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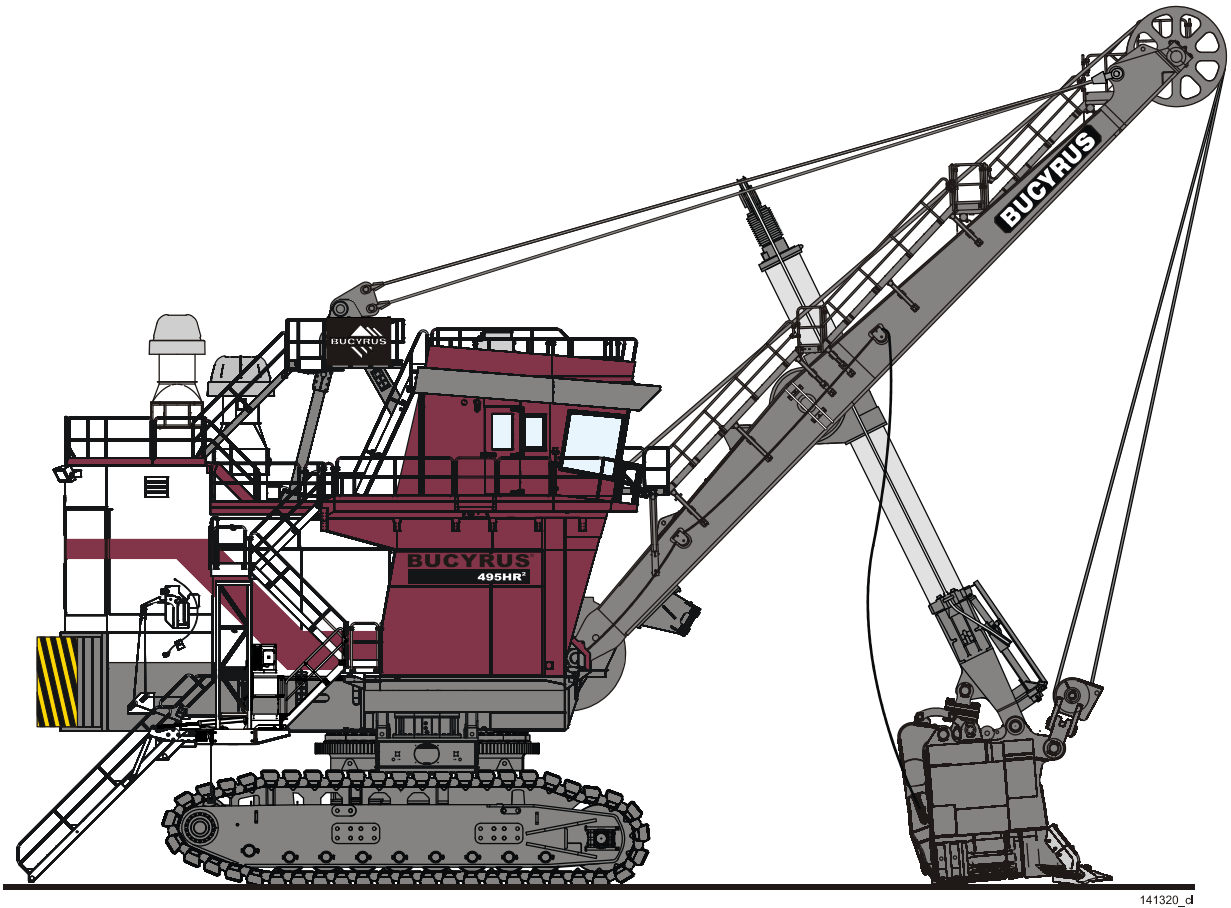
BUCYRUS®

495HR²
MINING SHOVEL
MAINTENANCE MANUAL

SN: 141320

Manual No. *10977*



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Bucyrus International, Inc.

1100 Milwaukee Ave. • P.O.Box 500 • South Milwaukee, Wisconsin 53172-0500 USA

495HR^2 Electric Mining Shovel Maintenance Manual

Manual No. 10977

SN: 141320

Table of Contents

This manual is divided into major sections covering the various servicable components and systems of the 495HR^2 Mining Shovel. These sections and their contents are organized as shown below.

SAFETY

SECTION 1 - INTRODUCTION

Revision History

August 2011 - Torque value change from 738 Ft-Lbs (1000.6 Nm) to 7,380 Ft-Lbs (10,006 Nm). 4-31, 4-42

CRAWLERS

This machine is provided with a crawler system composed of 2 independently-driven crawler frame assemblies, one on each side of the truck frame. Each crawler has its own belt driven by a sprocket-type drive tumbler. Individual crawler links are heavy alloy steel castings connected by heat treated pins.

Innovative drive tumblers made from large diameter steel castings have lugs extending beyond the tumbler rims. They are mounted on forged alloy steel shafts which turn on large anti-friction bearings mounted within the crawler frame. The sprocket type lugs provide a large area of contact against the crawler links, extending the life of both links and tumblers.

Lower rollers rotate on forged steel shafts mounted within the crawler side frames. Eight smaller rollers and 1 large roller per frame are specially suited to withstand the periodic single point ground reaction caused by uneven pit floors. Slide bars on top of each frame support the upper crawler belt, reducing propel friction and drag. These side frames are stress relieved weldments comprised of steel castings and cold weather steel plates.

The crawler assemblies are bolted to the truck frame with large diameter rods and torque nuts. Each crawler belt can be independently adjusted for tension.

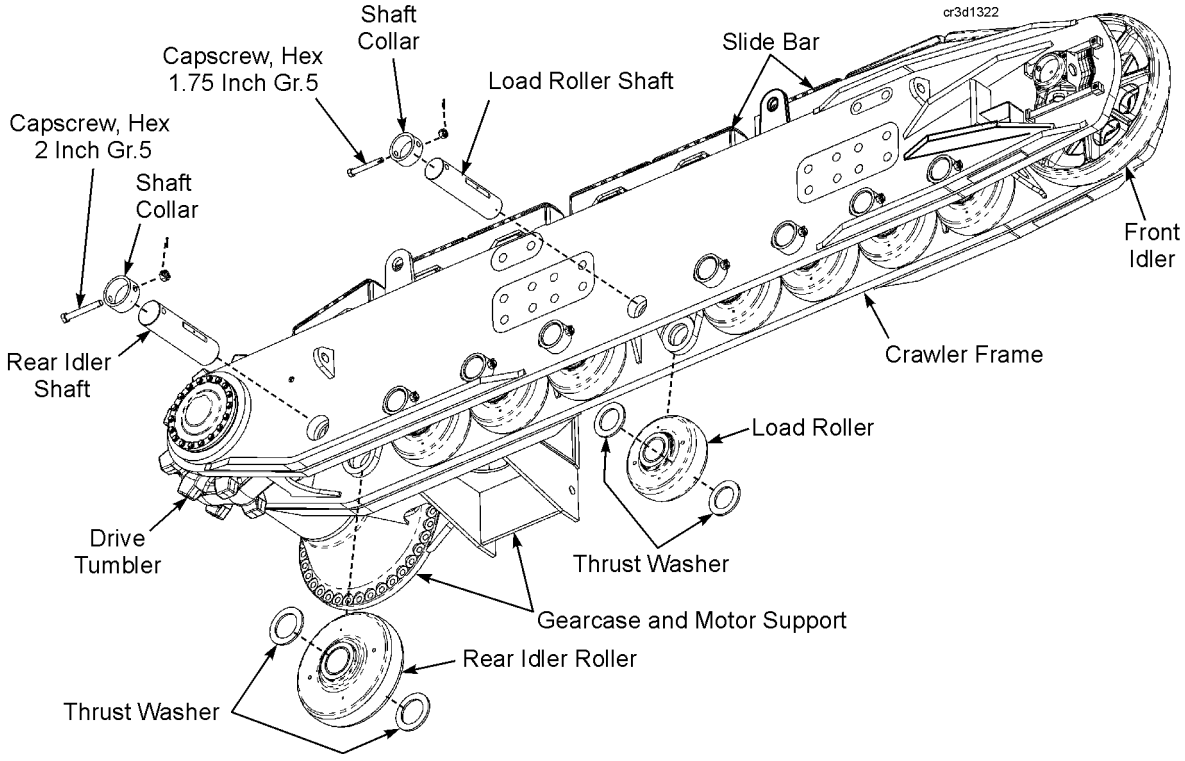


Figure 1-3 : Right Crawler Assembly (Left Opposite)

BOARDING STAIRS

A set of boarding stairs is attached to the machinery house platform - either on the left side of the machine, the right side or both. When lowered, the stairs allow entrance to the machinery house from ground level. To activate the stairs, a pull cord attached to a lever arm is reachable from the ground. An additional lever is available at the top of the stairs. These stairs must be in their raised and latched position to enable the operator's controls.

DANGER: STORED ENERGY! System may be under hydraulic pressure which can cause severe personal injury or death. Shut down pump and relieve system of all pressure before removing components.

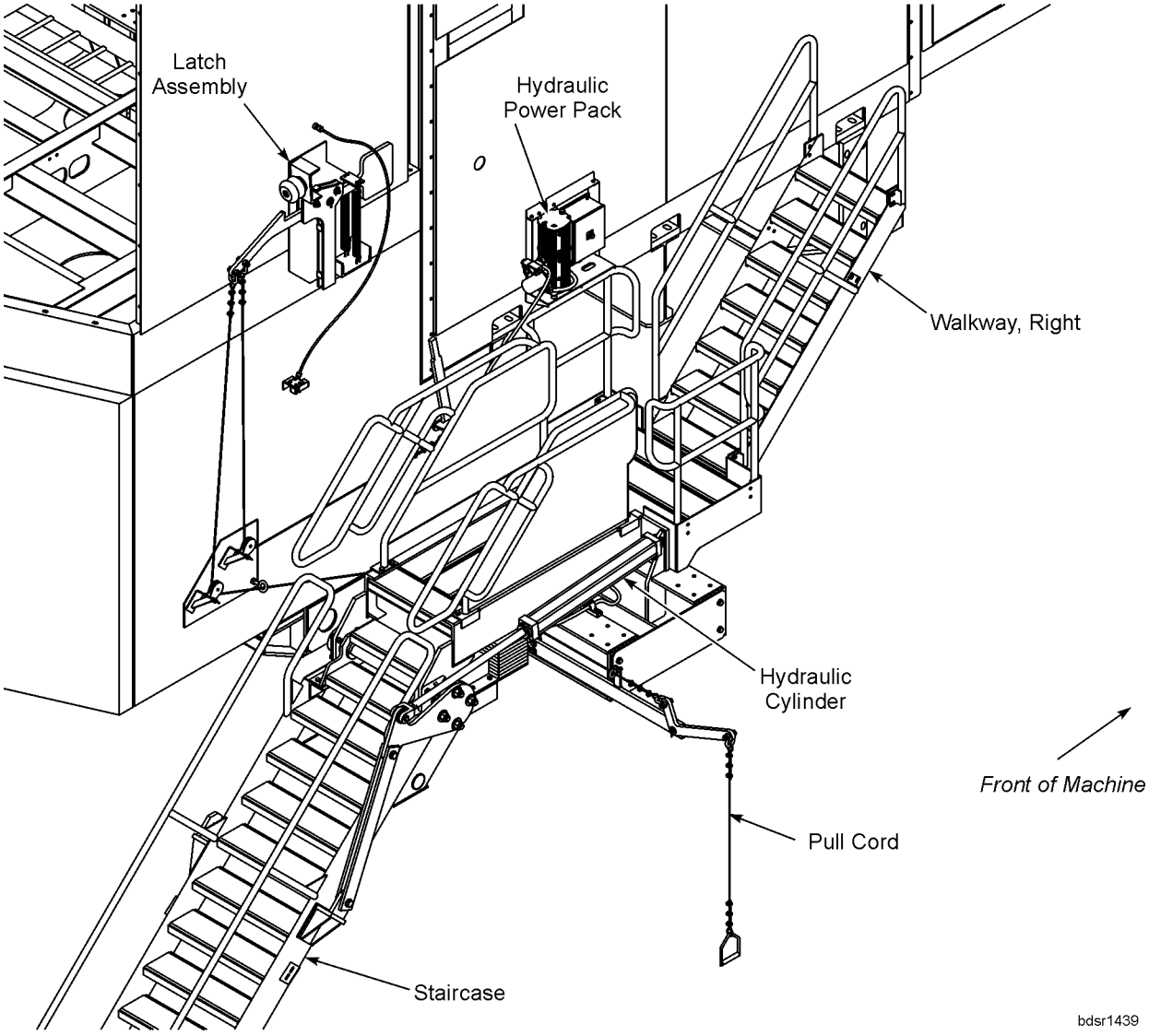


Figure 1-7 : Right Side Boarding Stairs

FRONT END EQUIPMENT

The front end equipment consists of the boom, the boom point sheaves, padlock, saddle block, dipper handle, dipper, dipper trip mechanisms, running ropes and boom suspension strands.

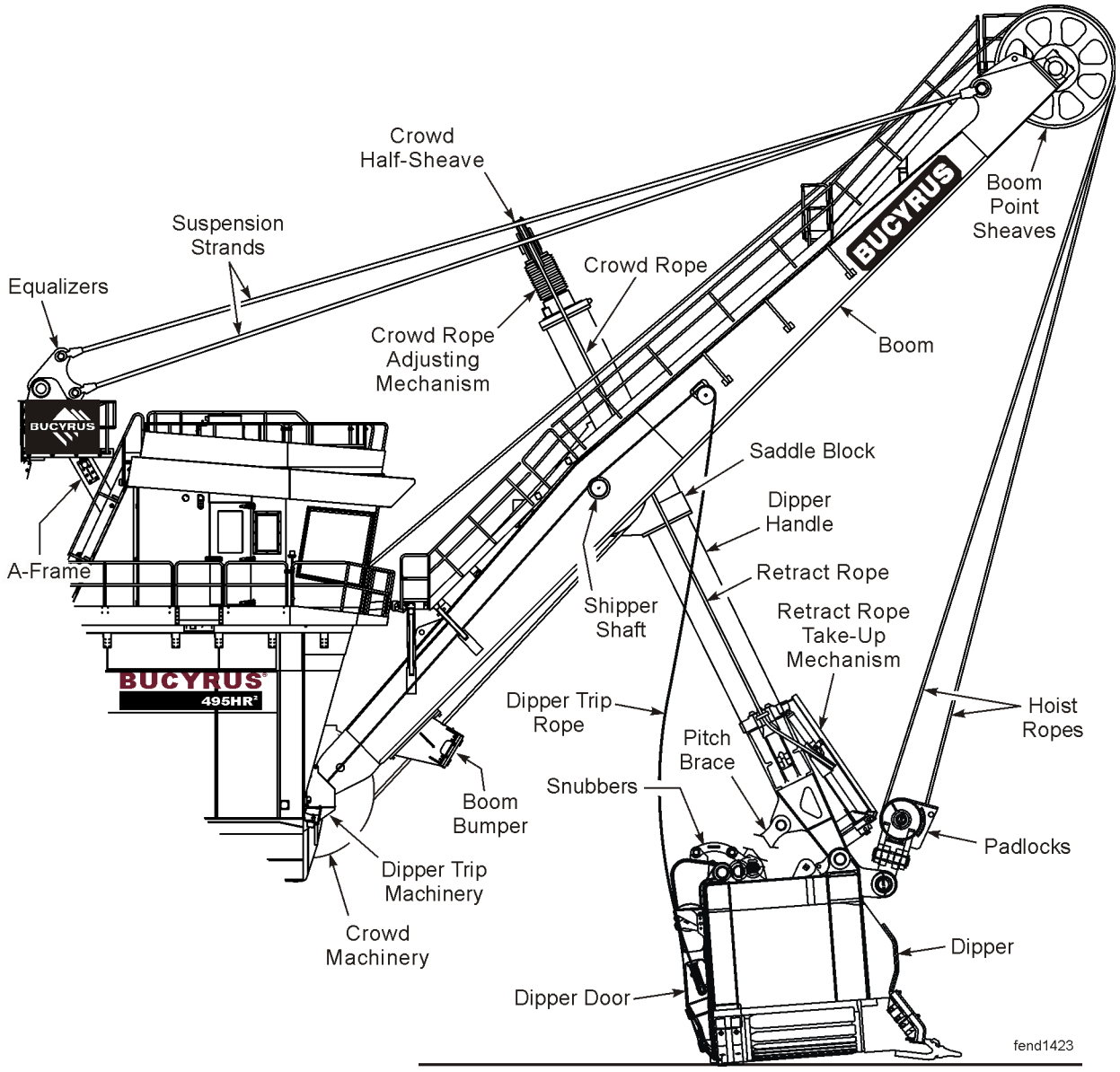


Figure 1-14 : Front End Equipment

SUSPENSION STRANDS

The suspension strands are designed to maintain the proper boom angle. These are fixed-length strands that support the entire weight of the boom and the load.

GENERAL ESTIMATED COMPONENT WEIGHTS

CAUTION: These are estimated weights only. Contact your Bucyrus International service representative for the exact weight of components on your specific machine before rigging and lifting.

LOWER WORKS

	Quantity	*Weight Each (U.S. Pounds)*
Truck Frame	1	191,330
Pintle Bushing	1	280
Lower Rail	9	570
Thrust Rail	9	170
Propel Brake Adapter	2	370
Propel Brake	2	650
Propel Brake Hub	2	60
Propel Motor	2	4,500
Propel Motor Blower	2	210
Propel Motor Duct Assembly	2	185
Propel Brake Guard	2	60
Coupling	2	90
Crawler Belt (2 per Machine)	2	244,000
Link, Crawler, 78.75 In. (47 per Belt)	47	2,450
Crawler Assembly~Shipping	2	128,500
Crawler Structure	2	83,880
Propel Gearcase	2	19,230
Front Idler	2	5,800
Shaft, Front Idler	2	1,150
Adjusting Block	4	370
Load Roller	8	2,020
Shaft, Load Roller	8	550
Rear Idler	2	3,800
Shaft, Rear Idler	1	700
Tumbler, Drive	1	7,120
Shaft, Drive Assy	1	4,330
Shaft, Drive	1	3,370
Sleeve, Center Pintle	1	9,100
Collar, Center Pintle, Upper	1	380
Washer, Thrust, Center Pintle	1	400
Nut, Lock, Assy. Center Pintle	1	1,470

4. REGREASING INTERVALS

The regreasing interval can be found in the following table. Follow either the recommended operating hours, or the time interval, which ever comes first.

Motor	*Regreasing Interval*	*Drive End Grease Amount Grams (oz.)*	*Non-Drive End Grease Amount Grams (oz.)*
Hoist motor	3000 operating hours or every 6 months	88 (3.1)	140 (5.0)
Propel motor	3000 operating hours or every 6 months	54 (1.9)	94 (3.3)
Crowd motor	3000 operating hours or every 6 months	54 (1.9)	94 (3.3)
Swing motor	1500 operating hours or every 3 months	54 (1.9)	80 (2.8)

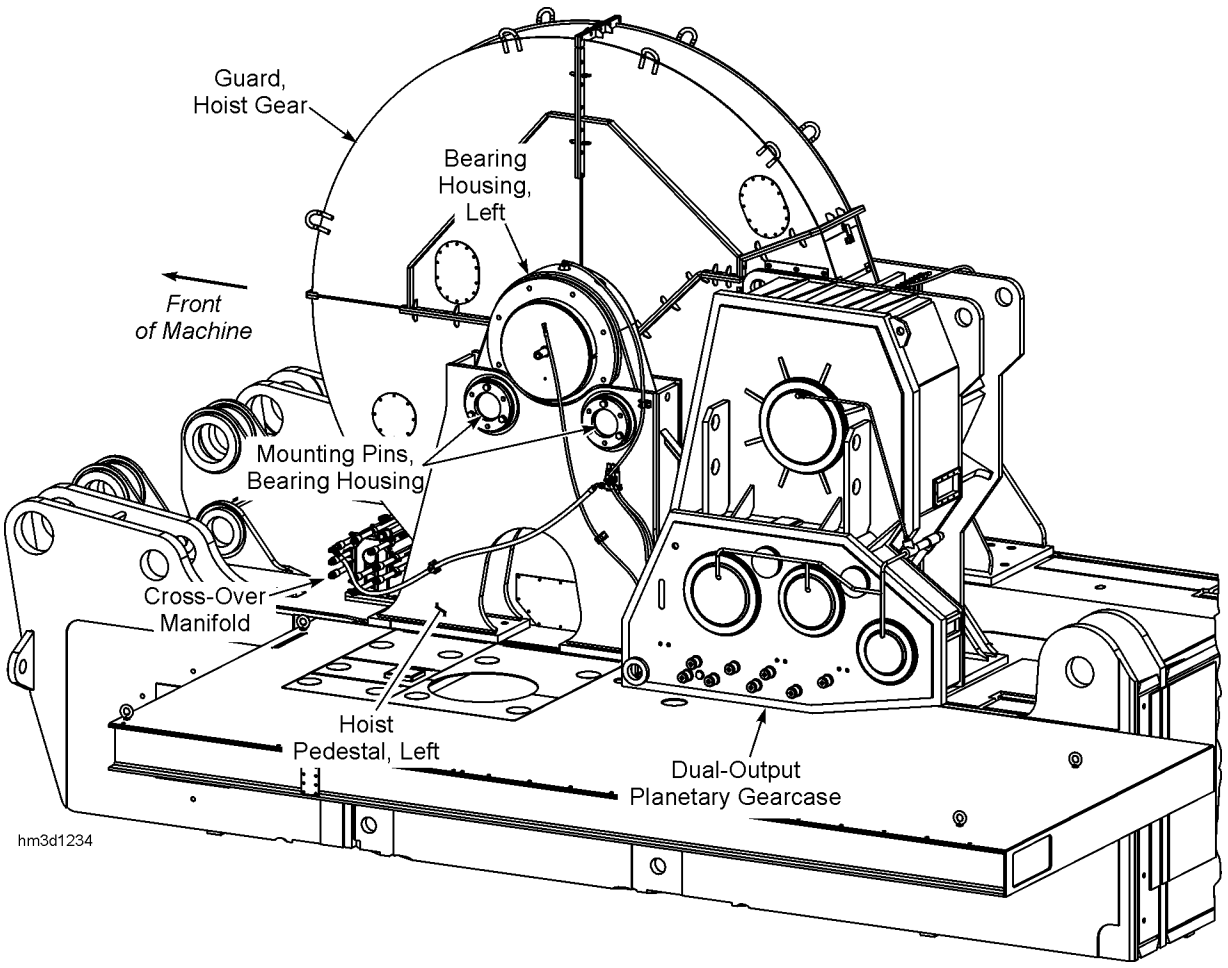
NOTES:

- It is critical that the drainpipe not be allowed to become plugged with caked or contaminated grease. If it does, then the pipe must be cleared.
- A common mistake is over-lubrication of bearings. When grease is added without removing the drain plug, the excess grease can be forced into and through the grease seals leading to grease leakage along the shaft (out of the motor or into the motor and possibly onto the motor windings). Proper lubrication is desired, but some under-lubrication is less harmful than over-lubrication.
- Bucyrus part number 59100651 is a 14 ounce cartridge of Mobilith SHC100 grease.

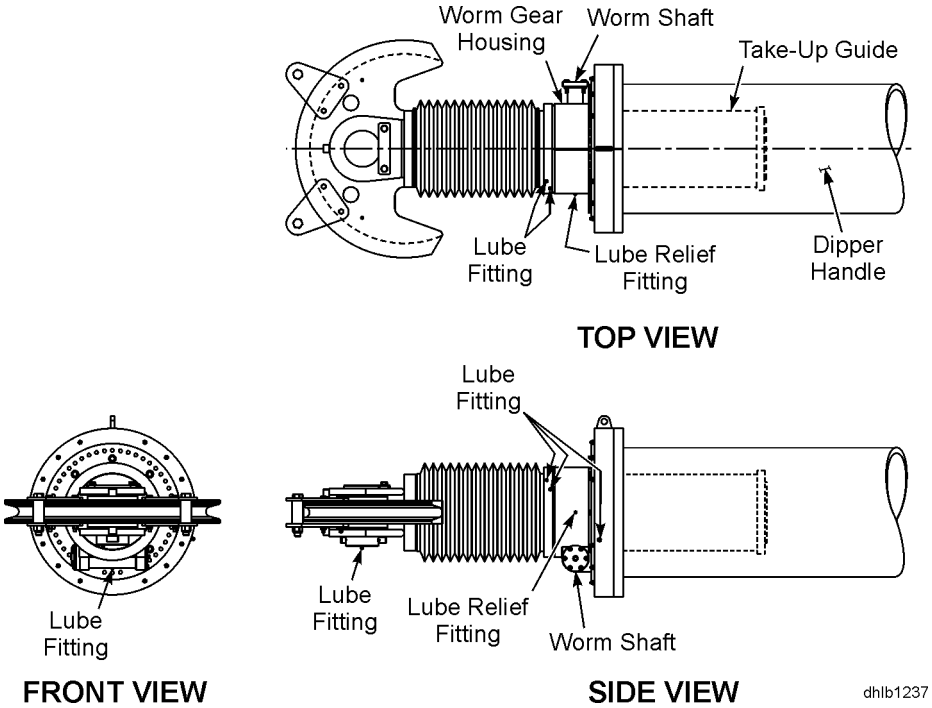
HOIST MACHINERY LUBRICATION

The hoist machinery drive is comprised of 2 stages of gear reduction. The first stage gear reduction is an enclosed system running submersed in lubricant. The gearcase housing is equipped with lubricant level check plugs on the right side of the case. A filter breather is provided to allow for air entry to equalize pressure differentials created by the warming and cooling of the gearcase, allows moisture to escape and prevents contaminants from entering.

The second stage of gear reduction is operating as a semi-enclosed system lubricated by OGL. The drum shaft bearings are grease lubricated by System “C-1” along with the intermediate shaft of the hoist gearing. The motor pinion shaft bearings are splash lubricated from the 1st stage gearcase.



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. Refill the crowd rope worm gear housing with OGL, if required. (Total capacity is approximately 3.0 gallons.)
   - Add, at the least a small amount of OGL through all four of the lube fittings in the crowd rope worm gear housing, to lubricate friction surfaces adjacent to those fittings.
   - Look for OGL to bleed from the relief valve fitting in the side of the worm gear housing, when lubricant capacity of the housing is reached.
   - Pump a small amount of OGL through the fitting on the half-sheave clevis pin.

NOTE: During initial assembly, prior to shipping, grease lubricant is applied to all friction surfaces of the assembly. Traces of grease lubricant will be visible during initial maintenance, but for all lubrication procedures in the field, use Open Gear Lubricant (OGL) – *not* grease.

EGL - ENCLOSED GEARCASE LUBRICANT

Applicable to Models 495BII, 495HF, 495HR and 495HD Electric Mining Shovels.

(September 1, 2005)

SCOPE

This specification covers the requirements for “Enclosed Gearcase Lubricant” used on models 495BII, 495HF, 495HR and 495HD Electric Mining Shovels.

The materials furnished under this specification are intended to lubricate spur, helical and spiral bevel gears as well as anti-friction bearings at the interior of enclosed planetary and non-planetary type gearcases (Hoist, Swing, Crowd and Propel).

This specification covers “Enclosed Gearcase Lubricants” that may be applied in service at temperatures ranging from –50ºC (-58ºF) to the highest ambient temperature conditions.

Guidelines for Selecting an Approved Lubricant

1. Using *Table 1*, determine the recommended oil type (Mineral or Synthetic) based upon the anticipated ambient temperature range.

AMBIENT TEMPERATURE RANGE

Ambient Temperature: The ambient temperature is defined as the air temperature in the immediate vicinity of the gearcase.

a. Use atmospheric temperature for gearcases located outside of the machinery house (Swing, Crowd and Propel Gearcases).
b. Use machinery house temperature for gearcases located inside of the machinery house (Hoist Gearcase) for some machines are equipped with machinery house heaters.
c. If the ambient starting temperature approaches the lubricant pour point, external heaters may be required to facilitate starting and insure proper lubrication. Use oil temperature for gearcases having oil immersion heaters.

Table 2-1: Guidelines for Selecting Approved Lubricant

Ambient Temperature Range	***ISO Viscosity Grade / Oil Type***
14°F to 100°F (-10°C to 37°C)	ISO VG 320 / Mineral or Synthetic (poly-a-olefin) Oil
Less than 14°F to 120°F (Less than -10°C to 50°C)	ISO VG 320 / Synthetic (poly-a-olefin) Oil

Under normal circumstances, an ISO VG 320 oil viscosity is required for all Gearcases (Hoist, Swing, Crowd and Propel). For cold weather applications, an ISO VG 220 oil viscosity may be used for the Propel Gearcases to help ensure that the lubricant pour point remains below that of the ambient starting temperature. The pour point and flash point of individual brand name gear oils must be observed. Refer to the oil manufacturers technical data sheets for these properties.

2. Select an approved lubricant for the Hoist, Swing, Crowd and Propel Gearcases from the Approved Lubricant *Table 2* & *Table 3*.

APPROVED LUBRICANTS

Lubricants that have been approved for use by the gearcase manufacturers are listed in the Approved Lubricant *Table 2* & *Table 3*. The use of non-approved lubricants may invalidate the Bucyrus International, Inc. product warranty obligation.

CERTIFIED LUBRICANTS

Lubricants certified by their manufacturers as complying with this specification will be listed on the “Certified Lubricants Listing for Open Gear Lubricant” (see the Bucyrus International, Inc. web site www.bucyrus.com for the latest listing). The use of non-certified lubricants may invalidate the Bucyrus International, Inc. product warranty obligation.

Specific product selection is the responsibility of the equipment operator/owner and is dependent on climate, application, performance and regional/local regulatory requirements.

Lubricant manufacturers seeking to certify their products should contact the following for direction:

Bucyrus International, Inc.

Engineering Services & Technical Support

1100 Milwaukee Avenue

South Milwaukee, Wisconsin 53172

Phone (414) 768-4000

SPECIFICATION REVISIONS

This specification is subject to change without notice. Please contact the following for the latest specification:

Bucyrus International, Inc.

Engineering Services & Technical Support

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South Milwaukee, Wisconsin 53172

Phone (414) 768-4000

Section 3
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 *LUBRICATION* and *SERVICE PROCEDURES* sections 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.	
	30. Operator's Cab HVAC	Clean filter and pressurizer in dusty conditions. Observe charge.	

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 Service Procedures section 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.	

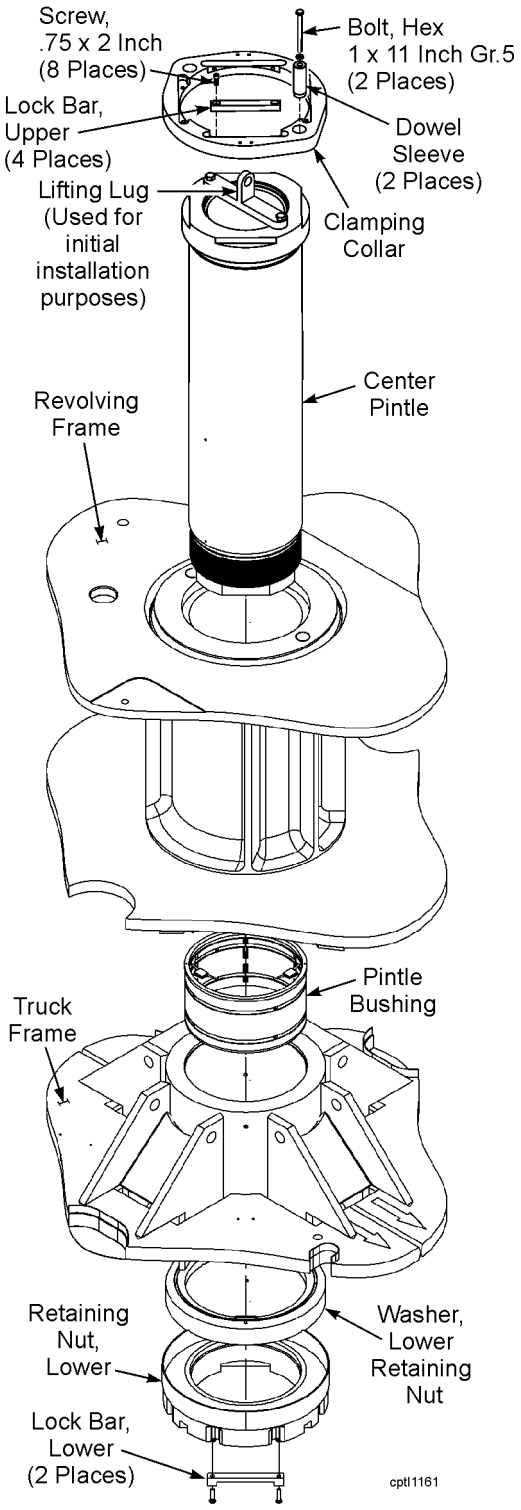


Figure 3-10 : Center Pintle Assembly

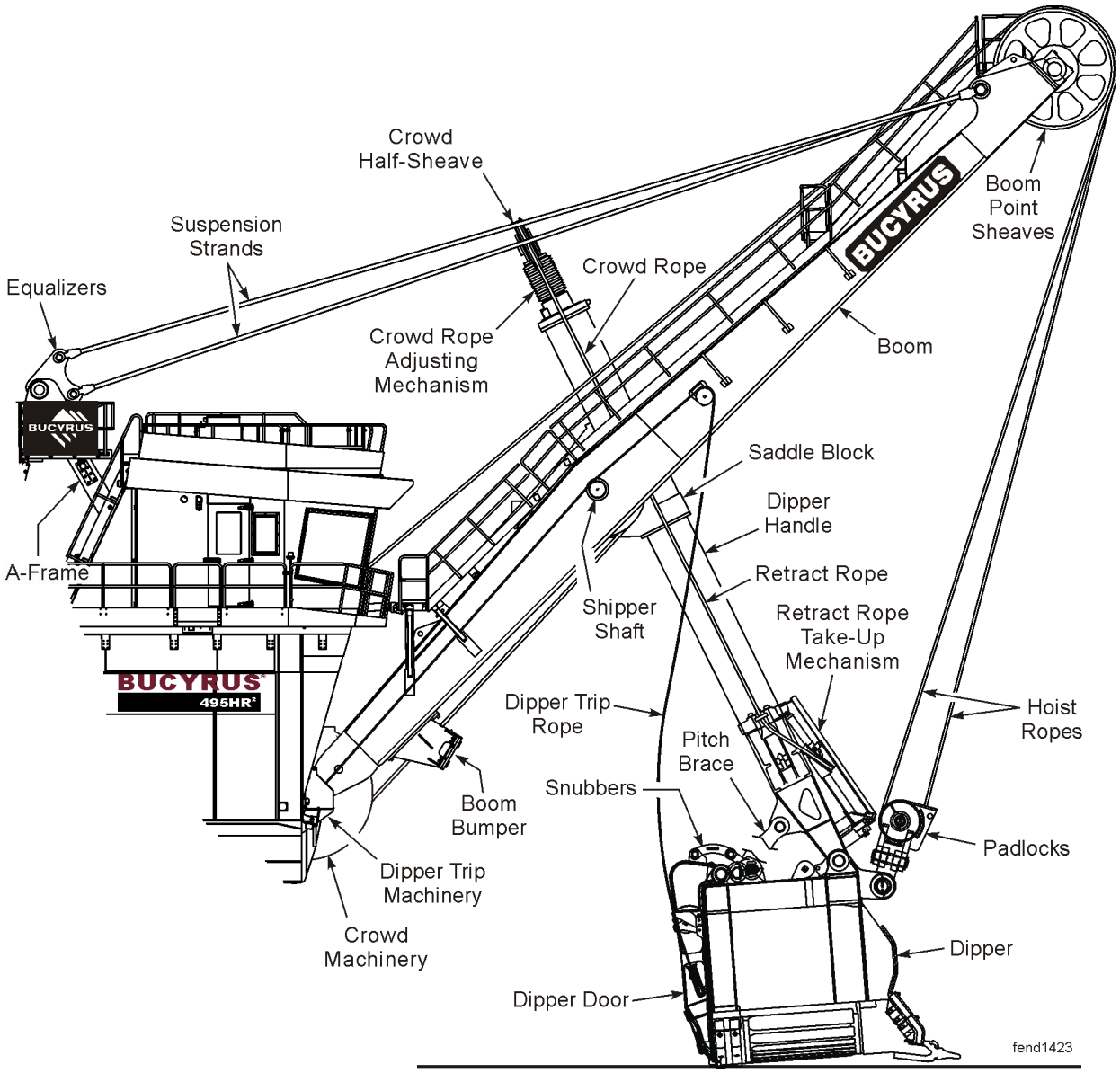


Figure 3-20 : Front End Equipment

Section 4
Service Procedures

LOWER WORKS

TRUCK FRAME ASSEMBLY

The truck frame assembly consists of the bolt-on crawler assemblies with belts, truck frame structure, propel motors and planetary gearcases, center pintle, roller circle, swing rack and lower roller circle rails.

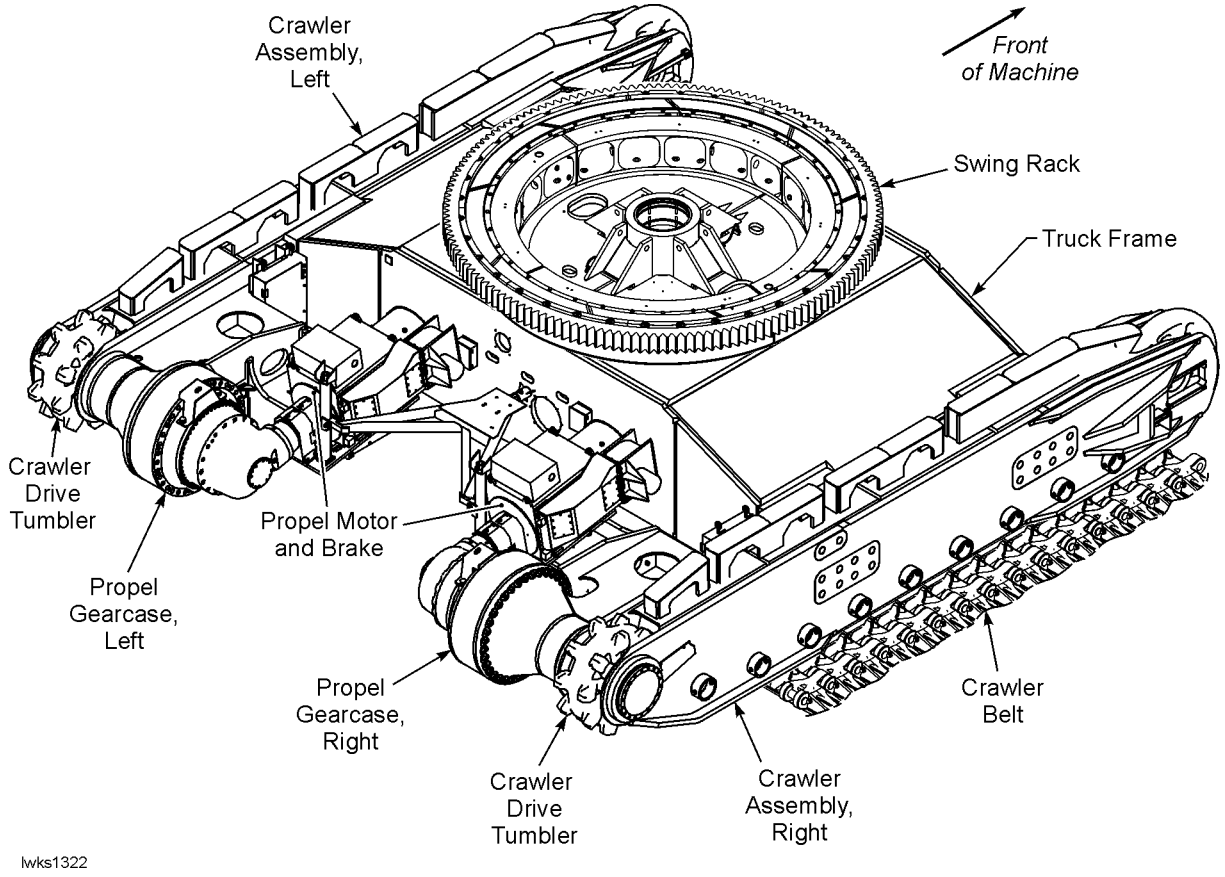


Figure 4-1 : Truck Frame and Crawlers Assembly

The truck frame is the primary support structure for the machine. The two bolt-on crawler side frames each have a propel motor and planetary gearcase. This assembly provides the operator complete independent control of each crawler.

Both the truck frame and crawler structures should be inspected during each maintenance period for areas of distress. If cracks are found in any of the structural welds or plates these should be repaired during the next scheduled maintenance period.

CRAWLER BELT TENSION ADJUSTMENT

1. Propel the machine forward on level ground until most of the slack in the crawler belt is on top of the crawler.
2. Safely park the machine. Remove the auto lube line from the end of the front idler shaft.
3. Position 2 identical hydraulic jacks to the rear of the adjusting blocks on each side of the front idler in the crawler side frame. Seat the jack ram into the counterbore provided in the adjusting block.
4. Remove the 2 shim retainer bars on each side to free the shims, and remove the shims from the storage space in front of each adjusting block.
5. Extend both hydraulic jacks in unison to move the front idler assembly forward to tighten the belt. Do not permit the adjusting blocks to misalign in the side frame.
6. Tighten the belt until all slack is removed and the crawler shoes start to lift off any slide bar.
7. Insert shims into the space on each side behind the adjusting blocks until a gap of 1.5 inches exists between the shims and the blocks.

NOTE: Shims of the same thickness and quantity must be used in the space on each side to maintain correct idler alignment in the crawler.

8. Release both hydraulic jacks and remove them from the crawler.
9. Put the remaining shims in the storage space in front of each adjusting block. Reassemble the shim retainer bars to the crawler. Reconnect the auto lube line.

NOTE: Both crawler belts should be adjusted to the same tension and the same overall length. This is to ensure that the machine will propel in a straight line. The machine will have a tendency to turn toward the shorter belt when propelling forward.

LOAD AND IDLER ROLLERS

The load and rear idler rollers are located at the bottom of each crawler side frame. The load rollers and rear idler distribute the machine weight on the crawler belt.

Each of the load rollers and rear idler roller turn on a fixed shaft secured in the crawler side frame by a lock collar and pin. Each roller is fitted with a bronze bushing.

Thrust washers are located between the rollers and inner frame bosses to retain lubrication and prevent the entry of dirt.

ROLLER REMOVAL OR REPLACEMENT

To remove a roller from the crawler side frame:

1. After a pit has been prepared, position a handling fixture under the roller for support when the shaft is removed.
2. Propel the machine forward to a position where the roller to be removed is directly over the hole. Separate the belt by removing the lock bolts. Lower each end of the belt into the pit exposing the roller for removal.
3. Disconnect the auto lube line from the end of the roller shaft. Plug the line to prevent dirt entry.
4. Remove the shaft retaining bolt.
5. Drive or pull the shaft out of the crawler frame, being careful to support the roller on a handling fixture, jack or cribbing. Remove the thrust washers as they come free.

The same procedure can also be used to remove the rear idler roller.

To install or replace a load or rear idler roller:

1. Position the replacement roller in the pit on some cribbing, a handling fixture or jack.
2. Start shaft through the outside crawler side frame member. When the shaft begins to exit the other side, install the thrust plate.
3. Raise the roller or idler into position and continue to drive the shaft through the roller or idler.
4. As the shaft exits the roller, install the other thrust plate.
5. Continue to drive the shaft through the crawler frame until the bolt retainer aligns with the hole in the collar.

NOTE: Install the load or idler roller shafts with their lubrication hole toward the front of the machine. The punch mark on the end of the shaft indicates the lube hole location.

6. Install the lock bolt.
7. Install and purge the automatic lube lines. Check the lube system operation and reinstall the guards.

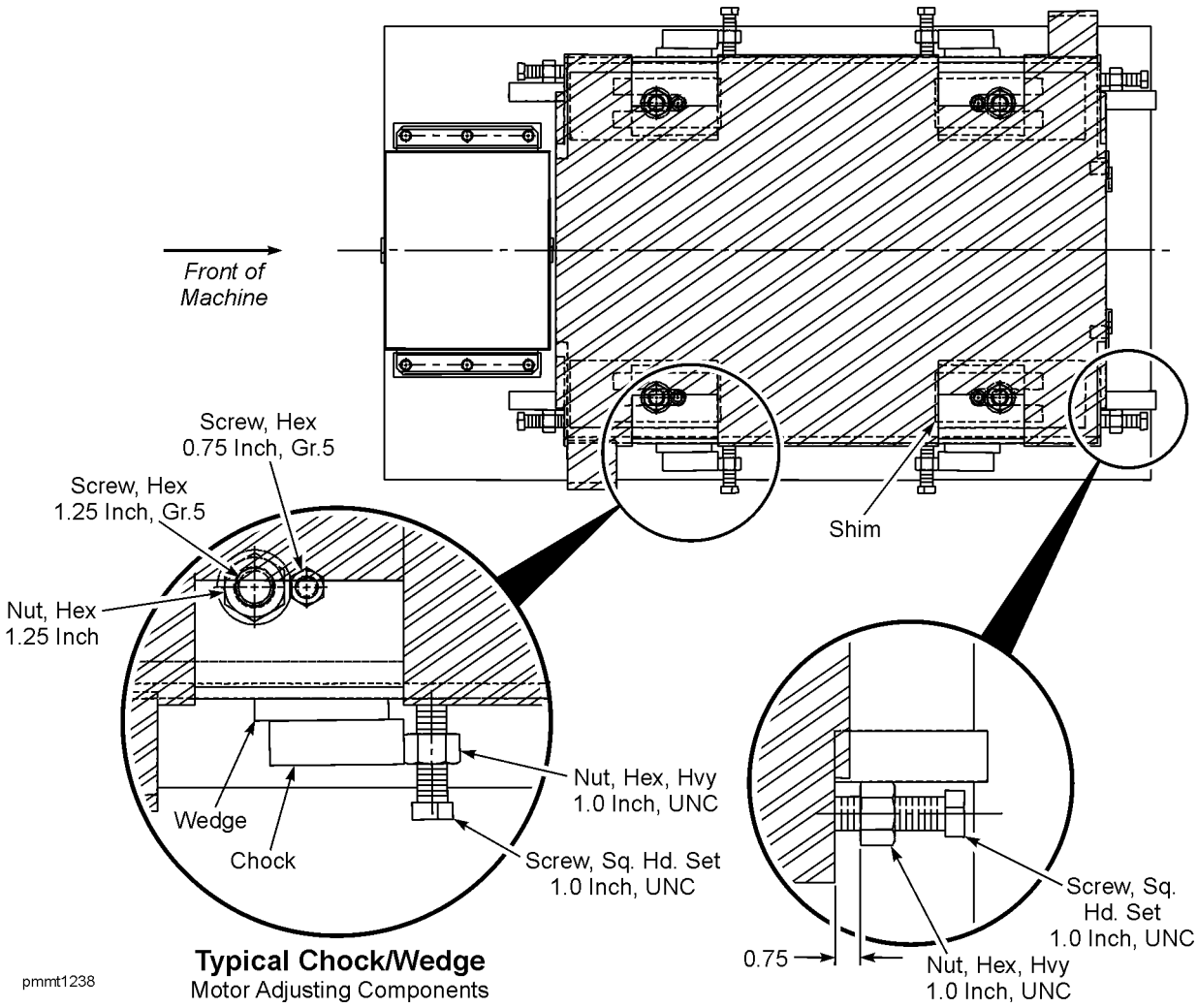
NOTES:

1. If the bearing is heated for assembly purposes, do not exceed 300°F (149°C).
2. After installing the bearing and bearing cartridge, pack the bearing with Multiplex EP2 grease (part number MP380900).
3. Shim Procedure:
   a. Install the retainer and tighten the capscrews to 179 Ft-Lbs for gap measurement.
   b. Measure the gap at 3 places equal distance from each other around the O.D. of the retainer.
   c. Take the average of the 3 measurements and subtract 0.001-0.004 inch to obtain the shim thickness.
   d. Install the shims and tighten the capscrews to 739 Ft-Lbs. If the shims are 2-piece, install them with the split as close as possible to the lube hole and seal the split with RTV.

TUMBLER REBUILD PROCEDURE

The drive tumbler can be repaired by a buildup of weld applied to the 9 drive lugs. To build up the lugs, proceed as follows:

1. Prepare a template as indicated in the sketch below. The template can be made of sheet metal, wood or template paper. Contact Bucyrus International, Inc. for details.
2. Clean the tumbler of all spalled or loose material, grease and contaminants. Use a grinder to remove imperfections. DO NOT USE A TORCH.
3. Preheat the tumbler rim to 550°F (273°C). Keep the hub area below 200°F (93°C). Maintain this temperature during welding.
4. Hold a medium length arc - slight weaving action permitted but keep it to a minimum to prevent local overheating. Weld beads must be applied adjacent to each other without removing the slag. This will result in a smooth overlay. Remove the slag between layers, maximum of 3 layers permitted.
5. Weld to within 0.19 inch of the final contour with weld rod that conforms to AWS E-9018. Use only low hydrogen electrodes.
6. Finish the contour buildup using Hobart “Tufanhard 550” electrode, or its equivalent. Use small diameter electrodes and deposit with stringer bead technique.
7. Allow the tumbler to cool slowly.
8. If needed, grind to a final lug contour.



Typical Chock/Wedge
Motor Adjusting Components

COLLECTOR RING INSPECTION

Inspect the collector rings and shoes frequently for grease and contaminant accumulations on the rings, shoes, insulators and incoming wires.

Clean the collector rings and related parts with an approved solvent regularly to prevent high potential grounds. Make sure each shoe bears firmly against the collector ring. The shoes are spring-loaded to maintain constant contact.

CAUTION: Solvents may be toxic or flammable. Adequate ventilation must be provided to minimize fire and health hazards caused by using solvents for cleaning. Use away from sparks, heat or flame to prevent fire or explosion. Follow the manufacturer's instructions.

Check the insulators for cracks or chipping and replace promptly if damaged. Verify that the screws securing the rings to the insulators do not protrude beyond the countersunk holes of the rings.

DANGER: A cracked or chipped insulator or an excessive amount of contaminants may cause an electrical fault. This could result in death or serious injury.

COLLECTOR RING REPAIR

Repair of the collector rings involves replacement of damaged insulators or defective shoes. The collector ring life expectancy exceeds the life expectancy of the machine. However, To replace the insulators or shoes:

1. Disconnect electrical power to the machine.

DANGER: HIGH VOLTAGE! Do not access the collector rings unless power to the machine has been disconnected and locked-out. Only authorized personnel should service the collector rings.

2. Remove the attaching hardware securing the insulator or shoe to the mounting. Access to the shoes mounted to the truck frame is obtained by entering the truck frame through the bottom access opening.
3. Install new insulators or shoes. Make sure all electrical leads are securely attached to the shoes and collector rings.

CAUTION: Do not attempt to inspect the underside of the revolving frame until power to the machine is disconnected.

SWING MACHINERY

The swing machinery is mounted on both the left and right sides of the revolving deck. Each machinery installation consists of a blower-cooled electric motor mounted vertically on top of a planetary gearcase. The motor drives the planetary gear system through a single input coupling.

1. Remove the 6 capscrews that attach the lower carrier retainer to the carrier. Remove the retainer.
2. Remove the inspection cover and its 6 capscrews. Separate the O-Ring from the inside of the inspection cover.
3. Pull the bearing carrier from the bearing. Separate the O-Ring from the top side of the carrier.
4. Remove the 5 capscrews from the bearing retainer. Remove the bearing retainer and the shim pack from the end of the shaft.
5. Use a suitable puller to remove the bearing from the end of the shaft.
6. Remove the 8 capscrews from the back side of the labyrinth seal.
7. Disassemble the upper bearing retainer, the oil seal and the labyrinth seal and remove these components from the shaft.
8. Inspect all parts. Repair or replace any worn or broken components.

SWING PINION SHAFT ASSEMBLY

Reassembly of the pinion shaft is opposite disassembly. However, use the following to determine the bearing shim pack thickness:

1. With the end retainer fastened to the end of the shaft, through the 3 holes in the lower bearing retainer, obtain a measurement of the distance between the end of the shaft and the outside of the pinion retainer. Average this measurement.
2. Measure the thickness of the retainer using the 3 holes and average this measurement.
3. Subtract the averaged plate measurement from the averaged overall dimension. Subtract 0.002 inch from this dimension. This results in the required shimpack thickness for use beneath the retainer and will allow for proper advance of the tapered bearing on the tapered shaft.
4. Remove the retainer and capscrews. Install a shimpack equal to the final dimension calculated above.
5. Using a crisscross pattern, tighten the 5 capscrews in stages of 50 Ft-Lbs each to a final torque value of 480 Ft-Lbs.

IMPORTANT! This staged tightening procedure is critical to allow for proper seating of the tapered portion of the shaft within the bearing surface. A sharp rise in torque value will indicate proper seating of the bearing to the shaft.

6. After the final torque value is reached lockwire the capscrews in place.

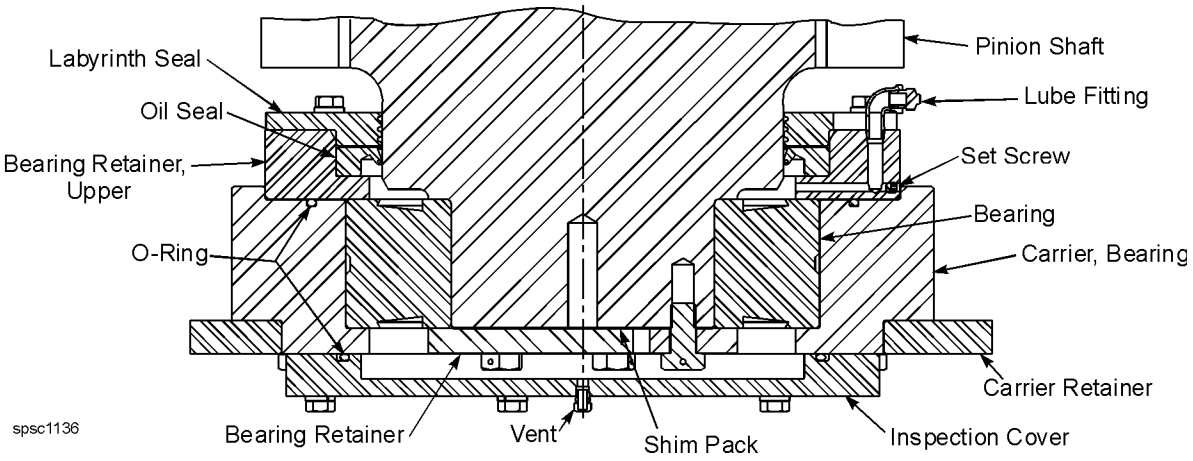
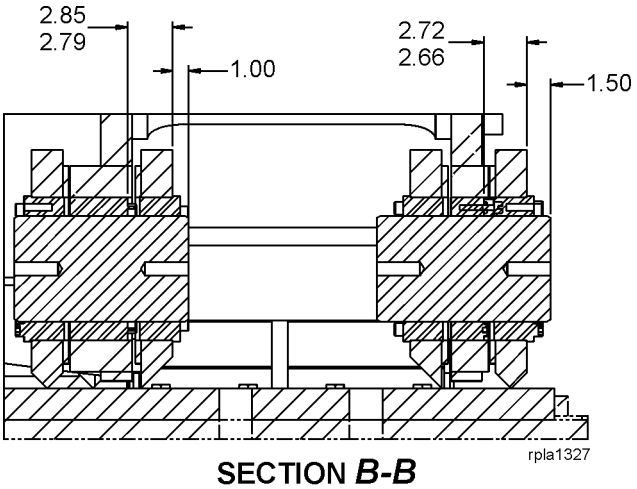
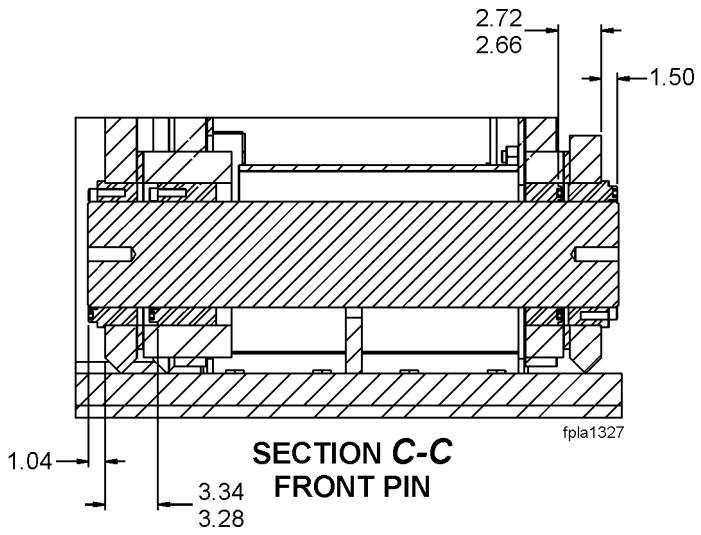


Figure 4-28 : Swing Pinion Shaft - End View



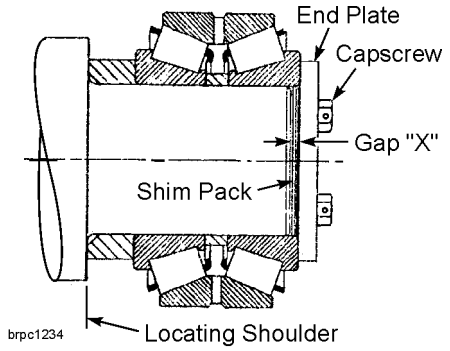
SECTION *B-B*
REAR PINS

3. Install the gearcase's front locking assemblies "B" and "C" and front pin using pilot bushings with assembly "B". Maintain pin and bushing dimensions in Section C-C and torque as specified below.



SECTION *C-C*
FRONT PIN

4. Clean and lightly oil all parts of locking assembly, shaft & housing bore.
5. Loosen all locking screws, remove 3 of the locking screws from "A" and "C" assemblies shown in the drawing above and place them in the "push off threads" to keep the inner and outer ring of the collar separated while locating the locking assembly in the bore.
6. Insert 3 equally spaced pilot bushings into assembly "B" and tighten longer socket head screws furnished with the bushing set.
7. Install locking assembly "B" into housing and onto end of the pin.
8. After locating the bushing, remove the 3 locking screws from assemblies "A" and "C" and replace them in their original location.
9. Hand tighten the locking screws. Use a torque wrench and set it 5% higher than the specified final torque. Tighten locking screws using only 1/4 turns. Once a full 1/4 turn is no longer achieved, continue to over torque for 1 or 2 more passes.



View C

5. Assemble shim pack with thickness equal to the gap measurement (0.002 - 0.005 inch).
6. Assemble the end plate and secure with 6 - 1.5 inch (Gr. 5) capscrews. Snug all capscrews to 15 Ft-Lbs using a STAR pattern.
7. Continue to tighten capscrews using a STAR pattern until all capscrews reach a torque value 1/3 the torque value - approximately 750 Ft-Lbs.
8. Continue to tighten capscrews using a STAR pattern until all capscrews reach a torque value 75% of proof load torque - 1460 Ft-Lbs.
9. Install lockwire to capscrews. Refer to WIRE LOCKING CAPSCREWS in *ENGINEERING DATA* section of this manual.
10. Ensure O-Ring is properly positioned against labyrinth seal. Using a suitable lifting device, assemble bearing housing (approximately 3,200 Lbs. each), to roller bearings.
11. Position O-Ring inside each bearing retainer. Assemble each outer retainer using 6 - 1 inch hex screws.

CROWD MOTOR

For lubrication of the drive motor, refer to GREASING MAIN AC DRIVE MOTORS in Section 3 of this manual. If removal of the crowd motor is necessary, follow the instructions below.

NOTE: Removal of the appropriate roof panel is necessary to facilitate this procedure.

Crowd the dipper outward and place the dipper on the ground.

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.

1. Disconnect and identify the electrical leads to the crowd blower motor and the crowd motor.
2. Remove the blower motor and duct as a unit from the crowd motor.
3. Remove the brake from the motor. Refer to Section 6 - BRAKES AND COUPLINGS.

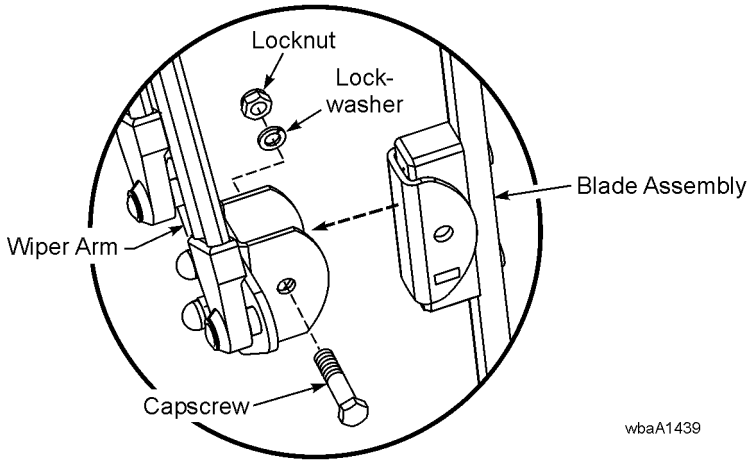
DANGER: STORED ENERGY! Gearing or drum must be blocked prior to removal of components in order to prevent unwanted movement. Failure to comply could result in death, severe personal injury, or damage to the machine.

To replace the wiper blade assembly:

1. Disconnect the washer fluid hose from the base.
2. Remove the locknut and lockwasher.
3. Holding the blade assembly with one hand, remove the capscrew with the other.
4. Save the hardware for reassembly.

NOTE: If provided, pretreat the rubber prior to assembly.

5. Position the new blade assembly into the sleeve of the arm, aligning the holes.



6. Reassemble the hardware and tighten to 6 - 7.t Ft-Lbs (8-10 N•m). DO NOT overtighten.
7. Connect the washer fluid hose to the base.

WIPER MOTOR REPLACEMENT

The windshield wiper motor is located in the center of the cab front wall behind the video monitors. One or more of the monitors will need to be removed in order to gain full access to the wiper motor.

NOTE: If the windshield wiper arm has not already been removed, it must be removed before the wiper motor can be replaced. For a step-by-step procedure, refer to WIPER ARM REPLACEMENT in this section of the manual.

IMPORTANT! For safety, always use a man basket when removing the wiper arm. Do not attempt to perform this procedure without it!

To remove the wiper motor:

1. Shut-down the machine.
2. Turn OFF the PLC power supply breaker to remove power to the wiper motor.
3. Remove the wiper arm assembly. For more information, refer to WIPER ARM REPLACEMENT in this section of the manual.
4. After removing the wiper arm, remove the 2 protective caps from the shafts of the wiper motor. Remove the 2 nuts and washers. The motor can now be removed from inside the cab.

The ladder is a movable structure with a bracket and two rollers at four locations on the ladder. The rollers straddle a rail on each side of the ladder frame. Wire ropes (one on each side of the ladder) connect to the top of the ladder, pass up through sheaves and down to a counterweight inside each side of the ladder mounting frame.

The ladder should be in the UP position when at rest, with the weight of the counterweights holding it in place. If not, or if rough action is noted, check for binding in the rail structure, damaged or missing rollers, or binding with the counterweights.

Periodically check for lubricant in the sheaves at the top of the ladder.

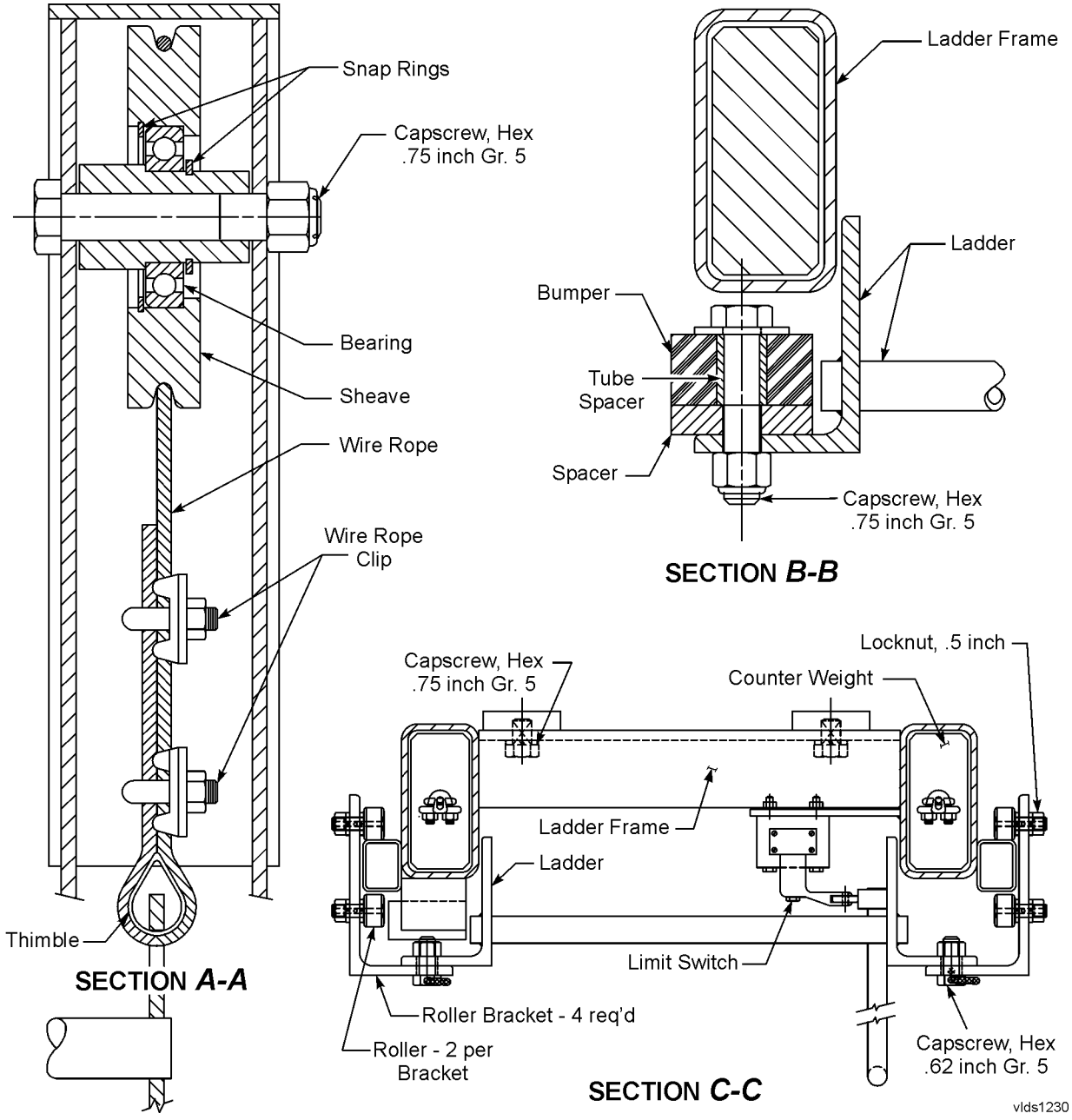
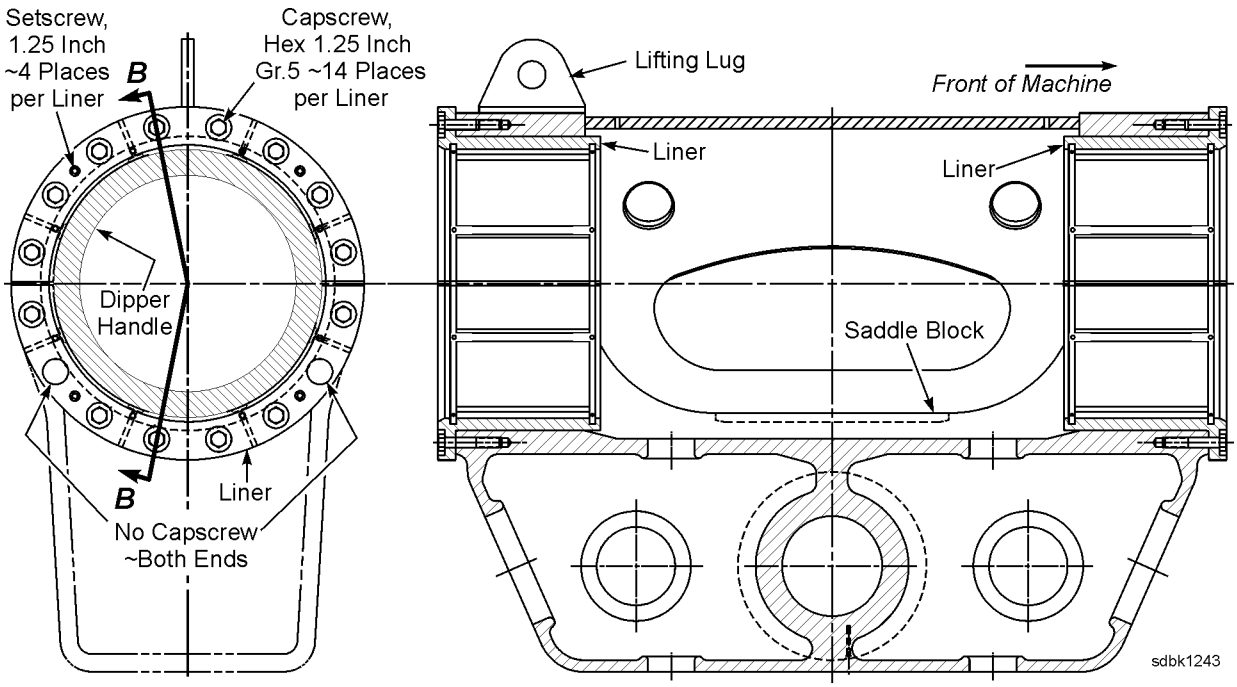


Figure 4-48 : Vertical Boarding Ladder, Miscellaneous Views

SADDLE BLOCK

The saddle block should be inspected daily for signs of excessive wear. Make certain that it is being adequately lubricated and that the injectors are functioning properly. Also check the condition of the shipper shaft sheaves for signs of unusual wear. The lubrication lines which run up the boom should be checked for any signs of damage or crimping which could impede the flow of lubricant to the saddle block.



SECTION *B-B*

Figure 4-53 : Saddle Block Bushing Arrangement

SADDLE BLOCK REPAIR

The saddle block liners should be replaced when the chamfer has been worn off the inner bushings, or when the measured distance from one side of the handle to the lining is 0.12 inch or less - with the handle pushed to the same side of the liner. Measure the liners at 4 equally spaced points about its circumference. It may be possible to remove the liner capscrews and rotate the liner for additional wear. Replace the liners as follows:

1. Remove the dipper handle per the procedures in DIPPER HANDLE REMOVAL.
2. Secure the rear liner with a crane and remove the liner mounting bolts. Remove the liner from the saddle block.

NOTE: The liner was installed with Loctite. It may be necessary to heat the saddle block or to cut the liner in order to remove it. Discard after removal.

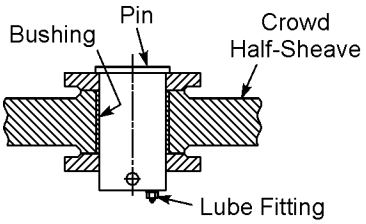
3. When installing new rear liners, uniformly coat the saddle block I.D. with retaining compound, part number 82833871, immediately before installation. Use retaining compound, part number 82833862, on the liner bolts.
4. Replace the front liners using the same procedures as above.

CROWD ROPE TAKE-UP MECHANISM ASSEMBLY

NOTE: Before re-assembling the take-up mechanism, clean all friction surfaces of the assembly with a cleaner that does not leave residue or deposits. Open Gear Lubricant (OGL) can be used to pre-lube individual parts for re-assembly.

Assemble the take-up mechanism in the following order:

1. Position the screw rod so it is vertical, with the square end on top.
2. Slide the bellows over the square end of the screw rod, down toward the clevis end of the rod. (Or, if the bellows will fit over the clevis, the bellows can be installed from that end of the screw rod, just before the half-sheave is pinned to the clevis.)
3. Slide the worm gear housing onto the screw rod until it mates with the bellows.
4. Slide the worm gear wheel onto the screw rod and spin it onto the threaded portion of the screw rod.
5. Slide the worm gear thrust washer onto the screw rod.
6. Slide the crowd take-up guide onto the screw rod.
7. Note the orientation of the lifting lug on the take-up guide. Position the worm gear housing so that the worm shaft housing is opposite to the lifting lug on the take-up guide. Check that the bolt holes on the housing and crowd take-up guide are aligned for the capscrews.
8. Install the 7 - 0.5 inch capscrews that fasten the worm gear housing to the take-up guide and tighten.
9. Bolt the screw rod stop plate to the end of the screw rod using the 4 - 0.75 inch capscrews. Tighten the clamps on the bellows.



SECTION *C-C*

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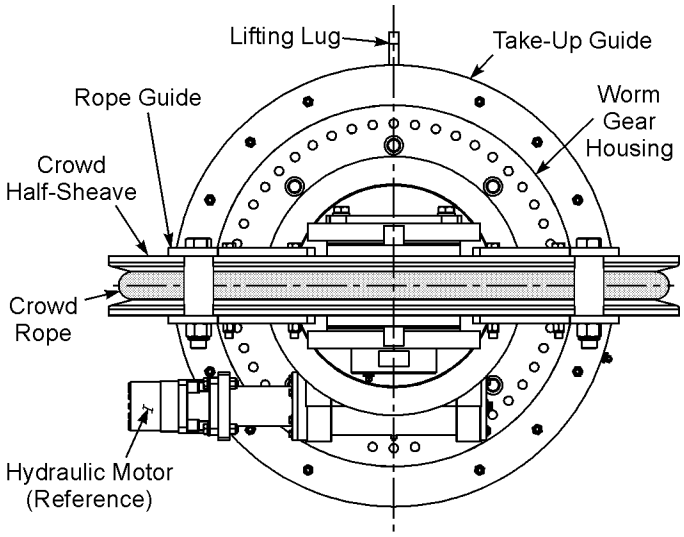


SECTION *B-B*

IMPORTANT! Before performing this procedure, ensure that the proper lifting devices are available and that you have a complete understanding of the removal process. DO NOT continue this procedure until you have read and fully understand the removal process.

Follow the procedure closely. As each set of pins are removed, specific dangers as well as changes in the dipper handle's C.G. (center of gravity) can occur. Ensure that the components being removed are securely supported and the spotter (rigging crew) is in direct radio communication with the crane operator.

DANGER: STORED ENERGY! Removal of dipper 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.

To remove the dipper:

1. Park the machine on a firm, level work surface. Position the revolving frame parallel with the crawlers, with the dipper over the front idlers. Allow approximately 75 feet of additional level work surface area behind the crawlers.
2. Position the dipper with the floor flat on level ground. Ensure the base of the dipper is fully supported and level.

DANGER: STORED ENERGY! If the dipper base is not fully supported and level, movement may result when the dipper is disconnected from the handle. Failure to comply could result in death, severe personal injury, or damage to the machine.

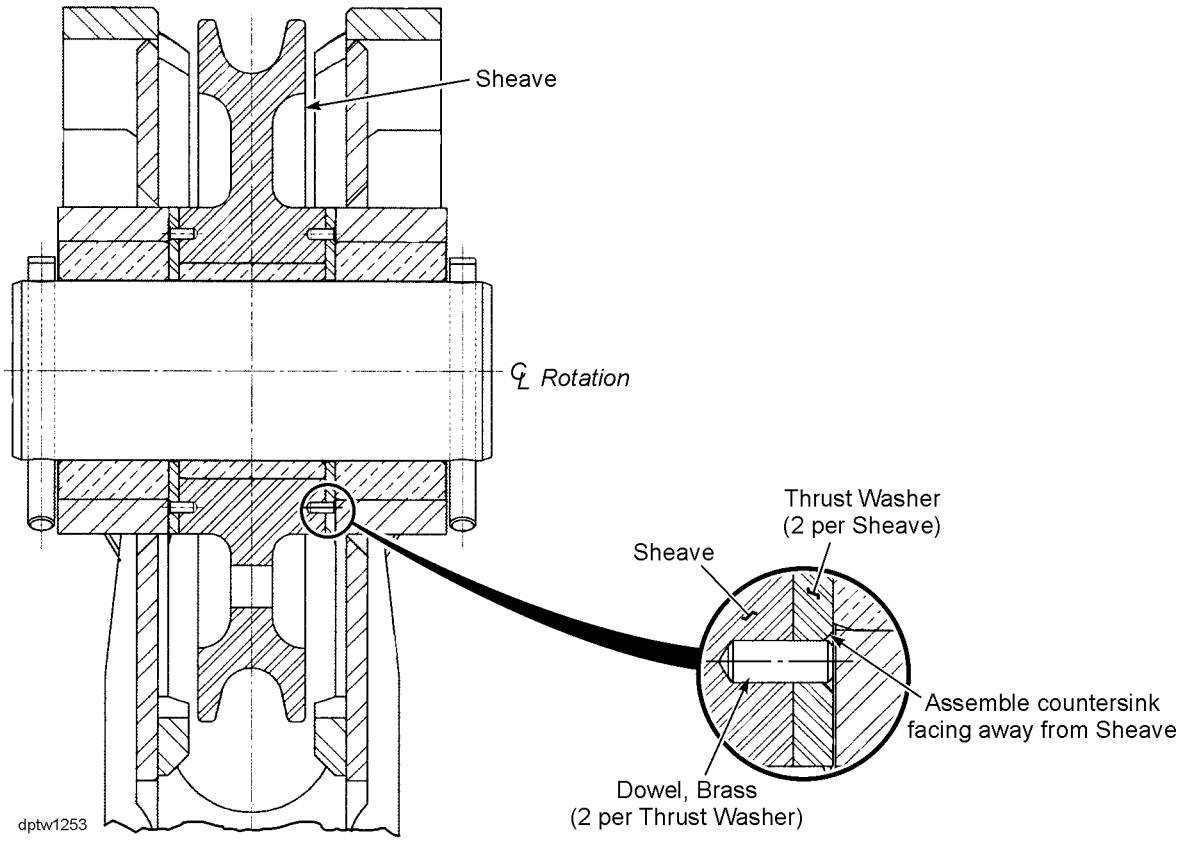
3. Clear the area of all personnel not directly involved in the process. Establish direct radio communication with the crane operator.
4. Disconnect the dipper trip rope from the dipper door.
5. Lower the hoist ropes slightly to allow for pin removal.
6. Remove the padlocks one at a time using the following procedure:

DANGER: STORED ENERGY! Removal of dipper 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.

   a. Using a suitable lifting device, raise the padlock (approximately 5,250 lbs) just enough to minimize the load placed on the dipper lug pin.
   b. Remove the T-bolts securing the dipper lug pin in place. See View A-A.

NOTE: An alternate; pin & collar clamp assembly may replace the T-bolts as a retaining mechanism. If so, remove the collar clamps and attaching hardware.

   c. With a second lifting device, position a strap type sling under the dipper lug pin (approximately 400 lbs) to support the pin during removal. Remove the pin. Do not lower the pin at this time, it will be reinstalled.



NOTE: When installing new thrust washers, line up 0.484 inch diameter holes with 0.484 inch diameter holes in sheave. Using these holes as a pilot, ream to 0.50 inch diameter for proper fit with 0.50 inch diameter dowel pin.

NOTE: Assemble thrust washer with countersink facing away from sheave.

NOTE: To retain thrust washer, peen end of dowel pin into countersink.

DIPPER TRIP ASSEMBLY

The dipper trip can be disassembled in place on the machine or removed as a complete unit. In either case, the disassembly procedure is the same.

The hydraulic unit is a self-contained unit, including a reservoir of hydraulic fluid, a stationary pump and electric drive motor, and a removable hydraulic motor (with handles) connected to the pump through a length of hydraulic hoses. To operate the unit, withdraw the hydraulic motor from its storage on the unit and install the motor on the dipper handle. Refer to the instructions in CROWD ROPE ADJUSTMENT in this section of the manual for the proper procedures. Press the start pump button on the control panel then use the hand held pendant station to control the pump.

Be sure the reservoir is filled with hydraulic fluid. Check for leaks in the piping. Replace the filter cartridge when indicated.

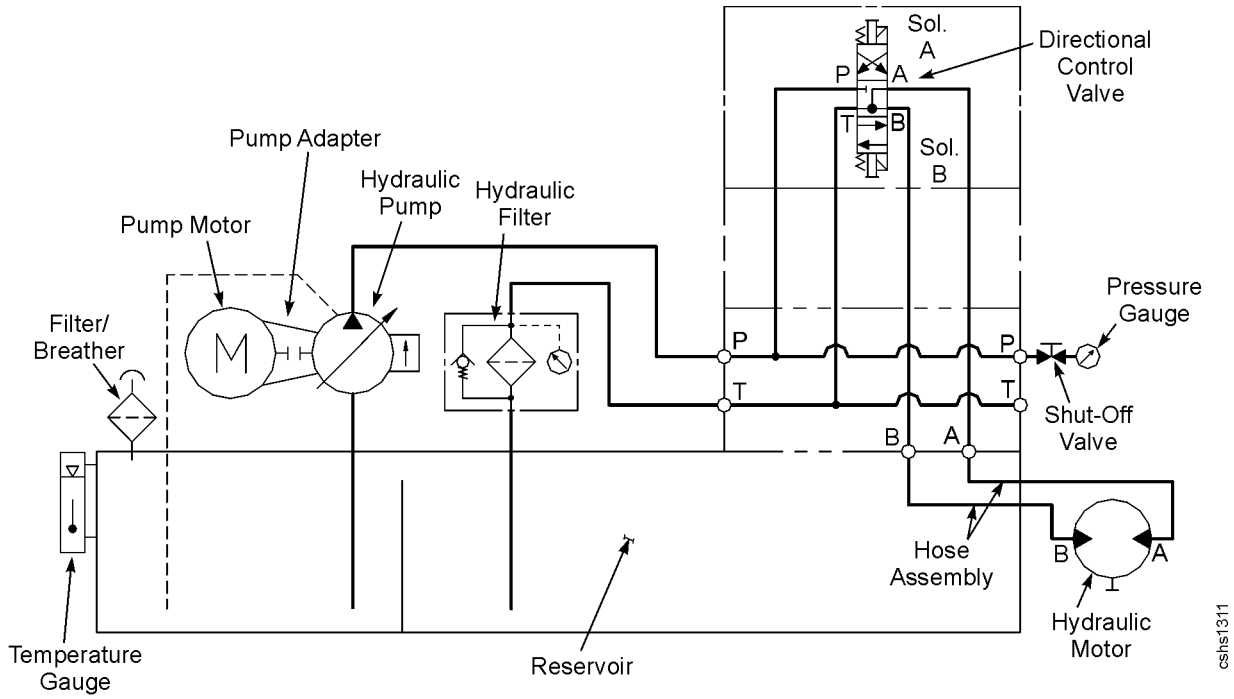


Figure 4-62 : Hydraulic Schematic – Crowd Screw Hydraulic Unit

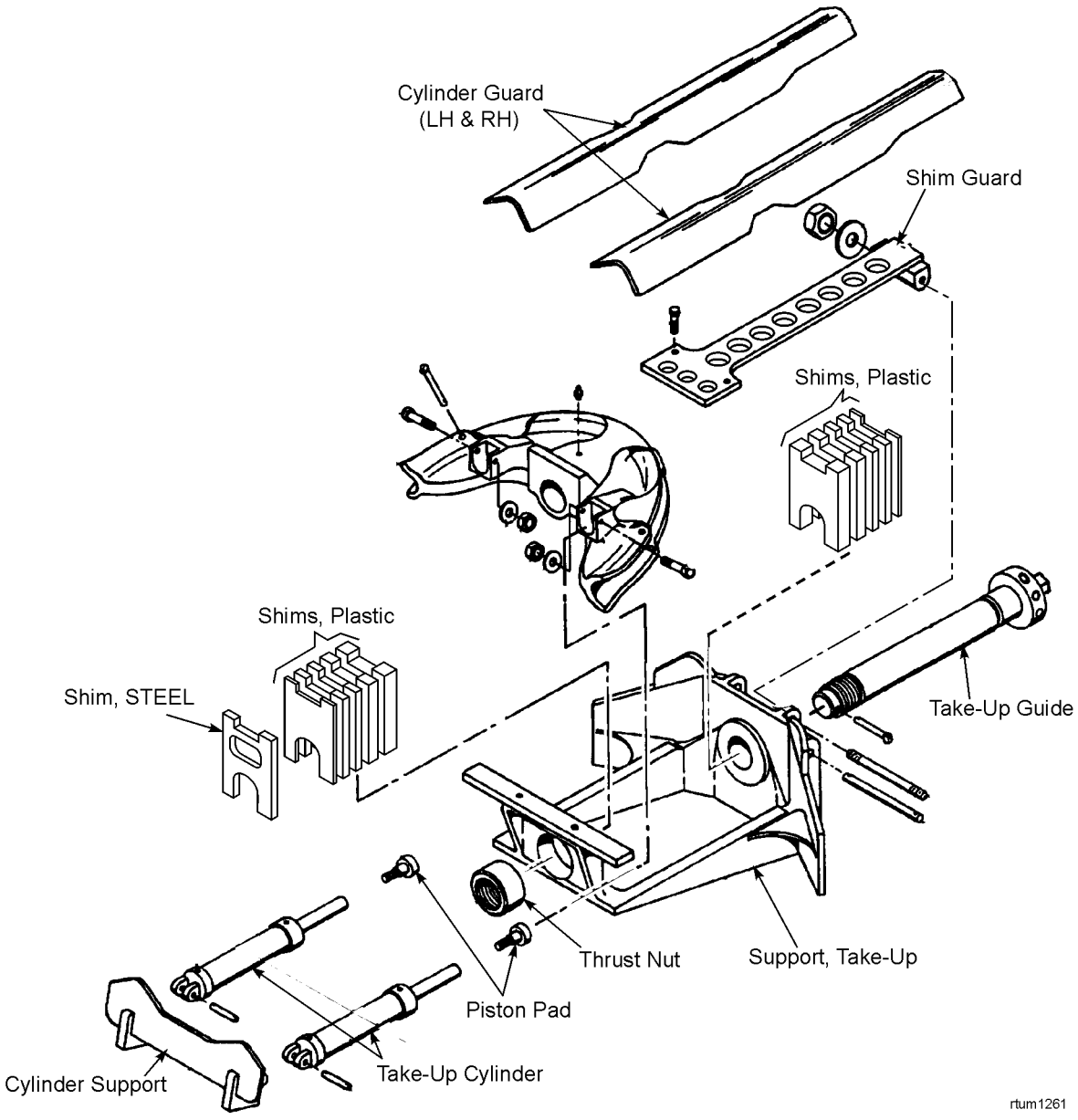


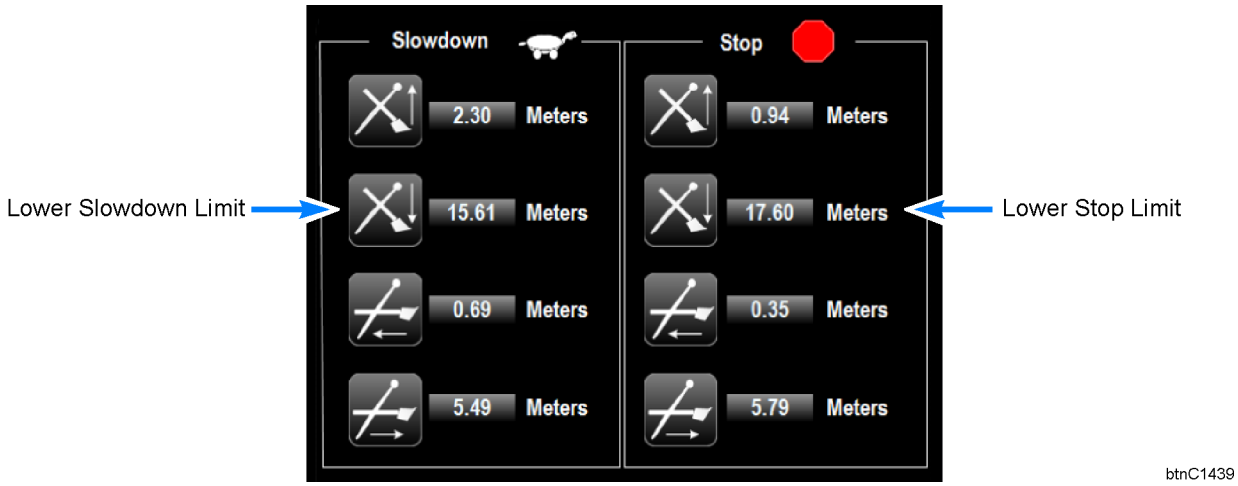
Figure 4-67 : Retract Rope Take-Up Mechanism

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

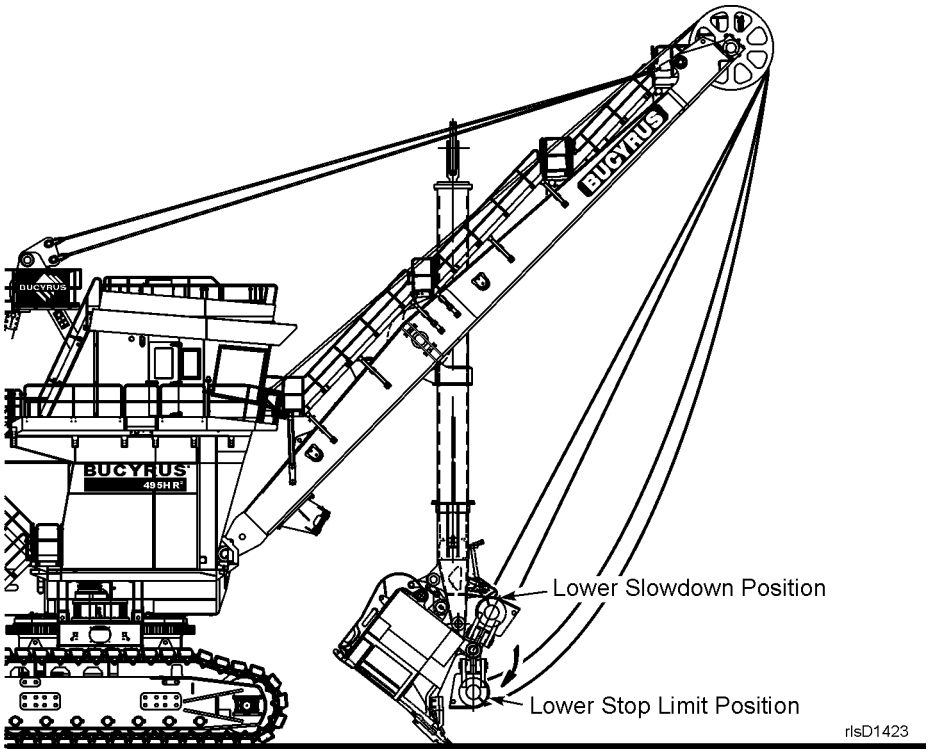
LOWER SLOWDOWN/STOP LIMITS

To set the lower slowdown and stop limits:

1. Position the handle vertically with the dipper teeth just touching pit floor and the hoist ropes tight. Press the LOWER SLOWDOWN LIMIT button on the operator display.



2. Keeping the handle vertical, let the padlocks fall forward until the padlocks contact the dipper.
3. Press the LOWER STOP LIMIT button on the operator display. The lower stop limit helps prevent rope from spooling off the hoist drum.



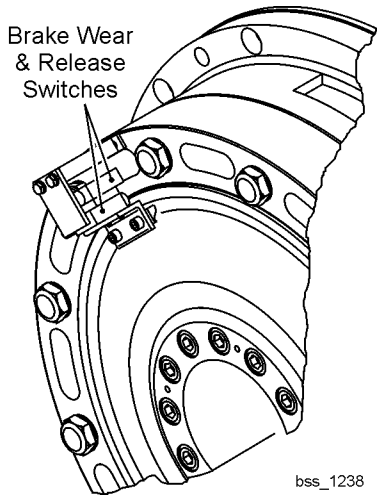
HOIST BRAKE INSTALLATION

The tachometer, furnished with the electric motor, must be installed before installing the brake assembly.

1. Install the drive hub and keyway on the motor. Refer to *PINION & HUB INSTALLATION* in *ENGINEERING DATA section*.
2. Install motor shaft nut and secure to shaft with Loctite.
3. Install brake adapter onto the motor and secure with hardware. Use care to align the access slots in the adapter for future tachometer inspections.
4. Lubricate the hub and friction disc splines with a light coat of Teflon grease or anti-seize compound.
5. Install the friction discs and center plates onto the shaft adapter in the required order before sliding on the brake assembly. Tighten the drive ring hardware and install the brake guard.

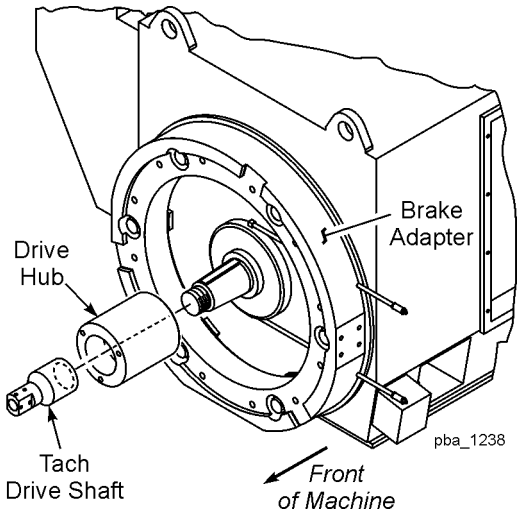
HOIST BRAKE WEAR & RELEASE SWITCHES

The hoist brake is equipped with two switches mounted to the outer edge of the brake housing. For more information, refer to *BRAKE WEAR & RELEASE SWITCHES - MULTIPLE DISC BRAKES* in this section of the manual.

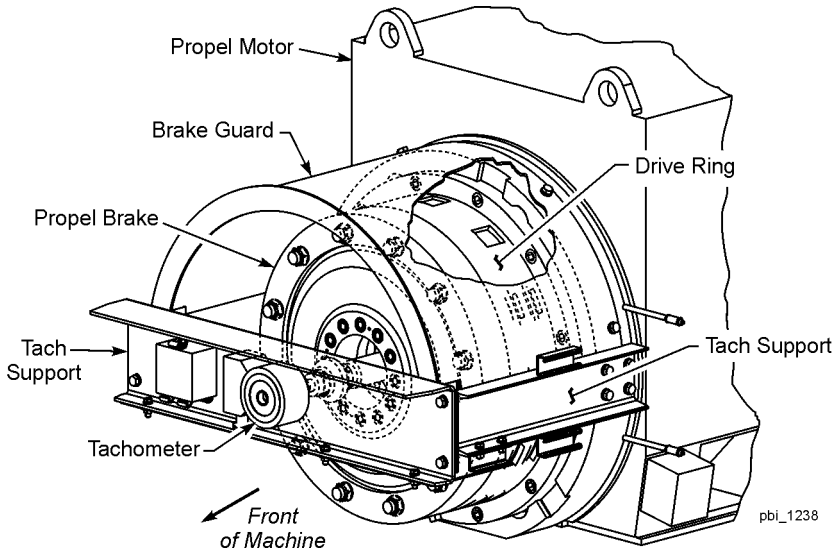


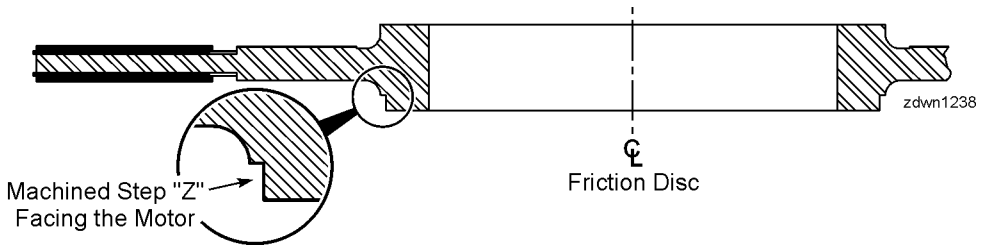
PROPEL BRAKE INSTALLATION

1. Install the drive hub and keyway on the motor. Refer to *PINION & HUB INSTALLATION* in *ENGINEERING DATA section*.
2. Assemble the tach drive shaft onto the propel motor shaft using retaining compound. Tighten to 300 Ft-Lbs.



3. Install the brake adapter to the motor.
4. Install brake adapter (approximately 365 lbs.) onto the motor and secure with hardware. Use care to align the access slots in the adapter for future tachometer inspections.
5. Lubricate the hub and friction disc splines with a light coat of Teflon grease or anti-seize compound.
6. Install the friction discs and center plates onto the shaft adapter in the required order before sliding on the brake assembly (approximately 365 lbs.). Tighten the drive ring hardware.
7. Install tach supports, tachometer and tach coupling. Refer to *TACHOMETER MOUNTING & ALIGNMENT* procedure in this section of the manual.
8. Install the brake guard.





9. Carefully align the splines between the hub and the disc and allow the new disc to rest.

IMPORTANT! Install brake specific spacer or shims. Refer to specific BRAKE ADJUSTMENT procedure.

10. Reinstall the piston and pressure plate onto the top of the friction disc and align the pneumatic fitting, access holes and studs accordingly. Pressurize the piston once more to minimum pressure allowing complete disengagement of the components.
11. Replace the stud nuts and tighten to 90–100 Ft-Lbs.

CAUTION: Tighten the stud nuts as per the instructions on the brake drive ring. Excessive, or improper, torque application can cause the drive ring to become deformed and seriously reduce the effectiveness and life of the brake assembly.

12. Ensure the air line and wear/release switches are properly reconnected. Refer to *BRAKE WEAR & RELEASE SWITCHES* in this section of the manual.

O-RING REPLACEMENT — ALL BRAKES

NOTE: On machines using hydraulic crowd in place of rope crowd, the crowd brake does not exist.

With machine parked on flat level surface, with dipper heel resting on the ground, the O-Rings may be replaced by disassembling the brake as follows:

1. For the propel brake, remove the tachometer, tach supports and the brake guard as required.
2. For hoist, crowd or swing brakes, remove the wear and release switches along with the mounting bracket and hardware. Remove the brake guard.
3. Release air pressure to the brake. Disconnect the air line to the brake inlet. Install a temporary pressure regulator with gauge and a closed shutoff valve to the brake inlet.

SEAL REPLACEMENT WITHOUT HUB REMOVAL

The instructions below offer additional procedures that may be useful when replacing seals on an existing installation.

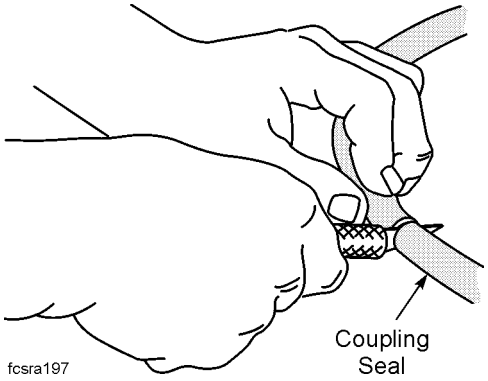
Replacement seals are continuous, one piece members. Unless the connected machines are being moved from their foundation for some other reason you need not disturb the existing mountings to get the new seals in place. The following cut and cement procedures offer a simple way to install new seals without moving machines or pulling coupling hubs.

Falk Steelflex and gear couplings are lubricated shaft connectors. In both designs, a metallic cover and elastomer seals contain the lubricant. Refer to the applicable Installation, Maintenance and Lubrication Instructions furnished with each coupling when replacing worn or damaged seals.

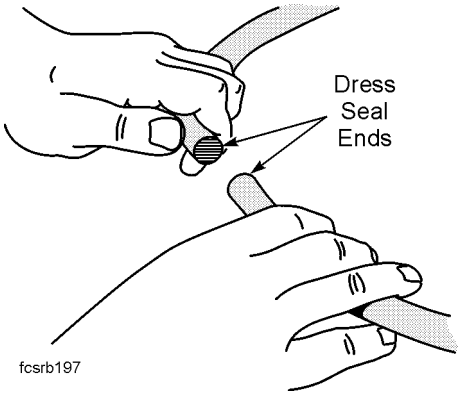
To install a new coupling seal without hub removal:

1. Cut the coupling seal using a clean, sharp utility knife.

NOTE: The following illustrations show O-Ring seals. The same procedures apply when replacing U-shaped or trapezoidal-shaped seals.



2. Lightly dress both cut surfaces on a grinding wheel. The resultant square evenly roughened seal ends provide excellent bonding surfaces. Thoroughly clean and degrease the cut ends.



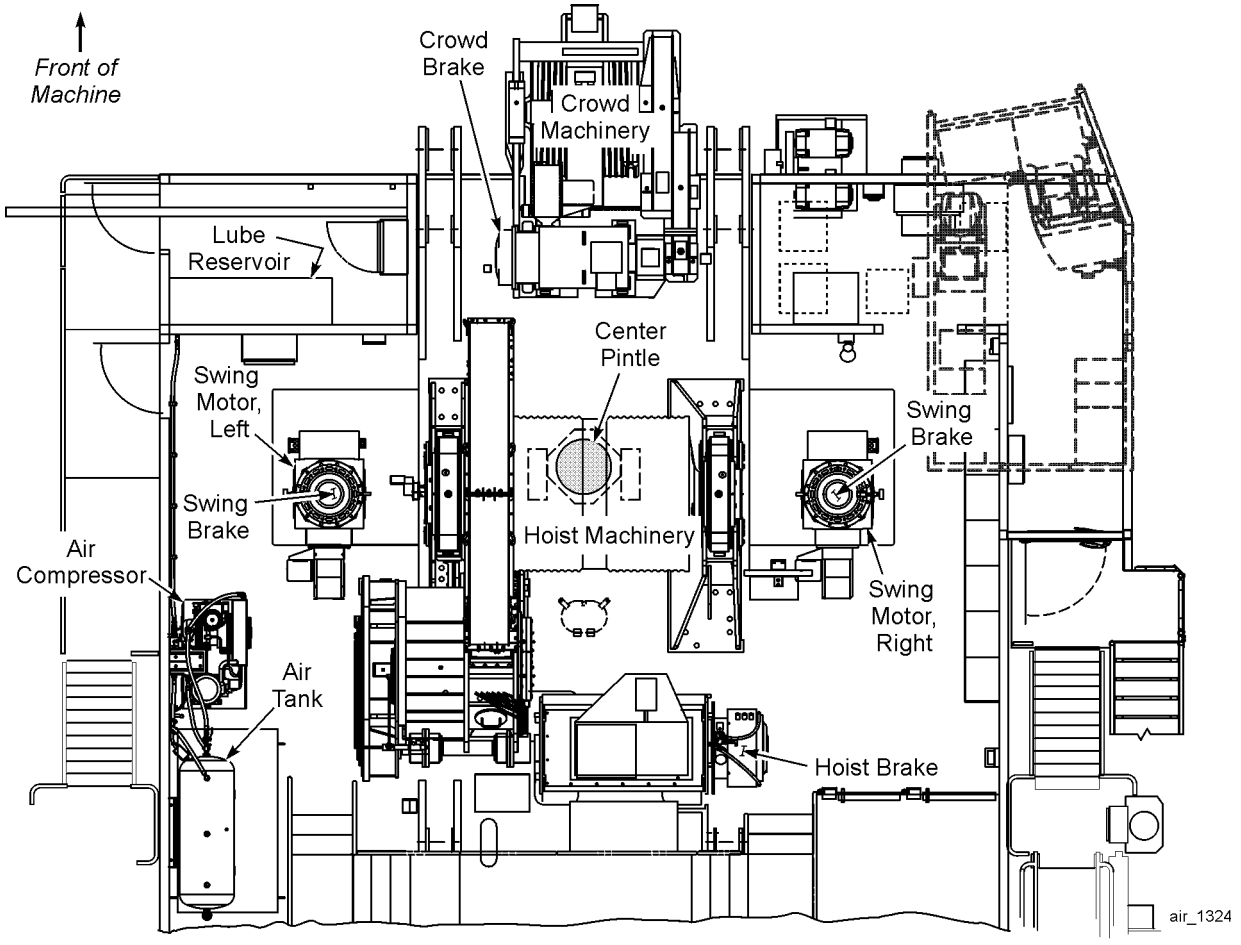
3. Apply adhesive to the seal ends as instructed by the adhesive manufacturer.

Section 6
Compressed Air System

AIR COMPRESSOR

The air compressor is located on the left side of the machine inside the machinery house. Air pressure is used to operate machinery brakes, lubrication and various other functions. Refer to manufacturer's manual for more information and specifications.

DANGER: STORED ENERGY! Air under pressure will cause severe personal injury or death. Shut down compressor and relieve system of all pressure before removing components such as valves, plugs, fittings and bolts.



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.

TURN-OF-NUT METHOD

CAUTION: THIS TIGHTENING PROCEDURE IS ONLY APPLICABLE FOR BOLT GRADES 5 AND 8 WITH UNC THREADS. For bolts with other than UNC threads, contact the Bucyrus International Service Department.

NOTE: When using this procedure the bolt threads and the surfaces under the bolt head and nut must be lubricated. This procedure is applicable only if the joint and under head surfaces for bolt and nut are machined for parallelism.

1. The bolts should be brought to a “snug tight” condition to ensure that the parts of the joint have good contact with each other. “Snug Tight” is defined as the tightness attained by torquing a bolt to the value specified in the table on the following page. Snug tightening should progress systematically from the most rigid part of the joint to its free edges while alternating from bolt to bolt to assure gradual even pull up of the mating parts. After all bolts have been snugged, the first bolts tightened at the most rigid part of the joint should be rechecked for proper torque retention. If these bolts are loose due to pull up of the joint, the snug tightening sequence should be repeated for all bolts in the connection. This rechecking and re-torquing procedure should be repeated as many times as is required until the joint is completely pulled up and all bolts are at the specified “snug tight” torque. Tightness of the mating surfaces of the joint should then be verified by using feeler gauges.

Table 8-3: Snug Tight Torque Values

Bolt Diameter		***Torque Values*** (1)	
Inches	***Cm***	***Ft-Lbs***	***Nm***
.500	1.27	15	20
.625	1.58	30	40
.750	1.90	53	71
.875	2.22	86	116
1.000	2.54	128	173
1.250	3.17	224	303
1.500	3.81	390	523
1.750	4.44	457	619
2.000	5.05	688	932
2.250	5.71	1005	1362
2.500	6.35	1375	1804
2.750	6.98	1664	2627
3.000	7.52	2462	3337

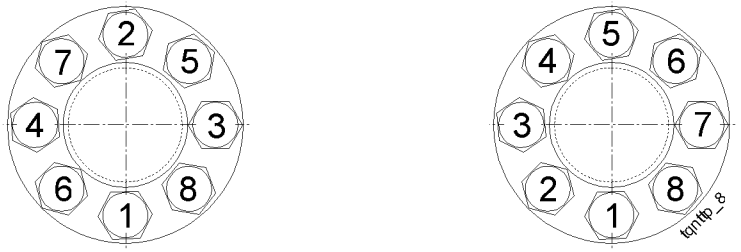
Part No.	***Nut Rotation***	***Bolt Length*** (2)
74773-01	1/3 Turn of +/- 10%	Up to and including 4 diameters
74773-02	1/2 Turn of +/- 10%	Over 4 diameters but not exceeding 8 diameters
74773-03	2/3 Turn of +/- 10%	Over 8 diameters but not exceeding 12 diameters

EXPANSION BOLT INSTALLATION

Table 8-22: Expansion Bolt Location Chart

Assembly	*Assembly Description*	*Bucyrus P/N*	*Supernut Size*	*Jackbolt Qty.*
S006904	Rack & Rollers	82637952	1.00	6
S006761	Hoist Pedestal Hardware	82637950	1.62	8
S006969	Hoist Pedestal Hardware, LH	82637950	1.62	8
S003806-VG01	Swing Drive	82637949	3.25	16

TIGHTENING PROCEDURE FOR 1.25-INCH TORQUE NUT



"STAR" Tightening Pattern **CIRCULAR Tightening Pattern**

Torque Nut with 8 Jackbolts

1. Ensure that a special steel washer, supplied with the torque nut, is placed beneath the torque nut. DO NOT USE STANDARD COMMERCIAL WASHERS.
2. The jackbolt threads and faces are prelubricated with graphite lube. Ensure that this lube is present. Apply additional lube (part number MP390331) as needed.
3. Check the base of the torque nut to ensure that all jackbolts are flush with the bottom.
4. Spin the torque nut onto the rod or bolt by hand.
5. Tighten the jackbolts to **27** Ft-Lbs as follows:
   a. Snug all jackbolts to **3** Ft-Lbs each.
   b. Using the STAR pattern shown, tighten all jackbolts to **15** Ft-Lbs.
   c. Switch to the CIRCULAR pattern shown and tighten all jackbolts to **20** Ft-Lbs.
   d. Continue with the CIRCULAR pattern and tighten all jackbolts to **30** Ft-Lbs.

NOTES:

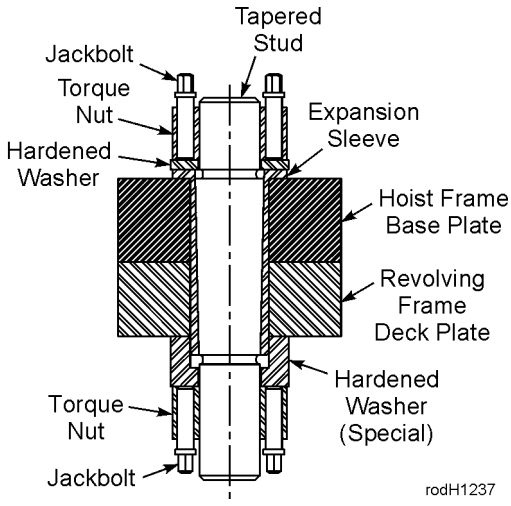
- With longer rods and bolts, stretch in the rod or bolt occurs during tightening of the jackbolts. Therefore, after tightening with the CIRCULAR pattern in step 5-d above, the first jackbolt may have loosened. The higher torque value is used in this step only to speed the tightening process. After performing the above steps, use a torque wrench for the final torque values and continue tightening the jackbolts in a CIRCULAR pattern until all jackbolts are tightened to a value of **27** Ft-Lbs.
- An impact wrench can be used for the initial tightening sequences, *however a torque wrench must be used to achieve the final torque values.*
- Repeat the above steps for all remaining torque nuts.

b. Switch to the CIRCULAR pattern shown and tighten all jackbolts to **57** Ft-Lbs.

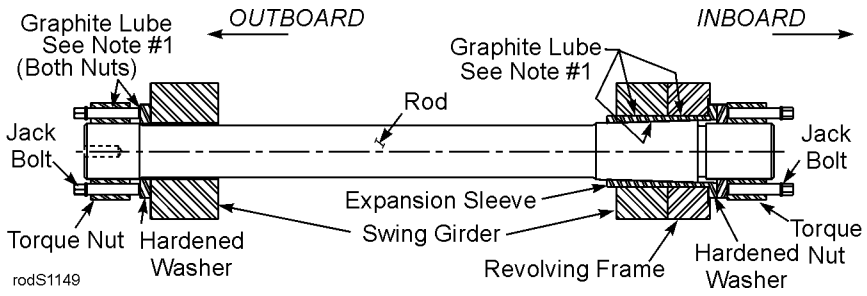
8. Ensure that a special steel washer, supplied with the torque nut, is placed beneath the upper torque nut. DO NOT USE STANDARD COMMERCIAL WASHERS.
9. Spin the upper torque nut onto the stud by hand.
10. Finalize the preload of the upper torque nut by tightening the upper torque nut jack bolts to **57** Ft-Lbs as follows:
    a. Using the STAR pattern shown, snug all jack bolts (1 round only) to approximately **30** Ft-Lbs.
    b. Set the torque wrench to **57** Ft-Lbs. Working in the CIRCULAR pattern, continue tightening the jack bolts of the upper torque nut until they are stabilized at full torque. This may take several rounds. (Stabilized is when the torque wrench is moving less than 1/8 turn.)
11. Finalize the preload of the lower torque nut by tightening the lower torque nut jackbolts to **57** Ft-Lbs as follows:
    - Set the torque wrench to **57** Ft-Lbs. Working in the CIRCULAR pattern, continue tightening the jack bolts of the lower torque nut until they are stabilized at full torque. This may take several rounds.

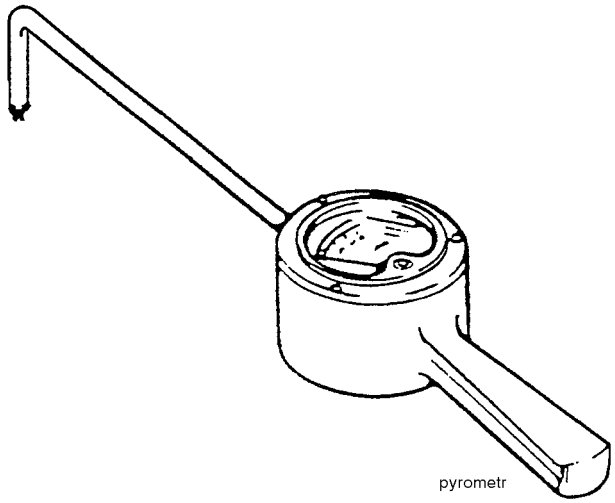
NOTES:

- An impact wrench can be used for the initial tightening sequences, *however a torque wrench must be used to achieve the final torque values.*
- Repeat the above steps for all remaining torque nuts.



SWING TORQUE ROD & TAPERED SLEEVE & 3.25 INCH TORQUE NUT





Some accurate method must be provided for quickly measuring the temperatures of the pinion, brake drum or coupling and shaft before mounting them. This is best done with a hand pyrometer (refer to the figure). When a hand pyrometer is not available, a centigrade thermometer can be used by placing putty over the bulb to hold it against the pinion or coupling. Heat the pinion, brake drum or coupling a few degrees above the desired temperature before removing it from the oven. Wait until it has cooled to the temperature desired, remove the thermometer and quickly mount the pinion, brake drum or coupling as described below.

5. After making sure the bore is clean, quickly mount the hot pinion, brake drum or coupling on the shaft. When it is nearly engaged with the taper fit (but not actually in contact), snap it forcible into place with a quick push. It is important that the hot pinion, brake drum or coupling be instantly snapped into position before it has cooled appreciably; otherwise it will immediately “freeze” to the shaft and cannot be adjusted further.
6. Check the “hot” or shrunk-on position of the pinion, brake drum or coupling on the shaft, using the micrometer depth gauge. The actual advance is the difference between depth gauge readings at the hot and cold positions. To control the stresses in the pinion, brake drum or coupling, the advance must be within the limits specified in the table below.

   If the advance is not within the limits given, the pinion, brake drum or coupling should be pulled and remounted.
7. Assemble the lockwasher and nut, tighten firmly and lock. *Where a lockwasher is not used, retaining compound must be used to keep the nut tight during operation.*

WARNING: When a lockwasher is used, the nut must be firmly tightened against it, then the tab on the lockwasher must be bent against the flat of the nut. This is required to keep the nut tight during operation.

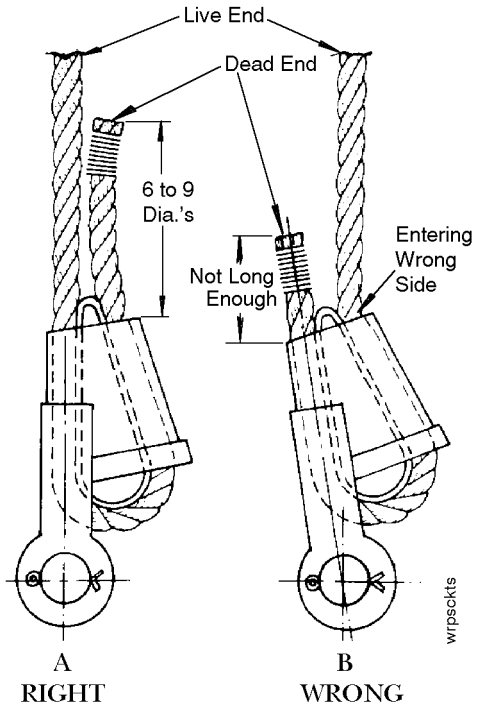
WELDING PROCEDURE

1. Refer to the previous butter-welding figures. The purpose of the butter weld layer is to provide a buffer between the weld required to fill the groove and the alloy cast steel. This technique is essential in preventing heat affected zone cracking in the cast steel which otherwise is likely to occur due to the shrinkage of the weld as the groove is filled. Butter welding permits the repair weld to be made at the preheat temperatures specified. Much higher temperature would otherwise be required for crack free welding.
2. Butter welding is done using 1/8 inch diameter E11018-M electrodes at a minimum preheat temperature of 250°F (121°C). (See section under *WELDING ELECTRODES* regarding use of the electrode drying oven.) Horizontal weld beads are applied to completely cover the cavity or surface to be welded. The edges of the butter weld must overlap the adjacent surface about 1/2 inch. This is to prevent subsequent welding from impinging upon the cast steel.
3. Before starting the butter weld, position a piece of thin mild steel plate under the bottom end of the tooth. This is to provide a shelf for starting the weld and to avoid irregular weld beads at the bottom which would become stress risers to cause cracking when the tooth is loaded in service.
4. Apply the butter weld, progressing with horizontal beads from bottom to top. Use care to keep the butter weld layer as smooth and regular as possible. When finished, remove all slag and grind any high spot which could trap slag when welding to fill the groove. In the case of repairing a broken tooth the prepared tooth segment is butter welded separately before positioning for final welding in place.
5. Filling the groove is done with 1/8 inch or 5/32 inch E11018-M electrodes at a minimum preheat temperature of 175°F (79°C). (See section under *WELDING ELECTRODES* regarding the use of the electrode drying oven.) Weld vertically up using a split layer technique as soon as the groove is wide enough to accommodate 2 or more beads. Refer to the butter-weld figures for the approximate weld bead sequence.
6. For replacing a tooth segment as shown, it will be necessary to prepare a tooth profile template. The template must be carefully made to fit the rack teeth as accurately as possible. Use the template to position the tooth segment prior to tack welding. When welding the tooth segment in place alternate welding from side to side to control distortion. Check frequently with the template.
7. When groove welding is finished check carefully for low spots and fill in as required. Grind the weld smooth and flush with the adjacent tooth surfaces. Use the tooth profile template to check grinding of a welded-on tooth segment. Grinding of the radius at the root of the tooth is very important. Avoid any nicks, gouges or grinding marks in a vertical direction. Grind a smooth radius using small diameter (peanut) grinders. Failure to achieve a smooth, notch-free radius may result in future cracking at the root of the tooth.
8. After the swing rack has cooled to ambient temperature, dye-penetrant test the repaired tooth for soundness.

WEDGE SOCKETS

One of the more popular field end attachments for wire rope is the wedge socket. Attachment and the dismantling of this device is both easy and simple.

1. Inspect the wedge and socket; remove all rough edges/ burrs that might damage the rope.



2. Welded ends of the rope should be cut off prior to assembly. This will allow the rope strands to distort slightly as they bend sharply around the wedge. If the welded end were not removed the minimal sliding of the strands would be restricted and evidenced further up the rope. This may result in the development of high strands, wavy rope and uneven loading.
3. Place the socket in an upright position and bring the rope around it in a large, easy to handle loop. Care must be taken to make certain that the live-loaded-side of the rope is in line with the ears.
4. The dead end of the rope should extend from the socket for a distance of six to nine times the rope diameter. The wedge is now placed in the socket.
5. Secure the socket and carefully apply a gradually increasing load to the live side of the rope in order to pull the wedge into position. Only tension sufficiently to hold the pieces in place.
6. After checking alignment increase the load GRADUALLY until the wedge is properly seated.

IMPORTANT! Avoid sudden shock loads.

This is the recommended procedure. If variations are made to suit special conditions, they should be carefully evaluated beforehand.

SEALS

Oil and grease seals are critical to machine availability. Careless storage, handling, removal and installation can contribute to reduced service life of machine components and higher cost of operation.

Seals come in all sizes, shapes and materials. Wherever possible, Bucyrus has specified the use of the most common solid molded element type seals for use on Bucyrus machines.

All types of oil and grease seals have a limited shelf life. Store seals in a cool, dry location protected from direct sunlight. Keep in sealed containers or packaging until ready to use. Seals keep lubricant clean and contained in their respective housings, bearings or passageways. Always handle seals carefully to prevent exposure to nicks, bends or pinching. Do not wash them in solvents as some solvents may destroy properties of the seal.