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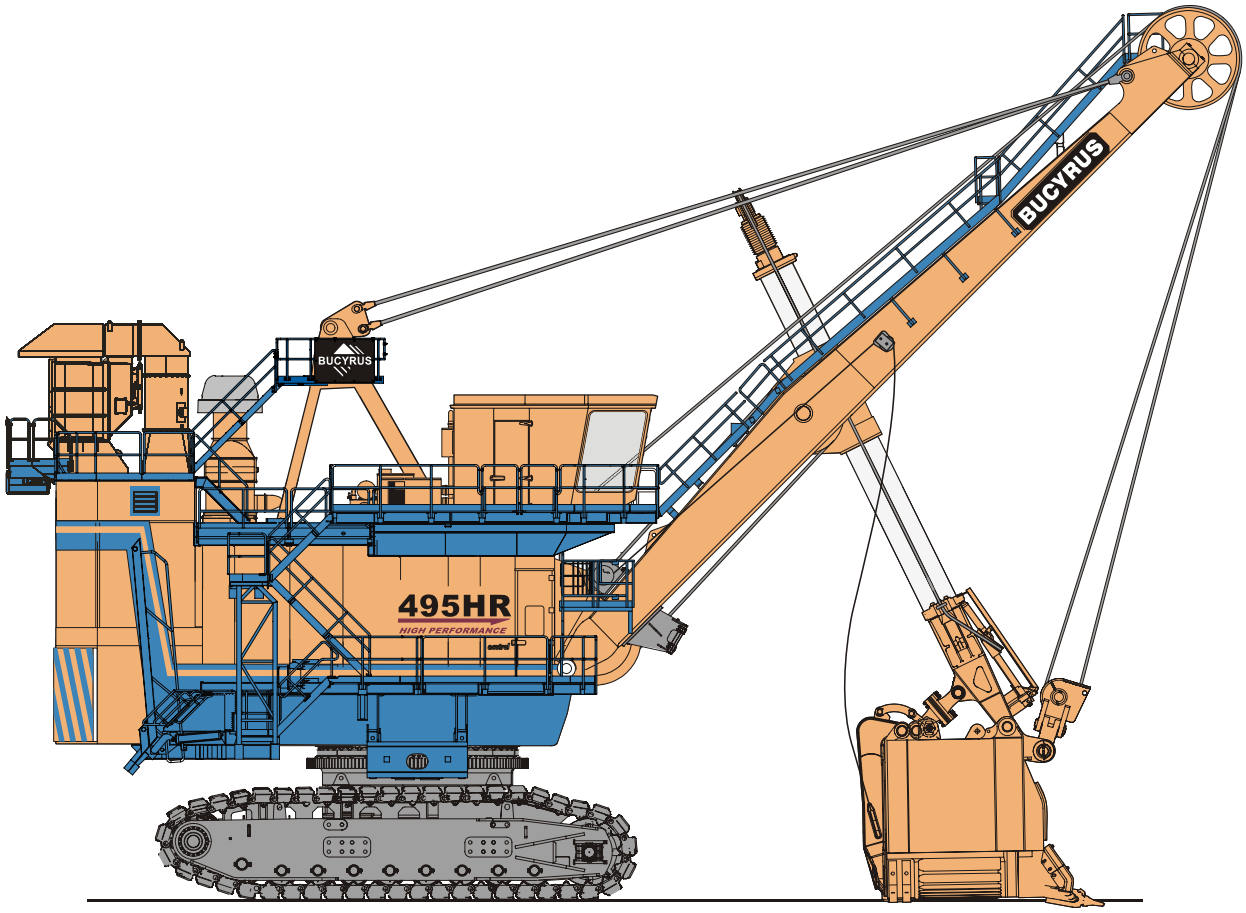
BUCYRUS®

495HR
MINING SHOVEL
MAINTENANCE and OPERATION MANUAL

SN: 141266

Manual No. *10744*



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Bucyrus International, Inc.

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495HR Electric Mining Shovel
Maintenance and Operation Manual

Manual No. 10744

SN: 141266 Lot 111

Table of Contents

This manual is divided into major sections covering the various servicable components and systems of the 495HR Mining Shovel. These sections and their contents are organized as shown below.

SAFETY

SECTION 1 - INTRODUCTION

MACHINE OVERVIEW

This mining shovel is designed and constructed to provide efficient service under the most severe conditions. The machine is built to the highest possible standards and will provide trouble free operation if properly maintained. This section of the manual introduces the machine and its functional capabilities and limitations.

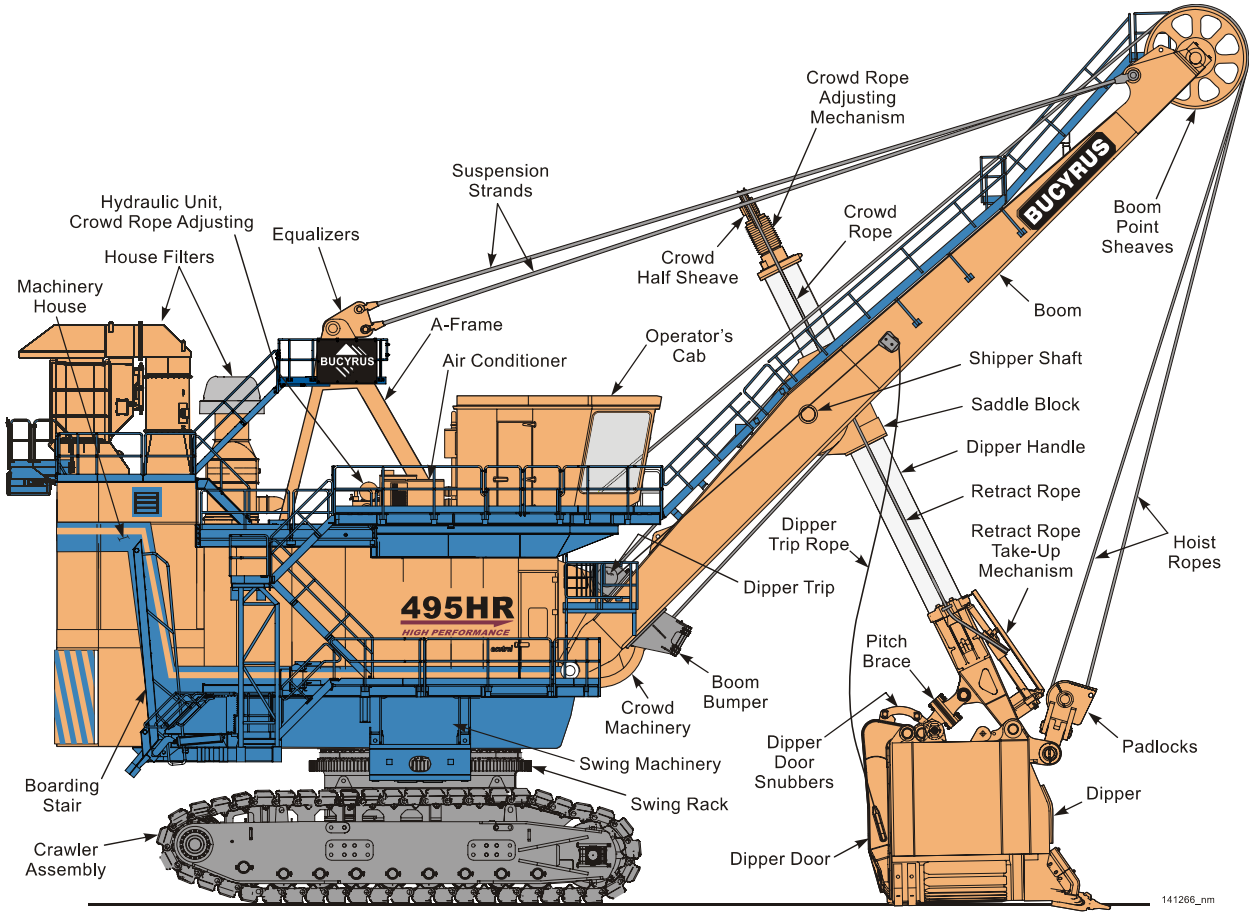
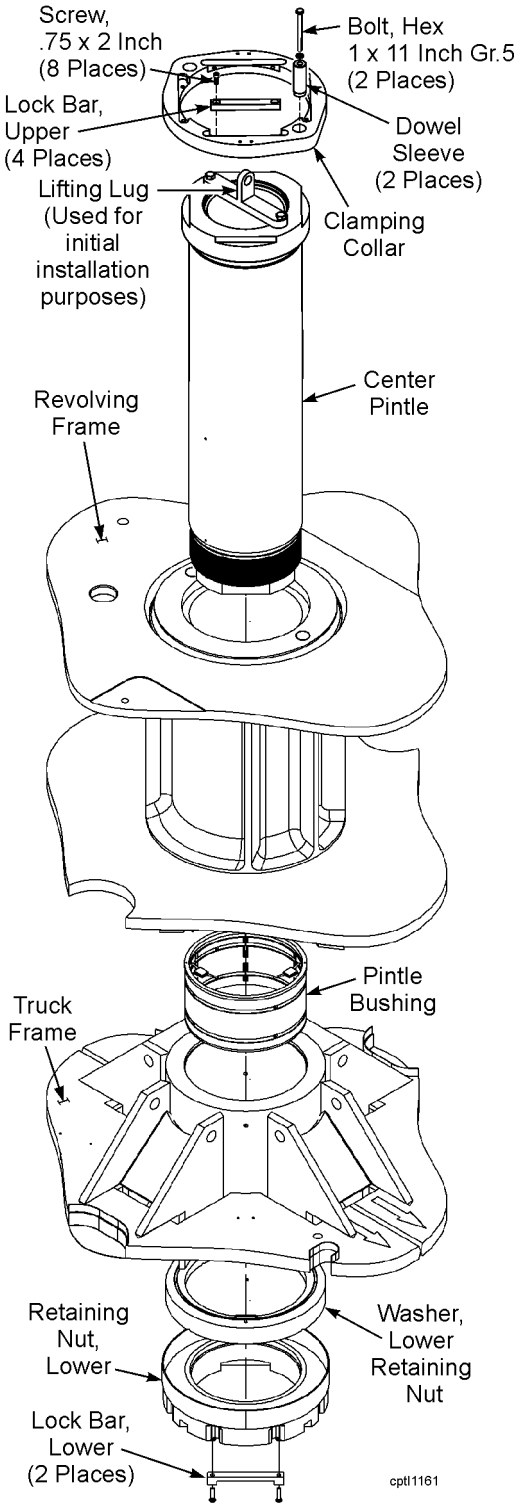
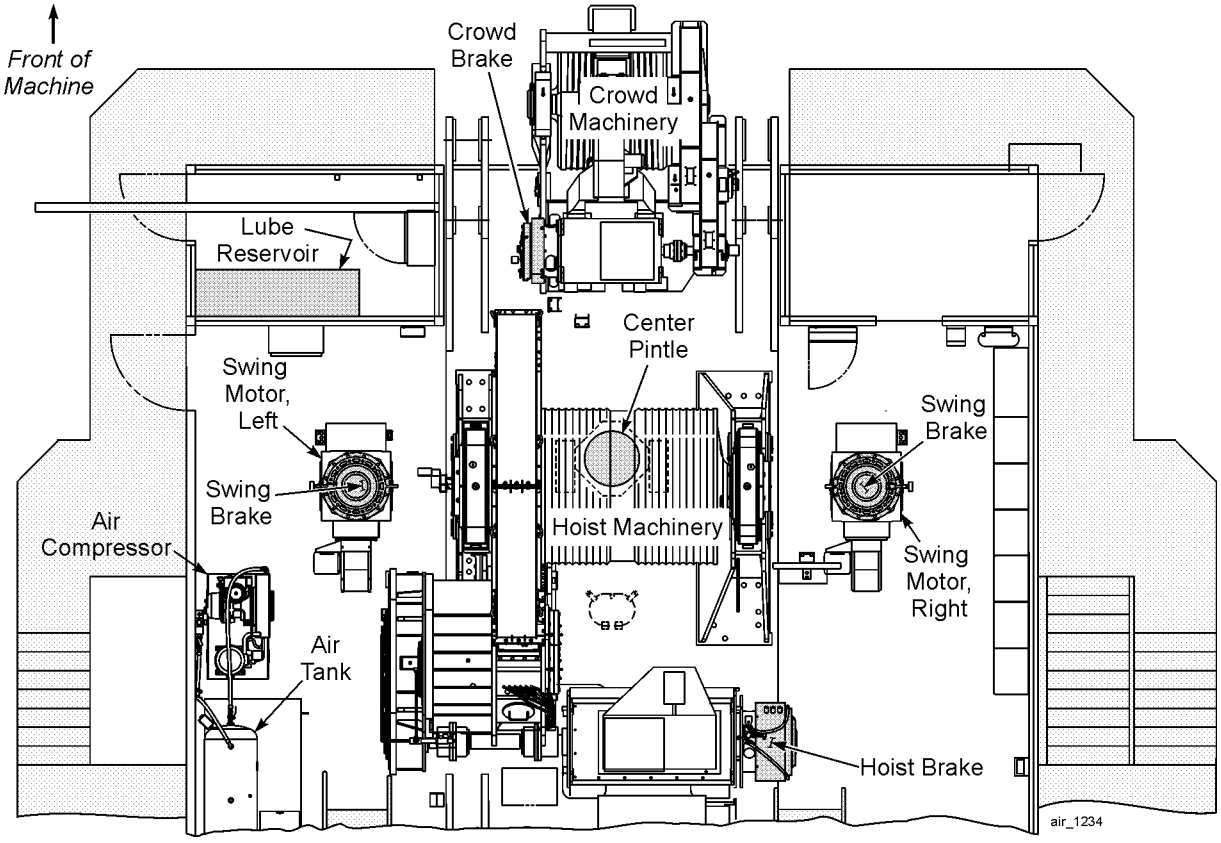


Figure 1-1: Nomenclature


Screw, .75 x 2 Inch (8 Places)
Bolt, Hex 1 x 11 Inch Gr.5 (2 Places)
Lock Bar, Upper (4 Places)
Dowel Sleeve (2 Places)
Lifting Lug (Used for initial installation purposes)
Clamping Collar
Center Pintle
Revolving Frame
Pintle Bushing
Truck Frame
Retaining Nut, Lower
Washer, Lower Retaining Nut
Lock Bar, Lower (2 Places)
cptl1161

COMPRESSED AIR SYSTEM

The compressed air system consists of a rotary screw type air compressor, air receiver, air brakes, controls and center pintle air swivel. Hydraulic high pressure hose is used throughout. The air system is used to operate all machinery motion brakes and lubrication components and to perform various other functions.



TYPICAL MACHINE SPECIFICATIONS

This specification describes the principal mechanical features of a standard Bucyrus International, Inc. 495HR IGBT Acutrol controlled machine. The machine is fully revolving, crawler mounted and equipped to operate from an alternating current power source.

NOTE: These are typical machine specifications.

Table 1-1: Weights

	(pounds)	***(kilograms)***
Working Weight (w/dipper)	2,688,000	1,219,300
Dipper (73 yd^3, 56 m^3)	168,000	76,200
Ballast	667,000	302,550
Net weight, minus ballast and dipper	1,850,000	839,150

Table 1-2: Front End Equipment

Boom	Welded, impact resistant steel	
Boom Point Sheaves	Twin grooved, flame hardened	
Boom Point Sheave Diameter	96”	243.84cm
Shipper Shaft Sheaves	Twin grooved, flame hardened	
Shipper Shaft Sheave Diameter	72”	182.88cm
Dipper Handle Diameter	34”	86.36cm
Dipper Handle Wall Thickness	3” (nominal)	7.62 cm

Table 1-3: Rope Data

	# Ropes	***Diameter***	***Type***	***Construction***
Hoist	2	2 3/4” 69.88mm	twin dual	6X37
Crowd	1	2 1/2” 63.5mm	single dual	6X37
Retract	1	2 1/2” 63.5mm	single dual	6X37
Dipper Trip	1	5/8” 15.9mm	single	6X37
Boom Suspension	4	3 1/4” 82.6mm	equalized	structural strand

Section 2
Operation

Always refer to the safety section of this manual before starting any maintenance procedure on this machine.

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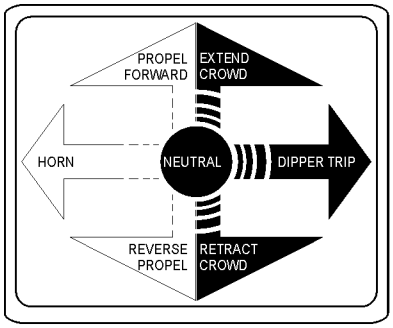
LEFT JOYSTICK



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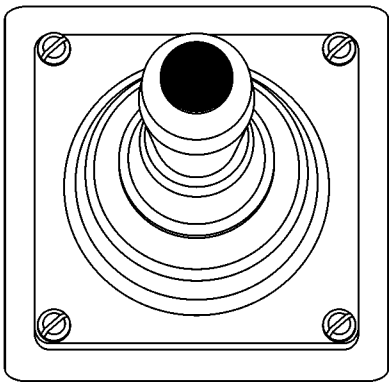


The left joystick controls the crowd/horn/dipper trip and propel. It is the vertical handle mounted on the left armrest of the operator's seat. The switch will spring return to neutral when released.

During normal operation, pushing the joystick forward will extend the dipper handle and dipper into the bank. Pulling the joystick rearward will retract the dipper handle and dipper toward the machine. The neutral position between the crowd and retract functions is defined by a detent that is easily felt. The rate of motion is controlled by varying the distance the joystick is moved from the neutral (center) position. Full forward or full rearward position provides maximum speed to the handle. Moving the joystick to neutral will cause a braking action slowing the crowding or retracting handle. Reversing the joystick will cause the motion to stop and if the joystick is held in this position, it will change the direction of the motion.

With the propel transfer switch in the PROPEL position, pushing the joystick forward will cause the left crawler to move forward. Pulling the joystick to the rear will cause the left crawler to move in the reverse direction. The crowd/retract motion is locked out electrically when the machine is in the propel mode.

DIPPER TRIP

The dipper trip is part of the left joystick function. Moving the left joystick to the right will activate the dipper trip mechanism which releases the dipper door latch. The dipper trip is operational throughout the entire range of the crowd motion.

SIGNAL HORN

Moving the left joystick to the left will activate the signal horn. The signal horn is operational throughout the entire movement range of the crowd motion.

START PUSHBUTTON

A pushbutton that, when pressed, will power up the drive system. The system ready light will go out.

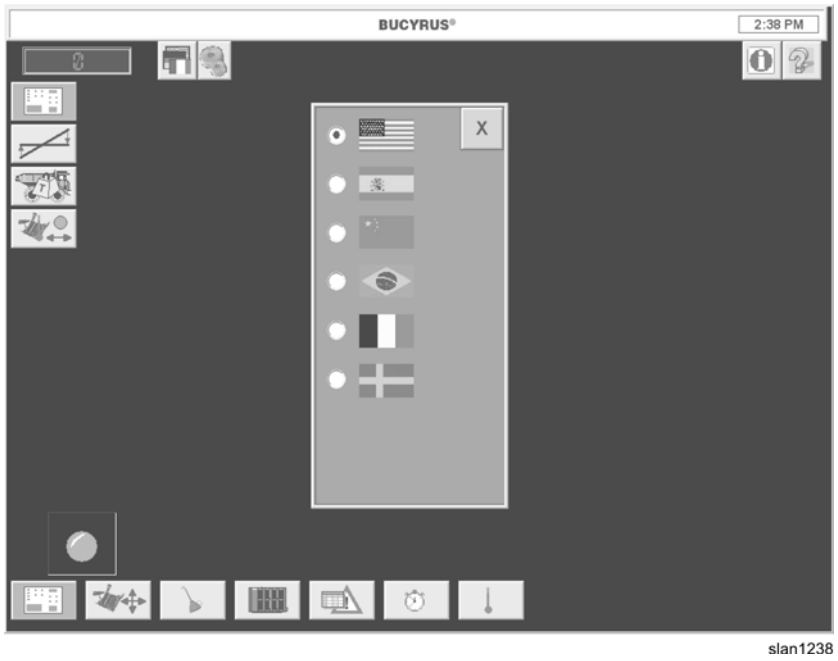


Figure 2-6: Language Screen

This screen allows the language used on the screens to be reset.

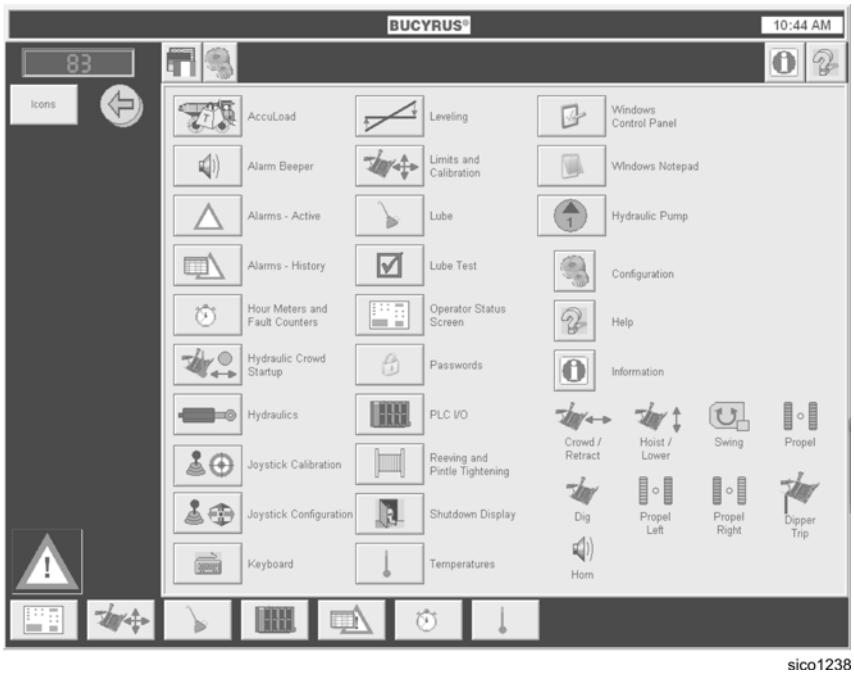


Figure 2-7: Icon Screen

This screen displays the icons used throughout all the screens in the system.

ON-BOARD INSPECTION

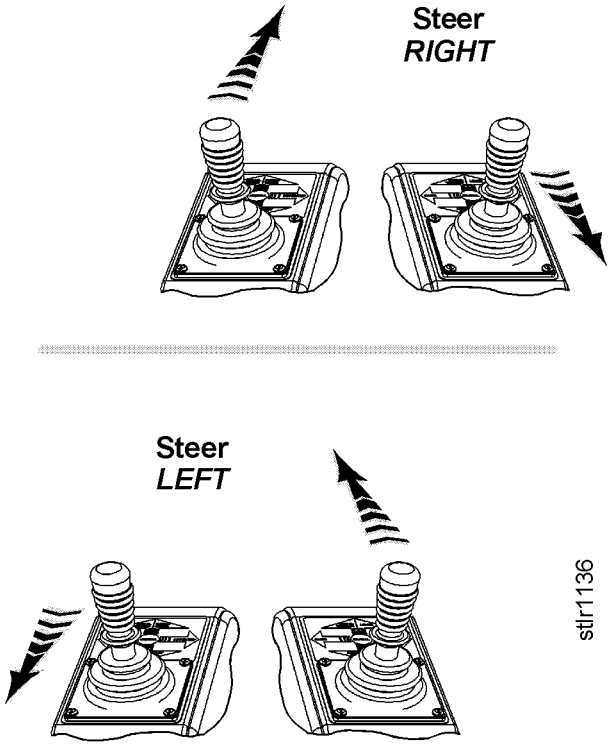
Check the following areas daily on board the machine:

1. Visually inspect the swing, crowd and hoist gearcases for oil levels and leaks. Repair or service as required.
2. Visually inspect all machinery for loose bolts, nuts, clamps or unusual deterioration. Repair as required.
3. Visually inspect the open gears of the swing, crowd and hoist machinery for proper lubricant film and evidence of adequate lubrication from the automatic lubricant dispensing system.
4. Visually inspect hoist and crowd ropes for wear, lubrication and evidence of birdcaging near the drum attachment beckets.
5. Check the oil level in the air compressor. Add oil if required.
6. Check lubricant supply level in the air system lubricator and lube system lubricators.
7. Inspect the automatic lubrication central pumping stations for any signs of malfunctioning. Check the lubricant supply and refill tanks if required.
8. Visually inspect swing, crowd and hoist brake assemblies for damage, wear and evidence of an overheated condition.
9. Check the operator's cab for cleanliness and visual condition of controls and location of special equipment that may be required by the mine site. Check all operating controls for freedom of movement. Controls should move freely without binding.
10. Clean windows of operator's cab.
11. Inspect all walkways and stairways to ensure there are no obstructions or fluids creating a safety hazard.
12. Ensure all external stairways and/or ladder(s) and optional man-basket are raised and properly stowed.
13. Perform the following manual lubrication points:

Crowd cushion sheave	OGL - 1 fitting
Padlock pins	OGL - 6 fittings
Dipper pins	OGL - 2 fittings
Dipper trip rope guide roller	OGL - 1 fitting
Latch lever sleeve	OGL - 1 fitting
Structural strand pins	OGL - 4 fittings

NOTE: Detailed information on the proper servicing of these components can be found in Sections 3 and 4 of this manual.

COUNTER-ROTATION TURNS



- To make a sharp right turn, move the LEFT joystick forward and pull the RIGHT joystick to the rear.
- To make a sharp left turn, move the RIGHT joystick forward and pull the LEFT joystick to the rear.

Although possible, a single sharp turn should be avoided to minimize material build up on the crawler belt roller path. This results in high loading of the crawler belt and associated propel components.

CAUTION: When using the counter-rotation method for turning, use a helper to ensure that the trail cable does not get fouled and/or torn from the machine.

NOTE: The ability of the machine to turn sharply is dependent on the surface on which the machine is setting. A soft surface will cause the crawlers to dig-in and machine to bog-down.

CAUTION: The propel brakes are released when either joystick is moved from the neutral position. The propel brakes are set when both joysticks are returned to the neutral position.

When moving the machine in a straight line, always propel forward (in the direction of the take-up axle) to reduce strain and wear on the crawler belts and propel mechanism. This is especially important in long propels or in deadheading back to the beginning of a cut.

EXCAVATED MATERIAL

It is important that the operator not only know the controls, but also recognize other aspects of the mining operation. Chief among these is the type of material to be excavated. It plays a great part in the overall efficiency of the machine.

Materials can be roughly divided into four categories:

1. *Easy digging.* This category includes all loose, free-flowing materials, such as sand and gravel deposits, stock pile materials such as finely crushed stone, ore fines, coal fines and any other similar materials. The dipper will usually obtain a heaped load.
2. *Medium digging.* This category includes only materials which can be excavated from their natural beds without blasting, and which break up in bulk with some voids. Such material includes clay, dry earth, clay-gravel mixtures, gravel with some boulders, certain types of ores, and coal. The dipper will usually obtain a full load, with filling augmented by the material's natural tendency to break apart when it encounters the dipper lip and teeth.
3. *Hard digging.* Included in this category are materials that require blasting, resulting in good fragmentation, but leaving large chunks which develop voids. Limestone, gypsum shale, cemented gravel, wet earth, clay and certain types of ore and overburden all fall within this category. The dipper will average less than a full load because of the resistance of the material against flow and voids due to blocky material.
4. *Very hard digging.* This category includes all materials that require heavy blasting and give irregular fragmentation. Taconite, granite, laminar shale, certain types of limestone, and conglomerate overburden fall into this category. The dipper will average considerably less than a full load, because of the large chunks and interlocking action of the material which block fill.

OPERATION CHECKS

During machine operation there are several things to consider relative to safe, efficient machine operation.

1. Check the motors for unusual noise, loss of power or failure to respond to controls.
2. Check hoist, crowd, swing and propel machinery for unusual sounds and overheating of bearings.
3. Avoid slack hoist ropes which could allow the ropes to become crossed on the drum, or skip a groove.
4. Check the air gauge frequently and investigate immediately if there is a drop in air pressure. Correct all air leaks.
5. When propelling, check the engagement of the drive tumblers on the crawler belt links and adjust the belts to correct any improper alignment.
6. When operating auxiliary functions, such as steering, note any tendency of the controls to jam or hang up. Check and correct any problems at the earliest opportunity.

OIL FILL CAPACITIES

TYPES OF LUBRICANTS AND CAPACITIES GUIDELINES

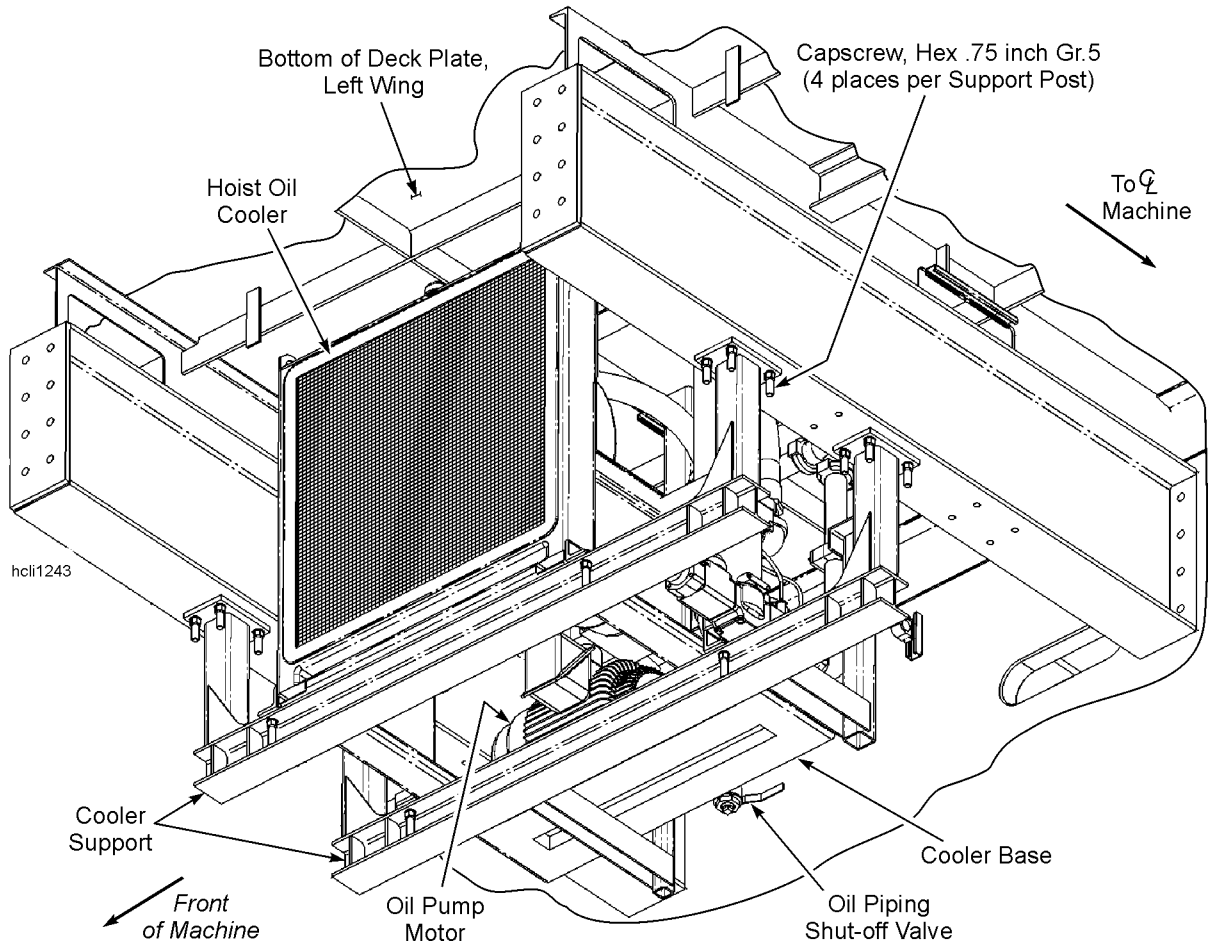
NOTE: Use the chart below as a guideline. Fill to the proper level as determined by the dipstick or oil sensor.

Description	*Type*	*Gallons*
All open gearing, bushings & dipper handle	OGL	275
Most, anti-friction bearings	MPG	137
Crowd, enclosed gearing - 1st. reduction	EGL	7
Crowd, enclosed gearing - 2nd. reduction	EGL	10
Propel, final drive bearings	MPG	27
Propel, planetary (horizontal) 2-cases	EGL	190
Propel, planetary (angled 10°) 2-cases	EGL	222
Swing, planetary 2-cases	EGL	172
Hoist, planetary case w/cooler	EGL	115
OGL bulk lube tank	OGL	200
Grease bulk lube tank	MPG	100

QUANTITIES FOR FIRST FILL OF LUBRICANTS

Gallons	*Drums*	*Type*	*Description*
475	8.6	OGL	Open Gear Lubricant
264	4.8	MPG	Multi-Purpose Grease w/EP Additives
444	8.1	EGL	Enclosed Gearcase Lubricant

NOTE: 1 drum = 55 gallons = 208 liters



4. With the supports and the cooler fully supported, remove the 0.75 inch capscrews (16 places) that fasten the 4 vertical posts of the supports to the revolving frame.
5. Carefully lower the cooler and support assembly down and out from beneath the revolving frame.

The cooler, cooler motor and/or oil pump can now be repaired or replaced.

The cooler pump and pump gearcase can be serviced without removal of the cooler or support structure. The filter assembly is in the output line at the rear of the cooler assembly. The filter cartridge can be replaced by removing the screws and cover at the top of the filter canister.

The relief pump is factory set at 150 PSI for protection of the pump and should not be changed. The cooler relief valve is factory set at 100 PSI for protection of the cooler core and should not be changed. The 51 PSI relief valve built into the filter downstream of the cooler is for the protection of the filter element. The check valve downstream of the filter is intended only as a means of preventing backflow from the gearcase when the filter element is being serviced.

The plumbing on the gearcase has varying orifices that are not adjustable. Based on the temperature/viscosity of the oil in the system, the operating pressure will vary considerably from cold start to fully stabilized conditions. The operating pressure may not be the same between different sized gearcases and may vary somewhat between individual units. Normal operating conditions will be acceptable for a pressure range of 20 PSI to 150 PSI without causing a trip condition.

LINCOLN TYPE SL-1 LUBRICANT INJECTORS

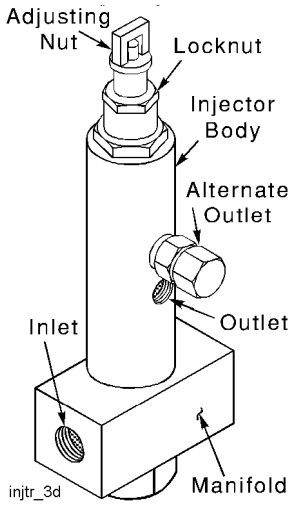
These pressure-operating, spring-reset, series-installed injectors are supplied in banks mounted on manifolds or individually. Each injector expels a maximum of 0.08 cu. inch of lubricant from its outlet port each cycle. Dual outlet ports on each injector permit the injectors to be piped in series for increased lube supply to a common point. The quantity of lube to each point on this machine has been carefully designed by our engineers for proper coverage. Each injector output can be adjusted; however Bucyrus recommends that injectors initially be set and used at their maximum setting.

NOTE:

MAXIMUM Operating Pressure:	3,500	PSI
RECOMMENDED Operating Pressure:	2,500	PSI
MINIMUM Operating Pressure:	1,850	PSI
MAXIMUM Recharge Pressure:	600	PSI

CAUTION: STORED ENERGY! Contact with or ingestion of petroleum products can be harmful. Automatic lubrication systems operate under pressure. Before opening any lube supply line, relieve the system and that line in particular, of any residual pressure.

To set an injector for maximum output:



1. Loosen locknut.
2. Turn adjusting screw until there is a small gap at the top of the stem.
3. Orient the adjusting screw so that the opening is toward the front of the injector.
4. Tighten the locknut.

MPG - MULTIPURPOSE GREASE

SD4711 (August 18, 2005)

SCOPE

1. This specification covers “Multi-Purpose Grease”.
2. Materials furnished under this specification are primarily intended to lubricate heavy duty ball, roller, and plain bearings.
3. The material furnished under this specification must be dispensable through the distribution lines of a centralized lubrication system to the most remote application point, at the lowest anticipated operating temperature. It must not plate or plug components of the centralized lubrication system such as injectors or metering blocks.
4. The particular grade or consistency selected must perform within the specific temperature range in which it is utilized.

PHYSICAL CHARACTERISTICS

1. Heat Resistance - Shall be thermally stable, should not flow or harden in service.
2. Retention - Shall not exhibit high leakage.
3. Stability - Shall work continuously with a minimum change in consistency.
4. Water Resistance - Shall withstand water washout or leaching.
5. Reversibility - Shall be stable with repeated heating and cooling.
6. Pressure Separation - Shall resist oil-soap separation.
7. Extreme Pressure - Shall withstand heavy shock loading.
8. Compatibility
    a. Low temperature greases shall be compatible with mineral oil base greases.
    b. Grease must be compatible with oil seal lip materials (Nitriles, Viton), and all centralized lubrication system components (i.e. gaskets, o-rings, vent valves, etc.). Reference ASTM D 4289-03.
9. Compounding
    a. Suitable for producing the extreme pressure characteristics (without inert fillers) required for heavy duty ball, roller, and plain bearing lubrication.
    b. Base fluid is to be mineral or synthetics which are compatible with mineral base.
    c. Thickener types are to be of the following varieties: Aluminum, Lithium, or Calcium.

Table 3-5: Certified Lubricant Listing for "MPG-Multi-Purpose Grease (SD4711)"

Manufacturer	***Product Description***
Bel-Ray	Molylube AC 1000 40890
Bel-Ray	Molylube AC 1000 40900
Bel-Ray	Molylube AC 1000 40922
Bel-Ray	Molylube LC135 67800
Bel-Ray	Molylube LC135 67810
Bel-Ray	Molylube LC135 67810
Bel-Ray	Molylube LC135 67832
Bel-Ray	Molylube LC133 67840
Bel-Ray	Molylube LC133 67850
Bel-Ray	Molylube LC133 67860
Bel-Ray	Molylube LC133 67872
Bel-Ray	Molylube LC131 27660
Bel-Ray	Molylube LC131 27670
Bel-Ray	Molylube LC131 27680
Bel-Ray	Molylube LC131 27692
Bel-Ray	Molylube 126 EP 23200
Bel-Ray	Molylube 126 EP 23220
Bel-Ray	Molylube 126 EP 23242
Bel-Ray	Termalene EP 72400
Bel-Ray	Termalene EP 72420
Castrol	Molub-Alloy 4086-0
Castrol	Molub-Alloy 4086/460-1
Castrol	Molub-Alloy 777-1 ES
Castrol	Molub-Alloy 777-2 ES
Chemtool Inc.	CSC 174 MGD
Chemtool Inc.	CSC MP1-220
Chemtool Inc.	CSC MP1
Chemtool Inc.	CSC MP0
Chemtool Inc.	CSC MP00
Exxon	Ronex Extra Duty 2
Exxon	Ronex Extra Duty Moly 2 / Mobilgrease XHP 462 Moly
Haycock Petroleum	Calcuplex M5 NLGI #1
Haycock Petroleum	Calcuplex M5 NLGI #2
Imperial Oil	Epic EP Moly
Imperial Oil	Unirex EP 1 Moly
Lubrication Engineers	Almagard Vari-Purpose 3750
Lubrication Engineers	Almagard Vari-Purpose 3751
Lubrication Engineers	Almagard Vari-Purpose 3752
Lubrication Engineers	Almaplex Ultra-Synthetic 1299
Lubritene	Lubrene Li 500 EP 2
Lubritene	Lubrene LiM 500 EP 2
Lubritene	Lubrene AXM 1000 EP 1
Lubritene	Lubrene AXM 1000 EP 2
Lubritene	Lubrene AXM 500 EP 1
Lubritene	Lubrene AXM 500 EP 2
Lubritene	Lubrene LXCa 700 EP 2

Section 4
Preventive Maintenance

INTRODUCTION

This section of the manual describes those aspects of preventive maintenance on the machine such as inspection, adjustment and routine repetitive tasks. Information related to lubrication techniques, frequency and service points is also partially included. Further detailed information can be found in Sections 3 and 5 of this manual.

PREVENTIVE MAINTENANCE PROGRAM

A Preventive Maintenance Program is a systematic series of operations performed periodically on equipment to prevent breakdowns.

Any breakdown *WILL* reduce productivity and increase overhead expense. Machinery is only new at one point in time. From that moment, the machinery begins to deteriorate through use and aging. A well organized maintenance program will avoid unexpected high-cost breakdowns and will increase component life.

A systematic approach to the program should be followed and detailed records of all findings kept, to detect potential problem areas. Valuable time and effort can be saved if defects are corrected before they lead to a major breakdown. The records should be reviewed often and kept on file for future reference.

Personnel involved in the program should go through an established training program, to know *WHAT* to check and *HOW* to rectify any potential problem area. When personnel are able to do routine maintenance and normal repairs efficiently, downtime is reduced and machine productivity increased. Also, to keep the machine in good running condition, the necessary parts, tools and current information should be kept on hand.

Equipment maintenance is a science and its practice an art. This art can be divided into 6 types of operations - *they are:*

- **Inspection** is probably the most important operation. Careful observation is required of all parts of the equipment. Slight abnormalities may not interfere with the equipment performance BUT those that are a deviation from the normal should be discovered early. When inspecting, notice placement, state of cleanliness, color, etc. of part(s). Example: discoloration indicates overheating; all guards, bolts in place and good housekeeping.
- **Cleaning** and keeping clean is essential for good operation. Periodic cleaning should be more frequent on exposed parts than those which are contained within cabinets. Parts, connections and joints should be free of dust, corrosion and other foreign matter.
- A **Feeling** operation is used more often to check guarded rotating machinery for vibration due to worn parts, lack of lubrication, overheating, etc. Feeling operation on electrical items should be performed as soon as possible *AFTER* power has been removed and the circuit grounded. Feeling of excessive heat may indicate an overloaded condition and should be corrected.
- A **Tightening** operation should be done on all connections that have worked loose due to vibration, etc. Loose parts are a definite hazard because they may fall out of place and

✓	Check Points - Daily		
	Location	***Check***	***Noted Discrepancy***
	23. Operator's Cab	Check for cleanliness and the visual condition of the controls. Check the location of special equipment that may be required by the mine site. Check all operating controls for freedom of movement. The controls should move freely without binding.	
	24. Operator's Cab	Clean all windows.	
	25. Walkways and Stairways	Inspect to ensure there are no obstructions, damage or fluids creating a safety hazard.	
	26. Boarding Stairs and/or Boarding Ladders	Ensure all are raised and properly stowed and latched.	
	DANGER: HIGH VOLTAGE! The machine trail cable carries a lethal voltage. Handle the cable in an approved manner with appropriate rubber gloves and insulated hooks or tongs.		
	27. Trail Cable	Visually inspect the trail cable for cuts, abrasions or other damage.	
	28. Cable Reel	At the Cable Reel, if equipped, check the Hydraulic Fluid Reservoir for proper fluid level. Add fluid if required.	
	29. Cable Reel Hydraulic System	Visually check the Cable Reel Hydraulic System for leaks. Tighten, repair or replace components as necessary.	

Date:	
Shift:	
Inspected by:	
Supervisor:	

5000 HOURS OR ANNUALLY

√	Check Points - 5000 Hours or Annually		
	Location	***Check***	***Noted Discrepancy***
	1. Propel Gearcase	Check for leaks, cracks - repair as required.	
	2. Crawler Frame Underside	Check for wear, cracks, damage.	
	3. Crawler Frame	Tighten all crawler frame connecting rod jack bolts per Section 5 in this manual.	
	4. Propel Motors	Verify motor coupling clearance and alignment using a dial indicator. (Refer to manufacturer's information.)	
	5. Propel Gearcase	Pull the bottom plug and collect a 1/2 gallon of lubricant. Inspect the sample for metal particles.	
	6. Final Drive Shaft Bearing	Lube must be present! If fresh lube is not present, investigate the problem.	
	7. Swing Rack	Verify the tension of the rack-to-truck frame mounting bolts and the rack joint assembly bolts.	
	8. Roller Circle and Rails	Check for wear. Replace rails or rollers when wear exceeds 1/2".	
	9. Center Pintle Bushing	Check the truck frame bushing and replace if required.	
	10. Center Pintle Upper Nut	Verify that the lock bars and retaining dowels are in place. Check that the nut is flush with the top of the pintle - if not, investigate the problem.	
	11. Revolving Frame	Thoroughly inspect the revolving frame integrity. Repair damage from cracks and wear. (Includes the ballast box weld joint and swing gearcase support welds.)	
	12. Revolving Frame Extensions	Check the extension bolts for security and retension as required.	
	13. Machinery House	Repair all damaged sections, panels, doors and latches.	
	14. House Filtration	Clean the filter units, inspect the blowers and fan blades closely. Repair or replace damaged and worn parts.	
	15. Hoist Motor Pinion Shaft	Inspect the bearings, retainers and seals for damage. Correct as needed. Inspect oil passages for obstructions.	

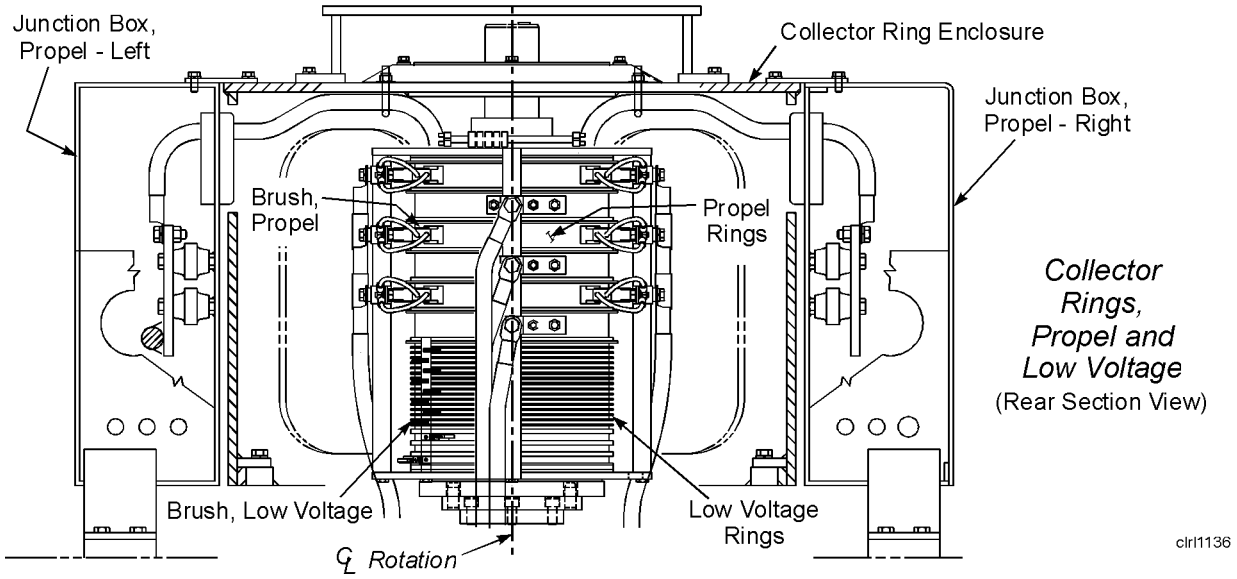


Figure 4-9: Collector Rings, Auxiliary

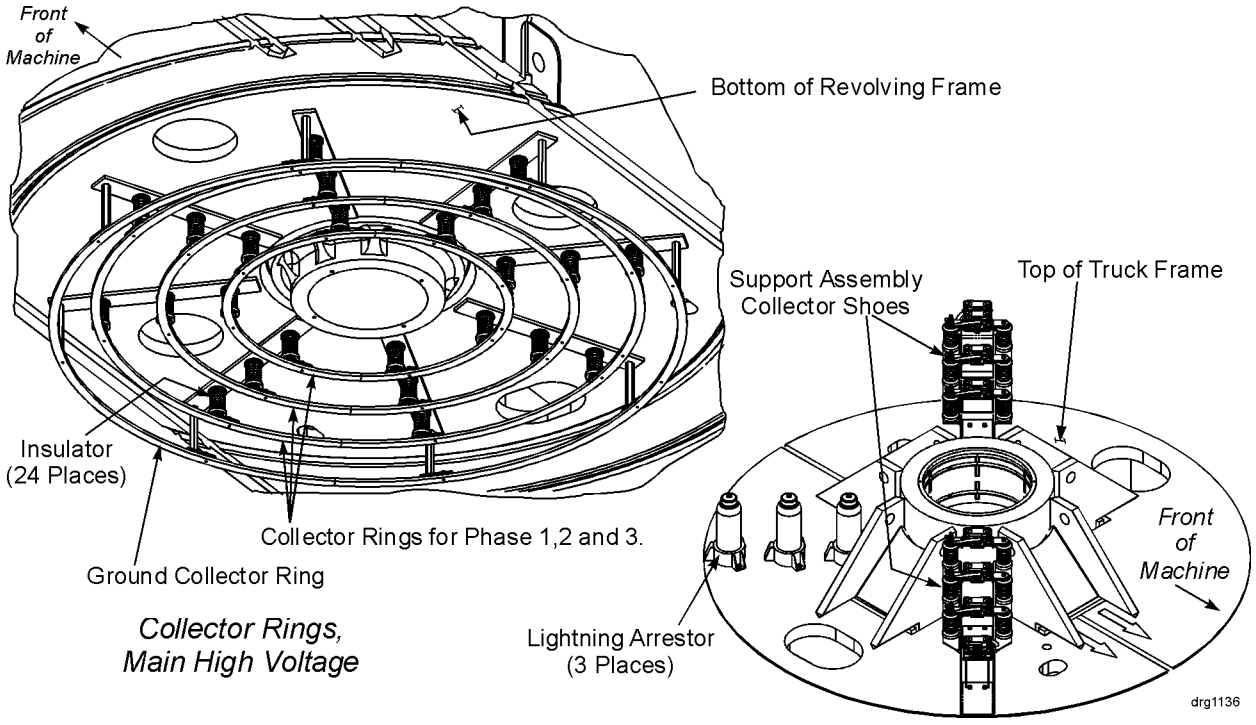


Figure 4-10: Collector Rings, High Voltage

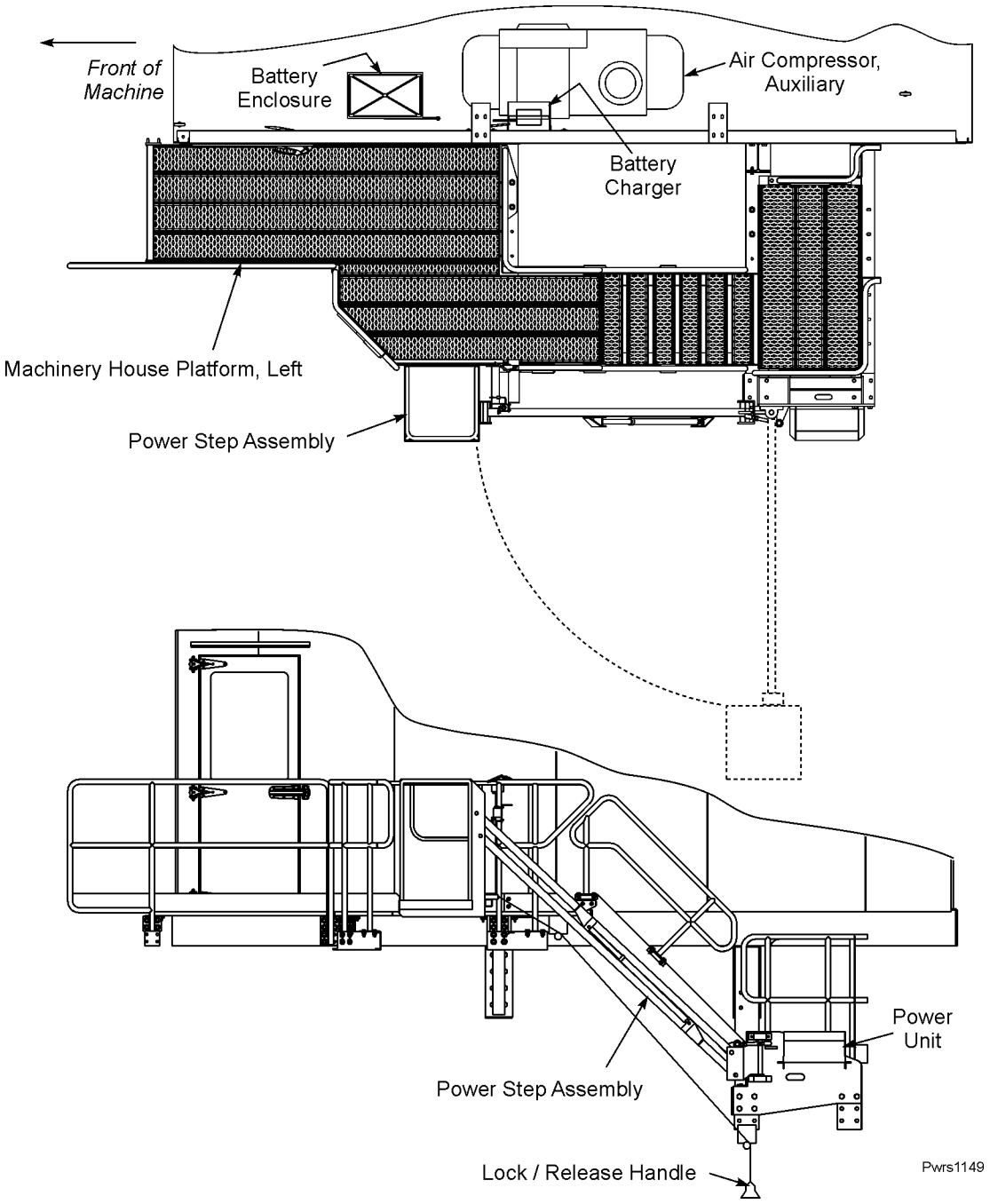


Figure 4-20: Power Step

ROLLER CIRCLE - ROLLER REPLACEMENT

NOTE: Replace a broken or flat roller immediately.

1. Place the machine on a level work area. Rotate the machine so that the roller to be replaced is near the front or the rear of the machine.
2. If a rear roller is to be removed, raise the rear of the machine with jacks (or by hoisting the dipper into a bank). If a front roller is to be removed, jack the boom by crowding the dipper into the ground.

DANGER: BLOCK THE MACHINE IN PLACE AFTER RAISING THE FRONT OR REAR UPPER RAILS OFF THE ROLLER CIRCLE. SHUT DOWN THE MACHINE, SET THE BRAKES AND DISCONNECT THE POWER SUPPLY. Failure to comply could result in serious injury.

3. If enough room exists above the roller cage to allow passage of the roller, remove the roller directly:
   a. Remove the capscrews from the roller to be replaced.
   b. Lift the roller with bushing and thrust washer from the cage.
   c. Remove the thrust washer as soon as it clears the inner cage.
4. If not enough room exists to allow passage of the roller above the roller cage, remove the outer cage:
   a. Remove the 2 outer splice bars from the ends of the roller segment containing the roller to be replaced.
   b. Remove the capscrews securing the rollers within the roller circle segment containing the roller to be replaced.
   c. Remove the outer cage member, then lift the roller with bushing and thrustwasher from the roller circle.
   d. Remove the thrust washer as soon as it clears the inner cage.
5. Place the roller on some cribbing at ground level. Remove the spacer and bushing.
6. Inspect the parts and replace as needed.

Reassembly is the reverse of disassembly:

   a. The diameter of the new roller must be within ±.001 inch of adjacent rollers. Measure the diameter of its adjacent rollers and grind the new roller(s) to match.
   b. Lubricate roller bushing I.D. with Molykote at assembly
   c. With the roller seated against the thrust rail, the gap between the thrust washer and roller is to be 0.12 inch nominal. Refer to ROLLER CIRCLE ADJUSTMENT.
   d. Tighten the capscrews to 210 Ft-Lbs.

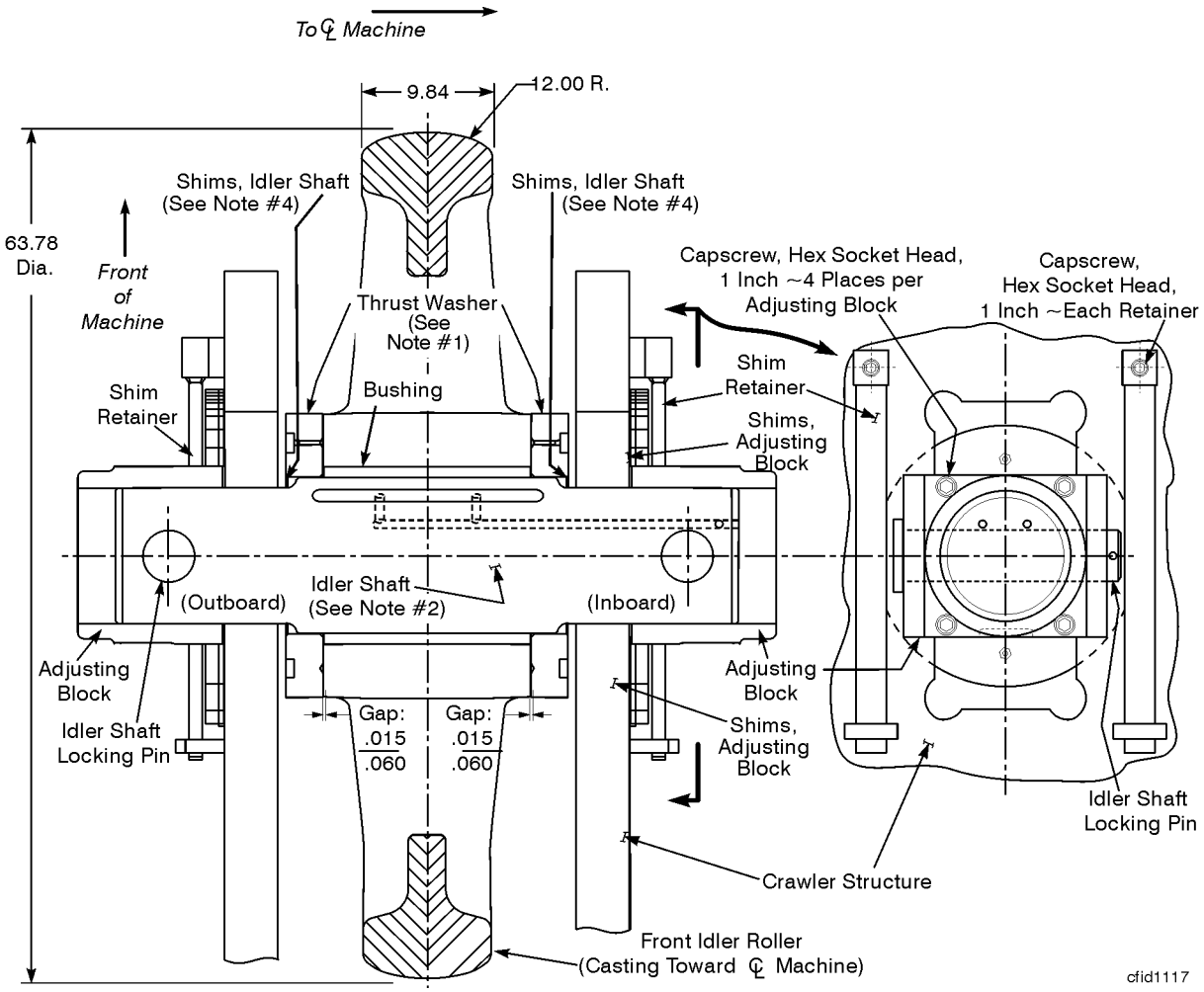


Figure 5-12: Front Idler Assembly - Section View

4. Using the jacks provided, push the adjusting blocks on both sides of the idler shaft forward to allow removal of the remaining shims.

NOTE: When using jacks to move the adjusting blocks, pressurize and release both jacks at the same rate to prevent binding of the idler shaft.

5. Release the belt tension by slowly releasing the jack pressure to allow the adjusting blocks to move to their rear-most position.
6. Separate the crawler belt behind the top of the idler and lay the forward crawler shoes on the ground in front of the crawler.

DANGER: HIGH VOLTAGE!ONLY QUALIFIED PERSONNEL ARE PERMITTED TO PERFORM THIS OPERATION. Failure to comply, could result in bodily injury or death.

Details for the Main Propel Shaft Fixture

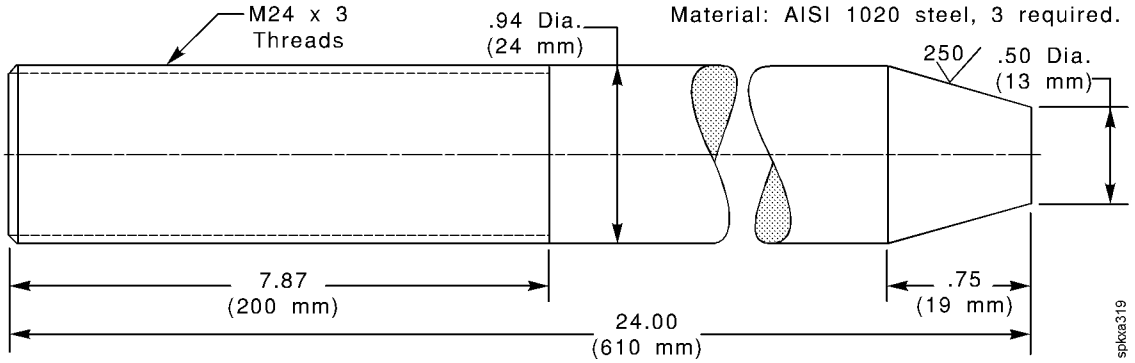


Figure 5-17: Propel Shaft Pilot Rod

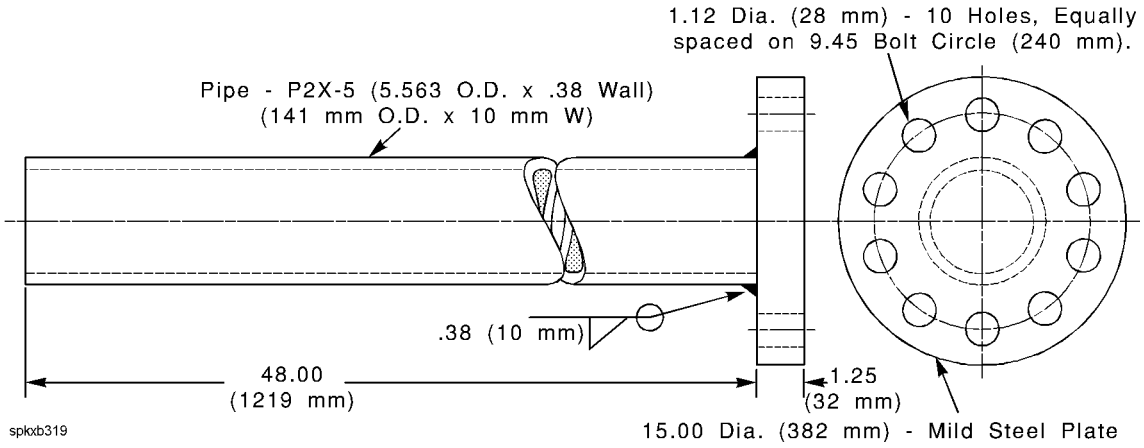


Figure 5-18: Propel Shaft End Support

CAUTION: RELEASE THE AIR PRESSURE TO THE BRAKE BEFORE DISCONNECTING THE AIRLINE. Plug the line immediately after disconnecting. Failure to comply could result in personal injury.

6. Support the motor (approximately 6,200 lbs.) with a crane.

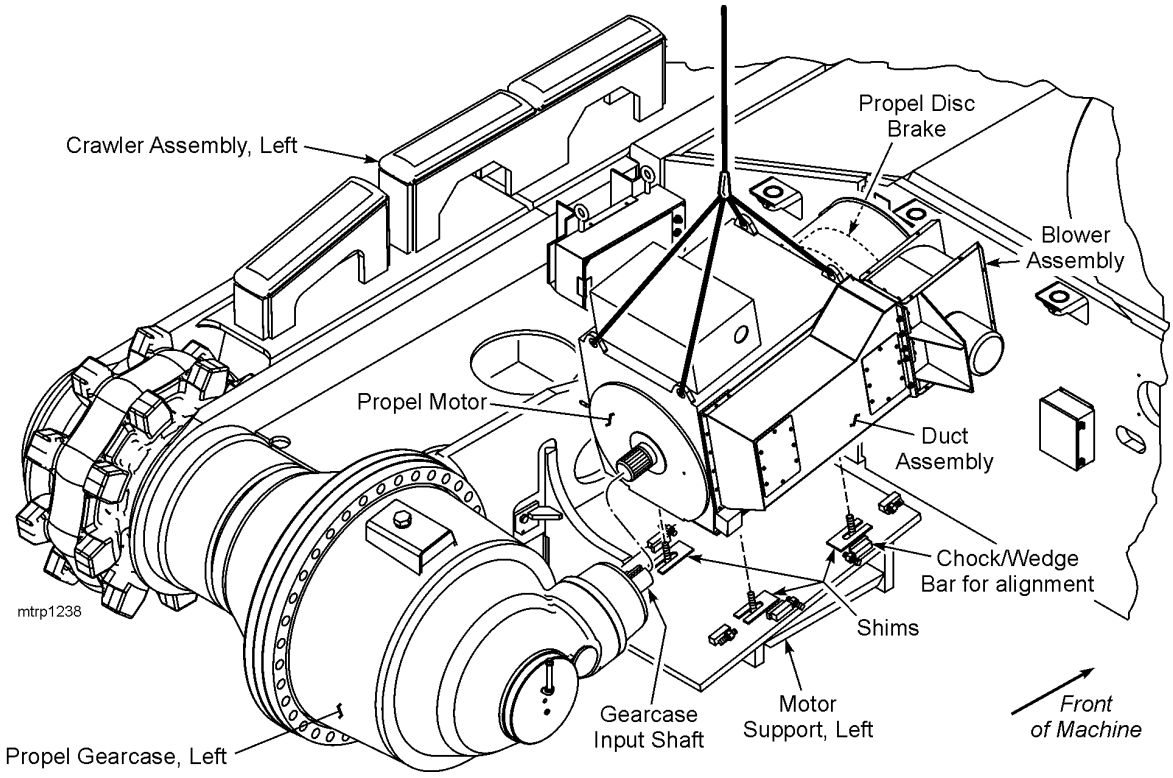


Figure 5-24: Propel Motor and Motor Support

7. Remove the 4 capscrews and related hardware that fasten the motor to the motor support. Lift the motor away from the machine to the cribbing. Secure the shims at the 4 motor mounting points at the time of removal so that they are available for reassembly.

Center pintle sleeve installation is the reverse of disassembly.

DANGER: HIGH VOLTAGE! Be sure the electrical lines are correctly connected and all connections are tight. Also make sure that the air and lube lines are connected to the correct outlets in the swivel assembly and that the connections do not leak.

SWING GEARCASE REMOVAL

Use the following procedure to remove a swing gearcase:

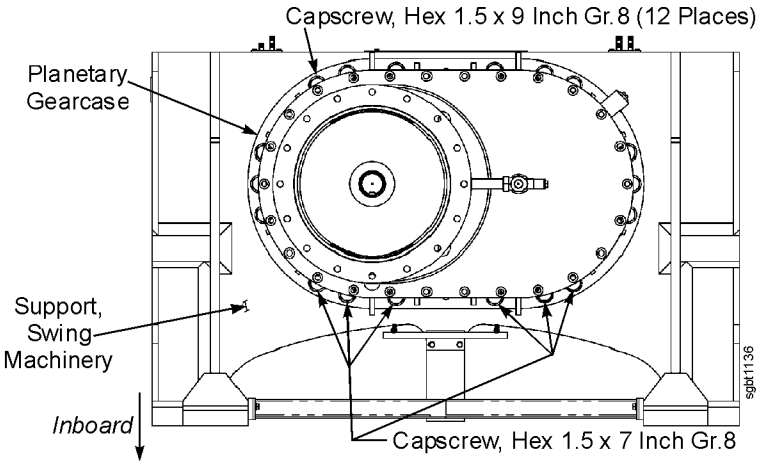
1. Position the machine with the dipper lip and front flat on the ground. Set all brakes.

DANGER: BEFORE ATTEMPTING TO DISCONNECT ANY POWER LEADS, PRESS THE MAIN POWER OFF BUTTON AND TAG IT TO AVOID INADVERTENT ENERGIZING OF THE ELECTRICAL CIRCUIT. Electrocution or serious injury may occur if appropriate safety measures are not followed. Electrical connections should only be handled by trained electrical personnel.

2. Remove the appropriate section of the machinery house roof panel over the gearcase.
3. Refer to the appropriate instructions in this section of the manual and remove the swing motor and brake assembly.

DANGER: STORED ENERGY! Gearing or drum must be blocked prior to performing maintenance in order to prevent unwanted movement. Failure to comply could result in death, severe personal injury, or damage to the machine. Refer to Section 1 - Swing Restraint.

4. Lift off the removable floor panels surrounding the gearcase.
5. Remove the 18 - 1.5 inch capscrews, nuts and lockwashers attaching the gearcase to the support on the revolving frame. Note the location of the 6 shorter capscrews.
6. Attach a suitable lifting device to the gearcase. Lift it up and clear of the machinery house. The weight of the gearcase is approximately 9,300 Lbs.



Installation of the gearcase is the opposite of removal. However, apply Molykote to the splines at the top of the 2 swing shafts and also inside the output gears at the bottom of the gearcase. Align the motor coupling per the procedures in Section 6 - BRAKES AND COUPLINGS in this manual.

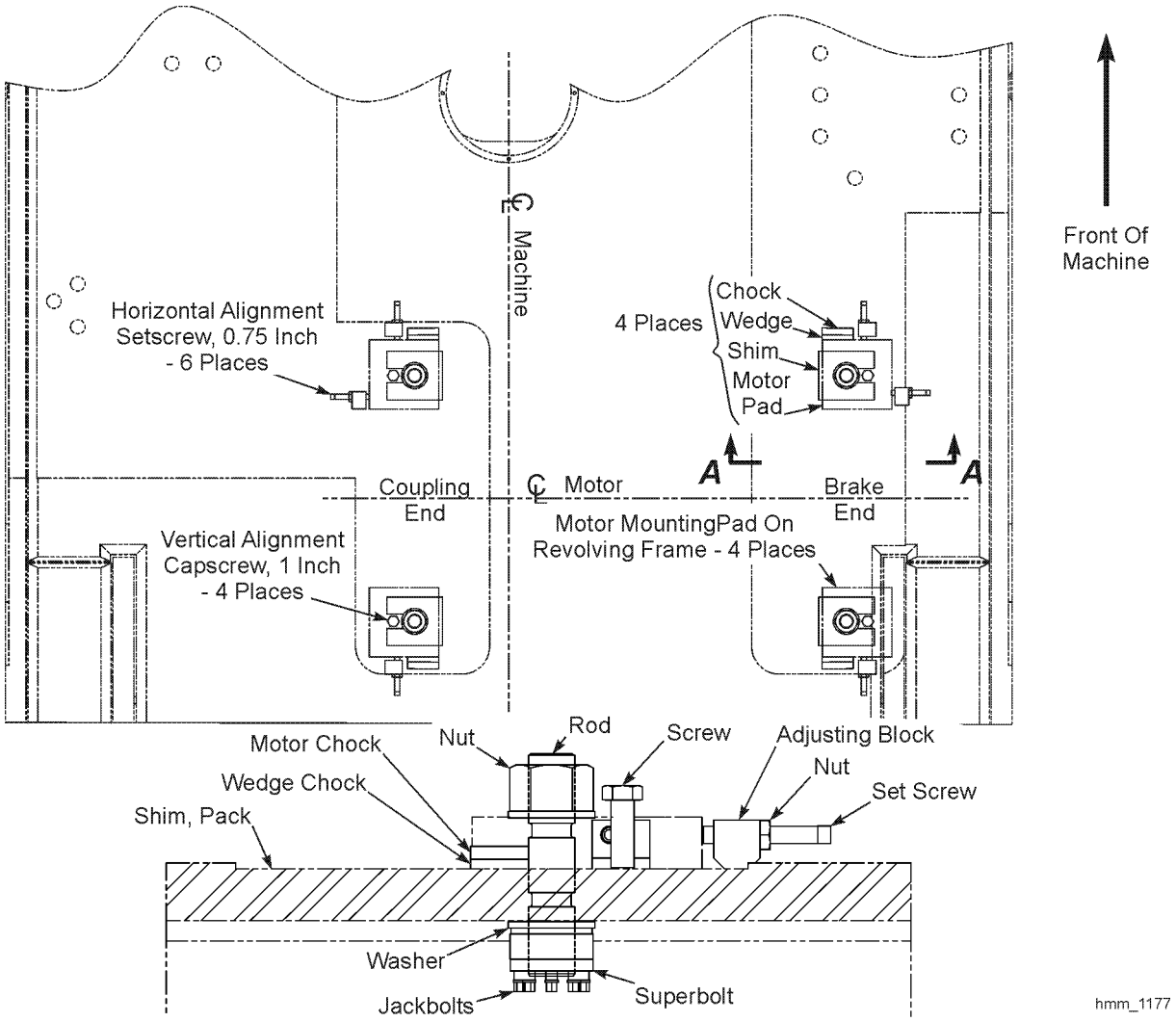


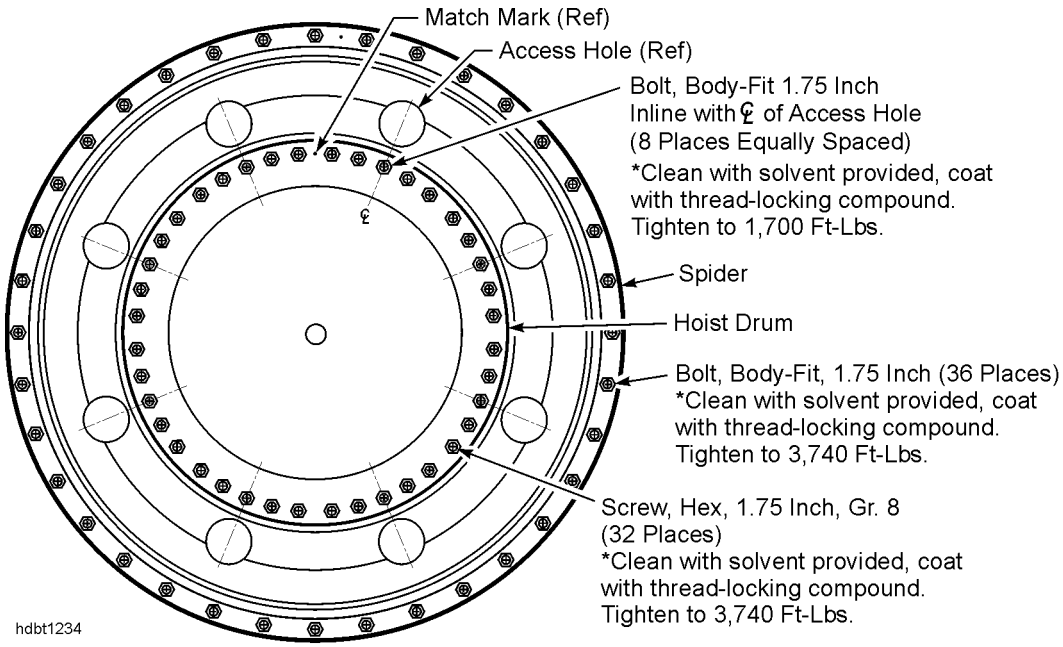
Figure 5-31: Hoist Motor Mounting - Plan View

9. Remove the 4 - 2.0 inch nuts that fasten the motor to its mounting pads on the deck. Using a suitable crane, lift the motor and brake assembly through the house roof and away from the machine. The weight of the hoist motor is approximately 15,000 Lbs. Wire the shims together, if used, and identify their location for future use.

Installation of the hoist motor is the reverse procedure.

NOTES:

- If replacing the original motor with a new motor, remove the alignment chocks and wedges from the motor mount, reinstall after setting and aligning the new motor.
- Align the coupling(s) using the procedure in Section 6 - BRAKES AND COUPLINGS, in this manual.
- The hoist motor is fastened to its mounting pads using 2.0 inch nuts and rods. To tighten use the Torque Nut tightening procedure at the end of this section of the manual.


Match Mark (Ref)
Access Hole (Ref)
Bolt, Body-Fit 1.75 Inch
Inline with ℄ of Access Hole
(8 Places Equally Spaced)
*Clean with solvent provided, coat
with thread-locking compound.
Tighten to 1,700 Ft-Lbs.
Spider
Hoist Drum
Bolt, Body-Fit, 1.75 Inch (36 Places)
*Clean with solvent provided, coat
with thread-locking compound.
Tighten to 3,740 Ft-Lbs.
Screw, Hex, 1.75 Inch, Gr. 8
(32 Places)
*Clean with solvent provided, coat
with thread-locking compound.
Tighten to 3,740 Ft-Lbs.
hdbt1234
*Refer to Parts Book for P/Ns.

VIEW A

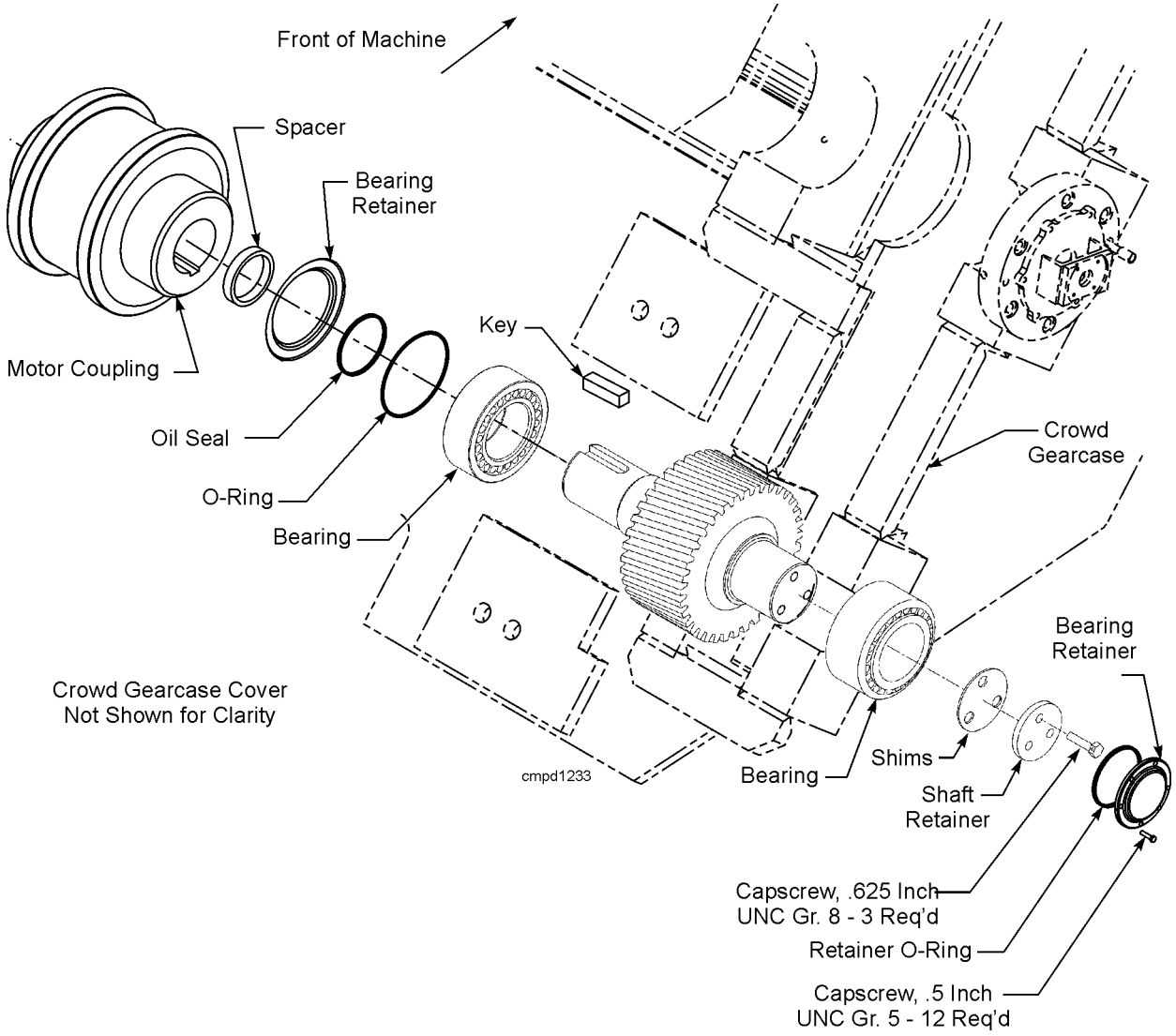


Figure 5-42: Crowd Motor Pinion - Exploded View

6. Attach a crane to the gearcase cover and remove the bolts securing the cover to the gearcase. Remove the bearing cap rods, nuts and washers.

NOTE: When removing torque nuts, refer to the proper removal procedure in Section 9 - ENGINEERING DATA.

7. Lift and remove the cover from the gearcase. Remove the cover seal from the gearcase.
8. Attach a crane to the motor shaft and lift the shaft assembly from the gearcase. Remove the first and second intermediate shafts in the same manner.

FOOTREST INSTALLATION

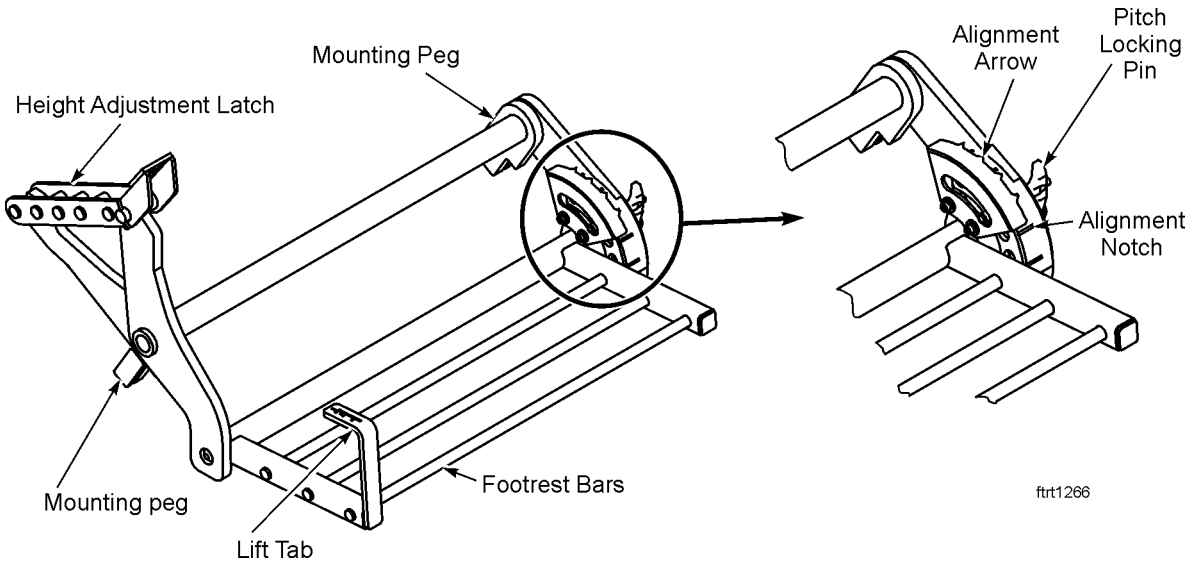


Figure 5-47: Footrest Components

On the front of the operator seat pedestal, remove and discard any plugs covering the three holes on each side. Insert the square tab of the footrest mounting peg into the MIDDLE of the three holes. Ensure the mounting peg slides fully into the seat pedestal, and that the footrest is stable.

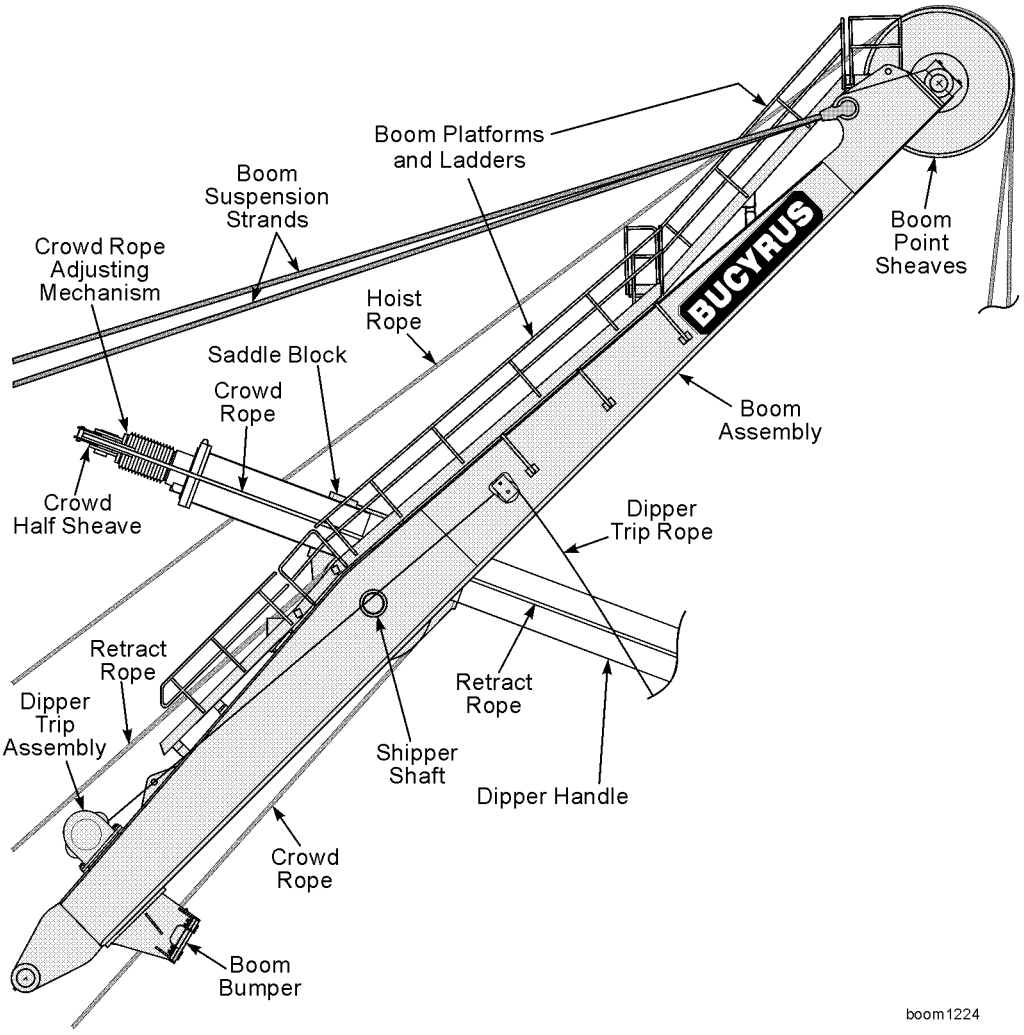


Figure 5-50: Boom Assembly

BOOM REPAIR

Repair of the boom is normally limited to very minimal additional damage sustained following the failure of an attached component. If any structural damage is found on the boom assembly contact Bucyrus International Service Department immediately.

DANGER: DUE TO THE HIGH LOAD CARRYING POSTURE OF THE BOOM ASSEMBLY, ANY QUESTIONABLE DAMAGE ON THE BOOM MAY SERIOUSLY ENDANGER HUMAN LIFE AND MUST BE INVESTIGATED BY QUALIFIED PERSONNEL BEFORE CONTINUED SERVICE CAN BE UNDERTAKEN.

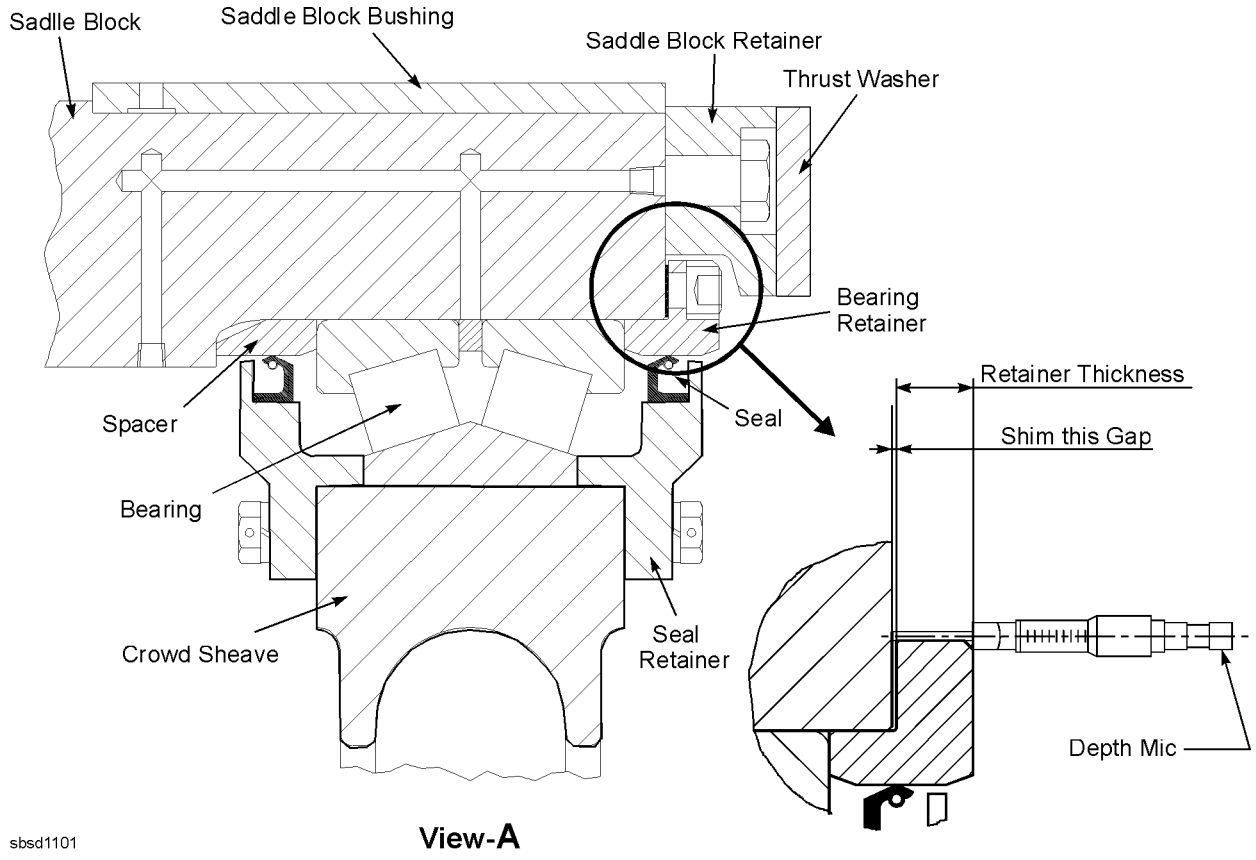


Figure 5-54: Saddle Block Sheave

7. Inspect and replace any worn sheave bearings and seals or saddle block bushings.

Bearing retainer shimming instructions:

a. Install the spacer and the bearing on the saddle block. Install the seals and the seal retainers. Press the bearing tight against the spacer.

NOTE: Do not install the saddle block retainer.

b. Install the bearing retainer. Tighten just until snug, the socket head cap screws that hold the bearing retainer in place.

c. Keeping the bearing tight against the spacer, measure the depth along the outer edge of the bearing retainer using the depth micrometer as shown. Remove the bearing retainer and measure the retainer thickness.

d. Subtract the measured retainer thickness from the measured depth to calculate the gap and assemble the shim with the thickness equal to the gap thickness -0.002 to -0.005.

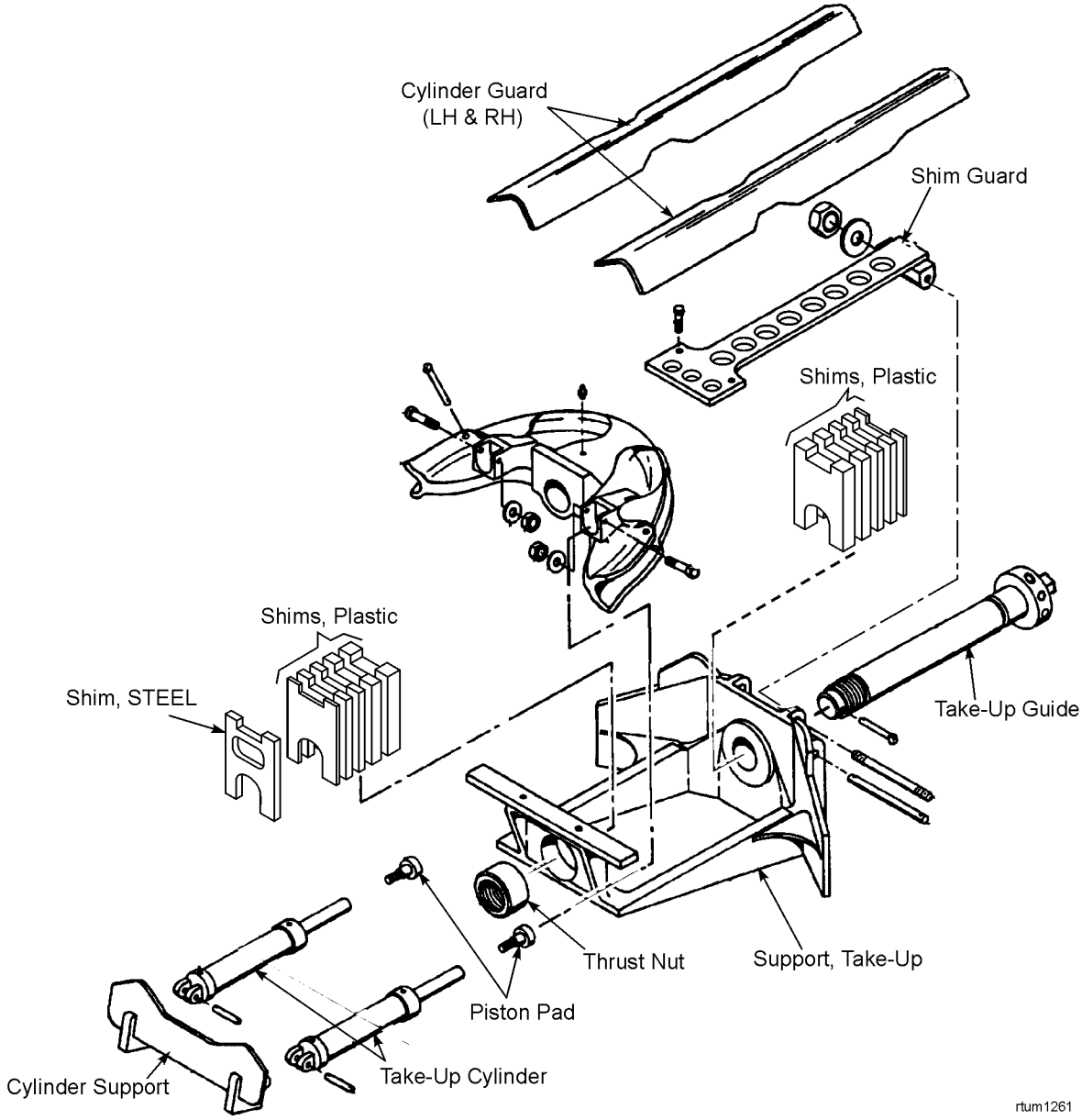
e. Re-install the bearing retainer and snug-tighten the cap screws. All cap screws require retaining compound 82 833 859. Tighten in a sequence 180° apart in 3 steps adding 1/3 torque value each time.

NOTE: All cap screws should be tightened to 146 Ft-Lbs.

8. Reinstall the saddle block in the boom. Reconnect the lube lines. Reinstall the dipper handle. Reeve the crowd and retract ropes on to the machine.

RETRACT ROPE TAKE-UP MECHANISM

The retract rope take-up mechanism is attached to the dipper handle at the dipper end and provides the ability to remove slack from, and apply the proper tensioning to, the retract rope.



NOTE: The steel shim must rest against the thrust nut.

To repair the retract mechanism:

1. Lower the dipper so that the front of the dipper is flat on the ground.
2. Remove the shim guard bolts and rotate shim guard out of the way.
3. Unload retract rope using hydraulic jacks to remove shims as follows:

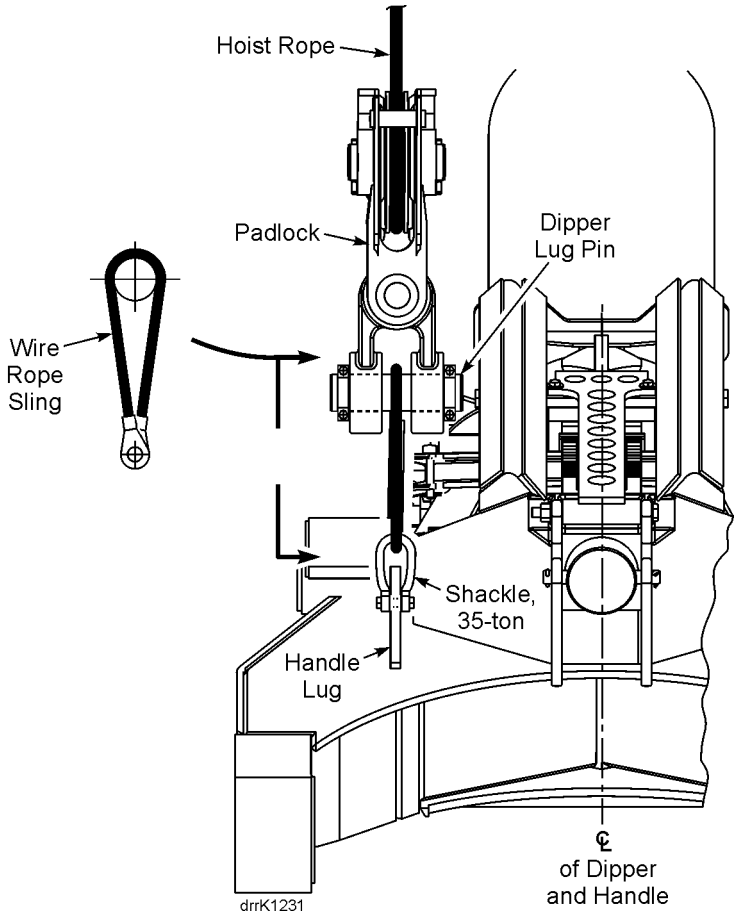


Figure 5-58: View B

9. Attach a shackle (35-ton capacity) to the dipper handle lifting lug. Lock the shackle pin in place.
10. Using a suitable wire rope sling, tie the padlock and shackle together.
11. Repeat steps 6 through 10 for the opposite padlock. Ensure both slings (used to connect the padlock and shackle) are identical in length.
12. Slowly raise the hoist ropes just enough to support the dipper handle and remove the load placed on the pitch brace pins. Ensure the load is evenly distributed between the two lifting points.
13. Using the hoist ropes to support the dipper handle, disconnect the pitch braces from the dipper handle using the following procedure:
    a. Using a suitable lifting device with a sling-type strap, support the pitch brace (approximately 950 lbs) from falling forward when the upper pin is removed. Remove the collar clamp from the upper pin. Refer to Section C-C. Using a second lifting device, remove the upper pitch brace pin (approximately 400 lbs).
    b. Lower the pitch brace so it rests on the dipper. See *Figure 5-59*.
    c. Repeat steps A and B for the opposite pitch brace.

1. Remove the drum guard and trip rope from the drum.
2. Open the gear and pinion guard.
3. Remove the drum retainer and drum.
4. Remove the bearing retainer and spacer on the drum side. Then remove the cover and bearing retainer at the other end of this shaft.
5. Support the gear and slide the shaft from the gear and base on the drum side of the base. Remove the gear, bearings, spacers and seals.
6. Repair or replace all worn or damaged parts and reassemble in reverse order of disassembly. Lubricate the bearings.
7. If the pinion was removed from the motor, when it is reinstalled, the motor shaft should be recessed inside of the pinion 1/16 inch.

A-FRAME

Periodically inspect the A-frame for signs of cracking or other damage. This check should include the mounting lugs and pins, the ladders and platforms, the equalizer links holding the boom structural strands and the leg shrouds on the machinery house roof. Make certain there are good seals around the leg shrouds.

If any repair welding is required, contact the Bucyrus International Service Department for a specialized repair process. For any other unusual problems consult the Bucyrus International Service Department.

Carefully inspect the mounting lugs and pins for cracks or other signs of wear or deterioration. Lubricate these areas occasionally to prevent rusting. Check the leg shrouds both from the inside and on the top of the machinery house to see that a tight seal is maintained and there are no leaks. If there are any signs of leaking, reseal around the shrouds with a suitable caulking compound.

Make certain the ladders are securely mounted in good condition. Repair any cracks as soon as they are noticed.

Check the condition of the platforms to see that they are secure and safe. At the same time inspect the equalizer links and connections of the boom structural strands.

DANGER: STORED ENERGY! Removal of equalizer pins requires the attached items to have proper support to release the load. Failure to comply could result in death, severe personal injury, or damage to the machine.

Under normal circumstances the A-Frame of the machine will most likely not be removed until disassembly of the machine is required. Please contact the Bucyrus International, Inc. Service Representative should any unusual circumstances arise.

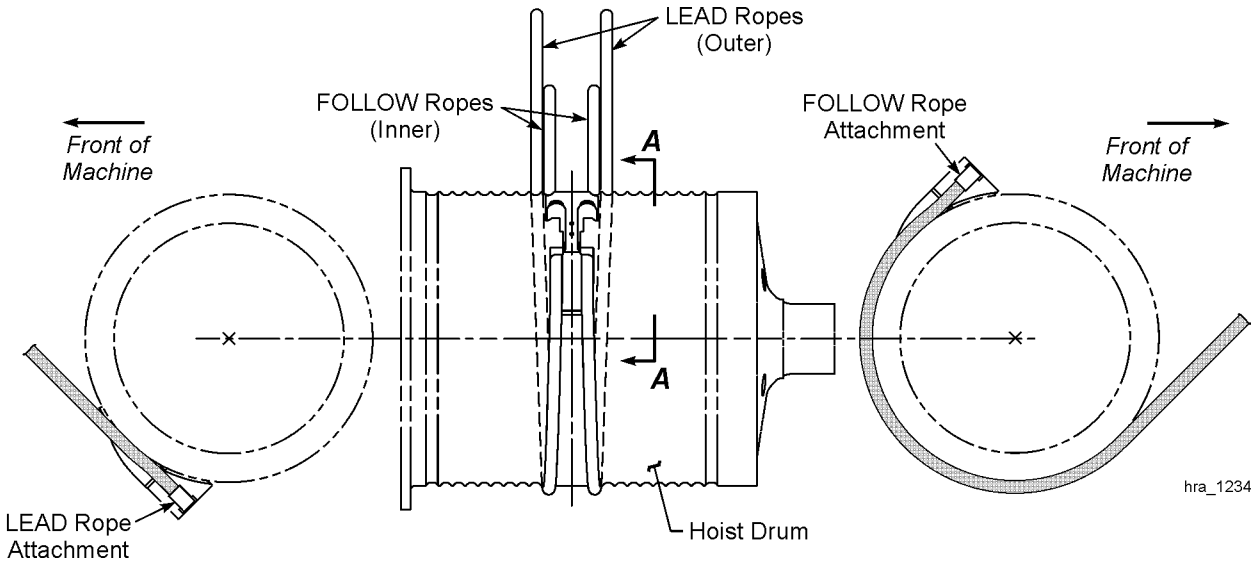
DANGER: The condition of the ropes may make it necessary to modify the procedures outlined, especially if the rope is broken or severely damaged. Be sure to always follow safety precautions when burning or climbing. Always keep the ropes under complete control.

2. Lower the dipper to the ground. Position the dipper so that the padlocks are directly beneath the point sheaves. The hoist ropes will be vertical and the heel of the dipper will be on the ground.
3. Position a person in the machinery house in a position to observe the hoist drum and ropes. Slowly rotate the drum in a lowering direction until all of the rope is spooled off of the drum and the rope sockets are in the bottom rear quadrant of the hoist drum.

CAUTION: Throughout this operation drum or rope positions must be communicated to the operator. Make sure that a system of signals is worked out in advance and that the line of communication is unbroken.

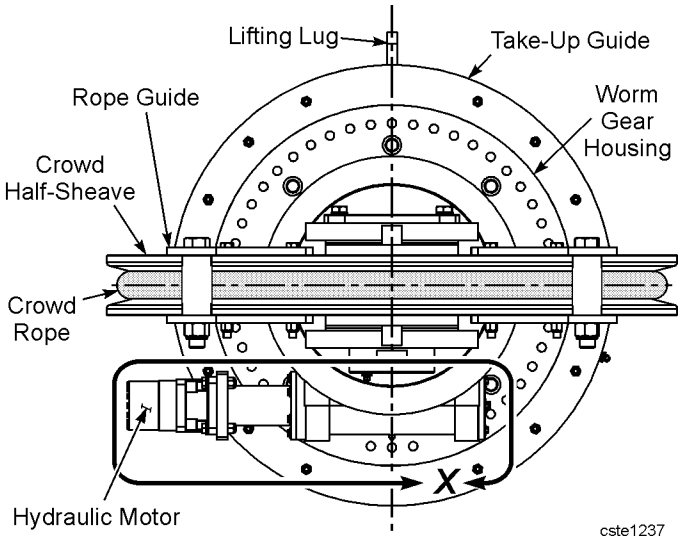
NOTES:

- Each hoist rope is a continuous length of rope.
- The “LEAD ROPE” is the portion of rope from the hoist drum, over the outer groove of the point sheaves, and down to the back of the padlock. The socket on the hoist drum for this rope “LEADS” the socket for the “FOLLOW” rope.
- The “FOLLOW ROPE” is the portion of rope from the front of the padlock, over the inner groove of the point sheaves, and back to the hoist drum.



- Do not overtighten the ropes. The ropes are properly adjusted when a very slight curvature is noticeable on the retract rope (a 3 to 5 inch sag) with a tight crowd rope.

1. Hoist the dipper until the dipper handle is horizontal, parallel to the ground. Retract the handle until the crowd half-sheave is within reach of the hydraulic unit on the machinery house roof, behind the operator's cab. (With the hoist ropes supporting the dipper and the handle just retracted, any slack that exists should be in the crowd rope.)



2. Remove the worm shaft retainer from the end of the worm shaft.
3. Retrieve the hydraulic motor from the hydraulic unit on the machinery house roof. Install the socket adapter (part number B008078-01, supplied with a key and set screw) and a standard 1.50 inch impact socket on the drive end of the motor.
4. Install the motor onto the worm shaft as shown in the illustration. Use 4 - 0.625 inch capscrews to attach the motor to the Drive Unit Adapter (S051069).

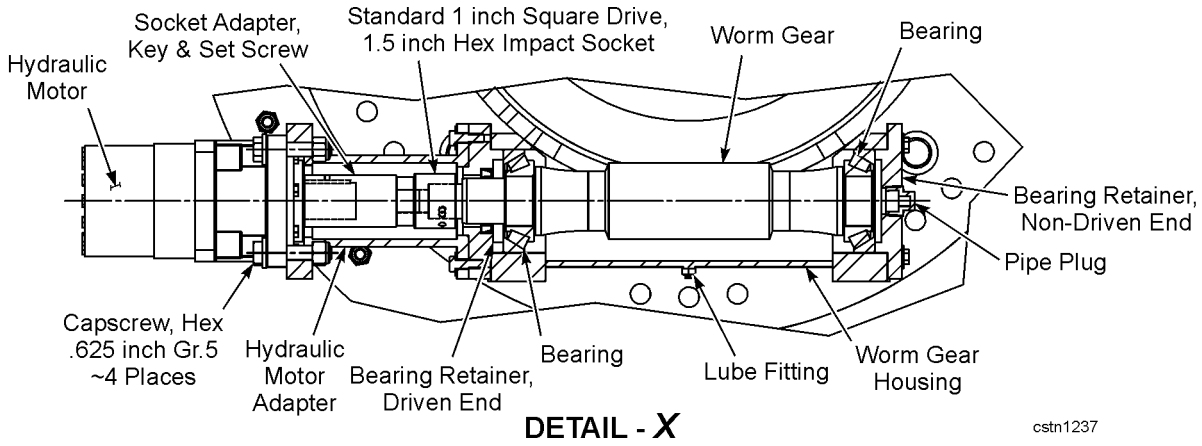


Figure 5-68: Worm Drive During Crowd Rope Adjustment

5. Using the hand-held pendant on the hydraulic unit, extend the crowd screw rod until the crowd rope is tight. Back off the crowd screw rod one-half inch to allow for proper slack in the rope.

Section 6
Brakes and Couplings

Always refer to the safety section of this manual before starting any maintenance procedure on this machine.

Table of Contents

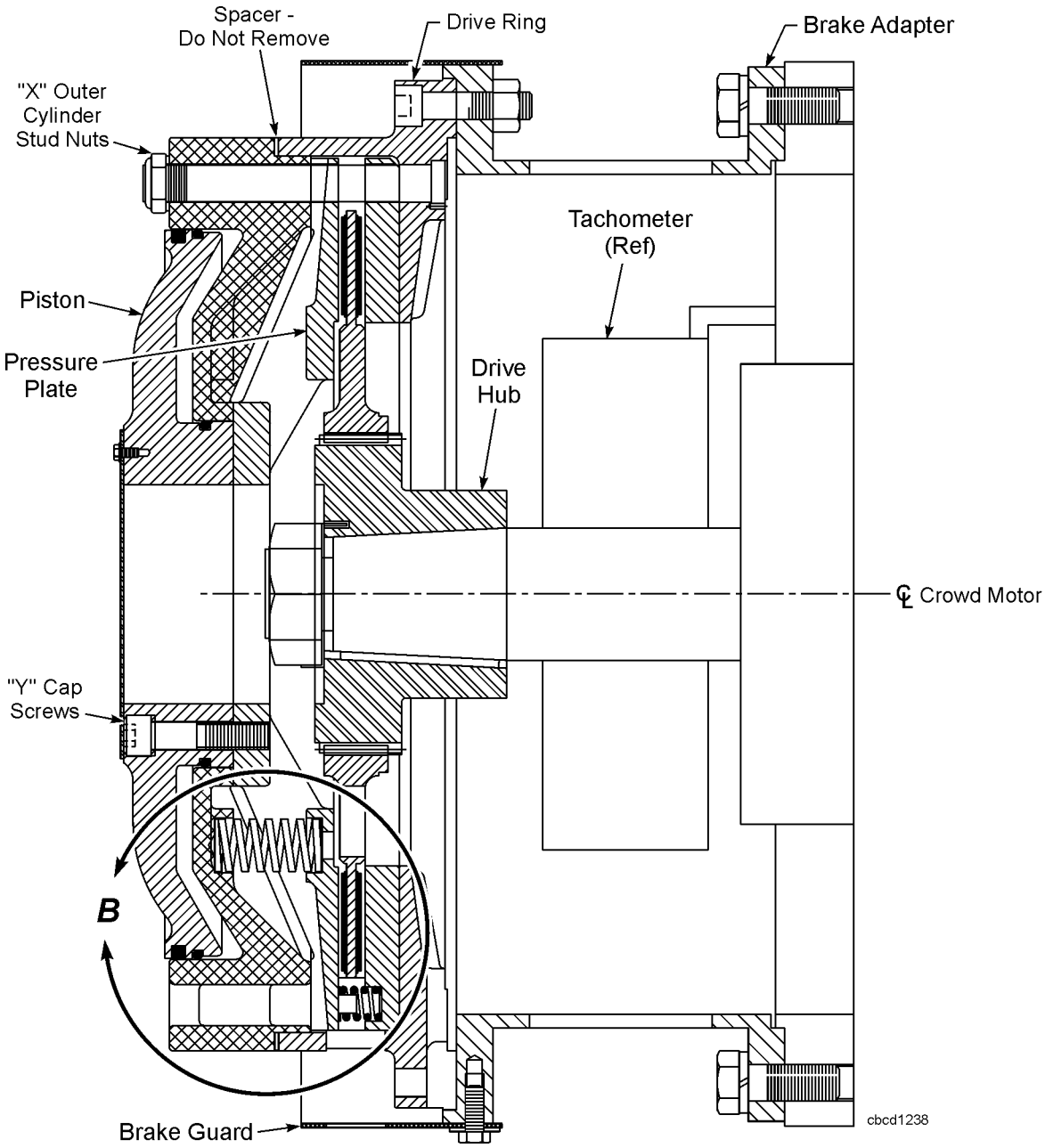


Figure 6-4: Section View B-B – Crowd Brake

The crowd brake is non-adjustable. Once the piston stroke has reached a specified point, the friction disc must be replaced. Refer to the Brake Adjustment Chart in *BRAKE ADJUSTMENT SPECIFICATIONS*. A friction disc must be replaced if it has become contaminated with grease, oil or foreign material. Refer to the *FRICTION DISC REPLACEMENT* procedure in this section of the manual.

TACHOMETER MOUNTING & ALIGNMENT

1. Assemble the tach drive shaft into propel motor shaft using retaining compound. Tighten to 300 Ft-Lbs.
2. Assemble tach shaft extension onto the tach drive shaft using the socket cap set screws, tach shaft extension should protrude beyond tach drive shaft by 1.31(+.13/-.00) as shown in View E.
3. Release the propel motor brake. The motor shaft can be rotated back and forth for tach alignment without breaking the motor coupling.

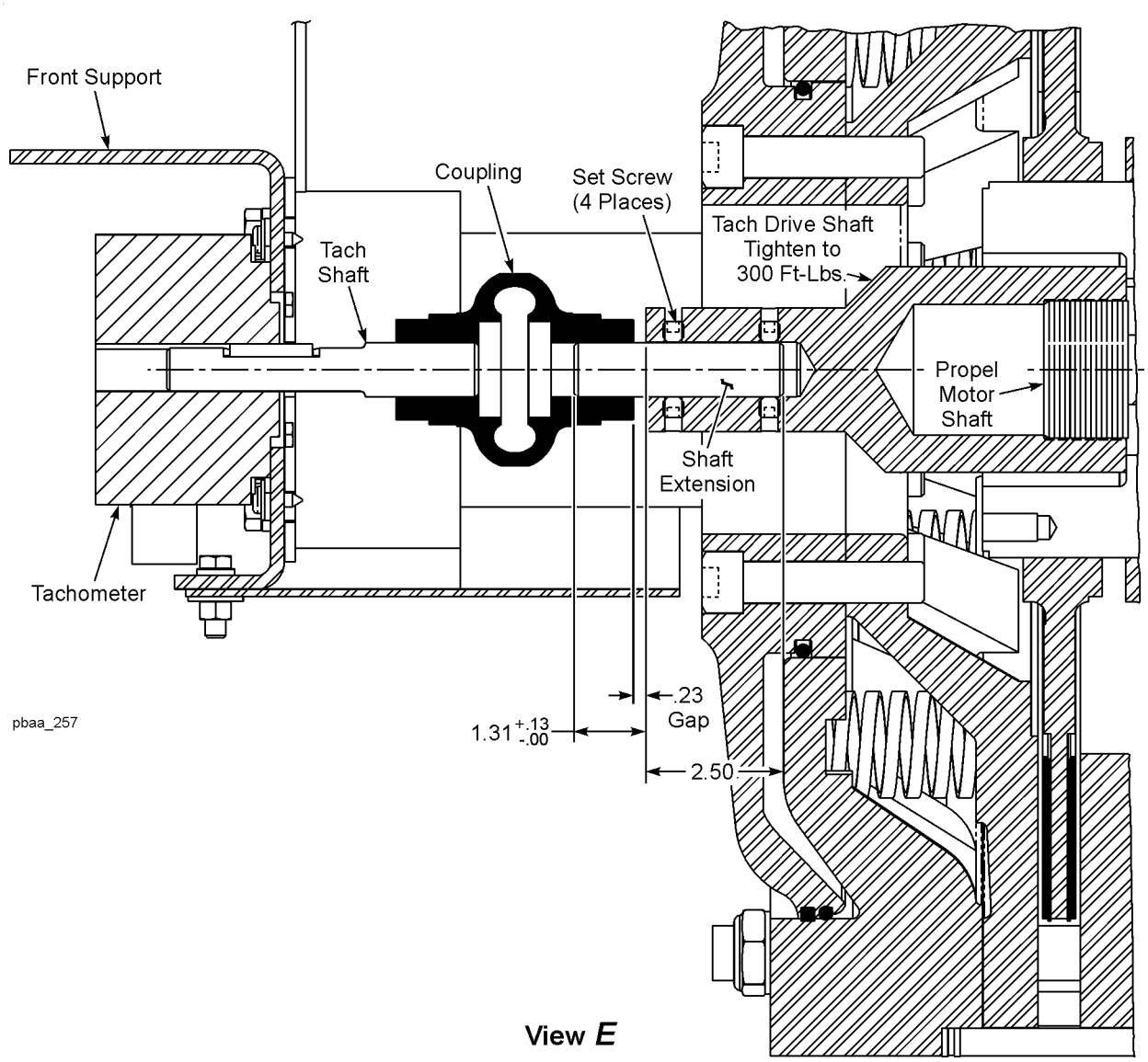


Figure 6-7: Tachometer Mounting & Alignment

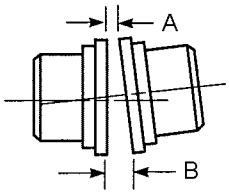
NOTE: It is recommended that piston and cylinder be marked so that the piston bolts pass through the same piston and pressure plate bolt holes at reassembly.

5. Inspect O-Rings for cleanliness, wear, deterioration, or cracks. Clean each as required and replace old or damaged O-Rings. Dress out any nicks or grooves in the cylinder wall with a fine stone and finish with a fine emery cloth prior to installing the new O-Ring seals.
6. Lubricate the O-Rings and grooves generously before assembly. Install the O-Rings in grooves as they would lay naturally. Do not nick, pinch, or twist O-Rings.

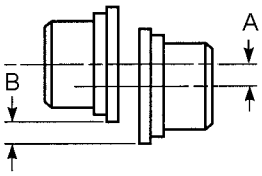
NOTE: It is a good practice to coat the inner surfaces of the piston and cylinder with a Teflon type lubricant. This coating of lubricant acts as a final filter to remove air system dust particles which could damage the O-Rings.

7. Reassemble the piston to the pressure plate with 12 capscrews. Tighten in a star tightening pattern to 200–220 Ft-Lbs.
8. Pressurize the piston to disengage the brake. Close the valve, and then remove the airlines. At this point the brake is disengaged and not connected to an air source.
9. Observe the pressure gauge. If no pressure drop is observed, continue to Step 10. If pressure drops, the seals are not properly seated. Release any remaining air pressure and go to Step 4.
10. Release the brake pressure by opening the temporary shutoff valve. Remove the temporary regulator and shutoff valve from the brake inlet. Reconnect the brake air line to the brake inlet.
11. For the propel brake, reinstall the tach supports and the tachometer.
12. For hoist, crowd or swing brakes, reinstall the wear and release switches along with the mounting bracket and hardware. Refer to *BRAKE WEAR & RELEASE SWITCHES* in this section of the manual.
13. Reinstall the brake guard.

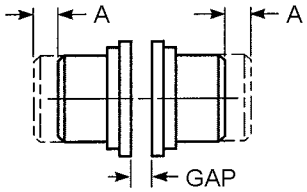
GRID COUPLING ALIGNMENT



ANGULAR ALIGNMENT is the difference between Gap "A" and Gap "B".



OFFSET ALIGNMENT is the amount distance (offset) between shafts.



END GAP is the min. gap between the shaft ends.

cplglmts

Table 6-3: Grid Coupling Data

Coupling	***Crowd***	***Propel***
*Part No.	C113194-01	S021581
Type	Grid	Grid
Motor Frame	812	812
# Bolts	14	8
Dia. (inch)	0.5	0.75
Torque (In-Lbs)	650	650
Torque (Ft-Lbs)	54	54
Max. Parallel Offset (in.)	0.022	0.022
Max. Angular Limit (in.)	0.04	0.04
Min. End Gap Limit (in.)	0.556	0.556
Grease Wt. (lbs.)	1.6	1.6

NOTES:

- Bolts are NOT Standard Fasteners. Values indicated are for clean, dry threads.
- *Use Parts Book to verify part number.

WARNING: DO NOT SUBSTITUTE STANDARD FASTENERS FOR COUPLING BOLTS.

LOCKOUT VALVES

A series of lockout valves are provided to enable maintenance personnel to isolate and remove compressed air from the swing, crowd, hoist and propel brakes should they require maintenance. This permits airflow to continue to the other brakes and features of the machine.

CAUTION: Isolating only one feature of the machine will not eliminate the danger of machine motion while maintenance is being performed. The user is responsible to ensure that all proper precautions, including lock-out/tag-out, bracing and any other necessary precautions have been taken, so that no unanticipated machine motions will occur.

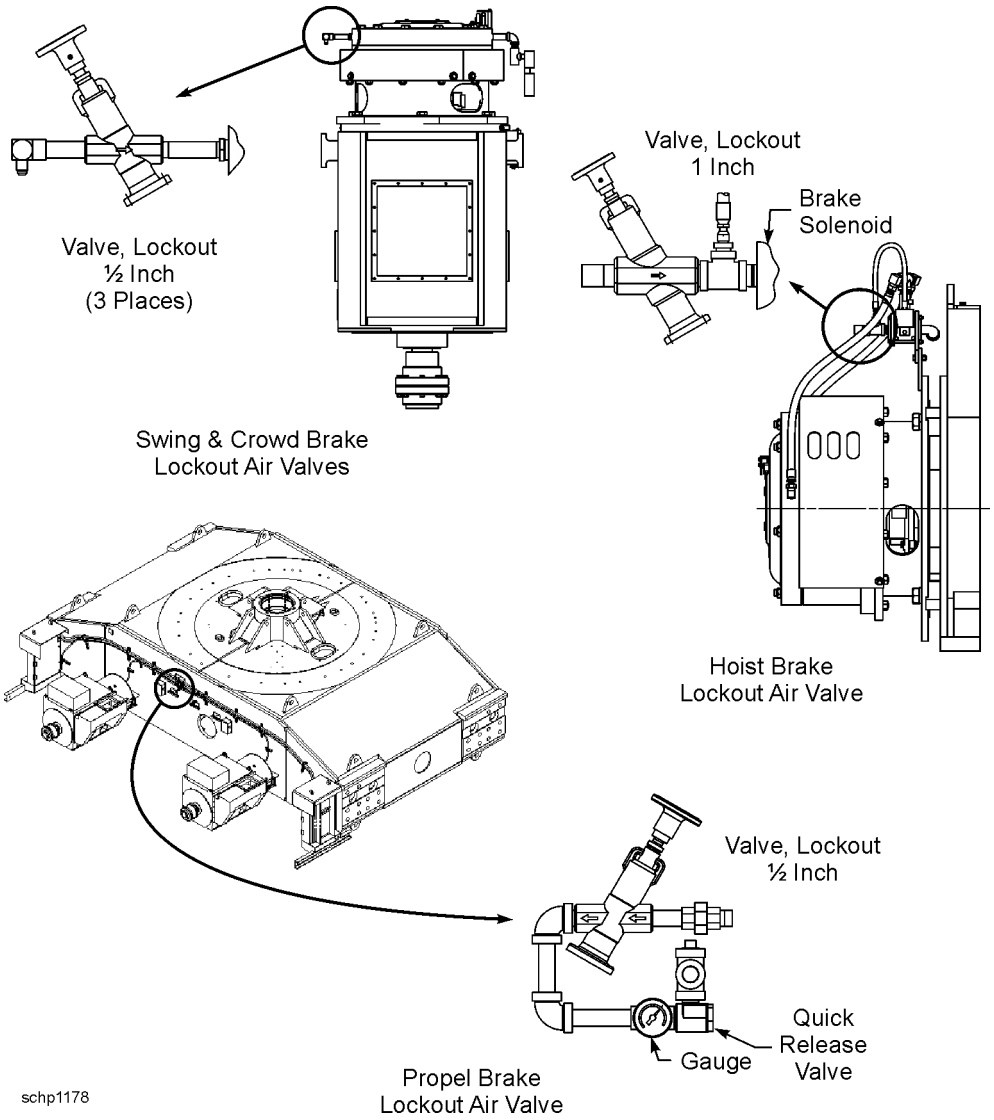


Figure 7-1: Lockout Valve Locations

DYNAVANE AIR CLEANER

Dynavane air cleaners are self-cleaning and do not require the routine service typical of air filters which collect and hold the dirt removed from the air. There are a few maintenance procedures which should be observed.

- The air entering the side of the cells should be kept free of rags, leaves and papers to assure free airflow. Applications exposed to this type of material should have intakes covered with a course mesh (5 mesh) screen to prevent entry of material larger than the bleed slot.

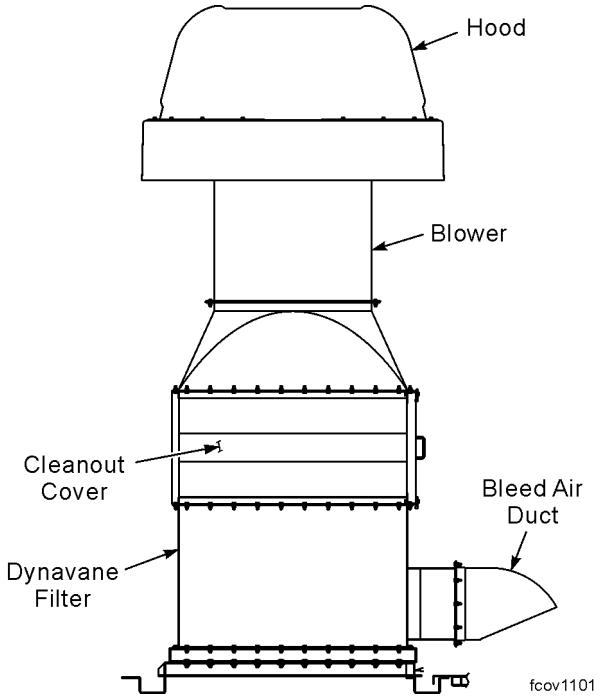


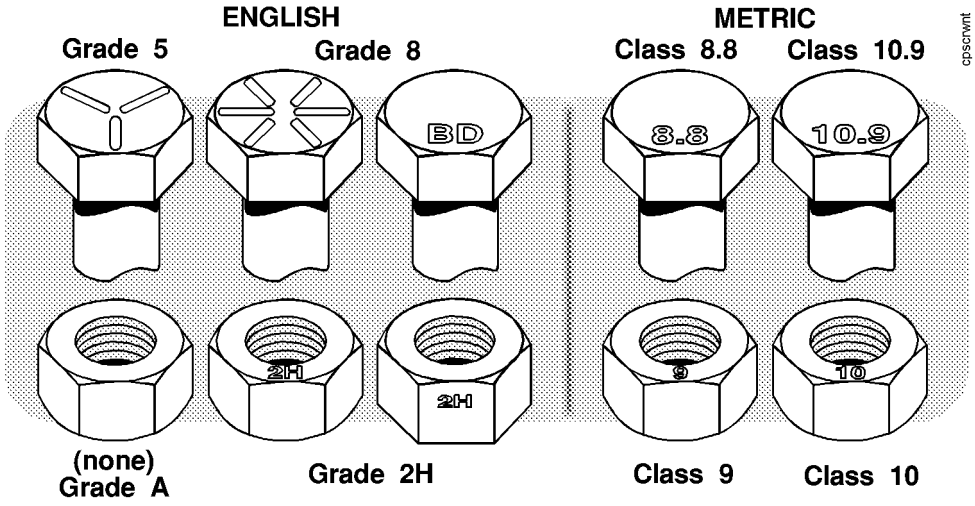
Figure 8-1: Filter Components Overview

- Check the bleed system to make sure nothing has impaired bleed airflow.
- The cells should be examined for buildup of deposits on the blades. A light coating of dust is normal and will not impair the operation or efficiency of the cell. Occasionally, due to the presence of oil mist or similar vapors in the air, heavier surface accumulations will occur and the cell will require cleaning. Cleaning the cells can be accomplished by brushing the surface of the blades or blowing down with compressed air.
- Another method of cleaning the Dynavane filters is to reverse the direction of fan rotation. This creates reverse air pressure which helps free up the dirt. The units can be removed for a more thorough cleaning.

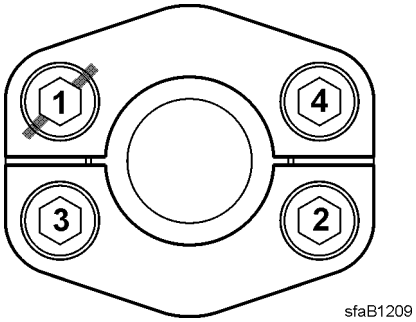
Section 9
Engineering Data

CAPSCREW (BOLT) GRADE

The grade classification of a capscrew (bolt) is identified by the marks on the head as shown below:



Use the SAME GRADE washer and nut as the capscrew. NEVER SUBSTITUTE A LESSER GRADE CAPSCREW IN PLACE OF THAT WHICH IS SPECIFIED.



6. Tighten all bolts in a diagonal sequence in three incremental steps. Use the appropriate torque value specified in the *TORQUE TABLE.*
7. Clean components before marking, then apply a legible mark with a permanent marker or paint across each bolt and clamp.

Table 9-19: Torque Table for Split Flange Assembly

Port Inch Size (Dash Size)	***Code 61 Bolt Size Inch (mm)***	***Torque Ft-Lbs***	***Code 62 Bolt Size Inch (mm)***	***Torque Ft-Lbs***
.50 (-8)	.31-18 (M8)	17 +/-2.0	.31-18 (M8)	17 +/-2.0
.75 (-12)	.38-16 (M10)	25 +/-4.5	.38-16 (M10)	30 +/-4.5
1.00 (-16)	.38-16 (M10)	31 +/-45	.44-14 (M12)	46 +/-4.5
1.25 (-20)	.44-14 (M10)	41 +/-5	.50-13 (M14)	69 +/-6
1.50 (-24)	.50-13 (M12)	52 +/-6	.63-11 (M16)	125 +/-8
2.00 (-32)	.50-13 (M12)	60 +/-6	.75-10 (M20)	208 +/-20
2.50 (-40)	.50-13 (M12)	85 +/-9	.88-9 (M22)	330 +/-25
3.00 (-48)	.63-11 (M16)	144 +/-15	1.13-7 (M27)	640+/-30
3.50 (-56)	.63-11 (M16)	125 +/-8	N/A	N/A
4.00 (-64)	..63-11 (M16)	125 +/-8	N/A	N/A
5.00 (-80)	.63-11 (M16)	125 +/-8	N/A	N/A

INITIAL TENSIONING

1. To seat the threads and eliminate clearances, use a small wrench to tighten the jackbolts on the mechanical tensioner to 10% of the final torque required (approximately **18** Ft-Lbs). Tighten the jackbolts in the tightening sequence indicated in Sequence 1.
2. Switch to a torque wrench and tighten the jackbolts to 50% of the final torque required (approximately **88** Ft-Lbs), again using the tightening Sequence 1.
3. Re-tighten the jackbolts to 75% of the final torque required (approximately **132** Ft-Lbs) — however, use tightening Sequence 2.

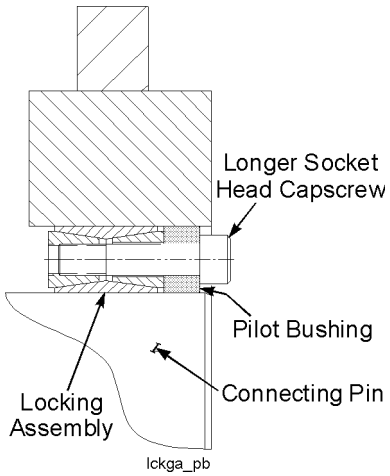
FINAL TENSIONING

4. Tighten the jackbolts to 110% of the final torque required (approximately **193** Ft-Lbs) using the tightening sequence in Figure 2.
5. Tighten all the jackbolts to the final torque required (**175** Ft-Lbs) using the tightening Sequence 2.

and repeat until all screws are tight. Refer to the proper section of the maintenance manual for the specific torque required.

Where pilot bushings are used:

1. Insert the locking assembly as stated above - except remove all socket head capscrews.



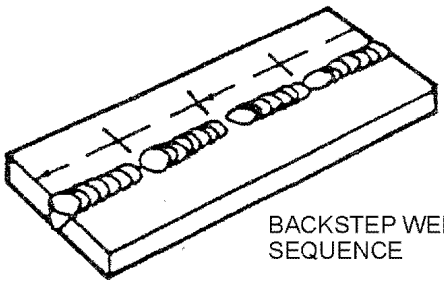
2. Insert 3 pilot bushings, equally spaced. Insert the longer capscrews supplied with the pilot bushings.
3. Tighten the capscrews using the same procedure required for the locking assembly capscrews.
4. Once the pilot bushing is has been properly tightened, remove the longer socket head capscrews and the pilot bushings. Replace the capscrews in the locking assembly with the socket head capscrews that came with the locking assembly.
5. Tighten all capscrews using the procedure above. Retain the pilot bushings and longer capscrews for future use.

The presence of any stress risers on the surface of a part is detrimental to fatigue life and can result in future cracking. Therefore, it is essential that the finished repair be smooth and well blended into the base metal. Repair weld any undercuts, grind off overlapped weld beads and blend out any notches or gouges. The best condition in a repair weld location is provided by grinding the repair smooth and flush with the surface of the base metal. Final grinding direction is to be identical with the direction of applied load on the structure. Refer to the figure.

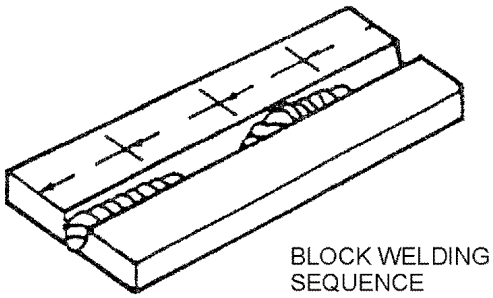
REPAIR WELDING OF BROKEN PARTS

All recommendations given for repair of cracks apply to repair of broken parts, with additional corrections. Depending on the size and cross-section of the part, a specific sequence of welding procedures may be required in making the repair. These techniques include back-step welding sequence, block welding sequence, alternating from side to side, welding simultaneously on opposite sides, etc. All of these precautionary measures are intended to minimize shrinkage stresses and subsequent distortion or cracking during welding. The method to follow should be determined after a careful analysis of the situation and by approaching the problem with common sense. Generally a procedure which has proven successful in previous experience could logically be applied in most cases.

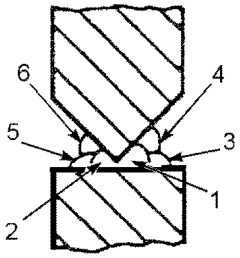
Use of doubling plates, stiffeners or other reinforcements to strengthen a member which has cracked in service, must be carefully considered before that repair measure is decided upon. Additional material added for strengthening alters the configuration and geometry of the member, possibly with a pronounced effect on the fatigue life of that structure. Many times, such attempts at strengthening by adding plates only serves to “chase the crack someplace else.” The stress flow in the part has been altered, creating a location for stress concentration. Attachments requiring fillet welds across a tension member for example, are poor repair methods. A sound repair weld, carefully made and smoothly blended into the base metal on all sides, is preferable to additional reinforcements. Any application of reinforcements requires careful consideration regarding total overall effect on the structure during service, and should be done only after consulting Bucyrus International, Inc.



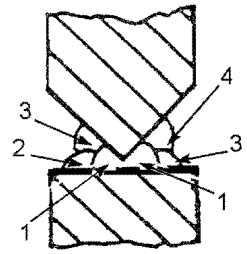
BACKSTEP WELDING SEQUENCE



BLOCK WELDING SEQUENCE

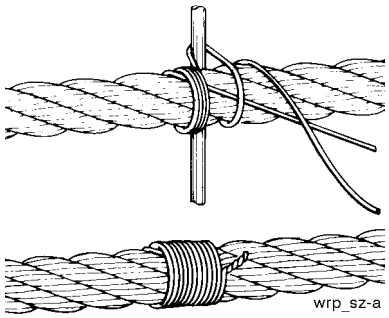


ALTERNATING WELDING (SIDE TO SIDE)



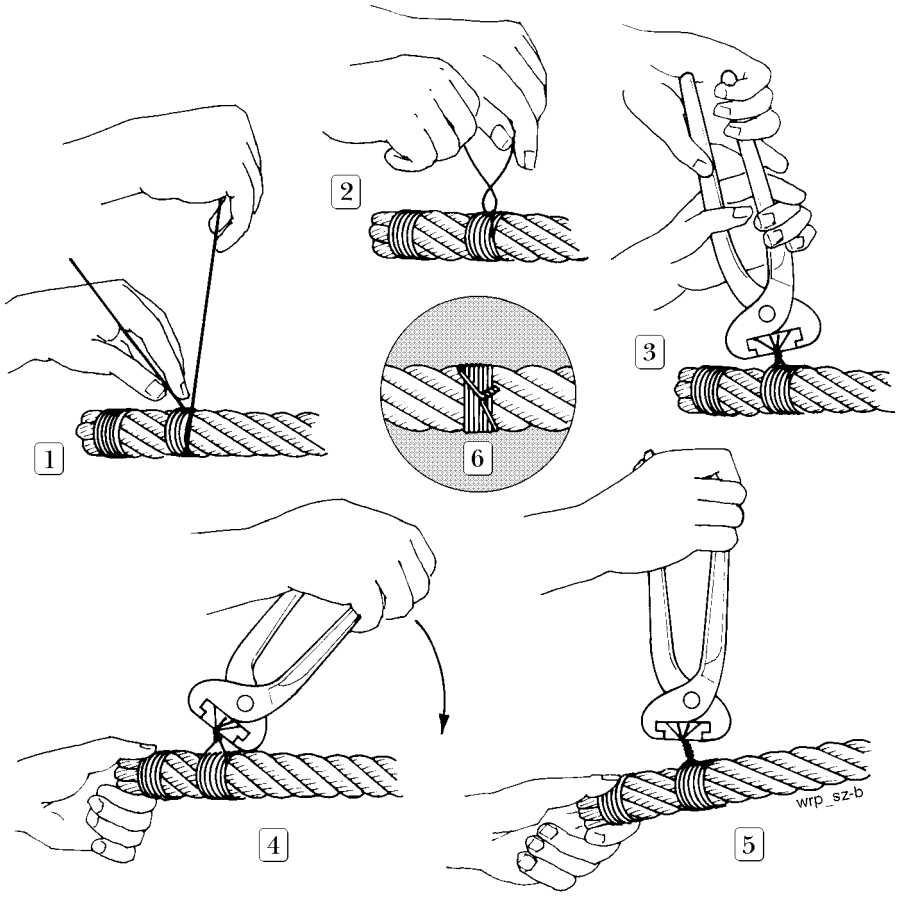
SIMULTANEOUS WELDING (OPPOSITE SIDES)

wldrpr-d



SEIZING Method A

The procedure illustrated below is the second of the two accepted methods for placing seizing on wire rope. This method is normally used on smaller ropes.



SEIZING Method B