Technical Manual

TRAINING

Qualified maintenance personnel using a scheduled maintenance program are the best way to minimize machine downtime and maximize productivity of equipment.

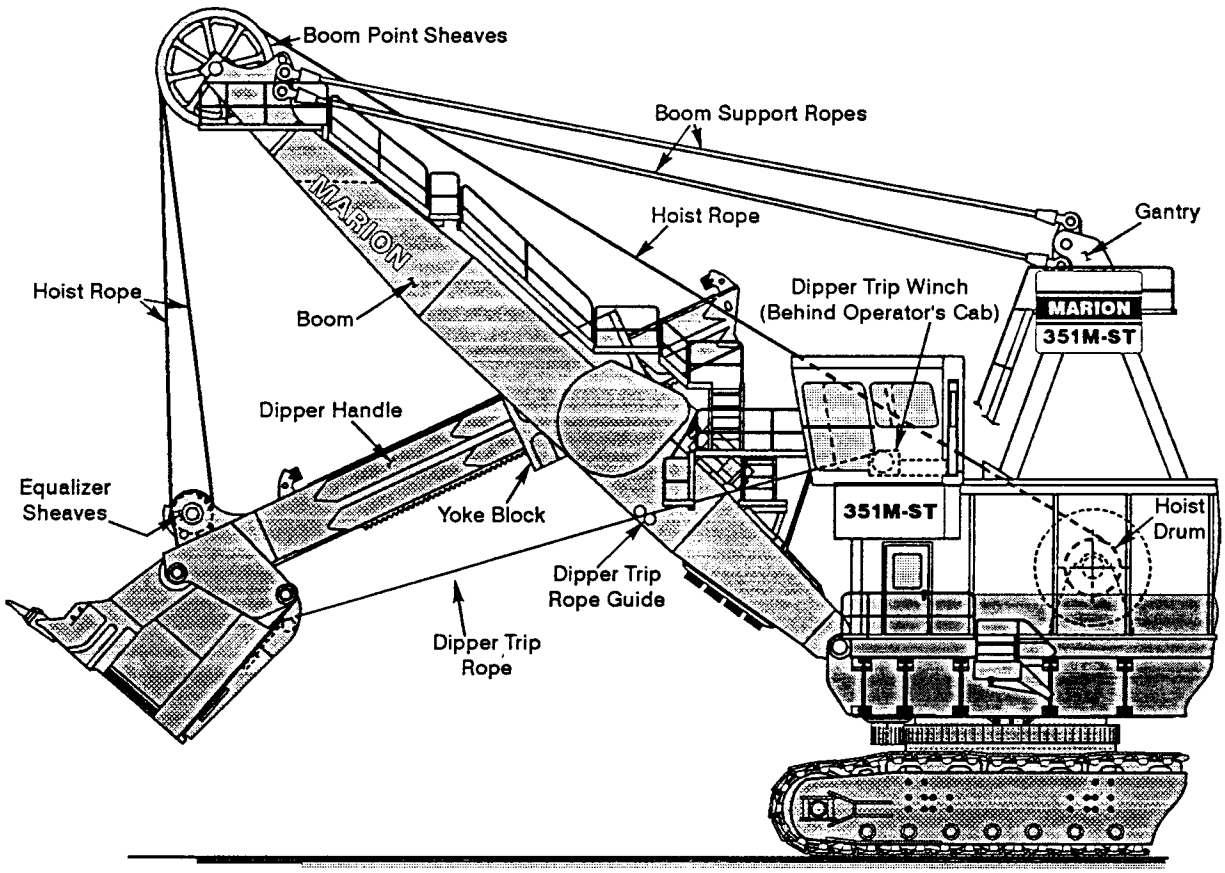
Marion offers factory and mine site maintenance seminars and special familiarization programs for mechanics, oilers, electricians and operators on a fee basis.

These programs are presented by qualified factory specialists and service technicians. Special customized training programs can also be developed to meet specific mine requirements.

Objectives of training and training materials are to provide the means for developing and maintaining on-site service repair capability.

For further information about Marion service training capabilities and programs contact:

Customer Service Department
Marion Division of INDRESCO Inc.
617 West Center St.
P.O.Box 505
Marion, OH 43302



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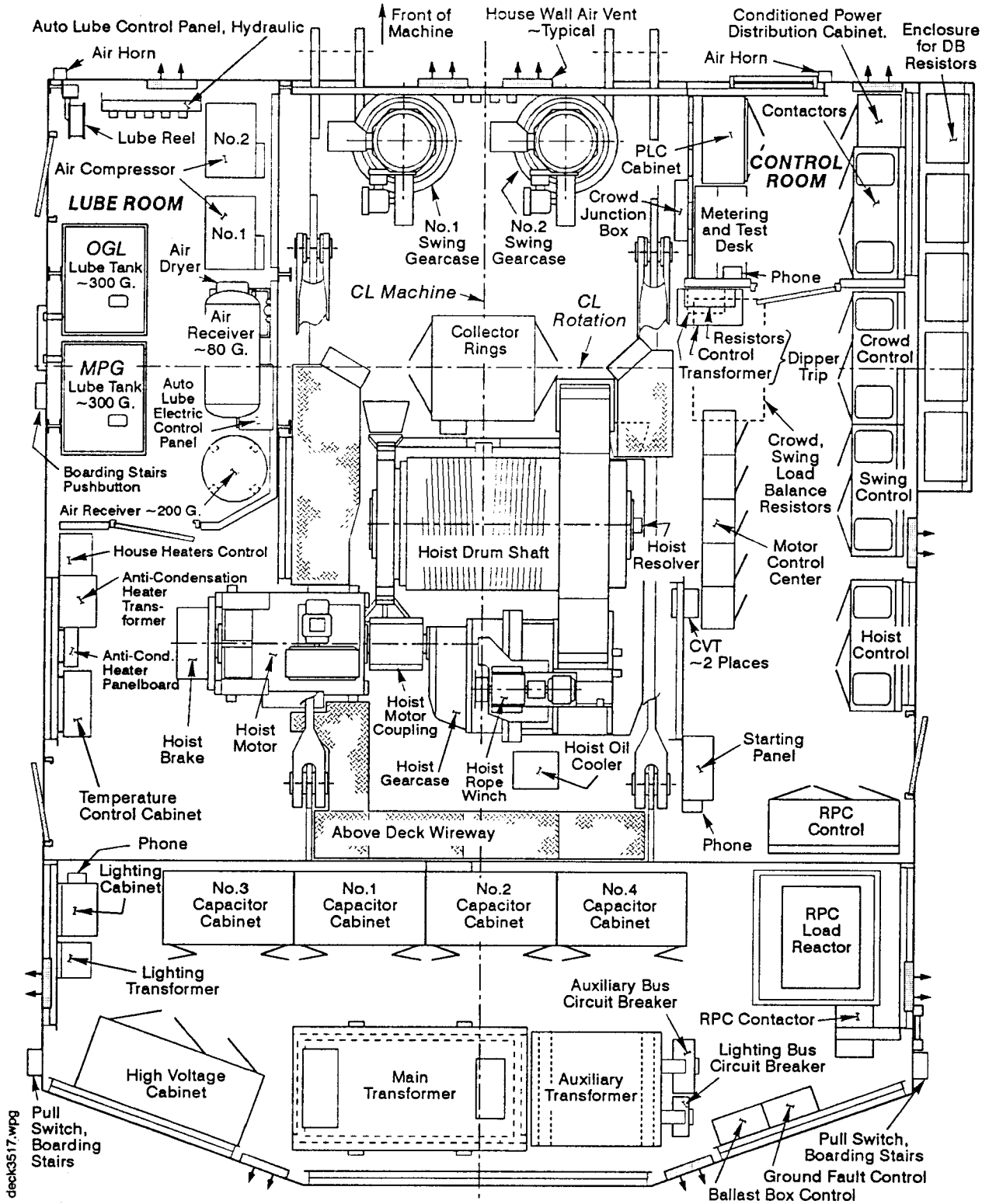
351M WIRE ROPE SYSTEM



351M DECK PLAN

2. With both masterswitches in the neutral position, push the *NEUTRAL POSITION* pushbutton in the I/O panel to accept the Offset Values.

3. Move each masterswitch in a circular motion to their maximum forward, reverse, left, and right positions. This records the maximum and minimum levels of each masterswitch.

4. After a couple of rotations, push the *MAXIMUM TRAVEL* pushbutton to accept the Range Values.

5. Place the *SET/RUN* key switch back to the *RUN* position and the *CALIBRATE* keyswitch back to the *OFF* position to complete the calibration.

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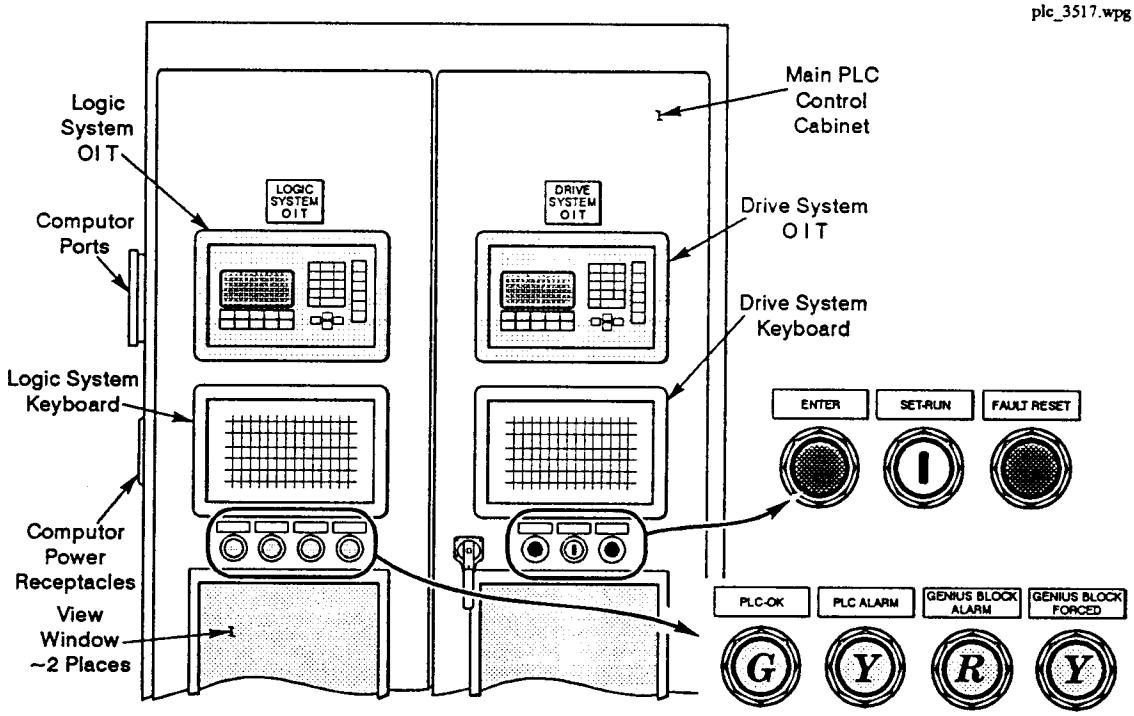


PCL CABINET

(Located in the Control Room at the Front of the Machine)

MASTERSWITCH REMOVAL

The Masterswitches can be removed for servicing by removing 4 masterswitch mounting screws and opening the console. As the masterswitch is removed, feed the control wires into the masterswitch mounting bracket.

NOTE: When replacing the masterswitch, make sure that the Y ("-") axis (cast into the mounting flange) faces forward. Refer to the Electrical Schematics, page code 23BC, for wiring diagrams.

- Lower limit occurs when the amount of hoist rope off the drum becomes greater than or equal to the preselected amount. This limit initiates an automatic shutdown sequence of the lower control, overriding the joystick signal, and setting the hoist brake. The annunciator will indicate this limit audibly. This limit is cleared by carefully raising the hoist drive to take up the rope on the drum.

CROWD MOTION LIMITS protect the machine against running the dipper handle into its bumpers at either end.

- Initial crowd limit occurs when the travel of the handle becomes greater than or equal to a programmed distance from the crowd out bumper on the handle. The annunciator will indicate this limit audibly. The limit is cleared by retracting the dipper handle.

- Final Crowd Limit occurs when the travel of the handle exceeds the preset distance. This limit initiates an automatic shutdown of the crowd control, overriding the joystick signal, and setting the crowd brakes. The operator must silence the alarm, select *BYPASS* and retract the handle out of the limit.

- Initial Retract Limit occurs when the travel of the handle becomes less than or equal to a programmed distance from the retract bumper on the handle. The annunciator will indicate this limit audibly. This limit is cleared by crowding out.

- Final Retract Limit occurs when handle travel becomes less than or equal to a preset distance. This limit initiates an automatic shutdown of the crowd control, overriding the joystick signal, and setting the crowd brakes. The operator must silence the alarm, select *BYPASS* and crowd out to clear the limit.

THE BOOM JACKING LIMIT protects the machine against impact loads due to jacking the boom.

- The boom jacking limit switch is activated when the boom is raised a preset amount due to operator over-crowding. This limit overrides the crowd joystick output signal and commands zero crowd speed. When the boom settles down to its normal position, this limit resets and control is automatically returned to the joystick. This limit is not annunciated.

NOTE: *Boom jacking is a non-productive operation.* It can be harmful to the machine and should be avoided.

CALIBRATION PROCEDURE - MOTION LIMIT

To calibrate this system, perform the following, in the sequence given.

✓ Place the *MOTION LIMIT* selector switch on the Right Control Console in the *BYPASS* position to bypass the hoist limits and the crowd retract limits.

✓ Place the *SET / RUN* key switch in the PLC cabinet in the Control Room to the *SET* position.

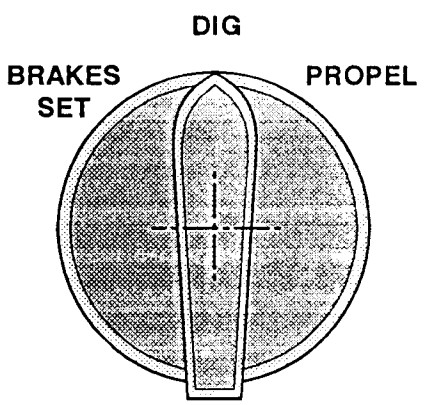
Because the swing motion is torque controlled, the machine will coast when the controller is returned to neutral. The swing motion is slowed or stopped by "*plugging*" the swing motions. This is accomplished by the operator moving the joystick lever in the opposite direction to that the drive is going, thus instructing the motor(s) to rotate in the reverse direction. In this way, the motor(s) dynamically brake the Swing. The Hoist, Crowd and Propel motions are speed controlled which means the controller position is directly related to motor speed. Therefore, when the controller is returned to the neutral position the motor will automatically plug to a stop. Stopping time can be increased only slightly by moving the controller in the opposite direction.

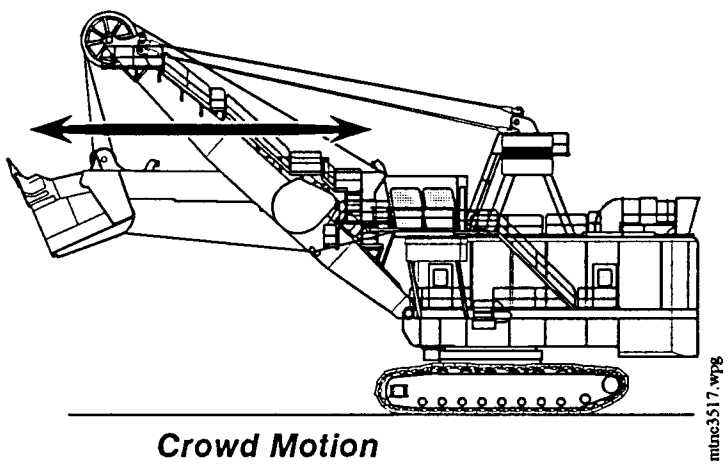
CROWD/L. PROPEL controller or joystick, at the operator's left, controls the crowd machinery to extend or retract the dipper handle through the yoke block in the boom.

CROWD MOTION - From the neutral position, forward movement of the joystick lever extends the dipper handle out, and rearward lever movement retracts it in.

The forward/rearward movement of the joystick controls the speed of the crowd out or retract motion in proportion to the amount the lever is moved away from neutral.

CONTROL TRANSFER





Crowd Motion

PRODUCTION EFFICIENCY

Electric shovels are only as efficient as the operator at the controls. The operator therefore controls machine production within the variables of dipper capacity, swing speed, bail pull, and material density. Other factors such as machine availability time, number of shifts, and fragmentation of material also effect machine production efficiency.

Many operators lose much of their productive efficiency in their inability to control the pit face/floor conditions or the proper spotting of the haul units.

Section 3

Lubrication

3.1 LUBRICATION PRINCIPLES

The proper lubrication of this machine is vital to its successful, continued operation. Application of the *CORRECT* lubricant in the *CORRECT* amount at the *CORRECT* place as part of a *PROVEN* maintenance program is required to keep the machine operating at a level of productivity that will make your mining operation profitable. Proper lubrication will provide better component service life and reduce repairs and downtime. When not properly lubricated, moving parts wear quicker and fail sooner.

The major portion of this machine is lubricated by an automatic system that dispenses lube to selected points at pre-selected, timed intervals during machine operation. This system is covered in more detail further on in this section. It is important to the operation of this auto lube system that you become familiar with it and understand its operation so you can maintain and service it and keep it operable. It is also necessary that you periodically inspect on a regular basis the lubed points for lubricant application to insure the system is performing its job.

Some components, due to their location and function, can not be readily covered by the auto lube system. A listing of these manually lubed areas that shows the lube application frequency is given in this section. You should become familiar with these points so you can service them properly at the intervals listed. A listing of the parts covered by the automatic lubrication system is also included.

Per Marion standard, the *LUBRICATION FITTINGS* used for manual service are the hydraulic type, push-on fittings, having 1/8 inch or 1/4 inch NPT threads.

BUSHINGS and BEARINGS operating in a highly contaminated atmosphere (dust, grit, etc.) should be lubed until clean grease seeps out around the journal or seal, or comes out the purge fitting if one is provided.

Overfilling an anti-friction bearing can cause it to run excessively warm. After lubing anti-friction bearings, especially those that are sealed such as in electric motors, remove the pressure fitting, or the relief plug when provided, and allow the bearing to purge itself of any excess lube during the first 10-15 minutes of operation. Replace the fitting or plug after that time.

Grease in a bearing generally deteriorates gradually, not suddenly. Only a small amount needs to be added to it at regular intervals to maintain the proper lubricant level. Adding a small quantity of grease to the bearing every 600 operating hours, unless otherwise specified, is adequate.

Once LE has been activated and the circuits complete their initial cycle, the preset timer in the controller (PC) will take over to initiate succeeding lube cycles.

A typical lube cycle for *Line-1* through *Line-5* is initiated by the controller through LE activation or the timer. The appropriate 3-way air solenoid valve and 4-way hydraulic solenoid valve are energized to direct air to the pump, which causes the pump to pump lubricant through the hydraulic valve to the selected circuit and its distribution injectors. When energized, the hydraulic valve closes off the vent return line to the reservoir. As the lubricant pressure builds in the circuit supply line, the injectors operate and push a metered amount of lubricant to the bearings, bushings, or open gearing. The lubricant pressure continues to build until it is sufficient to open the contacts in the pressure switch(es) in the circuit. When these contacts open, the controller de-energizes the air and hydraulic valves, shuts off the pump and vents the circuit supply line and distribution lines to the reservoir. The lubricant pressure in the circuit decreases, allowing the injectors to recharge themselves for the next cycle.

A cycle time is the interval between the initiation of lube cycles. The cycles will continue as long as LE is energized and *NO* fault is detected in the lube supply circuit.

IMPORTANT NOTES on SYSTEM OPERATION

1. The lube system controller (PC) is programmed to operate either MPG or OGL circuits. Both circuit types will not operate simultaneously.

2. The crawler MPG circuit has 2 cycle times. The cycle time selected is dependent on the machine operating mode. When in the *PROPEL* mode the number of lube cycles is increased to provide additional lube to the crawlers.

3. Some distribution circuits have two pressure switches to insure lubricant dispersal. (Refer to the system schematic.) These are wired in series and both must open to terminate a lube cycle.

4. When LE is de-energized by the operator, then all cycle times in the controller reset to zero and any cycles in progress stop.

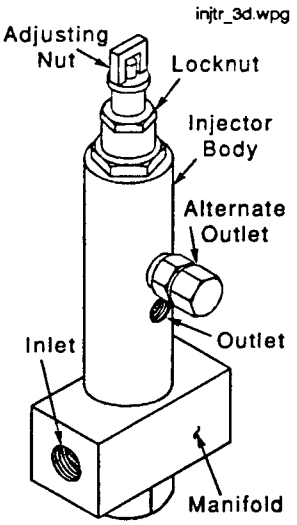
5. If any automatic lubrication supply circuit is operating at the time the machine's drive system control is changed from *DIG* to *PROPEL*, *DIG* to *BRAKES SET*, etc., the circuit(s) operating will complete its (their) cycle before being deactivated.

6. The Manual Reel selector pushbutton will "lock out" the other MPG auto lube supply circuits and not permit them to operate.

LINCOLN TYPE SL-1 LUBRICANT INJECTORS

These pressure operative, spring reset, series installed injectors are supplied in banks mounted on manifolds. Each injector will expel a maximum of .08 cu. inch of lubricant from its outlet port each cycle. Dual outlet ports on each injector permit the injectors to be piped in series for increased lube supply to a common point. The quantity of lube to each point on this machine has been carefully designed by our engineers for proper coverage. Each injector output can be adjusted, however Marion recommends they be set and used at their maximum setting.

NOTE:	MAXIMUM Operating Pressure: ..... *3500* PSI
	RECOMMENDED Operating Pressure: ..... *2500* PSI
	MINIMUM Operating Pressure: ..... *850* PSI
	MAXIMUM Recharge Pressure: ..... *600* PSI



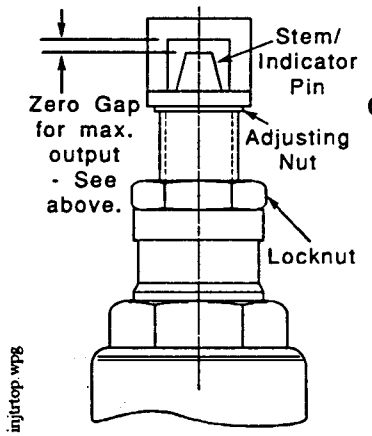
LINCOLN INJECTOR

To set an injector for *maximum output:*

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

To reduce injector output:

1. Loosen locknut.
2. Turn adjusting nut clockwise (CW) until desired discharge rate is obtained. This will force stem into body, retarding its movement.
3. Set the locknut.



CAUTION:

Do not turn adjusting nut down clockwise more than 5 full turns from maximum discharge setting. Check output flow from injector then to insure it is still operating. If not, back off adjusting nut until injector does consistently operate. Inspect adjusted injector for operation for 3 or 4 cycles after returning machine to work to make sure it is functioning.

3.5 LUBE DRAINAGE and VENTING SYSTEMS

Special provision is made at several points around the machine to drain &/or vent lubricant from the area of application, a catchment area, or a housing cavity.

Two inter-connected catch basins are provided on the top of the lower frame structure. One around the center journal and one around the roller circle area. There is a drain tube from the center journal catch basin that directs excess lubricant from these areas down through the lower frame. The drain tube from the rotating frame lube catchment system dumps into the center journal basin area also. Check that this lower frame drain is open to flow quarterly (1250 hours). Clean/flush the lower frame catch basins and drain annually (5000 hours).

DANGER: HIGH VOLTAGE. Do not work in or around the area between the lower and upper works unless power to the machine has been shutoff and locked out by qualified electricians. Failure to comply with this directive could result in personal injury or death.

A lube catch basin is provided on the machinery deck of the rotating frame around the center journal and under the hoist drum gear. Excess lube from these areas drains down through the upper frame structure in a tube into the drainage system on the lower frame. Check this drainage system quarterly (1250 hours) for flow. Clean/flush it annually (5000 hours).

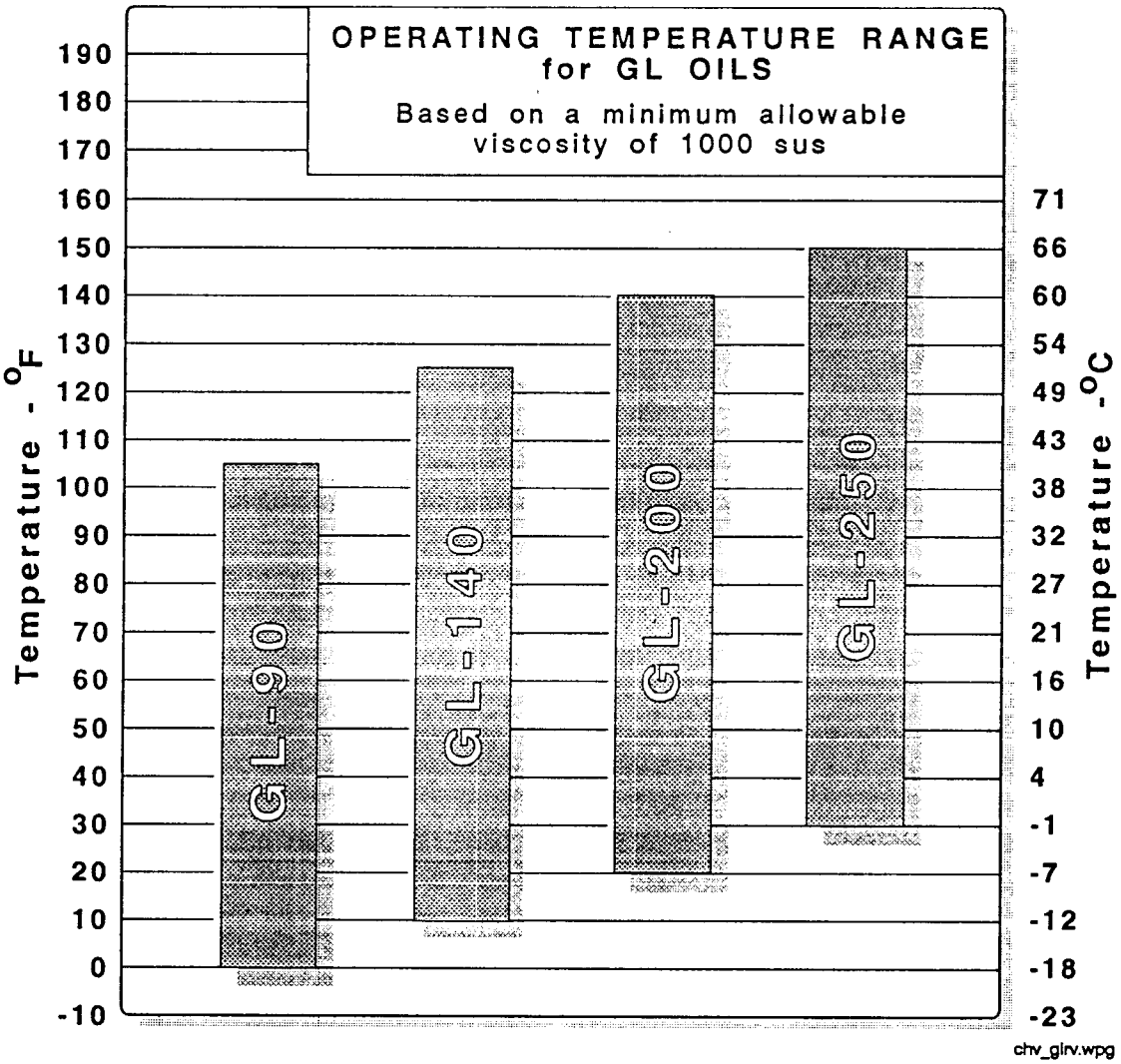
Any excess lube from the right hoist drum bearing cavity is directed into the catch basin by the gearcase structure. Excess lube from the left drum bearing cavity is funneled into a portable catch bucket, hooked to the inside of the left pedestal just below the drum. Check this pan monthly (420 hours) and empty it as required.

The intermediate hoist shaft bearing cavities in the gearcase have lube vent lines assembled to them. These lines direct any excess MPG lube from the bearing housings to the catch basin on the machinery deck. They also keep the MPG away from the pinion/gear mesh and thus avoids "washing" OGL off them. The vent lines are located just below the hoist gear/pinion mesh in the gearcase structure. The maintenance crew should verify once per week (every 100 hours) during their regularly scheduled PM period that these lines are open for venting MPG from these cavities to the catch basin.

A lube vent line is assembled to each lower swing bearing retainer plate on the underside of the rotating frame. This line provides a path for any excess MPG lube in the cavity of the main rotating shaft housing to follow. This vent line avoids over-lubricating the lower swing shaft bearing. Visually inspect these 2 vent lines once per shift (every 8 hours) to insure that they are open and not damaged. The maintenance crew should verify once per week (every 100 hours) during their regularly scheduled PM period that these lines are open for venting MPG from the cavities.

For further information, refer to the accompanying sketches of these areas on the following pages.

TEMPERATURE CHART ~ GL OILS



OIL TEMPERATURE

Gear Lubricant	°F		°C	
	Min.	Max.	Min.	Max.
GL-90	0	105	-18	41
GL-140	10	125	-12	52
GL-200	20	140	-7	60
GL-250	30	150	-1	66

MANUAL LUBE POINTS *(continued)*

NAME of PART	TYPE	NO. of POINTS	LOCATION	LUB. SYM.	METHOD & FREQUENCY
ROTATING FRAME					
Motor Couplings	Steelflex	2	Fill through Plug in Covers	LTG	Keep Full: Check Qtrly. (1250 hrs.)
Rotating Gear Cases CAPACITY: 52.0 U.S. gal.(197 liters)	Planetary	2	Fill through Dip Stick Hole to Level Indicated	HGL	Check Weekly (100 hrs.): Change semi-annually (2500 hrs.)

NOTE: Change the oil in a new or rebuilt crowd gearcase after the initial 100 hours (1 week) of machine operation. Thereafter, change it every 2500 hours, or as indicated by oil sample analysis. The maximum replacement interval is once per year. Flush the gearcase before refilling it with new oil.

HOIST MACHINERY					
Hoist Ropes	IWRC Wire	2	At Lagging	WRL	As Needed
Hoist Motor	Anti-Friction	2	Motor Bell Housing	EMG	Semi-Annually (2500 hrs.)
Blower Motor on Hoist Motor	Anti-Friction	2	Motor Bell Housings	EMG	Semi-Annually (2500 hrs.)
Motor Coupling	Gear Type	1	Fill through Plug in Flanges	LTG	Keep Full: Check Qtrly. (1250 hrs.): Relube Every 3 yrs. (15000 hrs.)
Hoist Gearcase CAPACITY - 50.2 U.S. gal.(190 liters) [with Oil Cooler - 55 U.S. gal. (208 liters]	Planetary	1	Fill through Port for Breather to Oil Level Plug in End of Case	HGL	Check Weekly (100 hrs.): Change Semi-Annually (2500 hrs.)

NOTE: Change the oil in a new or rebuilt crowd gearcase after the initial 100 hours (1 week) of machine operation. Thereafter, change it every 2500 hours, or as indicated by oil sample analysis. The maximum replacement interval is once per year. Flush the gearcase before refilling it with new oil.

Rope Reeving Sheaves	Oilite Bushing	2	Apply to Part	MO	Annually (5000 hrs.)
Rope Reeving Winch CAPACITY - 7 U.S.gal.(26.5 liters)	Reducer	1	Fill through Filler Plug		Refer to the Parts Book for oil specifications and recommended service.

CHECKING PUMP PERFORMANCE

(A summary of the causes of common malfunctions.)

No Liquid Delivered:

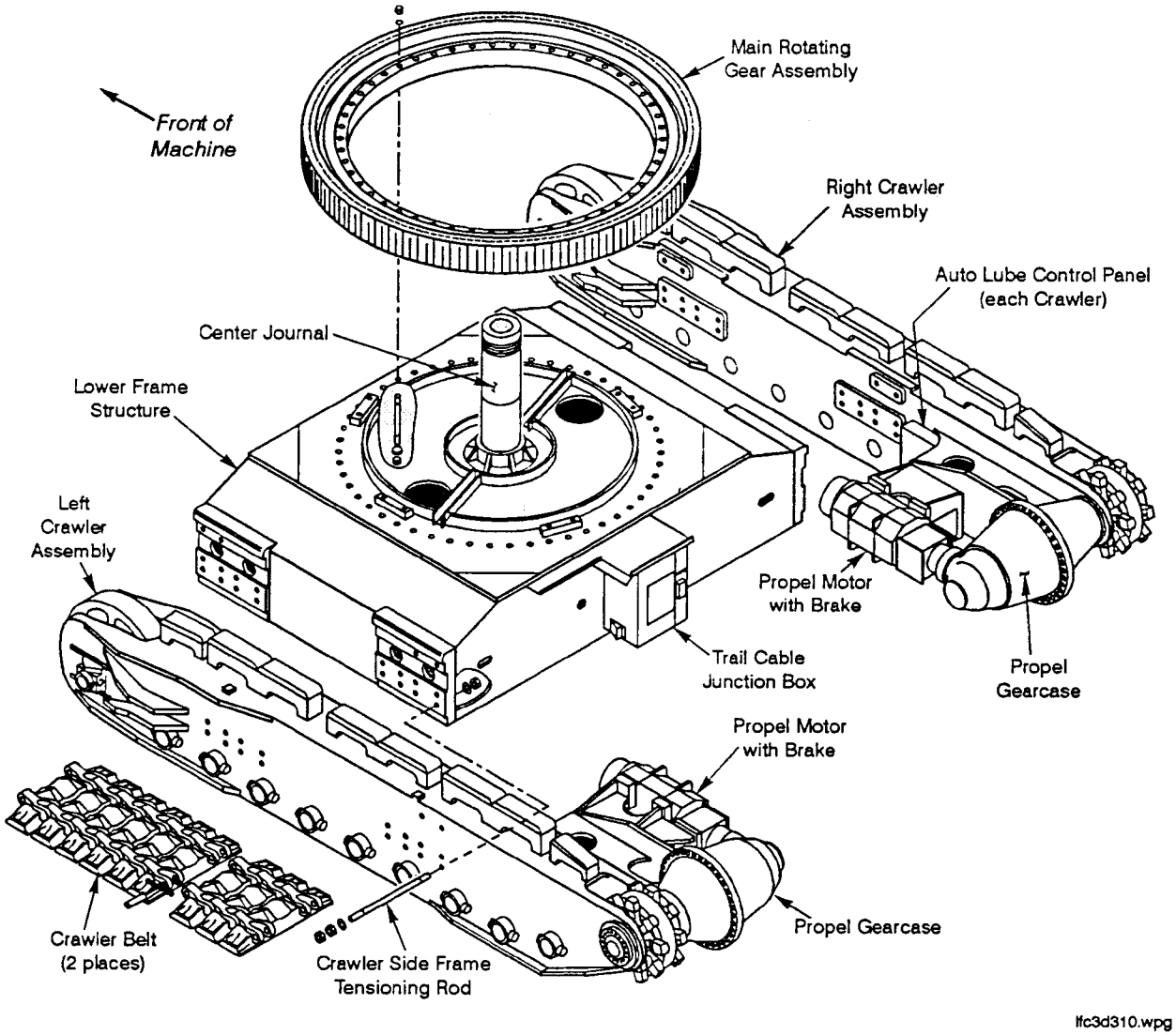
1. Pump not primed. If the pump fails to deliver liquid after 1 minute, stop the pump and prime it by pouring some liquid into the discharge side of the pump.
2. Rotating in the wrong direction.
3. Inlet lift too high. Check this with a gauge at the pump inlet.
4. Clogged inlet line.
5. Air pockets or vapor lock.
6. Air leaks in the inlet line.
7. Foreign matter under the valve seat or poppet. Remove and clean the poppet and valve seat. Caution: If the poppet or seat is damaged it must be re-machined or replaced.

Rapid Wear:

1. Abrasives in the liquid.
2. Incompatibility of the liquid and pump material.
3. Excessive pressure.
4. Non-lubricating liquid.

Excessive Noise:

1. Starved pump.
2. Air leaks in the inlet line.
3. Air or gases in the liquid.
4. Pump speed too high.
5. Relief valve chatter. Check the pressure setting.
6. Improper mounting. Check the alignment thoroughly. See the "Pump Installation and Operating Instructions.



351M LOWER FRAME and CRAWLERS ASSEMBLY
(Isometric View)

ROLLER CIRCLE ADJUSTMENT

Roller circle adjustment is required to prevent damage to the rollers, case, or rails if vibration, popping, snapping, or crackling occurs during rotation. Rapid wear and/or damage to roller circle components results from any one or a combination of the following:

- ✓ Roller spacers misaligned.
- ✓ Roller spacers or capscrews worn.
- ✓ Cage diameter too large or out of round.
- ✓ Incorrect roller or rail hardness.
- ✓ Improper machine ballast.
- ✓ Continuous operation on a steep grade.

ADJUSTMENT PROCEDURE

1. Place the machine on a level work area. the Roller circle capscrews should be uniformly snug ~ not tight and not loose.

2. Slowly rotate the shovel two revolutions with the dipper extended just above grade at its maximum radius.

3. Check to see that all the rollers are seated against the thrust rail. If not, further loosen the circle capscrews and repeat step two.

4. Check the gap between each roller and its thrust washer. If it is not .13 to .37 inch at all rollers, then wrap a chain or wire rope sling around the circumference of the outer roller circle cage and draw it up until the gap at each is .13 to .37 inch. Loosen the roller circle capscrews further if needed.

5. Tighten the roller circle capscrews to 20 Ft.Lbs. These should be tightened in the circle at those rollers which are engaged between the upper and lower rails. Rotate the shovel to position the successive rollers between the rails for tightening. Remove the tensioning device from around the outer circumference of the roller circle.

6. Rotate the shovel up to working speed, plugging and reversing it several times. Shut down and check that the rollers are seated against the thrust rail and that the gap between each roller and its thrust washer is .13 to .37 inch.

7. Re-tighten all the roller circle capscrews after one full shift of operation. With the dipper extended, tighten the capscrews at the rollers that are engaged between the upper and lower rails. Rotate the shovel to position the successive rollers there for tightening.

PROCEDURE for USE of MECHANICAL TENSIONER on CRAWLER RODS

NOTES:

√ *The Standard Preload for this Mechanical Tensioner (3.0 Dia Rod)* —
Tighten the Jackbolts on the tensioner to 233 Ft.Lbs. (428,400 Lbs. Clampload).

√ The rod threads should be clean and the fit of the tensioners and nuts on the rods should be very free. This is to allow for stretch of the rod during tensioning.

√ Perform Steps #2-#5 below completely for each Mechanical Tensioner — in the tightening sequence indicated in the overall view in the figure.

√ Due to stretching of long bolts and rods, Steps #4 and #5 below may have to be repeated to obtain the final preload.

√ Assemble all rods to the STANDOUT DIMENSION as shown in the figure before tensioning.

√ After 20 hours of machine operation, repeat Step #5 for all the rods, in the sequence indicated.

Initial Tensioning:

1. To seat the threads and eliminate clearances, use a small wrench to tighten the jackbolts on the mechanical tensioner to 10% of the final torque required (Approx. 23 Ft.Lbs.). Tighten the jackbolts in the sequence indicated in Figure #1.

2. Switch to a torque wrench and tighten the jackbolts to 50% of the final torque required (Approx. 117 Ft.Lbs.), again using the sequence in Figure #1.

3. Re-tighten the jackbolts to 75% of the final torque required (Approx. 175 Ft.Lbs.) — however, use the sequence in Figure #2.

Final Tensioning:

4. Tighten the jackbolts to 110% of the final torque required (Approx. 256 Ft.Lbs.)using the sequence in Figure #2.

5. Tighten all the jackbolts to the final torque required (100%, Approx. 233 Ft.Lbs.) using the sequence in Figure #2.

INSTALLATION NOTES:

1. Install the retainer with the lube hole on the horizontal centerline of the propel shaft and in line with the access hole.

2. After thorough cleaning, coat the splines and surfaces with Molylube grease paste (P/N 480206-3).

3. Pack the rear of the spline cavity with 1 pint grease (P/N 280206-3), prior to installing the shaft assembly.

4. *Shim Procedure For Gap "A":*

   A. After bearing installation, assemble the retainer to the shaft and tighten the capscrews to 225 Ft.Lbs. for gap measurement.

   B. Measure through the 3 small holes in the retainer with a depth micrometer to determine the distance from the outer face of the retainer to the end of the shaft.

   C. Remove the retainer and measure the retainer thickness at the 3 small holes.

   D. Take the average of the 3 measurements from Step B and subtract the average of the 3 measurements from Step C. From this difference subtract .001-.004 inch to obtain the shim thickness.

   E. Install the shims and tighten the capscrews to 905 Ft.Lbs.

5. *Shim Procedure For Gap "B":*

   Add the required amount of shims at Gap "C" to obtain a gap of .08 ±.02 inch at Gap "B".

6. *Shim Procedure For Gap "D":*

   A. Install the retainer and tighten the capscrews to 225 Ft.Lbs. for the gap measurement.

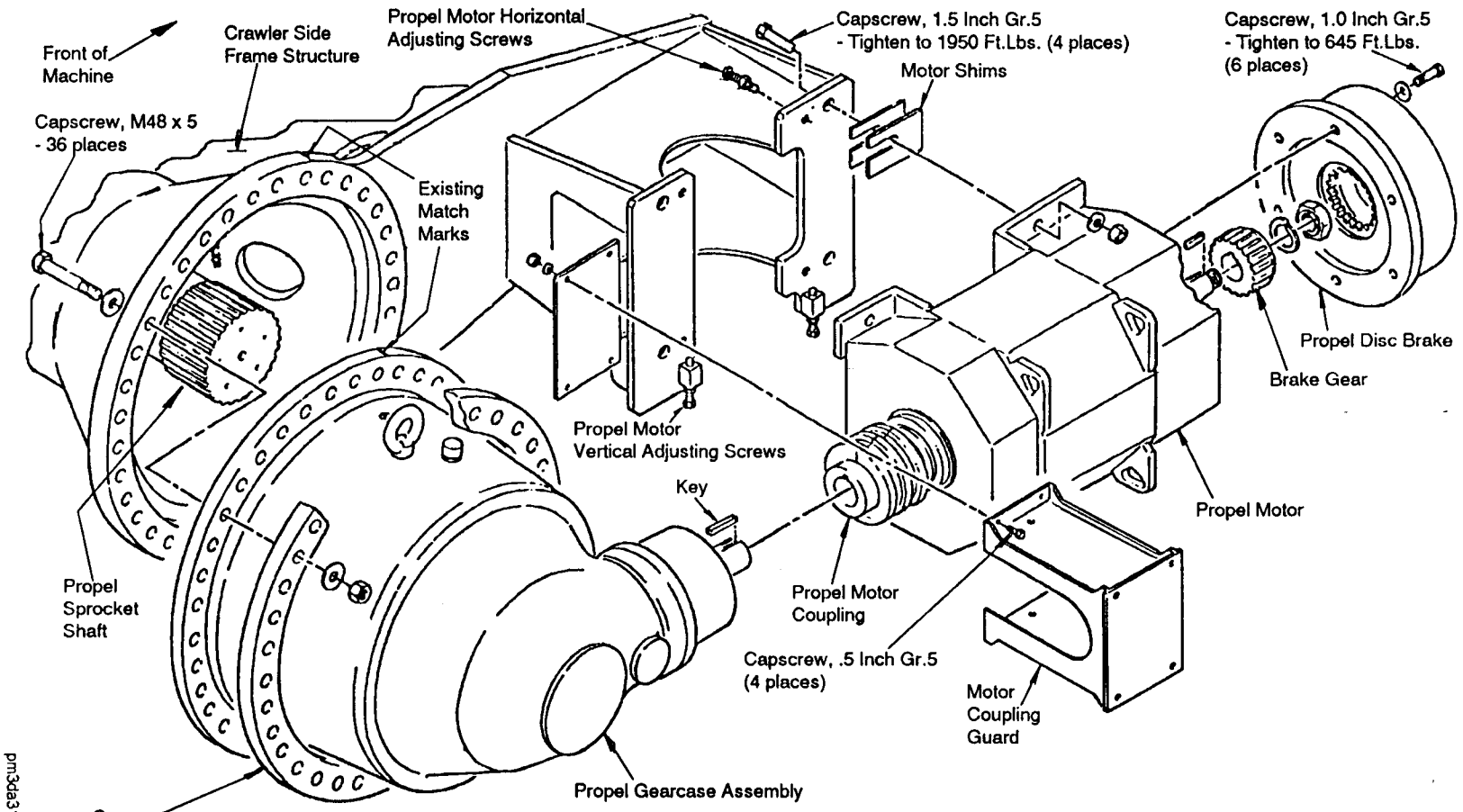
   B. Measure the gap at 3 places equidistant around the O.D. of the retainer.

   C. Take the average of the 3 measurements and subtract .001-.004 inch to obtain the shim thickness.

   D. Install the shims and tighten the capscrews to 905 Ft.Lbs.

   E. Fill the bearing cavity with Mobilux EP2 or equal grease (P.C. No. 380900-5).

7. If these shims are 2-piece, install with the split line horizontal and seal the split with RTV.



PROPEL MOTOR and GEARCASE ASSEMBLY

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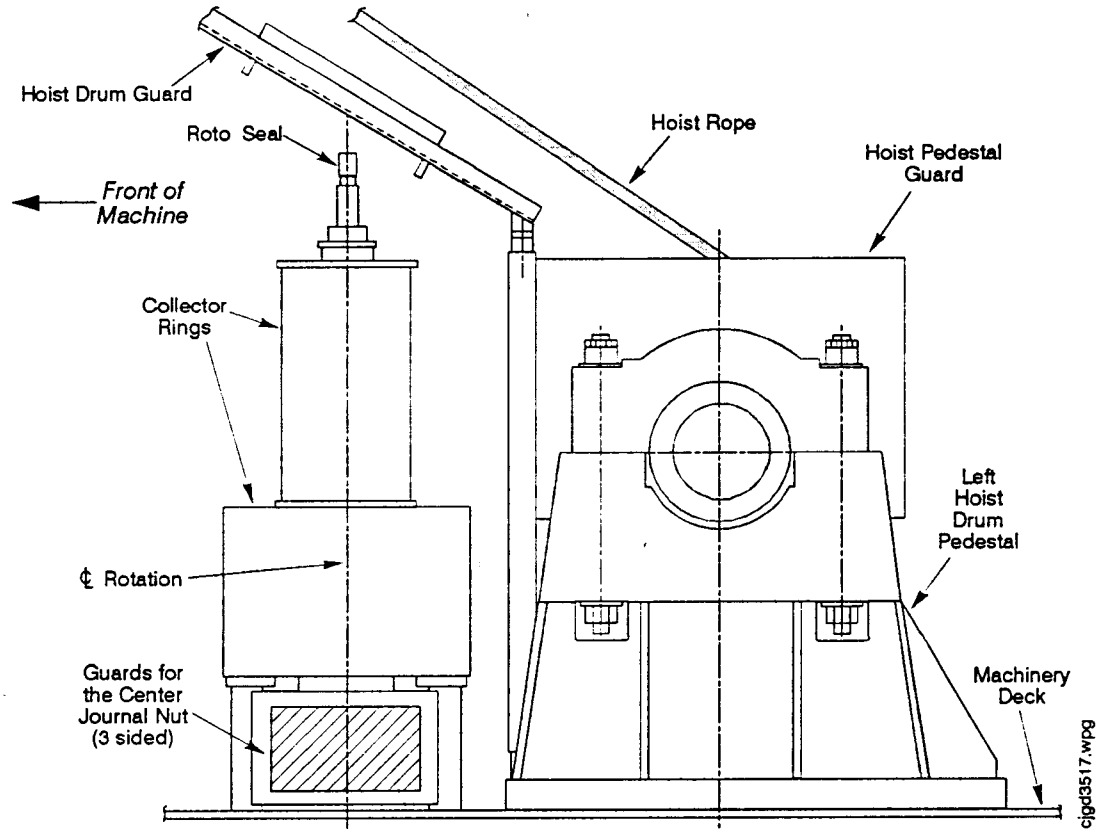
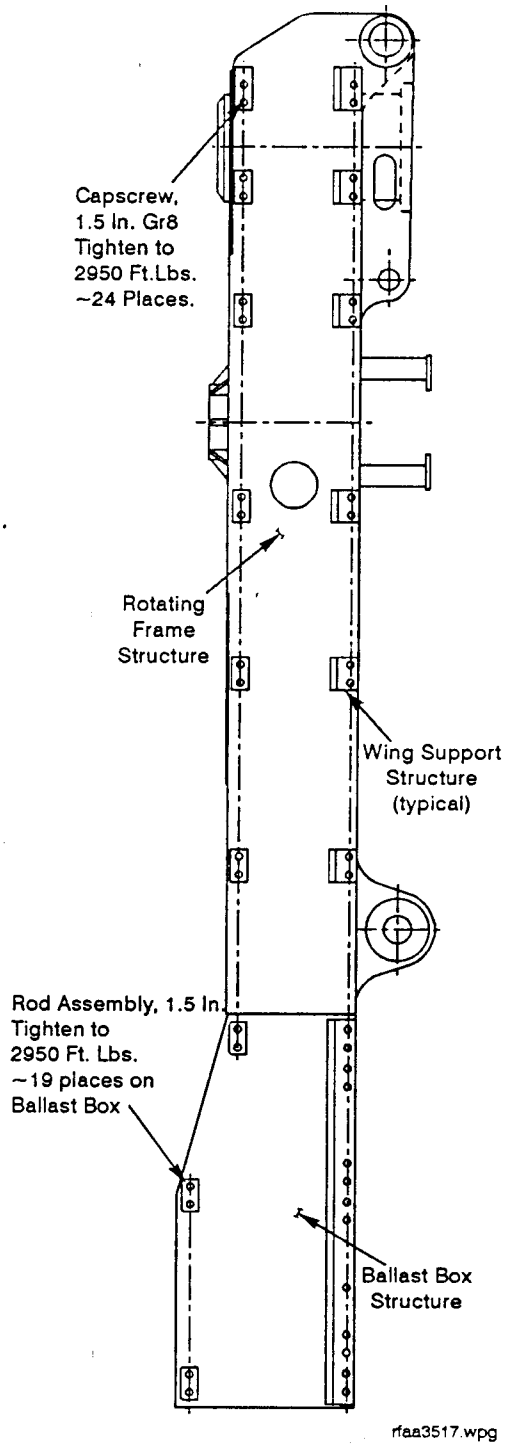


VIEW of GUARDS for the CENTER JOURNAL NUT

NOTES:

1. Check for broken or loose bolts monthly (420 hrs.).

2. Check the structure for cracking monthly (420 hrs.).



Section A-A *(From page 4.5.1)*

GEARCASE CAPSCREWS MECHANICAL TENSIONER PROCEDURE

NOTES:

✓ *The Standard Preload for this Mechanical Tensioner (1.75 Dia Capscrew)* — Tighten the Jackbolts on the tensioner to 75 Ft.Lbs. (129,600 Lbs. Clampload).

✓ The rod threads should be clean and the fit of the tensioners and nuts on the rods should be very free. This is to allow for stretch of the rod during tensioning.

✓ Perform Steps #2-#5 below completely for each Mechanical Tensioner — in the tightening sequence indicated in the overall view in the figure.

✓ Due to stretching of long bolts and rods, Steps #4 and #5 below may have to be repeated to obtain the final preload.

✓ After 20 hours of machine operation, repeat Step #5 for all the rods, in the sequence indicated.

Initial Tensioning:

1. To seat the threads and eliminate clearances, use a small wrench to tighten the jackbolts on the mechanical tensioner to 10% of the final torque required (Approx. 7.5 Ft.Lbs.). Tighten the jackbolts in the sequence indicated in Figure #1.

2. Switch to a torque wrench and tighten the jackbolts to 50% of the final torque required (Approx. 38 Ft.Lbs.), again using the sequence in Figure #1.

3. Re-tighten the jackbolts to 75% of the final torque required (Approx. 56 Ft.Lbs.) — however, use the sequence in Figure #2.

Final Tensioning:

4. Tighten the jackbolts to 110% of the final torque required (Approx. 83 Ft.Lbs.)using the sequence in Figure #2.

5. Tighten all the jackbolts to the final torque required (100%, Approx. 75 Ft.Lbs.) using the sequence in Figure #2.

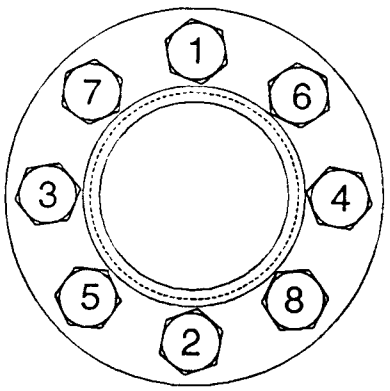


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Figure #1
Initial Tightening Sequence For Special Nut

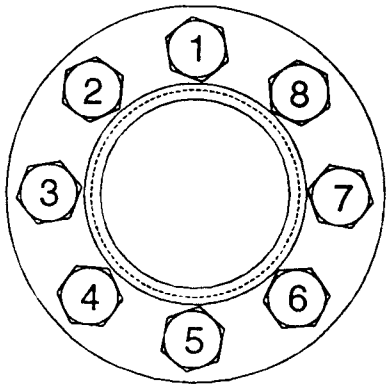
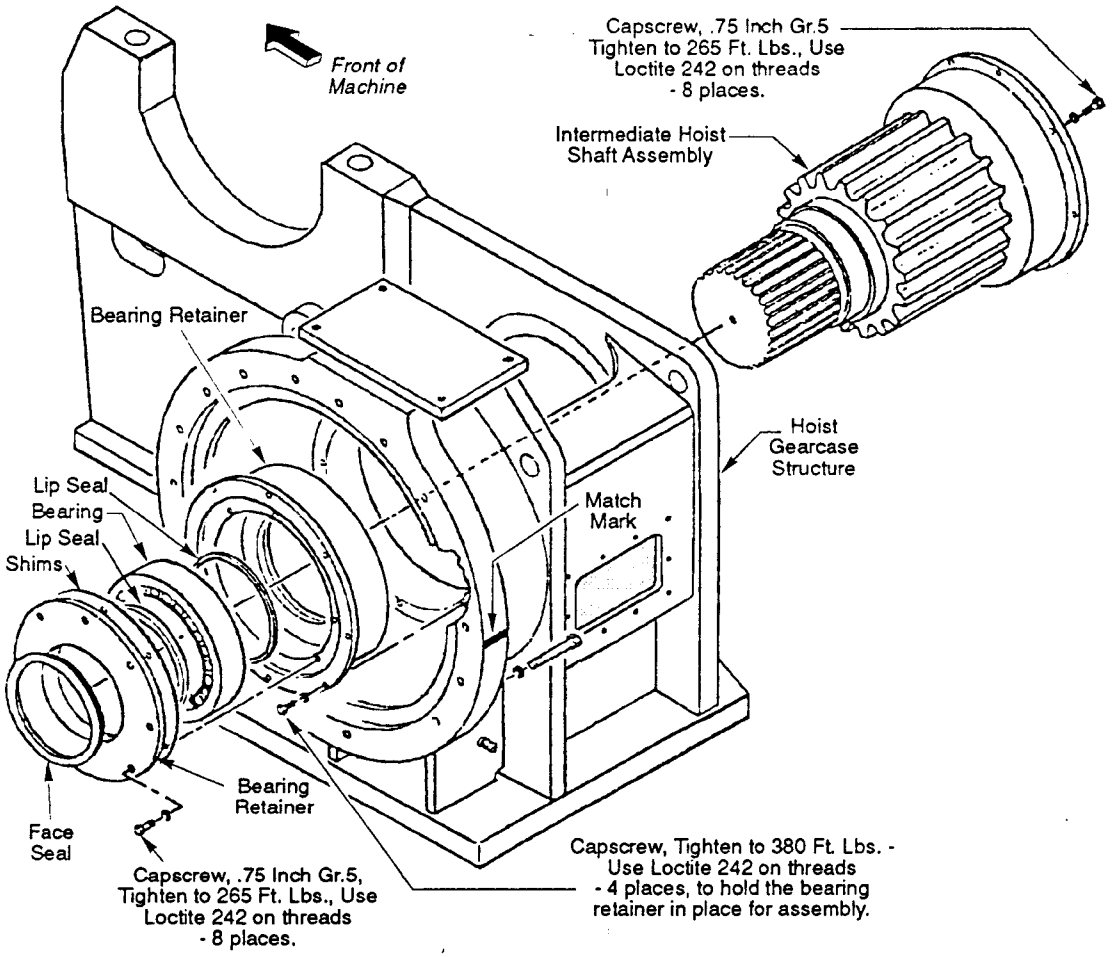


Figure #2
Final Tightening Sequence For Special Nut



INTERMEDIATE HOIST SHAFT and PEDESTAL

INTERMEDIATE HOIST SHAFT

To remove the Intermediate Hoist Shaft:

1. Park the machine in an open level area with the dipper resting on grade & the hoist ropes slackened.

2. Set all brakes & shut down the machine. Have a qualified electrician isolate the hoist rope winch.

3. Block the hoist drum to prevent rotation.

4. Remove the hoist gearcase. Refer to *HOIST GEARCASE REMOVAL* for the procedure.

7. Disconnect the electrical wiring to the hoist limit switch. Remove the coupling guard & support the base/limit assembly while removing the base mounting screws. Pull the assembly away from the bearing housing to disengage the coupling splines. Do not allow the coupling to carry the assembly weight. Store the coupling sleeve with the limit switch.

8. Remove 3 hatch covers from the center roof section and remove the 2 house arches above the drum.

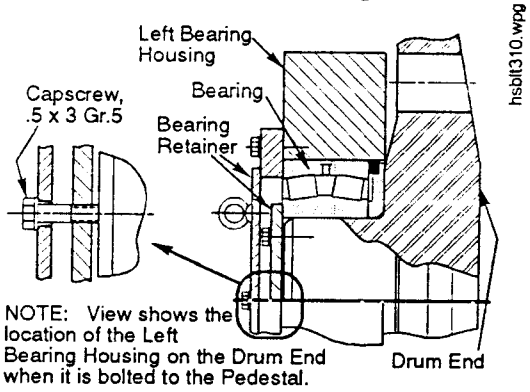
9. Remove the 2 top sections of the hoist gear guard and the guard on the left end of the drum assembly.

10. Remove the lube line fitting from the center of the left bearing retainer and install a .5 inch x 2.5 inch long capscrew with a hardened flat washer into the end of the shaft through the retainer to hold the bearing housing on the drum shaft during its removal.

11. Remove the rope winch from the hoist gearcase.

12. Remove the 4 rods which attach the bearing housings to the pedestals. Refer to the procedure for loosening the tensioning nuts on page 4.6.7.

NOTE: The bottom nut on the pedestal rods were assembled with loctite on the threads.



13. Attach lifting equipment of proper rating to the drum shaft.

14. Lift the drum assembly through the roof openings. Be aware of shims at the left bearing housing between it and the pedestal, both on top and in the front vertical contact surface. The drum must move to the left and to the rear to clear the house and gantry structure. Also, rotate the drum assembly slightly as it passes through the roof hatch to allow the gear teeth to clear.

15. Set the drum assembly on cribbing.

Reassembly is the reverse of disassembly:

a. Shim at the left pedestal as needed to obtain the proper gear contact pattern. Backlash should be .028 to .088 inch.

b. Coat the gear and pinion with OGL lube after checking the contact pattern.

c. Adjust the floating bearing housing to be 1.97 inches from the drum end bolting surface. Refer to *VIEW - A* on page 4.6.23.

NOTE: Remove the retainer bolt from the left hand housing & reconnect the lube line.

REMOVAL of the ROTATING (SWING) GEARCASE

1. Park the machine on a level work area with the dipper on the ground and the hoist ropes slackened.

2. Remove the hatch above the swing motor.

3. Have a qualified electrician isolate the swing motor, blower motor, anti-condensation heaters, over-temperature thermostat, brake, magnet valve and pressure switch. Disconnect all wiring.

4. Disconnect and plug the air line to the swing brake.

CAUTION: VERIFY THAT THE AIR LINE IN NOT PRESSURIZED BEFORE DISCONNECTING. Disconnected lines must be plugged. Failure to comply with this caution could result in serious injury.

5. Remove the swing motor blower assembly.

6. Attach slings to the 3 lifting eyes located at the motor mounting flange and remove the 16 - 1.25 Inch capscrews which secure the rotating gearcase to the upper frame structure.

7. Use M36 x 4 jacking screws in the 3 holes provided in the gearcase flange to lift the assembly clear of the pilot bore.

8. Lift the assembly clear of main rotating shaft splines, taking care to maintain a vertical lift.

9. Set the gearcase/motor assembly on cribbing. Be sure that the output shaft does not support the weight of the entire assembly.

10. Remove the motor & brake.

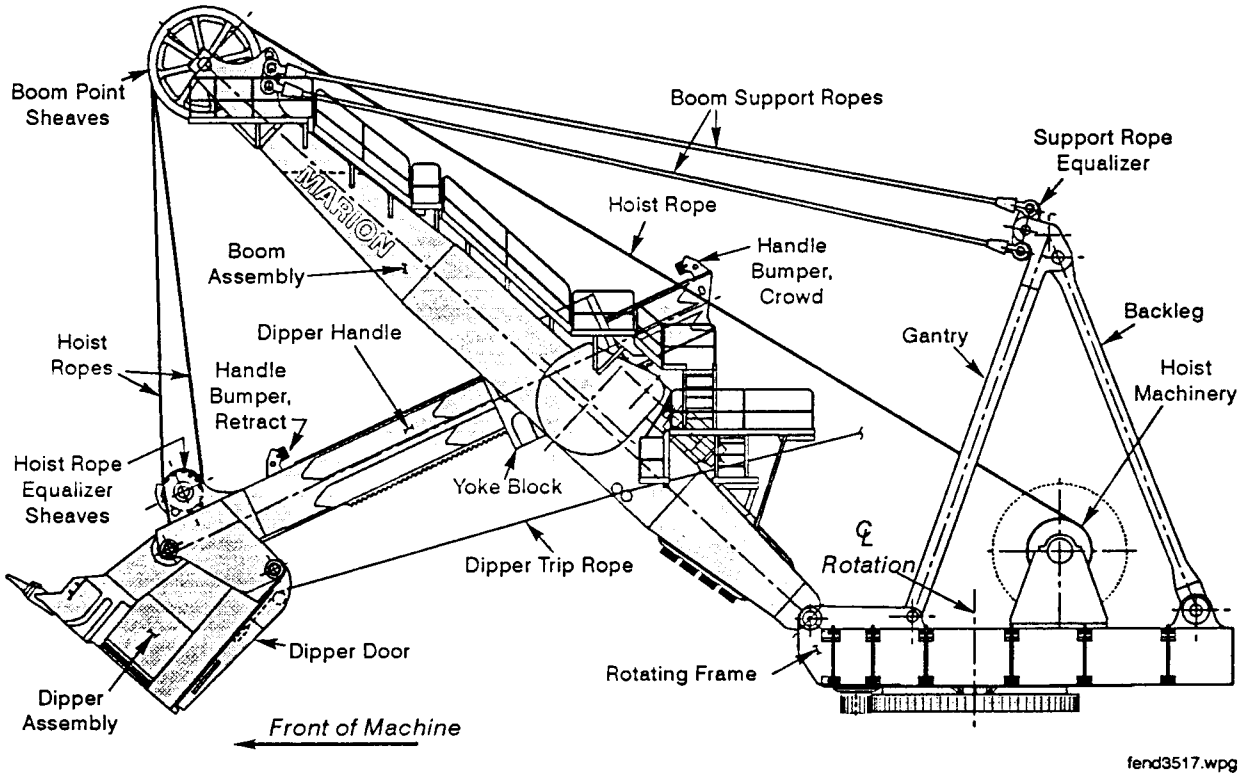
To install the gearcase/motor, *assemble in the reverse order of removal* — after the following have been completed:

a. Check the main rotating shaft splines for damage. Replace the shaft if cracks or excessive wear is found.

b. Replace the face seal at the top of the bearing lock nut.

c. Coat the main rotating shaft splines and approximately heap 2.6 Lbs. of MPG on the end of the shaft.

4.9 FRONT END ASSEMBLIES



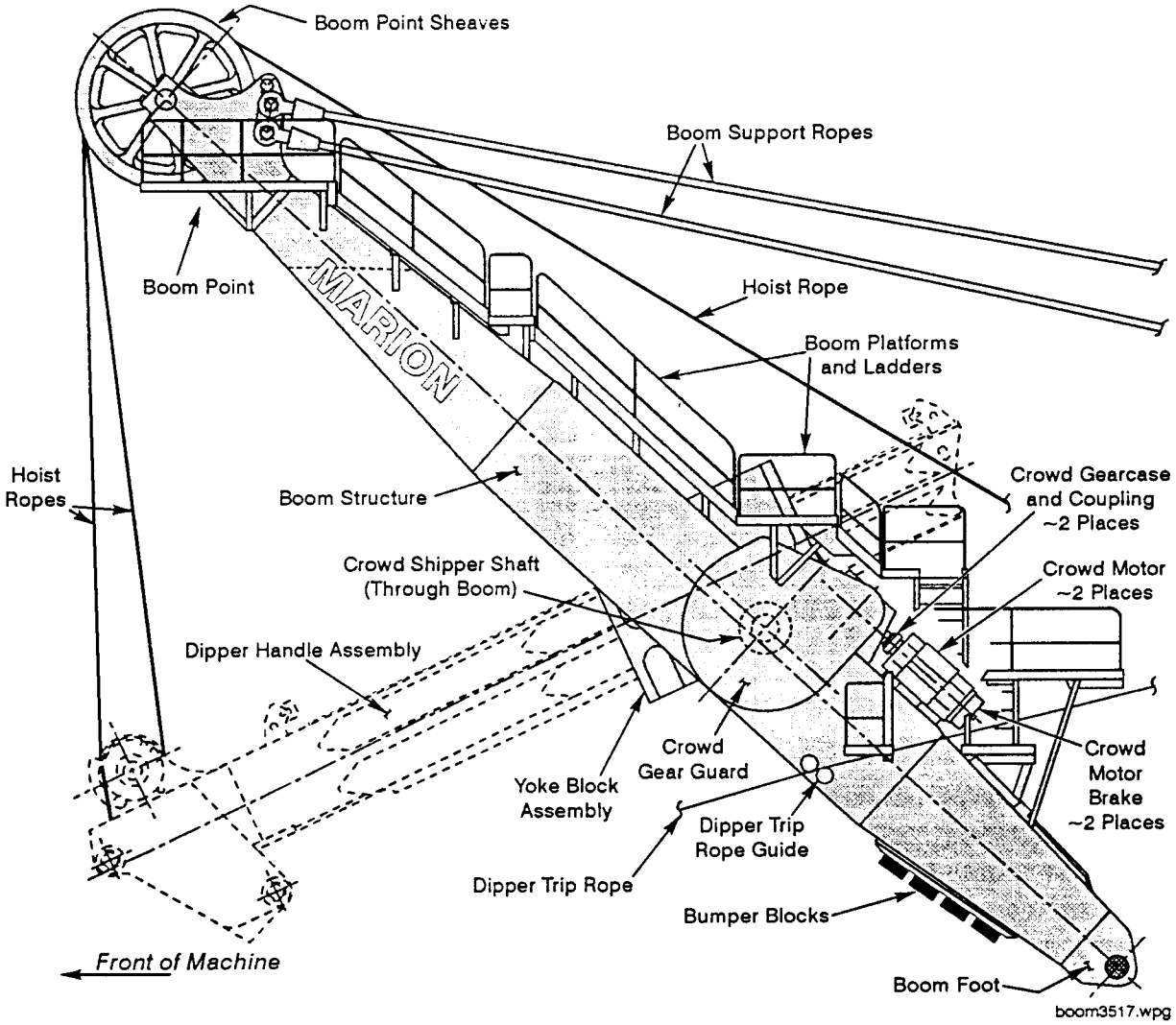
351M NOMENCLATURE ~ FRONT END

BOOM LOWERING/RAISING PROCEDURE

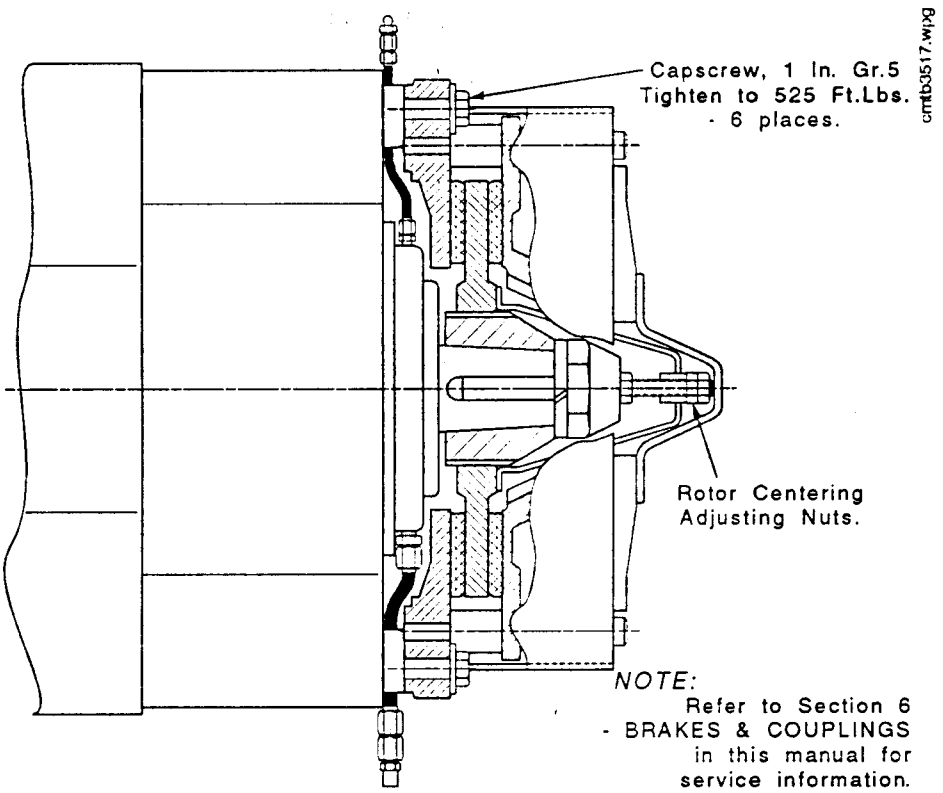
1. Park the machine in a level area with crane access on both sides of the boom.
2. Remove the dipper/handle assembly from the boom.
3. Position the rotating frame with the boom foot over the front and in line with the crawlers.
4. Set brakes and shut down the machine.

CROWD MACHINERY

The Crowd Machinery consists of two identical drive systems. Each motor is coupled to a right angle gear reducer which drives a separate shipper shaft. The shipper shaft pinions engage the handle racking to provide the crowd and retract motions. All components from one system is interchangeable with the other.



351M CROWD MACHINERY INSTALLATION



CROWD MOTOR BRAKE INSTALLATION

CROWD LIMIT

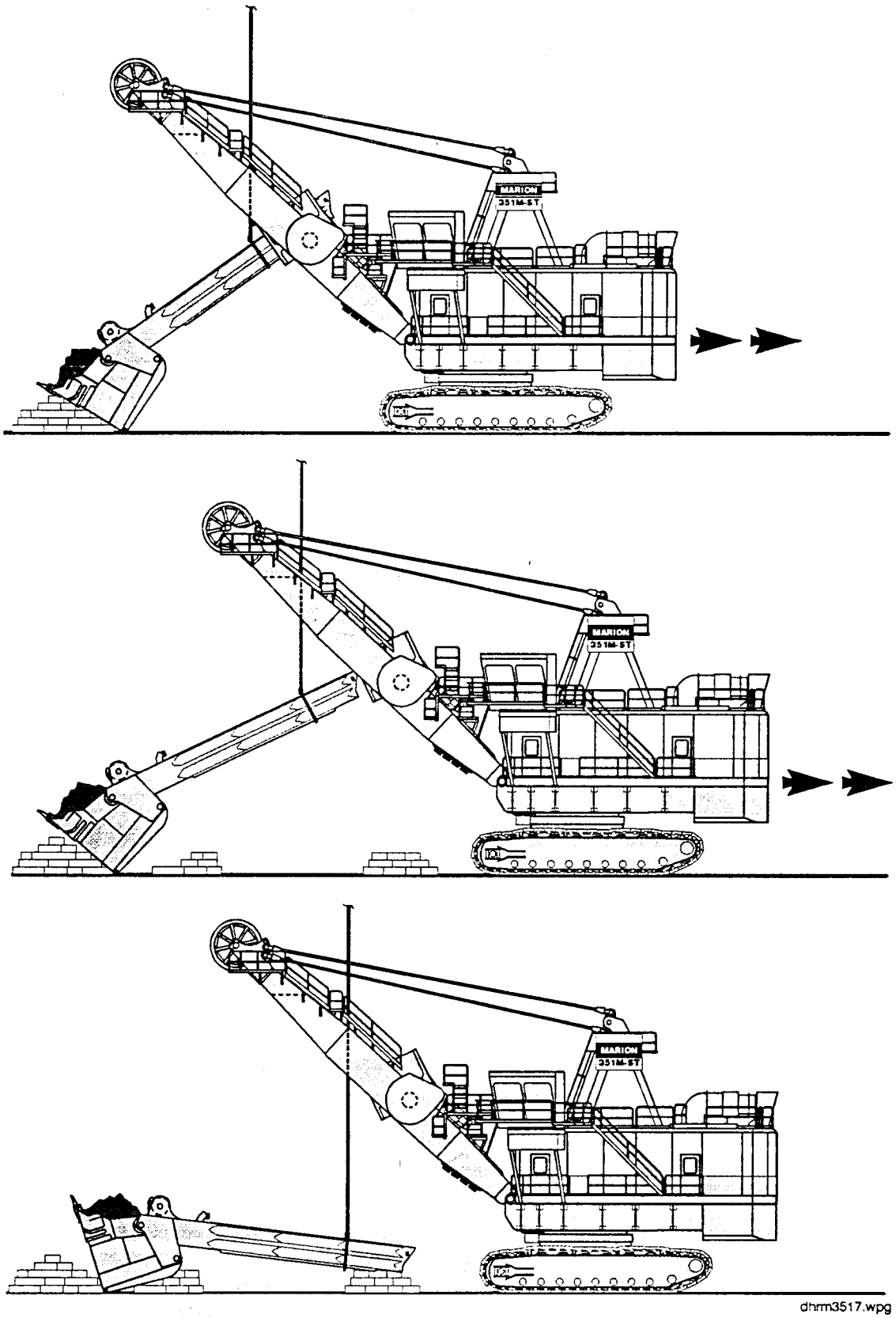
1. Align the coupling with the sleeve removed.
2. Add shims under the limit switch (resolver) mounting pads to obtain proper alignment.
3. Remove the limit switch and install the coupling sleeve.

NOTES:

✓ Indexing is not required.

✓ When the limit switch is disconnected or replaced and/or after removing the dipper handle, it must be recalibrated.

✓ Calibration is done from the operator's cab. Refer to Section 2 - *OPERATION*, in this manual, for the proper procedure. Also refer to the figures on the following pages.



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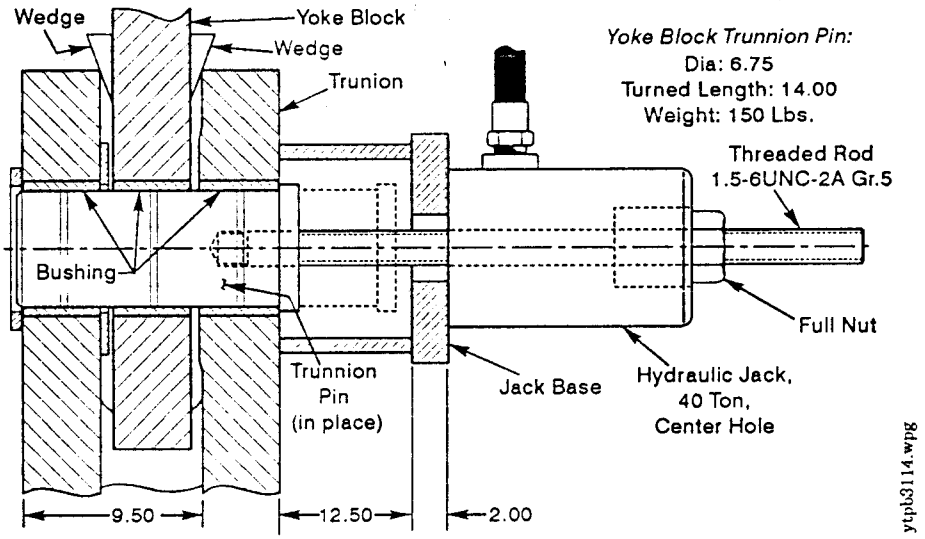
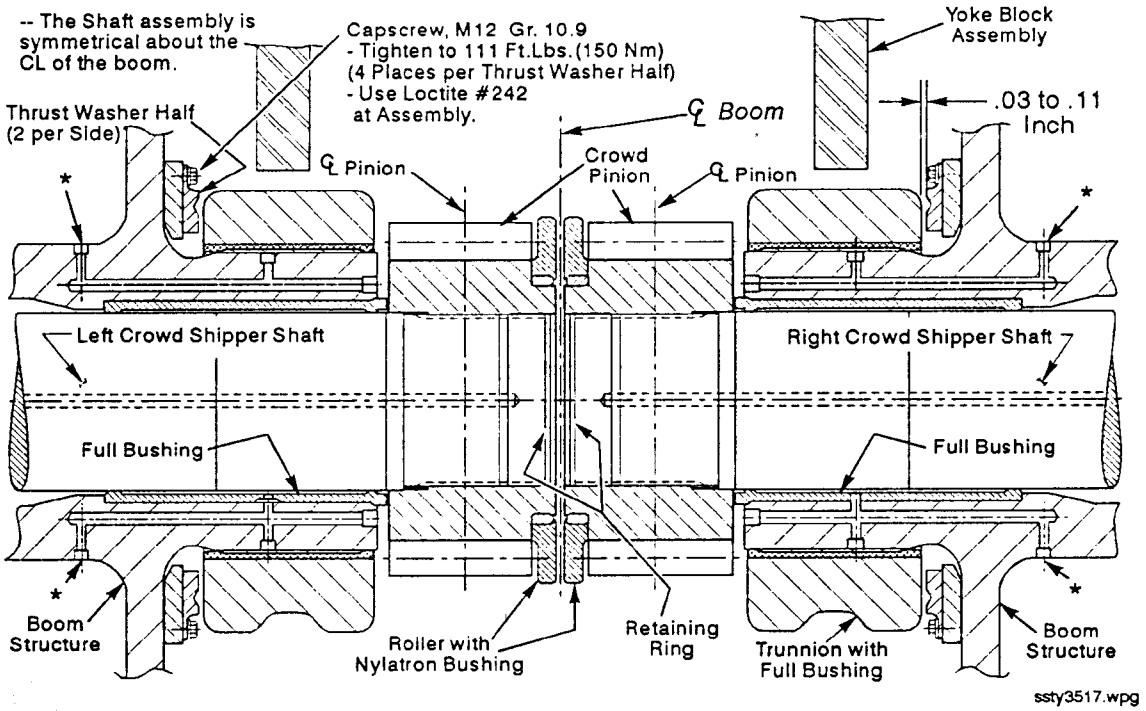
DIPPER/HANDLE REMOVAL From The BOOM



TRUNNION PIN REMOVAL

NOTES:

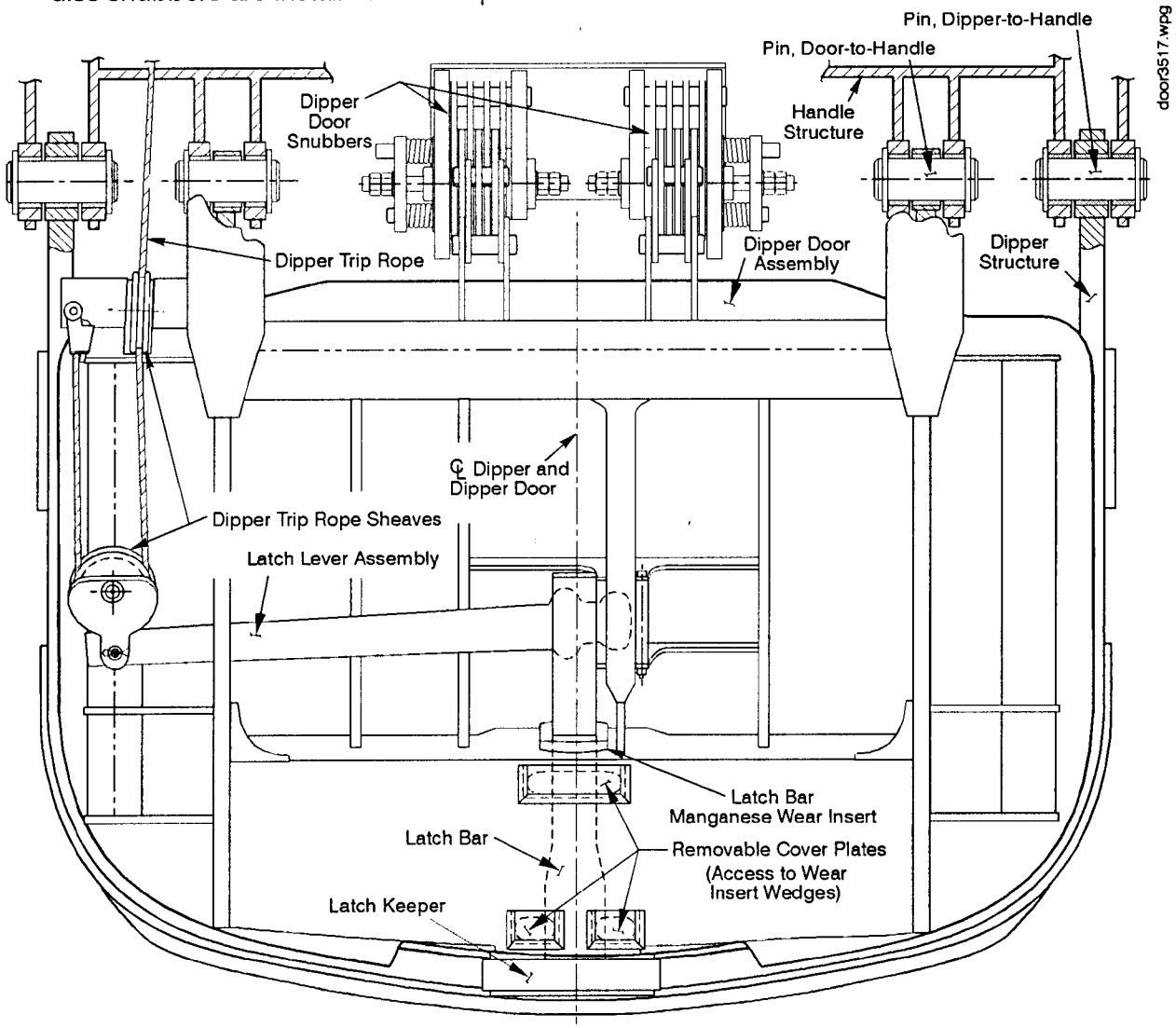
-- '*' Indicates Lube Access, from the top of the Boom.



Section A-A *(Through Shipper Shaft)*

DIPPER DOOR ASSEMBLY

The dipper door assembly includes the door structure and latching mechanism. Two pins attach the door to inboard lugs on the dipper handle. To reduce door slamming, two multi-disc snubbers are installed at the top of the door.



DIPPER DOOR MAINTENANCE

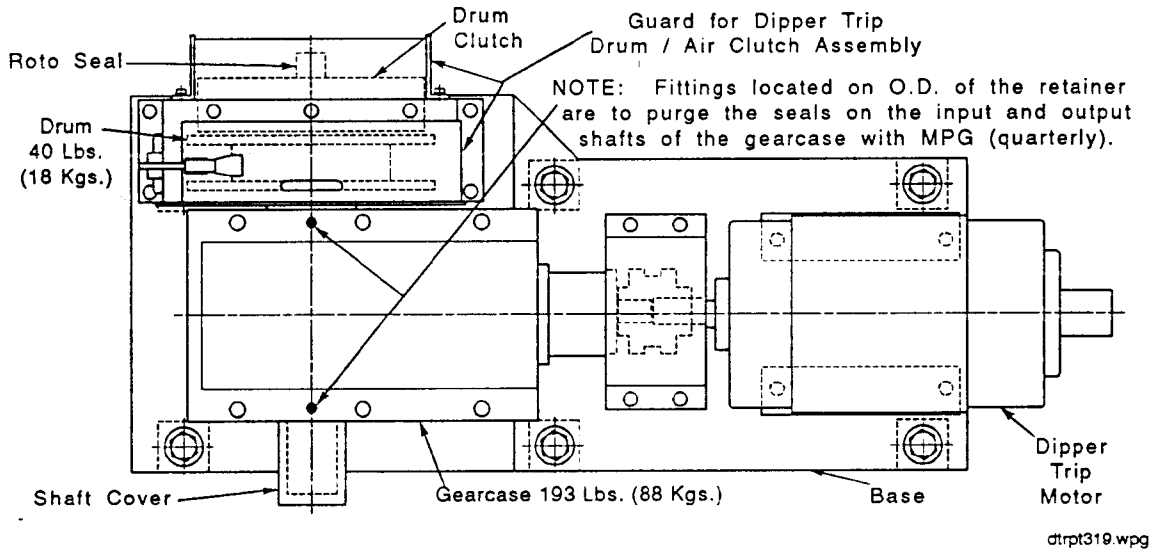
1. Lubricate the door hinge bushings with MPG *twice per shift*.

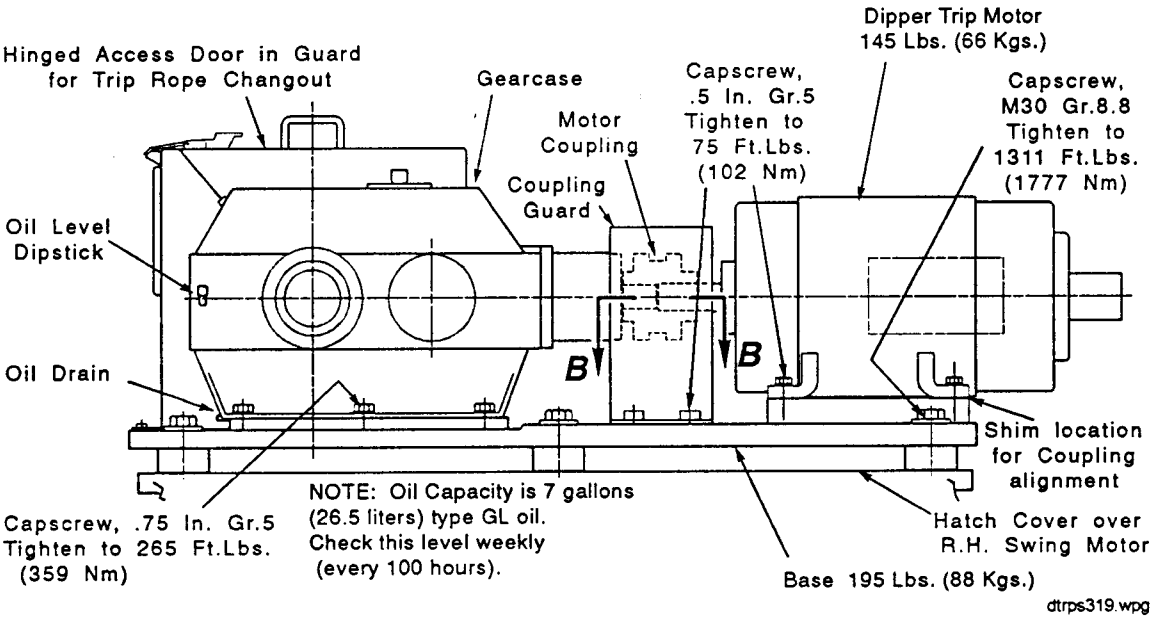
2. Lubricate the Trip Rope Sheaves on the Latch Lever and the Door Structure with MPG *twice per shift*. Lubricate the Latch Bar with oil twice per shift.

3. Lubricate the trip rope in the area of the trip rope sheaves daily with WRL.

4. Keep the snubber adjusted for proper door swing.

5. Adjust the door latch for proper engagement in the dipper latch keeper. Refer to "DIPPER DOOR LATCH BAR ADJUSTMENT" in this section of the manual.





DIPPER TRIP MACHINERY

[Approx. 2600 Lbs., 1179 Kgs.]

Normally, air flows to the clutch through the low pressure regulator, the quick release valve and the solenoid valve. When the door is opened (tripped), air flows through the high pressure regulator, the energized solenoid valve, and to the clutch. The quick release valve prevents possible damage to the low pressure regulator when the solenoid valve is energized.

CAUTION: The clutch will be damaged if the air pressure exceeds 120 PSI.

NOTES: (Dipper Trip Drum Clutch)

1. The fit of the drum to the clutch adapter shaft is .002-.007 Inch *LOOSE.*

2. Use Loctite RC/680 (or equivalent) between the drum and the adapter shaft at assembly.

3. the Fit of clutch adapter shaft to the gearcase output shaft is .0005-.0025 Inch *INTERFERENCE.*

4. Use Loctite RC/680 (or equivalent) between the adapter shaft and the output shaft at assembly.

5. the Key must not extend beyond the end of the shaft.

6. the Retaining ring inside the clutch adapter shaft is the axial stop for end of gearcase output shaft. Push clutch assembly onto the output shaft until it touches the retaining ring.

7. the Splines on the clutch adapter shaft for torque assembly contact may be lightly coated with Molycote M8800 (or equivalent). *LUBE MUST NOT CONTAMINATE FRICTION LINING SURFACES!*

8. Snap ring grooves inside the adapter shaft are furnished to use with a puller for removal of the gearcase output shaft. MARION will supply information on the puller arrangement upon request.

9. Tighten both set screws (No.1 and No.2) and loosen 1 turn. Re-tighten set screw No.1 then set screw No.2.

HOIST ROPE REPLACEMENT

1. Park the machine with the dipper front on the ground. Allow room in front of the dipper to pull the hoist ropes approximately 150 Ft. Slacken the ropes until they lay on the boom.

2. Attach a sling to each of the ropes at the equalizer sheaves. Attach the other end of the slings to a vehicle parked ahead of the dipper.

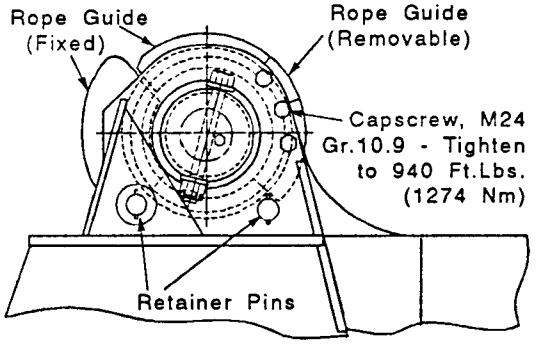
3. Remove the rope retainer pins and removable rope guides.

CAUTION: BE SURE THE HOIST ROPE LOOPS ARE LOOSE IN THE EQUALIZER SHEAVES. Unexpected movement by the sheaves and ropes when the pins are removed could cause injury.

CAUTION: Insure that there is phone or radio communications between all personnel involved with rope removal and installation.

4. Place the motion limits in the *BYPASS* position. The selector switch is on the right hand console in the operator's cab. Slowly rotate the hoist drum (take up the slack with a vehicle at the front of the machine) until the inside ropes (ropes "B" and "C") are completely unspooled and the inside clamps are on top of the drum.

5. Attach a winch rope to each of the inside hoist ropes, on the boom side of the hoist drum. Take up any slack in the winch ropes and insure that the winch rope attachment is tight on the hoist ropes.



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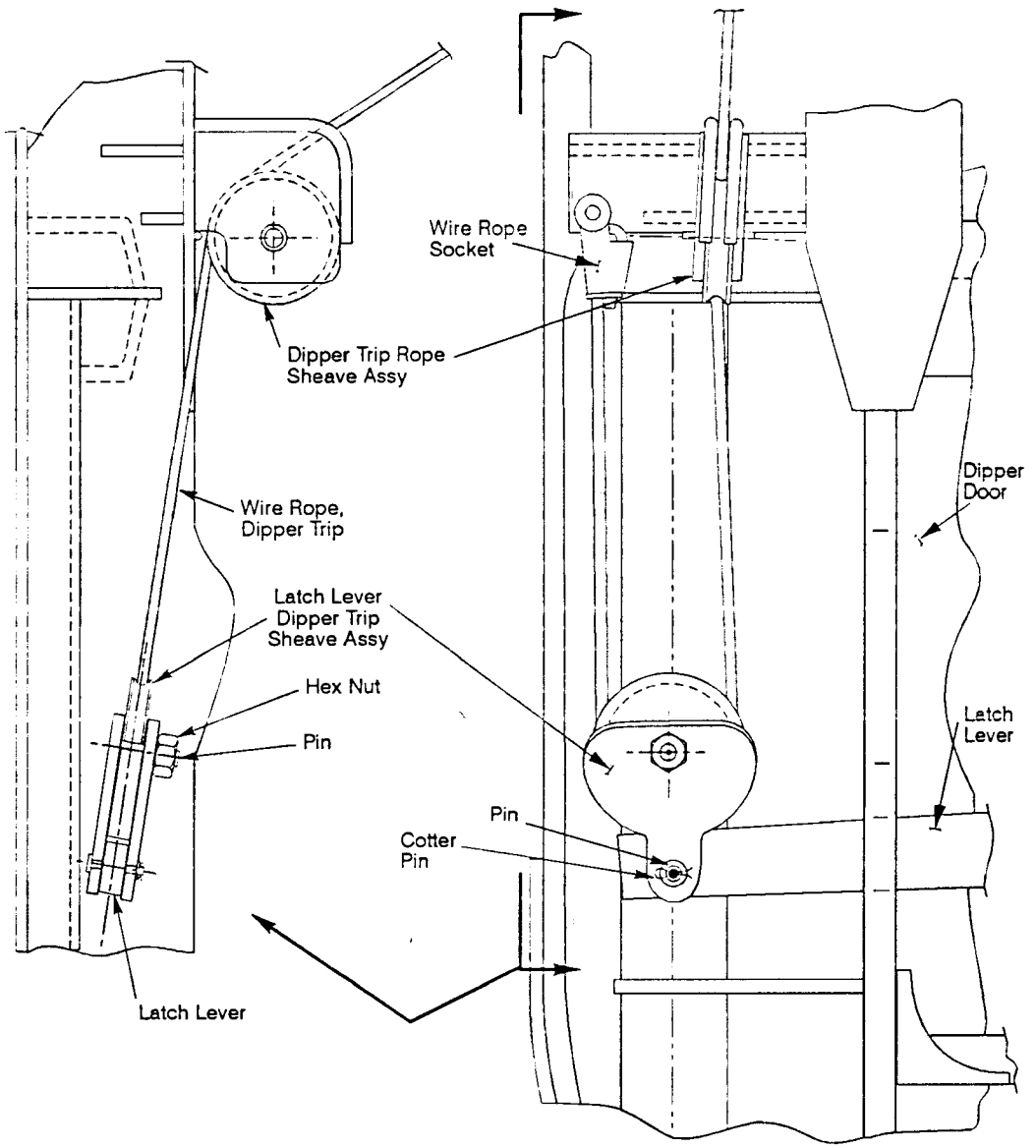
DIPPER HANDLE EQUALIZER SHEAVE
- Hoist Rope Reeving

6. Carefully loosen the 5 rope clamps on each inside hoist rope, then remove the nuts and clamps from the U-bolts.

7. Slowly continue to unspool the hoist ropes, by rotating the drum, paying out the winch and taking up the slack — until the drum rotates 180° to place the outside set of rope clamps (ropes "A" and "D") on top of the drum. Attach the winch ropes to the outside hoist ropes similar to the inside ropes and again insure that the connection is tight.

8. Take up any slack in the winch ropes. Carefully loosen the 5 rope clamps on each outside hoist rope, then remove the nuts and clamps from the U-bolts.



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View C-C

DIPPER TRIP ROPE-to-TRIP LEVER CONNECTION

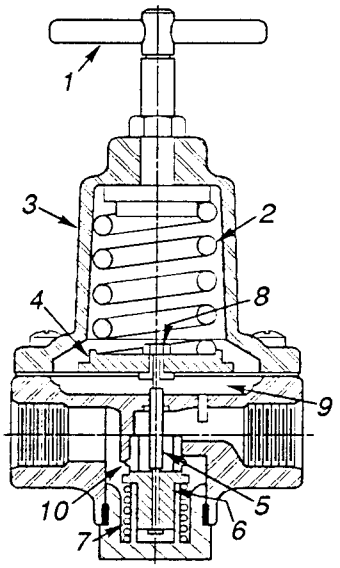
(From page 4.13.9)

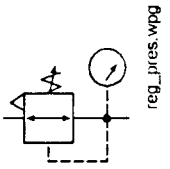
PRESSURE REGULATORS

These regulators are used in compressed air systems to maintain a nearly constant downstream (outlet) pressure despite changes in the upstream (inlet) pressure and in the downstream flow requirements. These units are of the relieving, diaphragm type and are each fitted with a gauge that indicates outlet air pressure.

Outlet pressure is controlled by a T-Handle adjusting screw (It.#1) on top of the regulator. Clockwise rotation (CW) *increases* outlet pressure, and counter-clockwise rotation (CCW) *decreases* it.

When the adjustment handle (It.#1) is rotated fully counter-clockwise, no force is applied to the regulating spring (It.#2), and the valve (It.#6) is held closed by the valve spring (It.#7). Clockwise rotation of the adjustment handle (It.#1) compresses the regulating spring (It.#2) which applies a downward force on top of the diaphragm (It.#4). The diaphragm and valve pin (It.#5) move downward, forcing the valve (It.#6) off its seat (It.#10). This allows air to flow through the regulator downstream to the system.





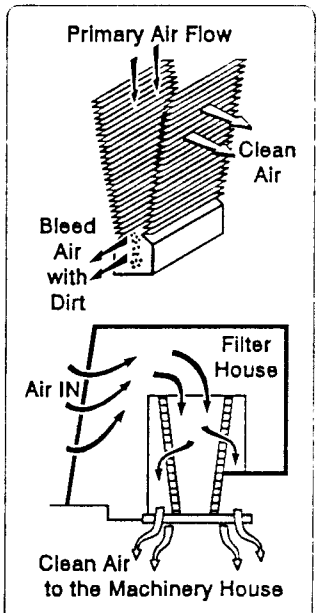
Graphic Symbol

Outlet pressure increases in the downstream system and sensing chamber (It.#9) and applies an upward force on bottom of diaphragm (It.#4). The diaphragm, valve pin (It.#5), and valve (It.#6) move upward, compressing the regulator spring (It.#2). Upward movement stops when the forces below the diaphragm balance the forces above the diaphragm. When there is no downstream flow demand, the balance of forces occurs with the valve (It.#6) closed. When there is downstream flow demand, the balance of forces occurs when the valve opens sufficiently to compensate for demand, thus maintaining the desired outlet pressure.

These air pressure regulators require no maintenance. If a unit leaks air excessively or malfunctions, replace it.

The *HOUSE AIR FILTRATION SYSTEM* uses filter fans to create a slight pressure above the outside air to reverse any possible *IN-FLOW* through rope and other openings. Thus, all air entering the house is filtered. *NOTE:* An open access door or cover will defeat this system, allowing dust and dirt to enter. Filtered air circulation reduces dust accumulation and related maintenance.

CONCEPT: Dirty air enters the filter house and inlet end of the wedge shaped filter cells. Most air (about 90%) changes direction quickly and passes through the narrow side passages. Dirt particles, with greater mass, tend to continue straight into the bleed air duct; thus, dirt particles and bleed air return outside.



HOUSE AIR FILTER SYSTEM

MAINTENANCE:

✓ Periodically check that bleed air ducts are open and clear.

✓ Keep inlet passages free of paper, leaves, wiping cloths, or any debris that would obstruct air flow.

✓ Look for deposit build-up on filter blades. A light coat of dust is normal, but a heavier coating requires cleaning.

✓ Brush surface and remove dust with compressed air. If necessary, wash heavy build-up with water or suitable solvent.

DANGER! **THE MACHINERY HOUSE ROOF MAY BE SLIPPERY. Use the hand rails as well as extreme caution during any maintenance or service on the roof.**

This machine utilizes 3 - 25 HP filter/fan units. Each delivers 22,680 CFM of filtered air to cool the machinery and provide clean air into the house. Bleed air is removed by tube-axial fans located in the bleed ducts. Inspect the fans and filter elements weekly (100 hours). Clean off dirt deposits with compressed air. In extreme conditions, remove the elements and wash with water.

NOTE: **Mine conditions will dictate the maintenance frequency of the filters. Monitor the filters closely and establish a schedule to suit existing conditions.**

3. Remove the capscrews that attach the mounting flange of the brake to the motor housing.

CAUTION: If the brake to be removed is a dual rotor brake and is mounted on a horizontal shaft 822 or 824 frame motor, remove the brake end cover to determine if the brake is equipped with a rotor centering device. A rotor hub with retainer plates attached to each end will have the centering device. Refer to page 6.1.13 for service information.

4. Take the entire brake assembly off the brake gear hub and the motor housing.

NOTE: Refer to page 6.1.1 for the weight of each brake assembly.

5. Remove the gear hub and key from the motor shaft. This is a shrink type fit on a tapered bore.

6. Check the rotor hub for wear or damage. Remove any burrs or nicks or sharp edges. Replace any parts as required.

INSTALLING the BRAKE as a UNIT

The rotor hub for each brake shrink fits onto the tapered motor shaft. Refer to *HUB/GEAR INSTALLATION* - Section 7 for Hub mounting. Use the motor nut furnished with the machine to retain the hub. The nut used on the swing motors has a Centering Boss for the Lifter Assembly.

CAUTION: Personal injury or machine damage could result if a substitute Swing Motor nut is used.

Lightly coat the Rotor Hub teeth with Molycote M8800 or equivalent and install the Brake Assembly in the reverse order of disassembly. Apply air to release the Brake Rotor. This will allow alignment of the mounting holes. Tighten the mounting screws per the chart on page 6.1.1.

Operate the brakes several times to insure that the rotor(s) will fully release. Check that the swing and crowd brake rotors float mid-way between the friction discs when the brakes are released. Adjust as required.

CAUTION: *INSTALL ALL GUARDS BEFORE OPERATING THE MACHINE.*

DISASSEMBLY of the BRAKE

The brake is preassembled at the factory for ease of shipment and installation. Partial disassembly is required to install brakes utilizing the rotor centering option.

1. Lay the brake assembly on a clean, flat surface, with the mounting flange facing down.

2. Loosen the locknuts (It.#9) *ONE TURN AT A TIME* in an alternating (criss-cross) pattern until the spring force is relieved.

CAUTION: The locknuts must be loosened gradually to prevent damage to the brake components.

3. Remove the locknuts and washers (It.#44) and slide the end plate (It.#12), spring housing (It.#8), and the pressure plate (It.#7) off the studs as an assembly, setting it aside on a clean dry surface. Use care to prevent damage to the friction material wear surface on the pressure plate.

NOTE: If a stud (It.#2) should happen to come loose, remove it completely and clean the threads in the mounting flange. Apply Loctite Loc-Quic Primer Grade "T" to the stud threads. After the threads have dried, apply Loctite #277 and install the stud until it bottoms in the threaded hole in the mounting flange.

NOTE: If a stud (It.#2) should happen to come loose, remove it completely and clean the threads in the mounting flange. Apply Loctite Loc-Quic Primer Grade "T" to the stud threads. After the threads have dried, apply Loctite #277 and install the stud until it bottoms in the threaded hole in the mounting flange.

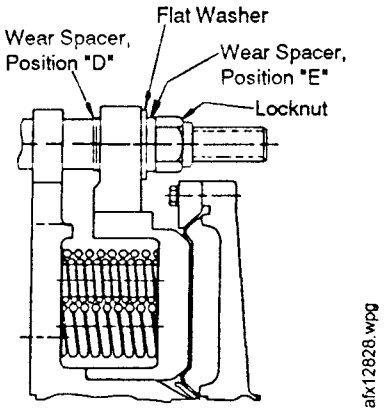
CAUTION: Loctite #277 must be shaken prior to application.

CAUTION: Loctite #277 may irritate sensitive skin. Refer to the product label for proper safety precautions.

Remove the rotors (It.#4) and reaction plate (It.#23) from the mounting flange (It.#1) sub-assembly, setting them aside on a clean dry surface.

21. Install the washers (It.#44), remaining wear spacers (It.#25), and locknuts (It.#9) removed in Step No.3. The wear spacers are stored under the locknuts (position "E") for re-use after replacing the friction discs.

22. While supporting the weight of the pressure plate, spring housing and end plate assembly, tighten the locknuts *ONE TURN AT A TIME* in a criss-cross pattern, until the spring housing is seated against the clamp tubes. Tighten the locknuts to 500 Ft.Lbs., lubed.



CAUTION: The locknuts must be tightened gradually to prevent damage to the brake components.

23. Upon returning the brake to service, monitor the operation and clearances of the brake. Refer to the note on page 6.1.21. Adjust if required.

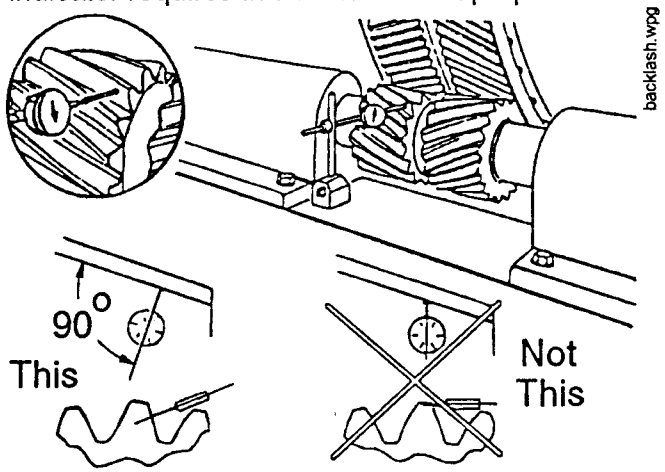
The chart below establishes approximate conversion from circular pitch (C.P.) to diametrical pitch (D.P.).

CONVERSION:

Circular Pitch ***FROM*** Inches (Millimeters)	Diametral Pitch ***TO*** Inches (Millimeters)
6.0 (152.4)	.5 (12.7)
5.5 (139.7)	.5 (12.7)
5.0 (127.0)	.625 (15.9)
4.5 (114.3)	.75 (19.0)
4.0 (101.6)	.75 (19.0)
3.5 (88.9)	.875 (22.2)
3.0 (76.2)	1.0 (25.4)
2.5 (63.5)	1.25 (31.8)
2.0 (50.8)	1.50 (38.1)
1.75 (44.5)	1.75 (44.5)
1.50 (38.1)	2.0 (50.8)
1.25 (31.8)	2.5 (63.5)
1.0 (25.4)	3.0 (76.2)
.875 (22.2)	3.5 (88.9)
.75 (19.0)	4.0 (101.6)

GEAR BACKLASH

All backlash values are given in the normal plane (perpendicular to the tooth face). Backlash checked with a dial indicator requires this device be set perpendicular to the teeth.



NOTE: Backlash is the amount by which a tooth space exceeds the thickness of an engaging tooth measured on pitch circles.

STEP 1 -- Clean the Worn or Fractured Part or Area to be Repaired or Rebuilt.

One of the most important considerations of a welding repair procedure is to clean the fractured area or worn part of all oil, grease, paint, moisture, dirt, rust spalled material, or any other material that may be detrimental to a weld.

Hydrogen has a bad effect on the properties of weld metal and can be found in most of the mentioned contaminates. As molten weld metal cools and solidifies, the hydrogen is rejected from the solution and becomes entrapped in the solidifying weld metal. It will collect at grain boundaries or at discontinuities of any type where it will create high pressures, which will in turn cause high stresses within the weld. Theoretically, these pressures and stresses could lead to minute cracks in the weld metal which could develop into larger cracks. Hydrogen will gradually escape from the solid steel over time.

Any spalled material should be air carbon arc gouged off or ground off because contaminates can be trapped under the spalled material. The spalled material may not allow the welding arc to penetrate to solid material.

Inspect the worn or fractured areas closely by visual inspection and/or nondestructive testing such as magnetic particle inspection or dye penetrant inspection. This will help determine the extent of the fracture. If one of the NDT techniques are used, make sure instructions on proper use are followed.

After testing decide whether to replace the part or risk the possibility of a potential future failure.

Some methods of cleaning a part are steam cleaning, blasting, or burning off the oils and greases with a torch. The cleaning process must be analyzed depending on how and where the part will be repaired and the type of material that requires cleaning. If heating torch should be used, make sure the operator of the torch is supervised closely. The flame should not be concentrated in one spot for long periods of time, but should be swept back and forth across the part. The burned ash can then be brushed off with a wire brush. Clean a large enough area around the fracture or worn part so that no contaminates reach the repair area.

STEP 2 -- Analyze and Inspect the Fractured or Worn Component for Proper Reporting.

The initial task is to seek out and compile as complete a history as possible of the failed or worn part. The following is a list of items that will be useful in analyzing the failure.

1. Determine when, where and how the failure occurred. Interview the operators.

2. What is the service history? Length of service? Was an accident involved? Have there been other similar failures?

EXAMPLES of CORRECT WELD REPAIRS

A sheave with a rope groove worn. Rebuild and keep as a spare.

STEP 1: Clean the sheave of all grease and oils for inspection of any fractures and clean it of contaminates that would be detrimental to welding.

STEP 2: Inspect the sheave visually and with magnetic particle inspection for signs of any other fractures. Compare the cost of rebuilding the groove with a new sheave. The decision is made to send the sheave to the manufacturer for rebuilding.

STEP 3: A review of the print shows the material is MN-MO cast material.

STEP 4: The sheave will be prepared for welding by sending it to the machine shop for a light clean-up cut to machine off any spalled material. The sheave will then be mounted on a welding positioner for rebuilding. Make a template to use as a guide to measure the depth of the weld metal.

STEP 5: Since the manufacturer has flame hardening equipment, a heat treatable type electrode will be used such as 4130 flux cored electrode and a constant voltage power source.

STEP 6: Use two preheating torches while rotating the welding positioner to preheat to 350°F (177°C). Use a temperature indicating device to continually check the preheat throughout the welding operation.

STEP 7: With automatic welding equipment, start welding at the center of the groove and as the groove builds up, start each layer at the groove walls and work to the center. Clean each pass of slag. Use the template to determine the correct amount of weld metal build up for machining. Once preheating has begun, do not stop until the job has been completed.

STEP 8: Since the part cannot be stress relieved in a furnace because of the machined hub, continue postheating the groove area for one hour. Keep the heat at 350°F (177°C) to 450°F (232°C).

STEP 9: Slow cool by turning the torches down while the sheave is still rotating so it cools at a rate of 50°F (10°C) per hour until it reaches 150°F (66°C).

STEP 10: After the sheave has cooled down to ambient temperature, inspect the weld visually and by magnetic particle inspection.

STEP 11: Send the sheave to a machine shop for re-machining to the contour of the drawings.

STEP 12: Flame harden the groove.

For other classes of wire rope not mentioned above, it may be necessary to add additional clips to the number shown. If a greater number of clips are used than shown in the table, the amount of rope turn-back should be increased proportionately. *THE ABOVE IS BASED ON THE USE OF CLIPS ON A NEW ROPE.*

IMPORTANT: Failure to make a termination in accordance with aforementioned instructions, or failure to periodically check and re-tighten to the recommended torque, will cause a reduction in efficiency rating.

The correct spacing and number of clips is shown below.

WIRE ROPE CLIP SPACING

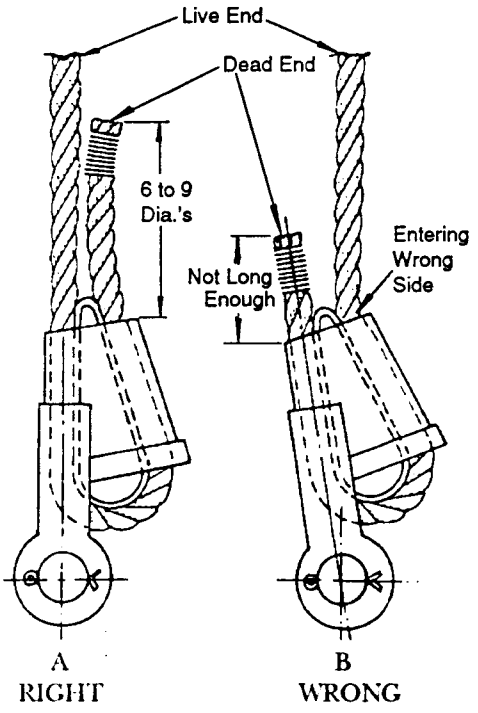
Rope Diameter (inch)	Rope Diameter (mm)	Clips	Space (inches)	Space (mm)
5/8	15	3	4	101
3/4	19	4	4-1/2	114
1	25	4	6	152
1-1/4	31	5	7-1/2	190
1-1/2	38	6	9	228
2	50	8	12	304
2-1/2	63	8	15	381
3	76	9	18	457

WEDGE SOCKETS

One of the more popular end attachments for wire rope is the *wedge socket.* for field, or on the job attachment, it is easily installed and quickly dismantled. The procedure is simple:

1. Inspect the wedge and socket; all rough edges or burrs, that might damage the rope, should be removed.

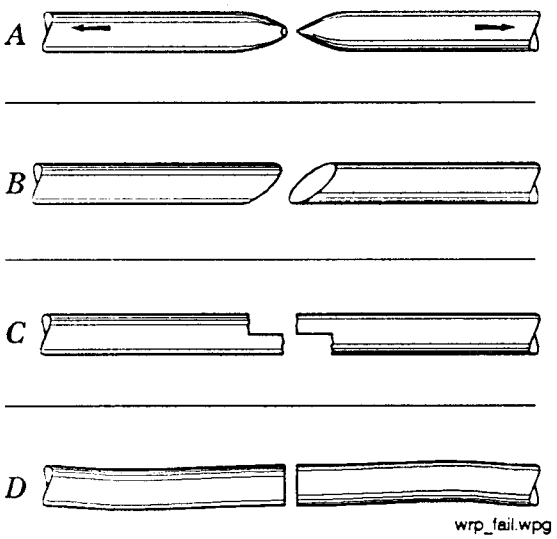
2. If the end of the rope is welded, the welded end should be cut off. This will allow the distortions of the rope strands, caused by the sharp bend around the wedge, to adjust themselves at the end of the line. IF the weld is not cut off, the distortions will be forced up the working line. This may result in the development of high strands and wavy rope.



wrpsckts.wpg

WEDGE SOCKET

A wire broken under a tensile load that exceeds its strength is recognized by the "cup and cone" configuration at the fracture point (Rope A). The *necking down* of the wire at this point shows that failure occurred while the wire retained its ductility. Shear-tensile fracture (Rope B) occurs in wire subjected to a combination of transverse and axial loads. Fatigue breaks are usually characterized by squared-off ends perpendicular to the wire either straight across or Z-shaped (Ropes C and D).



wrp_fail.wpg

TYPES of WIRE ROPE FAILURE

— INSPECTION SCHEDULES —

SHOVEL NO.: DATE:

PRE-SHUTDOWN CHECKS	SERVICE HOURS 250	500	1000	REMARKS
1. LUBE SYSTEM: a) Check the operation of all injector blocks (upper and lower) for grease (MPG) and open gear lube (OGL).	x			
2. GENERAL: a) Check for unusual noises from inside the machinery house while operating.	x			
b) Take temperature readings of all motion gearcases: Hoist:_____ Swing-L:_____ Swing-R:_____ Propel-1:_____ Propel-2:_____ Crowd-1:_____ Crowd-2:_____	x			
c) Check that all fans and blowers are operational	x			
d) Check the center journal. Adjustment required if the lift off the roller path is greater than 15 mm.	x			
3. GENERAL COMMENTS / WORK DONE:				

Ensure that the machine is positioned firmly and safely on level ground. Attach "DANGER" and "OUT OF SERVICE" signs where necessary. Remove signs on completion. Samples of any oil "dropped" must be taken and marked. Indicate work performed or condition of component or OK if no repairs required in space provided under each inspection description.

Consult service/shop manual for specific details.

SHOVEL NO.: DATE:

INSPECTION SCHEDULE	SERVICE HOURS 250	500	1000	REMARKS
FRONT END *3. DIPPER:* a) Shrouds - weld on new if required.	X			
b) Teeth - replace if required.	Daily			
c) Adapters - replace if required.	Daily			
d) Dutchman - repair if required.	X			
e) Latch Bar - check.	X			
f) Latch Lever - check.	X			
g) Shim Box - check and repair if required.	X			
h) Trip Chain - check.	X			
i) Trip Lever - check. Also check rope attachment.	X			
j) Dipper and Door - check for cracks.	X			
4. HOUSEKEEPING: a) Check all tools, parts, oil, rags, paper, debris, and cleaning fluids are removed from machine when service is completed.	X	X		

5. EXTRA WORK:

a)

b)

c)

d)

[Chart #1]

351M MINING SHOVEL
PROJECTED MAINTENANCE SCHEDULE

DESCRIPTION	QTY/ MACH.	OPERATING HOURS X 1000									
		10	20	30	40	50	60	70	80	90	100
Front Idler											
Wheel (Fin.)	2			R			X			X	
Bushing (Wheel)	2		R	R		R	R		R	R	
Shaft	2		R	X		X	R		R	X	
Thrust Washer	4		R	X		R	R		R	R	
Load Roller (small dia.)											
Wheel (Fin.)	16		R	X		X	R		R	X	
Bushing (Wheel)	16		R	R		R	R		R	R	
Shaft	16		R	X		X	R		R	X	
Thrust Washer	32		R	R		R	R		R	R	
Load Roller (small dia.)											
Wheel (Fin.)	2		R	X		X	R		R	X	
Bushing (Wheel)	2		R	R		R	R		R	R	
Shaft	2		R	X		X	R		R	X	
Thrust Washer	4		R	R		R	R		R	R	
Final Drive Shaft											
Sprocket Wheel	2		W	R		W	R		W	R	
Bearing (Outboard)	2			R			R			R	
Seal (Sprocket)	4			R			R			R	
Bearing (Inboard)	2			R			R			R	
Seal (Cartridge)	2			R			R			R	
Seal (Gearcase Cplg)	2			R			R			R	
Shaft	2			R			R			R	
Shoe Slide Bars											
Slide	12	W	W	R	W	W	R	W	W	R	
Propel Gearcase											
Gearcase Assembly	2			R			X			X	

X = Exchange for Rebuild R = Replace W = Weld Repair

DANGER: **NEVER USE EMERY CLOTH OR EMERY PAPER. Emery conducts electricity. Serious injury to personnel and equipment results.**

Commutation not corrected by simple remedies should be reported to the electrical equipment manufacturer.

PROPER LUBRICATION

Proper lubrication of bearings requires following this established procedure for all general conditions. First, be cautious against over-greasing. Establish a happy medium, keeping in mind that excess lube accumulates on armatures and windings, causing electrical failure. Lubricate all bearings on new equipment according to the chart below for the first day of service, and every 6 months of actual operation after that. Add lubricant until a small amount of lube appears at the shaft, or starts out the bottom drain hole in the bearing housing (with the plug removed). After the first day of service, lube the equipment while it is at operating temperature.

NOTE: Many small motors use sealed bearings that require no lube for 2 to 3 years. Add lube with the units stopped and the drain plug removed. Run the generator or motor with the bottom plug removed for a few minutes to allow ALL the excess lube to flow out. *REPLACE THE DRAIN PLUG*. In most cases, the main hoist, drag and swing motors have no plug to remove. Surplus grease flows out in the pocket beneath the bearing housing.

On vertical and a few horizontal motors, remove the plug as is done with generators. As mentioned in the 6 month lube procedure, these bottom plugs are removed before lubing, to see that excess lube escapes. Probing with a clean wire assures that the old grease has not hardened and blocked the passage. *REPLACE THE DRAIN PLUG*.

Bearing Lubrication Data - *Table 1*

Shaft Dia.		Lube	
(inches)	(mm)	(ounces)	(grams)
1	25.4	.5	14.2
2	50.8	2	56.7
2.5	63.5	3	85.0
3	76.2	4.5	127.5
3.5	88.9	6	170.0
4	101.6	8	226.8
4.5	144.3	10	283.5
5	127.0	12.5	354.4
5.5	139.7	15.5	439.4
6	152.4	18	510.3

In conclusion, a good troubleshooter attack plan includes:

- Adequate preparation including:
  - — Understanding the system and its components.
  - — Availability of wiring diagrams and test data.
  - — Quality test equipment designed for the job.
- Preliminary investigation to determine the effect of the fault.
- Estimation of the probable cause.
- Testing for determining the faulty part.
- Correction of the failure.
- Preventive maintenance.

2.0.0 INSTALLATION AND COMMISSIONING

Time spent ensuring the preparation for installation will pay dividends by reducing service requirements during operation.

2.1.0 Installation

Ensure the following:

- Area is clean, flat and strong enough to support the system.
- Adequate space is provided around the unit for service and air flow.
- There is nothing underneath which will obstruct airflow or distribution.

Mark out supply and return cutouts either from the drawing or the roof sealing frame AS900606. Carefully cut out apertures. Place sealing frame in position, and tack corners. Check that supply and return air plenum support assemblies fit. Some grinding may be required on the inside edge of the roof sealing frame assembly to provide clearance.

The support assemblies AS9006096 (return and supply) should mount with the drilled angle level - or near to - the ceiling. The supply and return air plenums bolt to these frames. The skirt of the mounting assembly can then be cut to suit and welded in position.

The roof sealing frame should then be welded to the roof, well sealed, and painted.

Lift the air conditioner into position making sure that the casing to cab seal is firmly in position on the underside of the unit prior to final positioning. Lower the unit down onto the sealing frame.

The mounting channels have holes on the bottom for mounting to studded bar, thus enabling ready removal of unit.

5.0.0 SPARE PARTS

5.1.0 Evaporator

Balloon #	380/415/460	525/575	Qty.	Description
55	AS900687	AS900687	1	Evap. Lid Assembly
35	AS900672	AS900672	1	Supply Air Fan Base Assy.
34	319-C057	319-C059	1	Supply Air Fan Motor
47	521-C026	521-C026	1	TX Valve
40	522-C002	522-C002	1	Liquid Line Solenoid Valve
42	523-C036	523-C036	1	Low Pressure Cutout 40/18 psi
43	523-C040	523-C040	1	High Pressure Cutout 300/210 psi
30	120-C024	120-C024	1	Evaporator Coil
32	410-C066	410-C066	1	Blower Wheel
	519-C005	519-C005	2	Pressure Switch Access Port
	UC901	UC901	6	Supply Air Vent
	AS9006110	AS9006110	1	Return Air Filter Assy.
31	691-C036	691-C036	6	Heater Element
	S9006109	S9006109	1	Return Air Filter Media
44	681-C004	681-C004	1	High Temperature Switch #1
45	681-C042	681-C042	1	High Temperature Switch #2

NOTE: Refer to Dwg. P9006005 For Balloon Help

7.0.0 RECOVERY OF REFRIGERANT

Although HFC134a is environmentally friendly, it is still good practice to recover refrigerant prior to opening up the system. Devices are fitted to minimize the amount required, but venting to atmosphere is to be avoided.

The lubricant is a POE style, and does not mix with other mineral oils.

A dedicated recovery unit should be used, as should a gauge set.

MATERIALS SHOULD NOT BE MIXED WITH R12, R22, MP39, OR OTHER REFRIGERANTS.