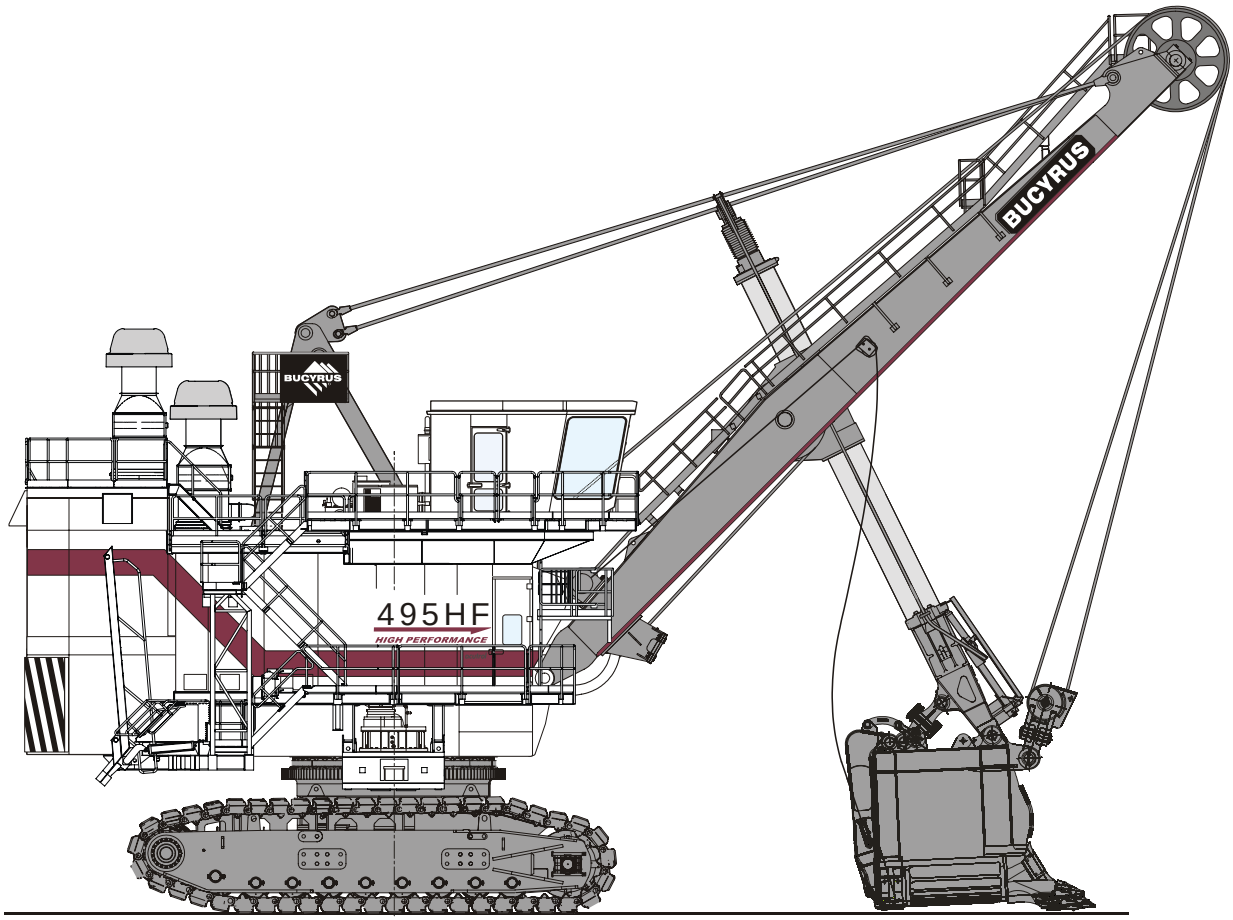
BUCYRUS®

# 495HF
# MINING SHOVEL
## MAINTENANCE and OPERATION MANUAL

***SN: 141243***

**Manual No. *10631***




**Bucyrus International, Inc.**

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

Section **1**

# Introduction

## GENERAL INFORMATION

This manual is designed to assist the owner in the operation and preventive maintenance of this machine. By following easy to understand step-by-step procedures the operators and maintenance personnel can perform all tasks in a safe manner. It is important to remember that when a systematic and thorough maintenance/service procedure is used for this machine, a minimum of unplanned downtime and more reliable operation will result.

Throughout this section, and the remainder of this manual, the use of the terms "*LEFT*, *RIGHT*, *FRONT*, and *REAR*" refer to machine locations as viewed by the operator sitting in the operator's seat in the cab.

THIS MANUAL IS NOT THE PARTS BOOK, and cannot be used as reference material to order parts. A separate, detailed parts book has been supplied for this purpose.

Periodic additions or revisions may be made to this manual. Should you require additional information or factory service assistance contact your regional service representative or:

Bucyrus International, Inc.
1100 Milwaukee Avenue
P.O. Box 500
South Milwaukee, Wisconsin, USA 53172-0500
Telephone (414)-768-4000

It is the policy of Bucyrus International, Inc. to improve its products whenever possible and practical to do so. The company reserves the right to make changes or add improvements to its machines at any time. This will be without incurred obligations to install such changes on machines sold previously. Due to this ongoing program of product research and development some procedures, specifications and parts may be altered in a constant effort to improve our machines.





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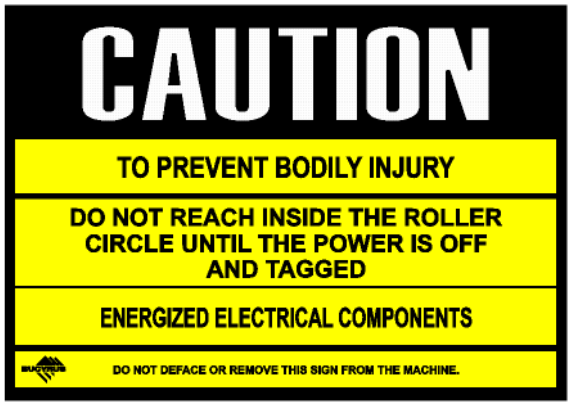


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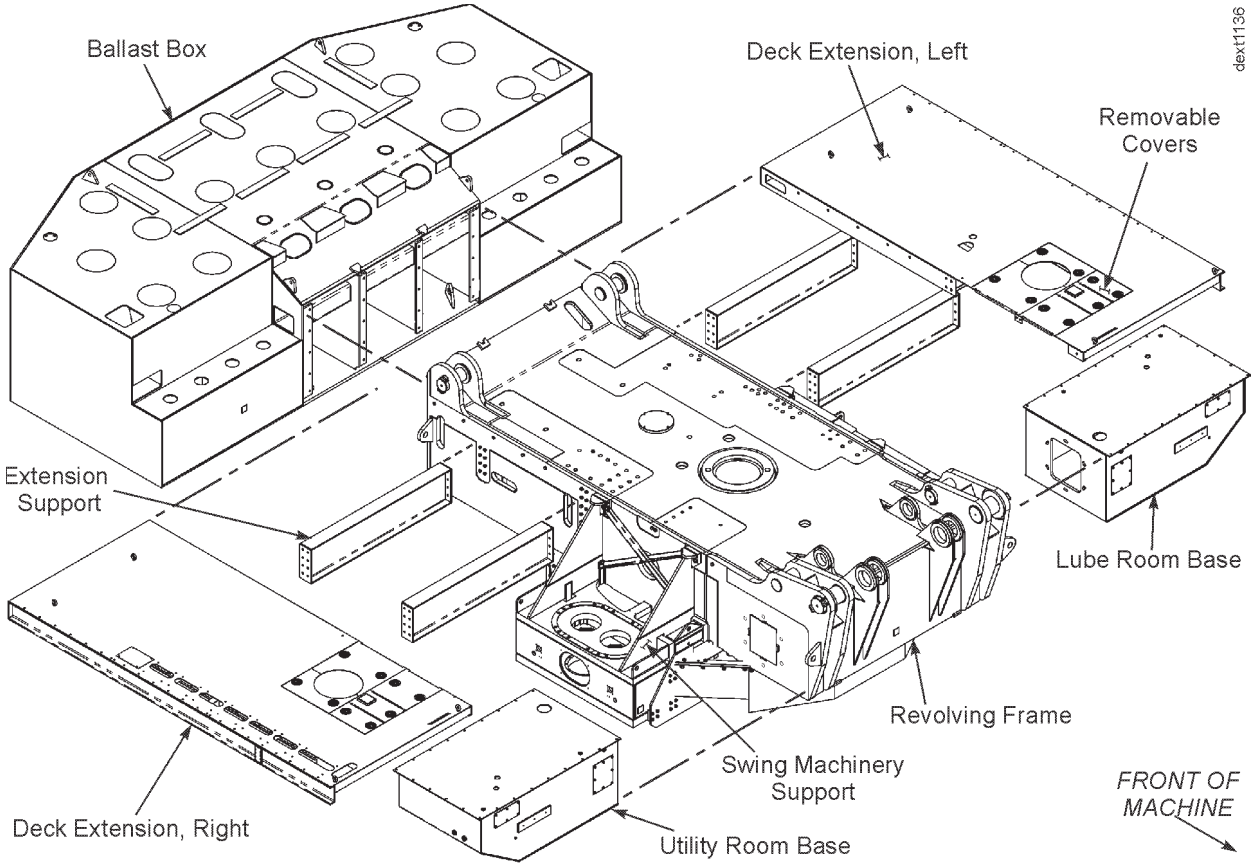
*Stored Energy Decals*

## DECK EXTENSIONS

Right and left side deck extensions are bolted to each side of the revolving frame. They provide a mounting area for the electrical transformers and accessory machinery as well as supporting the machinery house walls.




*Deck Extensions and Ballast Box*

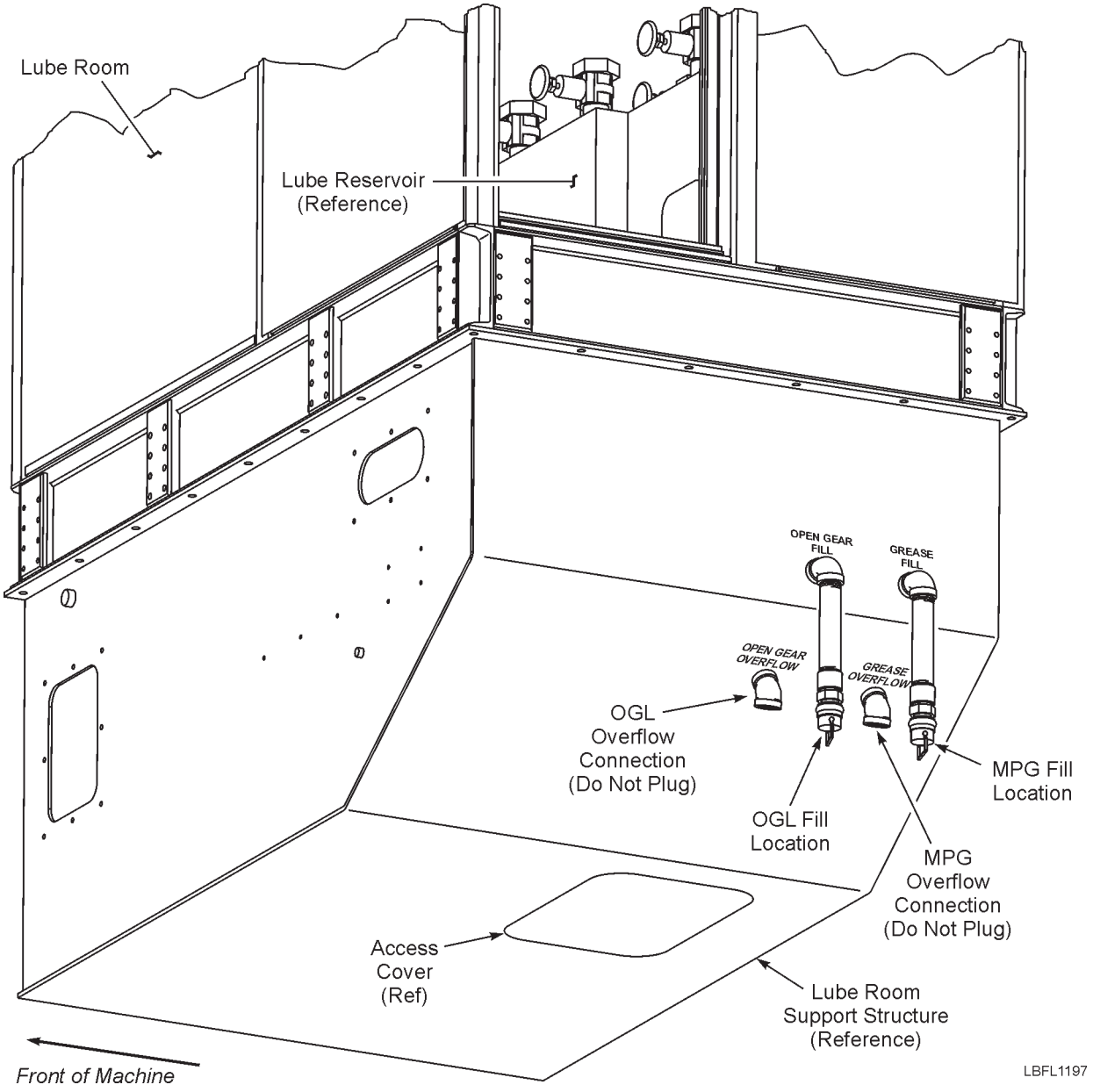
## BALLAST BOX

The ballast box is an all-welded steel fabrication located at the rear of the main revolving frame. A series of vertical plates in the box form compartments for holding ballast.

## MACHINERY HOUSE

The machinery house encloses the revolving frame, ballast box and deck extensions. It is constructed of self-supporting steel panels with built-in framing. Removable roof sections are provided over the swing machinery and to the side and rear of the A-frame. The house also provides mounting for the air ventilation and pressurization system. A separate electrical room is located over the ballast box. Platforms and stairs facilitate access to the sides and tops of the house for inspection and maintenance purposes. Boarding stairs permit easy access onto the machine.

## LUBE RESERVOIR FILL / OVERFLOW PLUMBING




*Lube Reservoir Fill / Overflow Plumbing*

The lube reservoir fill/overflow plumbing is located in the support structure directly below the lube room at the front, left side of the machine. Lubricants can be added at this location. The overflow connections are also located here. DO NOT plug the overflow connections.

## 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.**

| | *Quantity* | *Weight Each (U.S. Pounds)* |
|---|---|---|
| **Lower Works** | | |
| Truck Frame | 1 | 205,900 |
| 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 | 50 |
| Propel Motor | 2 | 4,500 |
| Propel Motor Blower | 2 | 210 |
| Propel Motor Guard | 2 | 50 |
| Coupling | 2 | 130 |
| Crawler Belt - RH | 1 | 192,900 |
| Crawler Belt - LH | 1 | 192,900 |
| Crawler Link — 140 Inch | 94 | 3,800 |
| Crawler Assembly - Shipping | 2 | 135,000 |
| Crawler Assembly - Mechanical | 2 | 132,000 |
| Crawler Structure | 2 | 80,100 |
| Propel Gearcase | 2 | 15,850 |
| Front Idler | 2 | 5,800 |
| Front Idler Shaft | 2 | 1,150 |
| Adjusting Block | 4 | 370 |
| Load Roller | 8 | 2,000 |
| Load Roller Shaft | 8 | 550 |
| Rear Idler | 2 | 3,750 |
| Rear Idler Shaft | 2 | 670 |
| Drive Tumbler | 2 | 7,120 |
| Drive Shaft Assembly | 1 | 4,200 |
| Drive Shaft | 1 | 3,370 |
| Center Pintle Sleeve | 1 | 9,060 |
| Center Pintle Upper Collar | 1 | 380 |
| Center Pintle Thrust Washer | 1 | 400 |
| Center Pintle Lock Nut Assembly | 1 | 1,480 |

## EMERGENCY STOP PUSHBUTTON

The machine stop/emergency stop pushbutton is located on the right operator's console. It is used to remove power from the machine motions after the motions have been stopped in the normal manner. A second purpose of the pushbutton is to stop the machine under operational emergency conditions. Pushing this button will provide electrical and immediate mechanical braking simultaneously. Therefore, this button should only be used if the operator intends the harshest braking of all motions. If the machine is in motion, power will remain on the motions in order to provide electrical braking for a few seconds. If the machine is in motion or stopped, this button will power the DC bus to approximately zero voltage quickly after the time delay.

**CAUTION: PRESSING THIS BUTTON WHEN ANY DRIVE IS IN MOTION MAY RESULT IN COMPONENT DAMAGE.**

## WINDSHIELD WIPER SWITCHES

The windshield wiper switches control the starting and stopping as well as the speed of the windshield wipers.

## CONTROL STOP PUSHBUTTON

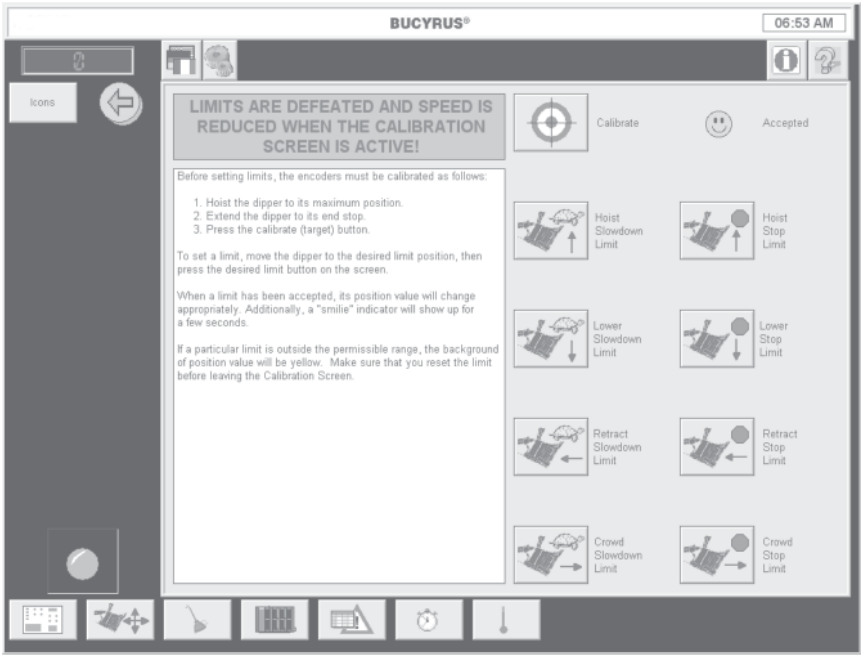
The control stop pushbutton is a pushbutton located on the right operator's console. Normally it is used to de-energize controls after the machine has been safely stopped by placing motion controls in neutral.

Actuation of this pushbutton when motions are running will cause all motions to automatically electrically brake to a stop and, when the motion speed has reached less than 5% speed, set all mechanical brakes. If the motions are already stopped, the brakes will be set and power is removed immediately. A similar switch is located on the front panel of the PLC control cabinet that can be used during testing of the machine.

**DANGER: THE OPERATOR SHOULD NEVER LEAVE THE OPERATOR'S SEAT BEFORE PRESSING THE CONTROL STOP PUSHBUTTON. Setting only the mechanical brakes with individual switches in not a sufficient safeguard to prevent machine damage and/or personnel hazards.**

## HEATED MIRRORS

The heated mirror switch is a 2-position switch located on the right control console. It is used to activate the heating mechanism in the operator's cab outside mirrors.




*Limit Calibration Help*

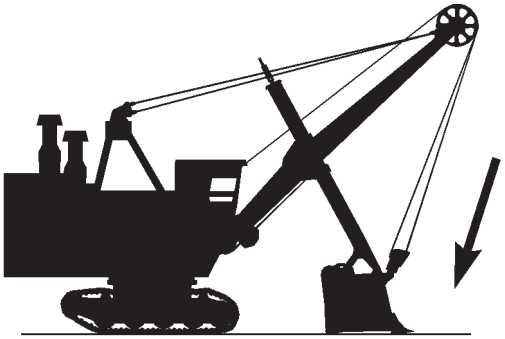
This screen will provide clarifying information on the calibration process.

## MACHINERY MOTIONS

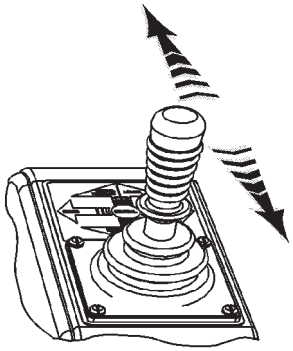
### HOIST MOTION

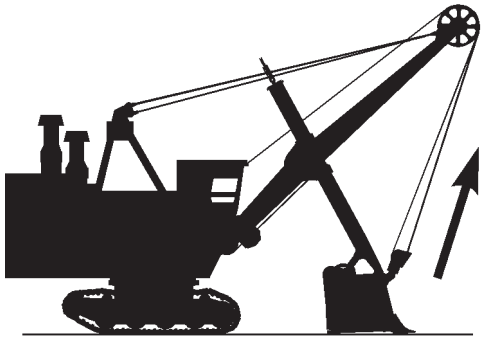
Hoist motion is controlled by the operator's right joystick. Set the propel transfer switch in the DIG mode. The crawlers should be positioned so that the digging is done over the front of the crawlers. Move the joystick between the hoist and lower until a "feel" is developed for the height, depth range and speed at which the dipper moves. Practice the hoist function until movement can be stopped smoothly.

**CAUTION: This joystick also controls the swing motion through left and right motions.**



To ***LOWER*** the Dipper:
Push the *Right* Joystick Forward,
away from the Operator.





To ***HOIST*** the Dipper:
Pull the *Right* Joystick Back,
toward the Operator.

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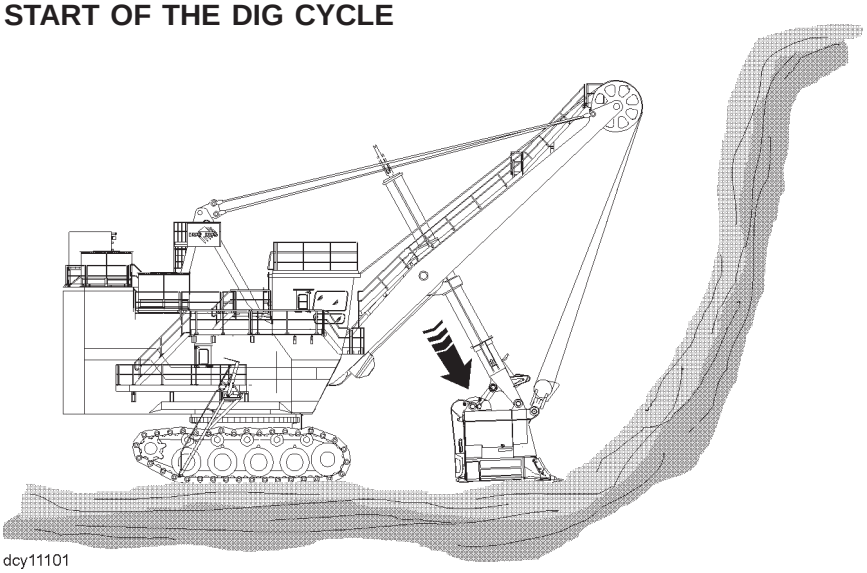
## START OF THE DIG CYCLE



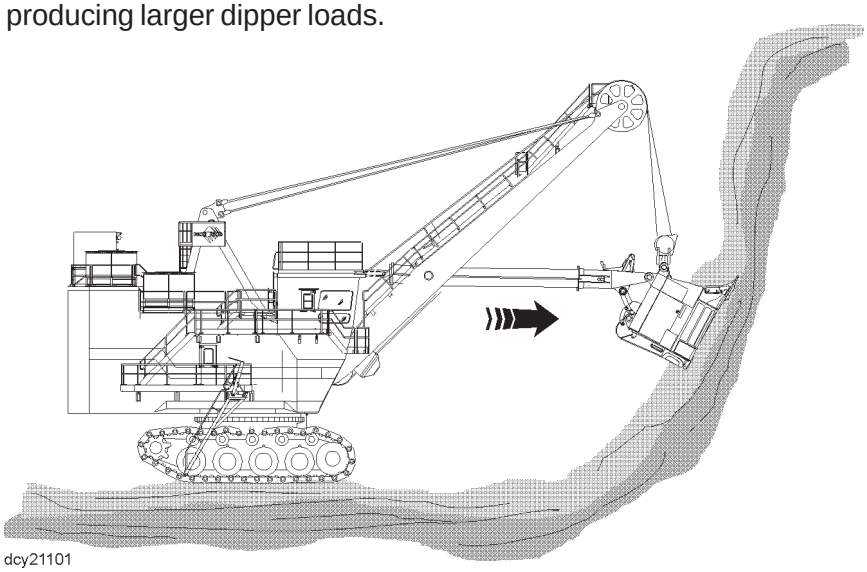

The crowd motion forces the dipper lip into the bank at the start of the digging cycle. It is the crowd thrust which enables the dipper lip and front opening to get into a column of material of sufficient cross section to fill the dipper rapidly.

*Force the Dipper Lip into the Bank*

There is a direct relationship between crowd depth of bank penetration and the distance the dipper must rise in the bank to fill the dipper. The deeper the “bite” the quicker the dipper will be filled, providing the hoist force is sufficient to cut the column of material. Do not attempt to lift the entire bank with each pass. As soon as the dipper is full, retract it from the bank and swing the machine to fill the truck.

Crowd penetration should be rapid just at the arc of entry and rise as the dipper enters the bank. This will permit as much digging as possible near the base of the bank. This is of particular advantage when digging loose or blasted material. The greater the hoist force and crowd thrust, the faster the dipper filling time of the dig cycle. The crowd thrust should be maintained to hold the dipper in the bank while it is being hoisted. An added benefit of proper crowd thrust and hoist force is that the opposing vertical resistance of the bank material tends to have a “ramming” effect in the dipper front opening, minimizing voids and producing larger dipper loads.

It is important that the full cutting surface of the dipper contact the bank on each pass. A full face cut combined with deep bank penetration will result in a full dipper for the least amount of hoist. A partial cut, even with deep bank penetration, requires a greater rise, and tends to leave voids in the dipper. This could necessitate additional passes to fill the haulage unit.



LUBRICATION BENCHMARKS ..... 30
ACSL - AIR COMPRESSOR (SCREW-TYPE) LUBRICANT ..... 30
MPO - MULTIPURPOSE OIL ..... 31
RWRL - RUNNING WIRE ROPE LUBRICANT ..... 32
SCHEMATICS - AUTOMATIC LUBRICATION ..... 33

*ADDITIONAL LUBRICATION BENCHMARKS:*

EGL - ENCLOSED GEARCASE LUBRICANT (495H) ..... *(insert)*
MPG - MULTIPURPOSE GREASE ..... *(insert)*
OGL - OPEN GEAR LUBRICANT ..... *(insert)*
CERTIFIED LISTING FOR OGL AND MPG LUBRICANTS ..... *(insert)*

*LUBRICATION SCHEMATICS:*

OGL SYSTEM A & B (E022349) ..... *(insert)*
GREASE SYSTEM C (D027286) ..... *(insert)*

## LOWER WORKS LUBRICATION

Although this machine does not spend very much time being propelled between digging sites, there are considerable forces exerted on the lower works of the machine. The severe loads and oscillations created during the constant cycles of the digging process tend to squeeze the lubricant out of bushings, creating a circumstance for wear if proper lubrication habits are neglected.

With the high possibility of operation while submersed in water the applied lubricant should have properties which allow for protection under theses circumstances.

When propelling over any long distances the machine should be lubricated at least every 1500 feet of travel, or every ½ hour. Bearings and bushings should be carefully watched and force lubricated until they run cool if evidence of heat buildup is apparent.

Under extremely harsh conditions such as propelling up a hill, frequent turns, or through deep water and mud the lubrication frequency should be increased.

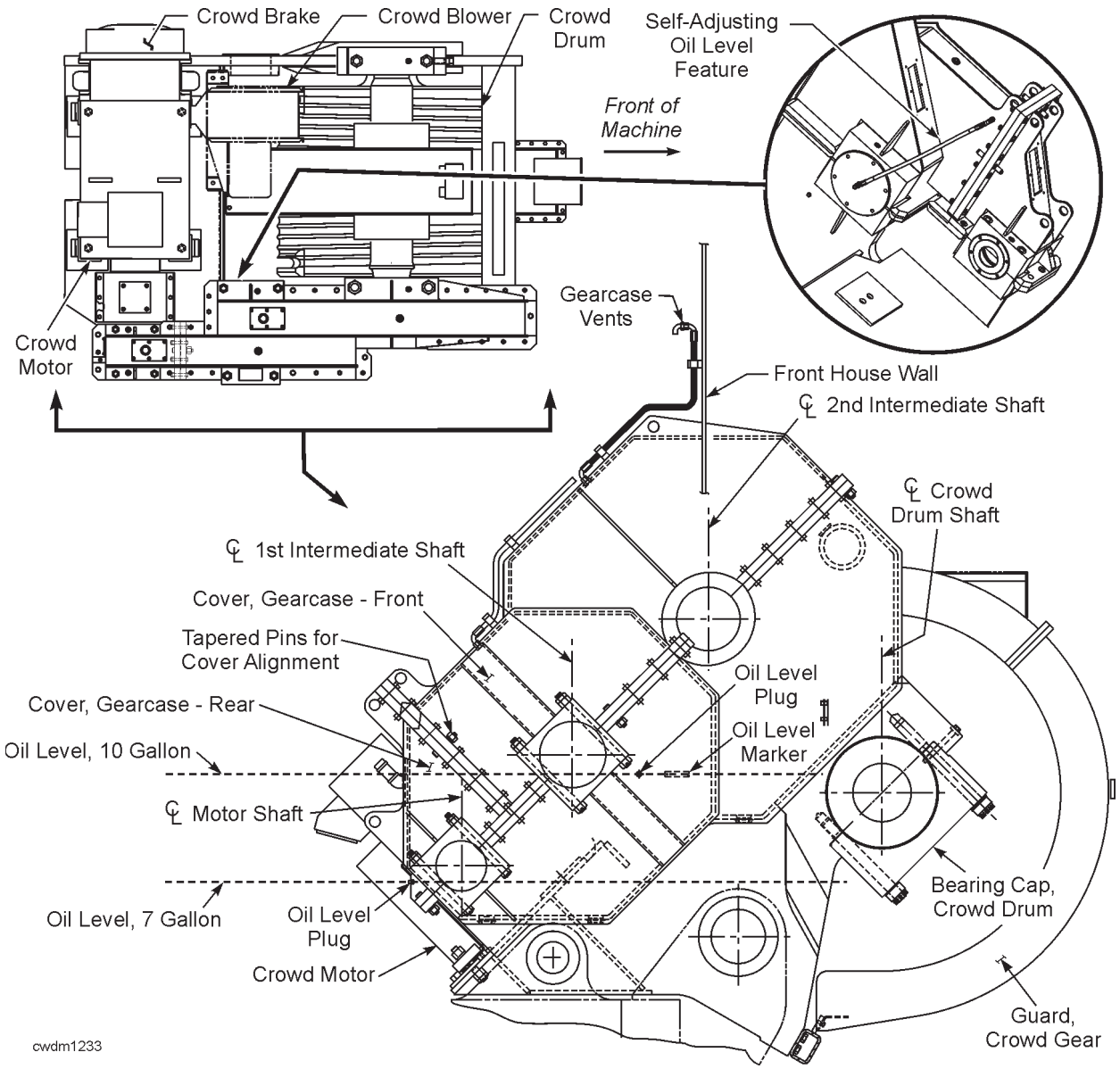
## PROPEL MACHINERY LUBRICATION

Propel planetary gearcases should be checked every 48 hours. Inspect the lubricant level with the machine on level ground and add the required amount of the recommended lubricant if necessary. If water has accumulated within the gearcases, remove the drain plug and drain into a container for waste removal, then refill with clean lubricant.

When radical changes in temperature, or at the recommendation of a testing facility, make it necessary to change the lubricant within a gearcase, it is advised to drain the box immediately after propelling the machine. This will allow for a more thorough removal of contaminants and foreign material due to the elevated temperature and suspension of particles within the lubricant.

## CROWD MACHINERY LUBRICATION

The crowd machinery includes 2 gearcases. The crowd first and second stages of gear reduction are totally enclosed systems submerged in gear lubricant. The gearcase is provided with an oil level plug to check for adequate lubrication, and a filter breather. The third stage of gear reduction, the crowd drum gear, is lubricated by OGL from lube system “B-1”. The bearings of the crowd drum, along with the shafts of the crowd reduction system are lubricated by grease from lube system “C-1”



## RWRL - RUNNING WIRE ROPE LUBRICANT

*SCOPE:* Lubrication performance requirements for hoist rope lubricant.

*APPLICATION:* Primarily for hoist ropes or any other running ropes where fatigue and not wear is of prime concern.

*GENERAL REQUIREMENTS:*

1. Penetrate between adjacent wires in order to lubricate and protect them against wear and to keep the rope core from drying out and deteriorating.
2. Provide a lubricant between sheaves and wire rope.
3. Resist being washed off.
4. Protect against rusting or corrosion.
5. Form a non-sticky film so that dust and dirt will not build up on the wires.
6. Remain pliable and resist stripping at the lowest temperatures to which the rope will be exposed.
7. Preferably, it should form a light colored transparent film so that wear, corrosion or broken wires can be readily detected by inspection.
8. Be capable of easy application, both manually and by devices without being heated.

*COMPOUNDING:*

Suitable for penetrating between the adjacent wires of a rope in order to lubricate them and also to replenish the lubricant in the core.

**Bucyrus International, Inc.**

**SPECIFICATION FOR**

## MPG – MULTI-PURPOSE GREASE

**SD4711** *(August 18, 2005)*

| PROPERTY | REFERENCE | REQUIREMENT |
|---|---|---|
| Pressure Oil Separation | The Lubrication Engineers Manual (United States Steel). | U.S. Steel test method - Cake penetration not less than 25% of grease penetration. |
| Grease Mobility | The Lubrication Engineers Manual (United States Steel). | U.S. Steel method - not less than 0.10 grams flow per second at the lowest anticipated ambient temperature. (Testing temperature not less than -34°C/-30°F). |
| Pumpability, Lincoln Ventmeter | The Lubrication Engineers Manual (United States Steel). | To vent from 1800 psi (127 kgf/cm^2) to less than or equal to 600 psi (42 kgf/cm^2) within 30 seconds at the lowest anticipated ambient temperature (Testing temperature not less than -25°C/-13°F). |
| Lubricating Solids (Molybdenum Disulfide, Graphite, Etc.) % by Weight | | Less than or equal to 5% |
| Lubricating Solids (Molybdenum Disulfide, Graphite, Etc.) Particle Size, (Microns, max.) | | 10 Microns |

NOTES:

1. Ambient Temperature - The ambient temperature shall be the temperature at the point of lubricant application.

2. Low Temperature Grease - For extended use in low temperature (-12°C to -46°C / +10°F to -50°F) areas, this product should be capable of slumping in containers and should be pumpable through lube lines without the aid of heat tracing. This product should meet the Mobility and Pump-ability criteria for the lowest anticipated ambient temperature. In order to minimize compatibility problems, it is desirable that the thickener and additive system be compatible with the additional grades that are suitable for the other ambient temperatures.

**Bucyrus International, Inc.**

**CERTIFIED LUBRICANTS LISTING**
**(January 22, 2007)**

## CERTIFIED LUBRICANT LISTING FOR "DRAGLINE ENCLOSED GEARCASE LUBRICANT (SD4721 Part A)"

### Mineral Oils

| Manufacturer | Product Description |
|---|---|
| Bel Ray | 100 Gear Oil 140 (ISO VG 460) |
| Bel Ray | 100 Gear Oil 250 (ISO VG 1000) |
| Bel Ray | 100 Gear Oil 350 (ISO VG 1500) |
| Bel Ray | 100 Gear Oil 460 SBF (ISO VG 460) |
| Bel Ray | 100 Gear Oil 1000 SBF (ISO VG 1000) |
| Bel Ray | 100 Gear Oil 1500 SBF (ISO VG 1500) |
| Exxon / Esso | Spartan EP 460 (ISO VG 460) |
| Exxon / Esso | Spartan EP 1000 (ISO VG 1000) |
| Lubritene | Lubrene Syn 1500 (ISO VG 1500) |
| Lubritene | Lubrene Super Series Gear Oil 1500 (ISO VG 1500) |
| Lubritene | Lubrene Super Series Gear Oil 1000 (ISO VG 1000) |
| Mobil | Mobilgear 600XP 460 (ISO VG 460) |
| Mobil | Mobilgear 634 (ISO VG 460) |
| Mobil | Mobilgear XMP 460 (ISO VG 460) |
| Mobil | Mobilgear 639 (ISO VG 1000) |
| Petro-Canada | Ultima 460 (ISO VG 460) |
| Petro-Canada | Ultima 1000 (ISO VG 1000) |
| Schaeffer Mfg. | #209A Universal Gear Lube (ISO VG 460) |
| Schaeffer Mfg. | #209A Universal Gear Lube (ISO VG 1000) |
| Schaeffer Mfg. | #294 Supreme Gear Lube (ISO VG 460) |
| Schaeffer Mfg. | #294A Supreme Gear Lube No Tack (ISO VG 460) |
| Shell | Omala 460 (ISO VG 460) |
| Shell | Omala 1000 (ISO VG 1000) |
| Shell | Omala 1500 (ISO VG 1500) |
| Shell | SP Plus Gear Oil (ISO VG 1500) |
| Talcor | Gear Oil EP (ISO VG 1000) |
| Whitmore Mfg. Co. | Paragon Heavy Duty Enclosed Gear Oil (ISO VG 460) |
| Whitmore Mfg. Co. | Paragon Heavy Duty Enclosed Gear Oil (ISO VG 1000) |
| Whitmore Mfg. Co. | Paragon Heavy Duty Enclosed Gear Oil (ISO VG 1500) |
| Whitmore Mfg. Co. | Paragon Gold High Performance Gear Oil (ISO VG 1000) |

### Synthetic (PAO) Oils

| Manufacturer | Product Description |
|---|---|
| Bel Ray | Synthetic Gear Oil 460 (ISO VG 460) |
| Bel Ray | Synthetic Gear Oil 1000 (ISO VG 1000) |
| Lubrication Engineers | 9846 Synolec Gear Lubricant (ISO VG 460) |
| Lubrication Engineers | 9899 Synolec Gear Lubricant (ISO VG 1000) |
| Mobil | Mobil SHC 634 (ISO VG 460) |

## MAINTENANCE PRECAUTIONS

The operator must be sure that the machine equipment is in a safe position before repairs or adjustments are made. The machine should not be endangered by falling rock or a possibly yielding support surface. Before beginning repair or adjustment, the operator shall:

1. Set the dipper on the ground.
2. Set all brakes.
3. De-energize control functions.
4. Do whatever else is necessary to prevent accidental movement of the machine.

**DANGER: HIGH VOLTAGE! IF POWER IS ESSENTIAL TO THE REPAIR, SUCH AS FOR TESTING, IT SHOULD ONLY BE ENERGIZED WHEN ALL PERSONNEL ARE CLEAR OF ELECTRICAL AND MECHANICAL HAZARDS. The power should only be energized during the testing period and not when repair work is actually being done.**

Prior to undertaking any work, maintenance personnel should notify the operator about the nature and location of the job. If work is to be done on or near moving parts, the starting controls should be locked in the OFF position and tagged. The lock and tag should only be removed by the maintenance people who installed them, or other authorized personnel. During all phases of maintenance, use extreme caution when working near electrical equipment. Never work near exposed, energized high voltage connections.

Approved protective equipment such as gloves and insulated hooks or tongs should always be used when high voltage electrical cables are handled.

**DANGER: Only qualified electricians are permitted to directly maintain electrical equipment such as motors, transformers and switches.**

While performing maintenance, the awkward positions assumed and the handling of heavy parts often increases the possibility of injuries. As a precautionary measure, use mechanical handling equipment whenever possible. The mining foreman can facilitate safer and easier maintenance work by providing blocking materials. Service crews should have a fundamental knowledge of lifting practices so their knees and legs are used rather than their backs.

**DANGER: Many of the components comprising the machine are heavy, bulky items. EXTREME CAUTION SHOULD BE USED WHEN LIFTING THESE ITEMS. PERSONNEL SHOULD BE CERTAIN OF THE WEIGHTS OF COMPONENTS BEFORE ATTEMPTING TO LIFT THEM, EITHER MANUALLY OR WITH A LIFTING DEVICE. ALL APPLICABLE SAFETY RULES MUST BE FOLLOWED WHEN USING A CRANE OR OTHER LIFTING DEVICE. Be aware of the load rating, lifting height and swing radius of the lifting device before lifting a load. Failure to follow all applicable safety rules when performing maintenance could result in serious injury, or death.**

***MAINTENANCE INSPECTION CHECK POINTS***

## EVERY 500 HOURS, OR MONTHLY

*(WHICHEVER OCCURS FIRST)*

1. Hoist Brake - Check proper operation, lining wear and adjustment. Refer to section 6 in this manual - Brakes and Couplings, for adjustment procedure.

2. Crowd Gearcase Lube - Check both gearcases for leaks, lubricant level and the condition of the gearcase breather. Clean or repair as needed.

3. Crowd Brake - Check operation, linings for excessive wear, quick release operation and solenoid valve operation.

4. Crowd Auto Lube System - Inspect the lube injectors, fittings and hoses. Verify correct operation of the system.

5. Swing Gearcases - Operate the machine while listening for unusual noises and vibrations. *Contact Bucyrus International if problems are encountered.*

6. Swing Gear Lubricants - Check levels and correct as required.

7. Swing Brake - Check for proper operation, lining wear, proper release and solenoid operation.

8. Air System Controls - Inspect all air gauges, regulators, filters and oil-to-air line lubricators.

9. Air System Lines - Inspect all tubing, hoses and fittings for damage and leaks. Repair all leaks.

**Electric Mining Shovel**
*Preventive Maintenance*
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| ITEM # | NOTED DISCREPANCY |
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Date: _____
Shift: _____
Inspected By: _____
Supervisor: _____

**2500 HOURS, OR SEMI-ANNUALLY** *(cont.)*

20. Crowd Gears/Pinions - Photograph all crowd machinery gears/pinions for future comparison. Ensure all teeth are clean for photo. Record the date and machine hours.

21. Swing Air System - Inspect all air lines and fittings for leaks. Repair as required.

22. Swing Motor Mounting - Inspect and tighten all swing motor mounting bolts.

23. Air System Pressure Switches - Verify the correct function and setting of switches and regulator.

24. Lube Room, Air Control Valves - Inspect all valves electrically and manually for proper operation. Repair/replace as required.

25. Lube Pump Stations - Verify that all pumps and controls are operating properly, repair as required.

26. Boom Point Machinery - Check all bearings, adjustments, retainers, seals - repair or replace as required.

27. Suspension Sockets - Check for worn pins, lug ends. If wear exceeds 0.25 inch replace bridge pendant.

28. Hoist Motor - Regrease drive end and non-drive end bearings.

29. Propel Motor - Regrease drive end and non-drive end bearings.

30. Crowd Motor - Regrease drive end and non-drive end bearings.

**Electric Mining Shovel**
*Preventive Maintenance*
pmc_1136

| ITEM # | NOTED DISCREPANCY |
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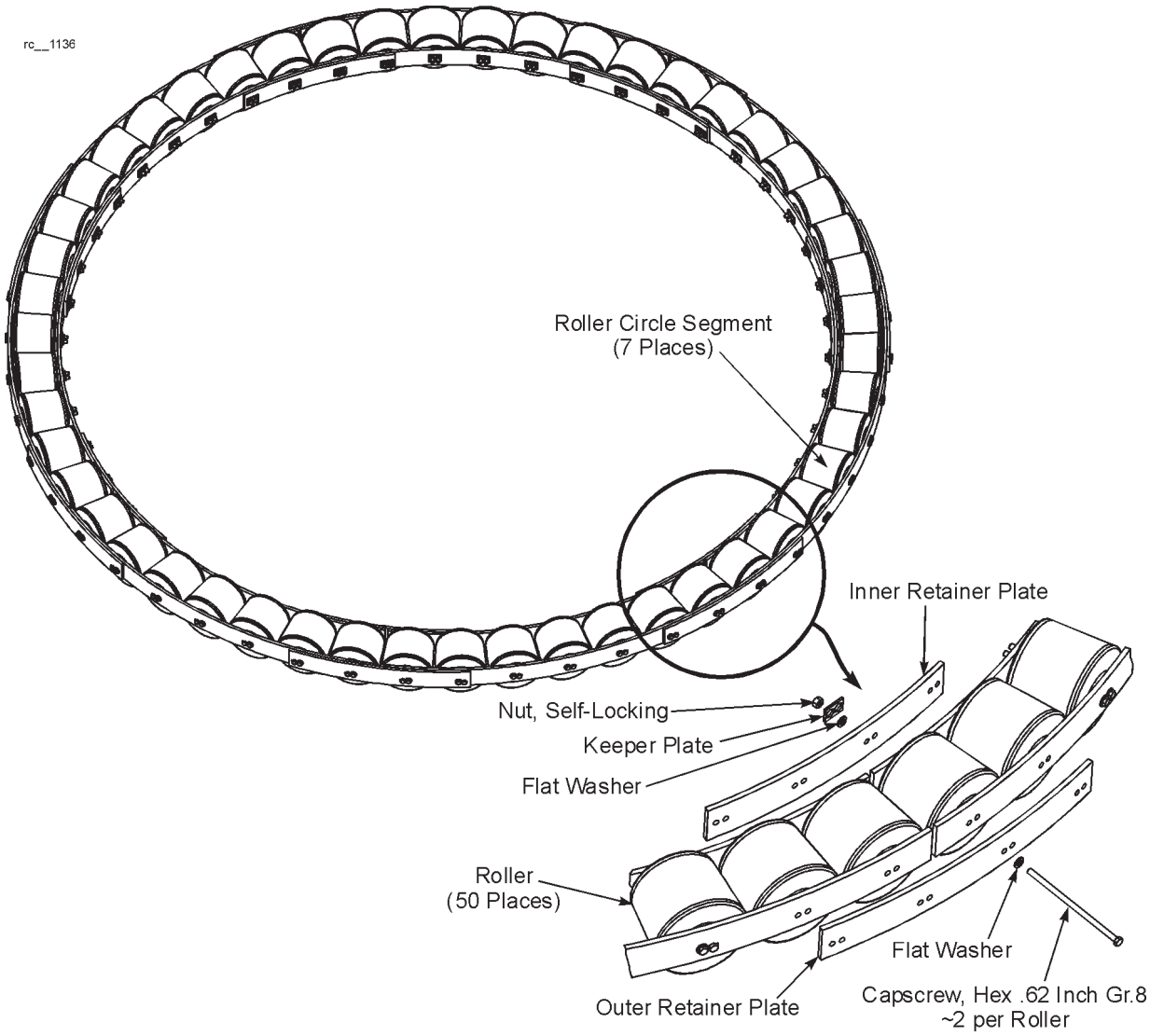
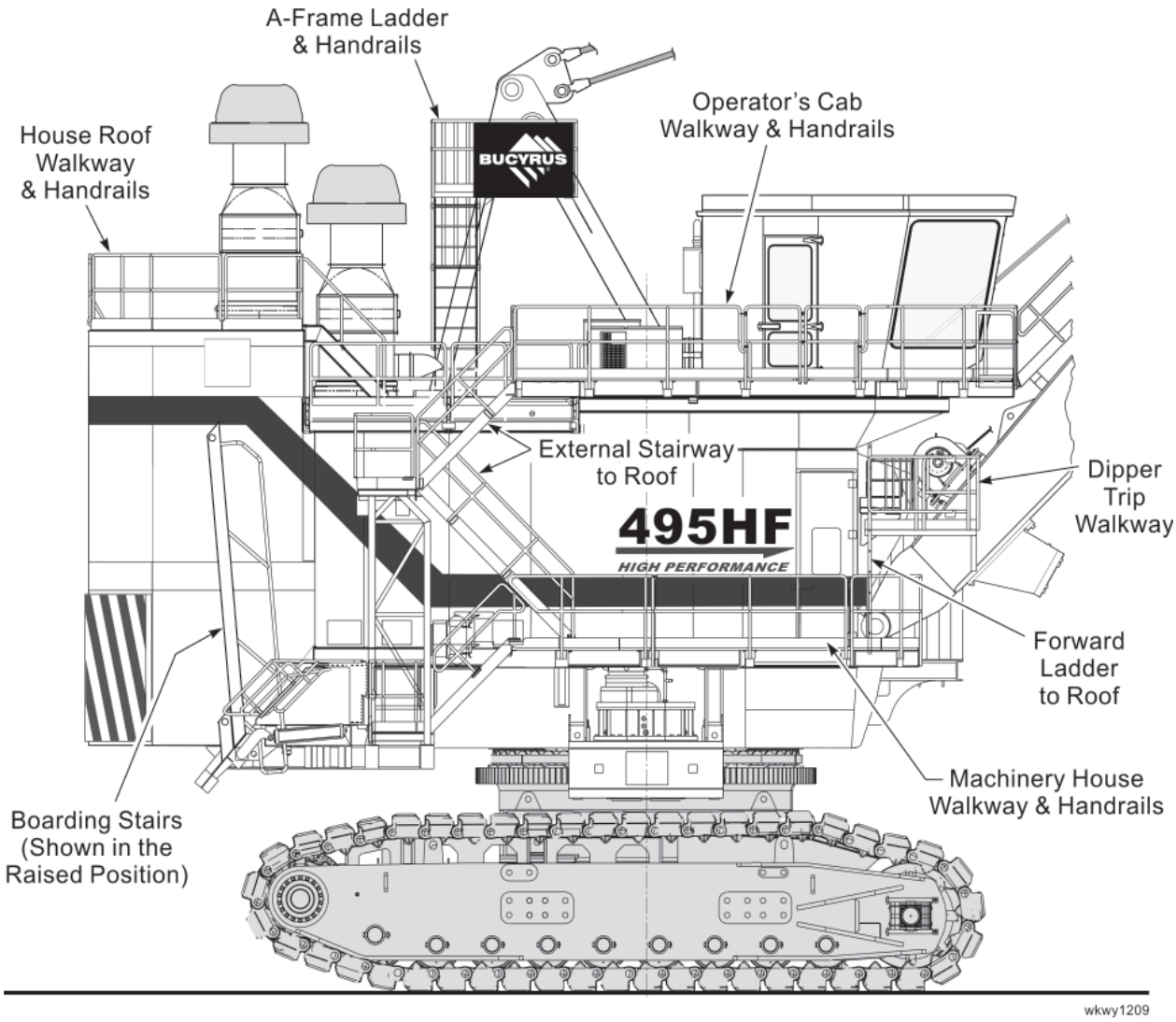
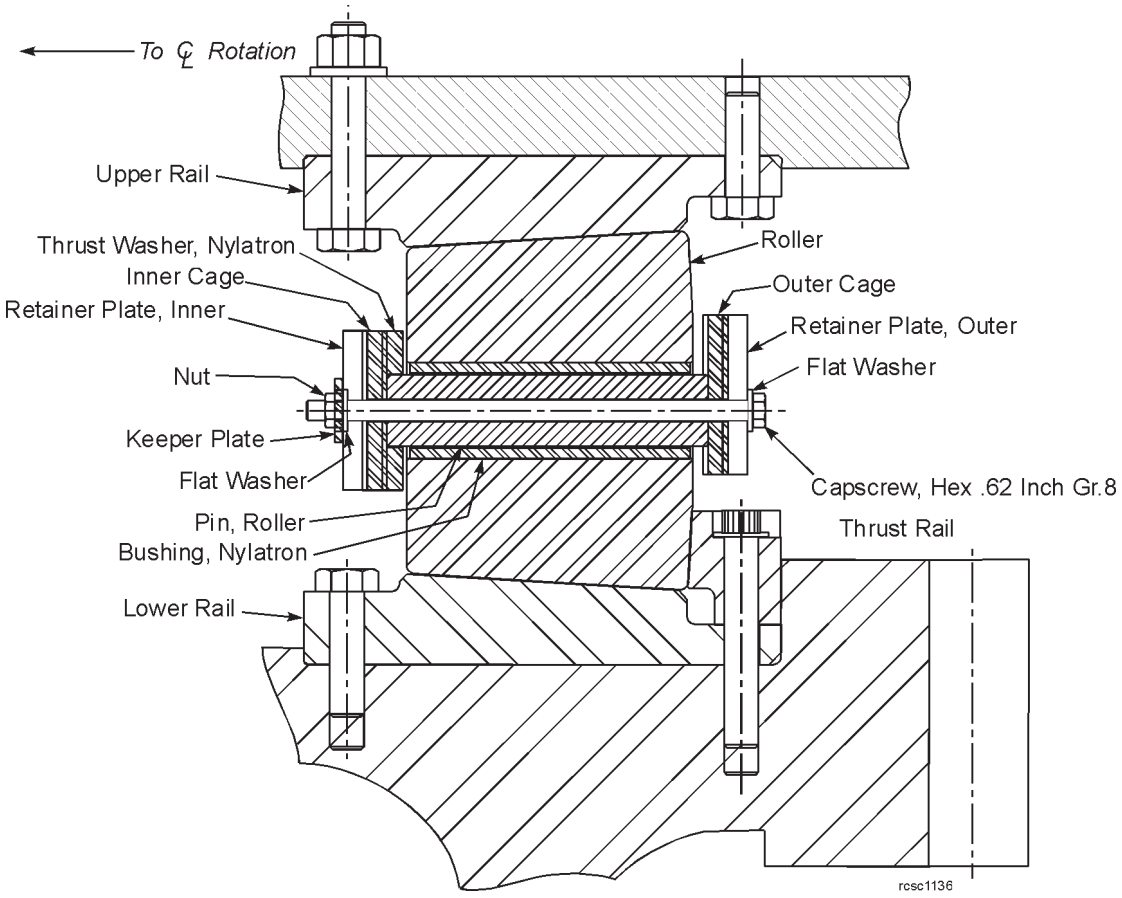



*Roller Circle Assembly*




*Machinery House Walkways and Platforms*

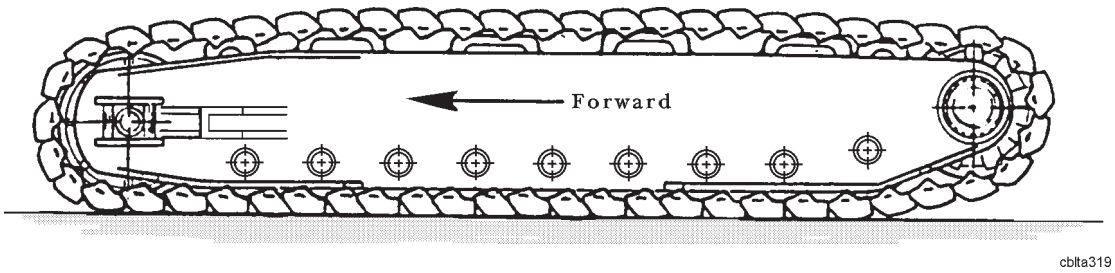



*Section A-A*

5. Slide the rail(s) along the roller circle to the nearest side of the revolving frame and lift the segment (approx. 500 Lbs.) clear of the machine.

6. Installation of new rails is the reverse of removal.

   - Clean and deburr all mating surfaces.
   - Be sure the rail flange is tight against the machined register on the revolving frame.
   - Check the rail height between adjacent rails. The variation in rail thickness is .005 inch maximum.
   - Tighten the mounting bolts to specification.




*Correct Belt Tension*

*NOTES:*
- *BEFORE* the drive lugs on the shoes touch the top of the crawler frame, replace or rebuild the slide bars to their original height.
- To check for the correct belt tension - while propelling the machine ensure that the crawler shoes effectively engage the drive tumbler. This is achieved when there is a minimum of radial shoe movement as it enters the load area of the drive tumbler.

## CRAWLER SHOE REPLACEMENT

**DANGER: STORED ENERGY! SECURE THE CRAWLER BELT BEFORE SEPARATING IT SO UNEXPECTED MOVEMENT UNDER ITS OWN WEIGHT IS PREVENTED. Failure to secure the belt could result in bodily injury or death.**

1. Park the machine safely on a level work area with the shoe to be replaced at the front idler at the belt separation point.

2. Add blocking between the top of the crawler frame and the shoes to remove any slack in the belt.

3. Using hydraulic jacks, remove any belt tension by removing the shims behind the adjusting blocks on each side of the front idler shaft.

*NOTE:* Propel the machine slightly back and forth to unseat the adjusting blocks rearward in the frame slots if they do not move on their own.

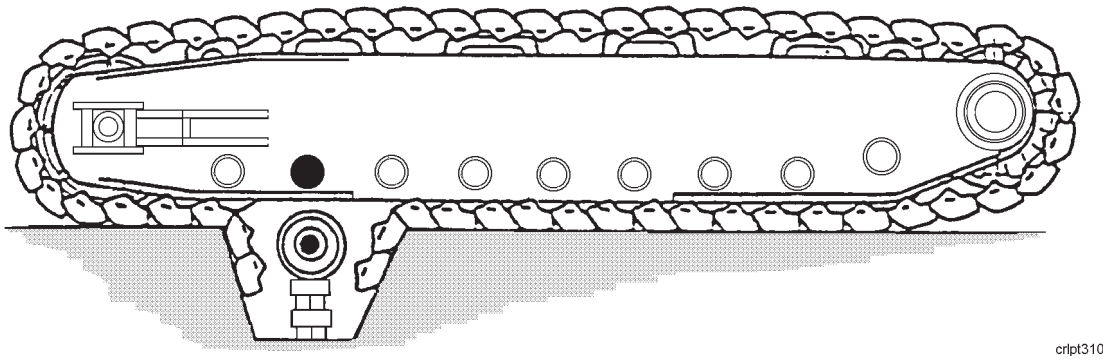
4. Block or support the shoe below the one to be removed. To separate the belt, remove the pin locking hardware and the pin from 2 places on the bottom of the shoe to be removed.

5. Sling and support the shoe to be removed and then remove the pin locking hardware and the pin from 2 places on the top of the shoe to be removed. Remove the shoe from the belt.

6. Position the new shoe into the belt. To fasten one end of the new shoe to the belt, insert the pins and locking hardware in 2 places to secure one end of the shoe. Remove the sling.

Since the rollers are captured between the sides of the crawler frame, removal or replacement requires the separation of the crawler belt and the lowering of the roller below the crawler side frame. This is best accomplished by digging a pit to the dimensions shown in the following chart.

| Pit Size | Height | Width |
|---|---|---|
| REAR IDLER | 55 inches | 79 inches |
| LOAD ROLLER | 39 inches | 63 inches |




*Load Roller Removal*

## 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 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.

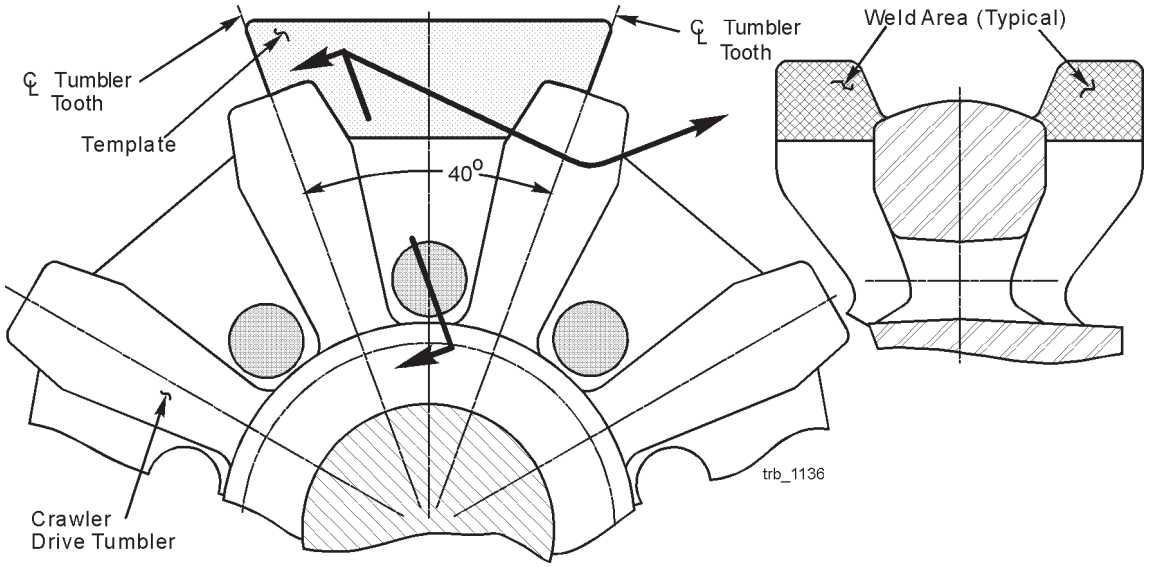
4. Hold a medium length arc - slight weaving action permitted but keep it to a minimum to prevent local overheating. Weld beads must be applied adjacent to each other without removing the slag. This will result in a smooth overlay. Remove the slag between layers, maximum of 3 layers permitted.

5. Weld to within .19 inch of the final contour with weld rod that conforms to AWS E-9018. Use only low hydrogen electrodes.

6. Finish contour the buildup using one of the following electrodes, or equivalent: Hardalloy 40 TiC, Stoody 100 HC 3/32 inch, Stoody 965 APG 0.045 inch. 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.




*Crawler Tumbler Rebuild*

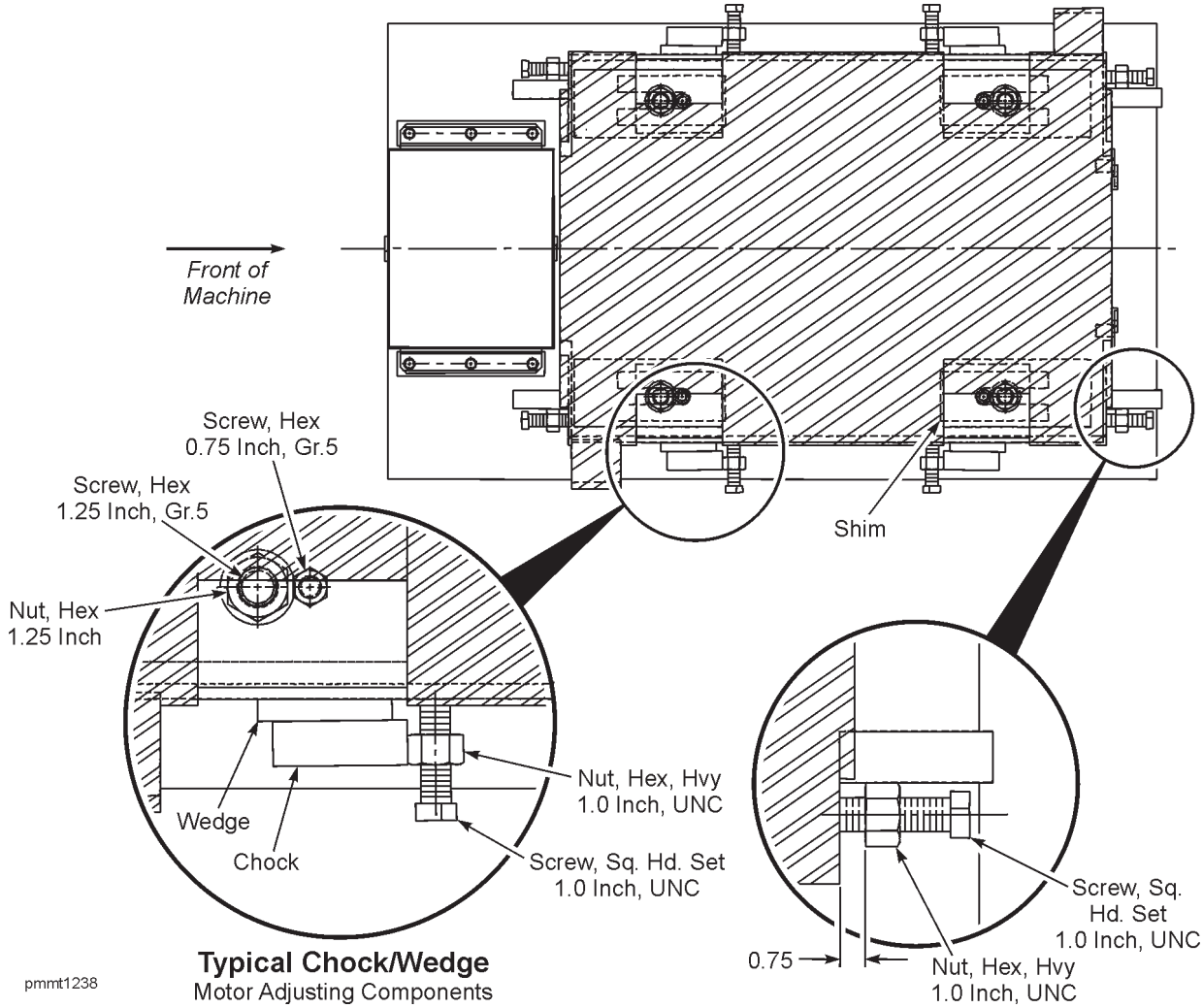
4. If alignment is required, use the 4 jacking screws & mounting bolts to move the motor horizontally & the 2 jack screws under the motor to move it vertically. Once aligned, determine the shim thickness required and install the shims.

5. Install the 4 motor mounting capscrews and related hardware.

6. Re-check the alignment. Position chock and wedge blocks under the motor if required.

7. Install all guards, air lines & wiring.

**CAUTION: ALL WIRING MUST BE DONE BY A QUALIFIED ELECTRICIAN.**



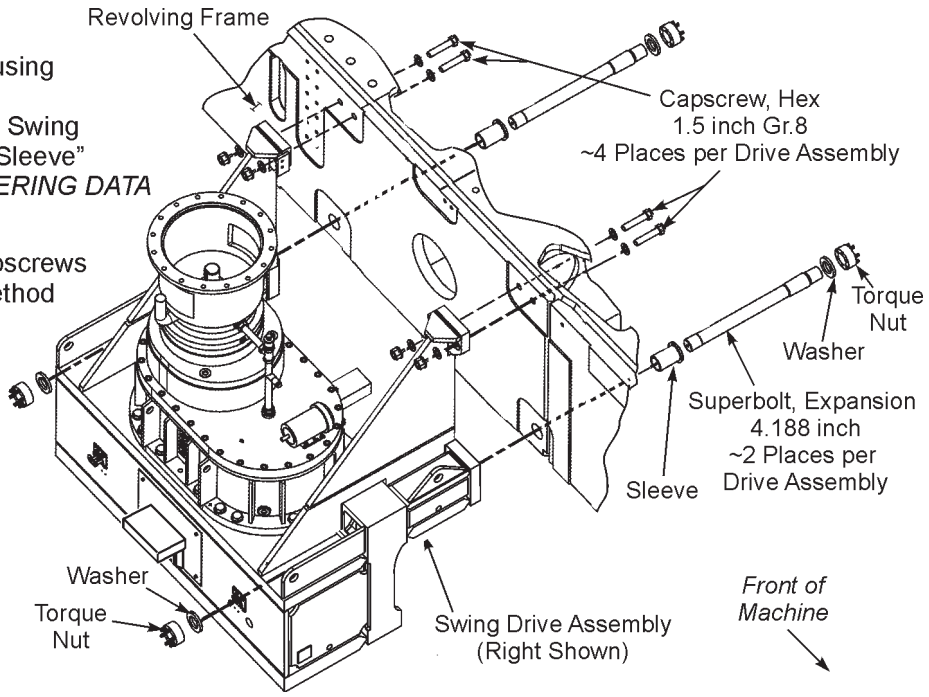

**Typical Chock/Wedge**
Motor Adjusting Components

The swing machinery should be inspected daily for proper lubricant level within the planetary gearcases. If lubricant level is found to be low it must be serviced prior to machine operation. The area of the mesh between the rack and pinions must be inspected. Proper lubrication, damage and the presence of foreign material are some of the items to look for in this area.

## SWING SUPPORT MOUNTING BOLTS

*NOTES:*

1. Tighten the superbolts using the procedures listed in "Tightening Procedure - Swing Torque Rod & Tapered Sleeve" in Section 9 ~ *ENGINEERING DATA* in this manual.
2. Tighten the 1.5 inch capscrews using the turn-of-nut method with an additional 1/3 turn per Section 9 ~ *ENGINEERING DATA* in this manual.

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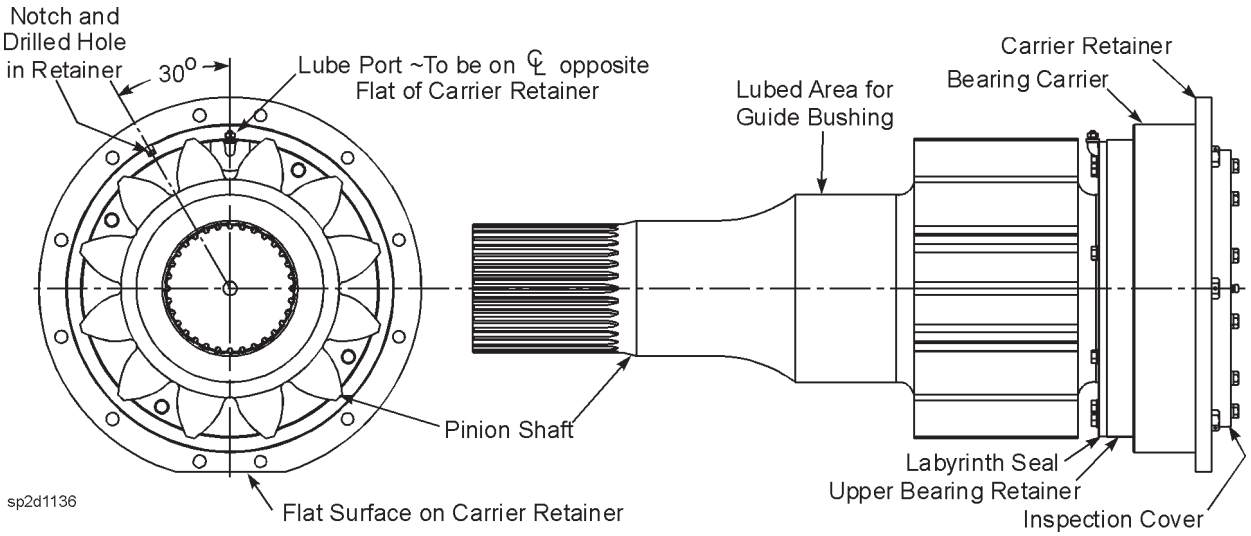
## SWING MOTOR

For lubrication of the drive motor, refer to *GREASING MAIN AC DRIVE MOTORS* in Section 3 of this manual.

**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.**

## SWING BLOWER

The blower assembly is mounted with the use of common hardware to the side of the swing motor. The blower is essentially a complete unit and will normally be replaced as a complete assembly.




## SWING PINION SHAFT INSTALLATION

1. Remove the outer cover on the gearcase support for access to the guide bushing near the top of the pinion shaft.

2. Prior to assembly, apply a thin coating of MolyKote lubricant to the splined sections at the end of the shaft and to the flat area of the shaft that accepts the guide bushing.

3. Ensure that the upper V-Ring face seal is in place in the bottom of the gearcase.

4. Ensure that the guide bushing is resting in its place on the support plate within the gearcase support structure.

5. Install the assembled swing pinion shaft into the swing gearcase support from beneath.

*NOTE:* Be sure that the guide bushing slides over the end of the pinion shaft as the shaft is inserted through the support plate within the gearcase support structure.

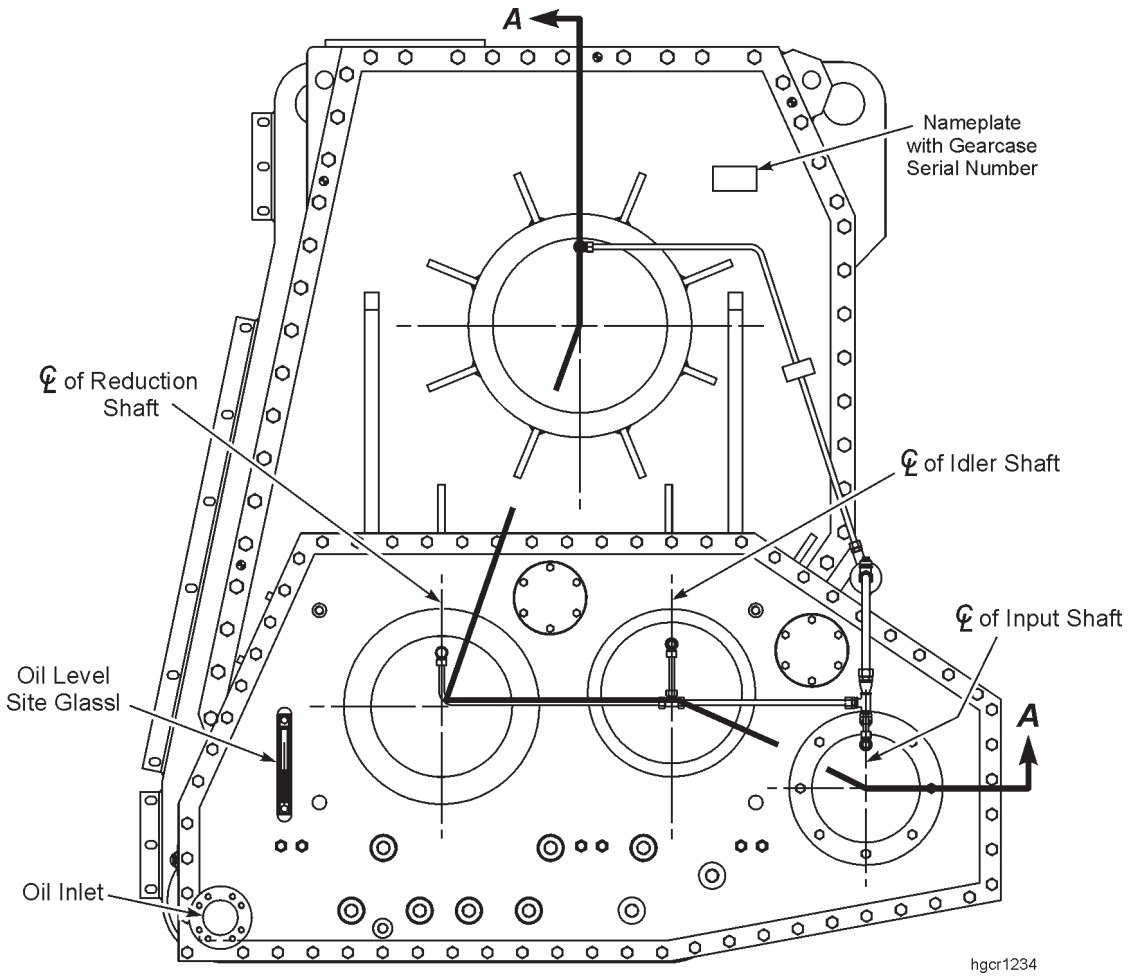
6. Tighten the lower carrier retainer capscrews and lockwire in place.

7. Install the split guide bushing retainer around shaft and over the guide bushing, install the capscrews and tighten.

## HOIST GEARCASE REPAIR

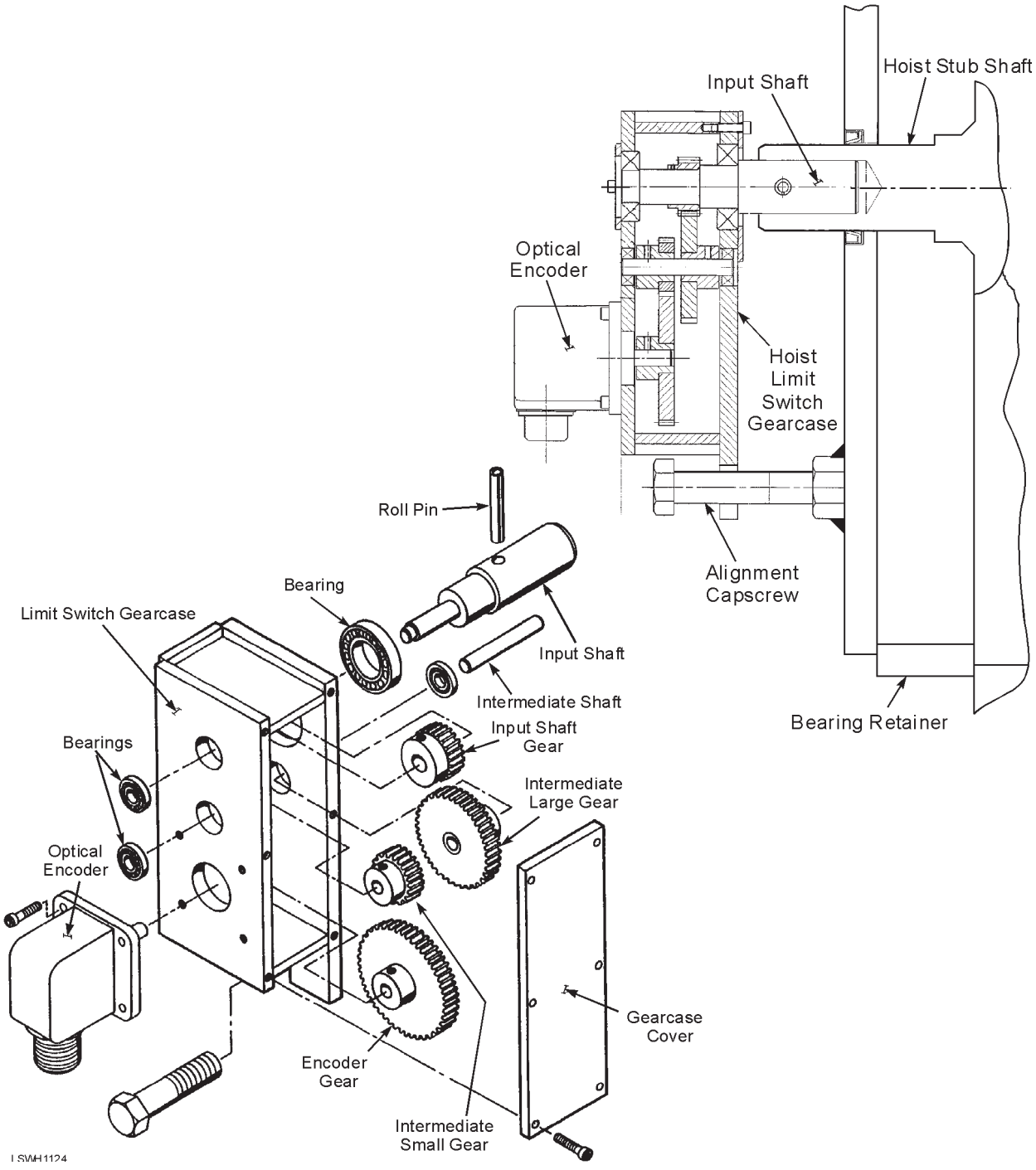
Repair of the hoist gearcase is best completed with the gearcase removed from the machine and in a shop environment. Basic “Level-1” repair involves replacement of seals and O-Rings in the pinion shaft area. Install oil seal with spring toward the bearing.

**DANGER:** **STORED ENERGY! Equipment must be blocked prior to gearcase removal in order to prevent unwanted rotational movement. Failure to comply could result in death, severe personal injury, or damage to the machine. On machines using planetary dual-output pinions such as on hoist or swing, both per drive must be engaged in the bull gear or swing rack to prevent rotation. The internal differential drive in the gearcase allows one pinion to rotate, even if the brake is set, when the other pinion has been removed.**



## HOIST LIMIT SWITCH

The hoist limit switch is used to prevent the padlocks on the dipper from being pulled into the boom point sheaves. The switch electrically cuts the reference signal. It is mechanically connected to the hoist drum shaft. It is composed of a gear reducer, an input shaft connected to the hoist stub shaft and an optical encoder. Setting the hoist limit switch is a function of the Operator's Display in the operator's cab. To set the hoist limit switch refer to *SETTING ROPE LIMITS* in this section of the manual



## CROWD DRUM REMOVAL

*If repair of the crowd drum is needed:*

1. Remove the crowd ropes and retract ropes from the drum. Refer to the *FRONT END EQUIPMENT* in this manual.

2. Remove the gear guard from the drum gear.

3. Disconnect the lubrication lines at the shaft end covers. Remove the end covers.

4. Remove the bolted-on crowd frame lower-front cross tie.

5. Attach a crane to the drum and apply enough force to support the weight of the drum. Support the bearing caps separately.

6. Loosen the torque nuts on the bearing caps. Refer to the procedures in Section 9 - *ENGINEERING DATA*. Remove the preload screw from each bearing cap.

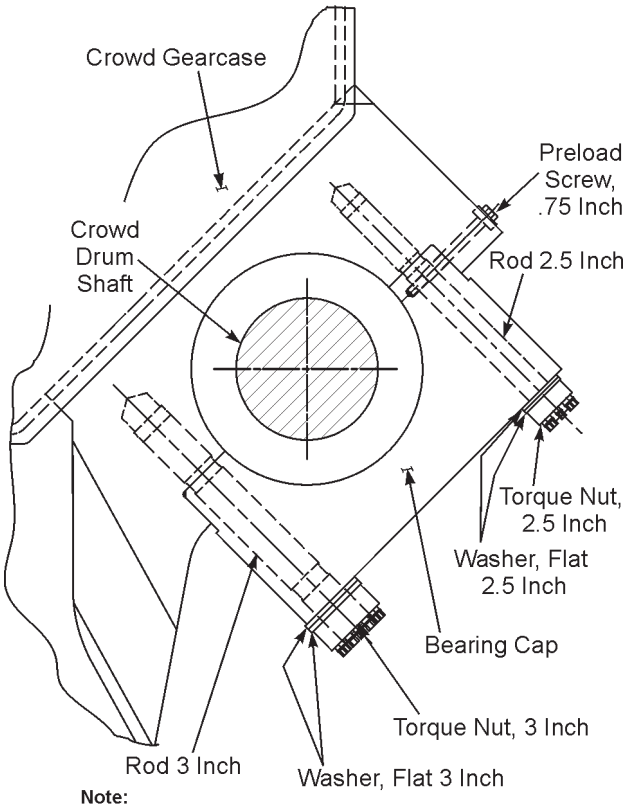
7. Remove the torque nuts and washers securing the bearing caps then carefully remove the bearing caps. The drum can then be lowered to the ground.

*NOTE:* The bearing cap rods are threaded into the bearing housing supports. These can remain in place.

8. Cut the lock wire and remove the retainer bolts from each end of the shaft. Remove the bearing retainers. Remove the shim pack, bearings, bearing spacer and labyrinth seals and wire together for future use.

9. If necessary, remove the hardware securing the drum gear to the drum and remove the gear. Consult the Bucyrus Service Department for repair procedures for the drum and gear.

***IMPORTANT:***
For repairs which include torque nuts, refer to the proper tightening AND loosening procedures.




**Note:**
Both Left and Right Hand Bearing Caps are identical.

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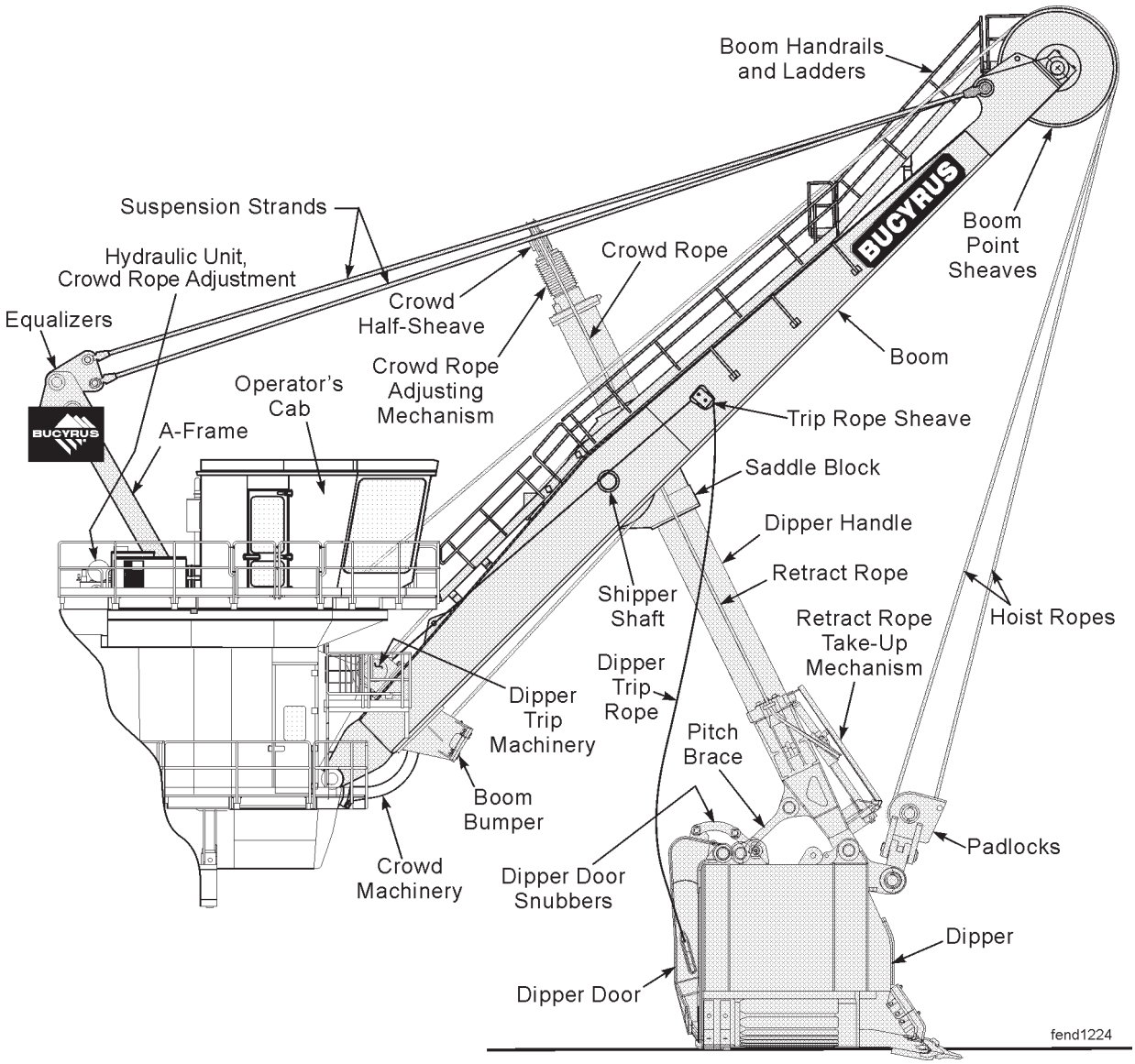
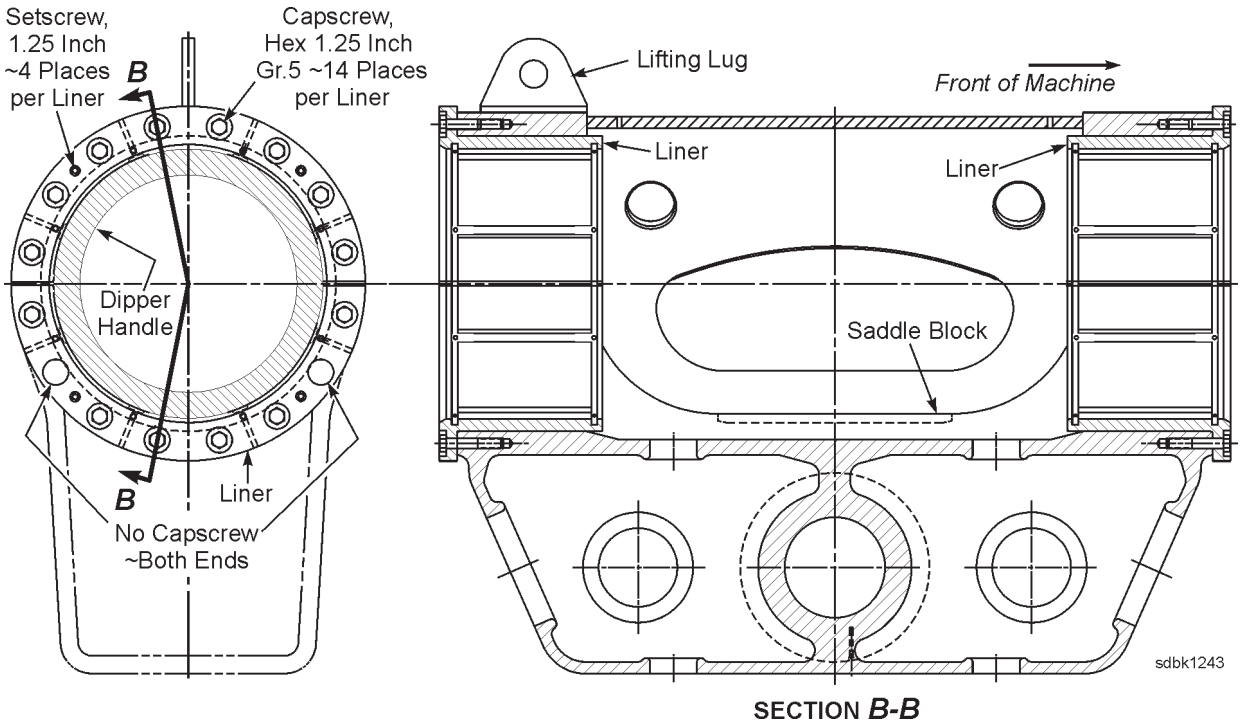
## FRONT END EQUIPMENT




*Front End Equipment*

## 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.




*Saddle Block Bushing Arrangement*

## SADDLE BLOCK REPAIR

The saddle block liners should be replaced either when the chamfer on the inside diameter flanged end of the liner has been worn off, 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 mating surfaces of liner O.D. and saddle block I.D. with Loctite 680 immediately before installation. Use Loctite 227 on the liner bolts.
4. Replace the front liners using the same procedures as above.

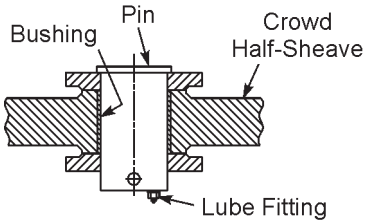
5. Slide the worm gear thrust washer onto the screw rod.

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 - .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 - .75 inch capscrews. Tighten the clamps on the bellows.




SECTION *C-C*

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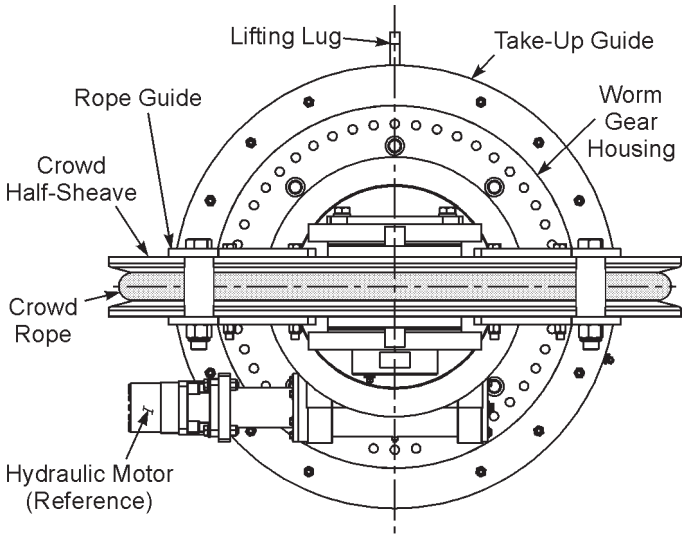



SECTION *B-B*

10. Pre-assemble the roller bearings onto the worm gear shaft, using a press or other appropriate tool.

11. Install a 0.50 inch bolt or threaded rod (at least eight inches in length) into the non-drive end of the worm shaft, opposite the drive end, for assembly purposes.

12. Insert the worm shaft (with both roller bearings) into its housing. Spin the worm shaft clockwise until it is fully inserted.

13. Install the non-drive end bearing retainer with its mounting hardware and tighten.

14. Measure the worm shaft end play. Add or remove shims to obtain 0.001 inch to 0.003 inch end float clearance and re-install the retainer.

5. Lower the hoist ropes slightly to allow for pin removal.

6. Remove the padlocks one at a time using the following procedure:

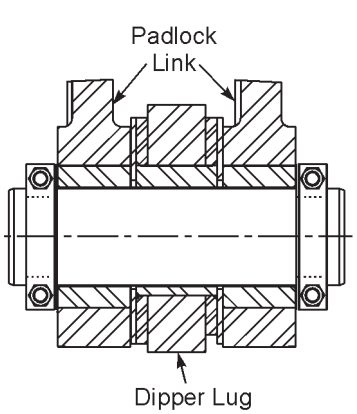
**DANGER: STORED ENERGY! Removal of dipper pins requires the attached items to have proper support to release the load. Failure to comply could result in death, severe personal injury, or damage to the machine.**

a. Using a suitable lifting device, raise the padlock (approx. 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.

*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 (approx. 400 lbs) to support the pin during removal. Remove the pin. Do not lower the pin at this time, it will be reinstalled.




*Section A-A*

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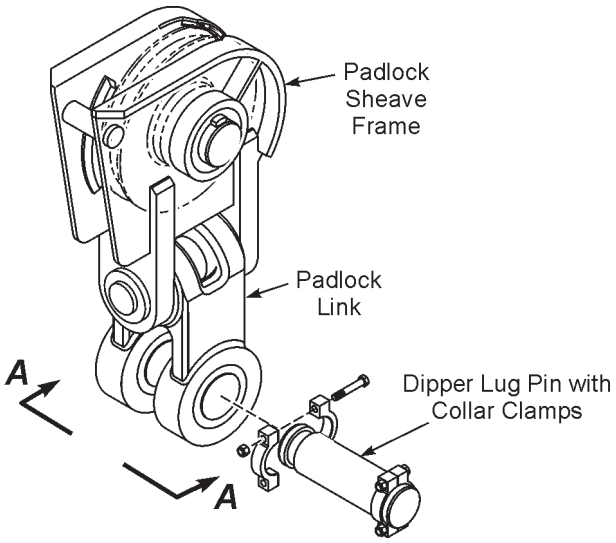
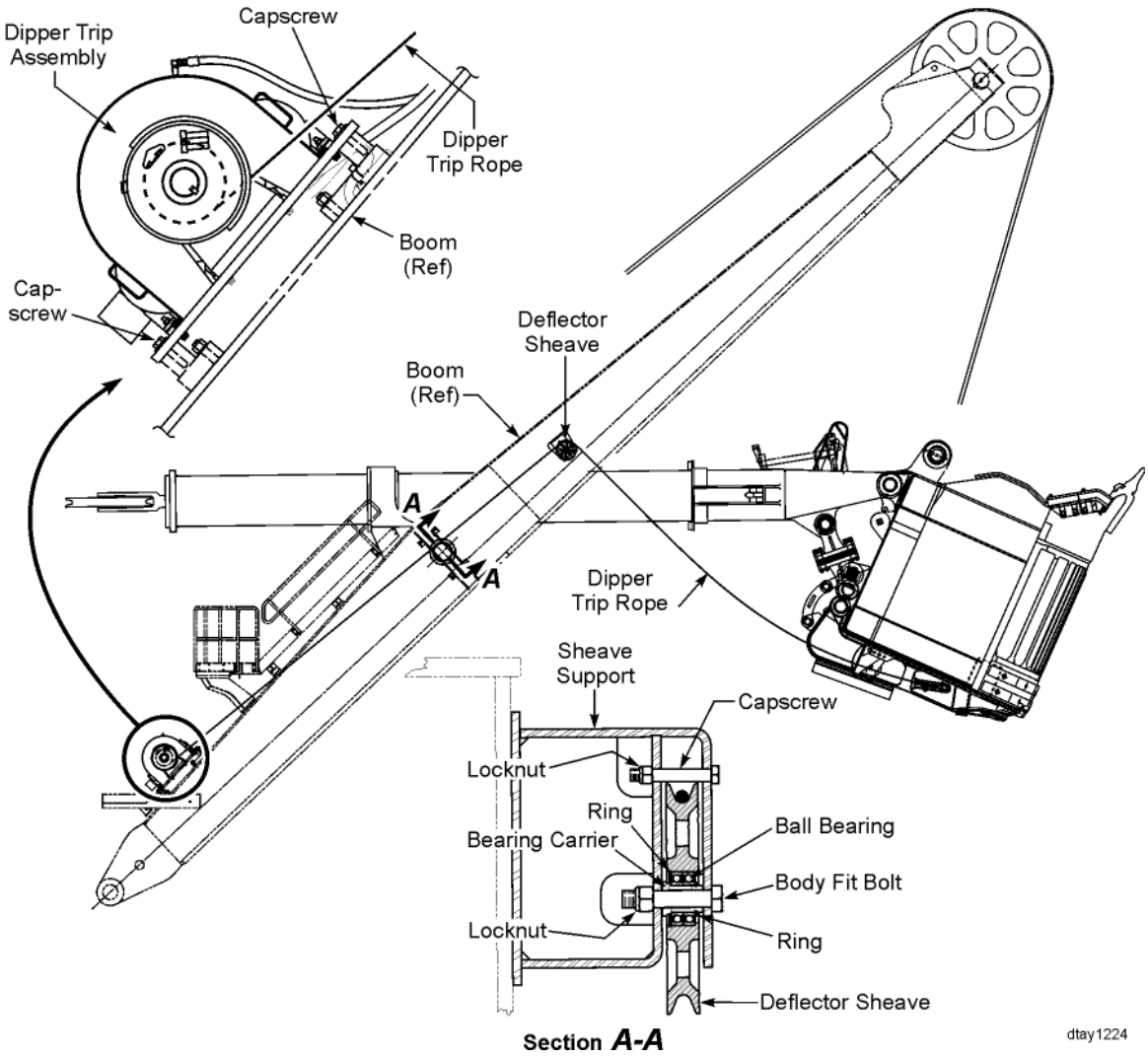



*View A*

## DIPPER TRIP ASSEMBLY

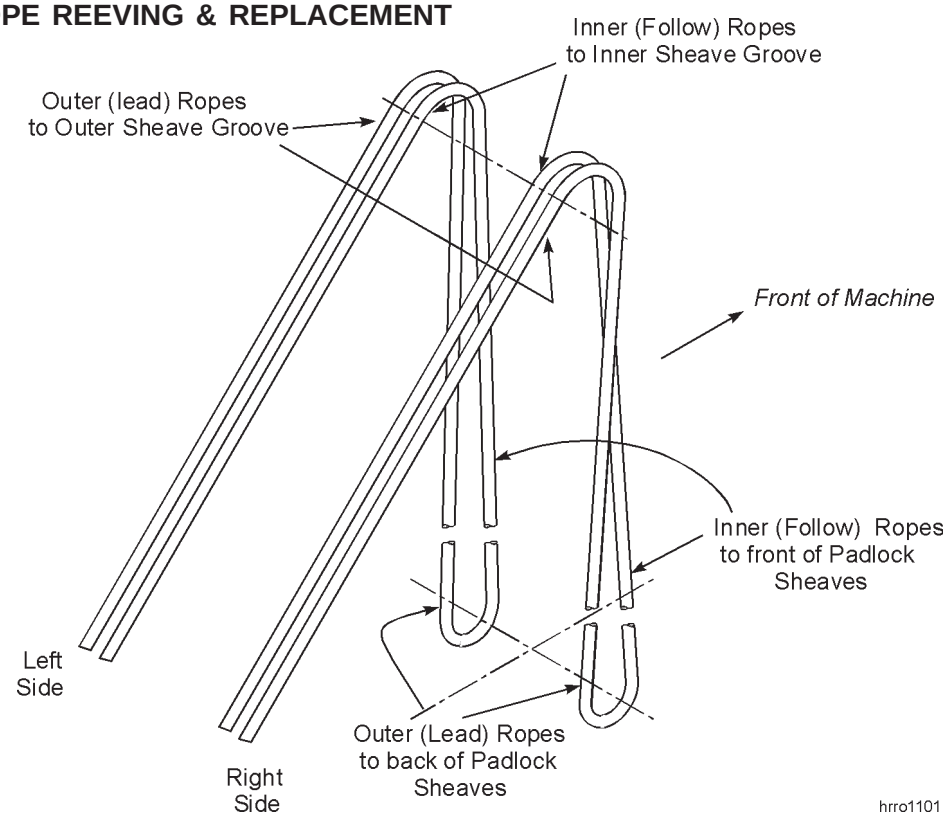
The dipper trip can be disassembled in place on the machine or removed as a complete unit. In either case, the disassembly procedure is the same.




**CAUTION: AVOID ANY METHODS WHICH ALLOW THE ROPE TO BECOME UNCONTROLLED AT ANY TIME DURING THE REEVING OPERATION. Death, serious injury, or damage to the machine will result should a rope become uncontrolled.**

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.

## HOIST ROPE REEVING & REPLACEMENT




*NOTE:* The procedure outlined in this manual assumes that the old hoist ropes are not broken or severely frayed, that the machine is equipped with an auxiliary rope winch and that all of the tools and supplies specified are on hand. *THE HOIST ROPE MUST BE KEPT UNDER COMPLETE CONTROL AT ALL TIMES.*

**CAUTION: AVOID ANY METHODS WHICH ALLOW THE ROPE TO BECOME UNCONTROLLED AT ANY TIME DURING THE REEVING OPERATION. Death, serious injury, or damage to the machine will result should a rope become uncontrolled.**

*To replace the hoist ropes:*

1. The machine should be in a clear, flat area with sufficient room in front of the machine to work. All applicable safety regulations should be followed. Only personnel directly connected with replacing the ropes should be allowed on or near the machine.

**DANGER: ROPE END(S) WILL FORCEFULLY UNCOIL IN RELEASE OF ENERGY WHEN SHIPPING RESTRAINTS ARE REMOVED.**

**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.**

10. Install the other end of the retract rope in the crowd drum in the same way.

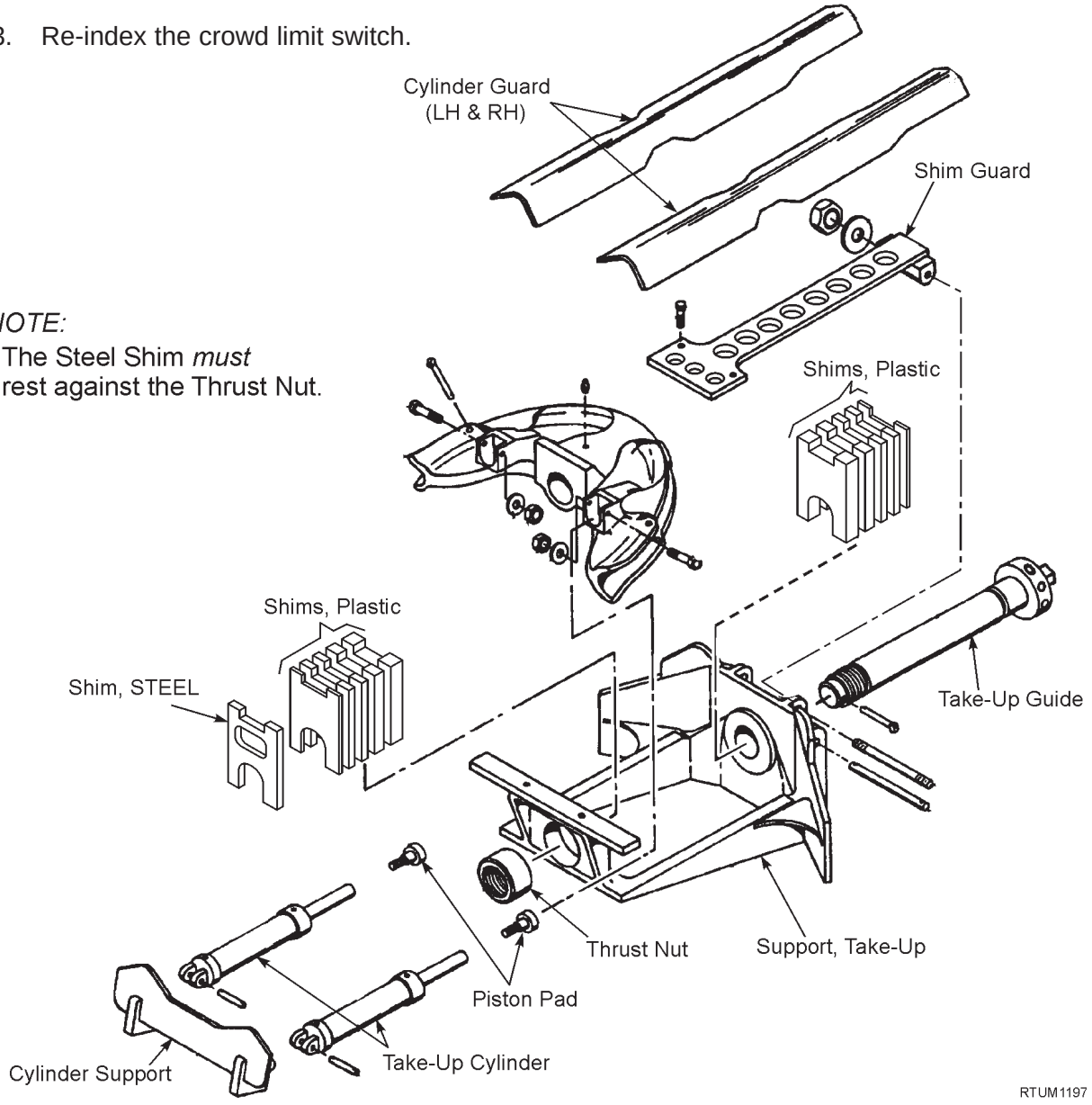
11. Be sure the retract rope is seated in the outer groove of the shipper shaft sheaves and the rope grooves of the front stops. Re-install the take-up nut rope retaining bolts and front stop rope retainers.

12. Take up any slack in the retract rope with the retract take-up mechanism. Refer to *RETRACT ROPE TIGHTENING*.

13. Re-index the crowd limit switch.

*NOTE:*

- The Steel Shim *must* rest against the Thrust Nut.




*Retract Rope Take-Up Mechanism*

## HOIST SLOWDOWN/STOP LIMITS

*To set the hoist slowdown and stop limits:*

1. With the handle at full crowd extension, hoist the dipper so the padlocks are approximately one foot from the boom point sheaves.

2. Press the HOIST STOP LIMIT button on the operator display.

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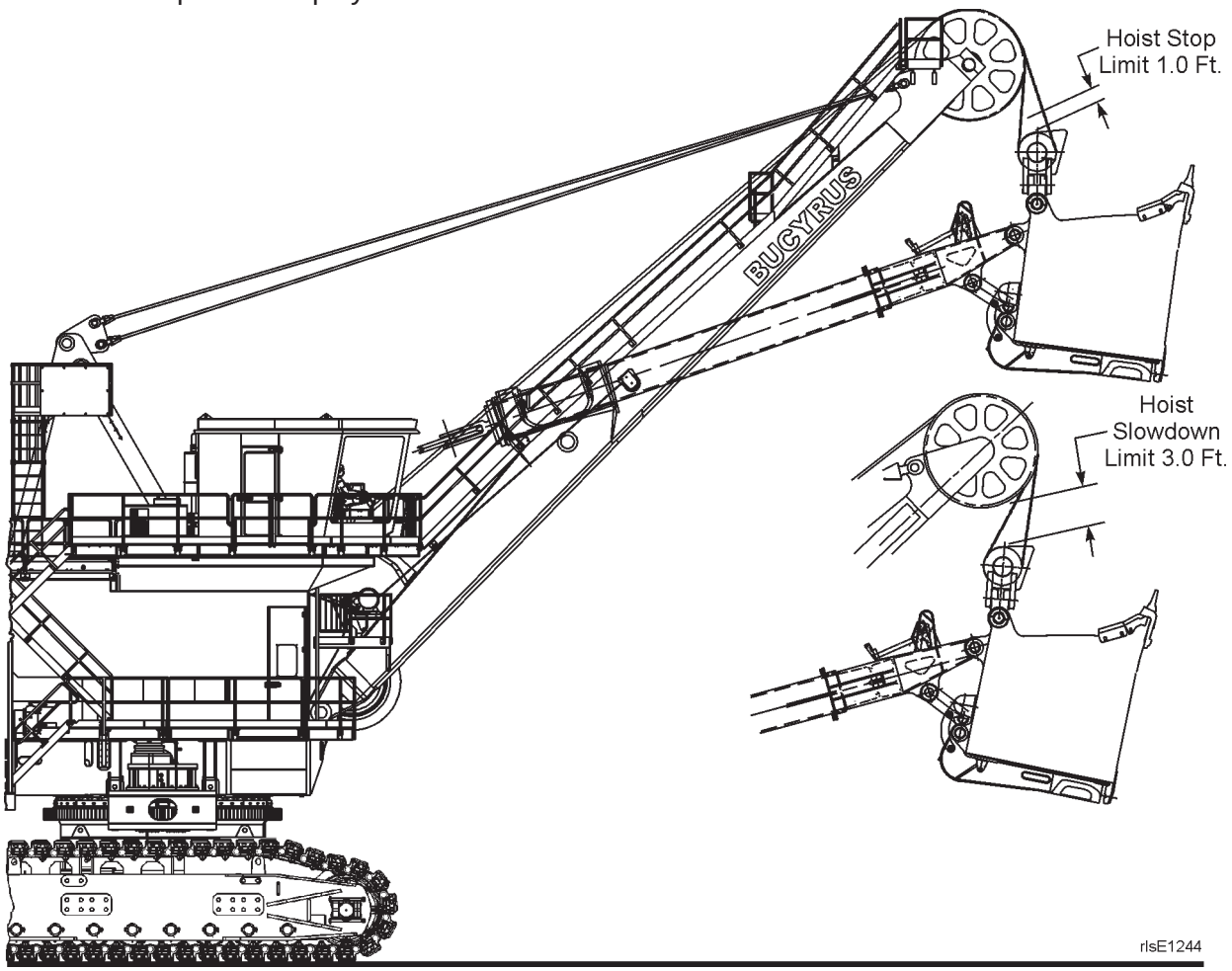
3. Lower dipper until the padlocks are three feet from the boom point sheaves. Press the HOIST SLOWDOWN LIMIT button on the operator display.



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## 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 Section 9 - *ENGINEERING DATA*.

2. Install motor shaft nut and secure to shaft with Loctite.

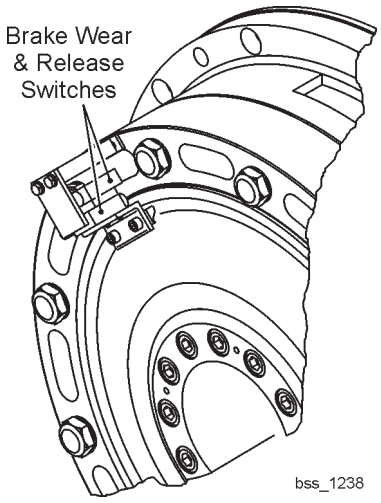
3. Install brake adapter onto the motor and secure with hardware. Use care to align the access slots in the adapter for future tachometer inspections.

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.

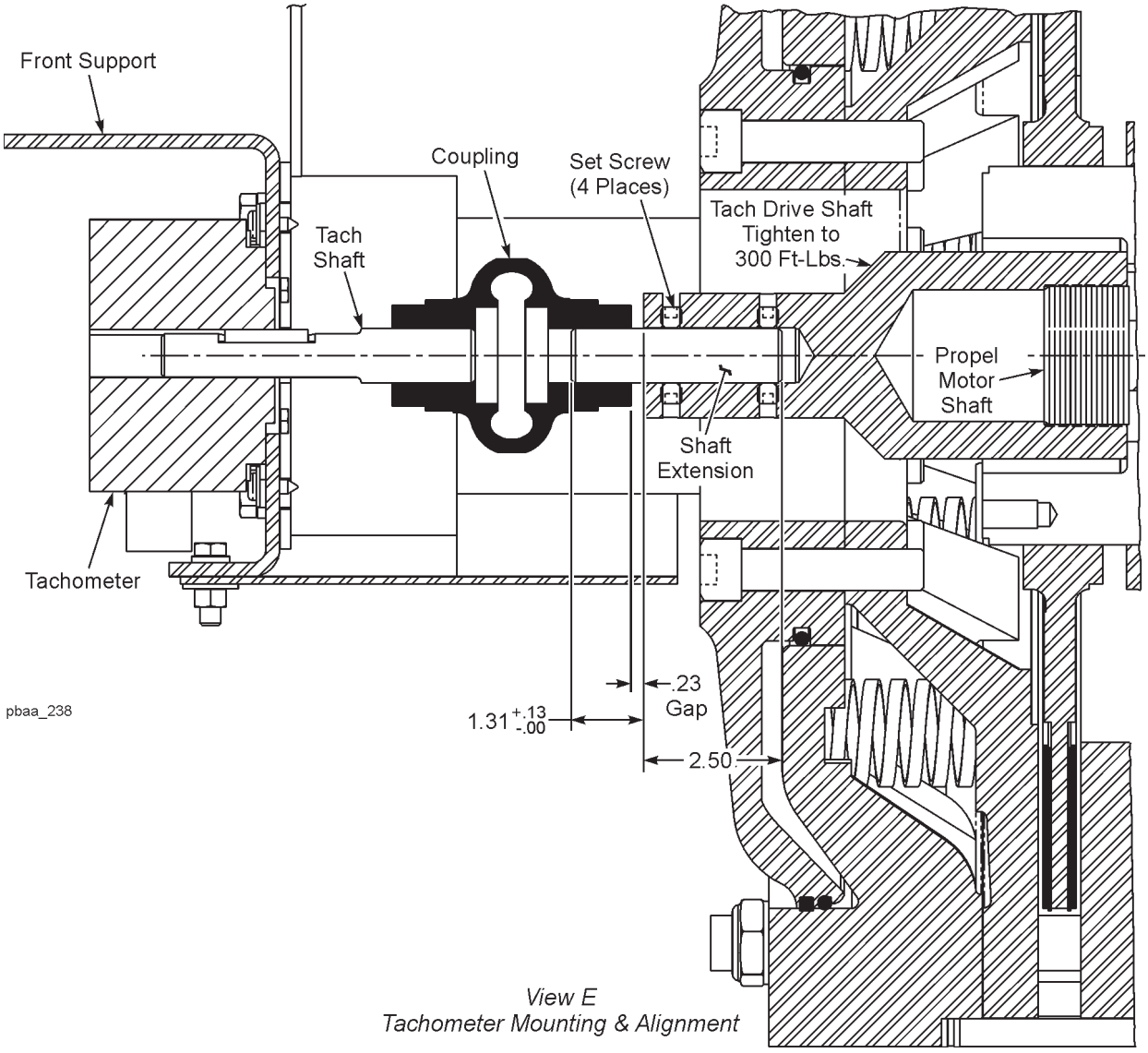


## TACHOMETER MOUNTING & ALIGNMENT

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.




*View E*
*Tachometer Mounting & Alignment*

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.

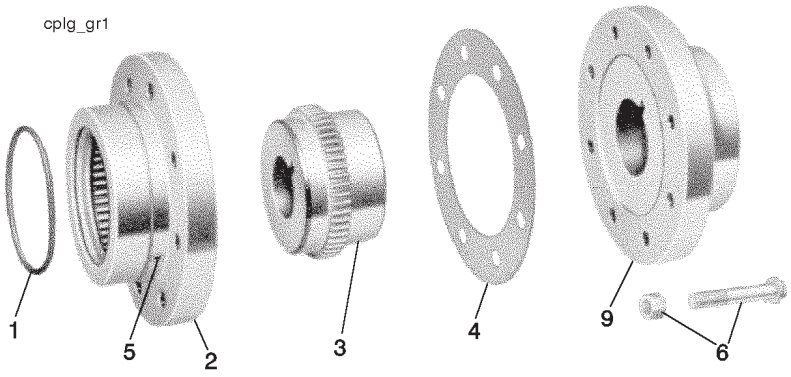
11. Replace the stud nuts and tighten to 90 - 100 Ft-Lbs.

**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.

## GEAR COUPLINGS

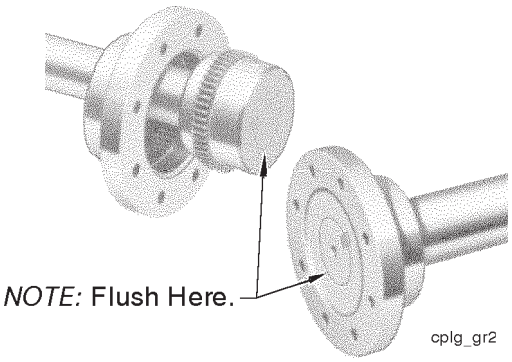
### INSTALLATION




1. Clean all parts. Heat hubs in an oven or use suitable dry heat. DO NOT rest gear teeth on container bottom or apply a flame directly to gear teeth. DO NOT heat hubs over 275°F (135°C) for mounting. Refer to motor shaft installation for hubs mounted on drive motors.

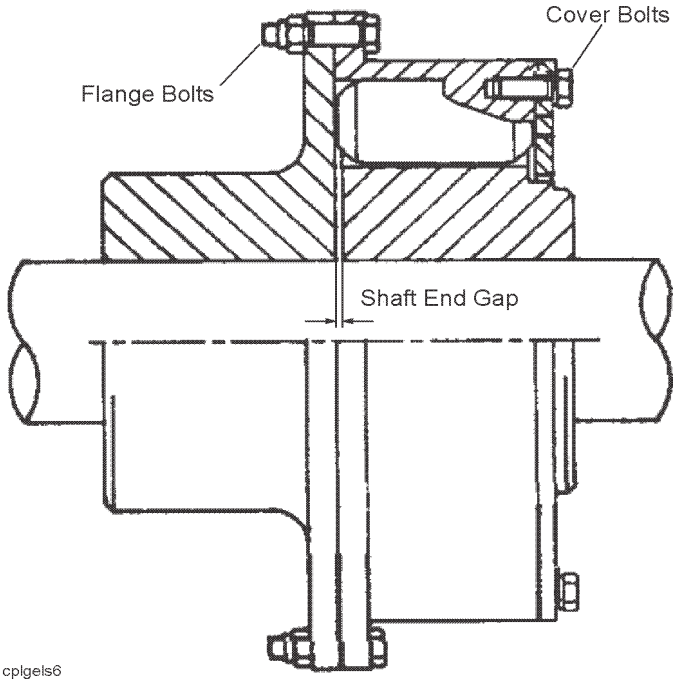
Pack sleeve teeth with grease and lightly coat seals with grease *BEFORE* assembly. *DO NOT DAMAGE THE SEALS.*

Use a dial indicator to align dynamically balanced couplings and assembly parts with mating match marks aligned. Mount the indicator on one hub and take readings for the *OFFSET* check on the O.D. of the other hub. The difference between the minimum and maximum readings *DIVIDED* by two should not exceed the values in the table. For *ANGULAR* check, take readings on either face of other hub. The difference between the minimum and maximum readings should not exceed the values in the gear coupling data table.




2. Mount the flanged sleeves, seal and hubs. Place the flanged sleeves *WITH* the seal rings on the shafts before mounting the hubs.

**CAUTION: DO NOT DAMAGE THE SEALS. Mount the hubs on their respective shafts, as shown, so that each hub is flush with its shaft end. Position the equipment in approximate alignment with the approximate gap specified in the table.**

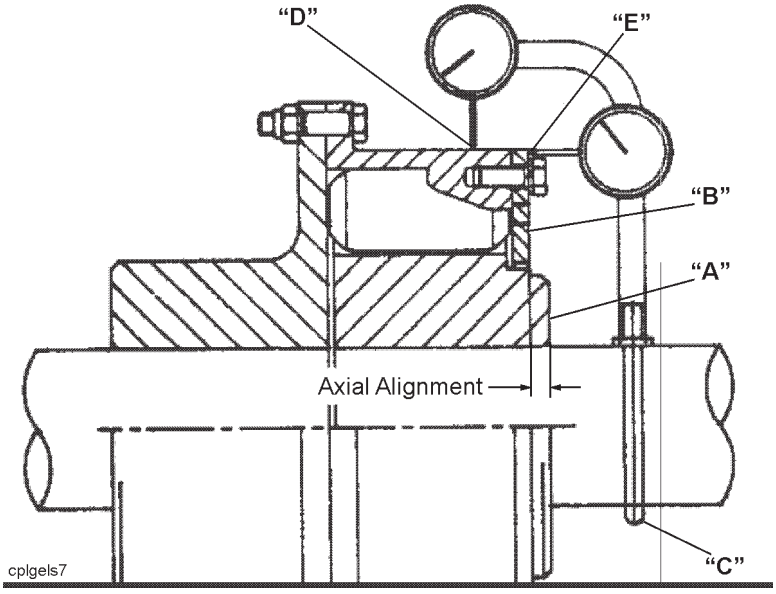



*END GAP TABLE*

| Coupling Size | Shaft End Gap (in) |
|---|---|
| PM 0.4 | 0.04 |
| PM 0.7 | 0.08 |
| PM 1.3 | 0.08 |
| PM 3 | 0.12 |
| PM 6 | 0.12 |
| PM 8 | 0.12 |
| PM 12 | 0.14 |
| PM 18 | 0.16 |
| PM 27 | 0.18 |
| PM 40 | 0.20 |
| PM 60 | 0.22 |
| PM 90 | 0.26 |
| PM 130 | 0.28 |
| PM 180 | 0.31 |
| PM 270 | 0.35 |
| PM 400 | 0.41 |
| PM 600 | 0.47 |

## COUPLING ALIGNMENT

The following describes how to verify that the alignment of the coupling is sufficient to prevent premature deterioration of the rubber elements. Note that the values given in the table are in inches.



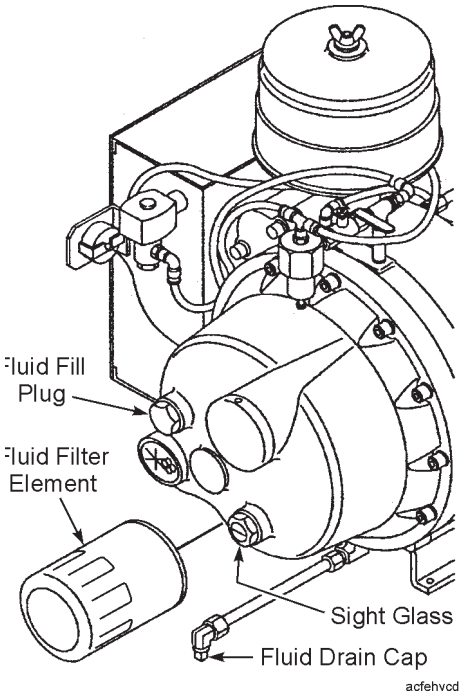
## COMPRESSOR MAINTENANCE

**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.**

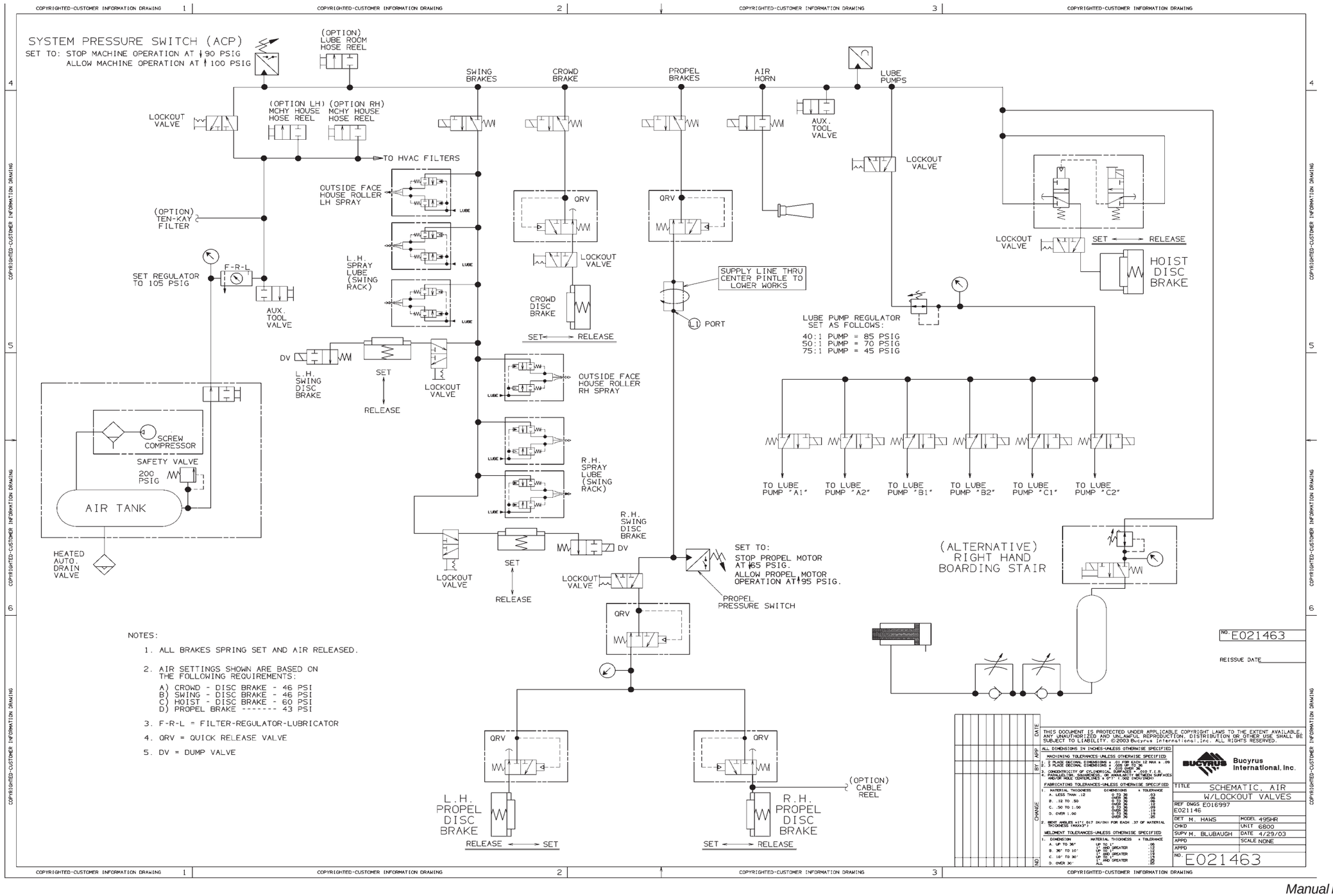
### FLUID & FLUID FILTER CHANGE PROCEDURE

When the compressor fluid is ready to be changed, the compressor needs to be shutdown with the power to the compressor disconnected.

NOTE: For long uninterrupted service, the compressor is factory filled with Sullube, a long life lubricant. Under normal service conditions the fluid should be changed every 8,000 hours of operation or once a year. Compressors using SRF 1/4000 fluid should be changed every 4,000 hours. Anytime measured pressure loss exceeds 20 psig (1.3 bar) the fluid should be changed.




1. Drain the fluid from the compressor using the fluid drain cap located beneath the compressor.
2. Complete flushing is required if the fluid has been contaminated, or when changing to a different lubricant.
3. Remove the old fluid filter and gasket. Clean the gasket seating surface. Apply a thin coat of fluid to the new gasket and hand tighten new fluid filter until gasket is seated. Continue tightening an additional 1/2 to 3/4 turn.
4. Remove the fill plug on the bell housing and fill with clean Sullair fluid. Sump capacity is 4.6 quarts (4,35 liters).
5. Check the fluid level in the sump. The sump is properly filled when the level in the fluid sight glass covers 3/4 of the sight glass (1/2 during normal operation). DO NOT OVERFILL.
6. Tighten the fill plug. Restart the compressor and check for leaks.




NOTES:

1. ALL BRAKES SPRING SET AND AIR RELEASED.
2. AIR SETTINGS SHOWN ARE BASED ON THE FOLLOWING REQUIREMENTS:
   A) CROWD - DISC BRAKE - 46 PSI
   B) SWING - DISC BRAKE - 46 PSI
   C) HOIST - DISC BRAKE - 60 PSI
   D) PROPEL BRAKE ------- 43 PSI
3. F-R-L = FILTER-REGULATOR-LUBRICATOR
4. QRV = QUICK RELEASE VALVE
5. DV = DUMP VALVE



ALL DIMENSIONS IN INCHES-UNLESS OTHERWISE SPECIFIED

MACHINING TOLERANCES-UNLESS OTHERWISE SPECIFIED
1. 3 PLACE DECIMAL DIMENSIONS ± .01 FOR EACH 12 MAX ± .06
2. 2 PLACE DECIMAL DIMENSIONS ± .03 FOR EACH 12 MAX ± .06
   .010 LOOP .06
3. CONCENTRICITY OF CYLINDRICAL SURFACES .010 T.I.R.
4. PERPENDICULARITY OF FACES AND PARALLELISM OF MACHINED SURFACES AND/OR HOLE CENTERLINES ± 0°-1.002 INCH/INCH

FABRICATING TOLERANCES-UNLESS OTHERWISE SPECIFIED

| 1. MATERIAL THICKNESS | DIMENSIONS | ± TOLERANCE |
|---|---|---|
| A. LESS THAN .12 | 0 TO 36 | .03 |
| | OVER 36 | .06 |
| B. .12 TO .50 | 0 TO 36 | .06 |
| | OVER 36 | .12 |
| C. .50 TO 1.00 | 0 TO 36 | 1/16 |
| | OVER 36 | 1/8 |
| D. OVER 1.00 | 0 TO 36 | 1/8 |
| | OVER 36 | 3/16 |

2. BEND ANGLES ±1°(.017 IN/IN FOR EACH .37 OF MATERIAL THICKNESS (MAX±3°)

WELDMENT TOLERANCES-UNLESS OTHERWISE SPECIFIED

| 1. DIMENSION | MATERIAL THICKNESS | ± TOLERANCE |
|---|---|---|
| A. UP TO 36" | UP TO 1" | 1/16 |
| | 1" AND GREATER | 1/8 |
| B. 36" TO 10' | UP TO 1" | 1/8 |
| | 1" AND GREATER | 3/16 |
| C. 10' TO 30' | UP TO 1" | 3/16 |
| | 1" AND GREATER | 1/4 |
| D. OVER 30' | ALL | 1/4 |

Bucyrus International, Inc.

| | |
|---|---|
| TITLE | SCHEMATIC, AIR W/LOCKOUT VALVES |
| REF DWGS | E016997 E021146 |
| DFT M. HAWS | MODEL 495HR |
| CHKD | UNIT 6800 |
| SUPV M. BLUBAUGH | DATE 4/29/03 |
| APPD | SCALE NONE |
| APPD | |
| NO. | E021463 |

NO. E021463

REISSUE DATE

## BOLT TIGHTENING

### TORQUE WRENCH METHOD

The following tables show torque values for bolt grades 2, 5 and 8 with UNC threads only. *Table 1* lists torque values for lubricated or plated threads and for using hardened washers. *Table 2* lists those for dry threads.

The bolts should be tightened to the specified total value in increments, alternating from bolt to bolt to assure gradual, even pull-up of mating parts. Tightening should progress systematically from the most rigid part of a joint to its free edges.

Circular bolt patterns should be tightened in a diametric crosshatch pattern while applying torque in increasing values to ensure proper pull-up of parts.

| Diameter | | Grade 5 | | Grade 8 | |
|---|---|---|---|---|---|
| Inch | Cm | Ft.Lbs. | Nm. | Ft.Lbs. | Nm. |
| **.250** | .63 | 6.3 | 8 | 9 | 12 |
| **.375** | .95 | 23 | 31 | 35 | 47 |
| **.500** | 1.27 | 55 | 74 | 80 | 108 |
| **.625** | 1.58 | 110 | 149 | 170 | 230 |
| **.750** | 1.90 | 200 | 271 | 280 | 379 |
| **.875** | 2.22 | 320 | 433 | 460 | 623 |
| **1.00** | 2.54 | 480 | 650 | 680 | 921 |
| **1.25** | 3.17 | 840 | 1,138 | 1,360 | 1,843 |
| **1.50** | 3.81 | 1,460 | 1,979 | 2,360 | 3,199 |
| **1.75** | 4.44 | 1,700 | 2,304 | 3,740 | 5,070 |
| **2.00** | 5.08 | 2,600 | 3,525 | 5,625 | 7,626 |
| **2.25** | 5.71 | 3,780 | 5,124 | 8,240 | 11,171 |
| **2.50** | 6.35 | 5,160 | 6,995 | 11,250 | 15,252 |
| **2.75** | 6.98 | 7,000 | 9,491 | 15,300 | 20,743 |
| **3.00** | 7.62 | 9,250 | 12,541 | 20,150 | 27,319 |

tbl_bt-L

*Table 1 - Lubricated or Plated Threads or with Hardened Washers*

| Diameter | | Grade 5 | | Grade 8 | |
|---|---|---|---|---|---|
| Inch | Cm | Ft.Lbs. | Nm. | Ft.Lbs. | Nm. |
| **.250** | .63 | 8.3 | 10 | 12 | 16 |
| **.375** | .95 | 30 | 40 | 46 | 62 |
| **.500** | 1.27 | 73 | 98 | 106 | 143 |
| **.625** | 1.58 | 146 | 197 | 226 | 306 |
| **.750** | 1.90 | 266 | 360 | 373 | 505 |
| **.875** | 2.22 | 426 | 577 | 613 | 831 |
| **1.00** | 2.54 | 639 | 866 | 906 | 1,228 |
| **1.25** | 3.17 | 1,120 | 1,518 | 1,810 | 2,454 |
| **1.50** | 3.81 | 1,950 | 2,643 | 3,150 | 4,270 |
| **1.75** | 4.44 | 2,270 | 3,077 | 4,980 | 6,751 |
| **2.00** | 5.08 | 3,470 | 4,704 | 7,500 | 10,168 |
| **2.25** | 5.71 | 5,040 | 6,833 | 11,000 | 14,913 |
| **2.50** | 6.35 | 6,880 | 9,327 | 15,000 | 20,337 |
| **2.75** | 6.98 | 9,330 | 12,649 | 20,400 | 27,658 |
| **3.00** | 7.62 | 12,300 | 16,676 | 26,800 | 36,335 |

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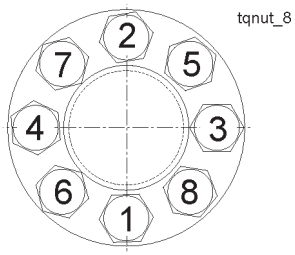
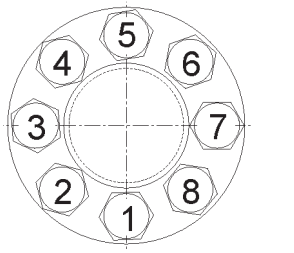
*Table 2 - Dry Threads*

## 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 (PN: 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.

## RACK & ROLLER TORQUE ROD, TAPERED SLEEVE & 1.5 INCH TORQUE NUT

1. The jackbolt threads, tapered portion of the rod bolt and the expansion sleeve ID are prelubricated with graphite lube. Ensure that this lube is present. Apply additional lube (PN: MP390331) as needed. Also apply a thin film of lube to the OD of the expansion sleeve, the revolving frame and swing girder bores, and the jack bolt end faces and threads.

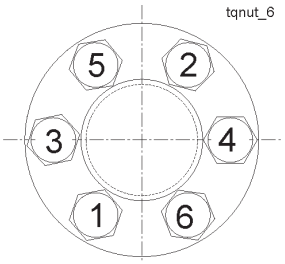
2. Check the base of the torque nut to ensure that all jackbolts are flush with the bottom.

3. Insert the expansion sleeve from the top of the structure.

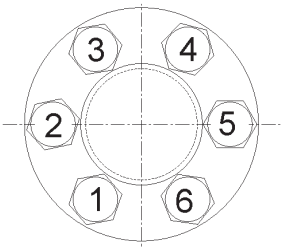
4. Insert the tapered stud into the sleeve. Note the direction of the taper on the rod.

5. Slip the special washer (spacer) over the lower threaded end of the stud.

6. Spin the lower torque nut onto the stud by hand.



STAR Tightening Pattern



CIRCULAR Tightening Pattern

*Torque Nut with 6 Jackbolts*

7. Tighten the lower nut jackbolts to **27** Ft-Lbs as follows:

   a. Using the STAR pattern shown, snug all jackbolts to approx. **15** Ft-Lbs each.

   b. Switch to the CIRCULAR pattern shown and tighten all jackbolts to **27** 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 **27** Ft-Lbs as follows:

    a. Using the STAR pattern shown, snug all jack bolts (1 round only) to approx. **15** Ft-Lbs.

    b. Set the torque wrench to **27** 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.)

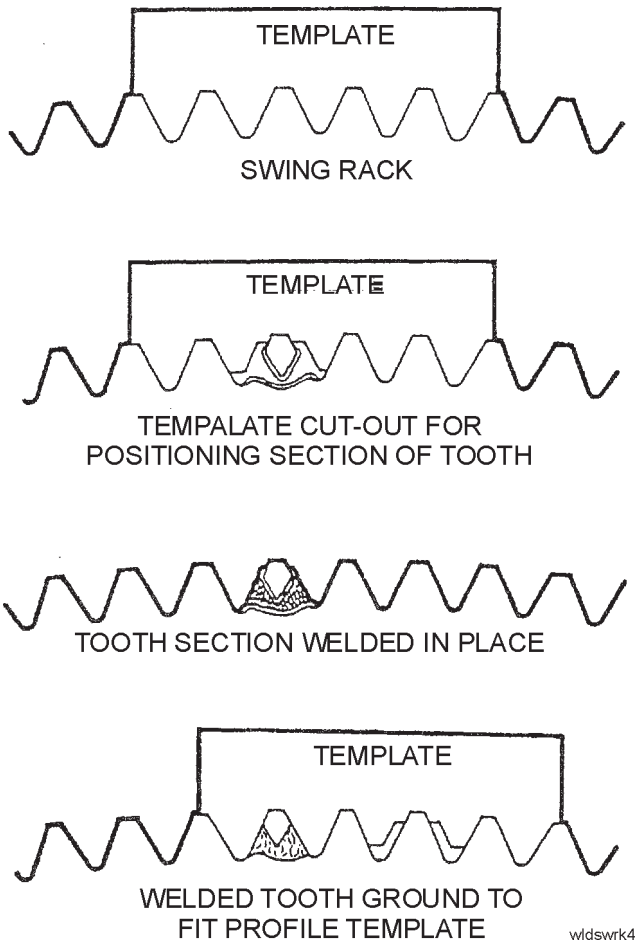
5. After making sure the bore is clean, quickly mount the hot pinion, brake drum or coupling on the shaft. When it is nearly engaged with the taper fit (but not actually in contact), snap it forcible into place with a quick push. It is important that the hot pinion, brake drum or coupling be instantly 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.**

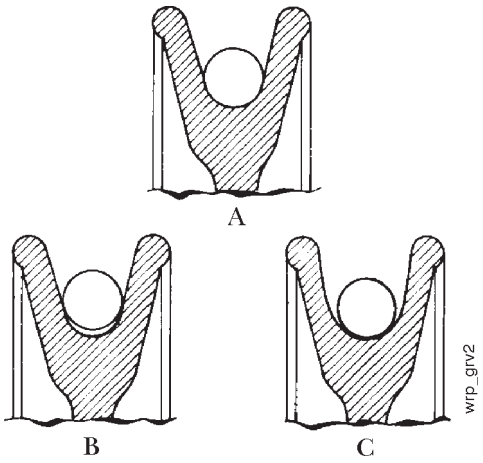



7. When groove welding is finished check carefully for low spots and fill in as required. Grind the weld smooth and flush with the adjacent tooth surfaces. Use the tooth profile template to check grinding of a welded-on tooth segment. Grinding of the radius at the root of the tooth is very important. 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.

## INSPECTION OF SHEAVES AND DRUMS

Machines should receive periodic inspections, and the results concerning their over-all condition recorded. Such inspections usually include the drum, sheaves, and any other parts that may come into contact with the wire rope. These are considered high wear items. As an additional precaution, any rope-related working parts, particularly those in the areas described below, should be re-inspected prior to the installation of a new wire rope.

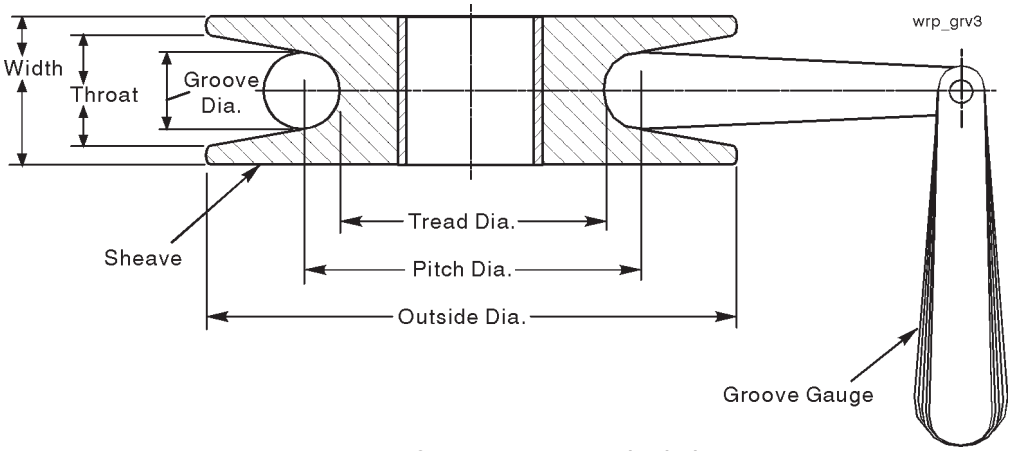



*Examples of Sheave Groove Conditions*

These cross-sections are illustrating three sheave-groove contact areas. “A” is correct, “B” is too tight, and “C” is too loose.

The very first item to be checked when examining sheaves and drums is the condition of the grooves. To accurately check the size, contour and amount of wear, a groove gauge is used. As shown in the figure, the gauge should contact the groove for about 150 degrees of arc when in optimal condition.

There are two types of groove gauges in general use. The two differ by their respective percentage over nominal.




*Groove Gauge for New or Re-Worked Sheaves*