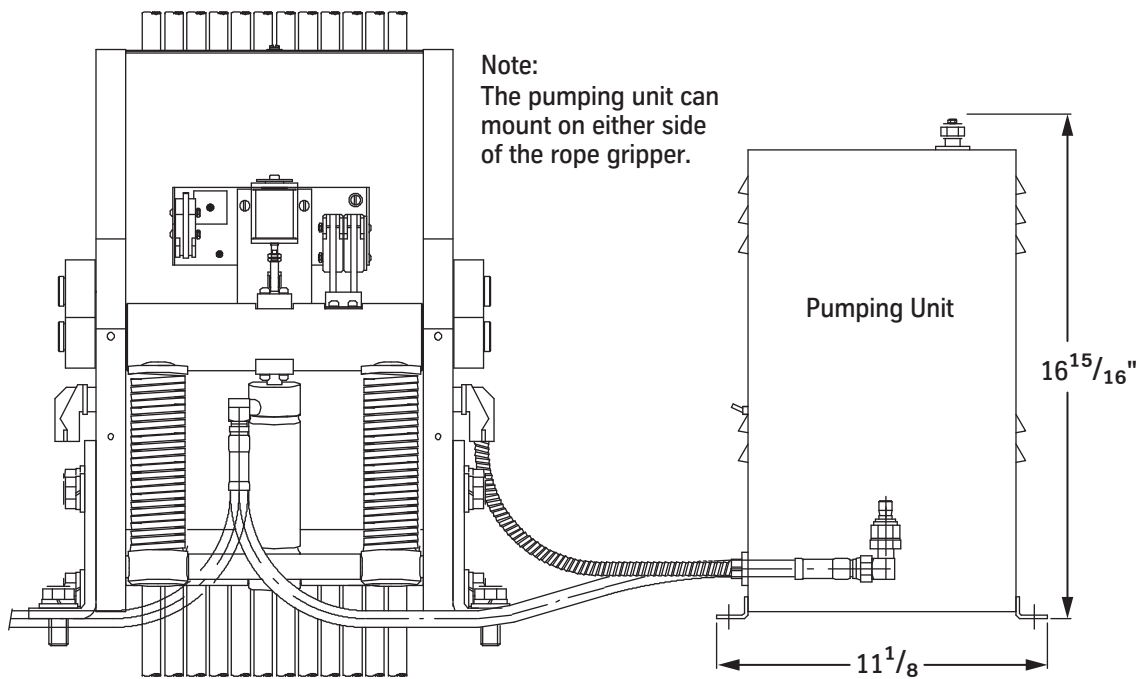
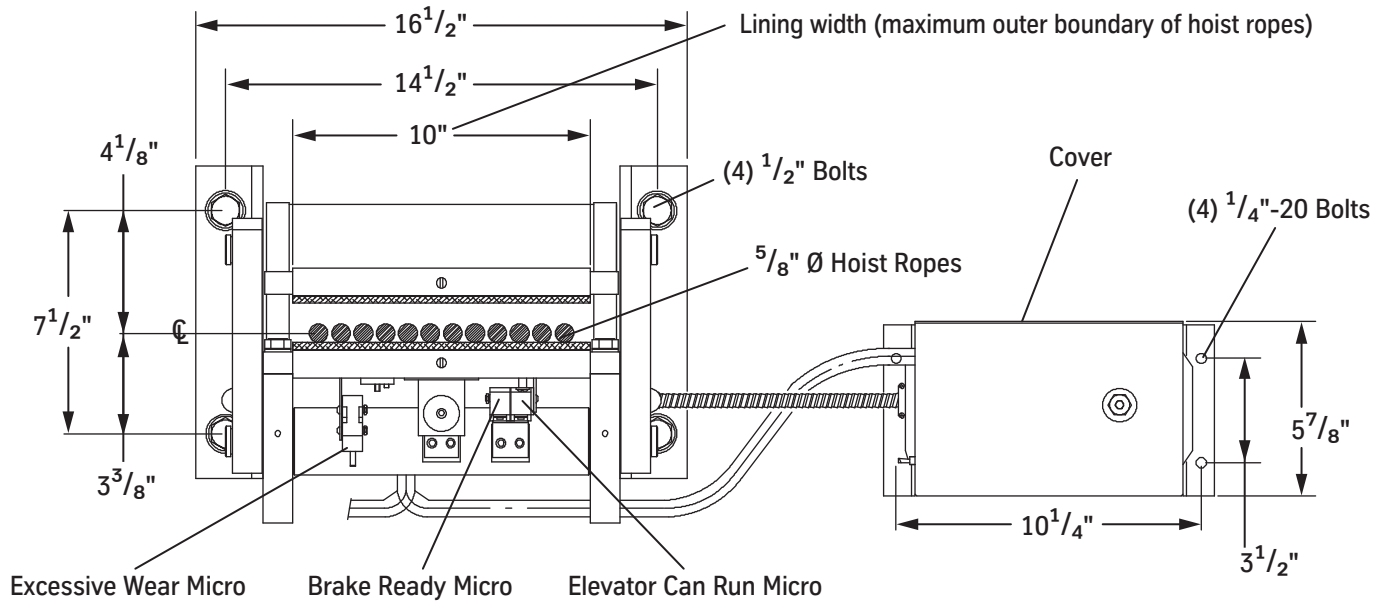


8000AC2 (HW 622)

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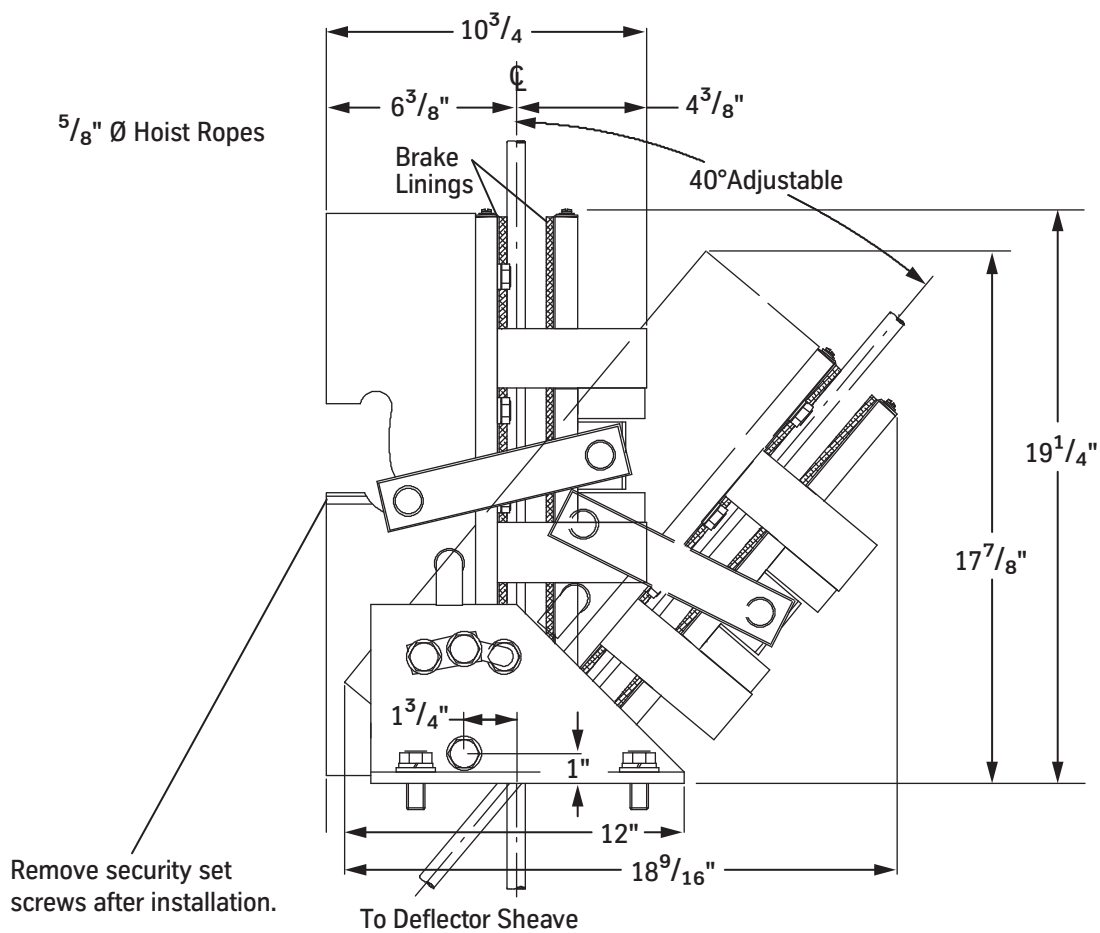


8000AC3 (HW 624)

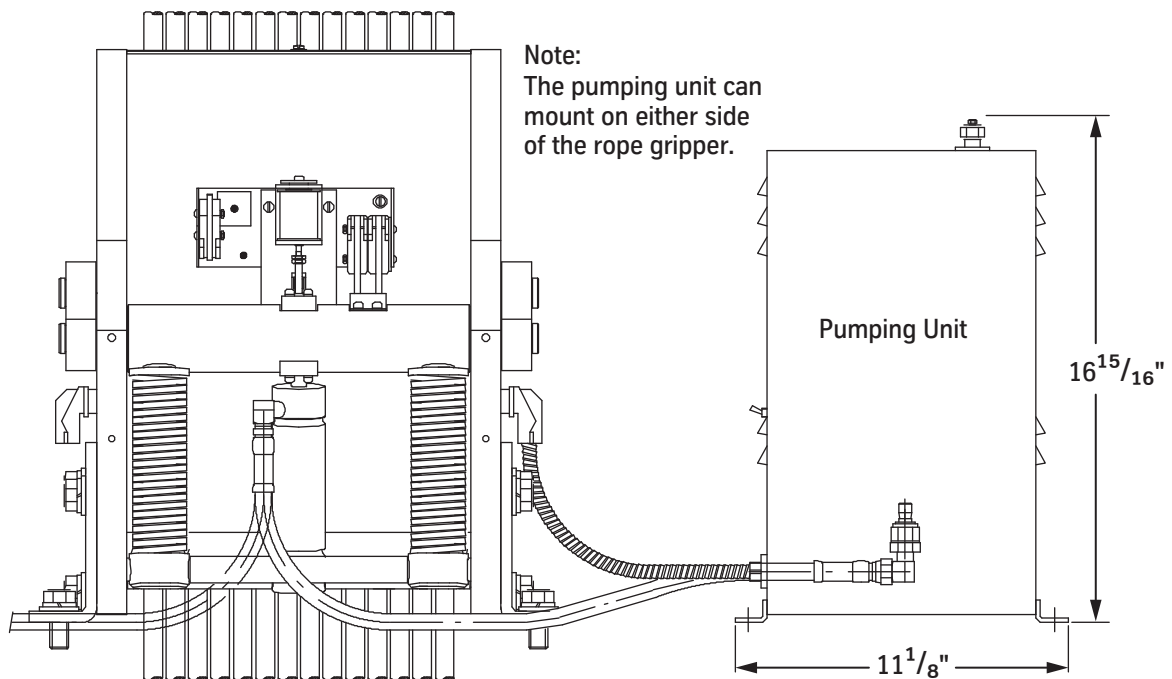
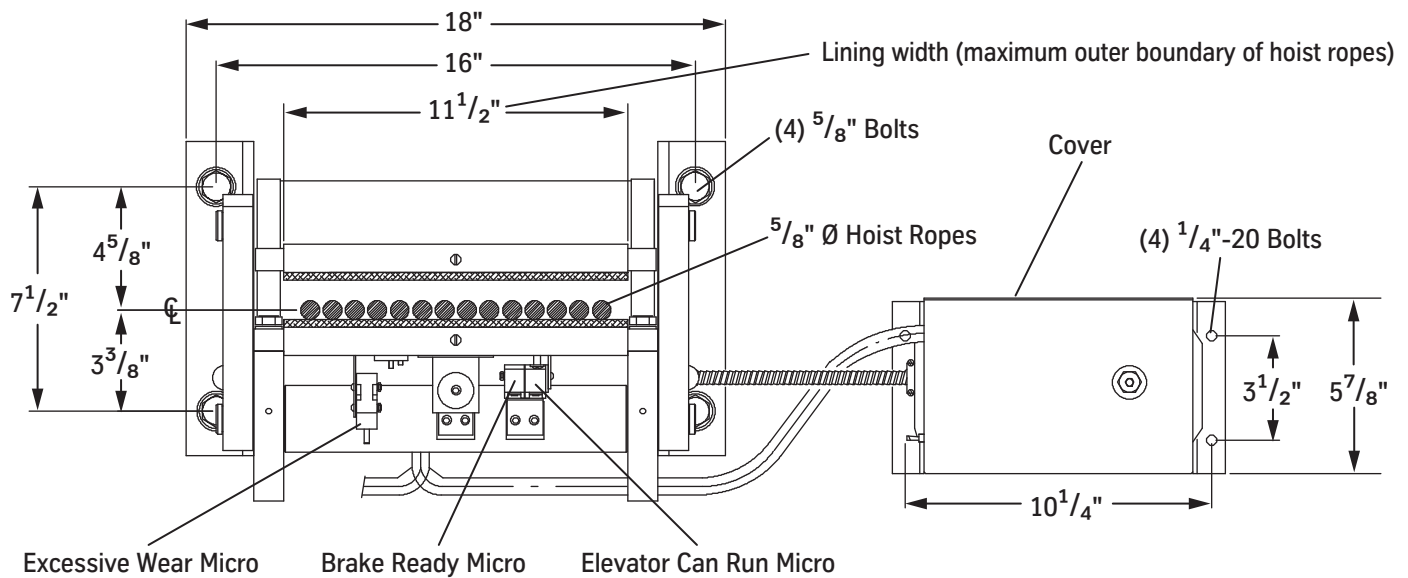


8000AC3 (HW 624)

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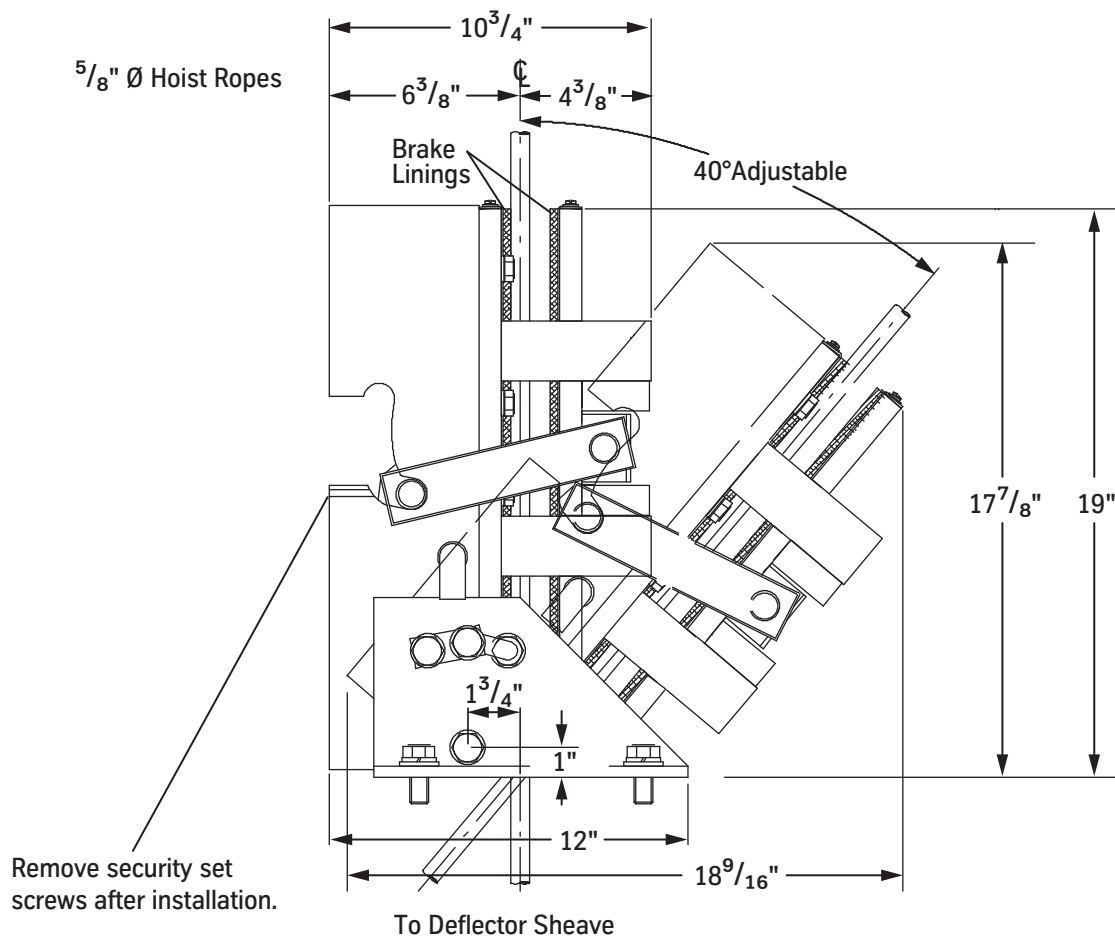


8000AC4 (HW 625)

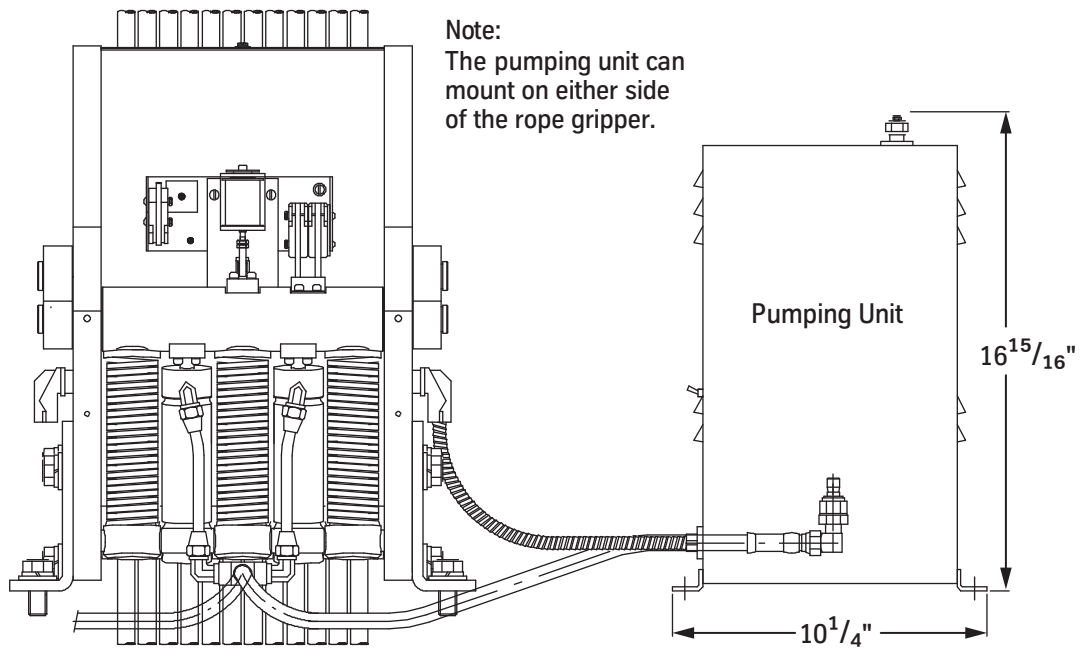
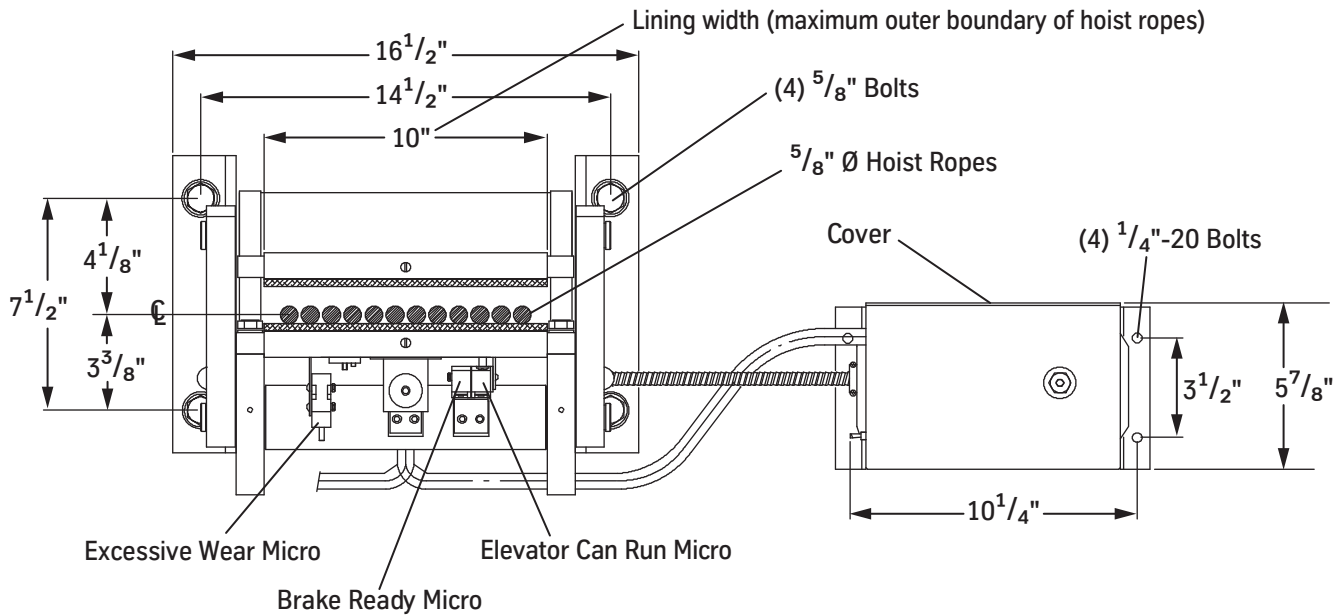


8000AC4 (HW 625)

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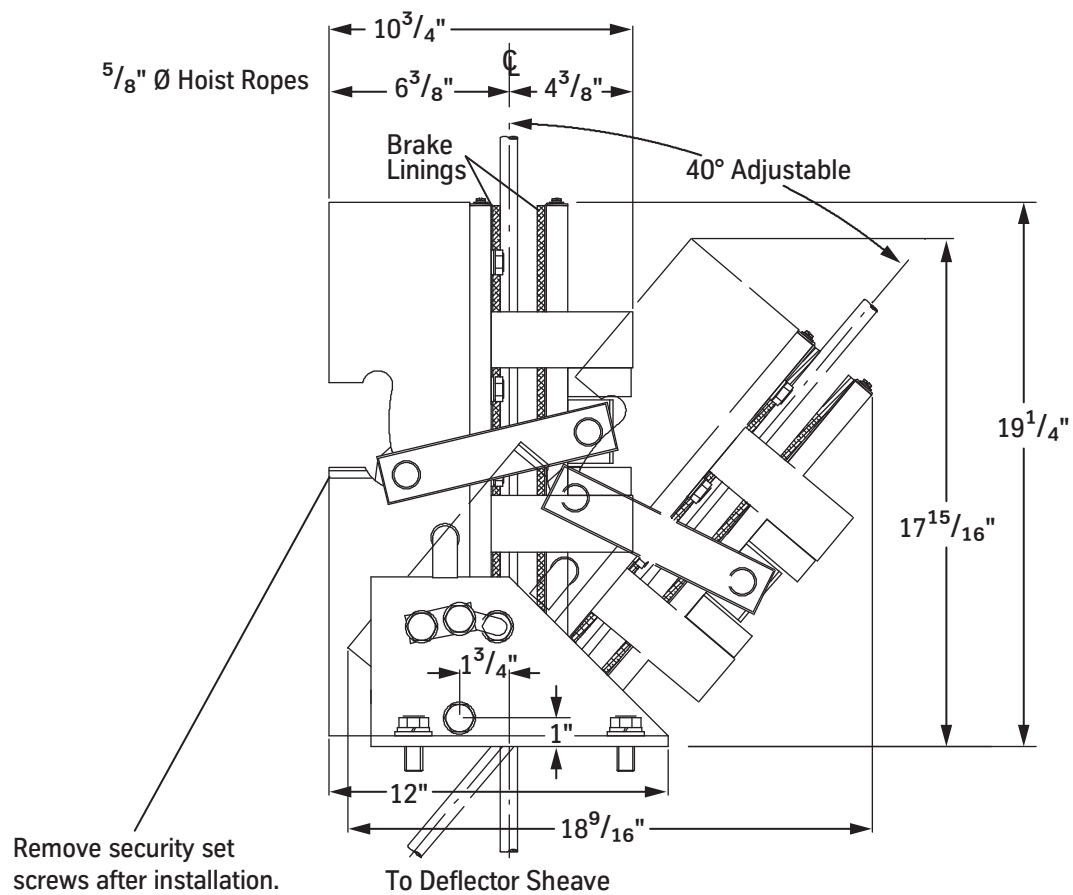


8000AC5 (HW 626)

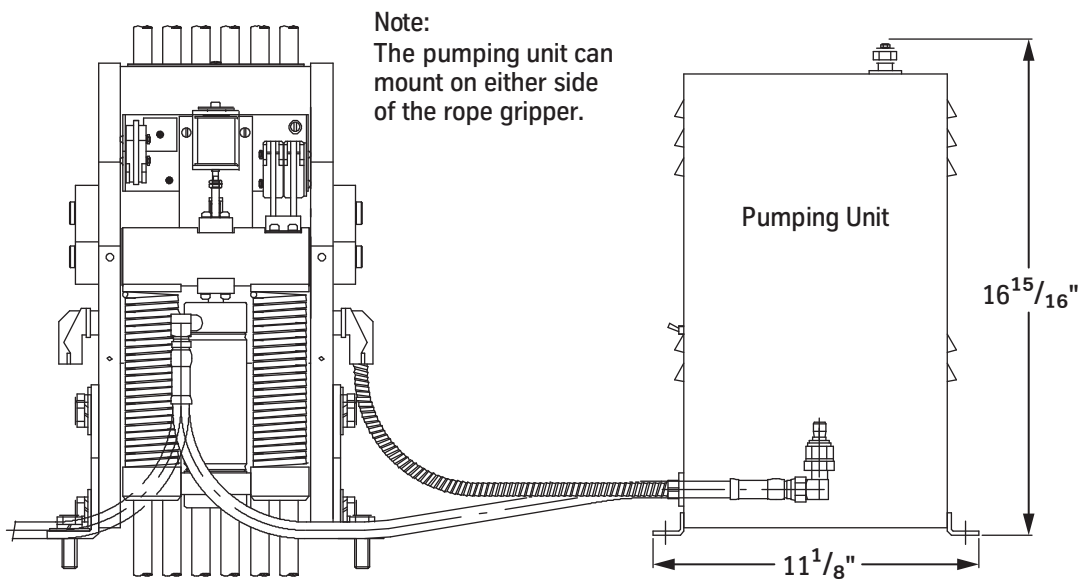
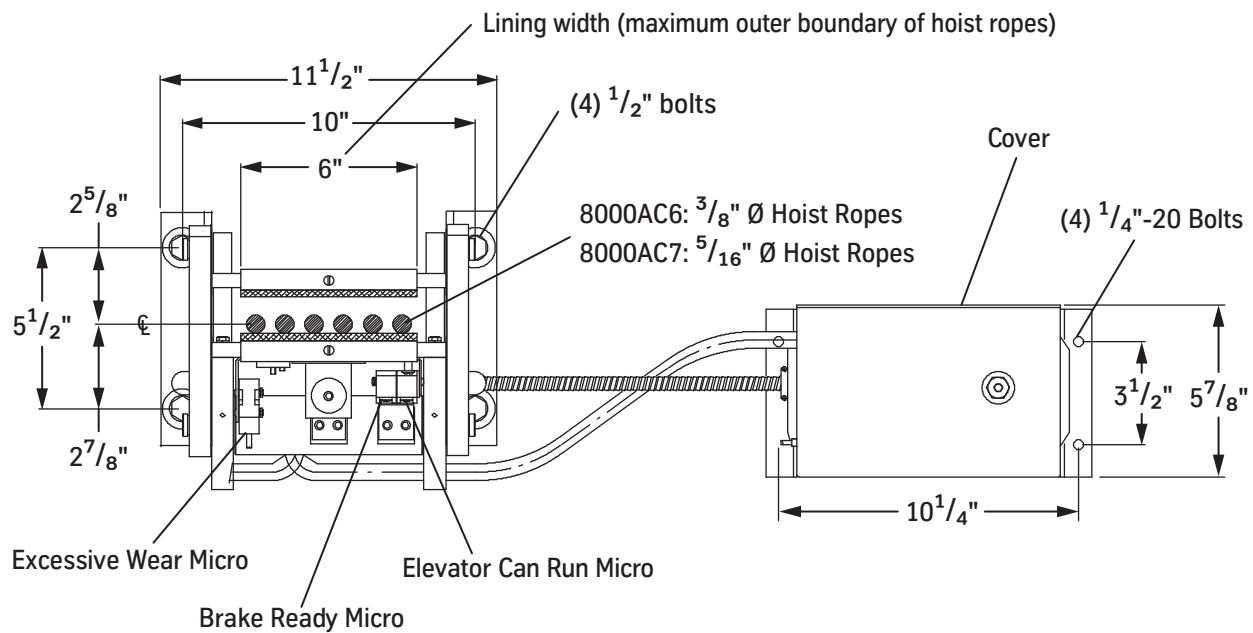


8000AC5 (HW 626)

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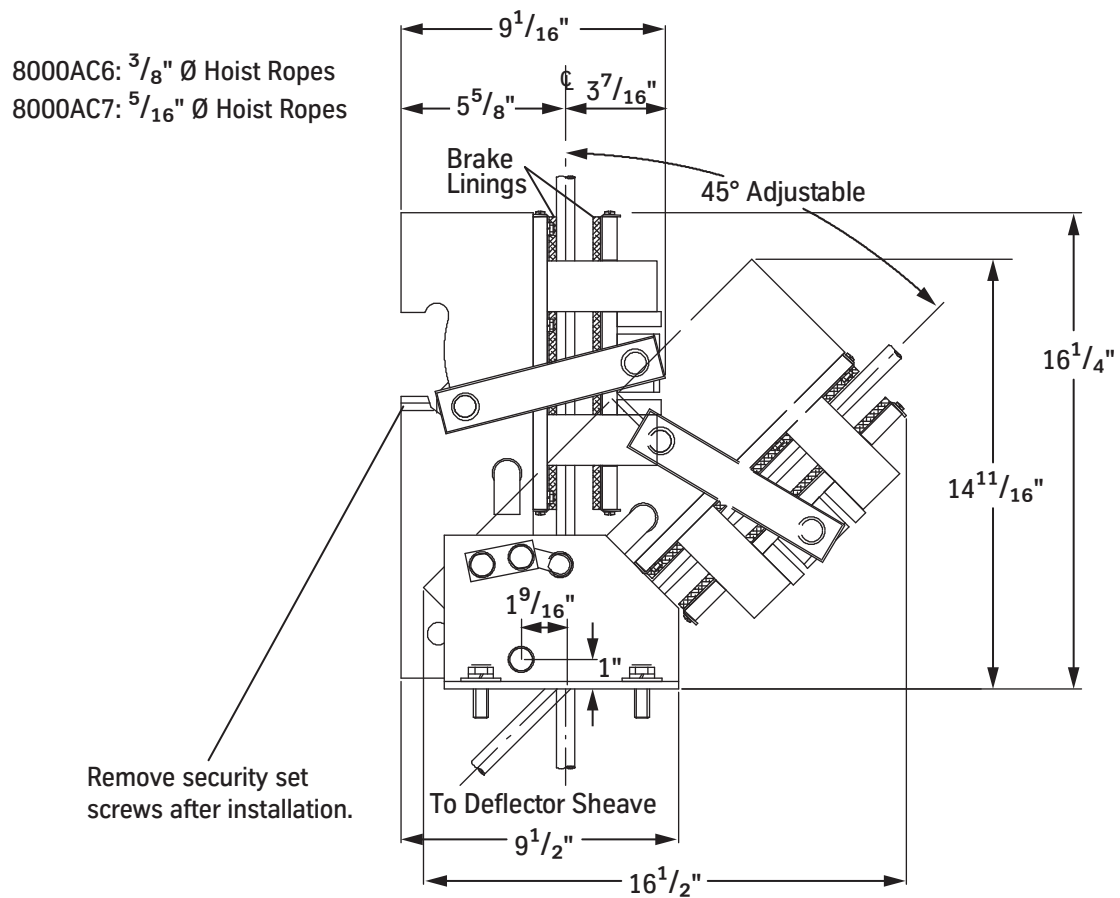


8000AC6/AC7 (HW 622)



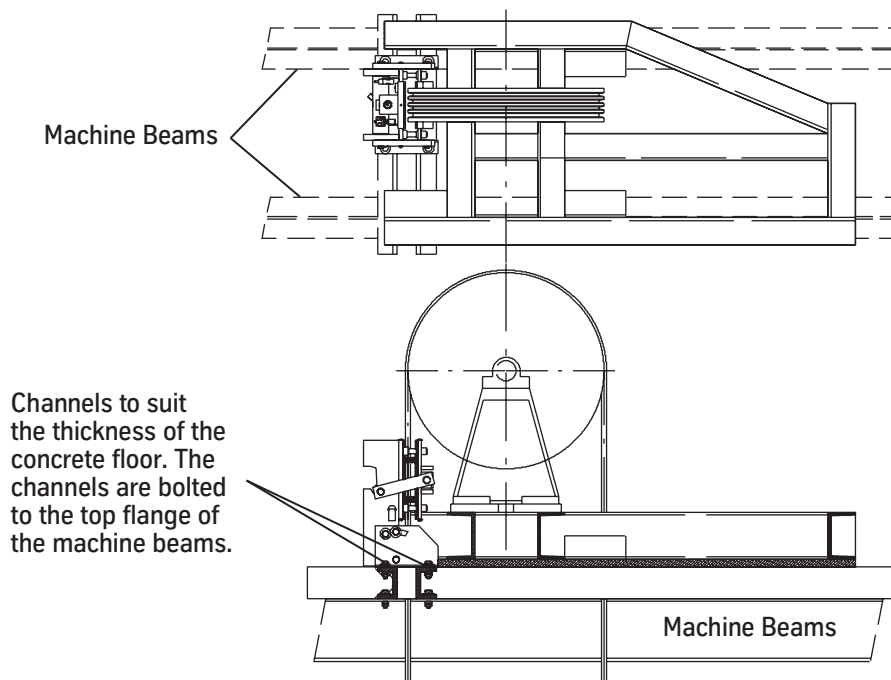
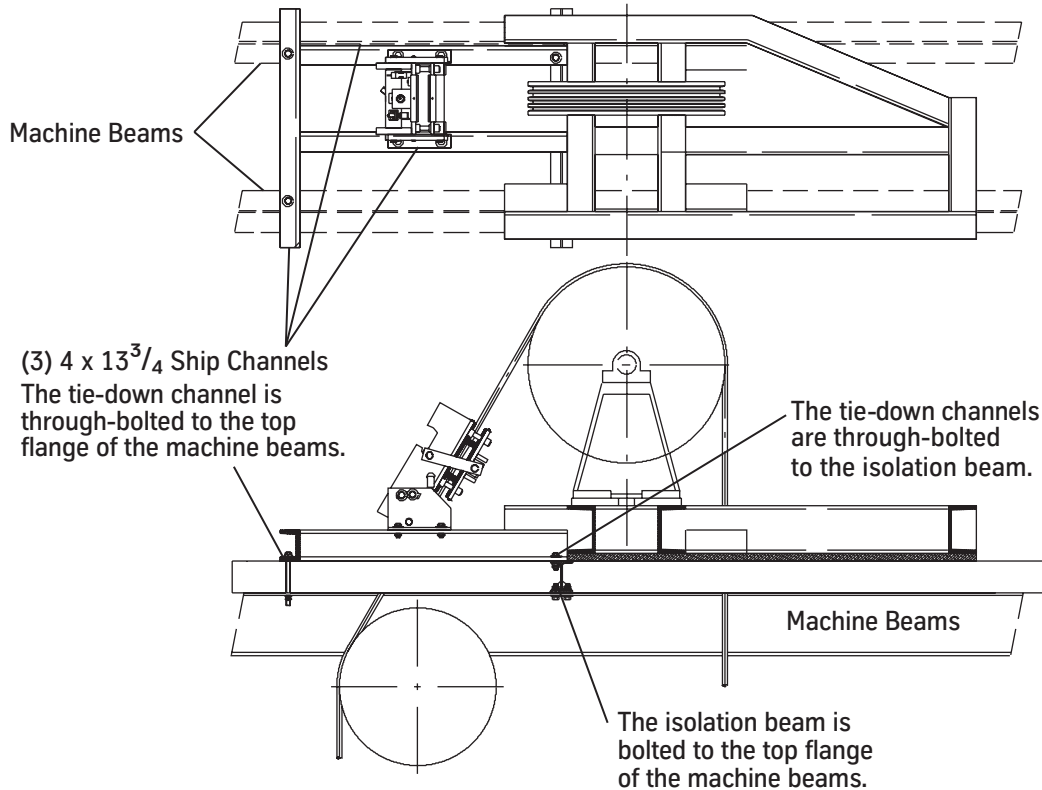
8000AC6/AC7 (HW 622)

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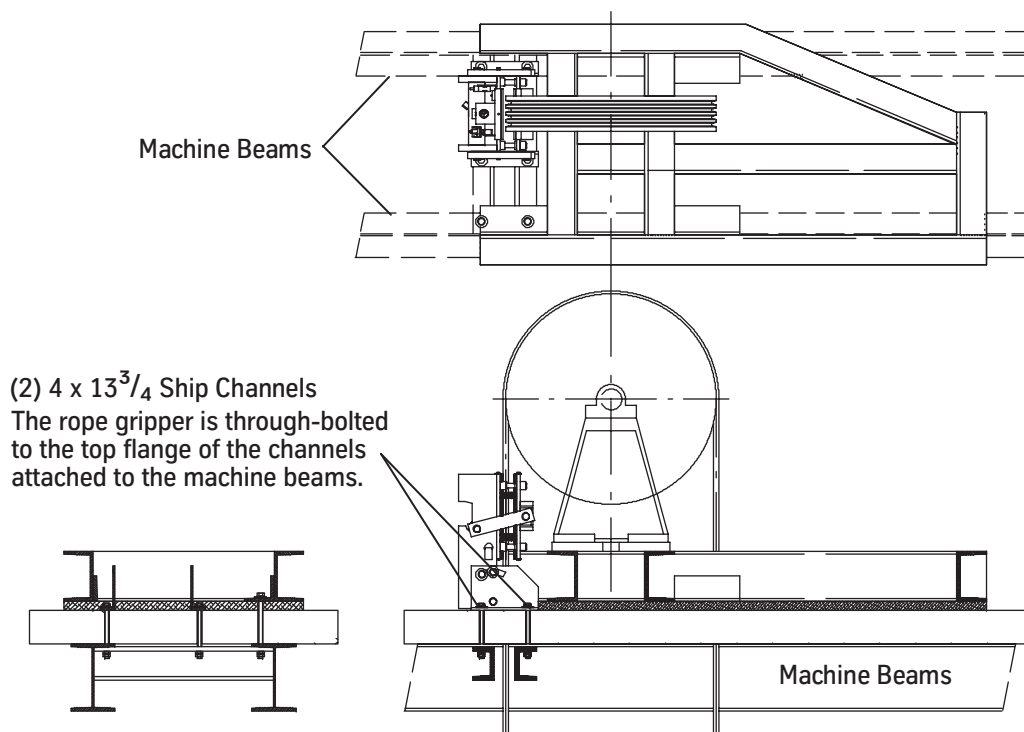
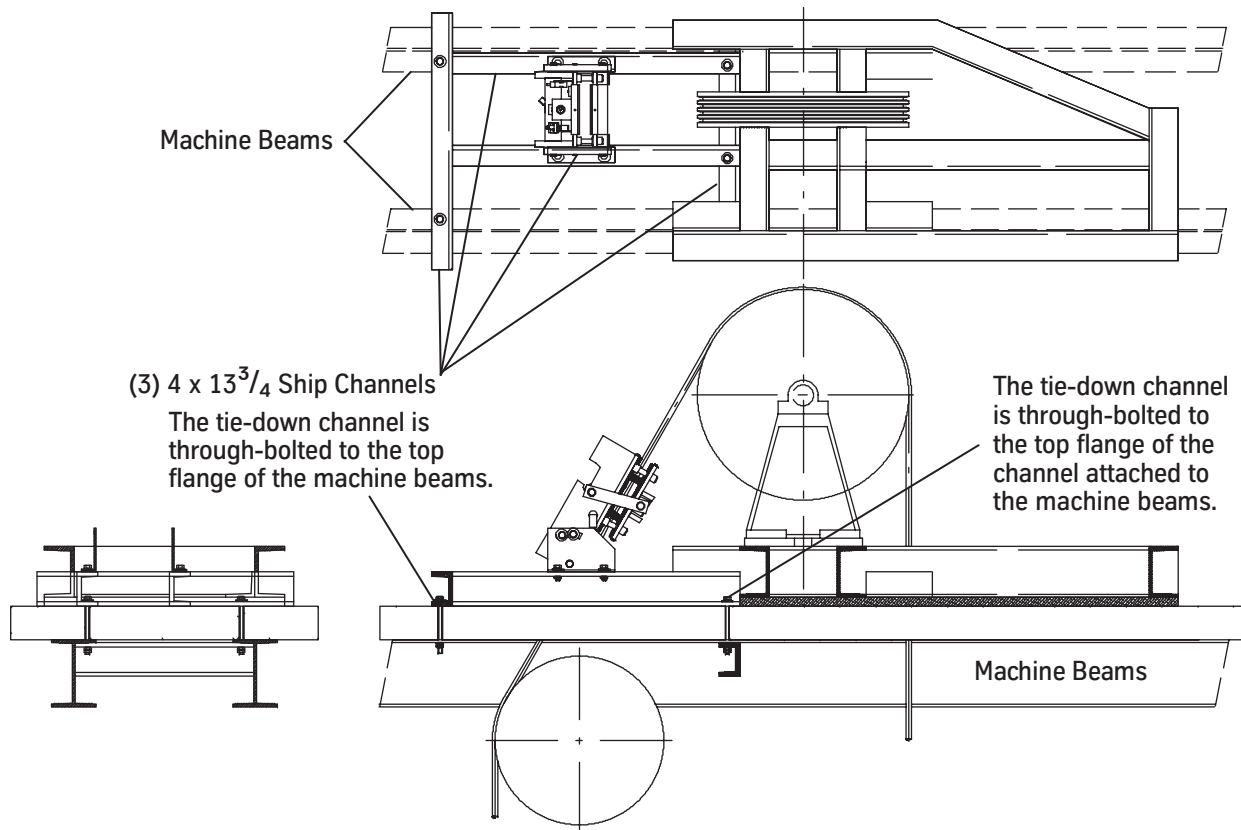


Typical Mounting Arrangements

New Installation of Overhead Machine



Existing Installation of Overhead Machine



Installation

- When adding a rope gripper to an existing installation, it might not be possible to mount the gripper in the machine room. Depending on the pumping unit location and facilitation of future gripper maintenance, mount the rope gripper horizontally or upside down if necessary.
 - The pumping unit must be mounted right side up.
 - Standard hydraulic hose length is 27 inches, and maximum available length is 8 feet.
1. Ensure that the security set screws hold the rotating shaft in the Loaded position. See Figure 2.
 2. Remove the four snap rings, and then remove both connecting arms.
 3. Remove the movable shoe assembly.

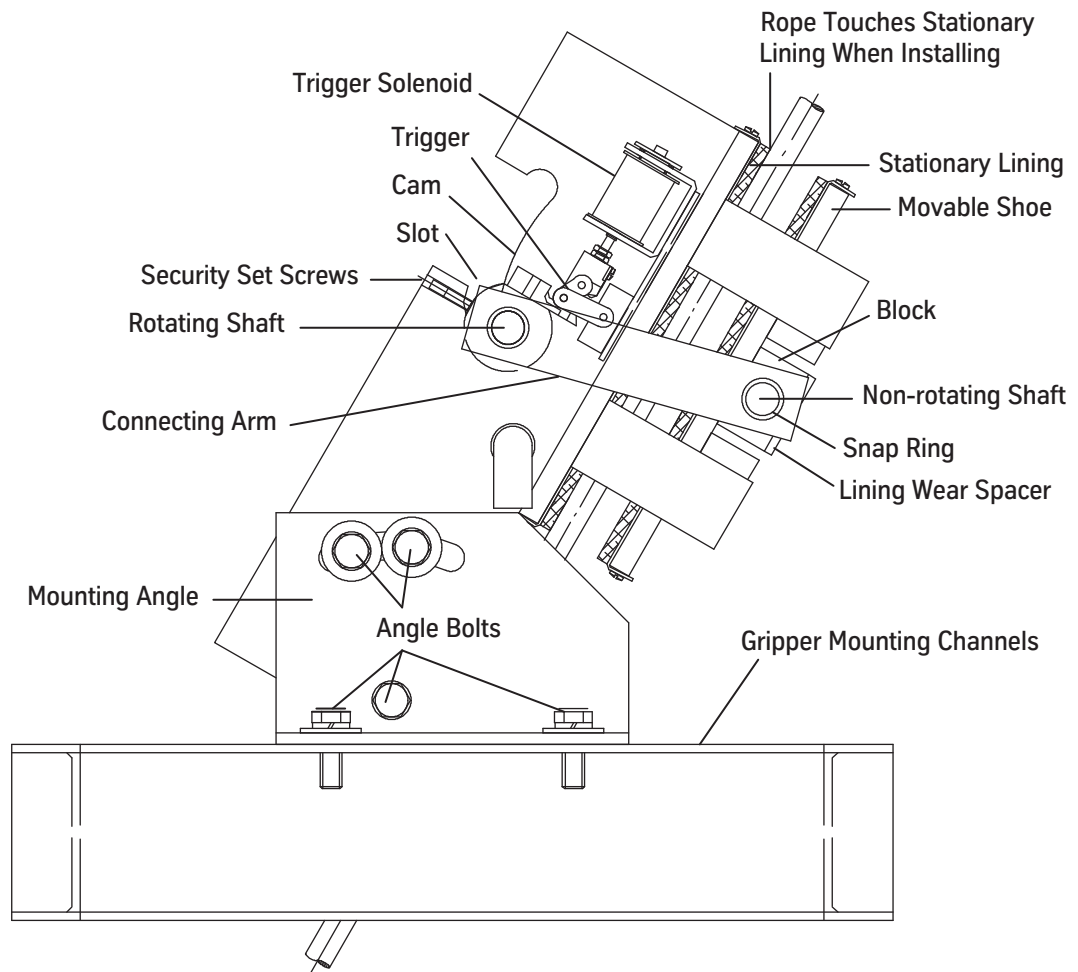


Figure 2 - Rope Gripper Detail

Installation

(continued)

4. Use the appropriate bolts to mount the rope gripper to the mounting channels through the mounting angles, and hand tighten.
 - Models 8000AC1 (620) and 8000AC2 (622): $\frac{1}{2}$ " UNC (Grade 5)
 - Models 8000AC3 (624), 8000AC4 (625), and 8000AC5 (626): $\frac{5}{8}$ " UNC (Grade 5)
5. Align the rope gripper so that the stationary shoe lining barely touches the ropes from top to bottom and from side to side.



CAUTION

Slight misalignment causes uneven and excessive lining wear.

6. Torque the rope gripper angle bolts (5 bolts per side):
 - Models 8000AC1 (620) and 8000AC2 (622): ~74 ft-lbs
 - Models 8000AC3 (624), 8000AC4 (625), and 8000AC5 (626): ~143 ft-lbs
7. Verify the rope alignment to ensure that it was not affected during torquing, and ensure that the ropes evenly touch the stationary shoe lining.
8. Reinstall the movable shoe assembly.
9. Reinstall the connecting arms with the chamfered corners facing inside, and then secure the four snap rings.
10. Find the best location for the pumping unit, which may be placed facing forward or backward on either side of the rope gripper.



CAUTION

Failure to remove the shipping cap and install the dipstick damages the pumping unit.

11. Remove the shipping cap from the pump unit, and install the dipstick.



The dipstick ships strapped to the inside of the pumping unit.

12. Route the male hydraulic fitting through the knockout on the side of the pumping unit.
13. Inside the pumping unit, lift and hold the ring on the female fitting, push the male quick-connect fitting into the female fitting, and then release the ring to secure the fittings together.



- If it is necessary to move the rope gripper wiring to the opposite side of the assembly, remove the 90° box connector, and then pull the wiring through the rope gripper and out the opposite side.
- Wiring from the rope gripper to the pump unit is color coded:

White = RG2	Orange = RG5
Black = RG3	Blue = RG6
Red = RG4	Green = Ground

Installation

(continued)

14. Connect terminals RG1, RG2, RG5, and RG7 to the elevator control. Check the control diagram for the proper connections. See Figure 3.

See job wiring diagrams for connections.

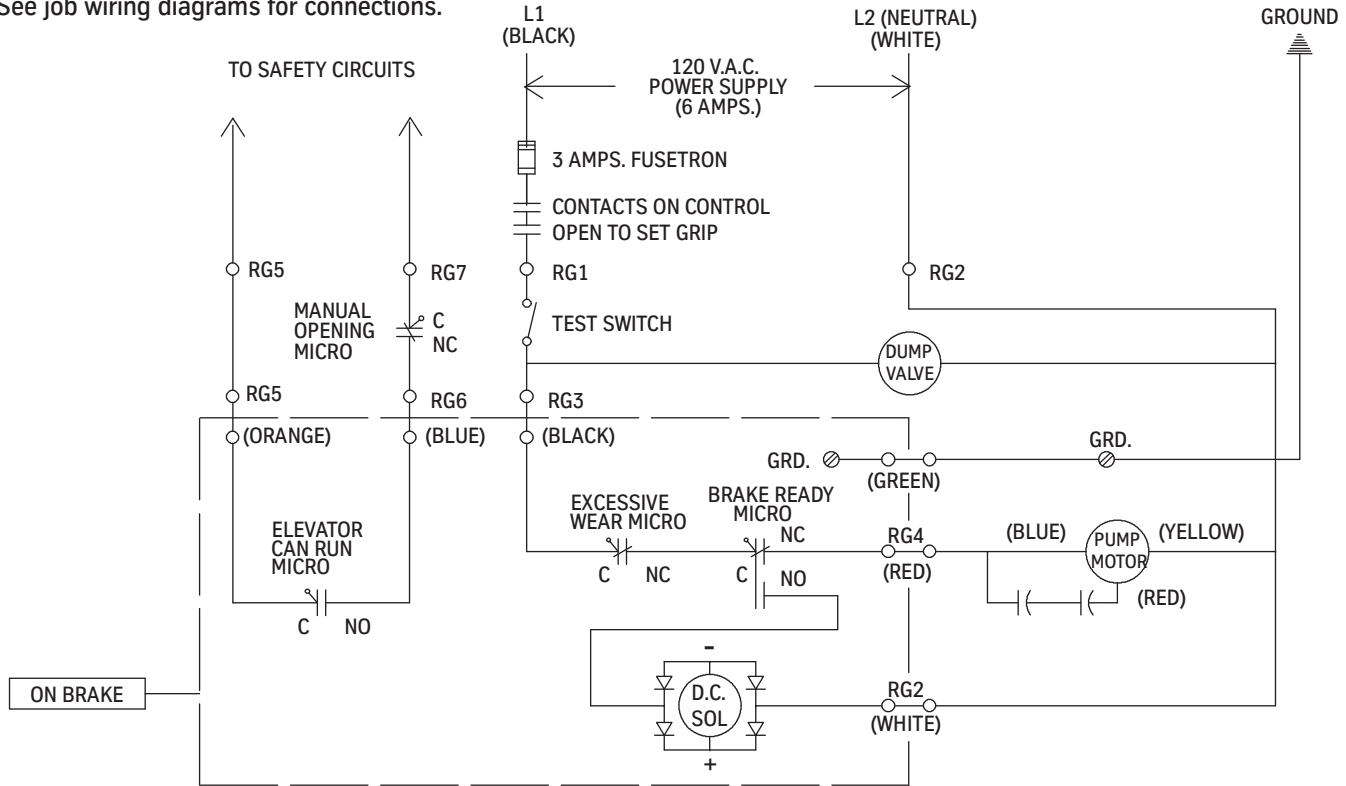


Figure 3 - Controller Wiring Diagram

15. After completing the wiring and hydraulic connections, use the appropriate valve stem setting procedure shown in Figure 4 on page 27 or Figure 5 on page 28 to ensure that the valve stem (dump valve) in the pumping unit is set to Automatic.
16. Turn the pumping unit test switch ON.
17. Verify that the solenoid latch on the rope gripper energizes and pushes the trigger down onto the latch. If it does not, check the control wiring.
18. When the rope gripper energizes, loosen the security set screws. If the arms move backward, use the hand pump, or jump terminals 3 to 4 to temporarily operate the electric pump.
19. Remove and store the security set screws in the bottom of the pump unit.



CAUTION Security set screws must be completely removed, or damage may occur when the rope gripper activates.

Installation

(continued)

To set the valve stem to Manual, turn the test switch OFF, and then twist and pull up the valve stem while pumping the hand pump.

To set the valve stem to Automatic, push and turn the valve stem, and then turn the test switch ON.

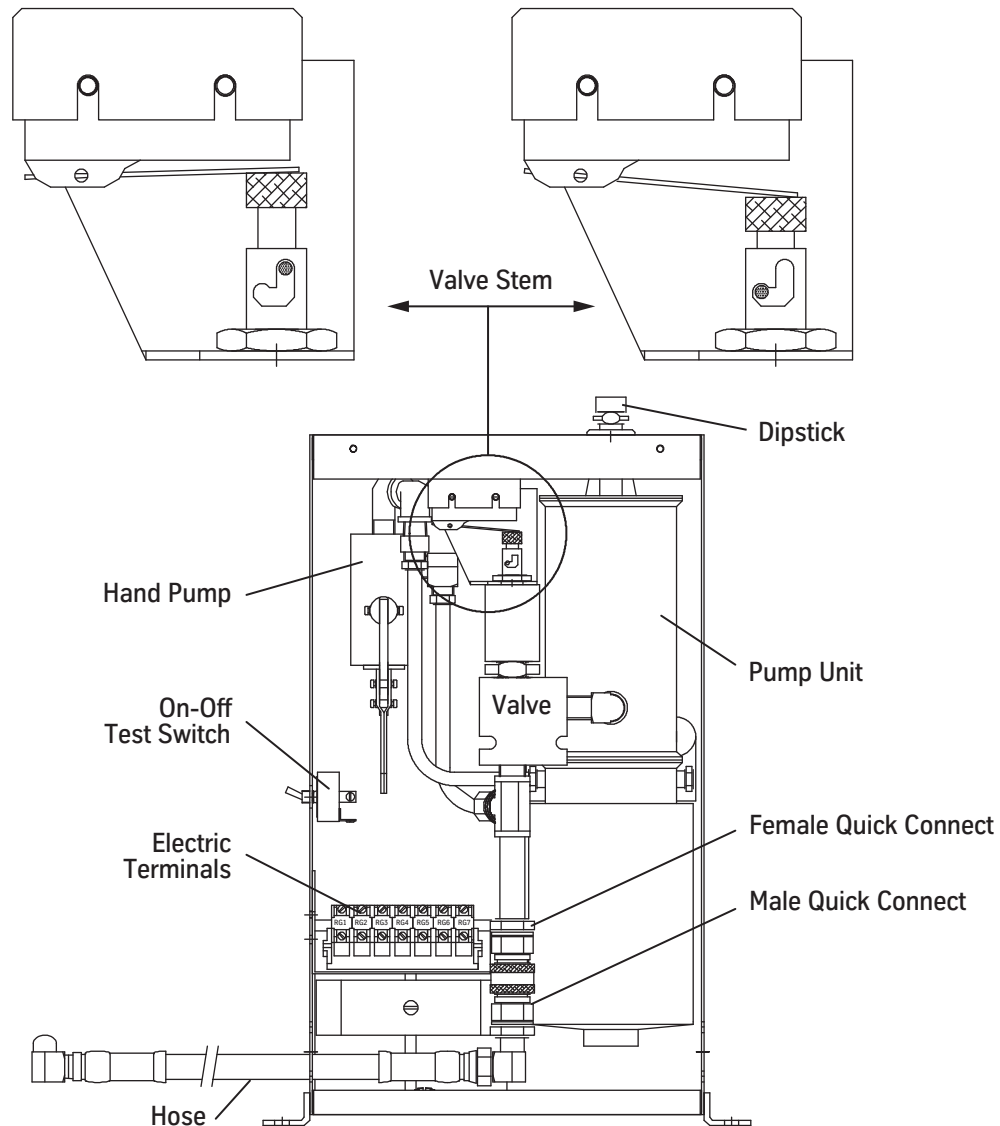


Figure 4 - Pumping Unit for 8000AC1, 8000AC2, 8000AC3, 8000AC4 (620, 622, 624, 625)

Installation

(continued)

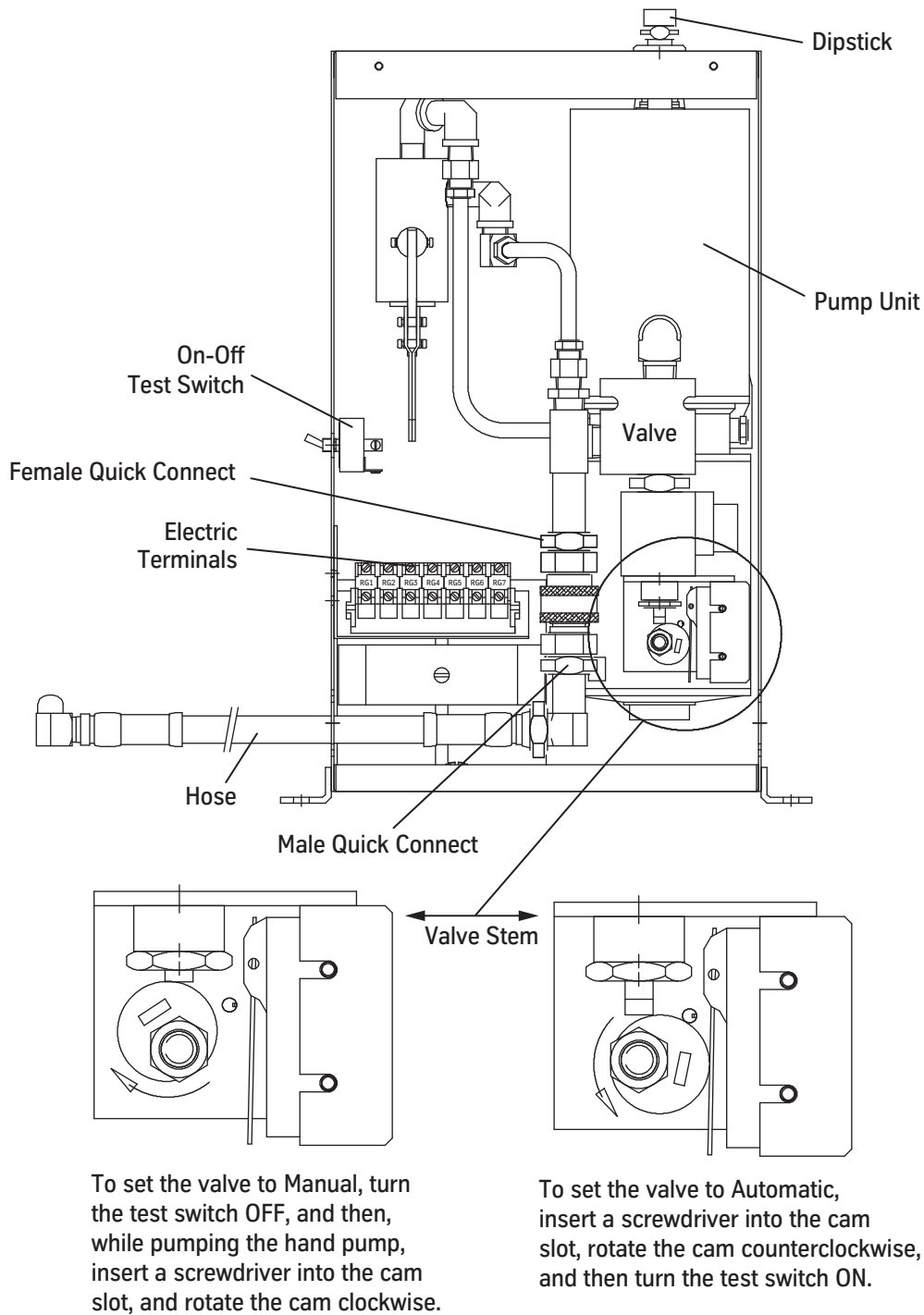


Figure 5 - Pumping Unit for 8000AC5 (626)

Preliminary Testing

1. Ensure that the rope gripper is in the Loaded position (not clamping the ropes) and the pumping unit valve stem is on Automatic.
2. Turn the test switch ON. See Figure 4 on page 27 or Figure 5 on page 28 for this procedure.
3. Turn the test switch OFF to activate the rope gripper and clamp the ropes.



When clamping the ropes, be sure that the microswitch contacts on the rope gripper stop or prevent power from being applied to the motor and machine brake.

4. Set the valve stem to Manual to open the manual microswitch contact and prevent the elevator from running.
5. Use the hand pump to return the rope gripper to the Loaded position.
6. Turn the valve stem back to Automatic. The manual microswitch contact closes and allows the elevator to run.
7. Turn the test switch ON.

Lining Wear-in

1. Ensure that the pumping unit valve stem is on Automatic, and turn the test switch ON.
2. Run the car at inspection speed from top to bottom, and wipe down the ropes to remove any dirt, excess oil, or grease. Then return the car to the top floor.
3. Jump terminals RG5 to RG6, and then run the empty car slowly DOWN. When the car is up to speed, turn the test switch OFF. The rope gripper clamps the ropes lightly, and the ropes begin to wear grooves in the linings.



- As the linings wear in, the rotating shaft moves up the cam slot and around the corners of the cam, and the connecting arms move up the side wall. See Figure 6 on page 30.
 - Model numbers 624, 625, and 626 have two corners. These grippers are not worn-in until the rotating shaft goes past the second corner.
 - Several car runs may be required to complete the lining wear-in.
4. For model numbers 620, 622, 624, and 625: once the rotating shaft has turned the corner, stop the car and remove the jumper from RG5 to RG6.
 5. For model number 626: if the lining wear-in is not completed after the grooves in the linings have reached about $\frac{1}{16}$ " deep, remove the spacer shims from between the shaft support blocks and the movable shoe; place the shims at the back of the support block to allow the rotating shaft to completely turn the corner and move up the cam. See Figure 6 on page 30.

Lining Replacement

- As the linings wear, the rotating shaft moves towards the end of the cam. Near the end, the excessive wear microswitch contact opens. The rope gripper does not automatically reload.
- If the grooves in the linings are worn to $\frac{3}{16}$ " or greater, complete the Install New Linings Procedure on page 32 as soon as possible.
- If lining wear is less than $\frac{3}{16}$ ", proceed to Add Spacer Shims on page 31.

Lining Wear-in

(continued)

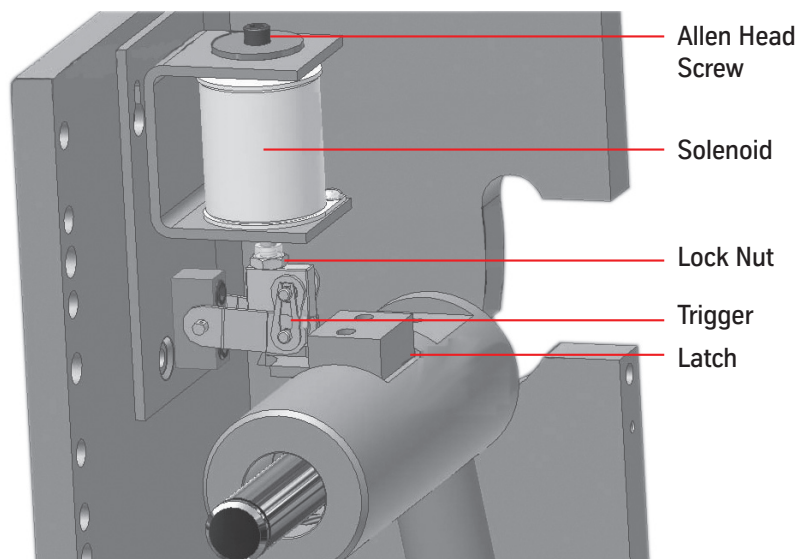
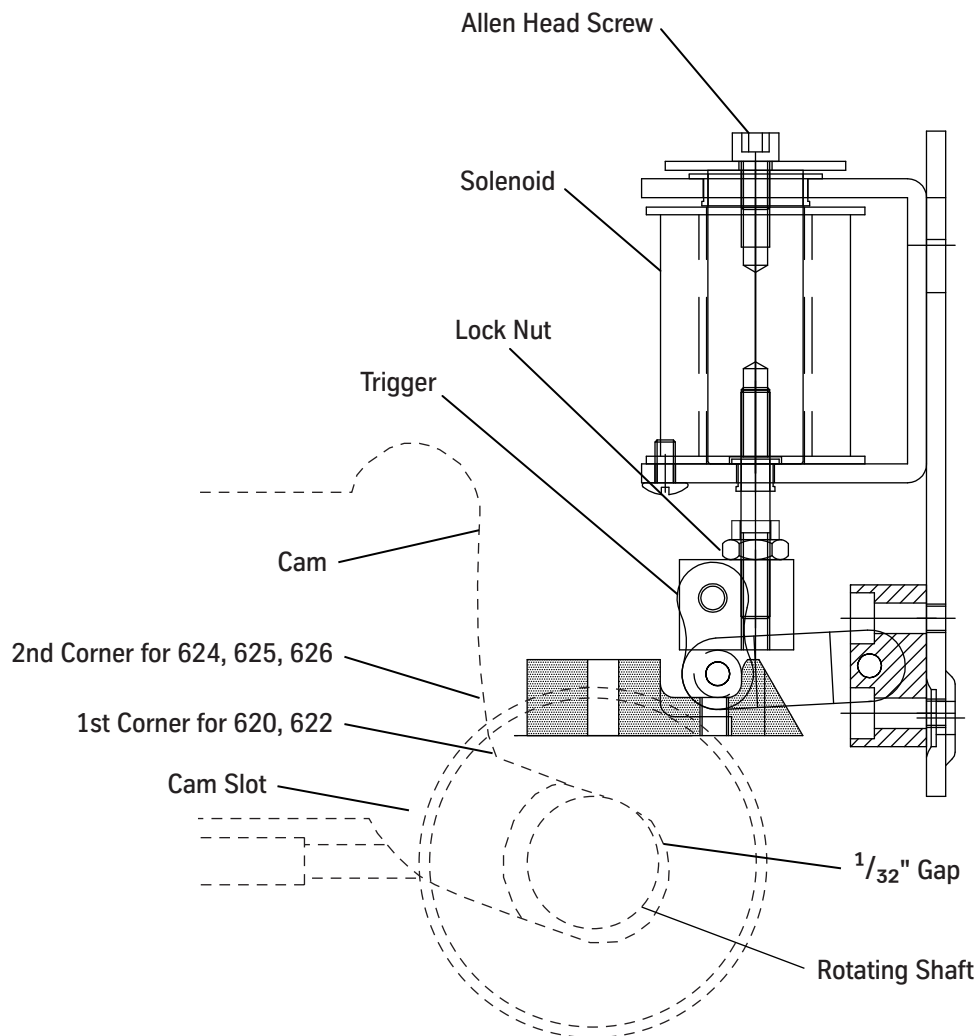


Figure 6 - Lining Wear-in

Add Spacer Shims



Before changing spacers, first install the security set screws to prevent unintended rope gripper activation.

If lining wear is not excessive (less than $\frac{3}{16}$ "), spacer shims can be added between the shaft support blocks and the movable shoe. See Figure 7.

1. Remove the bolts that hold the blocks to the movable shoe.
2. Place lining wear spacer shims under the blocks, and reinstall and tighten the bolts.



The addition of shims will move the rotating shaft toward the bottom end of the cam.

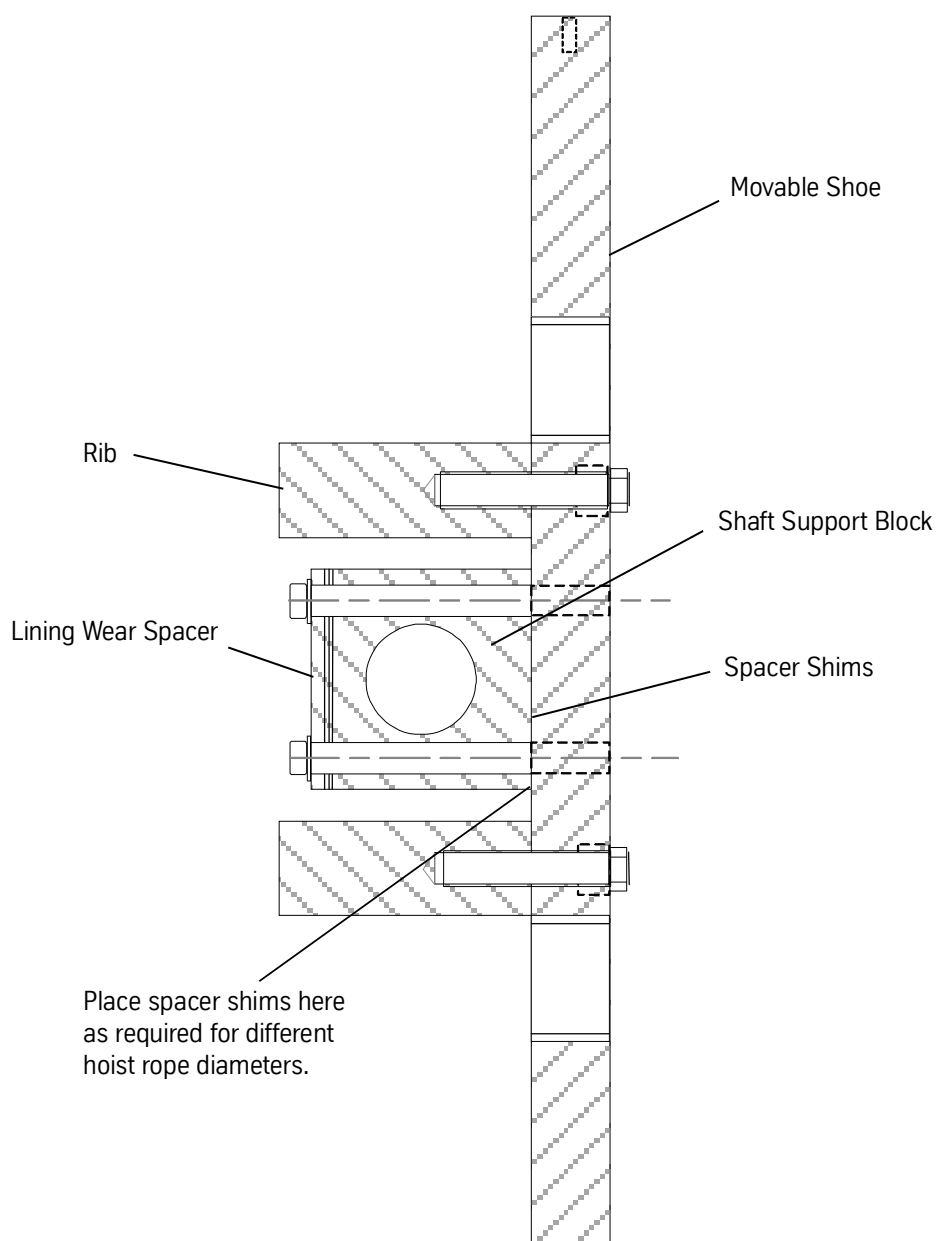


Figure 7 - Spacer Shims

Install New Linings

1. Use Manual Operation to reload the rope gripper.
2. Once the rope gripper is in the Loaded position, install security set screws so that they touch the rotating shaft.
3. Remove the four snap rings, and then remove both connecting arms.
4. Remove the movable shoe assembly.
5. Remove the two screws from each lining assembly, and then remove the linings.
6. See Table 1 for initial spacer and shim setup.
7. Loosen the mounting bolts, and tip the rope gripper to access the stationary shoe.
8. Complete inspection and replacement procedures.
9. Turn the valve stem to Automatic, and switch the pumping unit ON.
10. Carefully remove the security set screws. Use a hand pump, if necessary, so that the rotating shaft does not move.
11. Ensure that the arms have reached or gone past the wear-in line marked on the side wall, and the rotating shaft turns the corner at the bottom of the cam and moves up at least $\frac{1}{2}$ ". The rope gripper is now ready for operation.



Rope Size		Rope Gripper Model 620 or 622		Rope Gripper Model 624, 625, or 626	
mm	in.	Top	Bottom	Top	Bottom
		Lining Wear Spacer	Spacer Shims	Lining Wear Spacer	Spacer Shims
9	3/8"	1/8"	1/32" + 2 x 1/8"	1/32" + 1/8"	1/16" + 2 x 1/8"
10	3/8"		1/32" + 2 x 1/8"		1/16" + 2 x 1/8"
11	7/16"		1/32" + 1/16" + 1/8"		2 x 1/16" + 1/8"
12	1/2"		1/32" + 1/8"		1/16" + 1/8"
13	1/2"		1/32" + 1/8"		
14	9/16"		1/32" + 1/16"	1/32" + 1/16" + 1/8"	1/8"
15	5/8"		1/32"	1/32" + 1/8"	1/16"
16	5/8"		1/32"		1/16"
17	11/16"		1/32" + SPL Block*		1/16" + SPL Block*
18	11/16"		1/32" + SPL Block*		
19	3/4"		N/A	1/32" + 1/16" + 1/8"	SPL Block*
20	3/4"		N/A		
*SPL Block is 1/16" thinner.					

Table 1 - Initial Spacer and Shim Setup

Test Procedures



The following test procedures are required for compliance with Canadian CAN/CSA B44 and ASME A17.1-2000 Safety Code for Elevators.

Power Interruption Test

1. Run the car in slow speed.
2. Turn the toggle switch on the side of the pump unit to OFF. The rope gripper activates, clamps the ropes, and stops the car. The Elevator Can Run microswitch opens and signals the controller to interrupt power to the driving motor and the machine brake.

Ascending Car Overspeed Test

1. Verify that the car is empty.
2. While keeping the machine brake open, overspeed the car in the UP direction. The governor overspeed switch activates the rope gripper. The rope gripper stops the car before the counterweight strikes the buffer or decelerates the car to the speed for which the buffer is designed.



If it is impractical to overspeed the car, run the car UP empty at high speed with the machine brake held open, and manually trip the governor overspeed switch. The rope gripper causes the car to slow down and stop. The governor can then be tested to make sure the governor switch opens at the correct overspeed setting.

Uncontrolled Low Speed Test



Do not allow anyone to enter the elevator during this test.

1. Position the empty car at any floor with the door open.
2. Open the machine brake. The elevator moves UP, and the rope gripper activates.



If the car does not move when the machine brake opens, turn the brake drum or disc to start the car.

3. Verify that the car traveled no more than 48 inches.

Controller Circuits

- The controller circuits activate the rope gripper by opening contacts RG1, RG2, DZ1, and DZ2. See Figure 8 on page 35 for this section.
- The governor overspeed switch as well as the function blocks (GRC1, GRC2, DZC1, and DZC2, respectively) control the relay coils RG1, RG2, DZ1, and DZ2.
- If the circuits do not make contact when required, the elevator must be prevented from running.
- If other types of relays are used, circuits must prove that contacts from RG1, RG2, DZ1, and DZ2 are functioning properly; when failures are detected, the elevator is prevented from running.

GRC1 Circuits

- RG1 energizes:
 - if the car is not in the door zone when the mainline power turns ON.
 - if the car leaves the door zone (prevents rope gripper activation).
 - when switching from Inspection Operation to Normal Operation.
 - when resetting the governor overspeed switch.
 - during a time interval.
 - during a door closure signal.
 - when the car gate or door interlock makes contact.
 - if both the car and hoistway doors open between floors.
- RG1 de-energizes anytime the car is in the door zone when both the car gate contact and door interlock contact open. If the car then leaves the door zone (unintended motion), power to the rope gripper is removed, and the rope gripper activates.

GRC2 Circuits

- Redundant circuits required by the Canadian CAN/CSA B44 and ASME A17.1-2000 Safety Code for Elevators.
- Use separate logic for the timing function, door locks, gate switch, and door zone.
 - DZC1 logic may be used for circuits of RG1.
 - DZC2 logic may be used for circuits of RG2.

DZC1 Circuits

- Energized in the first door zone, and de-energized outside of the first door zone.
- Maximum door zone = 10 inches.

DZC2 Circuits

These circuits function the same as DZ1 using a second door zone signal.

Circuit Diagram

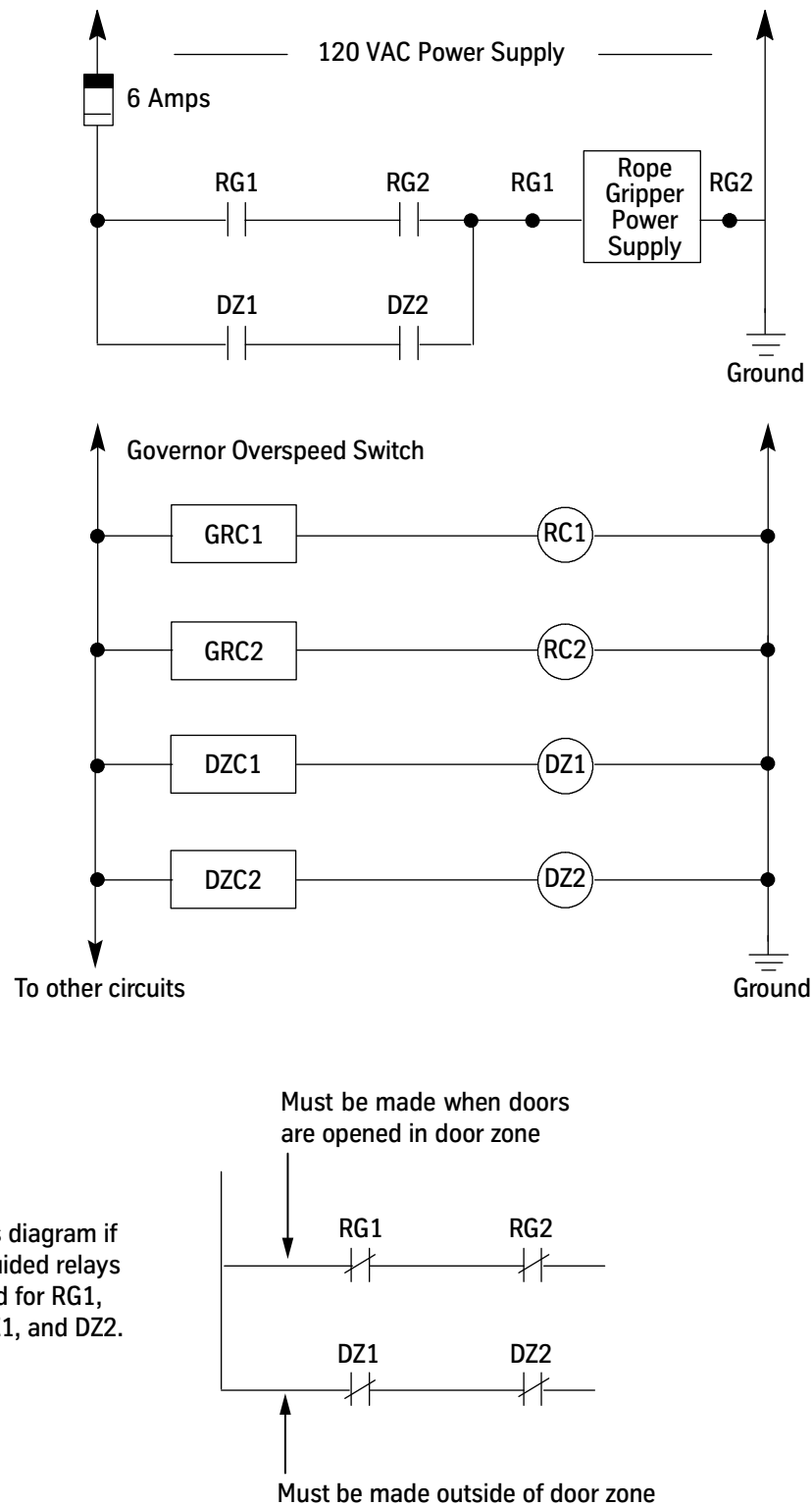


Figure 8 - Controller Circuits

Circuit Testing

Perform the following tests in both UP and DOWN directions while the car is running in slow speed. After passing all three tests, the rope gripper is ready for operation.

Pump Test Switch

1. Turn the pump test switch OFF.
2. Verify that the rope gripper:
 - grabs the ropes.
 - stops the car.
 - opens the control safety circuits to interrupt power to the motor and the machine brake.

Door Lock Circuit

1. With the car outside of the door zone, open the door or the door lock circuit.
2. Verify that the rope gripper:
 - grabs the ropes.
 - stops the car.
 - opens the control safety circuits to interrupt power to the motor and the machine brake.



The control circuits may require a manual reset before the rope gripper reloads.

Governor Overspeed Switch

1. Manually open the governor overspeed switch.
2. Verify that the rope gripper:
 - grabs the ropes.
 - stops the car.
 - opens the control safety circuits to interrupt power to the motor and the machine brake.

Operation

Normal Operation

- Power to the rope gripper is constantly maintained.
- When in the door zone, DZ1 and DZ2 provide power to the rope gripper; when the doors close, RG1 and RG2 energize.
- As the car leaves the floor, DZ1 and DZ2 de-energize, and power to the rope gripper is maintained through RG1 and RG2.
- When approaching a new floor, DZ1 and DZ2 energize again, and when the doors open, RG1 and RG2 de-energize.

Overspeed

- When overspeed is detected, the governor overspeed switch opens.
- An additional overspeed can be detected by an encoder or tachometer that detects the speed of the elevator.
- When detected, relays RG1, RG2, DZ1, and DZ2 de-energize, which removes power from the rope gripper, clamping the ropes and stopping the car.

Overspeed Reset

- Reset the governor overspeed switch and, if necessary, the elevator control circuits.
- Refer to the controller manufacturer's instructions for rope gripper reset.



Code requires manual reset of the rope gripper if triggered by a fault. Before the car is placed back into service, a qualified technician must inspect the elevator and correct any malfunction. A dangerous situation can result if a rope gripper is manually reset without first correcting the cause of the fault. (Example: If a brake failure occurs and is not corrected, then when the rope gripper is reset, it is likely that the car will fall up or down.)

Unintended Motion

- When the car is at a floor with the doors open, relays RG1 and RG2 de-energize, and relays DZ1 and DZ2 energize.
- If the car leaves the floor, DZ1 and DZ2 de-energize, removing power from the rope gripper, clamping the ropes, and stopping the car.

Unintended Motion Reset

Unintended motion reset is accomplished through elevator control circuits. Refer to and follow the control manufacturer's instructions for rope gripper reset.



Code requires manual reset of the rope gripper if triggered by a fault. Before the car is placed back into service, a qualified technician must inspect the elevator and correct any malfunction. A dangerous situation can result if a rope gripper is manually reset without first correcting the cause of the fault. Example: If a brake failure occurs and is not corrected, then when the rope gripper is reset, it is likely that the car will fall up or down.)

Manual Opening

During a power failure, the rope gripper activates. When power is restored, the rope gripper automatically reloads and puts the elevator back into service. If the car must be moved during a power outage, a manual pump is provided to open the rope gripper.

1. Turn the valve stem in the pumping unit to Manual. See Figure 4 on page 27 or Figure 5 on page 28.
2. Hand pump the rope gripper to the Loaded position to release the ropes.



When power is restored, if the hydraulic valve is left in the manually closed position, a microswitch contact prevents the elevator from running.

Troubleshooting

Rope Gripper Troubleshooting



When working on the rope gripper, keep hands clear.

Problem The electric pump functions, but the rope gripper does not pump open.

Cause Blown fuses at the controller.

Possible Solution 1. Check the hydraulic oil level. If low, apply a thin layer of a general purpose grease lubricant to the cam surface, trigger, latch mechanism, and movable shoe guides.



If the pump runs too long at low fluid levels, the fuse blows, and in some cases, the motor capacitors fail.

2. Verify that a 3 amp Fusetron™ fuse is installed. See Figure 3 on page 26. If the fuse is correct, skip to step 5. If the fuse is incorrect, contact ITS Field Engineering (1-800-655-9601).
3. Check the resistance of the dump valve coil, and verify that it is approximately 3.5 megohms. If the resistance reads as Open, replace the dump valve coil.
4. If the fluid level, dump valve coil, and amp draw are correct, place the dump valve in the Manual position, and run the pump. If the rope gripper opens with the pump running and the valve in the Manual position, replace the dump valve.
5. Check the pump unit amp draw:
 - a. Ensure that the security set screws are installed or that the rope gripper is clamped to the ropes.
 - b. Switch the pump unit OFF.
 - c. Disconnect the power supply from the controller at RG1 and RG2.
 - d. Disconnect the wire leads from the rope gripper.
 - e. Get an extension cord, and remove the female end of the cord.
 - f. Bare the wire ends of the cord, and connect cord L1 to RG1, and cord L2 to RG2.
 - g. Plug the extension cord into a 120 VAC wall outlet.
 - h. Put a clamp-on amp meter around cord L1, and switch the pump unit ON. The pump motor runs, and the amp draw spikes high and then lowers and levels out. If the draw is more than 6.5 amps, contact ITS Field Engineering.

Rope Gripper Troubleshooting

(continued)

Problem	The pump unit cycles ON and OFF with a cycle time of 15-60 seconds.
Cause	The brake-ready microswitch is out of adjustment.
Possible Solution	Perform the Microswitch Adjustment Procedure on page 40.

Microswitch Process Overview

1. The rope gripper is hydraulically pumped open and then electromechanically held in the Loaded position.
2. When the rope gripper rotating shaft reaches the Loaded position, the Brake Ready microswitch contact opens, turning the pump OFF.
3. The pump should run long enough to get the latch hook past the trigger, but not so long as to push the rotating shaft into the back of the cam slot.
4. The hydraulic pressure slowly bleeds off until the trigger and latch are resting together and engaged. See Figure 9.

Microswitch Adjustment Purpose

- Allow proper engagement of the trigger and latch.
- Prevent the rotating shaft from bottoming out in the cam slot.
- Allow clearance of approximately $\frac{1}{32}$ " between the rotating shaft and the bottom of the cam slot when the trigger and latch are engaged.

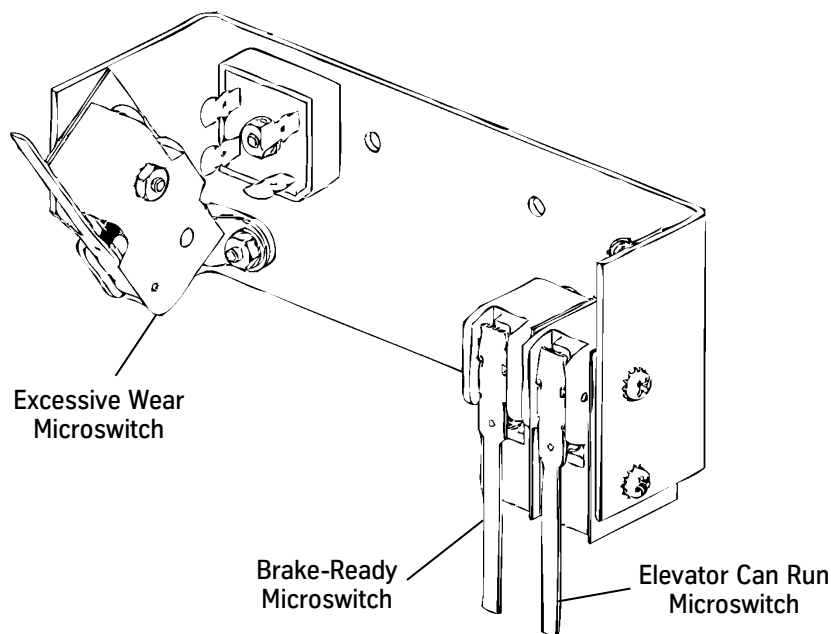


Figure 9 - Brake-ready Microswitch and Trigger Mechanism

Rope Gripper Troubleshooting

(continued)

Microswitch Adjustment Procedure

1. Turn the pumping unit OFF. The rope gripper activates and clamps the ropes. Note the position of the large washer and Allen screw on top of the latch coil.
2. Switch the pumping unit ON. As the rope gripper returns to the ready position, observe the large washer and Allen screw on top of the latch coil to verify that they rise with the passing of the latch under the trigger, and then lower and return to their original position.
 - If the large washer and Allen screw return to their original position, skip to step 4.
 - If the large washer and Allen screw do not return to their original position, then either the pump is not running long enough, which indicates that the microswitch is out of adjustment, or the latch is slightly out of adjustment causing the trigger to bind on one edge of the latch.



When the trigger and the latch engage, there is run-by room between the sides of the trigger and the latch, and the latch is centered on the trigger.

3. Repeat steps 1 and 2 to verify that the latch is centered.
 - If the latch is centered, skip to step 4.
 - If the latch is not centered:
 - a. Turn the pumping unit OFF. The rope gripper activates and clamps the ropes.
 - b. Slightly loosen the screws holding the latch, and, making sure the latch remains square, tap the latch into a more centered position.
 - c. Tighten the screws, and repeat steps 1 and 2.
4. Reinstall the security screws so that they just touch the rotating shaft, and verify that the coil activates.
5. Ensure that the large washer and Allen screw are seated properly, and attempt to raise the washer and Allen screw with thumbnail pressure.
 - If the washer can move, check all power to and across the coil.
 - If there is a problem with the power or coil, repair it, and then skip to step 8.
6. Remove one or both of the connecting arms from the rope gripper, and verify that the clearance between the rotating shaft and the cam slot is $\sim 1/32$ ". Then reinstall the connecting arms. If the clearance approaches zero, contact ITS Field Engineering (1-800-655-9601).

Rope Gripper Troubleshooting

(continued)

7. To make the pump run longer, adjust the screw outwards in $\frac{1}{4}$ turn increments. See Figure 10.



There are two screws in the actuating angle. Facing the unit, the left screw adjusts the brake-ready microswitch.



After each adjustment, check the clearance between the rotating shaft and the cam slot.

8. Check the microswitch adjustment. Remove the security screws and retest the rope gripper.

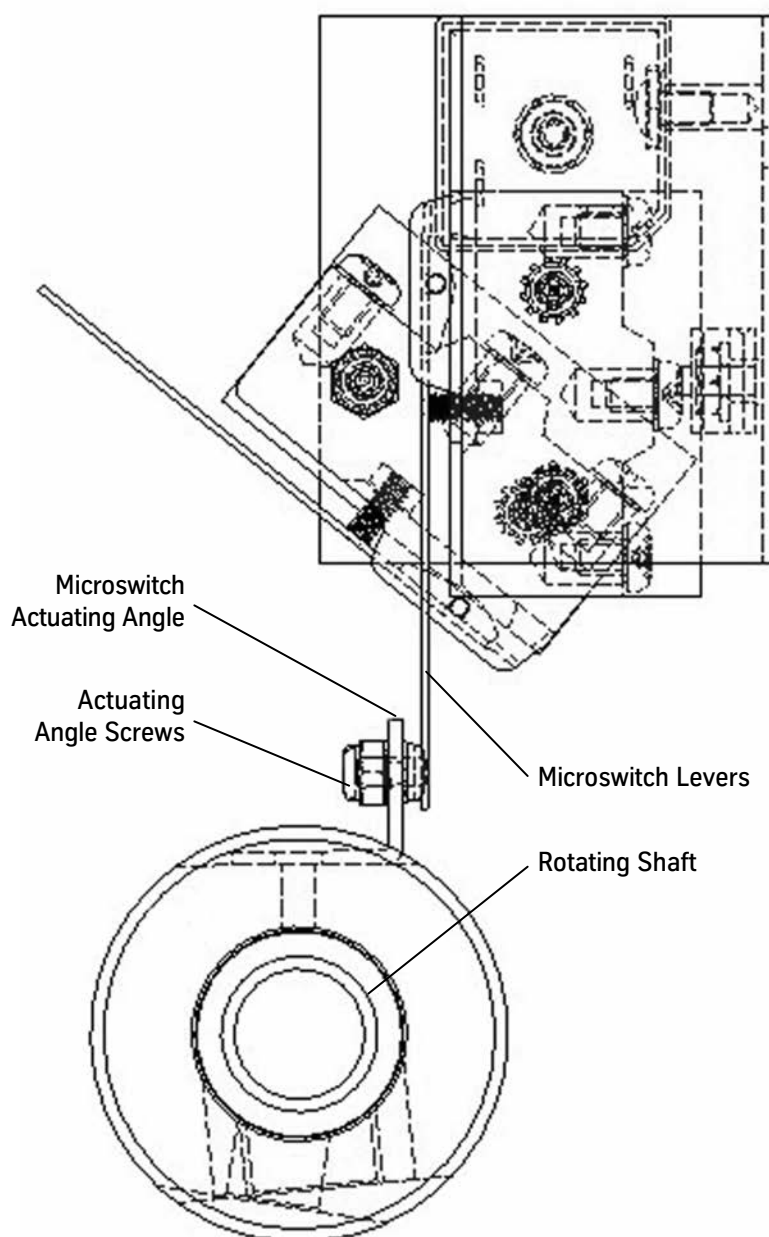


Figure 10 - Actuating Angle

Hydraulic Cylinder Troubleshooting

Problem Leaking cylinder.

Cause Leaking or ruptured hydraulic cylinders occur when the rope gripper does not latch properly due to:

- an out of adjustment microswitch that prompts the trigger and latch to disengage.
- a malfunctioning latch coil.
- a latch misalignment.
- repeated cycling, which causes fluid loss and unnecessary wear on the cylinder and pump unit.

Possible Solution Recommended Tools:

- 7" long, $\frac{5}{32}$ " ball nose Allen wrench or driver
 - Normal mechanic tools (wrenches, screwdrivers, Allen wrenches, etc.)
1. Pump the rope gripper into the Loaded position, and install the security screws to hold the rope gripper shoes open.
 2. Remove the four snap rings, both connecting arms, and the movable shoe.
 3. Turn the pumping unit OFF, and place the valve stem in the Manual position.
 4. Use the hand pump to pump the cylinder down and relieve pressure on the security screws. Remove the security screws.
 5. Return the valve stem to the Automatic position. The rotating shaft goes entirely up the cam.
 6. With the rotating shaft at the top of the cam, remove the hydraulic hose from the cylinder.
 7. Remove three angle bolts from both sides of the mounting angle. The mounting angles stay attached to the floor.
 8. Place the rope gripper on a suitable work surface. Hold the cylinder, locate the shaft, and remove the shaft from the rope gripper.
 9. Locate the block holding the cylinder stem to the rotating shaft tube, and use a 7" long, $\frac{5}{32}$ " ball nose Allen wrench or driver to remove four #10-32 screws from the block.
 10. Remove the block from the cylinder, and place the block on a new cylinder. To reinstall the cylinder, first install the shaft, and then install the block and the screws.
 11. Install the hose on the cylinder.
 12. Restore the rope gripper to the mounting angles.

Hydraulic Cylinder Troubleshooting

(continued)

13. With the valve stem at the Manual position, loosen the hose at the cylinder to bleed the air out of the system.
14. Pump the hand pump until oil comes out of the hose at the cylinder and no air is evident, and then reattach the hose.
15. Turn the pumping unit ON. Hand pump the cylinder down until the pump motor takes over the pumping.
16. With the rotating shaft down and the trigger latched, install the security set screws.
17. Reassemble the movable shoe, the arms, and the snap rings to the rope gripper.
18. When reassembly is complete, remove the security set screws, turn the valve to Automatic, and place the rope gripper back into operation.

Problem	The cylinder will not pump down or hold pressure.
Possible Solution	<ol style="list-style-type: none"> 1. Make sure the rope gripper is gripping the ropes, the pumping unit is OFF, and the machine brake is set. 2. Remove five angle bolts from both mounting angles, and set the mounting angles aside. 3. Locate the shaft holding the cylinder, and remove the shaft from the rope gripper. 4. With the valve stem in the Manual position, locate the block holding the cylinder stem to the rotating shaft tube, and use a 7" long, $\frac{5}{32}$" ball nose Allen wrench or driver to remove four #10-32 screws from the block. 5. Remove the block from the cylinder, and place the block on a new cylinder. To reinstall the cylinder, first install the shaft, and then install the block and the screws. 6. Install the hose on the cylinder. 7. Restore the rope gripper to the mounting angles. 8. With the valve stem at the Manual position, loosen the hose at the cylinder to bleed the air out of the system. 9. Pump the hand pump until oil comes out of the hose at the cylinder and no air is evident, and then reattach the hose. 10. Return the valve stem to Automatic, and turn the pumping unit ON. The rope gripper returns to the Loaded position.

Hydraulic Cylinder Troubleshooting

(continued)

- | | |
|---------|--|
| Problem | <ul style="list-style-type: none"> • The hand pump does not function. • The rope gripper will not pump open. |
|---------|--|

Cause	Air lock.
-------	-----------

- | | |
|-------------------|--|
| Possible Solution | <p>Use the following procedure to prime the hand pump by forcing fluid into the system. Repeat the procedure a few times if necessary to remove all of the air from the system.</p> <ol style="list-style-type: none"> 1. Disconnect the hydraulic hose from the rope gripper at the quick-connect coupling. 2. Put the dump valve in the Manual position, and lower the hand pump handle. 3. Electrically run the pumping unit, and verify that the pump handle rises. |
|-------------------|--|

Problem	Air in the line.
---------	------------------

Possible Solution	Bleed the air: loosen the hose at the cylinder, and then use the hand pump until no air is evident.
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Problem	The rope gripper pumps partially down, and the pump continues to run.
---------	---

Cause	Low fluid level.
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Possible Solution	Apply a thin layer of a general purpose grease lubricant to the cam surface, the trigger and latch mechanism, and the four movable shoe guides.
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VE Operation of the HW Rope Gripper

- The rope gripper trip switch contacts (GTS, GTSX, and RGD) on the elevator controller must open during Up Over-speed or when the doors open outside of the door zone.
- When the rope gripper is in the Loaded position and not in the Manual Opening mode, the rope gripper trip switch contacts are closed, indicating to the elevator control system that the elevator can run.
- The controls must be built to conform to all local and federal codes. For Canada, the circuits must conform with CAN/CSA B-44, Clause 3.12.9 (c) and (d).

Command	Definition
Loaded	The rope gripper is in ready position.
	The rope gripper shoes are open (not grabbing the ropes).
	The power supply to the rope gripper is present. The rope gripper trip switch contacts GTS, GTSX, and RGD on the elevator controller are closed.
	The electric trigger solenoid is energized from the power supply and holds the rope gripper in the Loaded position.
	The micro switch contact on the rope gripper is closed, indicating to the controller that the elevator can run.
Activation	The power supply to the rope gripper is disconnected when contacts GTS, GTSX, or RGD on the elevator controller are open.
	The electric trigger solenoid de-energizes and releases the rope gripper.
	The micro switch contact on the rope gripper opens, signaling the elevator controller to disconnect or prevent power on the motor and brake circuits.
	The rope gripper shoes close, grab the ropes, and stop the car.
Automatic Reloading	Contacts GTS, GTSX, and RGD on the elevator controller close, indicating all conditions are normal, and the rope gripper returns from the Activated to the Loaded position.
	The power supply is established. The hydraulic pump turns on, which forces oil into the cylinder, compresses the springs, and moves the shoe towards the Loaded position.
	When the shoe reaches the Loaded position, a contact opens and disconnects the hydraulic pump, the electric solenoid energizes and holds the rope gripper in the Loaded position, and a micro switch closes to allow the elevator to run.
Manual Opening	During a power failure, the rope gripper activates. When power is restored, the rope gripper automatically reloads and puts the elevator back into service. If the car must be moved during a power outage, a manual pump is provided to open the rope gripper.
	A hydraulic valve must be manually closed, and then the hand pump moves the rope gripper toward the Loaded position to release the ropes. If the hydraulic valve is left in the manually closed position, when power is restored, a microswitch contact prevents the elevator from running.

VE Controller Circuits

- The Vertical Express Controller Circuits activate the rope gripper and stop the car.
- The controls must be built to conform to all local and federal codes.
- For Canada, the circuits must conform with CAN/CSA B-44, Clause 3.12.9 (c) and (d). The CAN/CSA B-44 Code requires activation of the rope gripper in the ascending overspeed direction. For added safety, the circuits shown operate in both directions.
- To prevent a ground from rendering a protective device ineffective, ground one line of the control circuits and rope gripper supply, and wire the protective devices and contacts in the other line. See Figure 11.
- GTS and GTSX are wired in parallel with their contacts, which are wired in series with the rope gripper power supply. The failure of either relay will not prevent the rope gripper from activating.

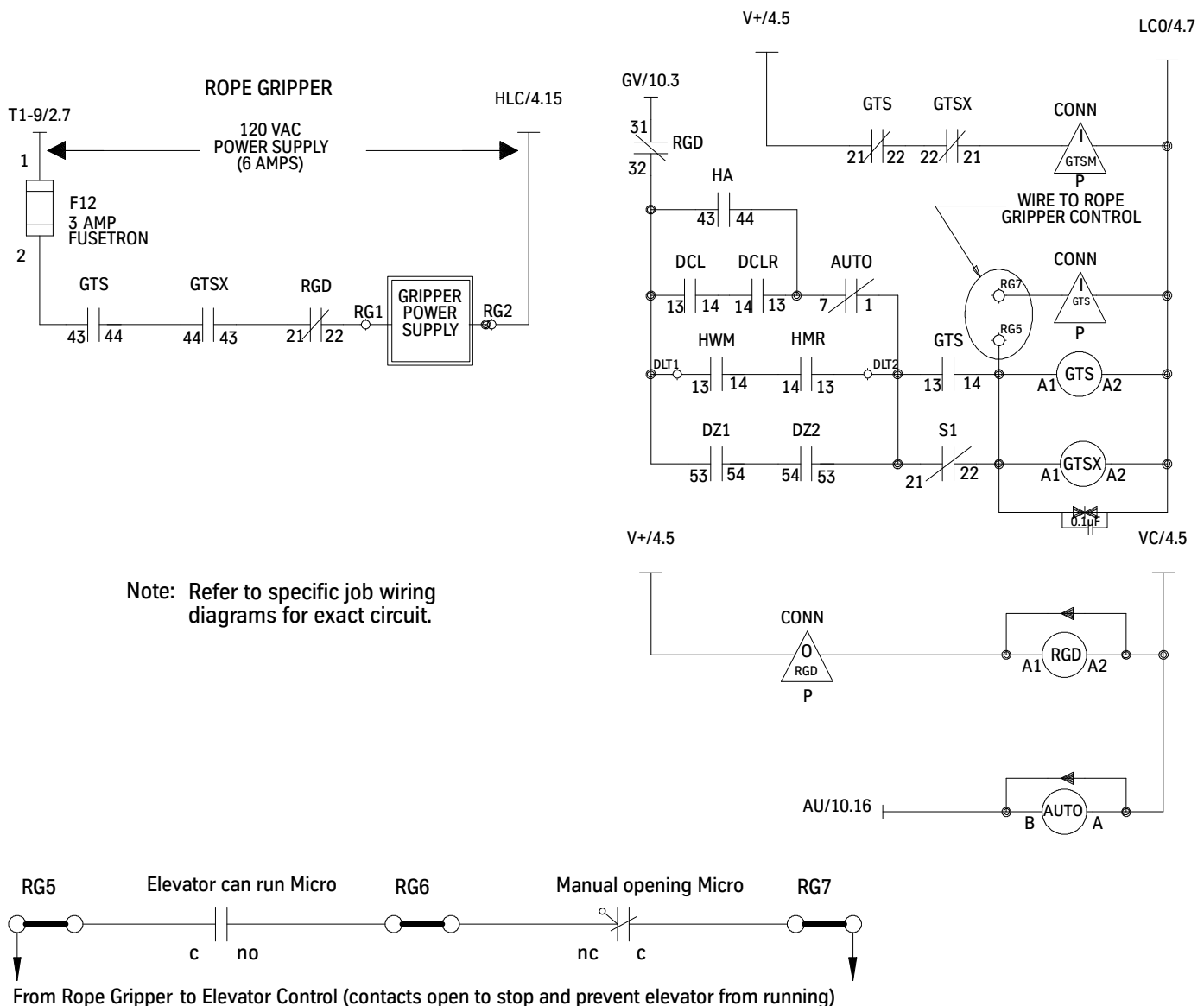


Figure 11 - Typical VE Controller Circuit for the HW Rope Gripper

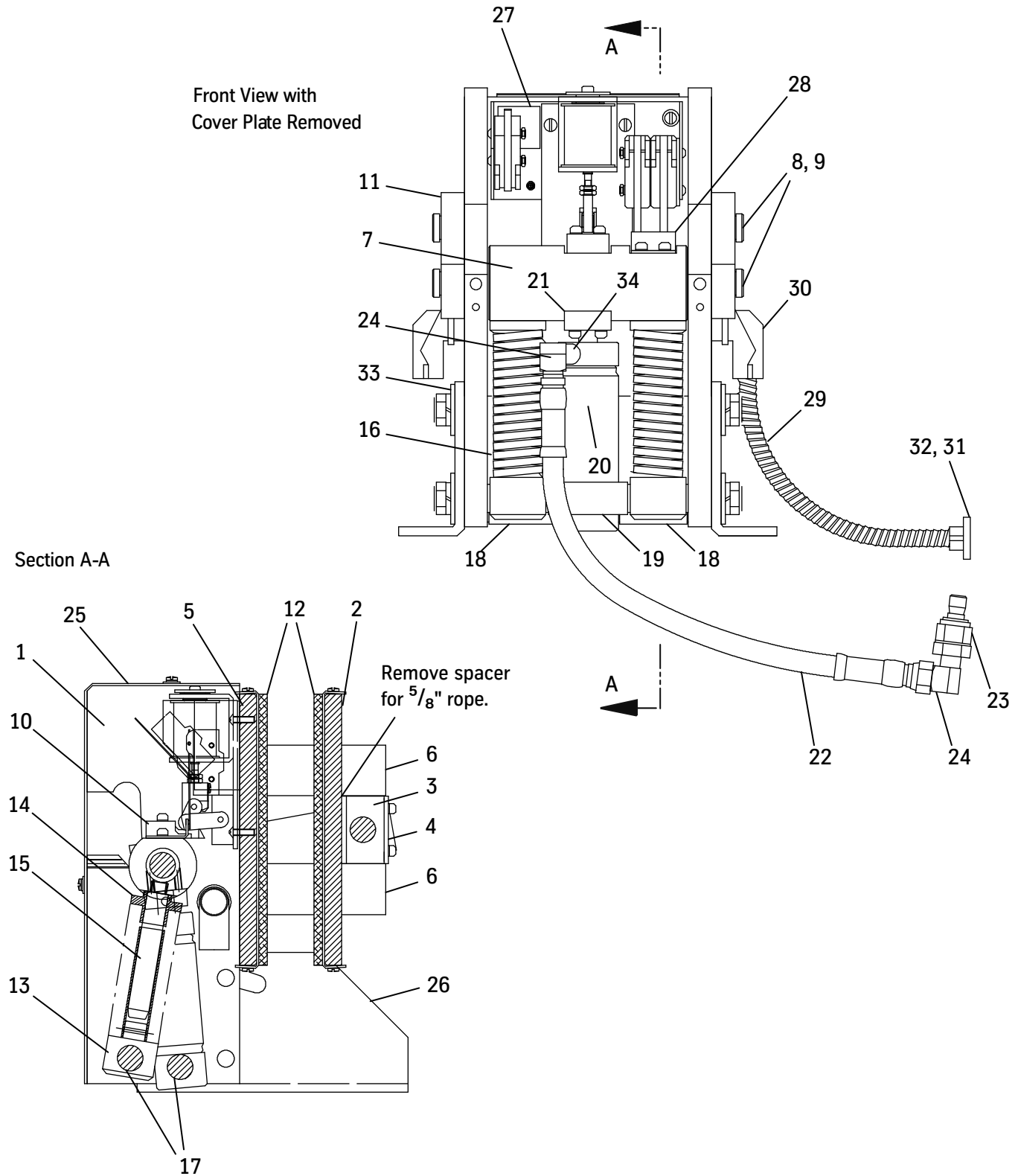
VE Controller Circuits

(continued)

Symbol	Circuit Name	Definition
DLT	Door Lock Relay Timed Contact	This relay closes when door lock contacts are made.
		This relay opens about $\frac{1}{4}$ sec. after door locks open. The time delay prevents the rope gripper from activating if a door lock is briefly clipped.
		To conform with CAN/CSA B-44, Clause 3.12.9 (c) and (d).
		If this relay fails to de-energize when the door is open, the elevator must be prevented from restarting.
DZ	Door Zone Relay Contact	This relay closes when the elevator is in the zone where doors can open.
		This relay opens when the car leaves the door zone.
		The maximum with door equipment by GAL Manufacturing is 9" above or below the floor level.
		For elevators with static control, the rope gripper activates if the inner landing zone is used and the car moves beyond 3" with the doors opened.
		To conform with CAN/CSA B-44, Clause 3.12.9 (c) and (d).
		This relay must be monitored; if the relay fails to operate as intended, the elevator must be prevented from restarting.
PF	Power Relay Contact	This relay opens approximately 30 seconds after power is established to allow GTS to become self-holding.
		This relay is de-energized while on Inspection Operation and should energize approximately 30 seconds after Automatic Operation is established.
		This relay allows an automatic reset to avoid a nuisance manual reset when a mechanic is exiting the car top after placing the car top station on Automatic Operation.
GTS & GTSX	Rope Gripper Trip Switch and Auxiliary Relays	Both relays energize for Normal Operation and de-energize to activate the rope gripper.
		GTS must be a pushbutton or manually reset relay. When the rope gripper is activated by over-speed or by the car leaving the door zone with the doors opened, the rope gripper grabs the ropes and prevents the car from running until personnel can inspect and manually reset this relay.
RGD Relay Contact	Rope Gripper Dropped	The rope gripper has failed.

Replacement Parts

8000AC1 (HW 620)

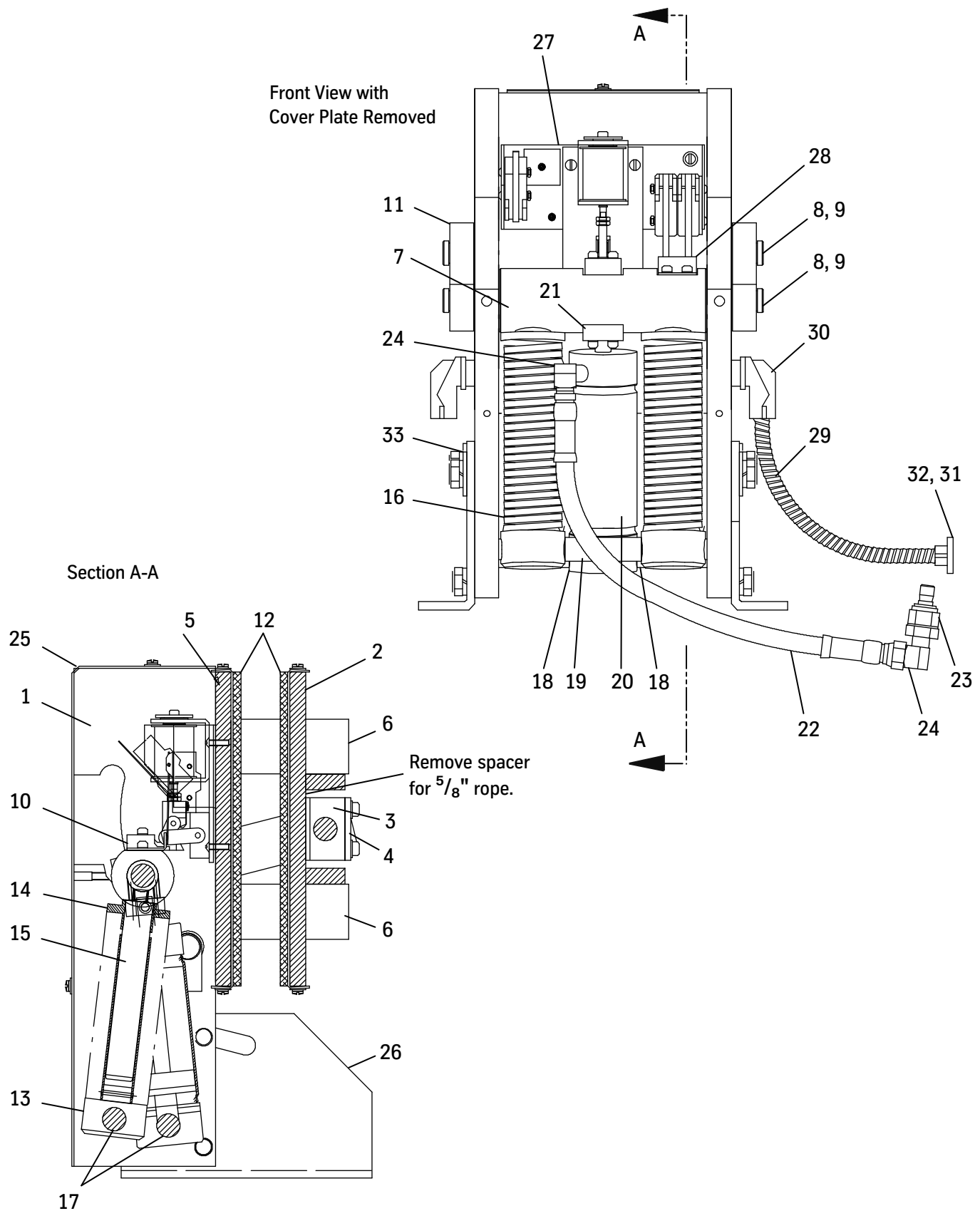


8000AC1 (HW 620)*(continued)*

Purchase individual parts from Hollister-Whitney at (217)222-0466. For more information, visit <https://www.hollisterwhitney.com/support/> or email info@hollisterwhitney.com.

ITEM	HW PART NO.	QTY.	DESCRIPTION
1	620-001	2	Wall, side
2	620-004	1	Shoe, movable
3	601-007	2	Block, shaft support
4	601-008	2	Spacer, lining wear
5	620-003	1	Stationary shoe assy.
6	620-096	4	Guide, movable shoe
7	620-015	1	Tubing assy.
8	620-018	2	Shaft, rotating and non-rotating
9	90-033	4	E-clip, Truarc™ No. X5133-74
10	601-078	1	Latch
11	601-020	2	Connecting arm assy.
12	601-022	2	Lining assy.
13	601-025	2	Spring lower support assy.
14	601-027	2	Spring upper support
15	601-029	2	Guide, spring upper support
16	601-030	2	Spring
17	620-031	2	Shaft
18	620-032	2	1 ³ / ₁₆ " spacer tubing
19	620-033	1	2 ⁵ / ₁₆ " spacer tubing
20	601-035	1	Hydraulic cylinder
21	622-036	1	Hydraulic cylinder pivot bracket assy.
22	600-037	1	Hose
23	600-038	1	Coupling, quick disconnect
24	600-039	2	Elbow, street, 90°
25	620-040	1	Cover
26	601-041	2	Mounting angle
27	620-064	1	Switch assy. (lead lengths, -1 = 10', -2 = 24', -3 = 18')
28	600-051	1	Actuating angle
29	600-081	1	Flexible conduit
30	600-082	1	Box connector, 90°
31	600-083	1	3/8" flexible connector
32	600-084	1	Bushing
33	601-095	2	Double bolt washer
34	601-039	1	Elbow, street, 90°
	622-100	1	Pumping unit (not shown)

8000AC2 (HW 622)

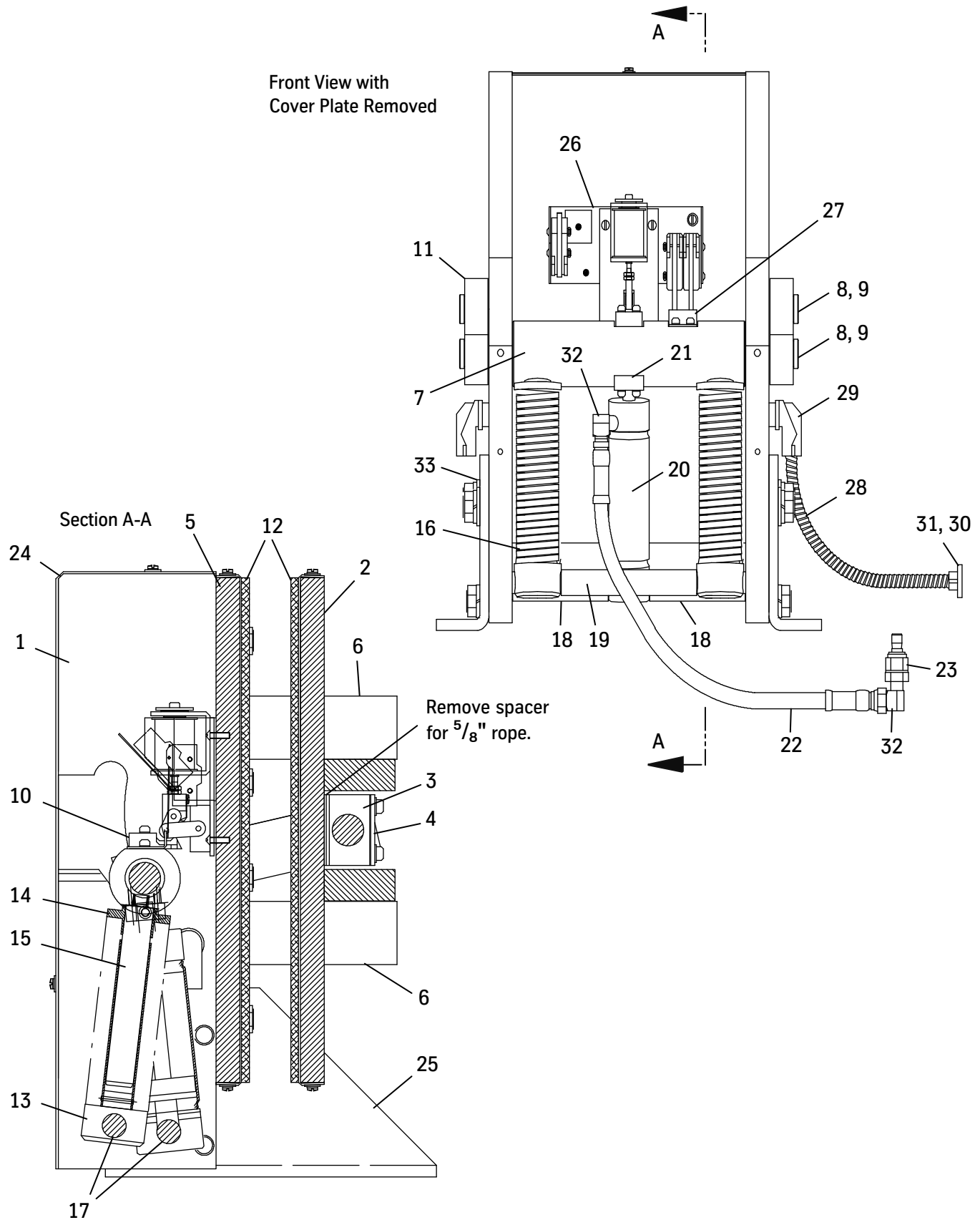


8000AC2 (HW 622)*(continued)*

Purchase individual parts from Hollister-Whitney at (217)222-0466. For more information, visit <https://www.hollisterwhitney.com/support/> or email info@hollisterwhitney.com.

ITEM	HW PART NO.	QTY.	DESCRIPTION
1	620-001	2	Wall, side
2	622-002	1	Movable shoe assy.
3	600-007	2	Block, shaft support
4	600-008	2	Spacer, lining wear
5	622-003	1	Stationary shoe assy.
6	622-096	4	Guide, movable shoe
7	622-015	1	Tubing assy.
8	622-018	2	Shaft, rotating and non-rotating
9	90-033	4	E-clip, Truarc No. X5133-74
10	601-078	1	Latch
11	600-020	2	Connecting arm assy.
12	600-022	2	Lining assy.
13	600-025	2	Spring lower support assy.
14	600-027	2	Spring upper support
15	600-029	2	Guide, spring upper support
16	600-030	2	Spring
17	622-031	2	Shaft
18	601-032	2	2 ¹ / ₈ " spacer tubing
19	620-033	1	2 ³ / ₈ " spacer tubing
20	600-035	1	Hydraulic cylinder
21	622-036	1	Hydraulic cylinder pivot bracket assy.
22	600-037	1	Hose
23	600-038	1	Coupling, quick disconnect
24	600-039	2	Elbow, street, 90°
25	622-040	1	Cover
26	600-041	2	Mounting angle
27	622-064	1	Switch assy. (lead lengths, -1 = 10', -2 = 24', -3 = 18')
28	600-051	1	Actuating angle
29	600-081	1	Flexible conduit
30	600-082	1	3/8" box connector, 90°
31	600-083	1	3/8" flexible connector
32	600-084	1	Bushing
33	600-095	2	Double bolt washer
	622-100	1	Pumping unit (not shown)

8000AC3 (HW 624)

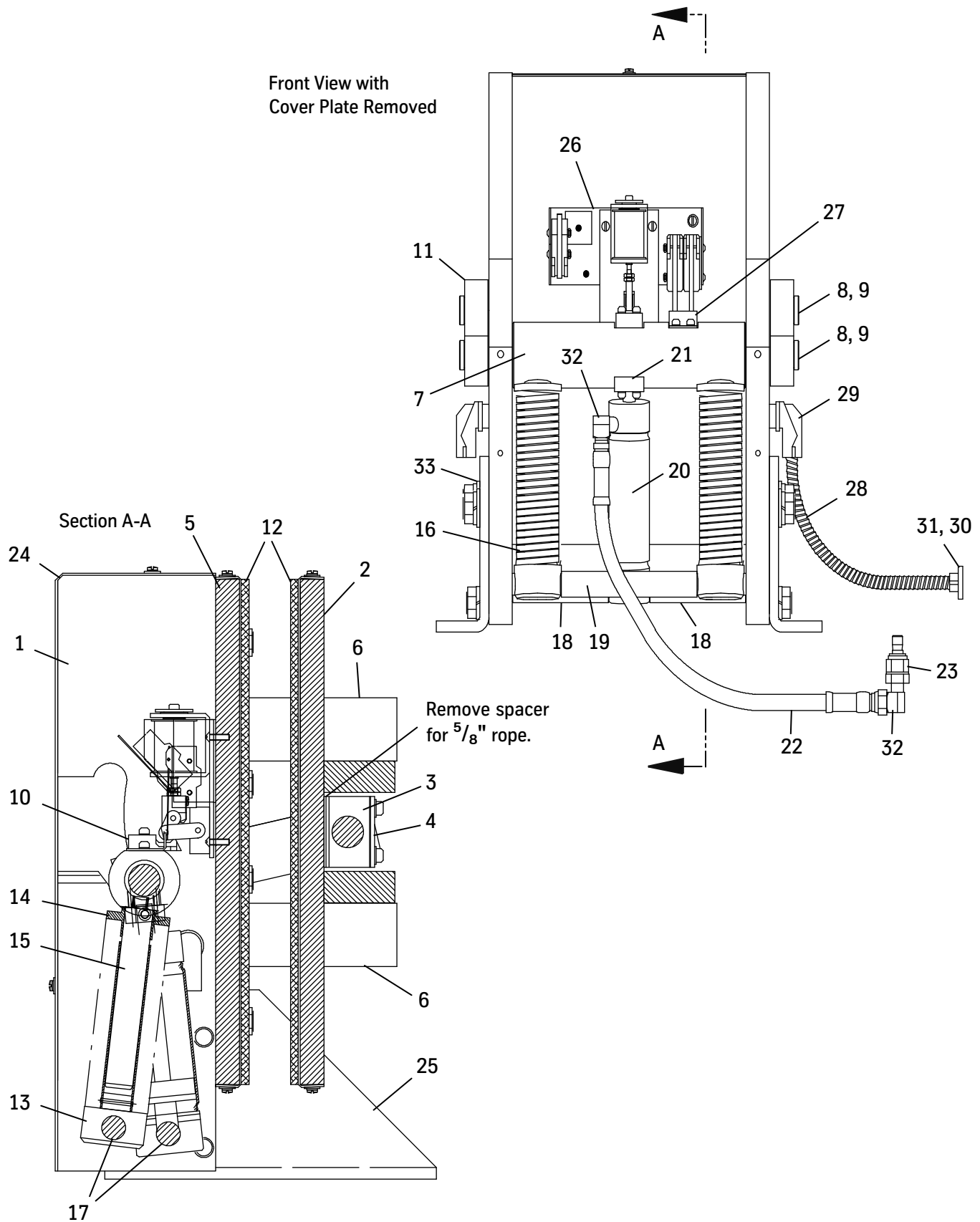


8000AC3 (HW 624)*(continued)*

Purchase individual parts from Hollister-Whitney at (217)222-0466. For more information, visit <https://www.hollisterwhitney.com/support/> or email info@hollisterwhitney.com.

ITEM	HW PART NO.	QTY.	DESCRIPTION
1	624-001	2	Wall, side
2	626-002	1	Movable shoe assy.
3	610-007	2	Block, shaft support
4	610-008	2	Spacer, lining wear
5	624-003	1	Stationary shoe assy.
6	626-096	4	Guide, movable shoe
7	624-015	1	Tubing assy.
8	626-018	2	Shaft, rotating and non-rotating
9	610-085	4	E-clip, Truarc No. X5133-74
10	601-078	1	Latch
11	610-020	2	Connecting arm assy.
12	610-022	2	Lining assy.
13	600-025	2	Spring lower support assy.
14	600-027	2	Spring upper support
15	600-029	2	Guide, spring upper support
16	600-030	2	Spring
17	626-031	2	Shaft
18	624-032	2	3 ⁷ / ₈ " spacer tubing
19	624-033	1	5 ⁷ / ₈ " spacer tubing
20	600-035	1	Hydraulic cylinder
21	622-036	1	Hydraulic cylinder pivot bracket assy.
22	600-037	1	Hose
23	600-038	1	Coupling, quick disconnect
24	626-040	1	Cover
25	610-041	2	Mounting angle
26	622-064	1	Switch assy. (lead lengths, -1 = 10', -2 = 24', -3 = 18')
27	600-051	1	Actuating angle
28	600-081	1	Flexible conduit
29	600-082	1	3 ³ / ₈ " box connector, 90°
30	600-083	1	3 ³ / ₈ " flexible connector
31	600-084	1	Bushing
32	600-039	2	Elbow, street, 90°
33	610-095	2	Double bolt washer
	622-100	1	Pumping unit (not shown)

8000AC4 (HW 625)

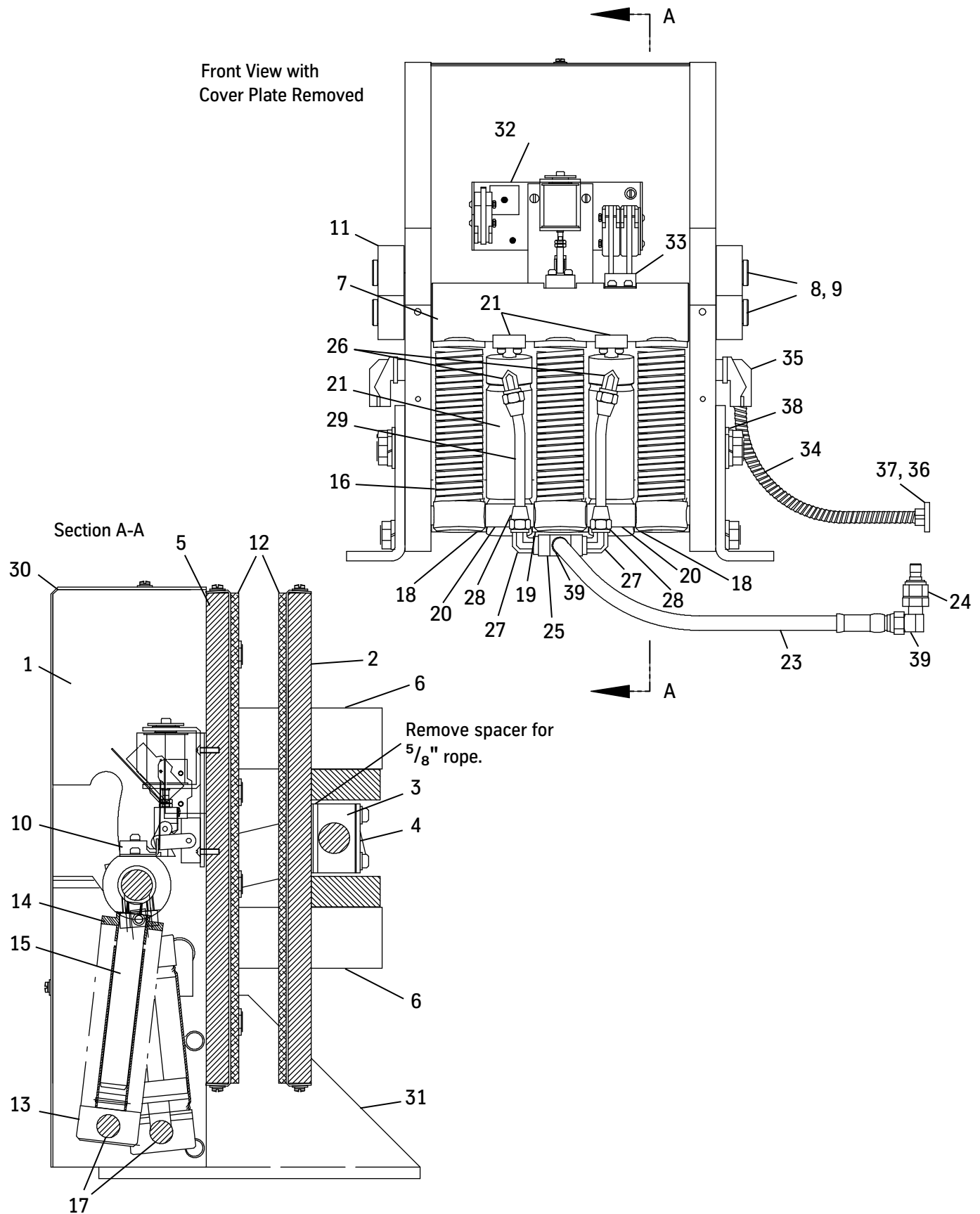


8000AC4 (HW 625)*(continued)*

Purchase individual parts from Hollister-Whitney at (217)222-0466. For more information, visit <https://www.hollisterwhitney.com/support/> or email info@hollisterwhitney.com.

ITEM	HW PART NO.	QTY.	DESCRIPTION
1	624-001	2	Wall, side
2	625-002	1	Movable shoe assy.
3	610-007	2	Block, shaft support
4	610-008	2	Spacer, lining wear
5	625-003	1	Stationary shoe assy.
6	626-096	4	Guide, movable shoe
7	625-015	1	Tubing assy.
8	610-018	2	Shaft, rotating and non-rotating
9	610-085	4	E-clip, Truarc No. X5133-74
10	601-078	1	Latch
11	610-020	2	Connecting arm assy.
12	625-022	2	Lining assy.
13	600-025	2	Spring lower support assy.
14	600-027	2	Spring upper support
15	600-029	2	Guide, spring upper support
16	600-030	2	Spring
17	610-031	2	Shaft
18	605-032	2	3 ⁷ / ₈ " spacer tubing
19	605-033	1	7 ¹ / ₄ " spacer tubing
20	600-035	1	Hydraulic cylinder
21	600-036	1	Hydraulic cylinder pivot bracket assy.
22	600-037	1	Hose
23	600-038	1	Coupling, quick disconnect
24	625-040	1	Cover
25	610-041	2	Mounting angle
26	622-064	1	Switch assy. (lead lengths, -1 = 10', -2 = 24', -3 = 18')
27	600-051	1	Actuating angle
28	600-081	1	Flexible conduit
29	600-082	1	3 ³ / ₈ " box connector, 90°
30	600-083	1	3 ³ / ₈ " flexible connector
31	600-084	1	Bushing
32	600-039	2	Elbow, street, 90°
33	610-095	2	Double bolt washer
	600-100	1	Pumping unit (not shown)

8000AC5 (HW 626)



8000AC5 (HW 626)*(continued)*

Purchase individual parts from Hollister-Whitney at (217)222-0466. For more information, visit <https://www.hollisterwhitney.com/support/> or email info@hollisterwhitney.com.

ITEM	HW PART NO.	QTY.	DESCRIPTION
1	624-001	2	Wall, side
2	626-002	1	Movable shoe assy.
3	610-007	2	Block, shaft support
4	610-008	2	Spacer, lining wear
5	626-003	1	Stationary shoe assy.
6	626-096	4	Guide, movable shoe
7	626-015	1	Tubing assy.
8	626-018	2	Shaft, rotating and non-rotating
9	610-085	4	E-clip, Truarc No. X5133-74
10	601-078	1	Latch
11	610-020	2	Connecting arm assy.
12	610-022	2	Lining assy.
13	600-025	3	Spring lower support assy.
14	600-027	3	Spring upper support
15	600-029	3	Guide, spring upper support
16	600-030	3	Spring
17	626-031	2	Shaft
18	601-032	2	2 ¹ / ₈ " spacer tubing
19	626-033	1	2 ³ / ₁₆ " spacer tubing
20	626-032	2	1 ⁷ / ₈ " spacer tubing
21	600-035	2	Hydraulic cylinder
22	622-036	2	Hydraulic cylinder pivot bracket assy.
23	610-037	1	Hose
24	610-038	1	Coupling, quick disconnect
25	610-086	1	³ / ₈ " tee
26	610-087	2	Elbow, 90° (³ / ₈ " tube O.D. x ¹ / ₄ " pipe)
27	610-088	2	Elbow, 90° (³ / ₈ " tube O.D. x ³ / ₈ " pipe)
28	610-089	4	Nut, short (³ / ₈ " tube O.D.)
29	610-090	2	³ / ₈ " tubing
30	626-040	1	Cover
31	610-041	2	Mounting angle
32	622-064	1	Switch assy. (lead lengths, -1 = 10', -2 = 24', -3 = 18')
33	600-051	1	Actuating angle
34	600-081	1	Flexible conduit
35	600-082	1	³ / ₈ " box connector, 90°
36	600-083	1	³ / ₈ " flexible connector
37	600-084	1	Bushing
38	610-095	2	Double bolt washer
39	610-091	2	Elbow, street, 90° (³ / ₈ " x ³ / ₈ ")
	622-100	1	Pumping unit (not shown)

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