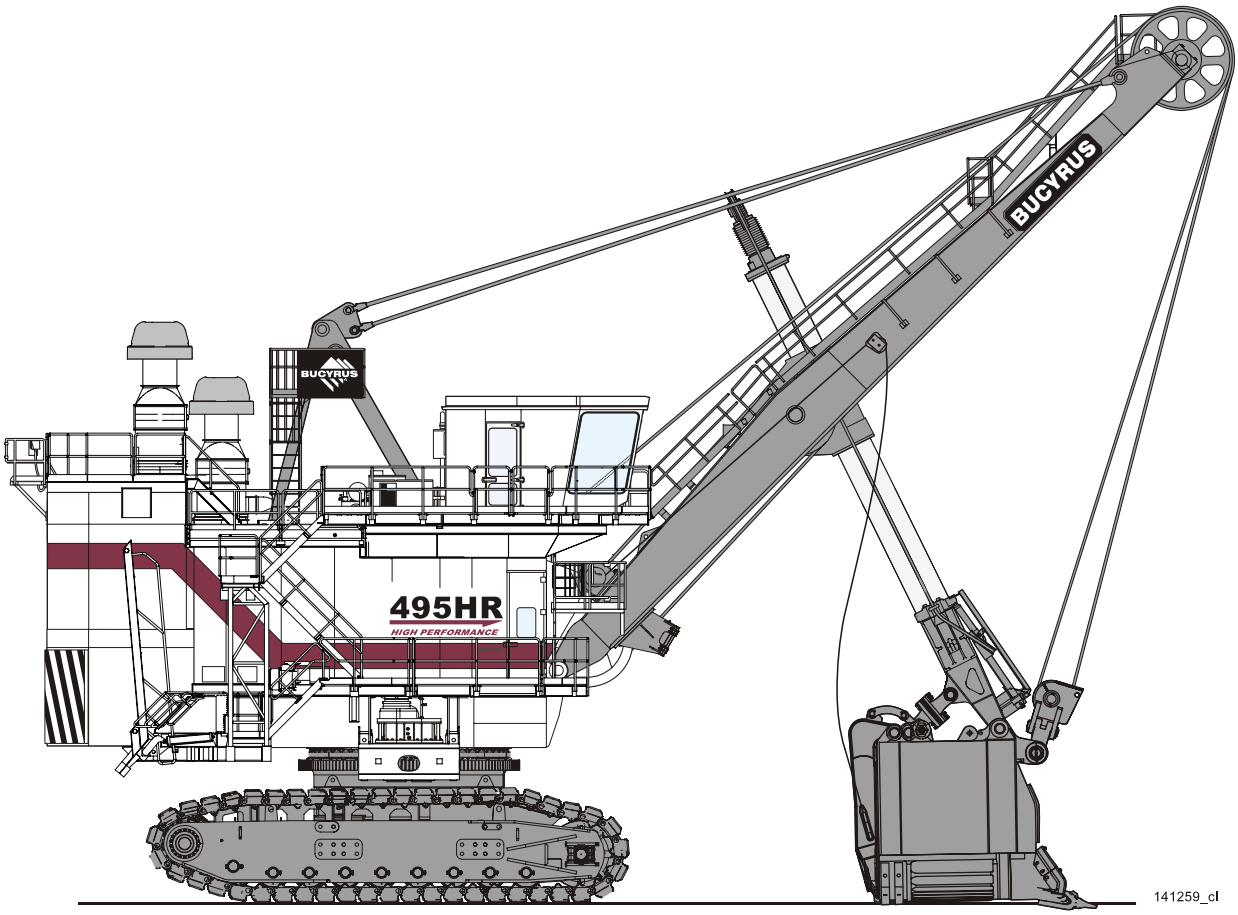
BUCYRUS®

495HR
MINING SHOVEL
MAINTENANCE and OPERATION MANUAL

SN: 141259
SN: 141263
SN: 141268

Manual No. *10692*



141259mc.cdr Pg.1

Bucyrus International, Inc.

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

495HR Electric Mining Shovel
Maintenance and Operation Manual

Manual No. 10692

SN: 141259 Lot 104 • SN: 141263 Lot 107 • SN 141268 Lot 112

Table of Contents

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

SAFETY

SECTION 1 - INTRODUCTION

MACHINE OVERVIEW

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

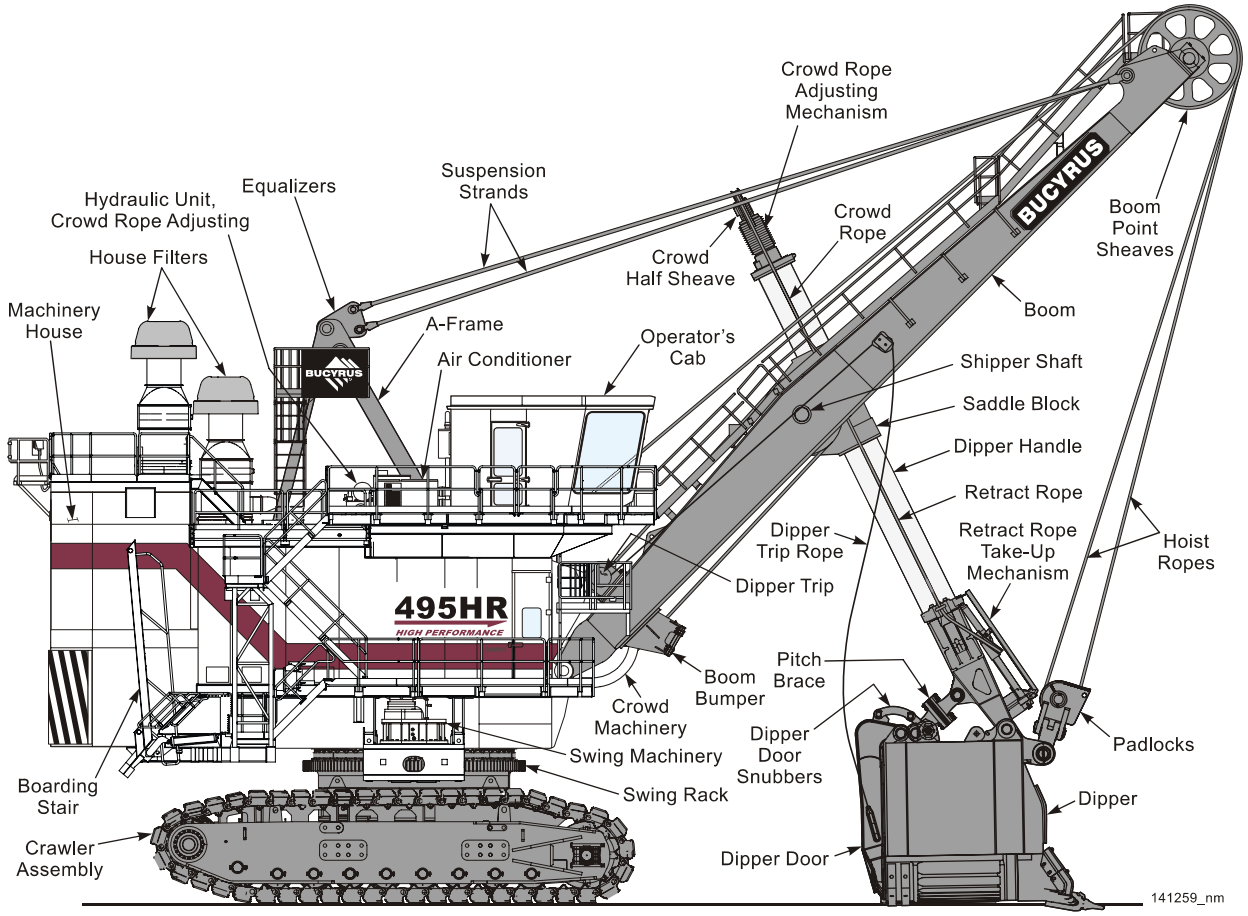


Figure 1-1: Nomenclature

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.

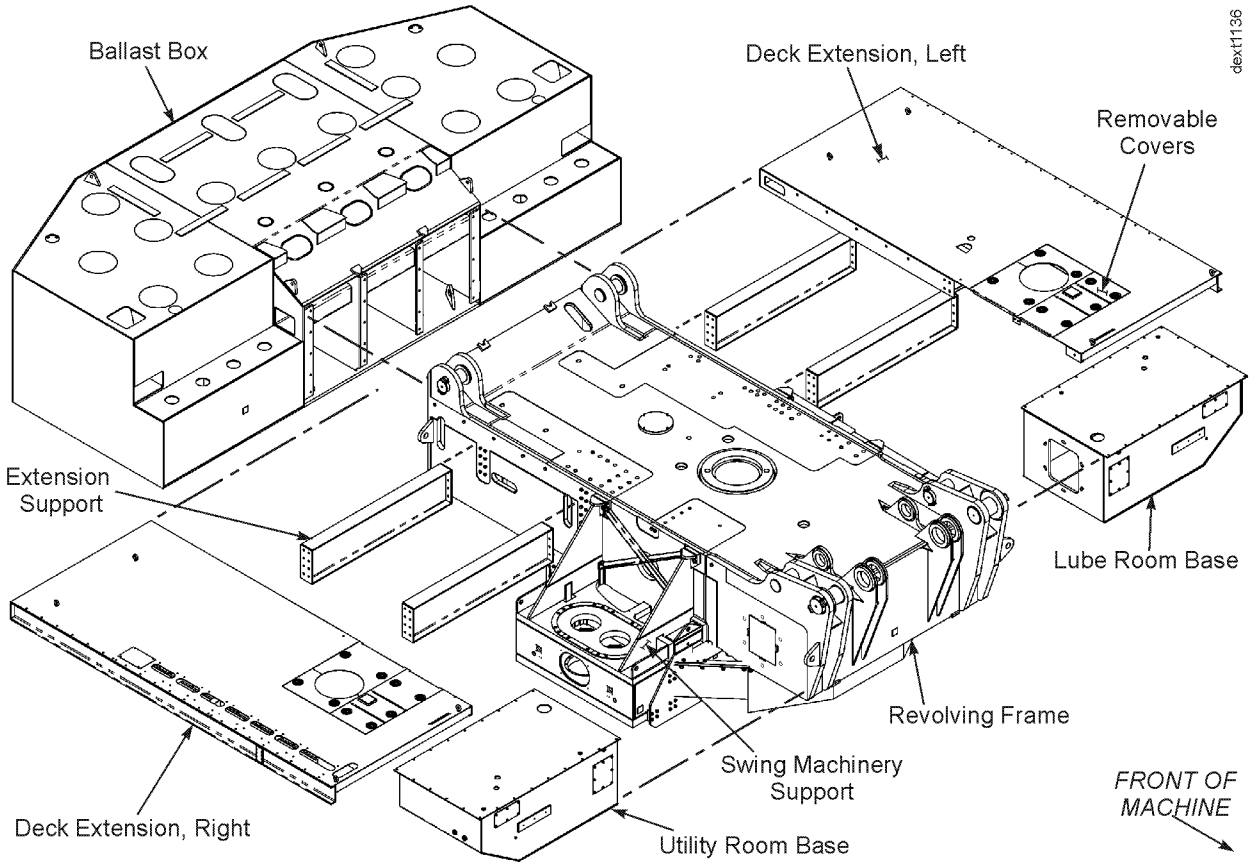


Figure 1-6: Deck Extensions and Ballast Box

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

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.

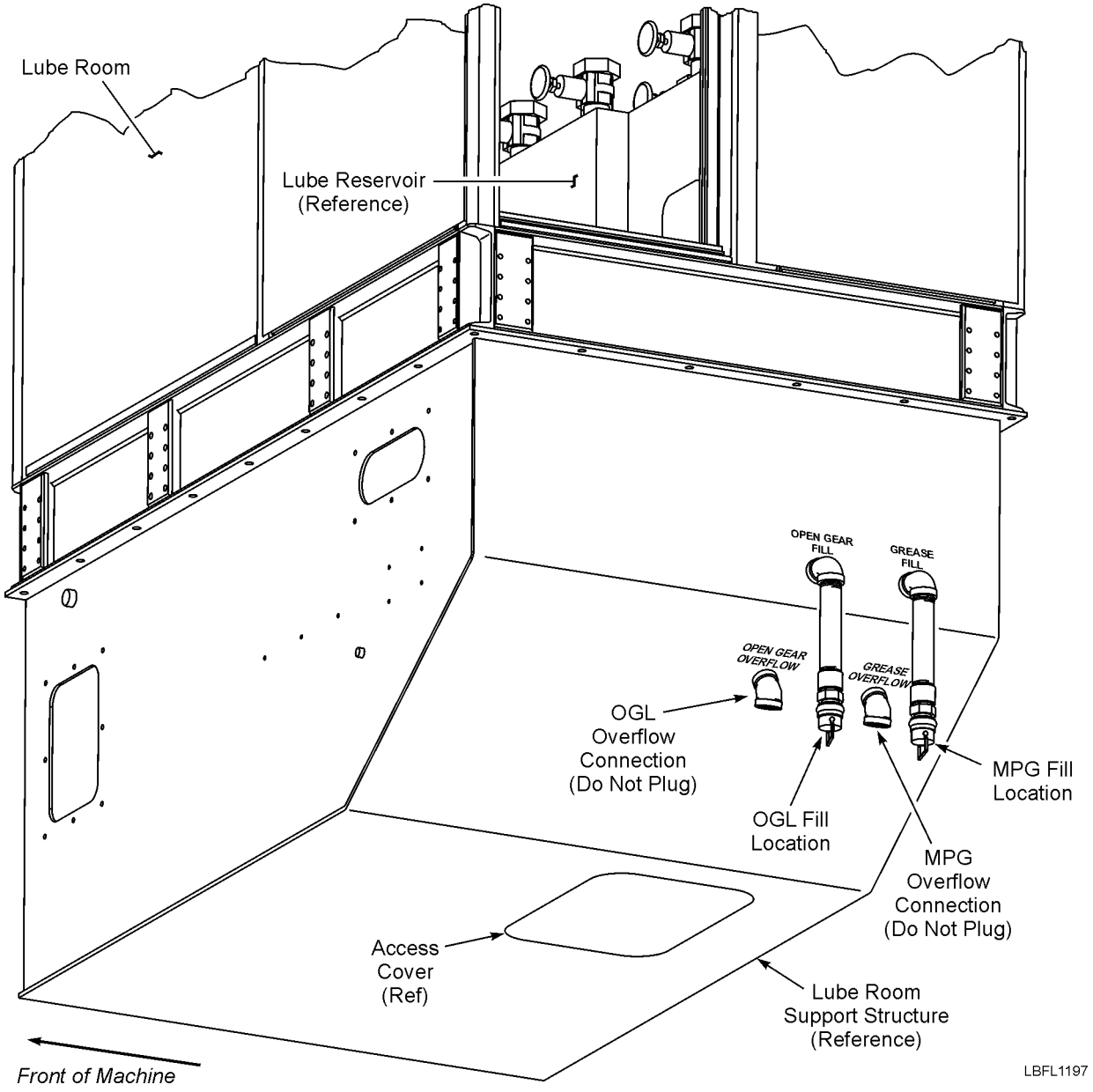


Figure 1-12: Lube Reservoir Fill / Overflow Plumbing

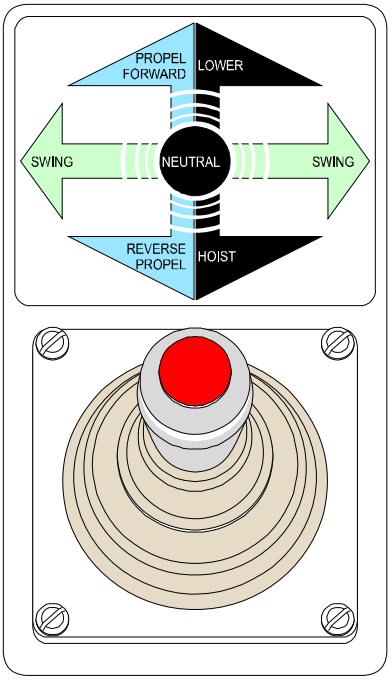
GENERAL ESTIMATED COMPONENT WEIGHTS

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

LOWER WORKS

	Quantity	*Weight Each (U.S. Pounds)*
Truck frame	1	191,430
Pintle bushing	1	280
Lower rail	9	570
Thrust rail	9	170
Propel brake adapter	2	370
Propel brake	2	650
Propel brake hub	2	60
Propel motor	2	4,500
Propel motor blower	2	210
Propel motor duct assembly	2	185
Propel brake guard	2	60
Coupling	2	130
Crawler belt (2 per machine)	2	244,000
Crawler link, 102 In. (47 per belt)	47	2,500
Crawler assembly~shipping	2	128,500
Crawler structure	2	74,750
Propel gearcase	2	15,840
Front iIdler	2	5,800
Front idler shaft	2	1,150
Adjusting block	4	370
Load roller	8	2,020
Load roller shaft	8	550
Rear idler	2	3,800
Rear idler shaft	1	700
Drive tumbler	1	7,120
Drive shaft assembly	1	4,330
Drive shaft	1	3,370
Center pintle sleeve	1	9,100
Center pintle upper collar	1	380
Center pintle thrust washer	1	400
Center pintle lock nut assembly	1	1,470

RIGHT JOYSTICK



omsr1136

The right joystick controls the hoist/swing and propel. It is a joystick mounted on the right console of the operator's seat. The joystick is used to control the hoist, swing and right crawler motions of the machine. The position of the propel transfer switch will determine whether this switch controls the hoist motion or the crawler motion.

With the propel transfer switch in the dig position, pushing the joystick forward will lower the dipper. Pulling the joystick to the rear will hoist the dipper. The neutral position between the hoist and lower functions is defined by a detent that is easily felt. The speed of moving the dipper is controlled by varying the distance the joystick is moved from the neutral (center) position. The full forward, or full rearward position provides maximum speed to the dipper. Moving the joystick to neutral will cause a braking action slowing the hoisting or lowering motion. Reversing the joystick will cause the motion to stop and if the joystick is held in this position, it will change the direction of the motion.

NOTE: When the right joystick is used in the hoist/lower mode the switch is a spring returned switch. That is, it will return to the neutral position when it is released.

Moving the right joystick to the left from the neutral position will cause the machine to swing to the left. Moving the joystick to the right will cause the machine to rotate to the right. The swing motion is operational throughout the entire movement range of hoisting or lowering the dipper. The swing rate of acceleration is controlled by varying the distance the joystick is moved from the neutral position. Moving the joystick to the neutral position will not stop the swing motion but will allow the machine to coast. To stop or change direction the control joystick is moved past the neutral point in the opposite direction. The rate of deceleration is controlled by varying the distance the joystick is moved from the neutral position in the opposite direction.

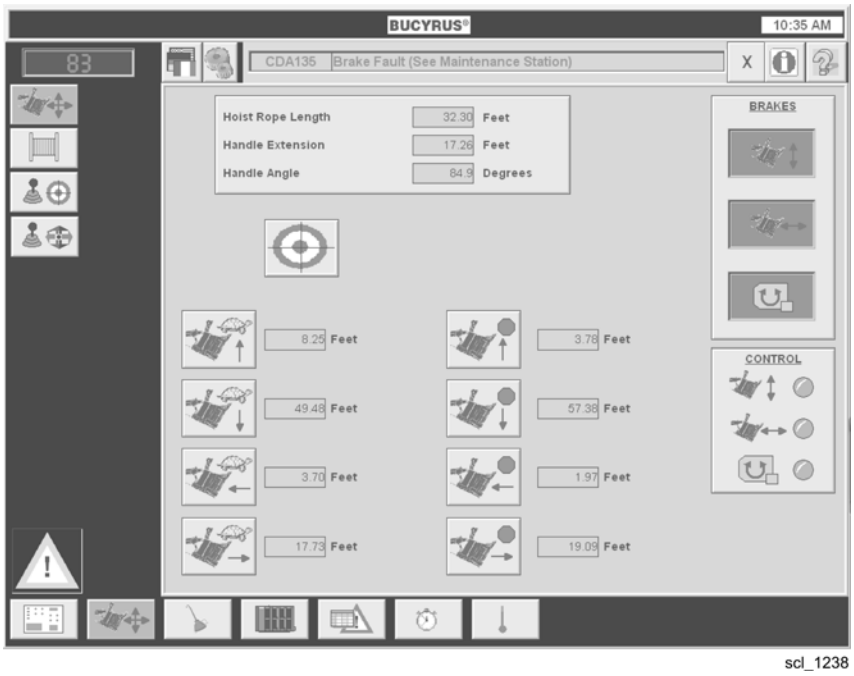


Figure 2-11: Calibration Limits

The Calibration screen is used to set the various limits required to control the movements of the machine.

On this screen can be found switches for the hoist, crowd and swing brakes along with status indicators for each.

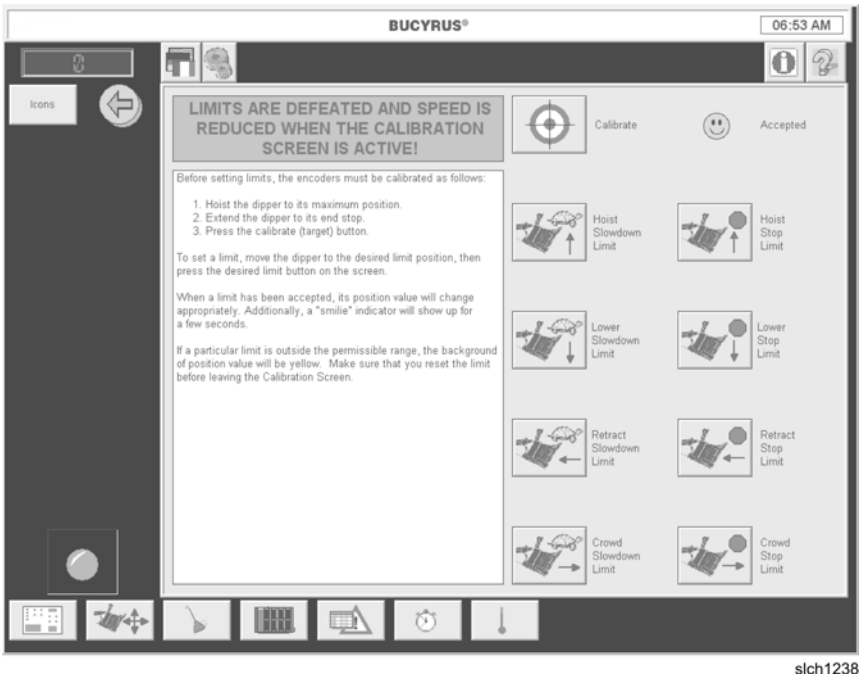


Figure 2-12: Limit Calibration Help

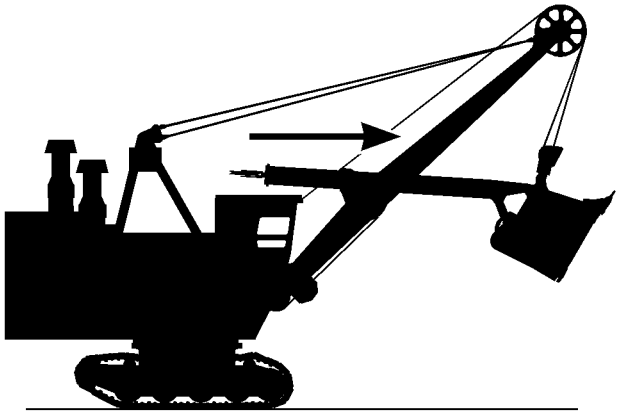
This screen will provide clarifying information on the calibration process.

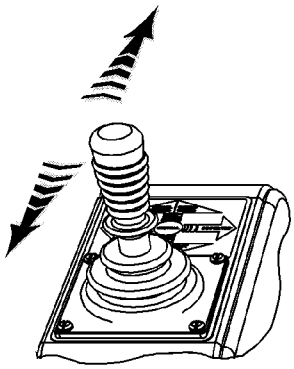
CROWD MOTION

Crowd motion is controlled by the operator's left joystick. Move the joystick to crowd and retract the dipper handle until a "feel" is developed for the limits and speed of the motion.

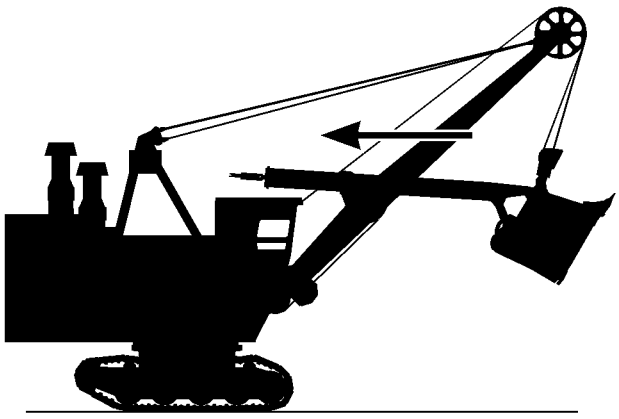
CAUTION: This joystick also controls the signal horn and dipper trip.

To ***CROWD***:
Push the *Left* Joystick Forward, away from the Operator.



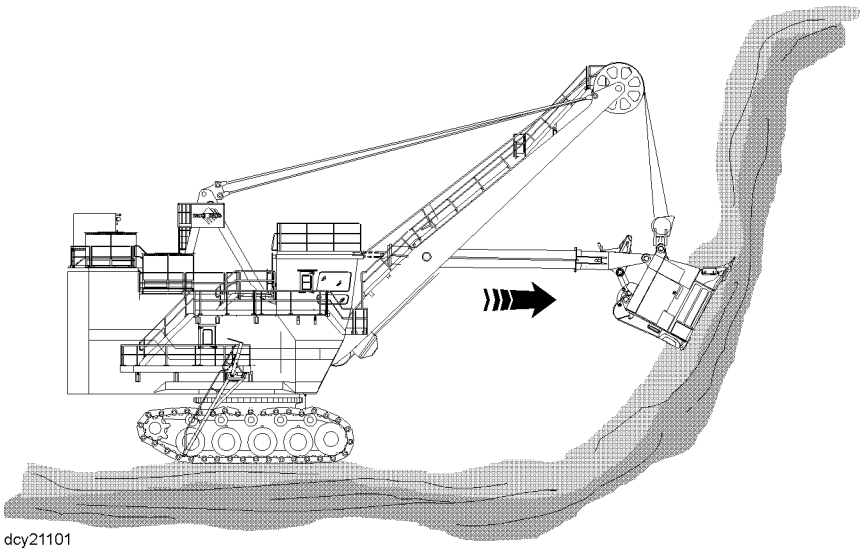


To ***RETRACT***:
Pull the *Left* Joystick Back, toward the Operator.

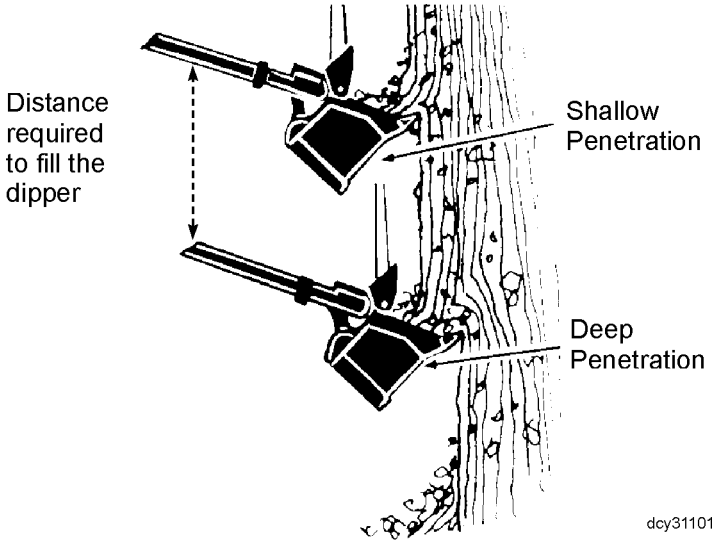


opcw1136

Practice the crowd and retract functions until the movement can be stopped smoothly. Combine the crowd and hoist functions and practice until smooth coordinated motions and subsequent machine effectiveness is achieved.



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.



Shallow bank penetration of the arc of entry and rise is ineffective and inefficient. A shaving cut dribbles material into the dipper resulting in voids and making additional passes necessary while accelerating dipper lip wear.

NOTE: A deeper bite = quicker fill times

Section 3
Lubrication

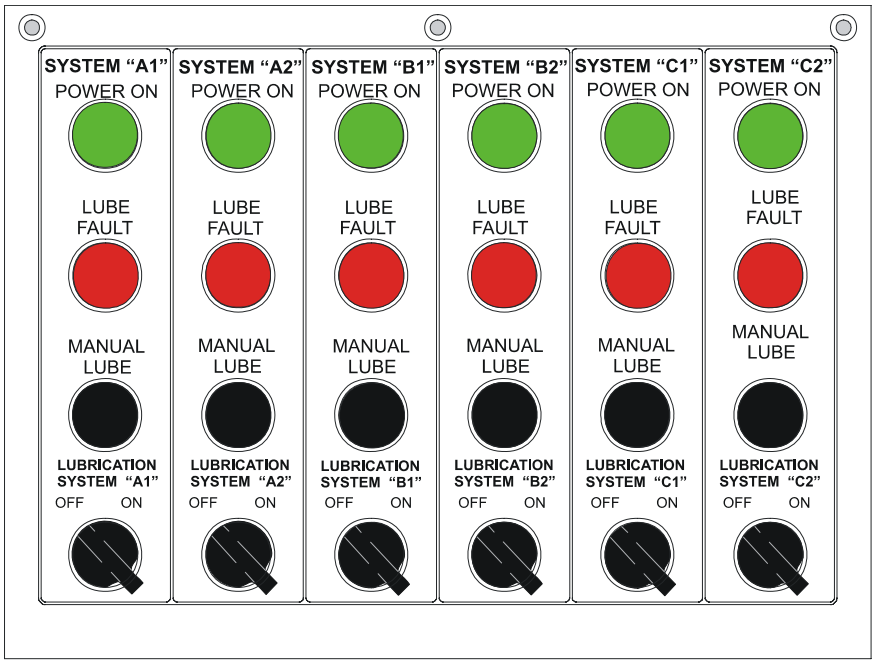
Always refer to the safety section of this manual before starting any maintenance procedure on this machine.

Table of Contents

AUTO LUBE CONTROL PANEL

The automatic lubrication control panel is mounted on the inboard most wall of the lubrication room. The panel provides the switches and override functions required to activate, reset and override the automatic functions.

POWER ON	Allows electrical power to energize the system.
LUBE FAULT	A light that, when lit, indicates that a fault is present in that system. Reset the fault by turning the affected system OFF and then ON.
MANUAL LUBE	A pushbutton that will disperse (on command) 1 measured quantity of lubricant to the injectors on that system.
ON /OFF	Energizes the system for normal operation.



lcpn1101

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 1/2 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.

OIL PUMP

The heart of the power unit is the hydraulic pump. It is self-lubricating. Preventive maintenance is limited to keeping the system fluid clean. This is done by changing the filters frequently. The recommendations listed below are a minimum requirement.

All return line filters and pressure filters should be changed a minimum of two times per year or, upon the visual or electrical indicator signaling otherwise.

The suction strainer (immersed below the oil level in the reservoir) should be cleaned once a year or every 4000 operating hours. The suction strainer should be removed from the reservoir and can be cleaned with compressed air, blowing from the inside out. If there are holes in the mesh or if there is mechanical damage, the strainer should be replaced. It is especially important that the suction or inlet piping and fittings be tight and in good condition to prevent air from being drawn into the pump.

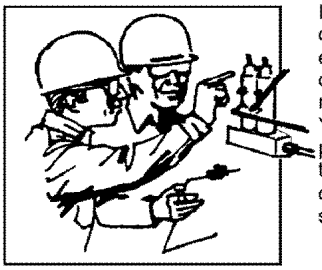
The reservoir air breather should be changed or cleaned once a year or every 4000 hours. The air breather filters all air drawn into the reservoir.

IMPORTANT! Failure to change or clean this filter can result in pump failure.

The electric motor requires very little attention when kept clean and dry.

INJECTOR ADVANTAGES

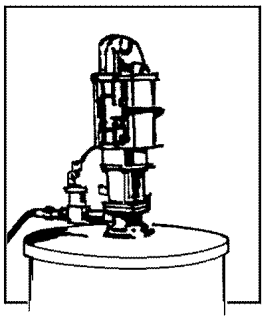
SIMPLICITY



Lincoln Centro-Matic is not only simpler and less expensive to install than other systems-it is also much easier to understand. Your maintenance personnel will appreciate the ease with which they can learn the operation and service of Centro-Matic.

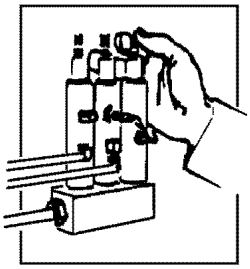
POWERFUL PUMPING UNIT

Lincoln's Power-Master pump widely recognized as a most powerful, trouble-free pump, so much so, that Lincoln Power-Master pumping units often are specified even where other centralized lubrication systems are used.

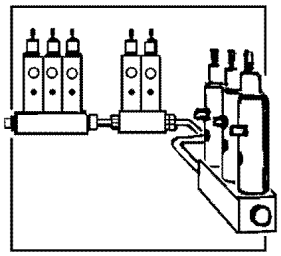


EXTERNAL ADJUSTMENT

A micrometer-type adjustment makes each injector (metering device) adjustable externally, without special tools. The Lincoln Centro-Matic System permits lubricant adjustments to meet actual bearing requirements - not just an approximation, as with all other systems.

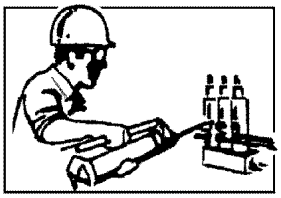


EXTREME PUMPING DISTANCE



Single-line design and powerful pumping unit permit installations at long distances from original refinery containers of bulk tanks to point of application. And if you plan to expand your operation, the Lincoln Centro-Matic System has the design and capacity that lets you do it - normally without adding booster pumps and controls.

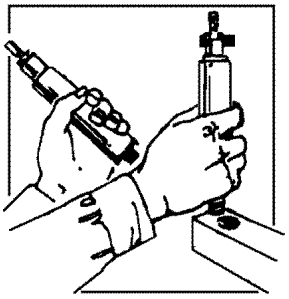
BUILT-IN GREASE FITTING



Lincoln Centro-Matic is the only system that has a capped grease fitting on the injector. This permits easy filling of lines when the system is installed. It also allows hand lubrication of the machine in the event of a pump or power failure, damage to the supply line, or even a malfunction in the air system. NO OTHER SYSTEM OFFERS THIS! The built-in grease fitting can also be used as an inspection system. When the cap is removed, the lubricant normally metered to a bearing will come out of the grease fitting head.

EASY INJECTOR REPLACEMENT

Should the Lincoln injector ever need replacing, it can be done quickly and easily without disturbing adjacent injectors or removing the supply line connections - does not require machine shutdown as do all other systems. As a matter of fact, injector replacement usually can be done between lubricating cycles, thus preventing lubricant loss or machine downtime.



injadvan

AIR COMPRESSOR LUBRICANT

Quin-Cip lubricant has proven under extensive testing to minimize friction and wear, limit lubricant carryover, and reduce carbon and varnish deposits. It will support the performance characteristics and life designed into all Quincy compressors and is highly recommended.

OGL - OPEN GEAR LUBRICANT

SD4713 (August 18, 2005)

SCOPE

1. This specification covers “Open Gear Lubricant”.
2. Materials furnished under this specification are primarily intended to lubricate open gears, but may also be used to lubricate racks, bushings, rails, rollers, dipper handles and propel mechanism components.
3. The material furnished under this specification must be dispensable through the distribution lines of a centralized lubrication system to the most remote application point, at the lowest anticipated operating temperature. It must not plate or plug components of the centralized lubrication system such as injectors, metering blocks, or spray nozzles.
4. This specification covers open gear lubricants that may be applied in service at temperatures ranging from -50°C (-58°F) to the highest ambient temperature conditions. The particular grade or consistency selected must perform within the specific temperature range in which it is utilized.

PHYSICAL CHARACTERISTICS

1. Materials furnished under this specification may be asphaltic (bitumen) compounds, or blends of a thickener and mineral oils and/or synthetic fluids. They may be in the form of viscous fluids, semi-fluid greases or pastes.
2. Materials furnished under this specification are produced with highly fortified blends of viscous fluids combined with additives to form stable, long lasting, high load carrying, wear resistant films that lubricate under mixed film and boundary conditions.
3. Open gear lubricants supplied under this specification must have excellent adhesive and cohesive qualities, must not chip or throw off, and must provide sufficient film thickness and scuffing resistance to prevent metal to metal contact between applications under all operating conditions.
4. Various grades or consistencies of open gear lubricants may be required to provide proper lubrication and application properties over a wide range of ambient temperatures. The consistency of the lubricant as applied must be appropriate for the method of application, and the in-service consistency shall be appropriate for the lubricant to meet or exceed the minimum performance requirements listed in the "MINIMUM PERFORMANCE REQUIREMENTS" section.
5. Viscosity, a fluid's resistance to flow, is the principal physical characteristic of a fluid in terms of its ability to produce a lubricating film between two interfacing surfaces. All lubricating fluids possess a natural viscosity that may be altered (enhanced) by additives such as resins or polymers. Some "viscosity enhancers" are shear sensitive, which could result in insufficient protection of the lubricated components under high load, elevated temperatures and/or high shear conditions. The viscosity of the fluids utilized in the open gear lubricants shall be sufficient under operating conditions for the product to meet or exceed the performance requirements listed in the "MINIMUM PERFORMANCE REQUIREMENTS" section.
6. Open gear lubricants supplied under this specification must be specifically formulated to protect surfaces, reduce wear, and provide satisfactory service life under all anticipated operating conditions.
7. Open gear lubricants supplied under this specification must have excellent water tolerance and rust preventive qualities, as well as minimal dripping qualities for operation over wide temperature ranges.
8. Should the material furnished under this specification contain a diluent to improve dispensability, special care must be exercised to ensure its compatibility with all centralized

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.

✓	Check Points - Every 500 Hours or Monthly		
	Location	***Check***	***Noted Discrepancy***
	31. Dipper Trip Rope	Inspect the ropes, replace badly worn, frayed or damaged ropes.	
	32. Hoist Drum Lagging Grooves	Check for damage and excessive wear.	
	33. Upper Rail Clamps	Tighten the clamps and verify the integrity of the rail end chocks.	
	34. Propel Planetary Gearcases	Pull the bottom plug and collect a 1/2 gallon of lubricant. Inspect the sample for metal particles.	
	35. Boarding Stairs and/or Boarding Ladders	Check all components, including: safety chain and gate, mounting bolts, hydraulic line and fittings, cylinder pin, arm pins and pin retainers. Replace any worn or damaged components. Lubricate the arm pins and cylinder pins. Check the lock pin and lubricate as necessary.	

Date:	
Shift:	
Inspected by:	
Supervisor:	

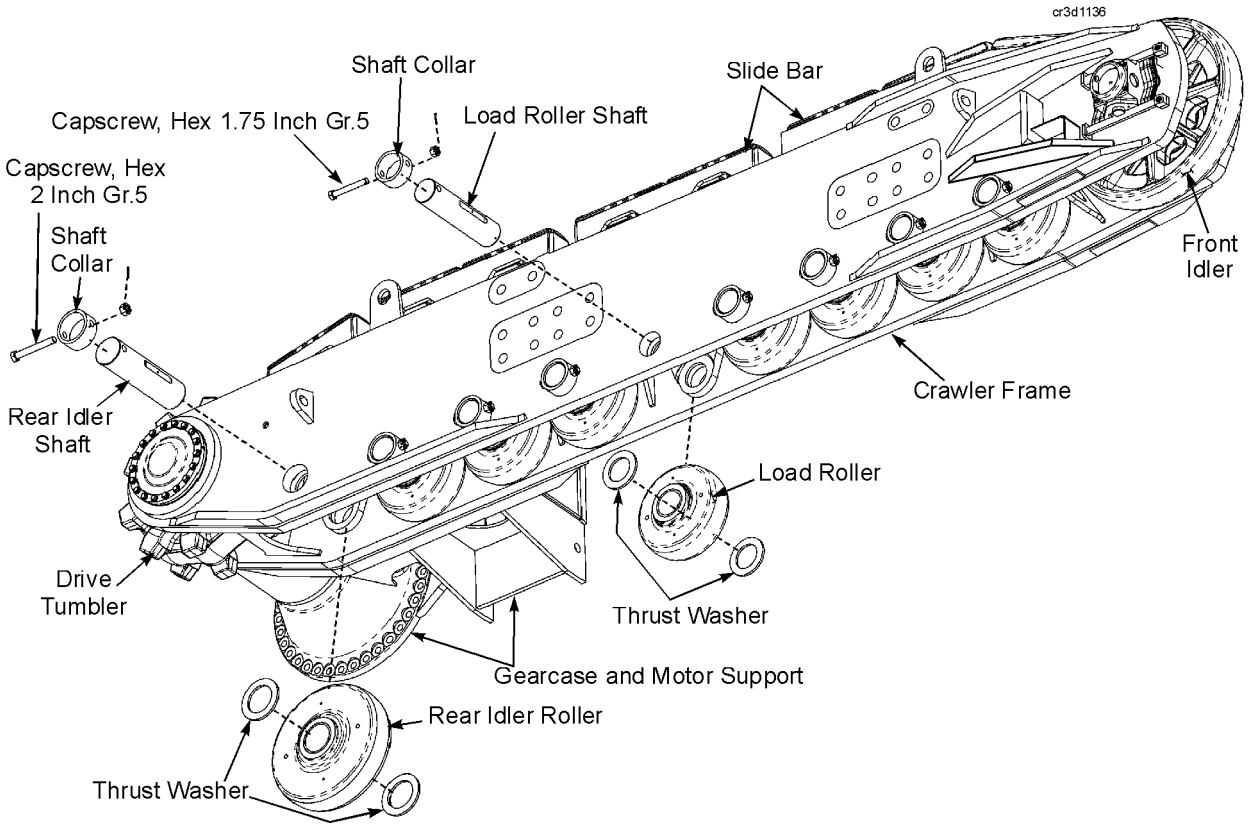


Figure 4-3: Crawler Assembly

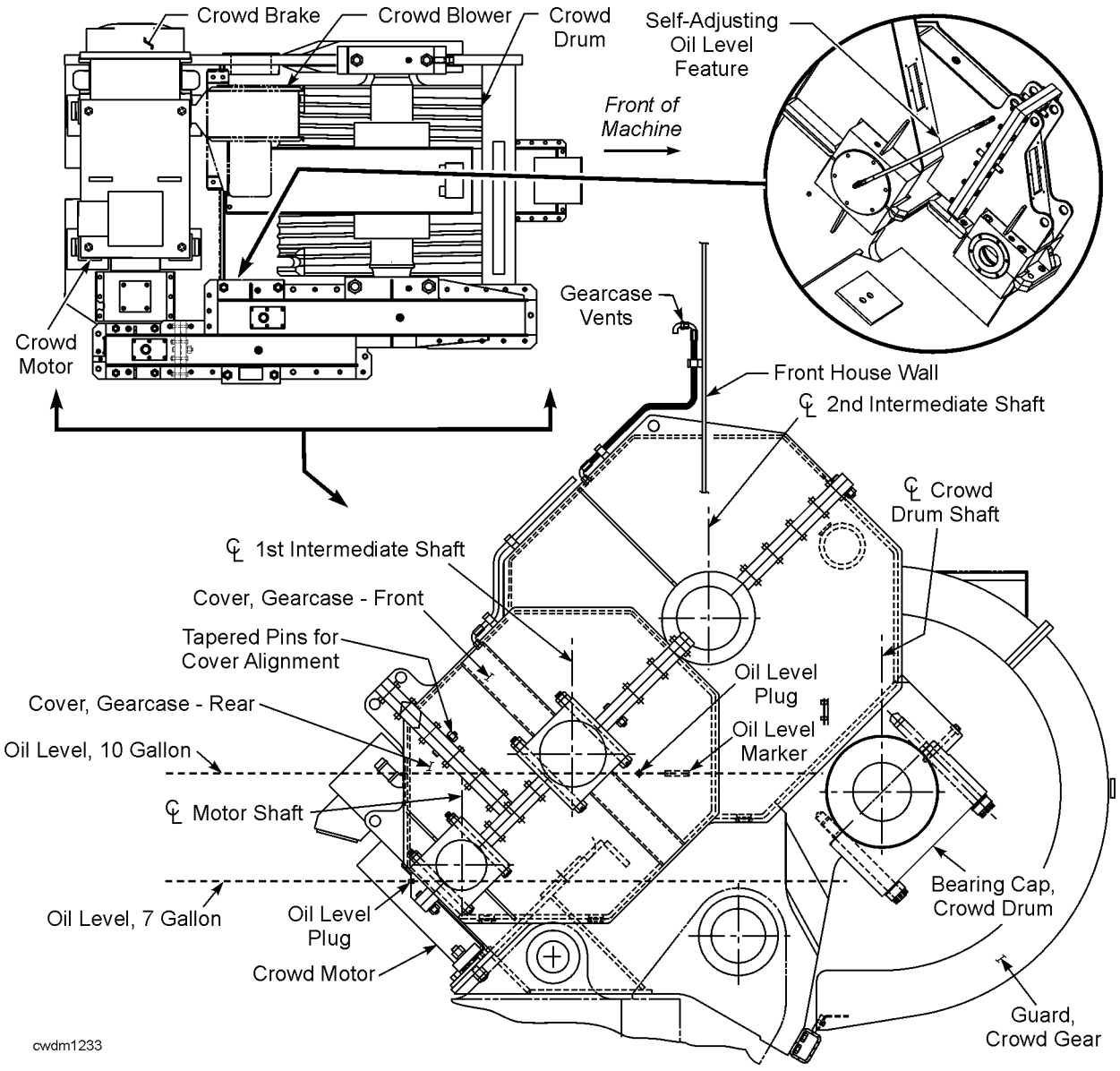


Figure 4-14: Crowd Machinery

Section 5
Service Procedures

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

Table of Contents

ROLLER CIRCLE ASSEMBLY

The roller circle assembly is a tapered roller thrust bearing which supports the revolving frame assembly. It is composed of 50 tapered rollers which are held in position by a steel cage. The cage is divided into eight (8) subassemblies - 7 sections contain 6 rollers each and 1 section contains 8 rollers. The rollers are supported with a steel spacer and a self-lubricating nylatron bushing.

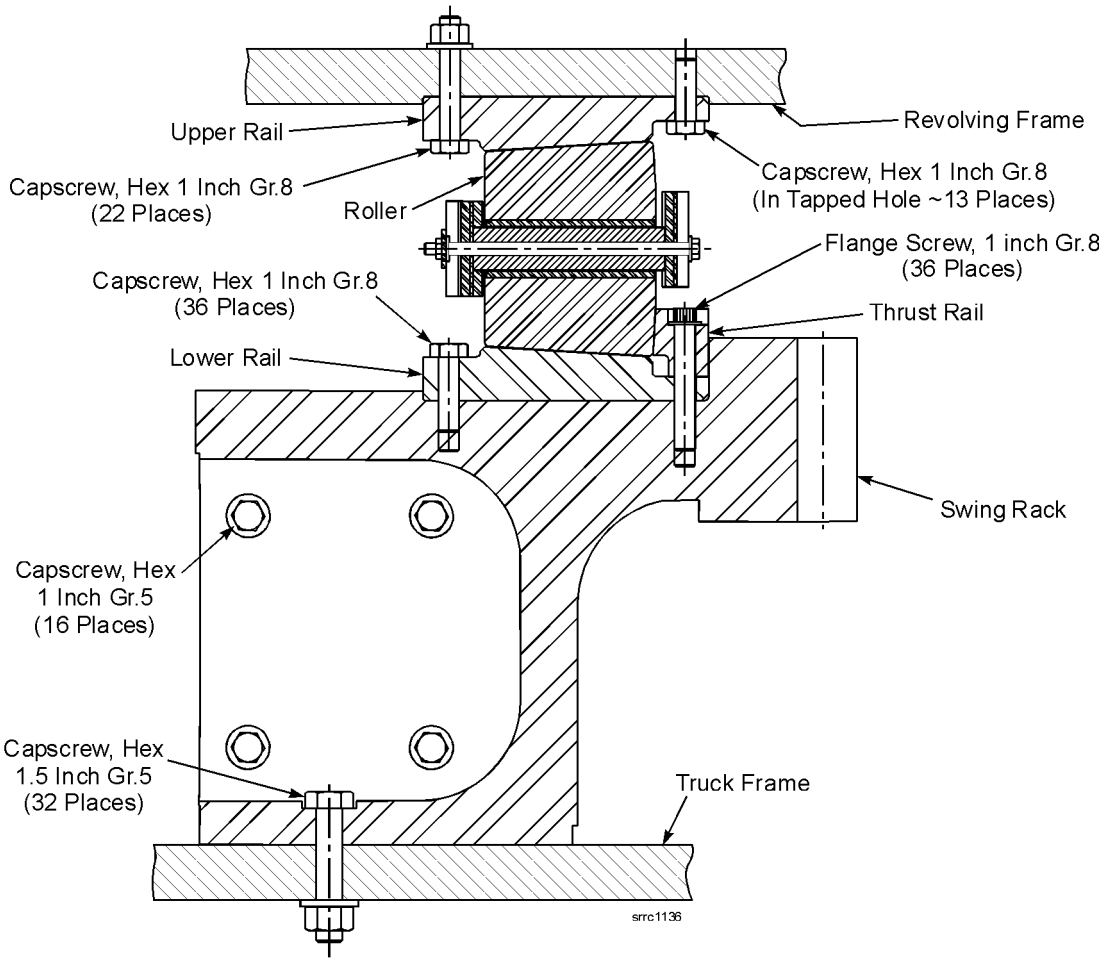


Figure 5-4: Swing Rack and Roller Circle Section View

Inspect the roller lube coverage daily. Only a light coat of OGL is required on the roller face and thrust rail. Check the roller and rail bolts monthly (420 hours), replace broken bolts and re-tighten all loose screws. Keep the lube drains open. Inspect the rollers and inside of the thrust rail for spalling. If this condition is found, check for proper ballast and roller alignment.

CRAWLER SIDE FRAME ASSEMBLY

The crawler side frame assembly provides the motion path and support structure for each crawler belt. Each assembly bolts to the truck frame structure and contains the propel machinery to drive its respective belt.

Each side frame assembly consists of the following components:

- 8 load rollers which transfer machine weight to the belt.
- 1 front idler roller.
- 1 rear idler roller.
- Drive tumbler shaft.
- Planetary propel gearcase, totally enclosed with right angle input.
- Propel motor with a single-disc, spring-set, air-released brake.
- Heavy duty fabricated frame structure with slide bars to guide the belt.

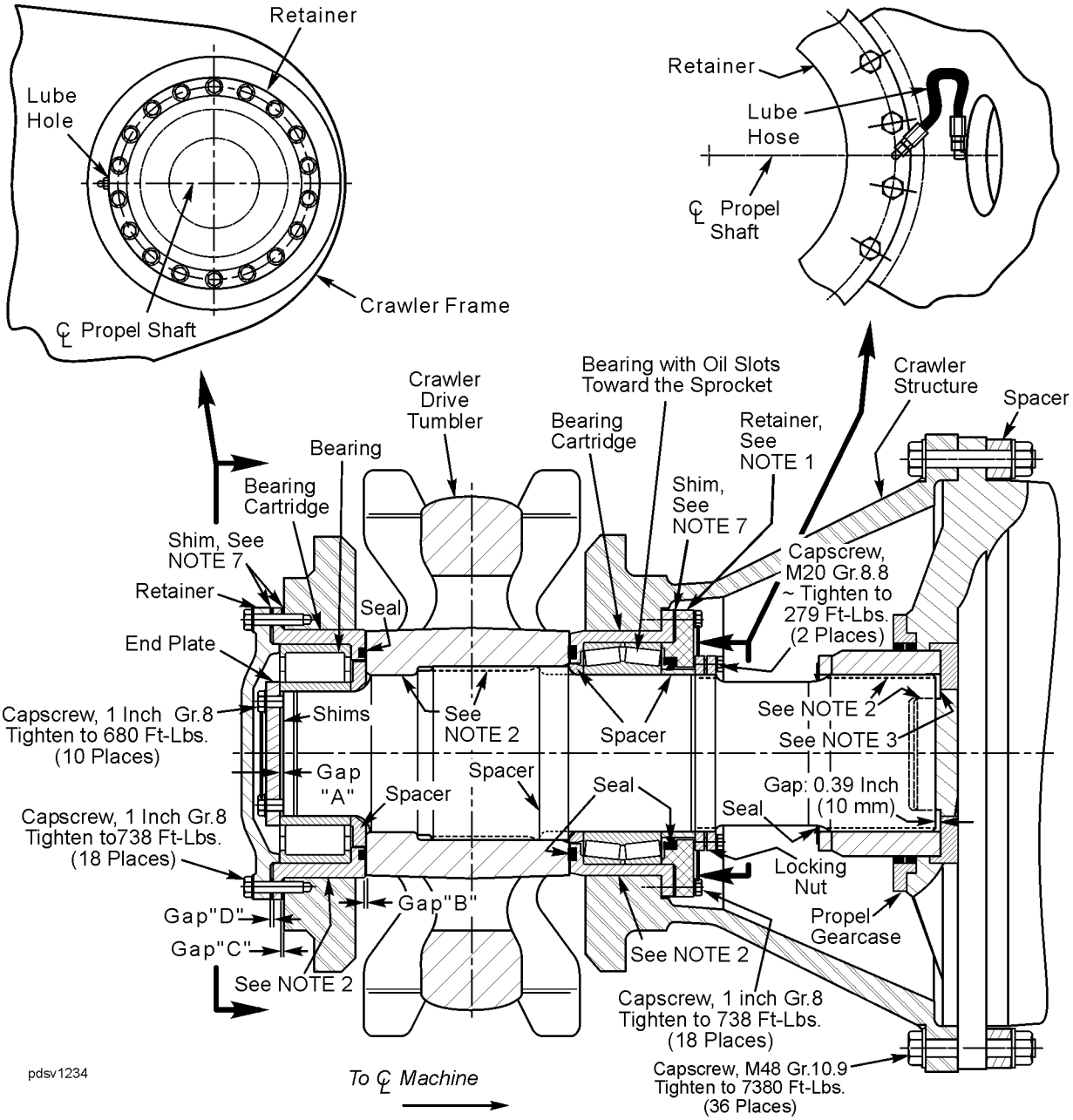


Figure 5-15: Propel Drive Shaft Assembly - Section View

PROPEL GEARCASE INSTALLATION

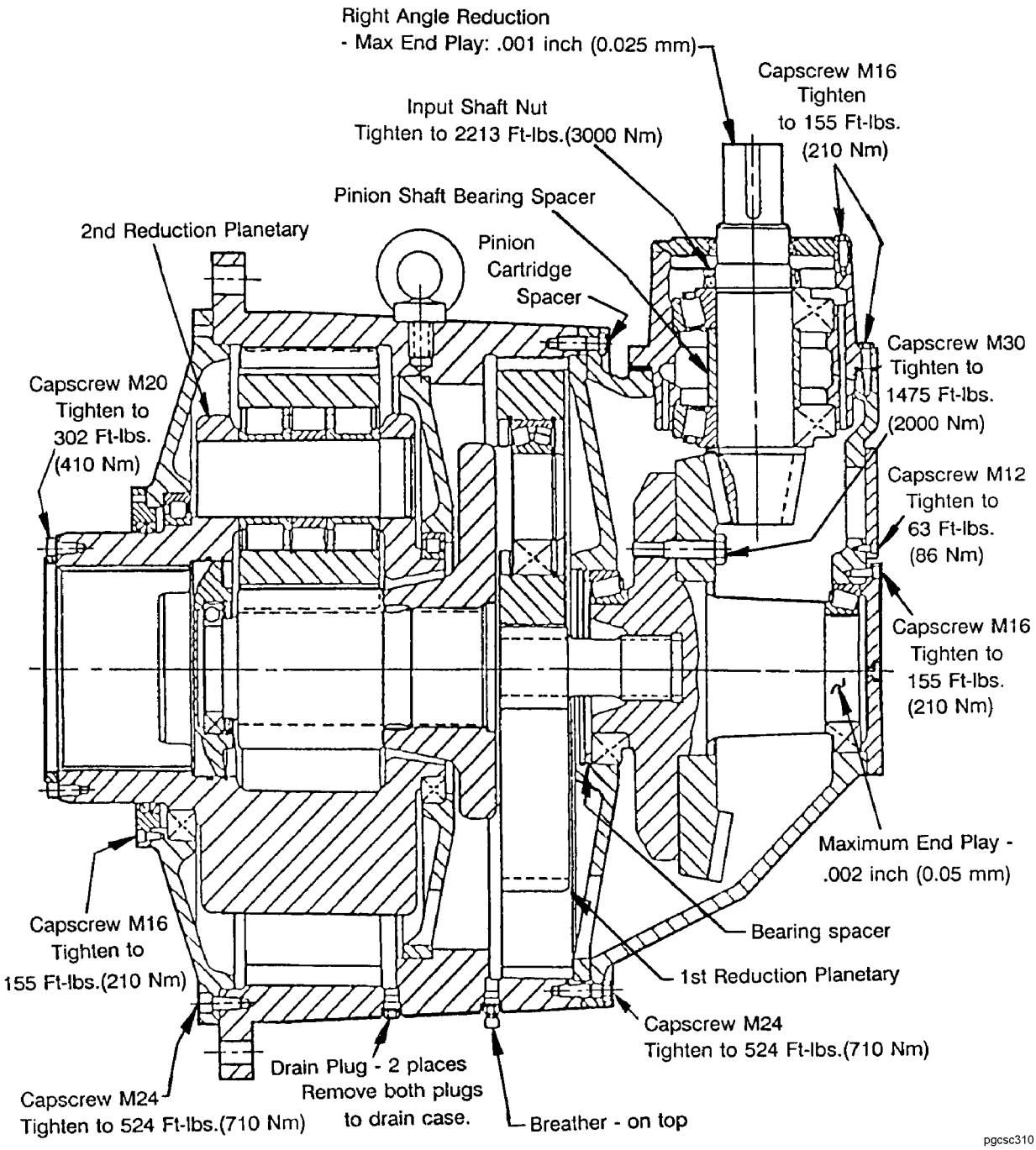


Figure 5-22: Propel Gearcase - Section View

3. Clearance for free rotation of the revolving frame must be provided between the truck frame bushing and the sleeve. Such clearance, however, cannot be excessive or premature wear of the truck frame bushing or sleeve will occur.

To determine this clearance, proceed as follows:

DANGER: HIGH VOLTAGE! EXTREME CARE MUST BE EXERCISED AT ALL TIMES WHEN PERFORMING MAINTENANCE IN THE CENTER PINTLE AREA. High voltage can cause serious or fatal injury. Installation, operation and servicing of components should be performed only by qualified personnel. ALWAYS DISCONNECT the electrical power BEFORE accessing the center pintle area.

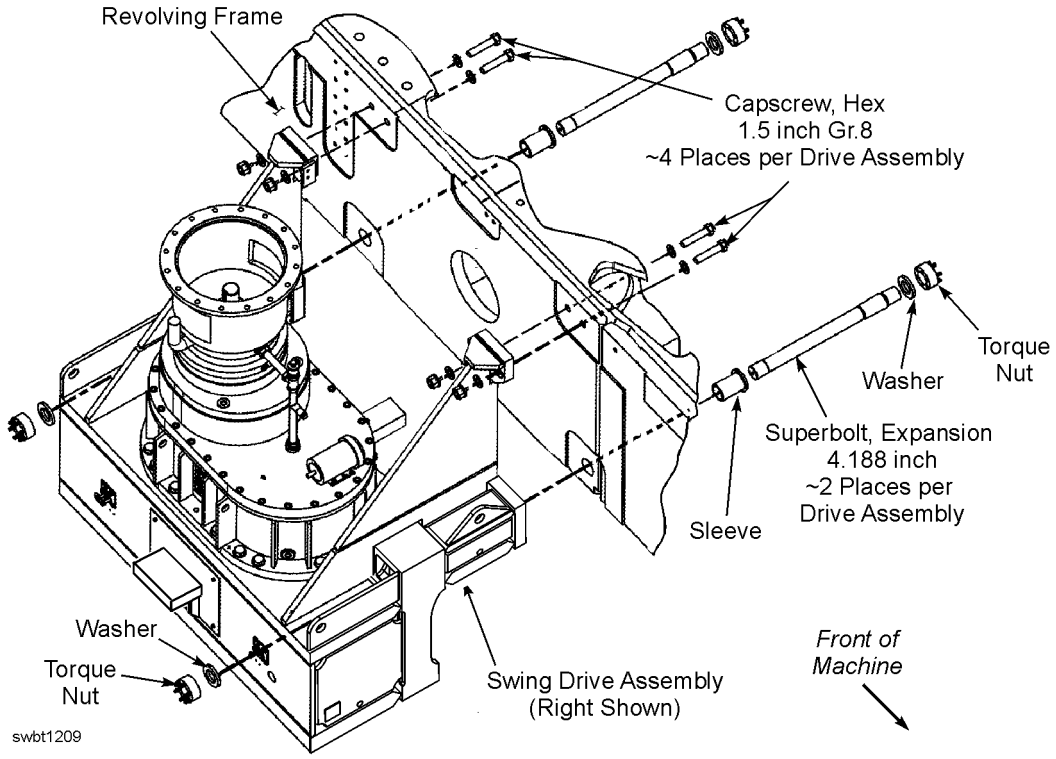
a. Disconnect the power to the machine. Enter the truck frame through the bottom access opening.

b. Remove the cover from the top of the truck frame and gain access to the space between the pintle and the rollers. Insert a feeler gauge between the sleeve and the bushing of the truck frame. Any measurement over 0.250" diametral clearance is considered excessive and replacement of the bushing and/or sleeve is necessary.

SWING SUPPORT MOUNTING BOLTS

NOTES:

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



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.

HOIST MACHINERY

The hoist machinery consists of:

- Large diameter hoist drum
- Integral single-helical hoist gear
- Dual-output planetary gearcase,
- Hoist motor and brake assembly

Frequently check the hoist machinery for loose or missing hardware. At least once a month, check the hardware on the hoist motor, shaft, couplings and right and left pedestals for tightness. Retighten or replace any missing hardware. Every 12 months remove the upper hoist gear guard inspection covers and the gearcase inspection covers and inspect the gear and pinions for pitting, abrasion, scratching, spalling, galling and/or other tooth wear. Check the gearcase for evidence of lubricant leakage. Replace any defective seals.

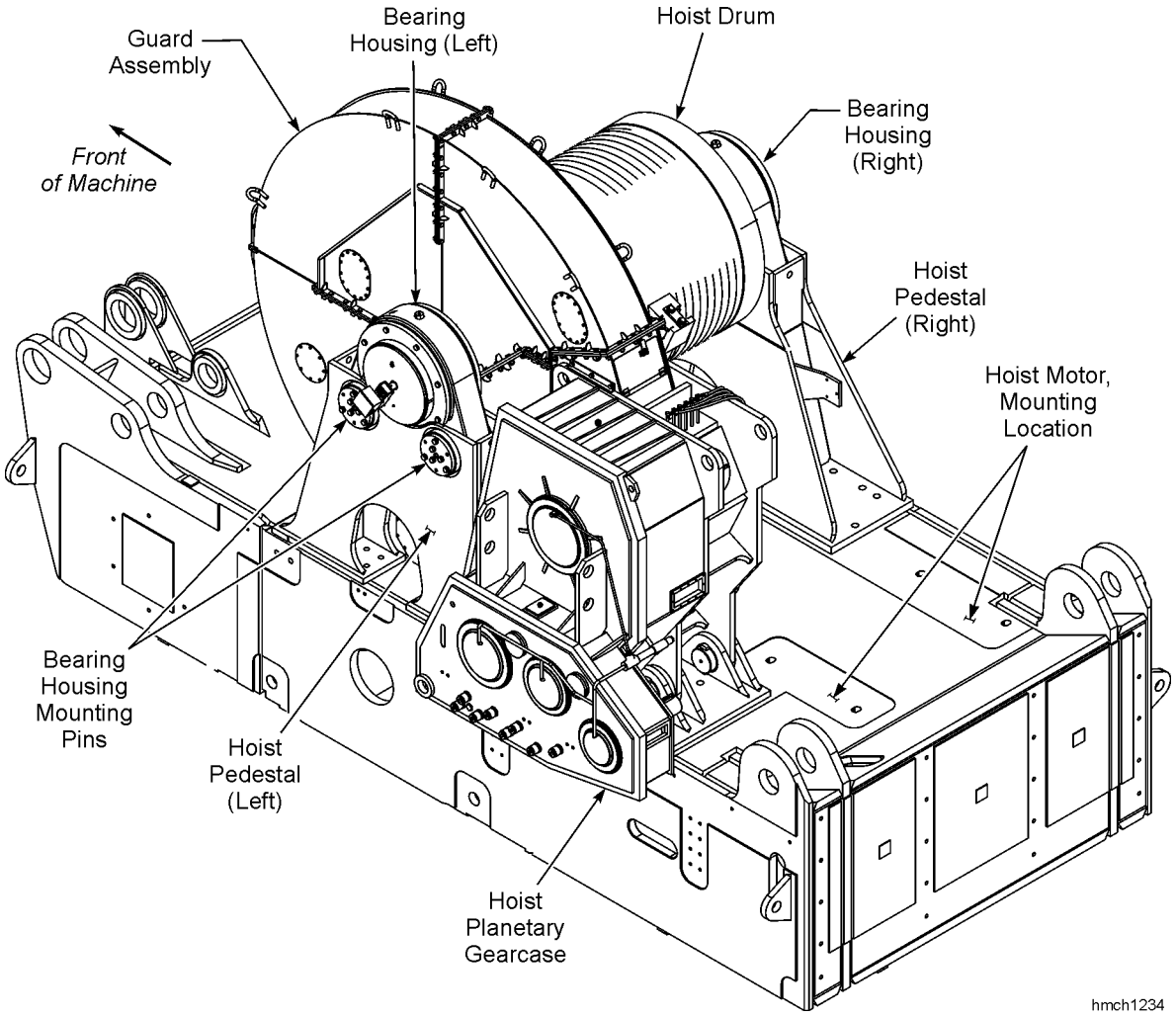


Figure 5-29: Hoist Machinery Assembly

HOIST DRUM ASSEMBLY

The hoist drum shaft uses a single-helical hoist gear fastened to a large-diameter drum with the hoist spider and rotates on double-row, tapered roller bearings.

Removal of the hoist drum shaft will require lowering and supporting the boom. To remove the hoist drum shaft:

1. Position the machine so that the dipper lip and front are flat on the ground.

DANGER: BEFORE PERFORMING ANY MAJOR MAINTENANCE ON THE HOIST MACHINERY, PRESS AND TAG THE MAIN POWER OFF BUTTON. Failure to comply may result in injury or death.

2. Remove the hoist ropes.
3. Remove the A-Frame ladders and platforms.
4. Remove the two machinery house fan/filter assemblies.
5. Remove the A-Frame shrouds.
6. Remove the center front roof panel, the 6 center roof panels and the 3 left roof panels over the left deck extension. Save all indicated items for re-use.

NOTE: To remove the center roof panel, cut the welds between the channels on the front wall panels and the center roof panel - both sides. The rubber sheets can remain attached to the roof panel. All front wall panels can remain in place, however the upper left and upper center wall panels can be removed, with their hardware, and saved for later re-use.

7. Remove 4 center roof cross-beams, 2 left roof cross-beams and 4 center roof fore/aft truss beams.
8. Using the crowd machinery (or a separate crane) support the weight of the boom to unload the A-Frame and main suspension strands.
9. Remove the upper A-Frame pins from the rear A-Frame legs. (Will require a cherry picker.)
10. Rotate the rear A-Frame legs back toward the rear of the machine and secure to the control room roof.
11. Using the crowd machinery (or a separate crane) lower the boom until the front A-Frame legs are pulled forward so that they are at an 80° to 85° angle to the top of the revolving frame. Set the crowd brake and block the boom in position. Install a safety cable to prevent the front A-Frame from being inadvertently over center.
12. Remove the drain lines from the bearing housings. Disconnect and remove the lube lines from the hoist bearing housings and the gear guard.
13. Disconnect the hoist limit switch wiring. Remove the hoist limit switch assembly from the drum shaft.

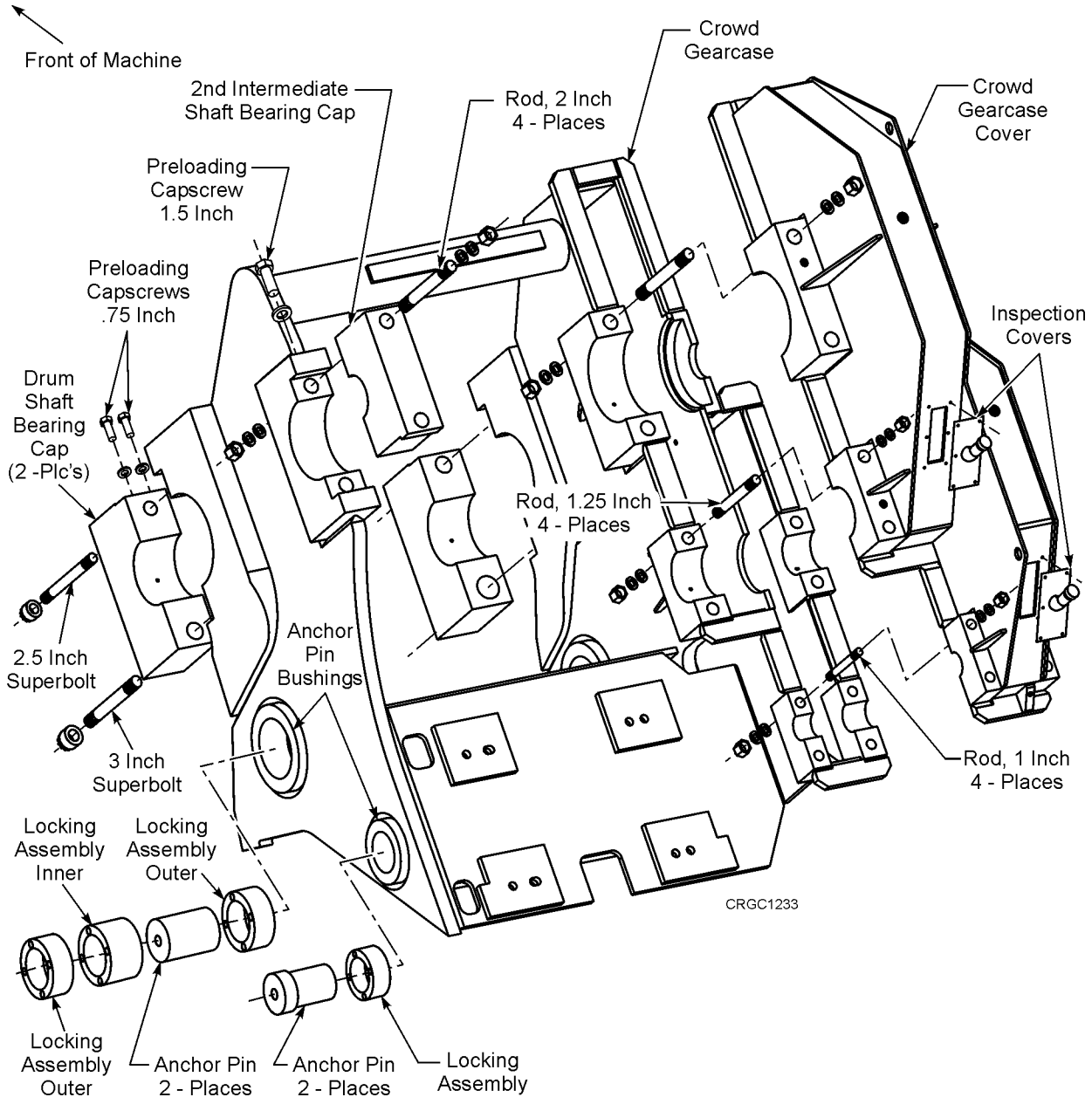


Figure 5-41: Crowd Gearcase

Every six months remove the inspection covers of the gearcases and inspect the gears and pinions for pitting, abrasion, scratching, galling, spalling and other abnormal tooth wear.

Check the crowd machinery attachment pins for movement under load. Tight attachment pins minimizes wear on the pins and pin holes. Check every 100 hours.

Weekly, remove the pipe plugs in the first reduction gearcase and the second reduction gearcase and check the lubricant level. The first reduction gearcase lubricant level plug is located at the rear of the gearcase cover, to the rear of the first reduction pinion.

MACHINERY HOUSE

The machinery house has separate structural members consisting of front and rear main truss and interconnecting beams. These form the permanent house structure.

Roof panels are individually fastened to the interconnecting beams. Any panel can be removed separately to provide access to a machinery house unit. All roof panels are secured with hold down bolts on retainer bands. Vinyl tape weather stripping is installed between the retainer band and roof panel.

Shroud covers around the A-frame legs have vinyl tape between the leg and shroud. Shroud support joints are sealed with rubber cement or silicone caulking.

All mating surfaces of the machinery house wall panels are sealed with rubber cement or silicone caulking to ensure weather tight seal.

Frequently inspect all house panels and structural members for cracking. Include a close examination of all roof structures. Examine all struts, beams and braces used to reinforce the machinery house.

Always restore defective structural members to their original state by repair welding.

Periodically observe the hinges and closure mechanisms on all doors and windows to ensure they will remain closed during machine operation. Verify the sealing of the leg closures of the A-frame. Tighten all loose bolts and replace all missing hardware. The absence or looseness of these fasteners can result in excessive vibration and wear of house components. Individually, these faults can be considered minor, but taken collectively, they represent a major exposure of the electrical and mechanical elements of the house to dust and water.

Check the condition of the house paint. Paint is not impervious to deterioration. A well-painted machine is less susceptible to rust, corrosion and progressive failure.

Be sure the pressurization system is functioning properly to keep the house well-ventilated at a pressure higher than atmospheric pressure.

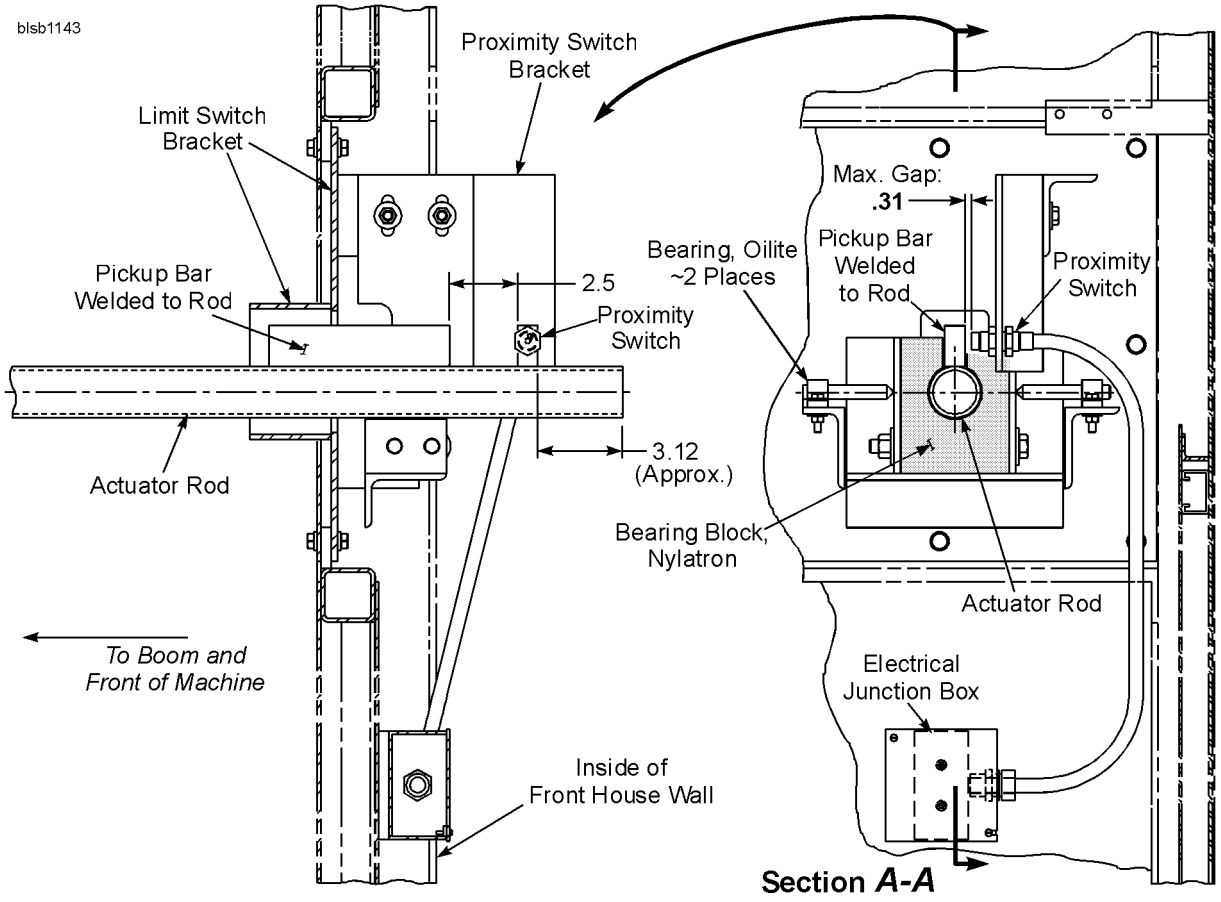
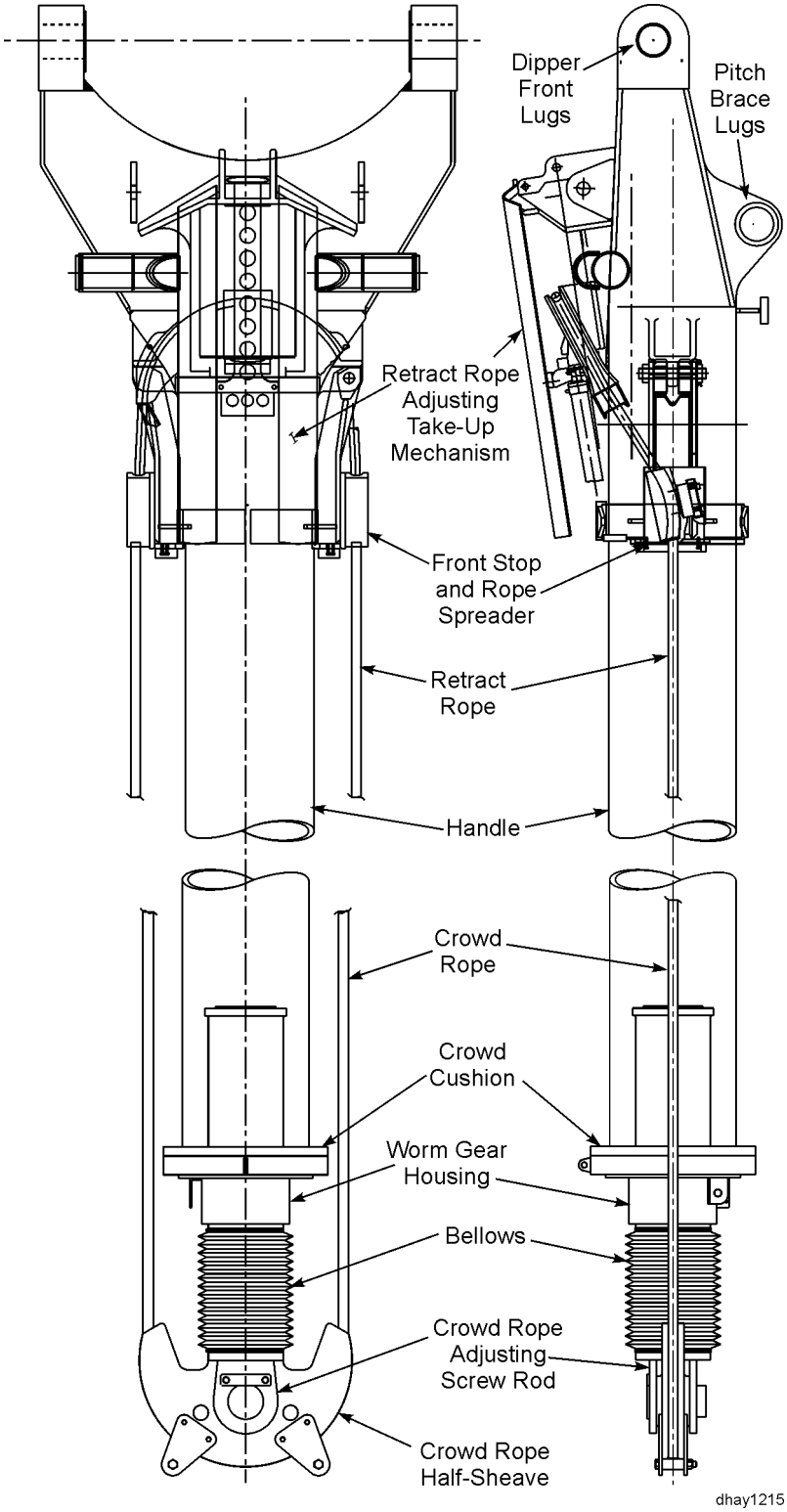


Figure 5-50: Boom Inductive Proximity Switch

2. Loosen the 0.38 inch capscrews that fasten the proximity switch bracket to the mounting angle. The slotted holes in both pieces allow for both horizontal and vertical adjustment.
3. Adjust the position of the proximity switch to the dimensions shown in Section A-A, *Figure 5-50*.

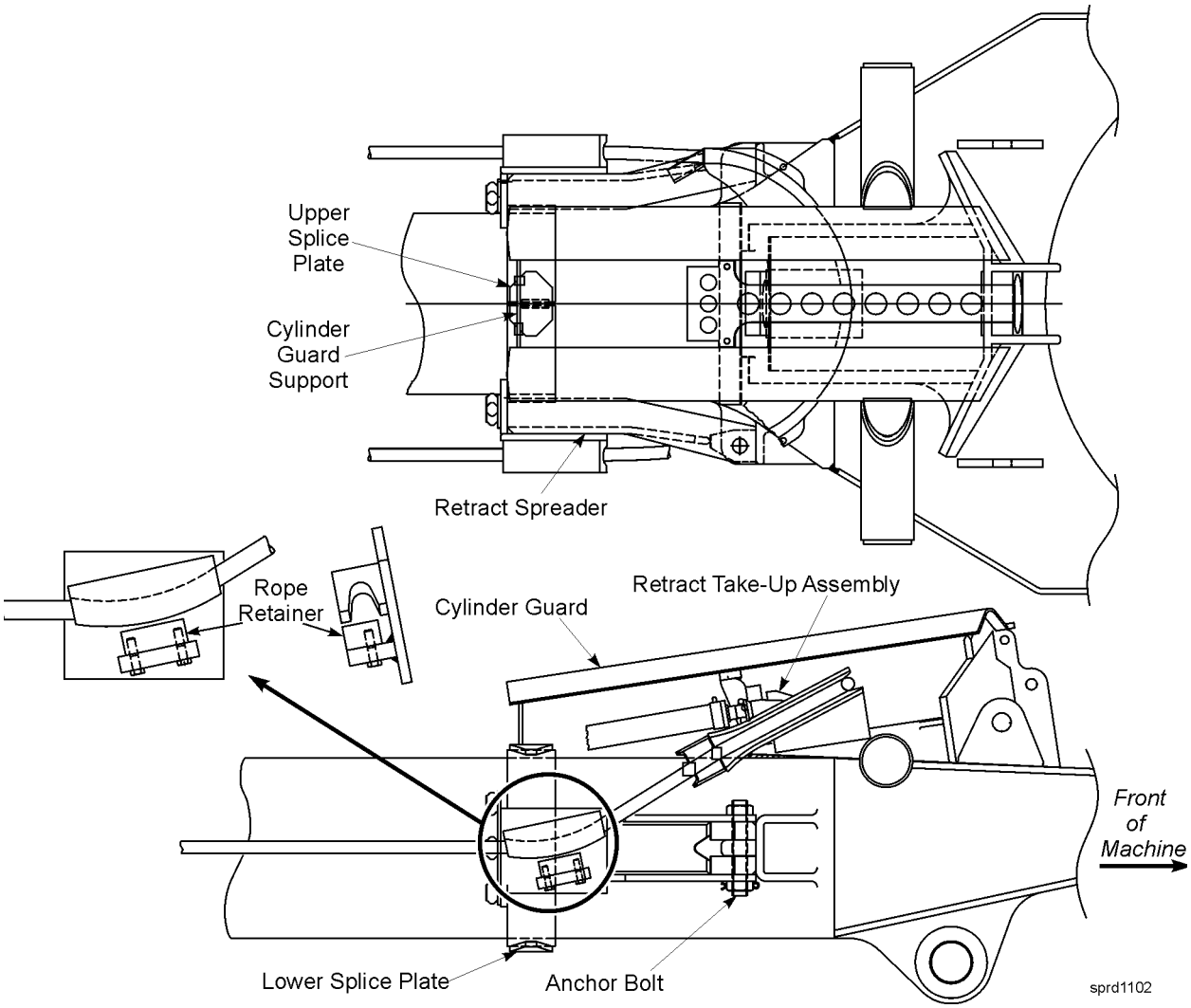
Overall sensitivity can be further adjusted from this initial position to suit conditions.


Dipper Front Lugs
Pitch Brace Lugs
Retract Rope Adjusting Take-Up Mechanism
Front Stop and Rope Spreader
Retract Rope
Handle
Crowd Rope
Crowd Cushion
Worm Gear Housing
Bellows
Crowd Rope Adjusting Screw Rod
Crowd Rope Half-Sheave
dhay1215

SPREADER REPAIR

NOTE: The following procedures involve burning and rewelding the spreader. Contact Bucyrus International Service Department for the proper weld specifications for this item.

1. Lower the dipper to the ground.



2. Back-off the retract rope as far as possible. Refer to removal step 3 of RETRACT TAKE-UP MECHANISM.
3. Remove the retract rope retainer bolts and retainers. Lift the retract rope out of the spreader grooves.
4. Carefully burn out the weld joining the cylinder guard support to one-half of the spreader only. The cylinder guard support can remain attached to the other half of the spreader.
5. Burn off the upper and lower splice plates from one-half of the spreader. The splice plates can remain attached to the other half of the spreader.

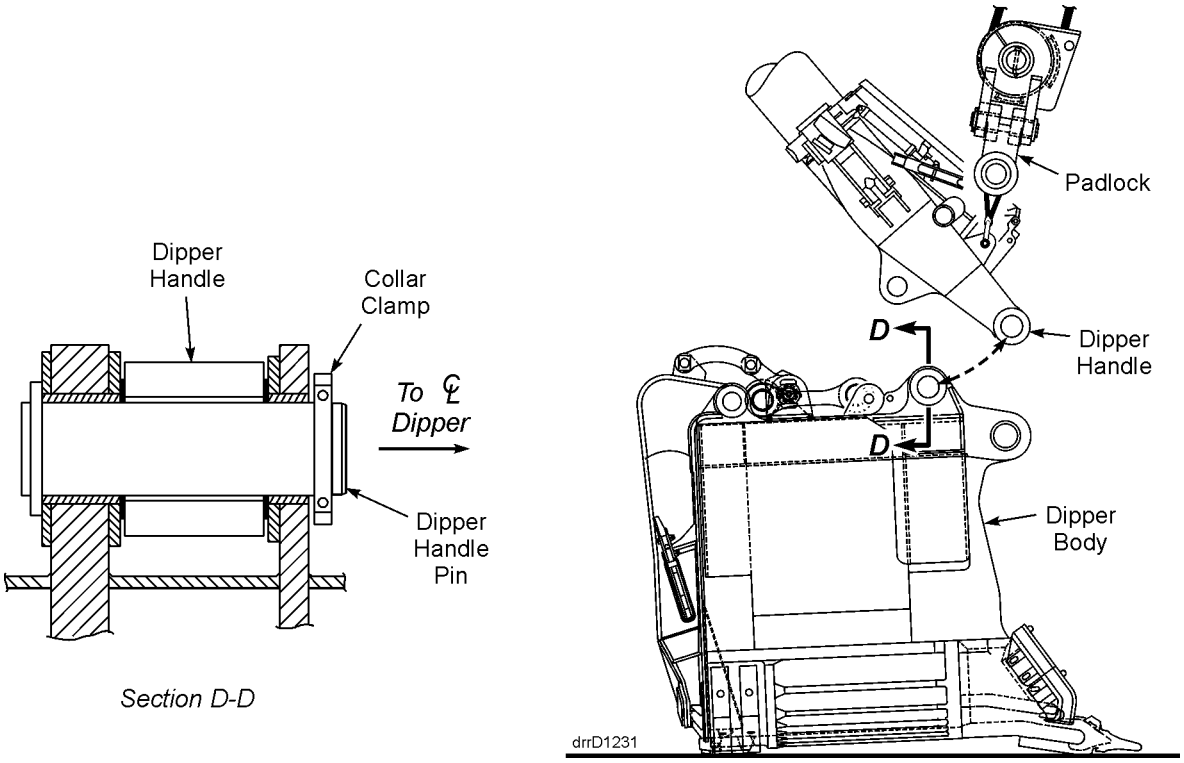


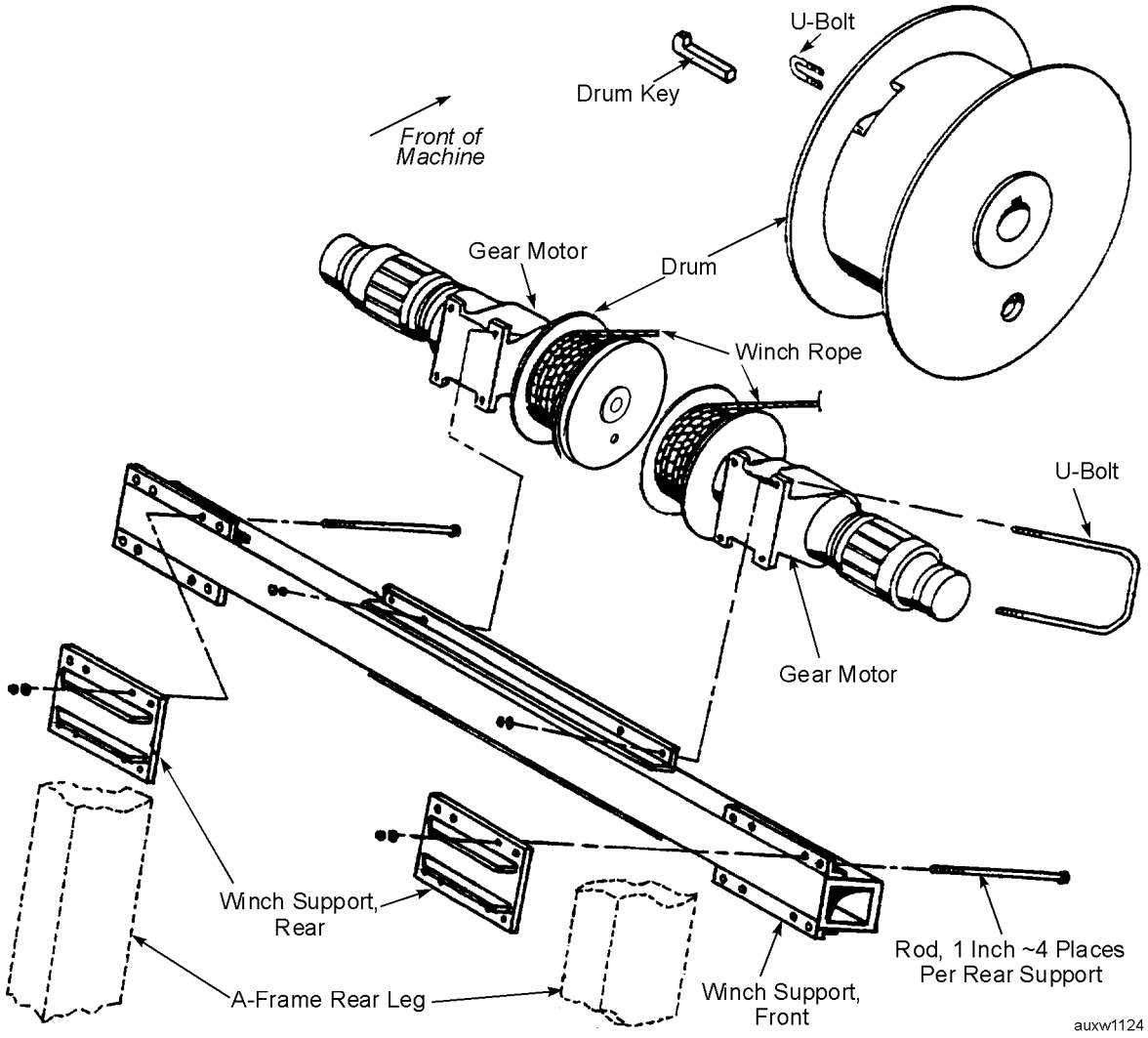
Figure 5-58: View D

16. Carefully move the machine away from the dipper by backing up.
17. When replacing dippers, ensure that the replacement dipper is resting on flat, level ground. Carefully reposition the machine so the revolving frame is parallel with the crawlers and the dipper handle lined up with the dipper lugs.

Installation of the dipper is the reverse of removal.

AUXILIARY WINCH

The auxiliary winch is attached to the hoist ropes to raise and lower the ropes during hoist machinery maintenance and change-out of hoist ropes. The winch consists of a drum and rope mounted to an electric gear motor. The winch can be single or double arrangement. The double arrangement is shown.



The winch can be single or double arrangement. The double arrangement is shown. The winch consists of a drum and rope mounted to an electric gear motor.

4. Hoist the winch until the lead ropes have cleared the padlock. Attach the free end of each hoist rope to the winch line that its lead end is attached to.
5. Pull both ropes over the point sheave, being careful to keep the lead rope (rear rope in padlock) on the outside groove of the point sheave.
6. Continue pulling the ropes into the machinery house. When the ends of the ropes reach a point where the follow rope can be tied off, stop pulling, detach the follow rope from the winch line and tie it off.
7. Pull the lead ropes until they are in a position to be placed in their becket resolvers. Place the lead rope ferrules in the resolvers, install the lead rope keeper and detach the winch line.
8. Slowly rotate the drum 180° in the hoist direction so that the follow ropes can be attached.
9. Hoist the winch attached to the follow ropes until the ropes can be attached to the drum.
10. Place the follow rope ferrules in the resolvers, install the lead rope keeper and detach the winch line.
11. Slowly rotate the drum in the hoist direction until the hoist ropes are tight. Make sure the ropes stay in the proper grooves.
12. Hoist the dipper approximately 1 foot off of the ground. Check to make sure the dipper hangs straight. If not, place shims between the ferrule and the ferrule socket on either the lead or the follow ropes on the side that the dipper hangs lower. If necessary, locally manufactured shims may be placed under both ferrules.
13. Hoist and lower the dipper several times to seat the ropes. Make sure the dipper hangs straight. If not, shim as above. Reset the hoist and crowd limit switches.

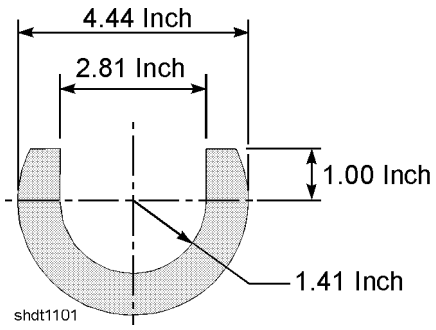


Figure 5-61: Shim for Hoist Rope Socket

NOTE: The above steps are used to remove and replace 1 pair of hoist ropes. When replacing a single hoist rope, be sure to check the alignment of the dipper and shim of the old rope if required to level the dipper.

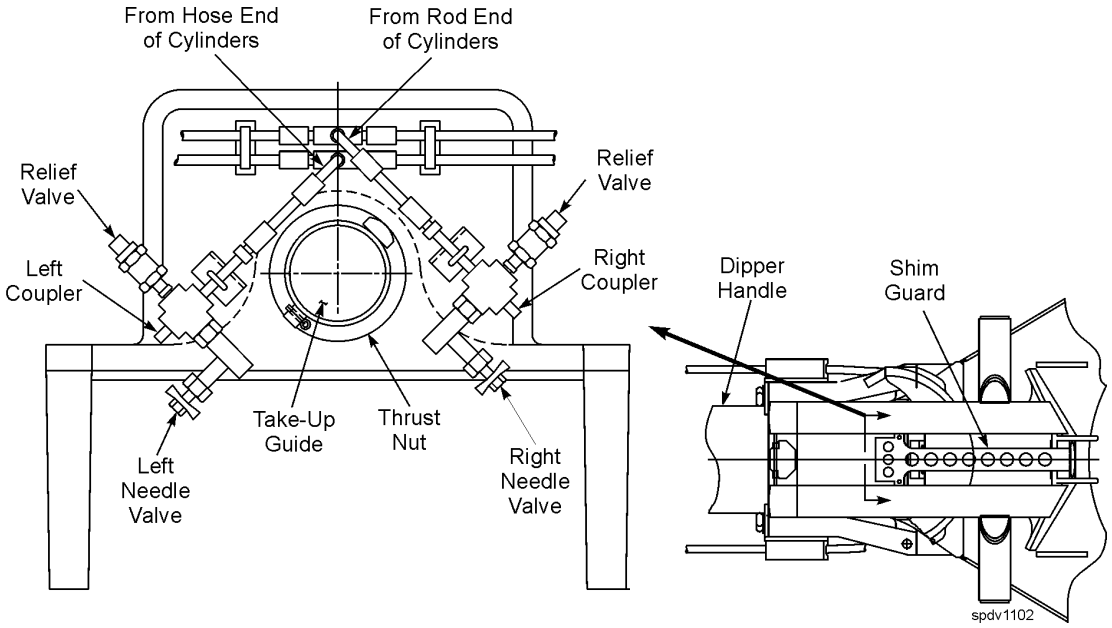
RETRACT ROPE TIGHTENING

NOTES:

- The constructional stretch may be out of the retract rope when it becomes necessary to adjust the rope for about the third time. Therefore, after the third rope adjustment or after replacement, back off the adjustment by one 0.5 inch shim after obtaining a tight rope by pressurizing the cylinders to prevent working with an overly tight rope.
- Do not overtighten the ropes. The ropes are properly adjusted when a very slight curvature is noticeable on the retract rope (a 3 to 5 inch sag) with a tight crowd rope.

With the dipper resting on the ground, rotate the crowd drum in such a way as to tighten the crowd rope and provide slack in the retract rope. Retighten the retract rope as follows:

1. Open the shim guard.
2. Clean up and grease the sliding areas on the take-up nut, support and screw.
3. Be sure that the right needle valve is open and the left needle valve is closed.
4. Extend the cylinders by injecting hydraulic fluid into the left fitting.



5. Shim the take-up nut at the desired position.

CAUTION: The take-up nut must be shimmed tight, both fore and aft, using all shims originally provided with machine.

6. Slowly open the left needle valve to release the pressure on the cylinders.

CAUTION: Oil within the needle valves is under high pressure. STAY CLEAR OF TAKE-UP NUT, SHIMS AND CYLINDERS WHEN OPERATING NEEDLE VALVE, AS THESE ITEMS COULD MOVE UNEXPECTEDLY AND CAUSE SERIOUS INJURY.

7. Close and secure the shim guard.

Section 6
Brakes and Couplings

BRAKES

This machine uses spring-set, air-released disc brakes on the *HOIST*, *CROWD, PROPEL* and *SWING* motions.

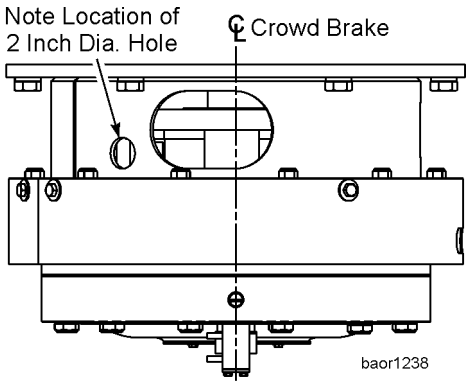
In the event of a power failure or loss of air pressure, the brakes will automatically set to stop the machinery motion. Pressure switches located near each brake control valve monitor air pressure at the brake. The brakes cannot be released for operation until the air pressure reaches the operating pressure.

Each brake is fitted with a proximity sensor to monitor lining wear and a limit switch to monitor the brake set or released position. When the lining wear limit is reached, it is announced on the operator's display terminal. The brake position is announced in the operator's control screen.

Table 6-1: Machine Motion Brakes

		HOIST	CROWD	PROPEL	SWING
Quantity		1	1	2	2
Friction Discs per Brake		3	1	2	1
Weight of Brake		1,550 Lbs.	490 Lbs.	650 Lbs.	490 Lbs.
Mounting Screws	Quantity	12	12	12	12
	Size	.75 Inch	.75 Inch	.75 Inch	.75 Inch
	Torque	200-220 Ft-Lbs. (271-298 Nm)	200-220 Ft-Lbs. (271-298 Nm)	200-220 Ft-Lbs. (271-298 Nm)	200-220 Ft-Lbs. (271-298 Nm)

brks1238



View ***BE***

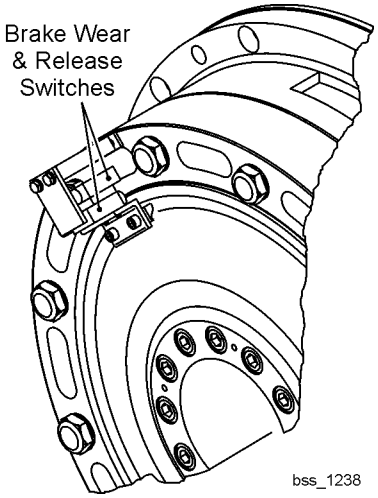
5. Using a lifting device and the holes provided in the outer portion of the drive ring, place the brake assembly onto the drive hub and lower while aligning the splines in the drive hub with those in the brake disc.
6. Apply at least 46 PSI compressed air to release the brake. Verify piston stroke.

NOTE: The brake will be fully released once air pressure exceeds 46 PSI on a properly functioning brake. However, air pressure in excess of 125 PSI could damage the internal seals of the piston.

7. Release the air pressure from the brake piston to relax the internal springs.
8. Tighten the drive ring for final installation.
9. Apply at least 46 PSI compressed air to release the brake. Verify that the proper gap remains between the pressure plate and friction surface of the disc.
10. Install safety guard around the brake assembly.

CROWD BRAKE WEAR & RELEASE SWITCHES

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

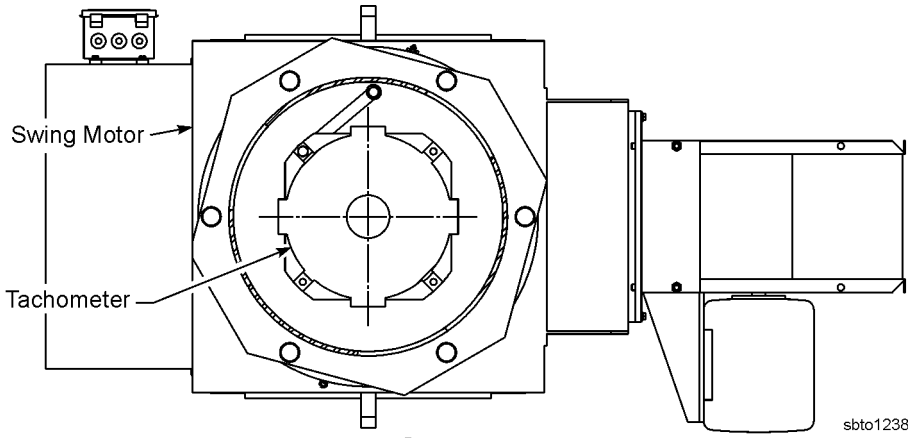


SWING BRAKE INSTALLATION

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

NOTE: Tachometer will only be installed on one of the two swing motors. Due to mechanical coupling the 2 swing motors and gearcases will operate at identical speeds.

1. The tachometer is to be oriented as shown in View G. Reposition if necessary.



View *G*

2. Install the drive hub and keyway on the motor. Refer to *PINION & HUB INSTALLATION* in Section 9 - *ENGINEERING DATA*.
3. Install motor shaft nut and secure to shaft with the lockwasher by bending tabs over flats.
4. Install brake adapter onto the motor and secure with hardware. Use care to align the access slots in the adapter for future tachometer inspections.
5. Lightly coat the splines of the drive hub with a Teflon grease allowing only a thin film of lubricant to remain on the splines. Excess grease will be thrown outward by centrifugal force and have a degrading effect on the brake.
6. Using a lifting device and the holes provided in the outer portion of the drive ring, place the brake assembly (approximately 500 lbs.) onto the drive hub and lower while aligning the splines in the drive hub with those in the brake disc.
7. Apply at least 46 PSI compressed air to release the brake.

NOTE: The brake will be fully released once air pressure exceeds 46 PSI on a properly functioning brake. However, air pressure in excess of 125 PSI could damage the internal seals of the piston.

8. Install shims, as required, to achieve a gap of 0.015 - 0.030 inch between the brake disc and the pressure plate. Refer to View D.

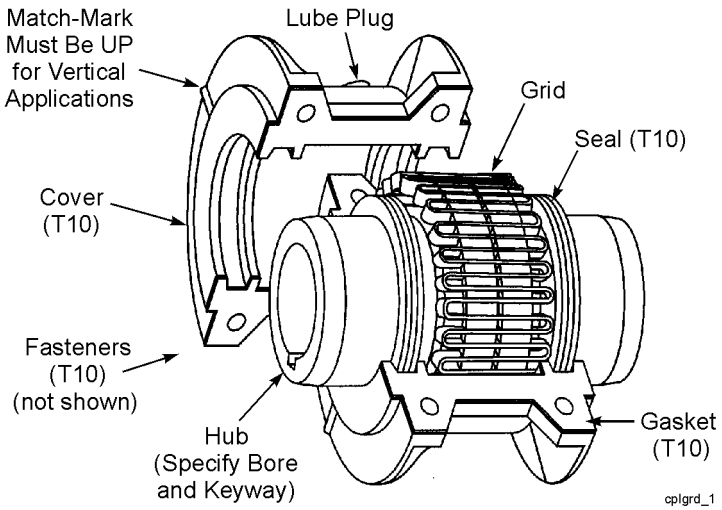
COUPLINGS

GRID COUPLINGS

These instructions apply to tapered grid couplings. They are designed to operate in either the horizontal or vertical position without modification. However, for vertical applications, the match mark shown above, must be up. The performance and life of the couplings depend largely upon how they are installed and serviced. Carefully follow these instructions for optimum performance and trouble-free service.

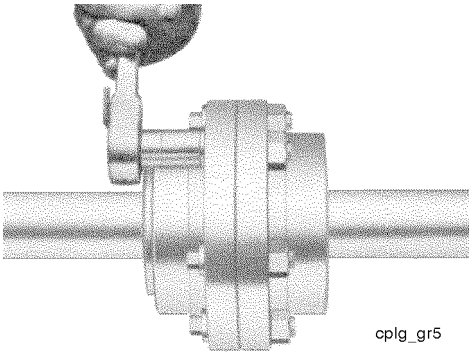
All coupling parts have identifying part numbers. When ordering parts, always *SPECIFY SIZE and TYPE*. Cover halves have 1/8 NPT lube holes. Use a standard grease gun and lube fitting.

For Long Term Grease (LTG) use part number MP295148.



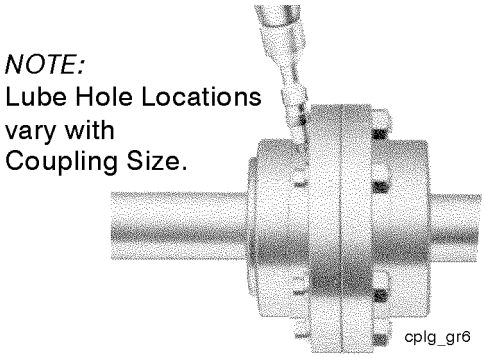
LUBRICATION

Adequate lubrication is essential for proper operation of the coupling. Refer to the table for the amount of lubricant required. It is recommended that the coupling be checked once a year and lubricant added if required. For extreme or unusual operating conditions, check more frequently. Grid couplings initially lubricated with LTG will not require re-lubrication until the connected equipment is stopped for servicing.



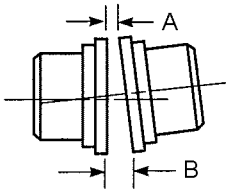
IMPORTANT! Tighten the flange bolts and nuts to the torque specified in the table.

6. For *TYPE G* couplings, fill with recommended grease until excess appears at the open hole; then insert plug. For *TYPE GV* couplings, proceed as outlined above. *IN ADDITION*, when flex hub is on *TOP*, vent by inserting a 0.010 thick *SMOOTH* feeler gauge between seal and hub. Fill until excess appears at feeler. Repeat at 90° intervals.

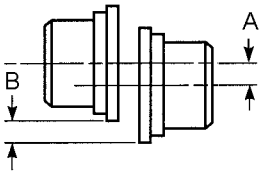


CAUTION: Make certain all plugs are inserted after lubricating.

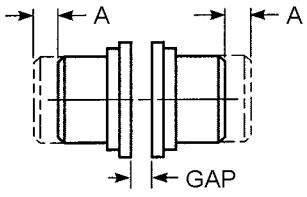
GEAR COUPLING ALIGNMENT



ANGULAR ALIGNMENT is the difference between Gap “A” and Gap “B”.



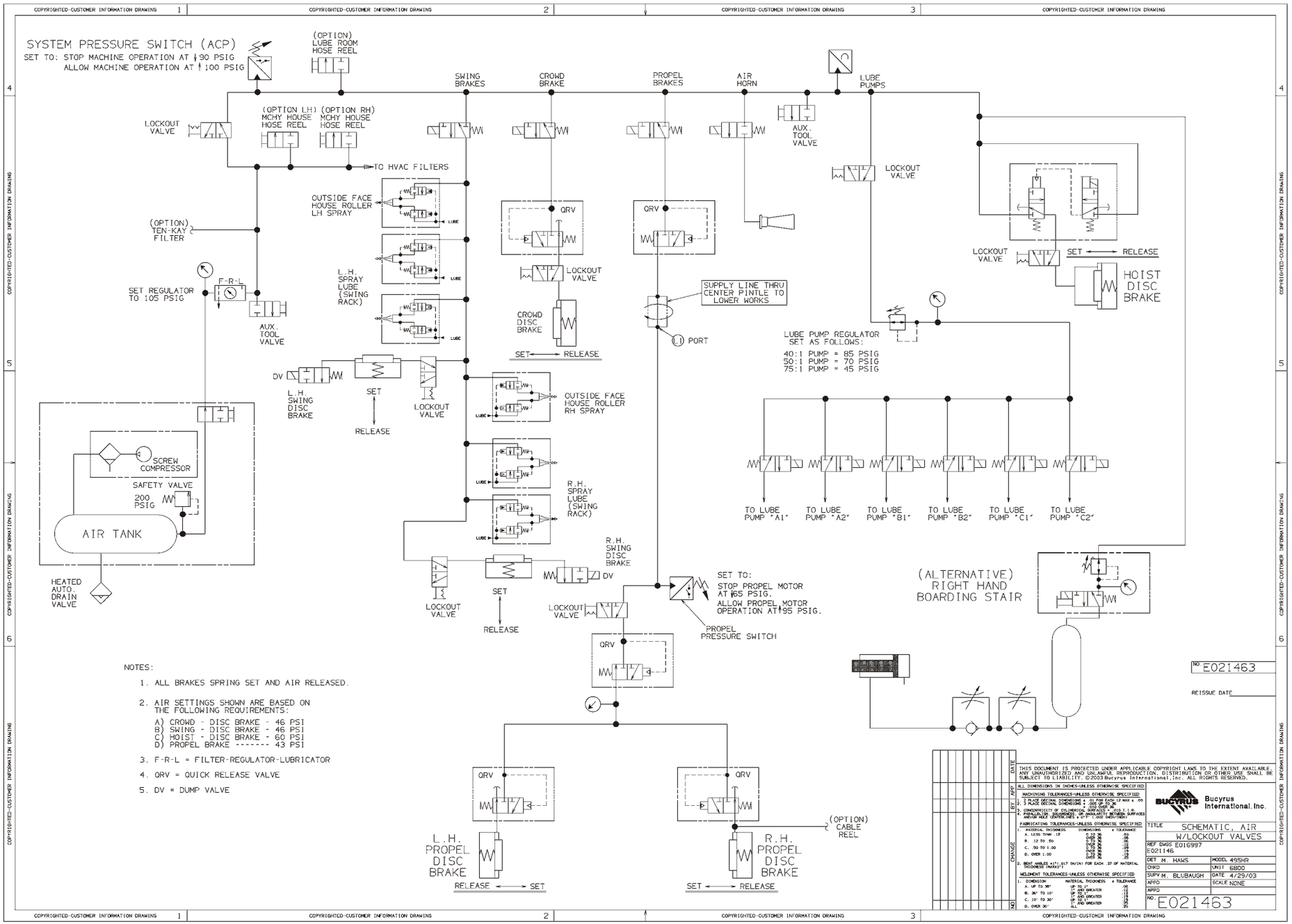
OFFSET ALIGNMENT is the amount distance (offset) between shafts.



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

cplglmts

AIR SCHEMATIC



Section 9
Engineering Data

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

Table of Contents

Table 9-7: Area Conversions

Metric to English	English to Metric
1 sq. Kilometer = 0.3861 sq. Miles	1 sq. Mile = 2.590 sq. Kilometers
1 sq. Kilometer = 247.1 Acres	1 Acre = 0.004047 sq. Kilometers
1 sq. Meter = 1.196 sq. Yards	1 Acre = 4047 sq. Meters
1 sq. Meter = 10.76 sq. Feet	1 sq. Yard = 0.8361 sq. Meter
1 sq. Meter = 1550 sq. Inches	1 sq. Foot = 0.0929 sq. Meter
1 sq. Centimeter = 0.1550 sq. Inch	1 sq. Foot = 929.0 sq. Centimeters
1 sq. Millimeter = 0.001500 sq. Inch	1 sq. Inch = 6.452 sq. Centimeters
	1 sq. Inch = 645.2 sq. Millimeters

VOLUME MEASUREMENTS

Table 9-8: Volume Standards - Cubic

Metric	English
1 cu. Meter = 1,000,000 cu. Centimeters	1 cu. Yard = 27 cu. Feet
1 Liter = 1,000 cu. Centimeters	1 cu. Foot = 1728 cu. Inches

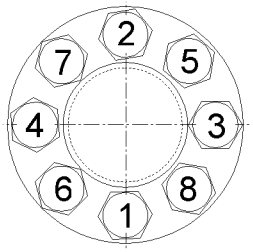
Figure 9-1: Volume Conversions - Cubic

Metric to English	English to Metric
1 cu. Meter = 1.308 cu. Yards	1 cu. Yard = 0.7646 cu. Meter
1 cu. Meter = 35.31 cu. Feet	1 cu. Foot = 0.02832 cu. Meter
1 cu. Meter = 61,020 cu. Inches	1 cu. Inch = 16.39 cu Centimeters
1 cu. Centimeter = 0.06102 cu. Inch	1 cu. Foot = 28.32 Liters
1 Liter = 0.03531 cu. Foot	1 cu. Inch = 0.01639 Liter
1 Liter = 61.02 cu. Inches	

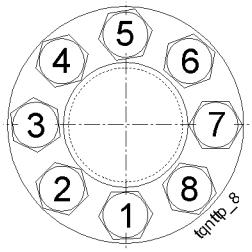
Table 9-9:Volume Standards - Wet

Metric	English
1 Hectoliter = 100 Liters	1 Gallon = 4 Quarts
1 Liter = 10 Decimeters	1 Quart = 2 Pints
1 Decimeter = 10 Centiliters	1 Pint = 4 Gills
1 Centiliter = 10 Milliliters	

TIGHTENING PROCEDURE FOR 2.5-INCH TORQUE NUT



"STAR" Tightening Pattern



CIRCULAR Tightening Pattern

Torque Nut with 8 Jackbolts

1. Ensure that a special steel washer, supplied with the torque nut, is placed beneath the torque nut. DO NOT USE STANDARD COMMERCIAL WASHERS.
2. The jackbolt threads and faces are prelubricated with graphite lube. Ensure that this lube is present. Apply additional lube (part number MP390331) as needed.
3. Check the base of the torque nut to ensure that all jackbolts are flush with the bottom.
4. Spin the torque nut onto the rod or bolt by hand.
5. Tighten the jackbolts to **233** Ft-Lbs as follows:
   a. Snug all jackbolts to **25** Ft-Lbs each.
   b. Using the STAR pattern shown, tighten all jackbolts to **115** Ft-Lbs.
   c. Switch to the CIRCULAR pattern shown and tighten all jackbolts to **175** Ft-Lbs.
   d. Continue with the CIRCULAR pattern and tighten all jackbolts to **225** 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 **233** 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.

TORQUE NUT REMOVAL PROCEDURE

CAUTION: THE PROPER REMOVAL OF TORQUE NUTS REQUIRES FOLLOWING STRICT PROCEDURES. LONGER ANCHOR BOLTS AND RODS REQUIRE GREATER CARE. If some jackbolts are completely unloaded prematurely, the remaining jackbolts will carry the entire load of the fastener. This may cause the jackbolts to become extremely hard to turn or even deformed.

NOTE: It is a good practice to spray the entire fastener and jackbolts with a penetrating type lubricant prior to attempting removal. This step will be critical if rust exists on the components.

1. Turn the first jackbolt counter-clockwise until it feels loose, but no more than 1/2 turn.
2. Repeat the loosening with the rest of the jackbolts. Use the reverse of the star pattern used to tighten the jackbolts. This will minimize loading on the last few jackbolts.
3. Repeat the entire loosening pattern, turning each jackbolt no more than 1/2 turn at a time, until the torque nut can be spun off the rod or bolt by hand.

After removal of the torque nut:

- Remove all jackbolts from the torque nut. Clean, inspect and lubricate the toque nut, hardened washer and the jackbolts for later reassembly.

NOTE: On smaller torque nut fasteners it may be possible to utilize impact tools to speed removal after performing step 2 above. However, *DO NOT USE IMPACT TOOLS FOR THE INITIAL LOOSENING PROCEDURE.* Longer anchor bolts may require several repetitions of the initial loosening process prior to switching to impact tools for assistance.

THREAD LUBRICATION

For the main studs of torque nut fasteners any standard anti-seize compound may be used. A thin, brush-on type application, or aerosol spray lubricant is acceptable.

Jackbolts are pre-lubricated from the factory with either moly or graphite lubricants depending on the intended use. Ensure lube is present on these surfaces and apply additional lube (part number MP390331) as needed. Similar lubricants may be used on the jackbolt tips and hardened washer during installation.

A complete penetration weld repair conditioned by grinding instead of adding reinforcement is favored to maintain the original pattern of stress flow designed into the structural members. Addition of reinforcement which is not part of the design can reduce fatigue strength because of the change in geometry from the original structure.

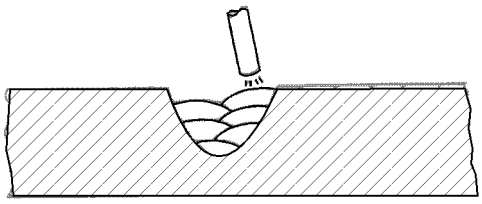
Effective repair welding of cracked, broken or bent structural members of the machine involves knowledge of the types of steel used, proper welding electrodes and recognized good welding practice. The chemical composition, mechanical properties and thickness of the steel determine the welding electrode to be used and the preheat temperature required.

WELDING ELECTRODES

With the exception of the boom, weld repairs on the various structures of the machine can be made with two basic classifications of shielded metal arc electrodes: E7018 and E8018-C1. Both are low hydrogen electrodes which deposit weld metal having excellent properties at strength levels with 70,000 to 80,000 PSI, and impact properties from -20° to -75°F (-29° to -59°C). These are all-position electrodes which produce high quality welds for repairing the structural components of heavy machinery.

NOTE: Although these electrodes are of superior quality, care must be exercised in their application. Low hydrogen electrodes are highly susceptible to moisture pickup after removal from sealed containers. To maintain low hydrogen, crack-resistant properties, they must be stored in electrode ovens at 250°F (121°C) up to the time of use. Small portable rod ovens at the welder's side are ideal. Use of dry low hydrogen electrodes cannot be over-emphasized.

Cracks caused by hydrogen are extremely fine and occur invisibly below the surface in the base metal heat affected zone, as shown. Therefore, they are not detectable at the time of welding.



1. Clean Steel - Remove all oil or grease.
2. Be sure steel is dry.
3. Pre-heat to required temperature.
4. Use dry low-hydrogen electrodes.
   Store in oven @ 250°F until time of use.
   Return to oven after:
   4 hours-E7018
   2 hours-E8018-C1
5. Discard any electrodes which have been wet.

wldrpr-a

These cracks can propagate in service and lead to ultimate failure of the part. It is necessary to adhere strictly to recognized good welding practice regarding the handling, storage and use of low hydrogen electrodes. To avoid underbead cracks, remove all oil or grease or other contaminates from the surface and be sure the steel is dry.

Preheat to the required temperature. Use only dry electrodes taken from the electrode oven. After exposure to the air, the electrodes must be returned to the oven. Time limit outside the oven is four hours for E7018 and two hours for E8018-C1 electrodes.

STORAGE

Reels of wire rope stock may be kept on hand for a considerable length of time. This is particularly true of slow-moving special ropes that may not be disposed of completely for several years. Consequently, wire rope should be stored in an are that is well-ventilated and stable with regard to temperature and humidity.

Do not store rope in contact with the bare ground or expose it to the elements. Excessive atmospheric vapors will condense moisture on the rope causing corrosion. If exposed to the direct sun, next to a boiler or in similarly warm conditions, the original lubrication will dry out and lose its preservation properties.

Similarly, storage in a dusty or chemical laden environment may coat the surface of the rope with corrosive materials or even deteriorate the fiber core. If it should be necessary to store rope outside, the reel should be set on blocks or raised off the ground, and covered with a waterproof covering.

CHECKING DIAMETER

It is critical to check the diameter of the delivered rope BEFORE installation on the machine. This is to ensure that the rope diameter meets the specified requirements for the given machine or equipment. An UNDERSIZE diameter rope will bring about a condition where stresses are exceeding design limitations. This will increase the possibility of injury or machine damage as the chances of breaking the rope will be increased. Use of an OVERSIZE diameter rope will bring about premature wear of that rope. The rope constantly being pinched and compressed in the grooves of the sheaves and drum causes this.

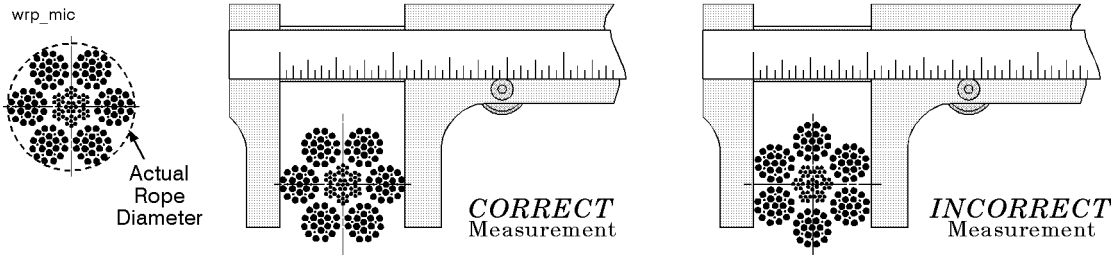


Figure 9-5: Correct Method for Checking Wire Rope Diameter

When checking it is imperative that the actual rope diameter is measured. This is defined as the diameter of the circumscribing circle, or its largest cross-sectional dimension. To ensure accuracy this measurement should be made with a wire rope caliper to obtain the outside dimension of 2 diametrically opposing strands of the rope. When measuring a rope with an odd number of outer strands, special techniques must be employed. Refer to the manufacturer of the product for accurate information.