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Technical Manual

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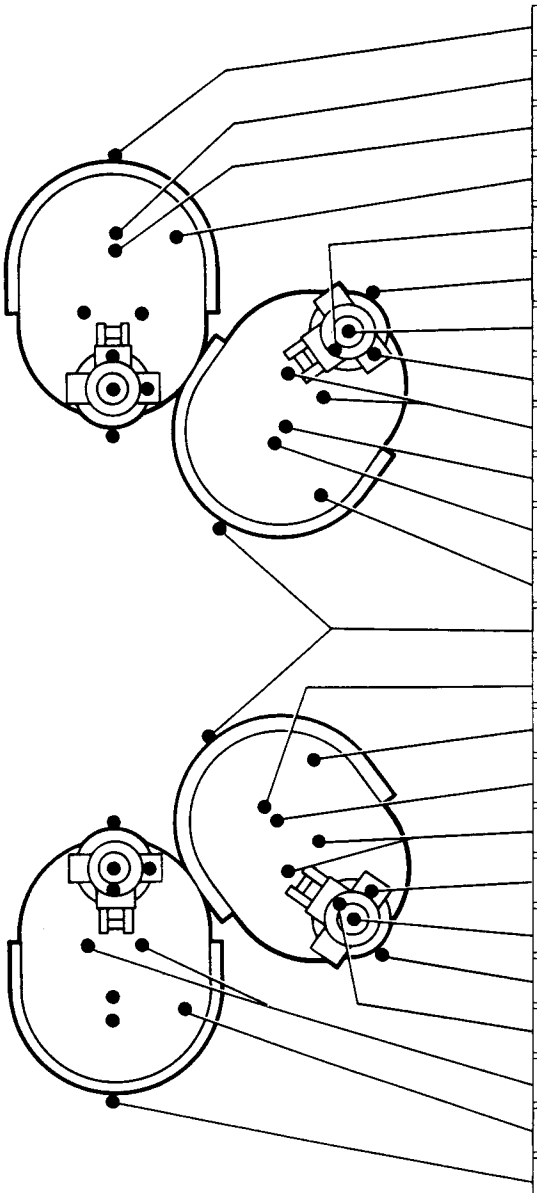
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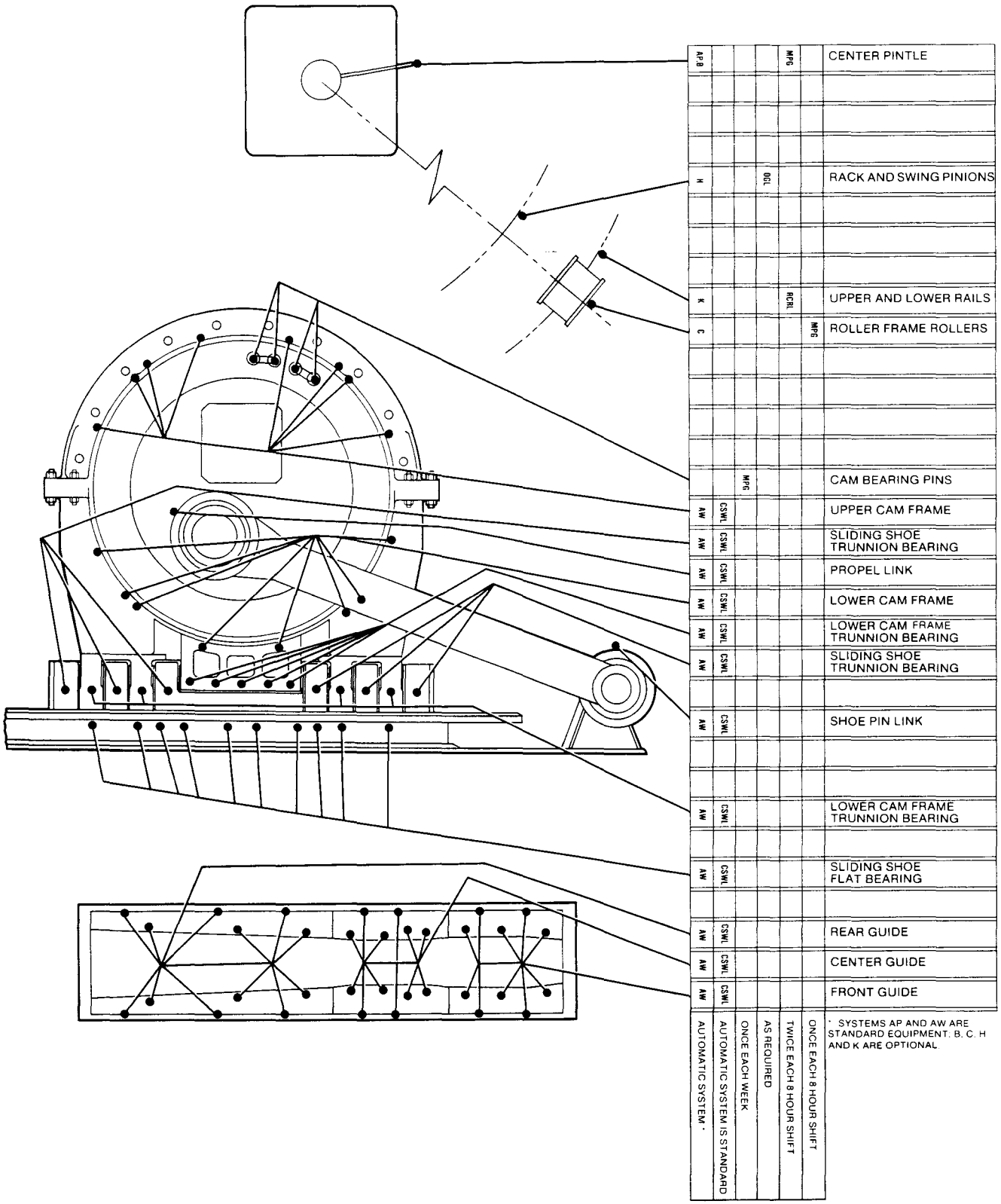


AUTOMATIC LUBE SYSTEMS — OPTIONAL	AS REQUIRED	ONCE EVERY 48 OPERATING HOURS	CHECK DAILY – CHANGE AS REQUIRED	ONCE EVERY 8 OPERATING HOURS	SEE MANUFACTURERS MANUAL	
		MPO				GEARCASE LOWER OIL SEAL
		MPG				VERTICAL SHAFT LOWER SLEEVE
O				MPG		VERTICAL SHAFT LOWER BEARING
			RGL			SWING GEARCASE — CAP. 1265 GAL.
O		MPG				MOTOR SHAFT UPPER BEARING
					X	SWING MOTOR
					X	MOTOR COUPLING
	MPO	MPG				*SWING MOTOR BRAKE
O		MPG				INT. SHAFT UPPER BEARINGS
O				MPG		VERTICAL SHAFT LOWER BEARINGS
		MPG				VERTICAL SHAFT LOWER SLEEVE
			RGL			SWING GEARCASE — CAP. 1265 GAL.
		MPO				GEARCASE LOWER OIL SEAL
		MPG				VERTICAL SHAFT LOWER SLEEVE
			RGL			SWING GEARCASE — CAP. 1265 GAL.
O				MPG		VERTICAL SHAFT LOWER BEARING
O		MPG				INT. SHAFT UPPER BEARINGS
	MPO	MPG				*SWING MOTOR BRAKE
					X	MOTOR COUPLING
					X	SWING MOTOR
O		MPG				MOTOR SHAFT UPPER BEARING
O		MPG				INT. SHAFT UPPER BEARINGS
			RGL			SWING GEARCASE — CAP. 1265 GAL.
		MPO				GEARCASE LOWER OIL SEAL

* USE MPG FOR BRAKES EQUIPPED WITH GREASE FITTINGS: USE MPO FOR BRAKES WITHOUT GREASE FITTINGS.

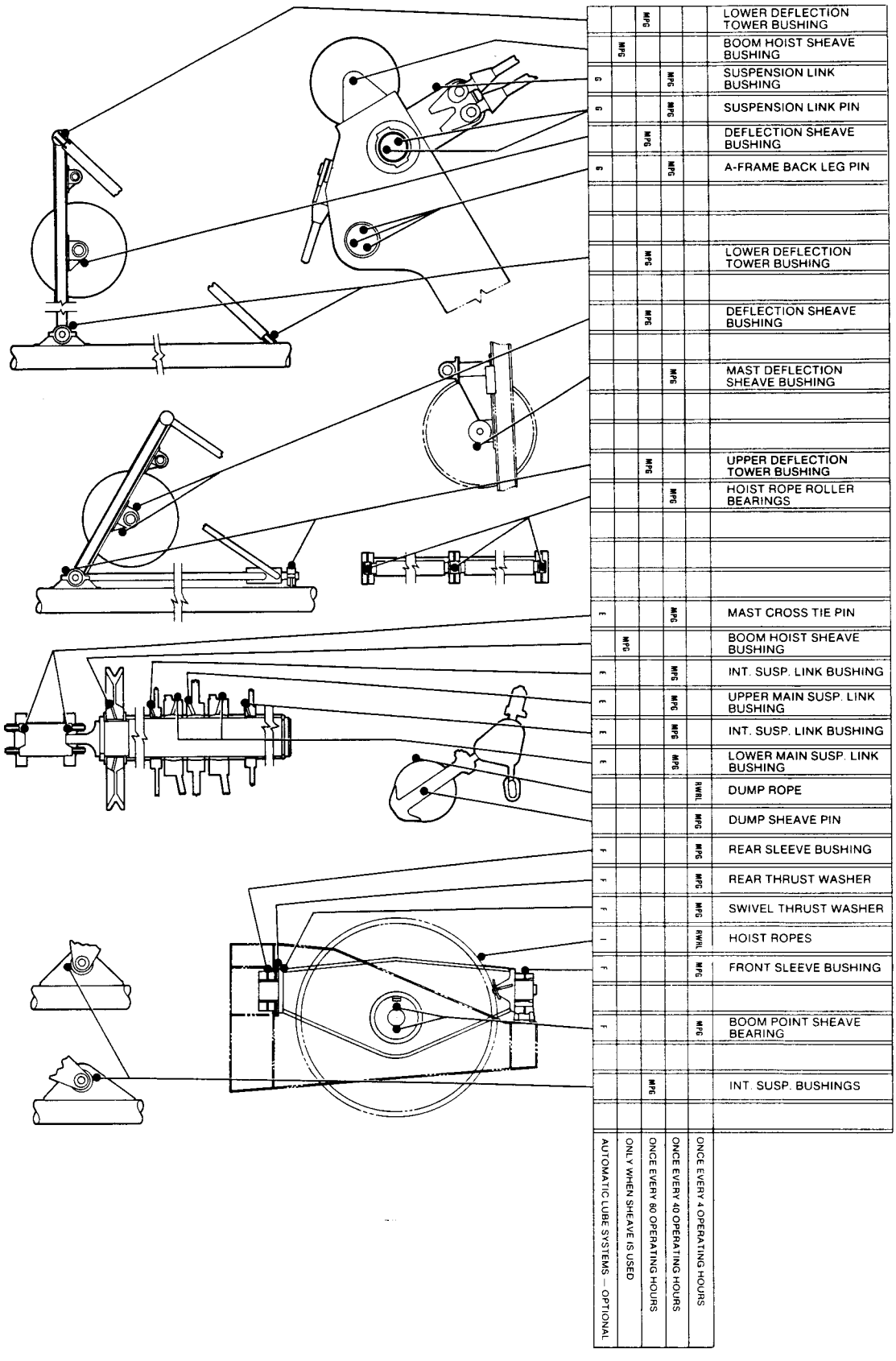
LUBRICATION
SWING MACHINERY (4 UNIT SWING)

FIGURE 112



LUBRICATION
PROPEL MACHINERY (EARLIER MACHINES)
FIGURE 116 (CONT.)

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LUBRICATION
FRONT END EQUIPMENT (TRAPEZOIDAL BOOM)
FIGURE 120

2. Empty drum.
3. Monitor broken supply lines and shut-off systems if such should occur.
4. A vent monitor in systems A and L which gives warning if the system does not vent properly.

The alarm system will be both visible and audible at the control panel and in the operator's cab.

COLD WEATHER EQUIPMENT (OPTIONAL)

As optional equipment for cold weather radiant heater can be supplied for use at the control panels and pumping stations, and thermostatically controlled heating tape can be supplied which can be wrapped around the lubrication lines.

LUBRICANT DRUM HANDLING EQUIPMENT (OPTIONAL)

As optional equipment an electric hoist can be supplied to lift lubricant drums from the ground onto the machinery deck. Also air operated elevator hoists can be supplied at each pumping station to facilitate the changing of drums of lubricant.

PROBLEM	CAUSE	CORRECTIVE ACTION
LUBRICATION SYSTEMS (continued)		
13. Excessive lubricant output through injector.	Piston and plunger packings worn.	Replace packing.
14. Reduced pressure through air line regulator.	a. Diaphragm swollen or stiff.	a. Replace diaphragm.
	b. Inner valve disc dirty or worn, or seat scored.	b. Clean and/or replace.
	c. Restricted air flow.	c. Clean filter and open supply valve.
15. Excessive pressure drop through air line filter.	Dirty air filter cone.	Clean.
16. Clogging of air line lubricator.	Over-lubrication.	Reduce oil feed rate by turning knob to lower setting.
17. Restricted air flow through air lines.	Flattened or kinked lines.	Bend or twist lines carefully to relieve restriction. Make sure all plugs, sockets, nipples and tees are free from restrictive defects.
18. Power loss in controls.	Electrical failure.	Examine all relays, timing units, disconnect switches and limit switches; verify all electrical connections and check wiring insulation.
AIR SYSTEM — AIR COMPRESSOR		
1. No air pressure.	a. Leaks in system.	a. Check for leaks and repair.
	b. Defective compressor or switch.	b. Repair or replace.
	c. Overload tripped.	c. Inspect compressor and motor, correct the cause, reset.
2. Frequent starting and stopping of compressor.	a. Leaks in system.	a. Check for leaks and repair as necessary.
	b. Frozen lines.	b. Clear frozen lines; make sure anti-freezer is operating correctly.
	c. Switch set incorrectly.	c. Check setting, adjust as necessary. Check valve leaking internally.
3. Compressor overheating.	a. Pump running backwards.	a. Check motor rotation and change connections if necessary.

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PROBLEM	CAUSE	CORRECTIVE ACTION
	BOOM	
1. Cracks in boom foot, chords, lacings, deflection sheave towers or boom point.	Overload.	Consult Bucyrus-Erie Company Service Department before undertaking repair welding.
2. Activation of pressurized warning system.	Crack in main longitudinal or apex chords.	Track air leak from chord with sonic detector and consult Bucyrus-Erie Company Service Department before undertaking repair welding.
3. Deflection and boom point sheaves do not rotate freely.	Lubrication deficiency and part failure.	Check all manual and automatic lubrication systems. Inspect all bushings, bearings, shafts, and spacers. Replace if necessary.
4. Broken or damaged upper boom structural strands or tower support structural strands.	Excessive loading.	Replace. Be sure to apply SRWL to protect the coating on the support or structural strands. If intermediate boom structural strands are replaced load them with the take-up device. Refer to Appendix for values.
5. Handrails, platforms, catwalks, or stairways.	Damaged welds or missing parts.	Repair weld or replace parts.
	DRAGLINE BUCKET	
1. Cracks in shroud, clevis plates, side and bottom plates, lip and arch.	Overloads, shock.	Preheat, torch, and repair weld. Refer to Appendix for repair welding information.
2. Abrasion, cracking or shearing of tooth tips.	Excessive wear patterns.	Hardsurface or replace.
3. Worn tooth horns.	Wear.	Check sides and slopes of tooth horn with template and rebuild if necessary. Refer to Appendix for repair welding information.
4. Severe wear or breakage of chain links in rigging.	Overload.	Use repair links.
5. Pivot and swivel mountings on rigging break.	Overload. Severe jerking and frictional rubbing.	Restore mountings and lubricate at periodic intervals.

TURN OF THE NUT METHOD

WARNING: This tightening procedure is good only for bolt grades 5 and 8 with UNC threads. For bolts with other than UNC threads contact the Bucyrus Erie Service Department.

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

1. The bolts shall be brought to a "snug tight" condition to insure that the parts of the joint have good contact with each other. "Snug Tight" is defined as the tightness attained by torquing a bolt to the value specified in Table 3 below. Snug tightening should progress systematically from the most rigid part of the joint to its free edges, alternating from bolt to bolt to assure gradual even pull up of the mating parts. After all bolts have been snugged, the first bolts tightened at the most rigid part of the joint should be rechecked for proper torque. If these bolts are loose due to pull up of the joint, the snug tightening sequence should be repeated for all bolts in the connection. This rechecking and re-torquing procedure should be repeated as many times as is required until the joint is completely pulled up and all bolts are at the specified "snug tight" torque. Tightness of the mating surfaces of the joint should then be verified by using feeler gauges.

TABLE 3
"SNUG TIGHT" TORQUE VALUES

Bolt Dia.		Torque Values (1)	
In.	Cm.	Ft. Lbs.	Nm.
.500	1.27	15	20
.625	1.58	30	40
.750	1.90	53	71
.875	2.22	86	116
1.000	2.54	128	173
1.250	3.17	224	303
1.500	3.81	390	528
1.750	4.44	457	619
2.000	5.08	688	932
2.250	5.71	1005	1362
2.500	6.35	1375	1864
2.750	6.98	1864	2527
3.000	7.62	2462	3337

(1) Tighten to values listed ∓ 10%. The torque values listed are calculated for 20% × proof load with lubricated threads and under the head surfaces of the bolt and nut.

2. The nuts and bolts should then be matched marked by center punching the bolt end and nut. On rod bolts match mark both rod ends and nuts. The bolts and nuts should then be tightened additionally by the applicable amount of nut rotation as specified in Table 4. It is not necessary to follow any particular bolt to bolt sequence during this portion of the "turn of the nut" tightening.

NOTE: Nut rotation is read between punch mark on the bolt and punch mark on the nut. For rod bolts, nut rotation is the cumulative total rotation between punch marks on both ends of the rod bolt.

TABLE 4

Part No.	Nut Rotation	Bolt Length (1)
747773-01	1/3 Turn of ± 10%	Up to and including 4 diameters.
747773-02	1/2 Turn of ± 10%	Over 4 diameters but not exceeding 8 diameters
747773-03	2/3 Turn ± 10%	Over 8 diameters but not exceeding 12 diameters

(1) In case part number or nut rotation designation is not given, the nut rotation can be determined by the bolt length (Grip length + 1/2 bolt diameter). For bolt lengths exceeding diameters contact the Bucyrus-Erie Service Department.

APPENDIX A5 — MAINTENANCE WELDING

SECTION 1 — REPAIR WELDING OF BASE, REVOLVING FRAME, A-FRAME, WALKING SHOES AND DRAG BUCKET

GENERAL

These recommendations for repair welding apply to the major structural members of the machine including the base, revolving frame, A-frame walking shoes, and drag bucket.

The high cyclic loading characteristics of the walking dragline are considered in the design and material selected for the construction of the machine. However, due to unusual operational conditions that may be encountered and to the great number of cyclic loadings that may be applied to the machine, fatigue cracks or other abnormalities may occur. Early detection of these conditions through regular machine inspection helps to avoid problems or emergency breakdowns.

Maintenance welding is applied to the repair of cracked, broken or bent structural components. Reconditioning of failed members requires attention to a number of details and careful application of the repair procedure. Only in certain cases is it necessary to strengthen members by added reinforcement.

WARNING: Such modifications should be made only upon recommendation by Bucyrus-Erie Company. Improperly applied reinforcements can have an adverse effect on the performance and life of the structure.

A broken member is best repaired by making a complete penetration weld, preferably by welding from both sides, using the correct welding electrode and observing all precautions, such as preheat, back-gouging, etc. The complete penetration groove weld should be ground flush with the base metal on both sides to remove all surface irregularities. An alternate procedure incorporates back-up bars to ensure sound, complete penetration welds in the repair area. Be sure to follow all applicable safety measures and federal, state and local regulations.

The reason for favoring a complete penetration weld repair conditioned by grinding, instead of adding reinforcement, is 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.

RECOMMENDED ELECTRODES AND PREHEAT

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. Refer to Table 1 for types of steel used in the structures and recommended electrode and preheat.

WELDING ELECTRODES

With the exception of the boom and mast, weld repairs on the various structures of the machine made with two basic classifications of shielded metal arc electrodes, namely 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 pounds per square inch, and impact properties from -20 degrees Fahrenheit to -75 degrees Fahrenheit. 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 exercized in their application. Low hydrogen electrodes are highly susceptible to moisture pick-up after removal from sealed containers. To maintain low hydrogen, that is, crack resistant properties, they must be stored in electrode ovens at 250 degrees Fahrenheit 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 overemphasized.

Cracks caused by hydrogen are extremely fine and occur invisibly below the surface in the base metal heat affected zone, as shown in figure 125. Therefore, they are not detectable at the time of welding.

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pass to remove all slag before continuing. Grind to remove any undercut or other defects which occur during welding.

Maintain the preheat until arc gouging and welding has been completed. Arc-air gouge to half thickness. Prepare a V groove for welding. Weld this half completely. Turn bucket over. Arc-air gouge to completely remove the crack from the second side and prepare a V groove for welding as before.

STRESS RELIEVING

On major repairs, such as a broken lip or one which has cracked through the thickness, thermal stress relieving is recommended after welding. Stress relieving is beneficial in removing residual weld stresses, reducing hardness in the weld area, restoring ductility and aids in removal of hydrogen from the metal.

Electrical resistance heating with thermocouple temperature control is recommended. The area to be heated should include several inches on either side of the repair and should extend the full depth of the lip from leading edge to the basket. Heating elements, however, should not be placed over the plate of the basket. Thermocouples should be placed over the weld in the area of the thickest and thinnest portions of the lip.

Rate of heating and cooling must be controlled to avoid drastic temperature differences in the metal. Up to 600 degrees Fahrenheit, the lip can be heated at the maximum rate attainable with the equipment. Over 600 degrees Fahrenheit, the rate of heating should be restricted to 100 degrees Fahrenheit per hour up to a temperature at 1050 degrees Fahrenheit. The thermocouple readings should be within a range of 1025 to 1075 degrees Fahrenheit for a period of time based on the thickness of the casting. To calculate the time in hours, multiply the average thickness of the lip in the repair area in inches by two. At the end of the holding time, the rate of cooling to 600 degrees Fahrenheit should be restricted to 100 degrees Fahrenheit per hour, after which air cooling is permissible.

PROCEDURE FOR REPLACEMENT OF BUCKET LIP SHROUDS (Refer to Figures 130 and 131)

Arc-air gouge to remove the shroud welds. Grind off the remainder of the weld and inspect the lip for soundness.

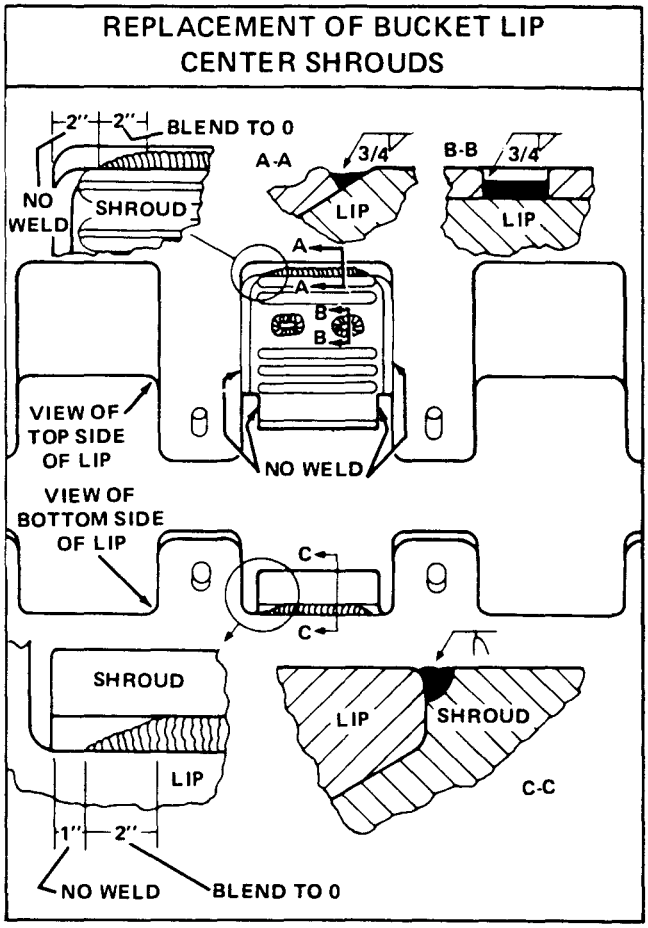


FIGURE 130

Install center shrouds according to welding details to welding details shown in figure 130. Install corner shrouds and shroud plates according to welding details shown in figure 131.

400 degree Fahrenheit minimum preheat is required for shroud welding. Use only oven dry E8018-C1 low hydrogen electrodes and follow applicable welding recommendations given in Procedure For The Repair Of Cracked Or Broken Dragbucket Lips.

NOTE: No welding is to be applied to the edge of the lip when attaching shrouds. All weld endings are to be away from the edge by the amount specified in figures 130 and 131, and blended as shown.

DRAG BUCKET TOOTH REPAIR

As wear patterns develop on the tooth the effective life of the tooth can be increased by applying hardsurfacing beads parallel to the lines of minimum stress. The hardsurfacing produces a slight

SECTION 2 — REPAIR WELDING SWING RACK TEETH

The following is a suggested method for the repair of cracked or broken swing rack teeth on walking draglines. The repair method should produce satisfactory results and provide a serviceable swing rack, provided the procedure is carefully followed in all details.

Repair of cracked teeth is illustrated in figures 136 and 137, and broken teeth in figure 138. The welding procedure is essentially the same for the three conditions shown.

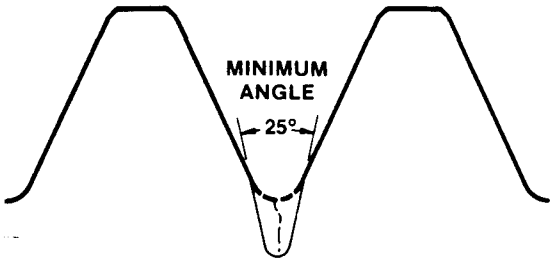
PREPARATION

1. Clean off the swing rack in the area of the tooth to be repaired to remove all traces of grease, oil or dirt. Wash down thoroughly with a solvent cleaner and wipe dry with clean rags.

2. Grind to completely remove the crack and prepare a groove for welding as shown in figures 136 and 137.

3. Dye penetrant test for complete crack removal.

4. In the case of a broken tooth, grind the fracture surface on the swing rack smooth and round off edges as shown in figure 138.



CRACK BETWEEN TEETH

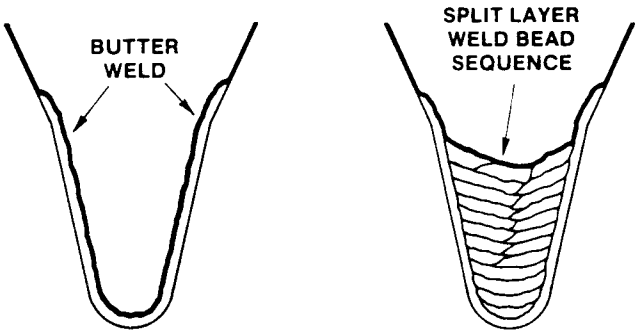
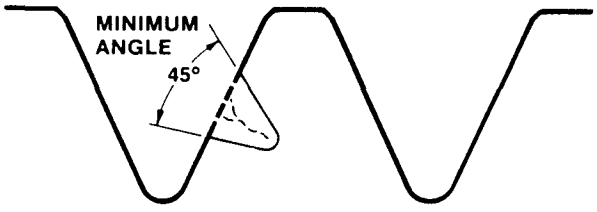


FIGURE 137



CRACKED
TOOTH

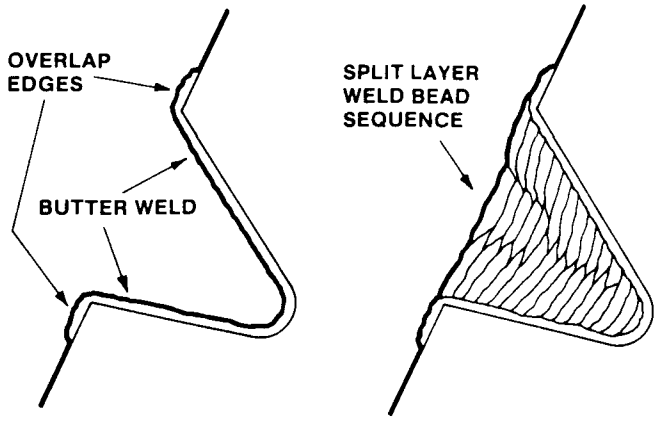
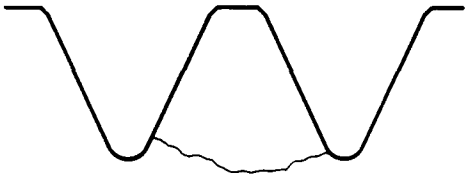


FIGURE 136



BROKEN TOOTH

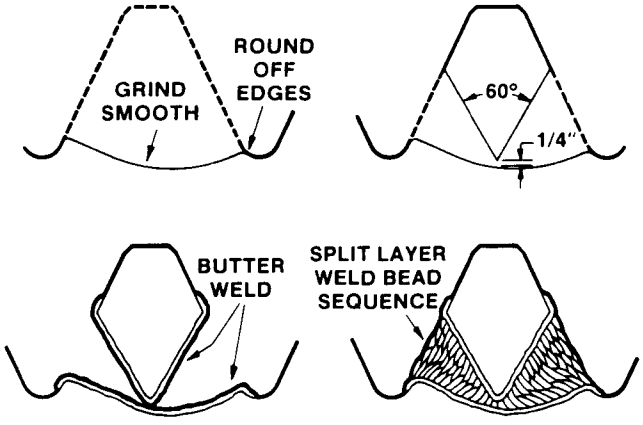


FIGURE 138

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APPENDIX A6 — LUBRICATION BENCHMARKS

MPG — MULTIPURPOSE TYPE GREASE

Scope

Lubricant performance requirements for Multi-Purpose Type Grease.

Application

For heavy duty ball, roller and plain bearings.

General Requirements

1. HEAT RESISTANCE - Shall be thermal stable.
2. RETENTION IN BEARINGS - Shall not exhibit high leakage.
3. MECHANICAL STABILITY - Shall work continuously with a minimum change in consistency.
4. WATER RESISTANCE - shall withstand water wash-out or leaching.
5. REVERSIBILITY - Shall be stable with repeated heating and cooling.
6. PRESSURE OIL SEPARATION - Shall resist oil-soap separation.
7. DISPENSABILITY - Shall have the ability to be pumped through automatic lubrication systems without the aid of heat tracing on the lube lines at the designated ambient temperatures.
8. EXTREME PRESSURE - Shall withstand heavy shock loading.
9. COMPATIBILITY - Low temperature greases shall be compatible with mineral oil base greases and their oil seal material.

Compounding

1. Suitable for producing the extreme pressure characteristics (without inert fillers) required for heavy duty ball, roller and plain bearing lubrication.

Specific Requirements

AMBIENT TEMPERATURE	NOTE #1	110° TO 30°F	40° TO 0°F	+10° TO -50°F
NLGI	ASTM. D-217	2	1	Note #2
Typical Penetration	ASTM. D-217	265-295	310-340	Note #2
Dropping Point °F, min.	ASTM. D-2265	325	325	Note #2
Timken O.K. Load, lbs., min.	ASTM. D-2509	40	40	40
Shell Four Ball EP	ASTM. D-2596			
Load Wear Index, kg., min.	ASTM. D-2596	40	40	35
Load Weld, kg., min.	ASTM. D-2596	200	200	200
Shell Four Ball Wear	ASTM. D-2266			
Wear Scar Diam., mm., max.	ASTM. D-2266	0.60	0.60	0.60
Copper Strip Corrosion	ASTM. D-130	Pass	Pass	Pass
Rust Test	ASTM. D-1743	Pass	Pass	Pass

Notations

1. AMBIENT TEMPERATURE - The ambient temperature shall be the temperature at the point of lubricant application.

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Viscosity Recommendations

1. Air Line Lubricant

AMBIENT TEMPERATURE	SAE NUMBER
Below 10°F	5W
Above 10°F	10W

2. Hand Oil Can - Viscosity to be suitable for application and temperature.

These performance requirements are benchmarks and not a specification. Therefore, meeting these limits as described above does not relieve the supplier of the responsibility associated with brand name products.

OGL — OPEN GEAR LUBRICANT

Scope

Lubricant performance requirements for the lubrication of open gearing.

Application

Lubrication between mating teeth in an open gear drive.

Methods of Application

1. Heated and either poured or hand sprayed on the gear teeth.
2. Sprayed or dripped on the gear teeth by means of an automatic lubrication system.
3. Applied by means of a cartridge gun.

General Requirements

The following are the requirements of the lubricant at the ambient temperature of the open gear drive.

1. ADHESIVE - Maintain film lubricity and be highly resistant to squeeze at contact points of mating surfaces.
2. FLEXIBILITY - The coating on the surface of the gear teeth must remain pliable.
3. EXTREME PRESSURE - Must withstand the high rolling and sliding contact pressures and have the ability to flow under loads.
4. CONSISTENCY - Should maintain consistency.
5. WATER RESISTANCE - Ability to resist water washout.

Types of Lubricants

1. PETROLEUM RESIN AND ASPHALTIC TYPES
   a. Hot Melt Type

NOTE: Since this type must be heated and melted before it is applied to the gears, safety codes should be checked before it is used.

   b. Diluted Type

      This should contain a fast drying diluent such as or equivalent to trichloroethelyne. The diluted viscosity must be such that the lubricant can be applied by either spraying or dripping at the ambient temperature of the open gear drive.

3. SPECIAL DRAGLINE VISCOSITY AND POUR POINT REQUIREMENTS

AMBIENT TEMPERATURE		130° to 30°	Below 30°F
Viscosity SUS @ 100°F	ASTM D-445 D-2161		Heater
Viscosity SUS @ 210°F	ASTM D-445 D-2161	220-240	Requirement
AGMA Lubricant No.		NONE Applicable	#2
Viscosity Index, Min.		85	
Pour Point °F, Max.		+30	

1. AGMA standard gear oil specification does not include pour point temperature. Pour point as specified is an additional Bucyrus-Erie requirement.
2. If ambient starting temperature approaches lubricant pour point, external heaters may be required to facilitate starting and insure proper lubrication.
3. If oil recommendation requires special seal or packing material, oil supplier should inform the Bucyrus-Erie Company Engineering Department of the need in time to obtain suitable seals or packings.

These performance requirements are bench marks and not a specification. Therefore, meeting these limits as described above does not relieve the supplier of the responsibility associated with brand name products.

RCRL — ROLLER CIRCLE RAIL LUBRICANT

Scope

Lubricant performance requirements for Roller Circle Rail Lubricant.

Application

Between the mating surface of the rollers and rails, and between the roller flange and rail.

Method of Application

1. Heated and either poured or hand sprayed on the roller rails.
2. Sprayed or dripped on the rollers and rails by means of an automatic lubrication system.
3. Applied by means of cartridge gun.

General Requirements

The following are the requirements of the lubricant at the ambient temperature at the roller circle rail.

1. ADHESIVE - Maintain film lubricity and be highly resistant to squeeze at contact points of mating surfaces.
2. FLEXIBILITY - The coating on the surface of the roller circle rail must remain pliable.
3. EXTREME PRESSURE - Must withstand the high rolling contact pressures and have the ability to flow under loads.
4. CONSISTENCY - Should maintain consistency.
5. WATER RESISTANCE - Ability to resist water washout.

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