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Service and Maintenance Manual

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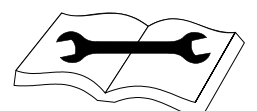
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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

This section contains the general safety precautions which must be observed during maintenance of the aerial platform. It is of utmost importance that maintenance personnel pay strict attention to these warnings and precautions to avoid possible injury to themselves or others, or damage to the equipment. A maintenance program must be followed to ensure that the machine is safe to operate.

⚠ WARNING

MODIFICATION OR ALTERATION OF AN AERIAL WORK PLATFORM SHALL BE MADE ONLY WITH WRITTEN PERMISSION FROM THE MANUFACTURER.

The specific precautions to be observed during maintenance are inserted at the appropriate point in the manual. These precautions are, for the most part, those that apply when servicing hydraulic and larger machine component parts.

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

⚠ WARNING

SINCE THE MACHINE MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA RESPONSIBILITY OF THE OWNER/OPERATOR.

B HYDRAULIC SYSTEM SAFETY

It should be noted that the machines hydraulic systems operate at extremely high potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system.

Do not use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks. Wear gloves to help protect hands from spraying fluid.



C MAINTENANCE

⚠ WARNING

FAILURE TO COMPLY WITH SAFETY PRECAUTIONS LISTED IN THIS SECTION COULD RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

- ENSURE REPLACEMENT PARTS OR COMPONENTS ARE IDENTICAL OR EQUIVALENT TO ORIGINAL PARTS OR COMPONENTS.
- NO SMOKING IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.
- REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.
- DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.
- OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICE MANUAL.
- KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.
- USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.
- NEVER WORK UNDER AN ELEVATED BOOM UNTIL BOOM HAS BEEN SAFELY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING, OR BOOM SAFETY PROP HAS BEEN ENGAGED.
- BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.
- BATTERY SHOULD ALWAYS BE DISCONNECTED DURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

REVISION LOG

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating Specifications

Capacity: Unrestricted: ANSI CE & Australia	500 lbs. (227 kg) 500 lbs. (230 kg)
Maximum Travel Grade, stowed Position (Gradeability)	45%
Maximum Travel Grade, stowed Position (Side Slope)	5°
Drive Speed - Stowed	3.1 mph (5.0 kph)
Elevated Drive Speed	0.6 mph (1.0 kph)
Gross Machine Weight - Approximate ANSI CE & Australia	9400 lbs. (4263 kg) 9700 lbs. (4400 kg)
Ground Bearing Pressure Pneumatic Foam Filled Solid Non-Marking Solid	59 psi (4.1 kg/cm ²) 64 psi (4.5 kg/cm ²) 70 psi (4.9 kg/cm ²) 81 psi (5.7 kg/cm ²)
System Voltage	12V DC
Maximum Main Relief Hyd. Pressure	4060 psi (280 Bar)

1.2 DIMENSIONAL DATA

Table 1-2. Dimensional Data

Turning Radius (Inside)	5' (1.52 m)
Turning Radius (Outside)	13' (3.96 m)
Machine Height (stowed)	6' 7" (2 m)
Machine Height (storage)	7' 1" (2.17 m)
Machine Length (stowed)	18' 2" (5.52 m)
Machine Length (storage)	13' 1" (3.98 m)
Up and Over Platform Height	17' 0" (5.17 m)
Horizontal Reach	19' 11" (6.06 m)
Machine Width	6' 4" (1.93 m)
Wheel Base	6' 2" (1.87 m)

Table 1-2. Dimensional Data

Platform Height ANSI CE & Australia	33' 9" (10.29 m) 33' 10.5" (10.33 m)
Ground Clearance	10.1" (23.7 cm)

1.3 CAPACITIES

Table 1-3. Capacities

Hydraulic Oil Tank (to Full Level)	20.6 gal. (77.9 L)
Drive Hub*	25.5 oz. (0.75 L)
Engine Coolant	1.55 gal. (5.9 L)
*Drive hubs should be one half full of lubricant.	

1.4 TIRES

Table 1-4. Tires

Size	265/50 D20 (20" x 9")
Maximum Tire Load	4800 lbs. (2177 kg)
Type	Air, Foam-Filled
Size	18" x 7"
Maximum Tire Load	4800 lbs. (2177 kg)
Type	Solid
Size	33" x 12"
Maximum Tire Load	4800 lbs. (2177 kg)
Type	Turf/Sand (Air, Foam-Filled)

1.5 ENGINE DATA

Table 1-5. Kubota D1105-E3

Type	Liquid Cooled
Number of Cylinders	3
Bore	3.07 in. (78 mm)
Stroke	3.09 in. (78.4 mm)
Total Displacement	68.5 cu. in. (1123 cm ³)
Compression Ratio	24:1
Firing Order	1-2-3
Output	24.8 hp (18.5 kW)
Low Idle RPM	1200 ± 50
High Idle RPM	3000 ± 50
Fuel Consumption	0.43 gal/hr

Table 1-6. GM 0.97L

Type	Liquid Cooled
Number of Cylinders	4
Bore	2.58 in. (65.5 mm)
Stroke	2.84 in. (72.0 mm)
Total Displacement	59 cu. in. (967 cm ³)
Compression Ratio	8.8:1
Firing Order	1-3-4-2
Output	28.6 hp (21.3 kW)
Low Idle RPM	1200 ± 50
High Idle RPM	3000 ± 50
Fuel Consumption	0.27 gal/hr

1.6 HYDRAULIC OIL

Table 1-7. Hydraulic Oil

Hydraulic System Operating Temperature Range	S.A.E. Viscosity Grade
+0° to +180° F (-18° to +83° C)	10W
+0° to +210° F (-18° to +99° C)	10W-20, 10W30
+50° to +210° F (+10° to +99° C)	20W-20

NOTE: Hydraulic oils require anti-wear qualities at least API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service.

NOTE: Machines may be equipped with Mobil EAL biodegradable and non-toxic hydraulic oil. This is a fully synthetic hydraulic oil that possesses the same anti-wear and rust protection characteristics as mineral oils, but will not adversely affect the ground water or the environment when spilled or leaked in small amounts.

NOTE: When temperatures remain consistently below 20 degrees F. (-7 degrees C.), JLG Industries recommends the use of Mobil DTE10.

NOTE: Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities.

Table 1-8. Mobilfluid 424 Specs

SAE Grade	10W30
ISO Viscosity Grade	55
Gravity, API	29.0
Density, Lb/Gal. 60°F	7.35
Pour Point, Max	-46°F (-43°C)
Flash Point, Min.	442°F (228°C)
Viscosity	
Brookfield, cP at -18°C	2700
at 40°C	55 cSt
at 100°C	9.3 cSt
Viscosity Index	152

Table 1-9. DTE 10 Excel 32 Specs

ISO Viscosity Grade	32
Pour Point, Max	-65°F (-54°C)
Flash Point, Min.	482°F (250°C)
Viscosity	
at 40°C	32.7 cSt
at 100°C	6.63 cSt
at 100°F	32.7 cSt
at 212°F	6.63 cSt
Viscosity Index	164

Table 1-10. Quintolubric 888-46

Density	0.92 g/cm ³ @ 15°C (59°F)
Pour Point	< -30°C (< -22°F)
Flash Point	300°C (572°F)
Fire Point	360°C (617°F)
Auto ignition Temperature	>450°C (842°F)
Viscosity	
at 0°C (32°F)	320 cSt
at 20°C (68°F)	109 cSt
at 40°C (104°F)	47.5 cSt
at 100°C (212°F)	9.5 cSt
Viscosity Index	190

Table 1-11. Exxon Univis HVI 26 Specs

Specific Gravity	32.1
Pour Point	-76°F (-60°C)
Flash Point	217°F (103°C)
Viscosity	
at 40°C	25.8 cSt
at 100°C	9.3 cSt
Viscosity Index	376
NOTE: Mobil/Exxon recommends that this oil be checked on a yearly basis for viscosity.	

Major Component Weights

⚠ WARNING

DO NOT REPLACE ITEMS CRITICAL TO STABILITY WITH ITEMS OF DIFFERENT WEIGHT OR SPECIFICATION (FOR EXAMPLE: BATTERIES, FILLED TIRES, PLATFORM) DO NOT MODIFY UNIT IN ANY WAY TO AFFECT STABILITY.

Table 1-12. Critical Stability Weights

Components	LBS.	KG.
Counterweight	1875 ± 75	850.5 ± 34
Tire and Wheel - 20x9 Pneumatic	130	59
Tire and Wheel - 20x9 Foam-Filled	220	99.8
Tire and Wheel - 18x7	230	104.3
Tire and Wheel - 33x12 Pneumatic	129	58.5
Tire and Wheel - 33x12 Foam-Filled	227	125.6
Platform & Console - 30x60	242.5	110
Platform & Console - 30x48	216	98
Battery	66	30

1.7 FUNCTION SPEEDS

Test Notes

1. Stop watch should be started with the function, not with the controller or switch.
2. Drive test results reflect 20"x 9" air filled tires.
3. All speed tests are run from the platform. These speeds do not reflect ground control operation.
4. The platform speed control knob must be at full speed (turned clockwise completely).
5. Function speeds may vary due to cold, thick hydraulic oil. Tests should be run with the oil temperature above 100° F (38° C).
6. Some flow control functions may not work with the speed knob clicked into the creep position.

Table 1-13. Function Speed

Function	Speed Tolerances (Seconds)
Main Lift Up	19-25
Main Lift Down	13-19
Swing Right & Left (Max 10% Difference Between Left & Right)	58-72
Telescope Out	12-18
Telescope In	15-21
Platform Rotate Left & Right (Max 15% Difference Between Left & Right)	23-34
Jib Up	24-30
Jib Down	15-21
Lower Lift Up	15-21
Lower Lift Down	14-20
High Drive Forward & Reverse (200 Feet)	42-47 (2.9-3.2 MPH)
Drive Above Horizontal Forward & Reverse (50 Feet) (CE)	57-85 (0.4-0.6 MPH [0.6-0.9 kph])

Table 1-14. Function Speed Machine Position

Function	Machine Position
Main Lift	Boom retracted, telescope in. Main lift up, record time. Main lift down, record time.
Swing	Boom at full elevation, telescope retracted. Swing the turntable to the end stop. Swing the opposite direction, record time. Swing the other direction, record time.
Telescope	Boom at full elevation, telescope retracted. Telescope out, record time. Telescope in, record time.
Drive	Test should be done on a smooth, level surface. Start approximately 25 feet from starting point so that the unit is at a maximum speed when starting the test. Results should be recorded for a 200 foot course. Drive forward, record time. Drive reverse, record time.
Drive (Above Horizontal)	Test should be done on a smooth, level surface. The platform speed control knob should be selected out of creep speed. This verifies that the switches are working when the boom is above horizontal. Results should be recorded for a 50 foot course. Drive forward, record time. Drive reverse, record time.
Platform Rotate	Platform level and completely rotated one direction. Rotate the opposite direction, record time. Rotate the other direction, record time.
Jib	Platform level and centered with the boom. Start with jib down. Jib up, record time. Jib down, record time.
Lower Lift	Main boom horizontal, telescoped in. Lower lift up, record time. Lower lift down, record time.
Jib Swing	Platform level and centered with the boom. Start with jib at horizontal. Begin with jib swung fully to left. Swing fully to right, record time. Swing to left, record time.

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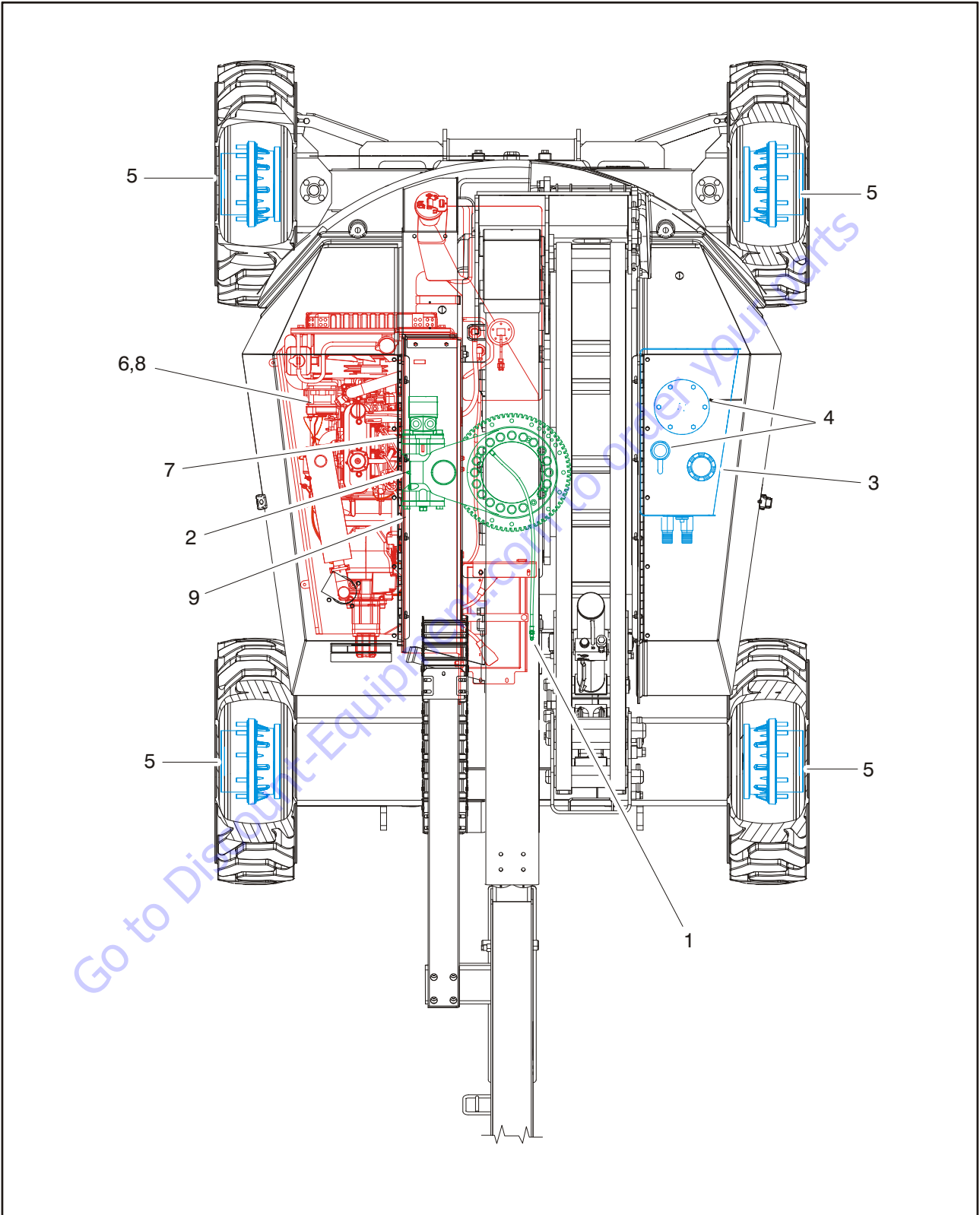


Figure 1-1. Operator Maintenance and Lubrication Diagram

1.8 OPERATOR MAINTENANCE

NOTE: The following numbers correspond to those in Figure 1-1., Operator Maintenance and Lubrication Diagram.

Table 1-15. Lubrication Specifications

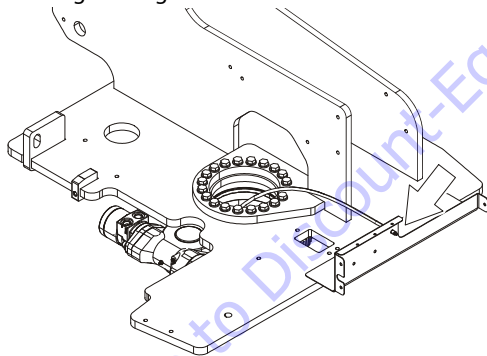
KEY	SPECIFICATIONS
BG*	Bearing Grease (JLG Part No. 3020029) Mobilith SHA 460.
HO	Hydraulic Oil. API service classification GL-4, e.g. Mobilfluid 424.
EPGL	Extreme Pressure Gear Lube (oil) meeting API Service Classification GL-5 or Mil-Spec Mil-L-2105.
MPG	Multipurpose Grease having a minimum dripping point of 350° F (177° C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EO	Engine (crankcase) Oil. Gas - API SF, SH, SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.

*MPG may be substituted for these lubricants, if necessary, but service intervals will be reduced.

NOTICE

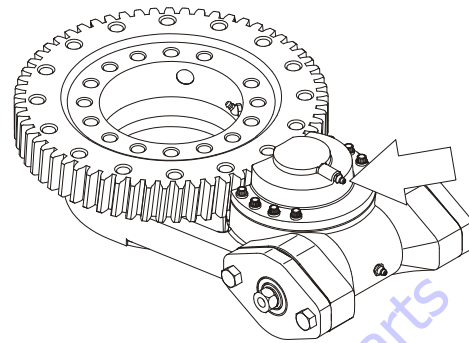
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

1. Swing Bearing

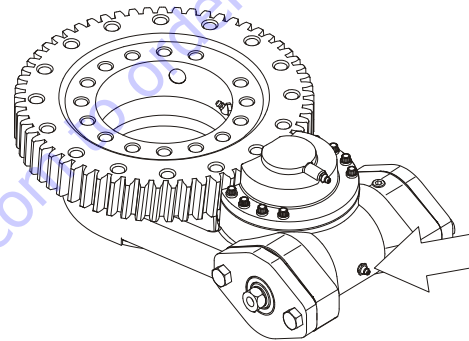


Lube Point(s) - Remote Fitting
 Capacity - A/R
 Lube - BG
 Interval - Every 3 months or 150 hrs of operation
 Comments - Apply grease and rotate in 90 degree intervals until bearing is completely lubricated

2. Swing Bearing/Worm Gear Teeth



Lube Point(s) - Grease Fitting
 Capacity - A/R
 Lube - Lubriplate 930-AAA
 Interval - A/R

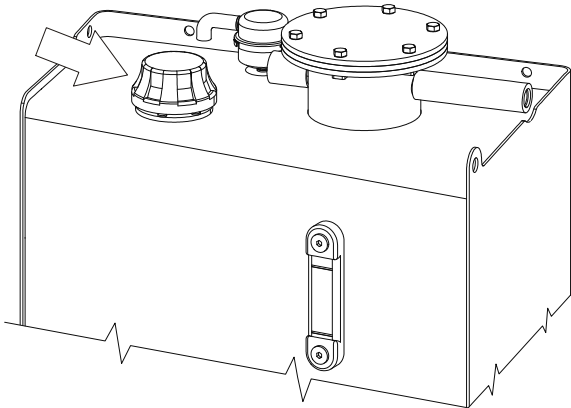


Lube Point(s) - Grease Fitting
 Capacity - A/R
 Lube - Mobil SHC 460
 Interval - A/R

CAUTION

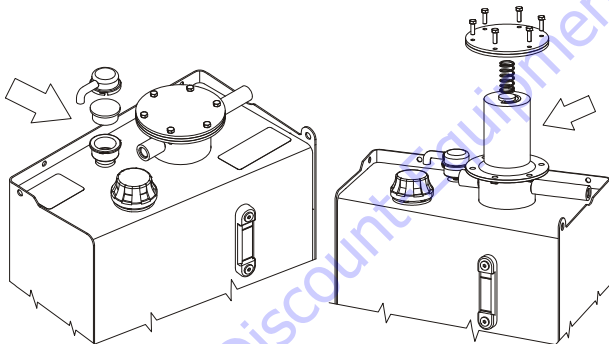
DO NOT OVERGREASE BEARINGS. OVERGREASING BEARINGS WILL RESULT IN DAMAGE TO OUTER SEAL IN HOUSING.

3. Hydraulic Tank



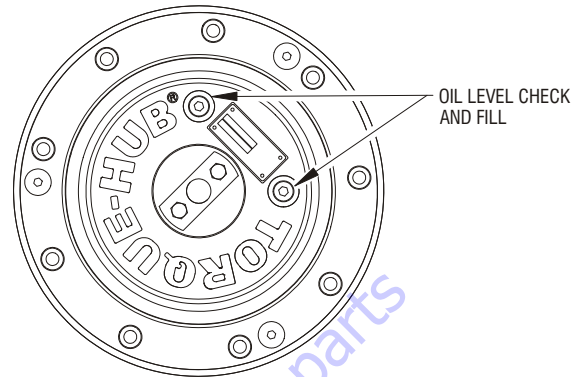
Lube Point(s) - Fill Cap
 Capacity - 24.8 Gal. (93.9 L), 20.6 Gal. (77.9 L) to Full Level; 17.8 Gal (67.4 L) to Low Level
 Lube - HO
 Interval - Check Level daily; Change every 2 years or 1200 hours of operation.
 Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate all systems a minimum of two complete cycles and recheck oil level in reservoir.

4. Hydraulic Tank Return Filter and Breather



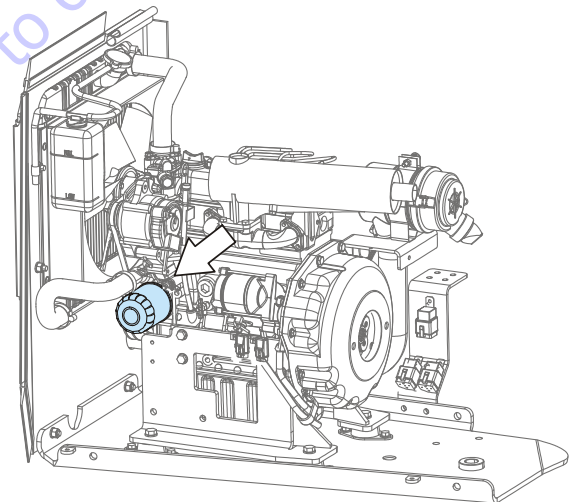
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.
 Comments - For breather element, twist top to replace.

5. Wheel Drive Hub



Lube Point(s) - Level/Fill Plug
 Capacity - 25.5 oz. (0.75 L)(1/2 Full)
 Lube - EPGL
 Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

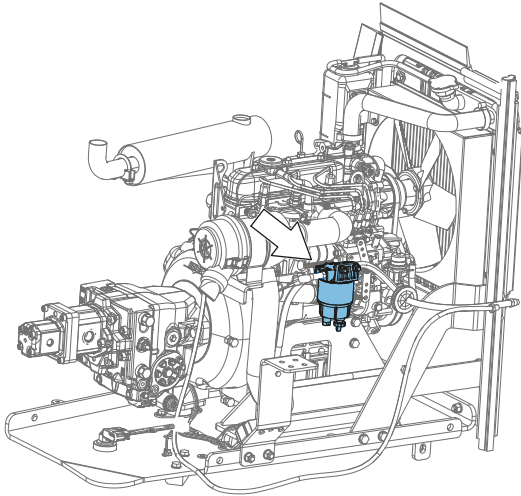
6. Oil Change with Filter - Kubota



Lube Point(s) - Fill Cap/Spin-on Element
 Capacity - 5.4 Quarts (5.1 L) w/Filter
 Lube - EO
 Interval - Check level daily; change every 500 hours or six months, whichever comes first. Adjust final oil level by mark on dipstick.

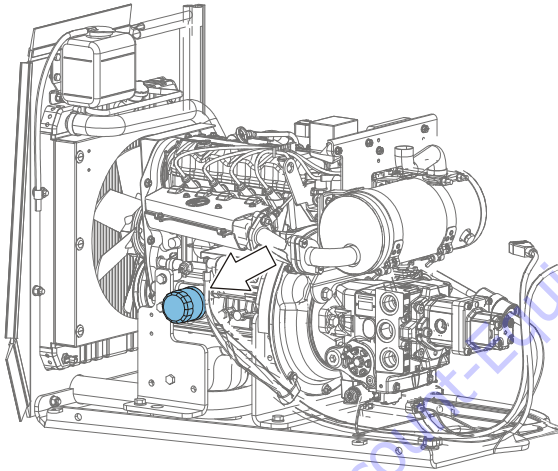
SECTION 1 - SPECIFICATIONS

7. Fuel Filter/Water Separator - Kubota



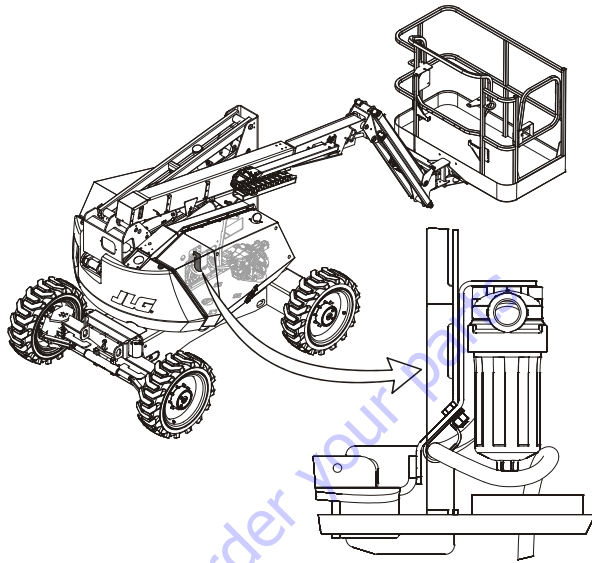
Lube Point(s) - Replaceable Element
Interval - Every year or 600 hours of operation

8. Oil Change with Filter - GM



Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 3.1 Quarts (3 L) w/Filter
Lube - EO
Interval - Check level daily; change every 500 hours or six months, whichever comes first. Adjust final oil level by mark on dipstick.

9. Charge Filter



Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.

Comments - Remove the engine tray retaining bolt and pull out engine tray to gain access

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)																			
SAE GRADE 5 BOLTS & GRADE 2 NUTS										SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*									
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loclote® 262™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loclote® 262™ or Vibra-TITE™ 131)		Clamp Load		Torque (Dry or Loclote® 263 K=0.20)		Torque (Loclote® 242™ or 271™ OR Vibra-TITE™ 111 or TITE™ 131) K=0.15		
					IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB
4	40	0.1120	0.00604	380	8	0.9	6	0.7											
4	48	0.1120	0.00661	420	9	1.0	7	0.8											
6	32	0.1380	0.00909	580	16	1.8	12	1.4											
6	40	0.1380	0.01015	610	18	2.0	13	1.5											
8	32	0.1640	0.01400	900	30	3.4	22	2.5											
8	36	0.1640	0.01474	940	31	3.5	23	2.6						1320					
10	24	0.1900	0.01750	1120	43	4.8	32	3.5						1580					
10	32	0.1900	0.02000	1285	49	5.5	36	4						1800					
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12				2860	143	16	129	15	
1/4	28	0.2500	0.0364	2320	120	13.5	86	10	135	15				3280	164	19	148	17	
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16			4720	25	35	20	25	20
5/16	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23		5220	25	35	25	35	20
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38		7000	45	60	40	55	35
3/8	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43		7900	50	70	45	60	35
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61		9550	70	95	65	90	50
7/16	20	0.4375	0.1187	7560	55	75	40	54	60	82	50	68		10700	80	110	70	95	60
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	66	92		12750	105	145	95	130	80
1/2	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108		14400	120	165	110	150	90
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133		16400	155	210	140	190	115
9/16	18	0.5625	0.2030	12950	120	163	90	122	135	183	109	148		18250	170	230	155	210	130
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183		20350	210	285	190	260	160
5/8	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207		23000	240	325	215	290	180
3/4	10	0.7500	0.3340	21300	260	353	200	285	348	449	240	325		30100	375	510	340	460	280
3/4	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363		33600	420	570	380	515	315
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	648	386	523		41600	605	825	545	740	455
7/8	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576		45800	670	910	600	815	500
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785		51500	860	1170	770	1045	645
1	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858		59700	995	1355	895	1215	745
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968		68700	1290	1755	1160	1580	965
1 1/8	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087		77000	1445	1965	1300	1770	1085
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368		87200	1815	2470	1635	2225	1365
1 1/4	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516		96600	2015	2740	1810	2460	1510
1.3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792		104000	2385	3245	2145	2915	1785
1 1/2	6	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042		118100	2705	3680	2435	3310	2030
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379		126500	3165	4305	2845	3870	2370
1 1/2	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676		142200	3555	4835	3200	4350	2665

NO. 5000059 REV. K

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER

REFERENCE JLG THREAD LOCKING COMPOUND		
JLG P/N	Loctite® P/N	Description
0100011	242™	Medium Strength (Blue)
0100019	271™	High Strength (Red)
0100071	262™	Medium - High Strength (Red)

Figure 1-2. Torque Chart - Sheet 1 of 5 - (SAE Fasteners)

Values for Magni Coating Fasteners (Ref 4150701)																		
SAE GRADE 5 BOLTS & GRADE 2 NUTS																		
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Locitte® 242™ or 271™ OR Vibra-TITE™ K=0.16)		Torque (Locitte® 262™ or TITE™ 131) K=0.15		Clamp Load	Torque (Dry or Locitte® 263) K=0.17		Torque (Locitte® 242™ or 271™ OR Vibra-TITE™ K=16)		Torque (Locitte® 262™ or TITE™ 131) K=0.15		
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]		IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB
4	40	0.1120	0.00604	380	7	0.8												
4.8	48	0.1120	0.00661	420	8	0.9												
6	32	0.1380	0.00909	580	14	1.5												
8	40	0.1380	0.01015	610	14	1.6												
8	32	0.1640	0.01400	900	25	2.8												
10	36	0.1640	0.01474	940	26	2.9												
10	24	0.1900	0.01750	1120	36	4.1												
10	32	0.1900	0.02000	1285	42	4.7												
1/4	20	0.2500	0.0318	2020	86	9.7	80	9										
1/4	28	0.2500	0.0364	2320	99	11.1	95	11										
5/16	18	0.3125	0.0524	3340	15	20	14	19										
5/16	24	0.3125	0.0580	3700	15	20	15	21										
3/8	16	0.3750	0.0775	4940	25	35	25	34										
3/8	24	0.3750	0.0878	5600	30	40	28	34										
7/16	14	0.4375	0.1063	6800	40	55	40	54										
7/16	20	0.4375	0.1187	7550	45	60	44	60										
1/2	13	0.5000	0.1419	9050	65	90	60	82										
1/2	20	0.5000	0.1599	10700	75	100	71	97										
9/16	12	0.5625	0.1820	11600	90	120	87	118										
9/16	18	0.5625	0.2030	12950	105	145	97	132										
5/8	11	0.6250	0.2260	14400	130	175	120	156										
5/8	18	0.6250	0.2560	16300	145	195	136	185										
3/4	10	0.7500	0.3340	21300	225	305	213	290										
3/4	16	0.7500	0.3730	23800	255	345	238	324										
7/8	9	0.8750	0.4620	29400	365	495	343	466										
7/8	14	0.8750	0.5090	32400	400	545	378	514										
1	8	1.0000	0.6060	38600	545	740	515	700										
1	12	1.0000	0.6630	42200	600	815	563	765										
1 1/8	7	1.1250	0.7630	42300	675	920	635	863										
1 1/8	12	1.1250	0.8560	47500	755	1025	713	969										
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219										
1 1/4	12	1.2500	1.0730	59600	1055	1435	993	1351										
1 3/8	6	1.3750	1.1350	64100	1250	1700	1175	1598										
1 3/8	12	1.3750	1.3150	73000	1420	1930	1338	1820										
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122										
1 1/2	12	1.5000	1.5800	87700	1865	2585	1754	2385										

NO. 500059 REV. K

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 3. * ASSEMBLY USES HARDENED WASHER

Figure 1-3. Torque Chart - Sheet 2 of 5 - (SAE Fasteners)

SOCKET HEAD CAP SCREWS														
Magni Coating (Ref 4150701)*						Zinc Yellow Chromate Fasteners (Ref 4150707)*								
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .17	Torque (Locite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.16		Torque (Locite® 262™ or Vibra-TITE™ 131) K=0.15		Clamp Load See Note 4	Torque (Dry) K = .20	Torque (Locite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.18		Torque (Locite® 262™ or Vibra-TITE™ 131) K=0.15
						IN-LB	[N.m]	IN-LB	[N.m]			IN-LB	[N.m]	
4	40	0.1120	0.00604											
48	48	0.1120	0.00661											
6	32	0.1380	0.00909											
8	40	0.1380	0.01015											
8	32	0.1640	0.01400											
10	36	0.1640	0.01474											
10	24	0.1900	0.01750											
32	32	0.1900	0.02000											
1/4	20	0.2500	0.0318	2860	122	14	114	13	15	2860	143	16	129	15
28	28	0.2500	0.0364	3280	139	16	131	15	17	3280	164	19	148	17
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	LB	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	4720	25	35	20	25
24	24	0.3125	0.0580	5220	25	35	20	25	20	5220	25	35	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	7000	45	60	35	50
24	24	0.3750	0.0878	7900	40	55	40	55	35	7900	50	70	45	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	9550	70	95	60	70
20	20	0.4375	0.1187	10700	65	90	60	80	60	10700	80	110	70	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	12750	105	145	95	110
20	20	0.5000	0.1599	14400	100	135	95	130	90	14400	120	165	110	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	16400	155	210	140	155
18	18	0.5625	0.2030	18250	145	195	135	185	130	18250	170	230	155	170
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	20350	210	285	190	220
18	18	0.6250	0.2560	23000	205	280	190	260	180	23000	240	325	215	250
3/4	10	0.7500	0.3340	30100	320	435	300	380	280	30100	375	510	340	380
16	16	0.7500	0.3730	33600	355	485	335	455	315	33600	420	570	380	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	41600	605	825	545	620
14	14	0.8750	0.5090	45800	570	775	535	730	500	45800	670	910	600	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	51500	860	1170	775	815
1	7	1.0000	0.6630	59700	845	1150	795	1060	745	59700	995	1355	895	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	68700	1290	1765	1160	1580
1 1/8	12	1.1250	0.8560	77000	1225	1685	1155	1570	1085	77000	1445	1985	1300	1770
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	87200	1815	2470	1635	2225
1 1/4	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	96600	2015	2740	1810	2460
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	104000	2385	3245	2145	2915
1 3/8	12	1.3750	1.3150	118100	2300	3130	2245	2945	2030	118100	2705	3680	2435	3310
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	126500	3165	4305	2845	3870
1 1/2	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	142200	3555	4835	3200	4350

NO. 5000059 REV. K

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 *3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Figure 1-4. Torque Chart - Sheet 3 of 5 - (SAE Fasteners)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)											
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS					CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*						
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Locitite® 263™)	Torque (Lub)	Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 131)	Torque (Locitite® 111 or 140)	Clamp Load	Torque (Dry or Locitite® 263™) K=0.20	Torque (Lub OR Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.18	Torque (Locitite® 262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13			
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22			
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47			
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8	8.85			
6	1	20.10	8.74	11	7.9	9.4	12	12.5			
7	1	28.90	12.6	18	13	16	19	18.0	25	23	19
8	1.25	36.60	15.9	26	19	23	28	22.8	37	33	27
10	1.5	58.00	25.2	50	38	45	55	36.1	70	65	55
12	1.75	84.30	36.7	88	66	79	97	52.5	125	115	95
14	2	115	50.0	140	105	126	154	71.6	200	180	150
16	2	157	68.3	219	164	197	241	97.8	315	280	235
18	2.5	192	83.5	301	226	271	331	119.5	430	385	325
20	2.5	245	106.5	426	320	383	469	152.5	610	550	460
22	2.5	303	132.0	581	436	523	639	189.0	830	750	625
24	3	353	153.5	737	553	663	811	222.0	1065	960	800
27	3	459	199.5	1080	810	970	1130	286.0	1545	1390	1160
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2095	1885	1575
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2855	2570	2140
36	4	817	355.5	2560	1920	2300	2690	509.0	3665	3300	2750
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5865	5275	4395

1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
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 *3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQ

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Figure 1-5. Torque Chart - Sheet 4 of 5 - (METRIC Fasteners)

Values for Magni Coated Fasteners (Ref 4150701)										
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS					CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*					
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™) K=0.17	Torque (Loctite® 262™ OR Vibra-TITE™, 131) K=0.16	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™, 111 or 140) K=0.15	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K= 0.16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0	3.13			
3.5	0.6	6.78	2.95	1.8	1.7	1.5	4.22			
4	0.7	8.78	3.82	2.6	2.4	2.3	5.47			
5	0.8	14.20	6.18	5.3	4.9	4.6	8.85			
6	1	20.10	8.74	9	8.4	7.9	12.5	13	12	11
7	1	28.90	12.6	15	14	13	18.0	21	20	19
8	1.25	36.60	15.9	22	20	19	22.8	31	29	27
10	1.5	58.00	25.2	43	40	38	36.1	61	58	55
12	1.75	84.30	36.7	75	70	66	52.5	105	100	95
14	2	115	50.0	119	110	105	71.6	170	160	150
16	2	157	68.3	186	175	165	97.8	265	250	235
18	2.5	192	83.5	256	240	225	119.5	365	345	325
20	2.5	245	106.5	362	340	320	152.5	520	490	460
22	2.5	303	132.0	494	465	435	189.0	705	665	625
24	3	353	153.5	627	590	555	222.0	905	850	800
27	3	459	199.5	916	860	810	286.0	1315	1235	1160
30	3.5	561	244.0	1245	1170	1100	349.5	1780	1680	1575
33	3.5	694	302.0	1694	1595	1495	432.5	2425	2285	2140
36	4	817	355.5	2176	2050	1920	509.0	3115	2930	2750
42	4.5	1120	487.0	3477	3275	3070	698.0	4885	4690	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
 *3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

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Figure 1-6. Torque Chart - Sheet 5 of 5 - (METRIC Fasteners)

SECTION 1 - SPECIFICATIONS



NOTES:

A large area consisting of two columns of horizontal lines, intended for handwritten notes or specifications. The lines are evenly spaced and extend across most of the page width.

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SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

This section provides the necessary information needed by those personnel that are responsible to place the machine in operation readiness and maintain its safe operating condition. For maximum service life and safe operation, ensure that all the necessary inspections and maintenance have been completed before placing the machine into service. With proper care, maintenance, and inspections performed per JLG's recommendations, and with any and all discrepancies corrected, this product will be fit for continued use.

Preparation, Inspection, and Maintenance

It is important to establish and conform to a comprehensive inspection and preventive maintenance program. The following table outlines the periodic machine inspections and maintenance recommended by JLG Industries, Inc. Consult your national, regional, or local regulations for further requirements for aerial work platforms. The frequency of inspections and maintenance must be increased as environment, severity and frequency of usage requires.

Pre-Start Inspection

It is the User's or Operator's primary responsibility to perform a Pre-Start Inspection of the machine prior to use daily or at each change of operator. Reference the Operation and Safety Manual for completion procedures for the Pre-Start Inspection. The Operator and Safety Manual must be read in its entirety and understood prior to performing the Pre-Start Inspection.

Pre-Delivery Inspection and Frequent Inspection

The Pre-Delivery Inspection and Frequent Inspection shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

The Pre-Delivery Inspection and Frequent Inspection procedures are performed in the same manner, but at different times. The Pre-Delivery Inspection shall be performed prior to each sale, lease, or rental delivery. The Frequent Inspection shall be accomplished for each machine in service for 3 months or 150 hours (whichever comes first); out of service for a period of more than 3 months; or when purchased used. The frequency of this inspection must be increased as environment, severity and frequency of usage requires.

Reference the JLG Pre-Delivery and Frequent Inspection Form and the Inspection and Preventive Maintenance Schedule for items requiring inspection during the performance of these inspections. Reference the appropriate areas of this manual for servicing and maintenance procedures.

Annual Machine Inspection

The Annual Machine Inspection must be performed by a Factory-Trained Service Technician on an annual basis, no later than thirteen (13) months from the date of the prior Annual Machine Inspection. JLG Industries, Inc. recognizes a Factory-Trained Service Technician as a person who has successfully completed the JLG Service Training School for the subject JLG product model. Reference the machine Service and Maintenance Manual and appropriate JLG inspection form for performance of this inspection.

Reference the JLG Annual Machine Inspection Form and the Inspection and Preventive Maintenance Schedule for items requiring inspection during the performance of this inspection. Reference the appropriate areas of this manual for servicing and maintenance procedures.

For the purpose of receiving safety-related bulletins, it is important that JLG Industries, Inc. has updated ownership information for each machine. When performing each Annual Machine Inspection, notify JLG Industries, Inc. of the current machine ownership.

Preventive Maintenance

In conjunction with the specified inspections, maintenance shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

Reference the Preventive Maintenance Schedule and the appropriate areas of this manual for servicing and maintenance procedures. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.

Table 2-1. Inspection and Maintenance

Type	Frequency	Primary Responsibility	Service Qualification	Reference
Pre-Start Inspection	Prior to use each day; or At each Operator change.	User or Operator	User or Operator	Operation and Safety Manual
Pre-Delivery Inspection	Prior to each sale, lease, or rental delivery.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Frequent Inspection	In service for 3 months or 150 hours, whichever comes first; or Out of service for a period of more than 3 months; or purchased used.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Annual Machine Inspection	Annually, no later than 13 months from the date of the prior inspection.	Owner, Dealer, or User	Factory-Trained Service Technician	Service and Maintenance Manual and applicable JLG inspection form.
Preventive Maintenance	At intervals as specified in the Service and Maintenance Manual.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual

2.2 SERVICE AND GUIDELINES

General

The following information is provided to assist you in the use and application of servicing and maintenance procedures contained in this book.

Safety and Workmanship

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.

2. At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.
3. Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

Components Removal and Installation

1. Use adjustable lifting devices, whenever possible, if mechanical assistance is required. All slings (chains, cables, etc.) should be parallel to each other and as near perpendicular as possible to top of part being lifted.
2. Should it be necessary to remove a component on an angle, keep in mind that the capacity of an eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90 degrees.
3. If a part resists removal, check to see whether all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

Component Disassembly and Reassembly

When disassembling or reassembling a component, complete the procedural steps in sequence. Do not partially disassemble or assemble one part, then start on another. Always recheck your work to assure that nothing has been overlooked. Do not make any adjustments, other than those recommended, without obtaining proper approval.

Pressure-Fit Parts

When assembling pressure-fit parts, use a molybdenum disulfide base compound or equivalent to lubricate the mating surface.

Bearings

1. When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used but do not spin the bearing.
2. Discard bearings if the races and balls (or rollers) are pitted, scored, or burned.
3. If bearing is found to be serviceable, apply a light coat of oil and wrap it in clean (waxed) paper. Do not unwrap reusable or new bearings until they are ready to install.
4. Lubricate new or used serviceable bearings before installation. When pressing a bearing into a retainer or bore, apply pressure to the outer race. If the bearing is to be installed on a shaft, apply pressure to the inner race.

Gaskets

Check that holes in gaskets align with openings in the mating parts. If it becomes necessary to hand-fabricate a gasket, use gasket material or stock of equivalent material and thickness. Be sure to cut holes in the right location, as blank gaskets can cause serious system damage.

Bolt Usage and Torque Application

NOTICE

SELF LOCKING FASTENERS, SUCH AS NYLON INSERT AND THREAD DEFORMING LOCKNUTS, ARE NOT INTENDED TO BE REINSTALLED AFTER REMOVAL.

1. Always use new replacement hardware when installing locking fasteners. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Torque Chart Section 1.)

Hydraulic Lines and Electrical Wiring

Clearly mark or tag hydraulic lines and electrical wiring, as well as their receptacles, when disconnecting or removing them from the unit. This will assure that they are correctly reinstalled.

Hydraulic System

1. Keep the system clean. If evidence of metal or rubber particles are found in the hydraulic system, drain and flush the entire system.
2. Disassemble and reassemble parts on clean work surface. Clean all metal parts with non-flammable cleaning solvent. Lubricate components, as required, to aid assembly.

Lubrication

Service applicable components with the amount, type, and grade of lubricant recommended in this manual, at the specified intervals. When recommended lubricants are not available, consult your local supplier for an equivalent that meets or exceeds the specifications listed.

Battery

Clean battery using a non-metallic brush and a solution of baking soda and water. Rinse with clean water. After cleaning, thoroughly dry battery and coat terminals with an anti corrosion compound.

Lubrication and Servicing

Components and assemblies requiring lubrication and servicing are shown in the Lubrication Chart in Section 1.

2.3 LUBRICATION AND INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.
2. The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in the Lubrication Chart in Section 1. Always examine filters for evidence of metal particles.
3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.
4. It is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

NOTE: *Metal particles may appear in the oil or filters of new machines due to the wear-in of meshing components.*

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.

Changing Hydraulic Oil

1. Filter elements must be changed after the first 50 hours of operation and every 300 hours (unless specified otherwise) thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils.
2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.
3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

Specified lubricants, as recommended by the component manufacturers, are always the best choice, however, multi-purpose greases usually have the qualities which meet a variety of single purpose grease requirements. Should any question arise, regarding the use of greases in maintenance stock, consult your local supplier for evaluation. Refer to Section 1 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2.4 CYLINDER DRIFT

Theory

When a hydraulic cylinder is supporting a load, cylinder drift may occur as a result of any of the circumstances below:

- Normal leakage of load holding valves or malfunction of load holding valves. See Cylinder Leakage Test and Table 2-2, Cylinder Drift below for evaluation.
- Damaged or worn piston seals.
- Normal thermal expansion or contraction of the hydraulic oil within cylinders (See Cylinder Thermal Drift below).

The first two circumstances may result in cylinder movement due to oil leaking out of the cylinder externally or by leaking back to tank or due to oil leaking internally from one cylinder chamber to the other.

Thermal expansion or contraction of oil in hydraulic cylinders is a normal occurrence and does not result in oil leaking out of the cylinder or leaking internally from one cylinder chamber to the other. Thermal expansion or contraction is the tendency for materials to change size in response to a change in temperature.

Cylinder Leakage Test

Cylinder oil must be at stabilized ambient temperature before beginning this test.

Measure drift at cylinder rod with a calibrated dial indicator.

In an area free of obstructions, cylinder must have load applied and appropriately positioned to detect drift.

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

Cylinder Bore Diameter		Max. Acceptable Drift in 10 Minutes	
inches	mm	inches	mm
3	76.2	0.026	0.66
3.5	89	0.019	0.48
4	101.6	0.015	0.38
5	127	0.009	0.22
6	152.4	0.006	0.15
7	177.8	0.005	0.13
8	203.2	0.004	0.10
9	228.6	0.003	0.08

NOTE: This information is based on 6 drops per minute cylinder leakage.

Cylinder Thermal Drift

The oil in all hydraulic cylinders will expand or contract due to thermal effects over time and may result in changes to the boom and/or platform position while the machine is stationary. These effects occur as the cylinder oil changes temperature, usually from a higher oil temperature as it cools and approaches the ambient air temperature. Results of these effects are related to several factors including cylinder length and change in temperature over the time the cylinder remains stationary.

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
 - a. Excessive sloppiness in joints.
 - b. Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
 - a. Frayed or separated fibers on the liner surface.
 - b. Cracked or damaged liner backing.
 - c. Bearings that have moved or spun in their housing.
 - d. Debris embedded in liner surface.
3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):
 - a. Detectable wear in the bearing area.
 - b. Flaking, peeling, scoring, or scratches on the pin surface.
 - c. Rusting of the pin in the bearing area.
4. Re-assembly of pinned joints using filament wound bearings.
 - a. Housing should be blown out to remove all dirt and debris...bearings and bearing housings must be free of all contamination.
 - b. Bearing / pins should be cleaned with a solvent to remove all grease and oil...filament wound bearing are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).
 - c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

NOTE: This instruction applies to repairs, or modifications to the machine and to welding performed from the machine on an external structure, or component,

Do the Following When Welding on JLG Equipment

- Disconnect the battery.
- Disconnect the moment pin connection (where fitted)
- Ground only to structure being welded.

Do NOT Do the Following When Welding on JLG Equipment

- Ground on frame and weld on any other area than the chassis.
- Ground on turntable and weld on any other area than the turntable.
- Ground on the platform/support and weld on any other area than the platform/support.
- Ground on a specific boom section and weld on any other area than that specific boom section.
- Allow pins, wear pads, wire ropes, bearings, gearing, seals, valves, electrical wiring, or hoses to be between the grounding position and the welded area.

NOTICE

FAILURE TO COMPLY WITH THE ABOVE REQUIREMENTS MAY RESULT IN COMPONENT DAMAGE (I.E. ELECTRONIC MODULES, SWING BEARING, COLLECTOR RING, BOOM WIRE ROPES ETC.)

NOTE: Refer the Operation and Safety Manual for completion procedures for the Pre-Start Inspection.

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	Inspections	
	Pre-Delivery ¹ or Frequent ² (Quarterly) Inspection	Annual ³ (Yearly) Inspection
Boom Assembly		
Boom Weldments	1,2	1,2
Hose/Cable Carrier Installations	1,2	1,2
Pivot Pins and Pin Retainers	1,2	1,2
Sheaves, Sheave Pins	1,2	1,2
Bearings	1,2	1,2
Wear Pads	1,2	1,2
Covers or Shields	1,2	1,2
Extend/Retract Chain or Cable Systems ⁴	1,2	1,2
Platform Assembly		
Railing	2	2
Gate	1,2,3	1,2,3
Floor	2	2
Rotator	1,2,3,4	1,2,3,4
Lanyard Anchorage Point	1,2,6	1,2,6
Turntable Assembly		
Swing Bearing or Worm Gear	1 ⁵⁰ ,2	1 ⁵⁰ ,2
Oil Coupling	4	4
Swing Drive System	1,4	1,4
Turntable Lock	1,2,3	1,2,3
Hood, Hood Props, Hood Latches	3	3
Chassis Assembly		
Tires	1,2	1,2
Wheel Nuts/Bolts	1 ⁵⁰	1 ⁵⁰
Wheel Bearings		1,2,4,5
Oscillating Axle/Lockout Cylinder Systems		1,2,4,5
Extendable Axle Systems	3	3
Steer Components		1,2
Spindle Thrust Bearing/Washers		1,2
Drive Hubs	1,4	1,4

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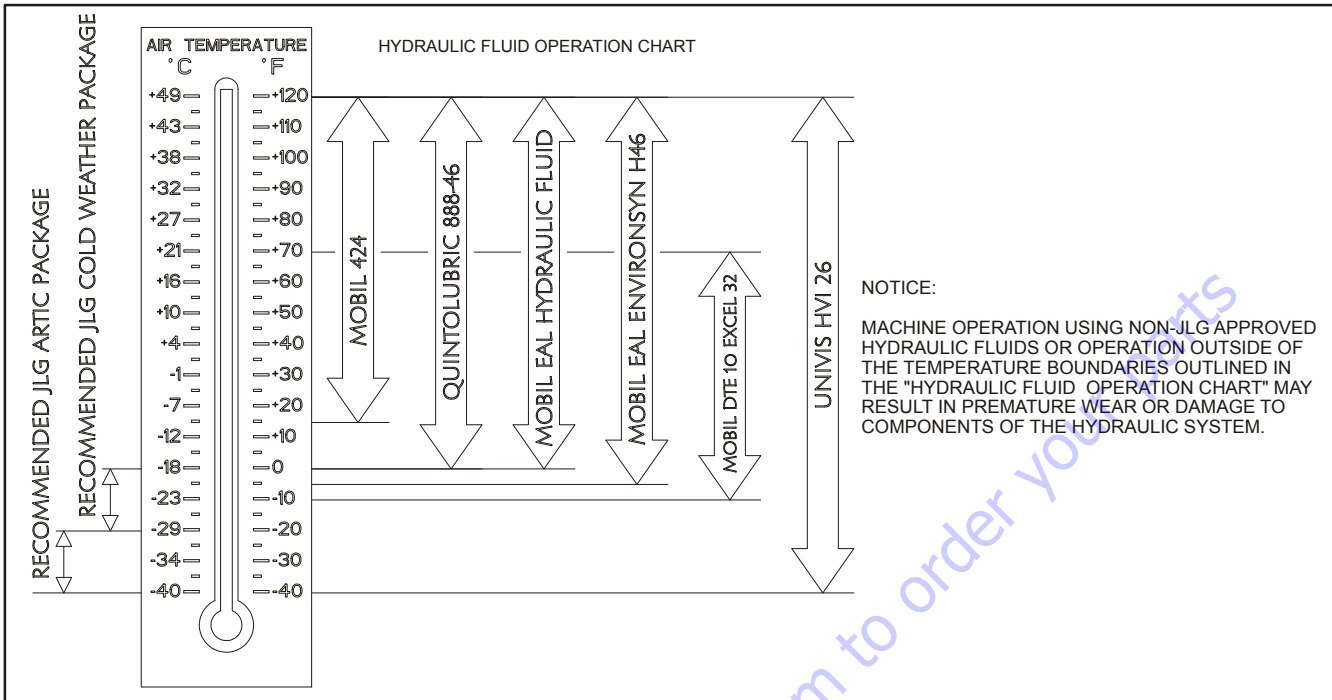
Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	Inspections	
	Pre-Delivery ¹ or Frequent ² (Quarterly) Inspection	Annual ³ (Yearly) Inspection
Functions/Controls		
Platform Controls return to neutral/off when released	1,3,6,9	1,3,6,9
Ground Controls return to neutral/off when released	1,3,6,9	1,3,6,9
Function Control Locks, Guards, or Detents	1,3,9	1,3,9
Footswitch (shuts off function when released)	1,3,9	1,3,9
Emergency Stop Switches (Ground & Platform) arrest all platform movement	1,3,6	1,3,6
Function Limit or Cutout Switch Systems	1,3,9	1,3,9
Capacity Indicator	1,3,9	1,3,9
Drive Brakes	1,3,9	1,3,9
Swing Brakes	1,3,9	1,3,9
Auxiliary Power	1,3,9	1,3,9
Power System		
Engine Idle, Throttle, and RPM	1,3,7	1,3,7
Engine Fluids: Oil	4	4
Engine Fluids: Coolant	1,4,7	1,4,7
Air Filter	1,4	1,4
Fuel Filter(s)	1,5	1,5
Drain Oil Build Up in 2-Stage Vaporizer (LP Only)	1,4	1,4
Exhaust System	1,4	1,4
Batteries	1,4	1,4
Battery Fluid	4	4
Battery Charger	1,3	1,3
Intake System	1,2	1,2
Glow Plug (Diesel Only)	1,2,3	1,2,3
Serpentine Belt, Tensioner, Pulleys	1,2,3	1,2,3
Fuel Reservoir, Cap, and Breather	1,2,4	1,2,4
Hydraulic/Electric System		
Hydraulic Pumps	1,2,4	1,2,4
Hydraulic Cylinders	1,2,4,5	1,2,4,5
Cylinder Attachment Pins and Pin Retainers	1,2	1,2
Hydraulic Hoses, Lines, and Fittings	1,2,4	1,2,3,4
Hydraulic Reservoir, Cap, and Breather	1,2,3,4,5	1,2,3,4,5
Hydraulic Filter(s)	1,4,5	1,4,5
Hydraulic Fluid	4,5	4,5
Electrical Connections	1,2	1,2
Instruments, Gauges, Switches, Lights, Horn		1,3

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	Inspections	
	Pre-Delivery ¹ or Frequent ² (Quarterly) Inspection	Annual ³ (Yearly) Inspection
General		
All Decals/Placards Installed, Secure, Legible	9	9
Annual Machine Inspection Due		9
No Unauthorized Modifications or Additions	9	9
All Relevant Safety Publications Incorporated	9	9
General Structural Condition and Welds	2	2
All Fasteners, Pins, Shields, and Covers	1,2	1,2
Grease and Lubricate to Specifications	9	9
Function Test of All Systems	9	9
Paint and Appearance	5	5
Stamp Inspection Date on Frame		9
Notify JLG of Machine Ownership		9
Footnotes:		
¹ Prior to each sale, lease, or delivery		
² In service for 3 months; Out of service for 3 months or more; Purchased used		
³ Annually, no later than 13 months from the date of the prior inspection, Includes all daily and quarterly inspections, mandated by regulating body		
⁴ Replace every 12 years or 7,000 hours		
⁵⁰ Indicates a 50 hour interval required to perform task after initial use of machine. This only occurs once in machine life		
²⁵⁰ Indicates a 250 hour interval required to perform task after initial use of machine. This only occurs once in machine life		
Performance Codes:		
1 - Check for proper and secure: installation, adjustment, or torque		
2 - Visual inspection for damage: (cracks, corrosion, abrasions, distortion, excessive wear, broken welds, gouges, chafing and threads showing)		
3 - Proper operation		
4 - Check for proper sealing, signs of leakage and fluid level		
5 - Clean and free of debris		
6 - Decals installed and legible		
7 - Check for proper tolerances, routing, and lubrication		
8 - Fully Charged		
9 - Verify/Perform		

SECTION 2 - GENERAL



Fluid	Properties		Base				Classifications			
	Description	Viscosity at 40°C (cSt, Typical)	Viscosity Index	Mineral Oils	Vegetable Oils	Synthetic	Synthetic Polyol Esters	Readily Biodegradable*	Virtually Non-toxic**	Fire Resistant***
Mobilfluid 424		55	145	X						
Mobil DTE 10 Excel 32		32	164	X					X	
Univis HVI 26		26	376	X						
Mobil EAL Hydraulic Oil		47	176		X			X	X	
Mobil EAL EnviroSyn H46		49	145			X		X	X	
Quintolubric 888-46		50	185				X	X	X	X

* Readily biodegradable classification indicates one of the following:

CO2 Conversion > 60% per EPA 560/6-82-003

CO2 Conversion > 80% per CEC-L-33-A-93

** Virtually Non-toxic classification indicates an LC50 > 5000 ppm per OECD 203

*** Fire Resistant classification indicates Factory Mutual Research Corp. (FMRC) Approval

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Figure 2-1. Hydraulic Oil Operation Chart

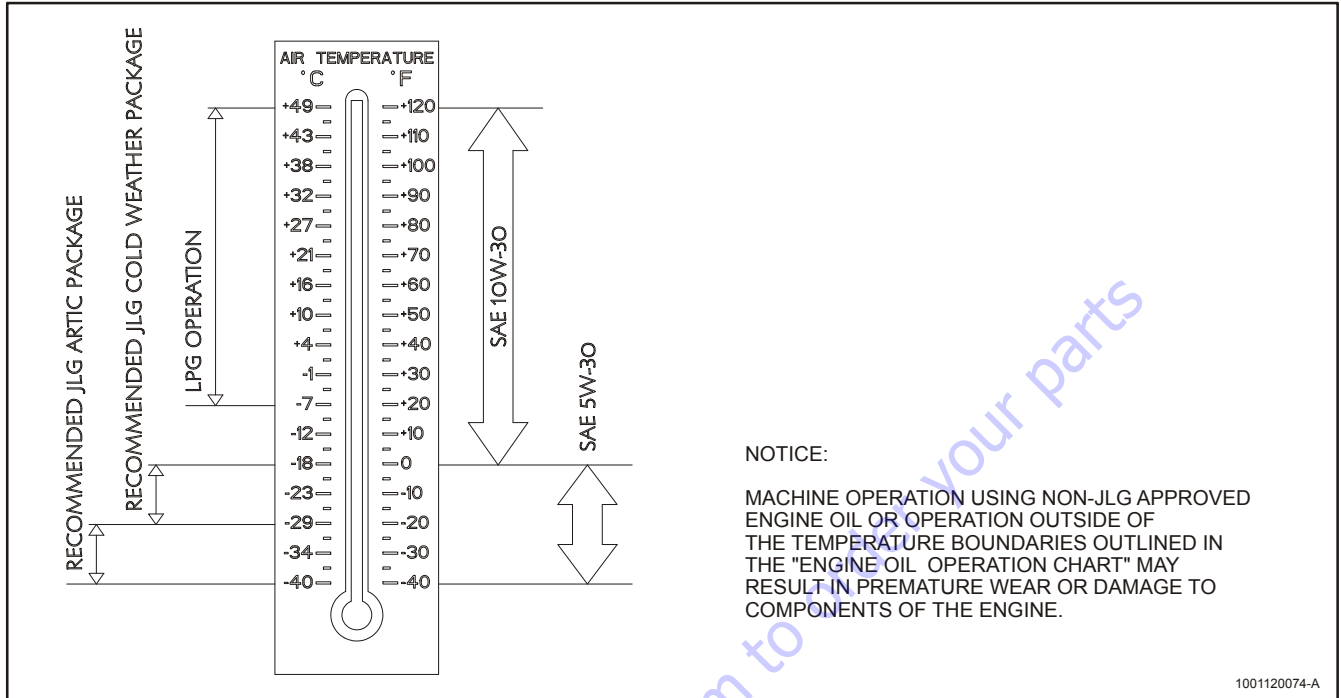


Figure 2-2. Engine Oil Operation Chart - GM

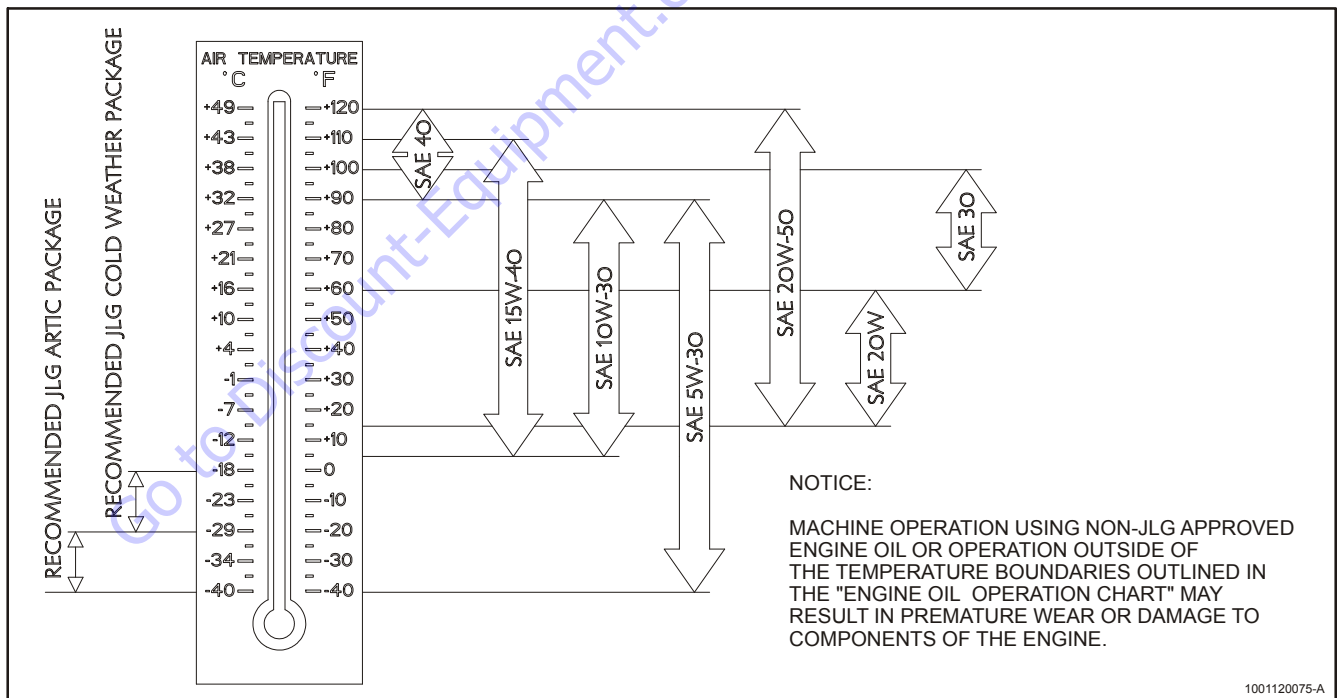


Figure 2-3. Engine Oil Operation Chart - Kubota

SECTION 2 - GENERAL



NOTES:

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PARTS FINDER

**Search Website
by Part Number**



**Search Manual
Library For Parts
Manual & Lookup Part
Numbers – Purchase
or Request Quote**

Search Manuals

Enter your information to search for a manual or parts manual for your parts.

* Brand:

* Model:

* Serial:

* Part Number:

SEARCH

**Can't Find Part or
Manual? Request Help
by Manufacturer,
Model & Description**

Parts Order Form

Please fill in the information below to request help finding a part or manual.

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Part Number:

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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES AND WHEELS

Tire Replacement

JLG recommends a replacement tire be the same size, ply and brand as originally installed on the machine. Please refer to the JLG Parts Manual for the part number of the approved tires for a particular machine model. If not using a JLG approved replacement tire, we recommend that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original
- Tire tread contact width equal or greater than original
- Wheel diameter, width, and offset dimensions equal to the original
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load)

Unless specifically approved by JLG Industries Inc. do not replace a foam filled or ballast filled tire assembly with a pneumatic tire. When selecting and installing a replacement tire, ensure that all tires are inflated to the pressure recommended by JLG. Due to size variations between tire brands, both tires on the same axle should be the same and all four tires should contain the same fill media.

Wheel and Tire Replacement

The rims installed on each product model have been designed for stability requirements which consist of track width, tire pressure, and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in an unsafe condition regarding stability.

Wheel Installation

It is extremely important to apply and maintain proper wheel mounting torque.

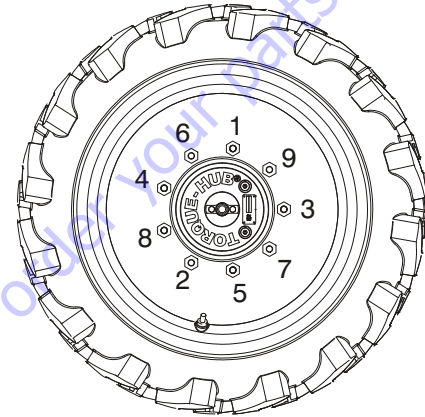
⚠ WARNING

WHEEL NUTS MUST BE INSTALLED AND MAINTAINED AT THE PROPER TORQUE TO PREVENT LOOSE WHEELS, BROKEN STUDS, AND POSSIBLE DANGEROUS SEPARATION OF WHEEL FROM THE AXLE. BE SURE TO USE ONLY THE NUTS MATCHED TO THE CONE ANGLE OF THE WHEEL.

Tighten the lug nuts to the proper torque to prevent wheels from coming loose. Use a torque wrench to tighten the fasteners. If you do not have a torque wrench, tighten the fasteners with a lug wrench, then immediately have a service garage or dealer tighten the lug nuts to the proper torque. Over-tighten-

ing will result in breaking the studs or permanently deforming the mounting stud holes in the wheels. The proper procedure for attaching wheels is as follows:

1. Start all nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.
2. Tighten nuts in the following sequence.



3. The tightening of the nuts should be done in stages. Following the recommended sequence, tighten nuts per wheel torque.

Table 3-1. Wheel Torque Chart

TORQUE SEQUENCE		
1st Stage	2nd Stage	3rd Stage
40 ft lbs (55 Nm)	95 ft lbs (130 Nm)	170 ft lbs (230 Nm)

4. Wheel nuts should be torqued after each wheel removal. Check and torque every 3 months or 150 hours of operation.

3.2 DRIVE ORIENTATION SYSTEM

The Drive Orientation System (DOS) is intended to indicate to the operator conditions that could make the direction of movement of the chassis different than the direction of movement of the drive/steer control handle. The system indicates to the operator the need to match the black and white directional arrows on the platform control panel to the arrows on the chassis. The system uses a limit switch mounted on the underside of the turntable, an indicator light and an override switch on the platform display panel. The limit switch trips when the turntable is swung +/- 42 degrees off center of the normal driving position. This occurs approximately when the boom is swung past a rear tire. When the turntable is in the normal drive position with the boom between the rear tires, no indications or interlocks are made. When the machine is actively driving when the turntable is swung past the switch point, the system is ignored until drive/steer is released. When drive is initiated with the boom swung past the switch point, the DOS indicator will flash and the drive/steer functions will be disabled. The operator must engage the DOS override switch to enable drive/steer (High Speed drive will remain disabled). When the DOS is enabled, the DOS indicator will be illuminated continuously and a 3-second enable timer will be started and will continue for 3 seconds after the end of the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

3.3 BEYOND TRANSPORT POSITION - DRIVE SPEED CUTBACK SYSTEM

When the boom is positioned beyond the Transport Position as described in the Transport Position Sensing System in Section 4, the drive pump is automatically restricted to approximately 0.75 mph (1.2 kph). See Drive System in this section for

more detail on the drive speeds, and see Chassis Tilt Indicator System in this section for interaction with the tilt sensor.

3.4 DRIVE/STEER - BOOM FUNCTION INTERLOCK SYSTEM (CE ONLY)

The Drive/Steer - Boom Function Interlock System uses the Transport Position Sensing System to sense when the boom is out of the transport position. Drive and Boom functions are simultaneously functional when the booms are within the transport position, as on the standard machine. When the boom is beyond the transport position, the control functions are interlocked to prevent simultaneous operation of any boom function with drive/steer functions. While operating drive/steer functions the boom functions are inoperable, likewise, while operating boom functions drive/steer functions are inoperable.

3.5 DRIVE SYSTEM

The Drive system consists of a variable displacement closed loop pump, four low speed high torque orbital type motors, directional control valves, and a series of flow dividers.

Drive Speed is controlled by a combination of engine RPM and drive pump displacement. Traction and torque are controlled through the flow divider system which is engaged or bypassed depending on the drive mode selected. There are three drive modes selectable at the platform control box, and the functionality of the drive system is dependent on the position of the boom (in or out of transport, see Transport Position Sensing System in Section 4 and Beyond Transport Position - Drive Cutback System in this section). The following chart describes how the system works in each drive mode.

Table 3-2. Drive System Mode Chart

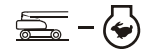
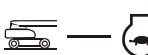

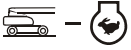
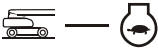
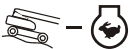
Boom Position	Drive Selection		Engine Speed when Drive is Actuated	Drive Pump Displacement	Flow Dividers	Max. Speed MPH (kph)
In Transport	Max Speed		High-3000 RPM	91%	Bypassed	3.1 (4.9)
	Mid Engine		Mid-1800 RPM	58%	Engaged	0.96 (1.5)
	Max Torque		High-3000 RPM	44%	Engaged	1.5 (2.4)

Table 3-2. Drive System Mode Chart

Boom Position	Drive Selection		Engine Speed when Drive is Actuated	Drive Pump Displacement	Flow Dividers	Max. Speed MPH (kph)
Out of Transport	Max Speed		High-3000 RPM	22%	Engaged	0.6 (1.0)
	Min. Engine Noise		Mid-1800 RPM	46%	Engaged	0.6 (1.0)
	Max Torque		High-3000 RPM	22%	Engaged	0.6 (1.0)

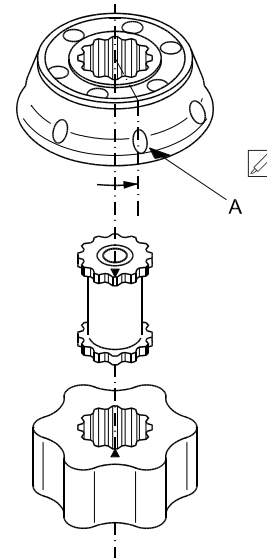
3.6 DRIVE MOTOR

Disassembly

1. Remove the drain plug (13) and washer (14).
2. Carefully place the motor in a vise and remove the two seal plugs (33) from the end cover (32).
3. Remove the four bolts (34) from the assembly.
4. Lifting from below the port plate (23), carefully lift the components from the port plate (23) up from the motor assembly as a unit.
5. Separate the port plate (23) from the other components.
6. Remove the o-ring (19).
7. Remove the stop ring (24).
8. Remove the disc valve (25).
9. Remove the spacer (30).
10. Pour oil into the spacer hole and use a 0.56 in. (14.25 mm) mandrel as a piston to press up the pressure plate (26).
11. Remove the guide pin (27).
12. Remove the o-rings (28 & 29).
13. Remove the crinkle washer (31).
14. Remove the valve drive (22).
15. Carefully lifting from under the gear set (20) to prevent parts from dropping out, remove the gear set (20).
16. Remove the o-ring (19).
17. Remove the cardan shaft (18).

Assembly

1. Carefully lift from under the gear set to prevent parts from falling out. Lay the gearwheel set so the o-ring groove is upwards. Mark the wheel of the gearwheel set at the point where the bottom of an internal tooth is opposite the bottom of an external tooth.



2. Mark the tip of a spline tooth on the end of the valve drive (22) with the widest splines. Line up the mark on the rotor and valve drive (22). The end with the widest splines must point upwards.
3. Grease the o-ring (19) with petroleum jelly. Install it in the gearwheel (20) and channel plate groove.
4. Fit the channel plate (23) so the o-ring groove is upwards and the check valve holes line up with the through hole in the gear set.
5. Install the balls (35).

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6. Align the mark on the valve drive (22) with a hole in the outer rim. Turn the disc valve (25) counterclockwise until the splines in the two parts engage.
7. Place the crinkle washer in the end cover (32).
8. Grease the two o-rings (28 & 29) with petroleum jelly and install them in the balance plate grooves.
9. Install the guide pin (27) in the end cover (32).
10. Install the balance plate in the end cover (32).
11. Grease the spacer (30) with petroleum jelly to prevent it from dropping out.
12. Install the valve housing (32) on the motor assembly. The ports should face in the same direction as the drain port.
13. Secure the assembly together by installing the bolts (34) and torquing 55 to 59 ft.lbs. (75 to 80 Nm).

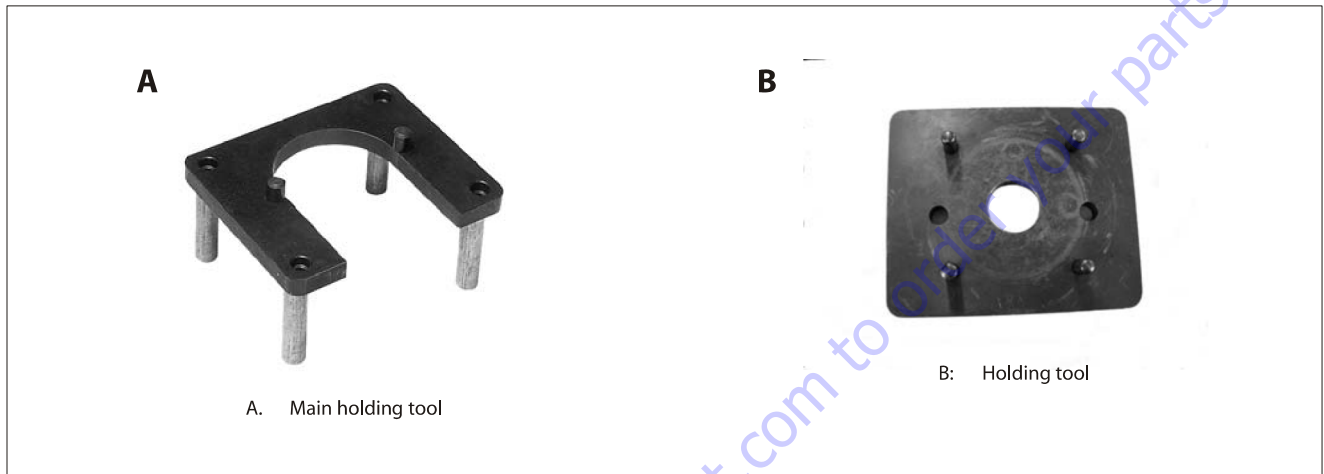
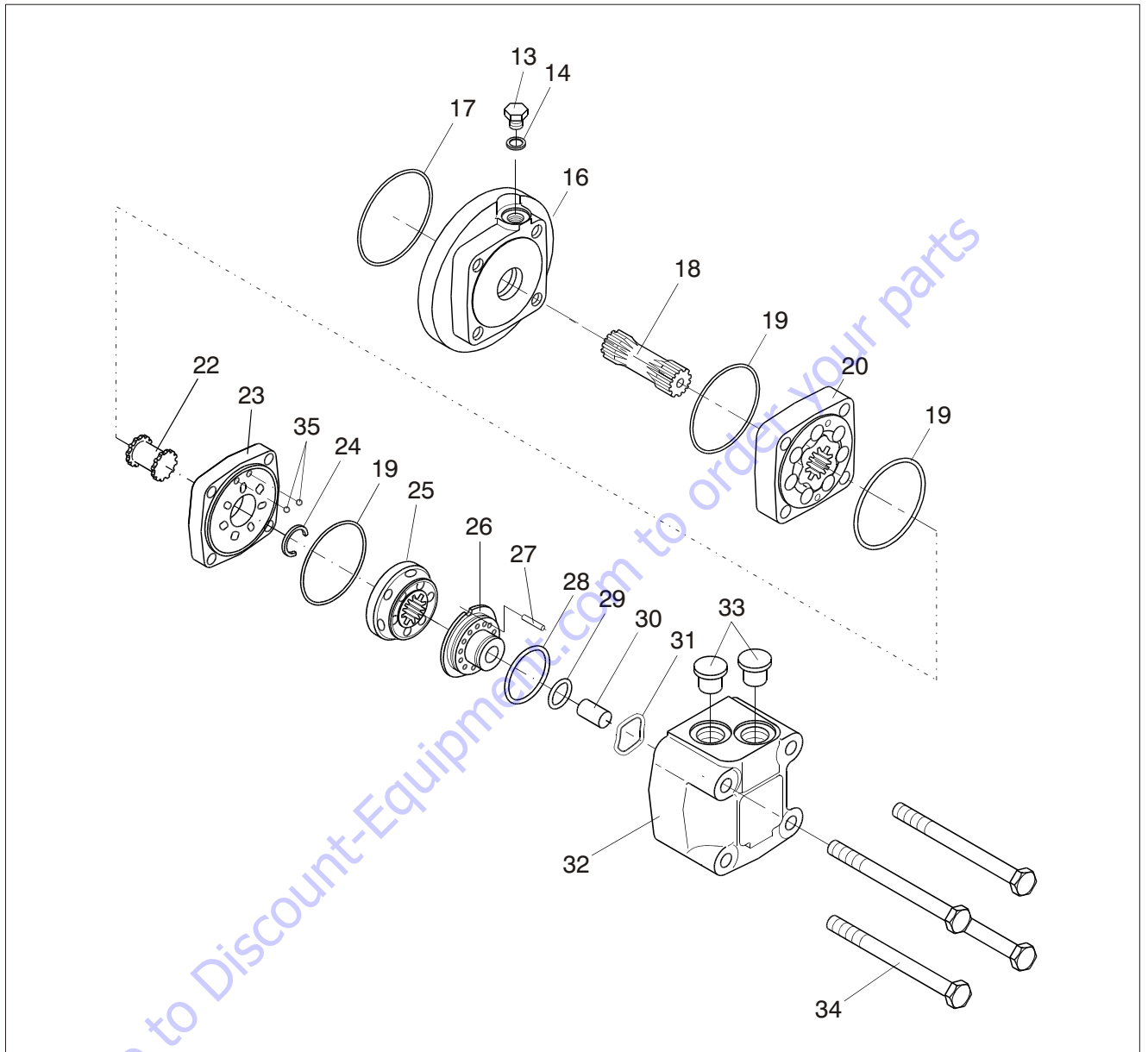


Figure 3-1. Drive Motor Special Tools



- | | | | | |
|---------------------|------------------|--------------------|--------------------|---------------|
| 13. Drain Plug | 18. Cardan Shaft | 23. Pressure Plate | 28. O-ring | 33. Seal Plug |
| 14. Washer | 19. O-ring | 24. Guide Pin | 29. O-ring | 34. Bolt |
| 15. Not Used | 20. Gear Set | 25. Channel Plate | 30. Spacer | 35. Ball |
| 16. Mounting Flange | 21. Not Used | 26. Stop Ring | 31. Crinkle Washer | |
| 17. O-ring | 22. Valve Drive | 27. Disc Valve | 32. End Cover | |

Figure 3-2. Drive Motor

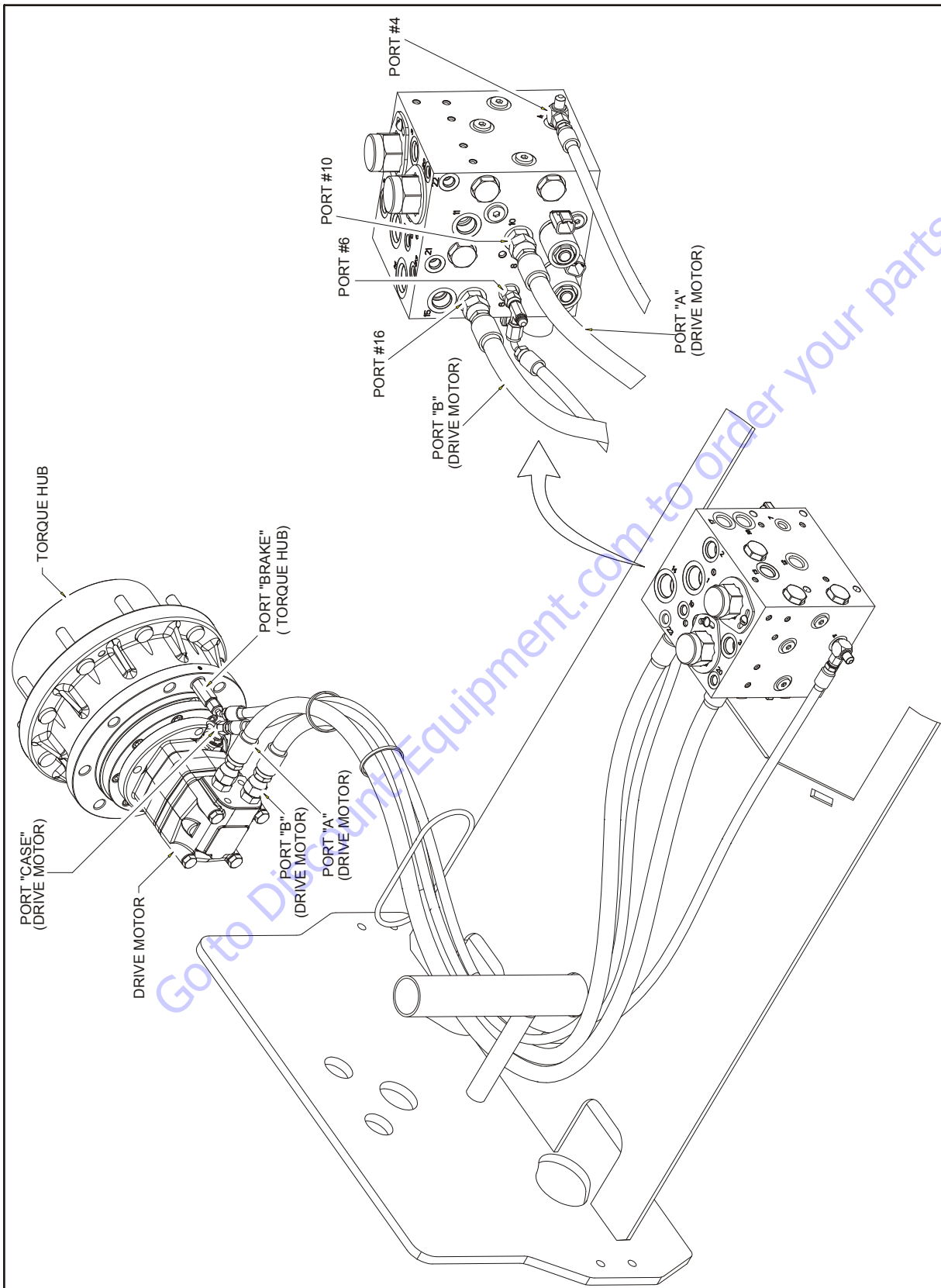


Figure 3-3. Right Front Drive Hydraulic Lines

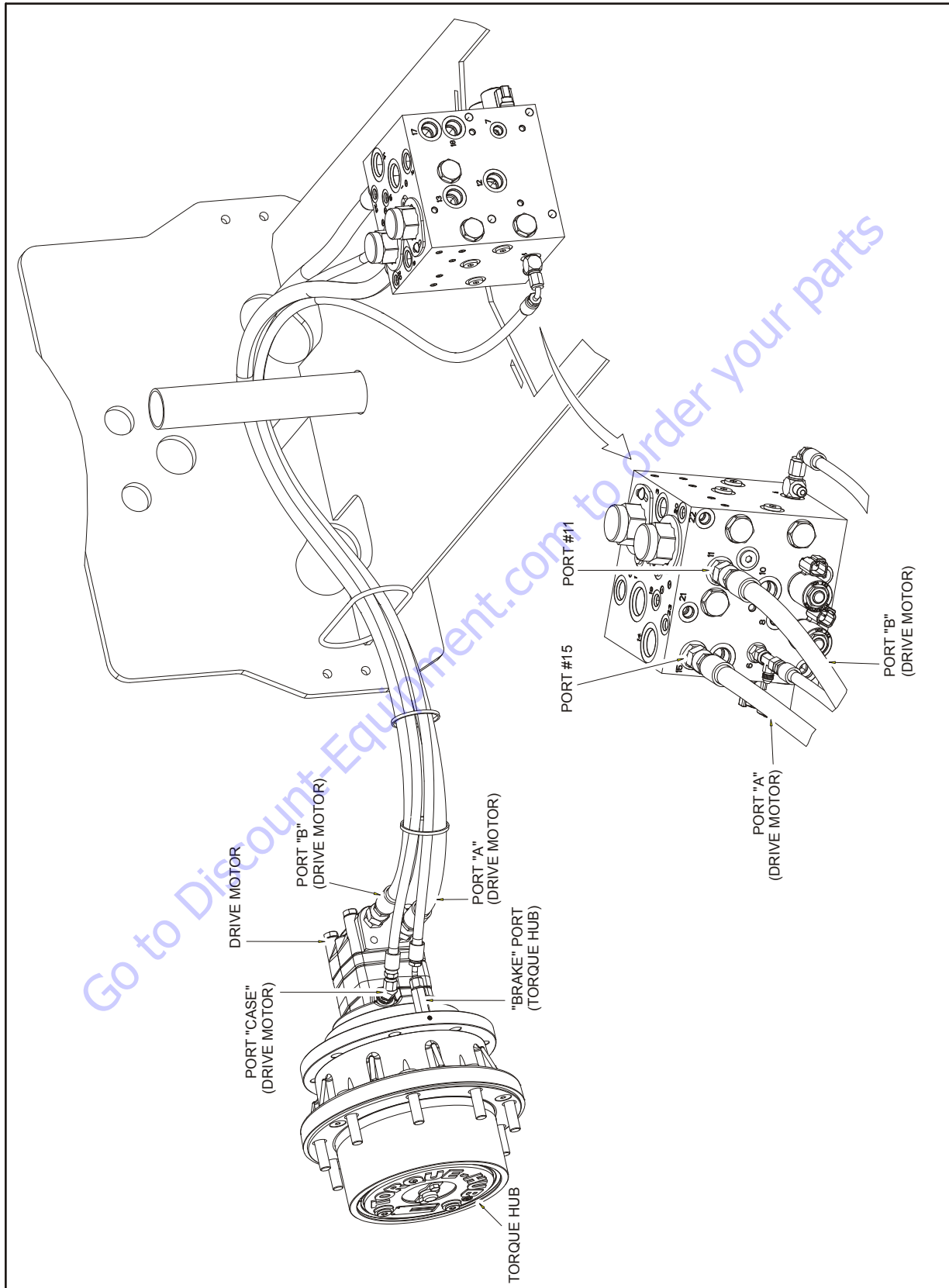


Figure 3-4. Left Front Drive Hydraulic Lines

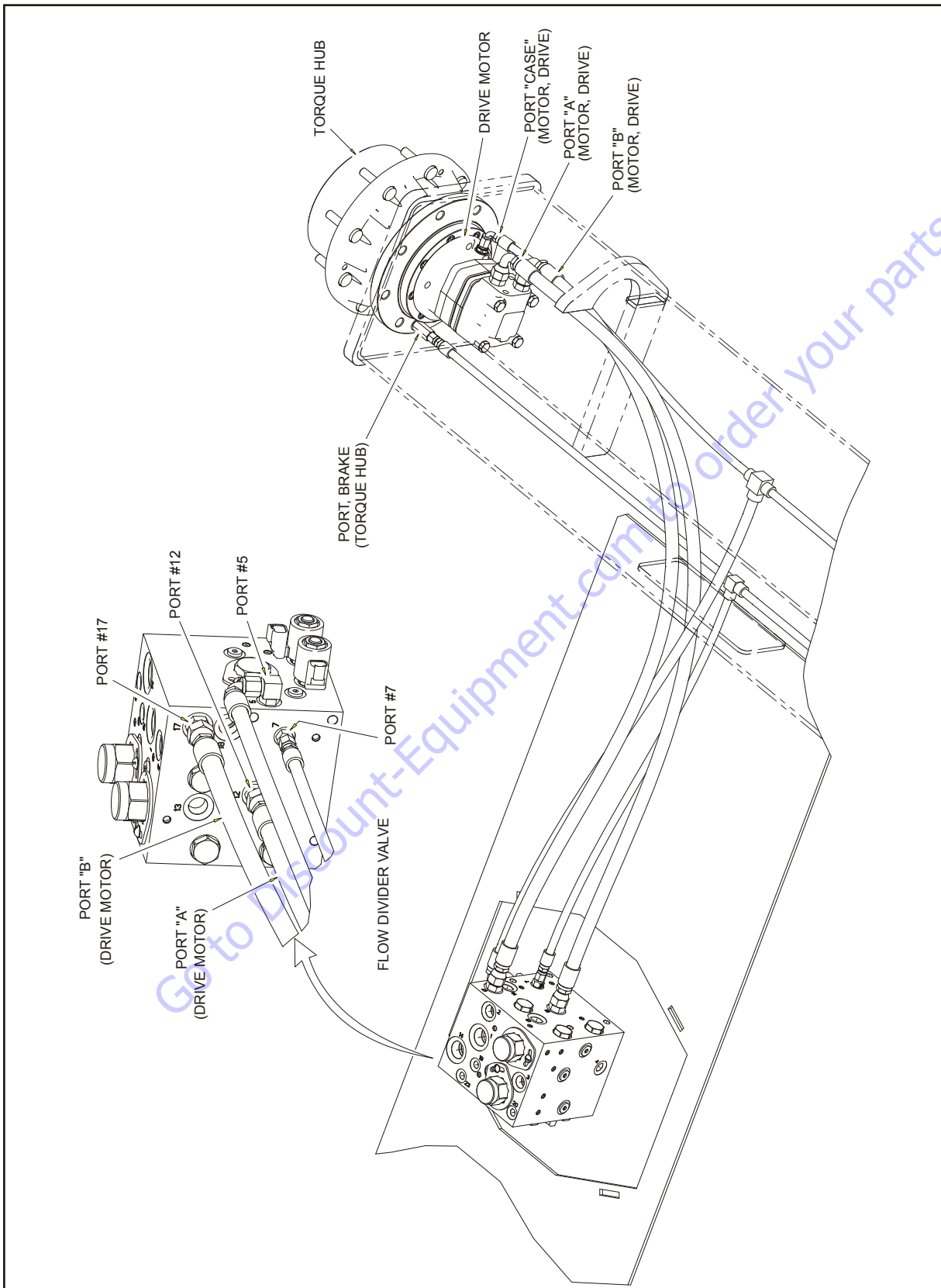


Figure 3-5. Right Rear Drive Hydraulic Lines

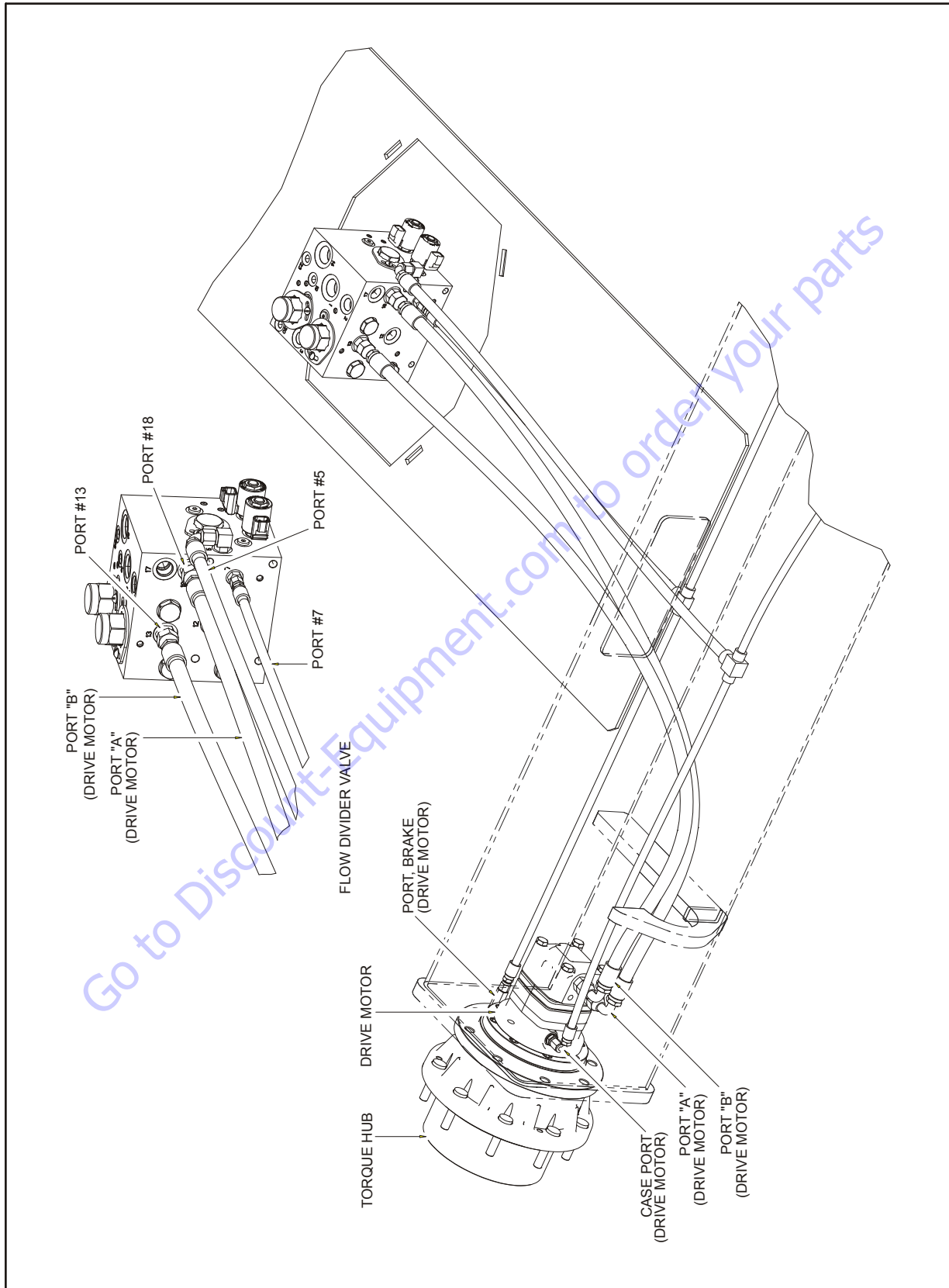


Figure 3-6. Left Rear Drive Hydraulic Lines

3.7 DRIVE HUB

Roll, Leak and Brake Testing

Torque-Hub units should always be roll and leak tested before disassembly and after assembly to make sure that the unit's gears, bearings and seals are working properly. The following information briefly outlines what to look for when performing these tests.

NOTE: *The brake must be released before performing the roll test. This can be accomplished by either pressurizing the brake using the Brake Leak Test procedure below or by tightening the bolts into the brake piston through the end plate (See Spindle-Brake Disassembly Procedure)*

NOTE: *Bolts must be removed while performing brake release test.*

THE ROLL TEST

The purpose of the roll test is to determine if the unit's gears are rotating freely and properly. You should be able to rotate the gears in your unit by applying constant force to the roll checker. If you feel more drag in the gears only at certain points, then the gears are not rolling freely and should be examined for improper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if the gears in your unit seem to roll hard as long as they roll with consistency.

THE LEAK TEST (MAIN UNIT)

The purpose of a leak test is to make sure the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your leak checking fitting starts to fall after the unit has been pressurized and allowed to equalize. Leaks will most likely occur at the pipe plugs, the main seal or wherever o-rings or gaskets are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where the o-rings or gaskets meet on the exterior of the unit, then checking for air bubbles. If a leak is detected in a seal, o-ring or gasket, the part must be replaced, and the unit rechecked. Leak test at 10 psi for 20 minutes.

THE BRAKE TEST

Input Brake
 4,300 in-lb. (486 Nm) Static, 348 psi (24 bar) Full Release
 240 - 260 Initial Pressure Release
 3,625 psi (250 bar) maximum o-ring check.

If brake does not release at these pressure values, brake has to be inspected, repaired or replaced.

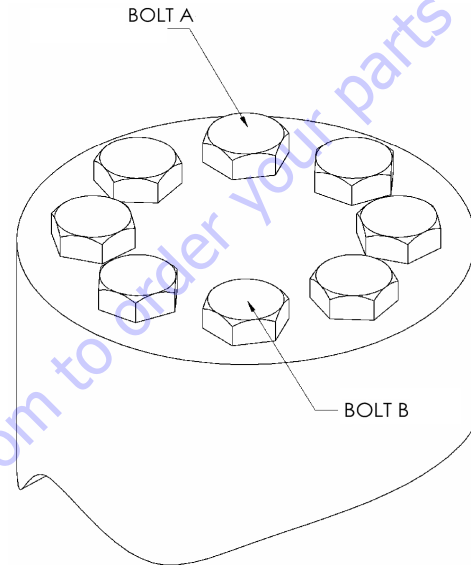
NOTE: *Failure to perform this test may result in damaged or ineffective brake parts.*

Tightening and Torquing Bolts

If an air impact wrench is used to tighten bolts, extreme care should be taken to ensure that the bolts are not tightened beyond their specified torque.

The following steps describe how to tighten and torque bolts or socket head cap screws in a bolt circle.

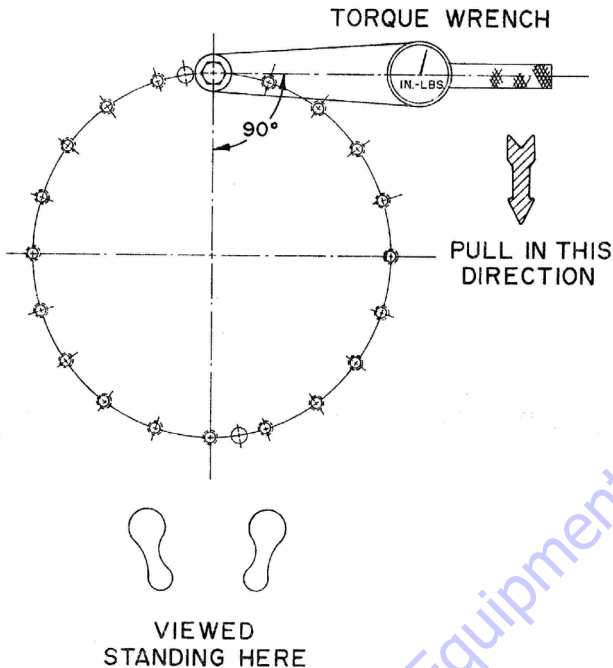
1. Tighten (but do not torque) bolt "A" until snug.



2. Go to the opposite side of the bolt circle and tighten bolt "B" until equally snug.
3. Crisscross around the bolt circle and tighten remaining bolts.
4. Now use a torque wrench to apply the specified torque to bolt "A".
5. Using the same sequence, crisscross around the bolt circle and apply an equal torque to the remaining bolts.

Measuring Rolling Torque

1. Screw one bolt down into the housing and rotate the housing so that the bolt is at twelve o'clock.
2. Position the torque wrench so that it is perpendicular to the vertical centerline as shown.
3. The correct reading can only be made if the torque wrench is pulled slowly (approximately 3.5 rpm) and smoothly towards you.



4. Remove the Cover Subassembly (6) from the unit. The unit can be carefully pressurized with air to pop the cover subassembly out of the unit.
 5. Remove O-Ring (17) from groove in Cover Subassembly (6).
 6. Remove the Sun Gear (11).
 7. Loosen and remove the three Flat Head Bolts (19) that retain the Ring Gear (1E) to the Housing (1D).
 8. Lift the Ring Gear (1E) off of the Housing (1D).
 9. Remove the O-Ring (18) from between the Housing (1D) and the Ring Gear (1E).
 10. Using a 1/8" diameter punch, drive the Roll Pin (4G) into the Planet Shaft (4E) until it bottoms against the Spindle (1A).
 11. Grasp the Roll Pin (4G) using needle nosed pliers or some sort of hooked tool, and pull the Planet Shaft (4E) out of the Spindle (1A).
 12. Using a 1/8" diameter punch, drive the Roll Pin (4G) out of the Planet Shaft (4E).
- NOTE:** The roll pins should not be reused when reassembling the unit.
13. Slide the Planet Gear Subassembly (4F) out of the Spindle (1A) being careful to not drop the Needle Bearings (4C) in the process.
 14. Remove the Thrust Washers (4B), all the Needle Rollers (4C) and the Thrust Spacer (4D) from the Planet Gear (4F).

Main Disassembly

1. Perform Roll Check, Leak Check and Brake Check if applicable prior to disassembling the unit.
2. Drain oil from unit. Note the condition and volume of the oil.
3. Remove Retaining Ring (6G) by prying the open end of retaining ring out of the groove in the Ring Gear (1E) with a screwdriver, then grasp the loose end with pliers and pull the retaining ring completely out of the groove.

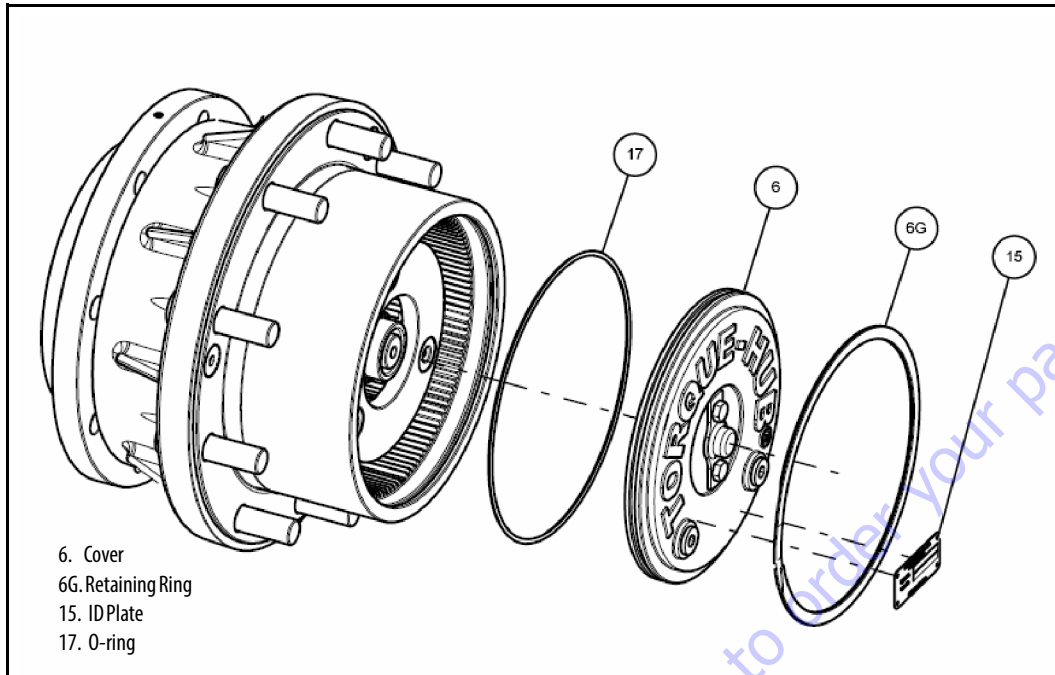


Figure 3-7. Main Disassembly - Figure 1

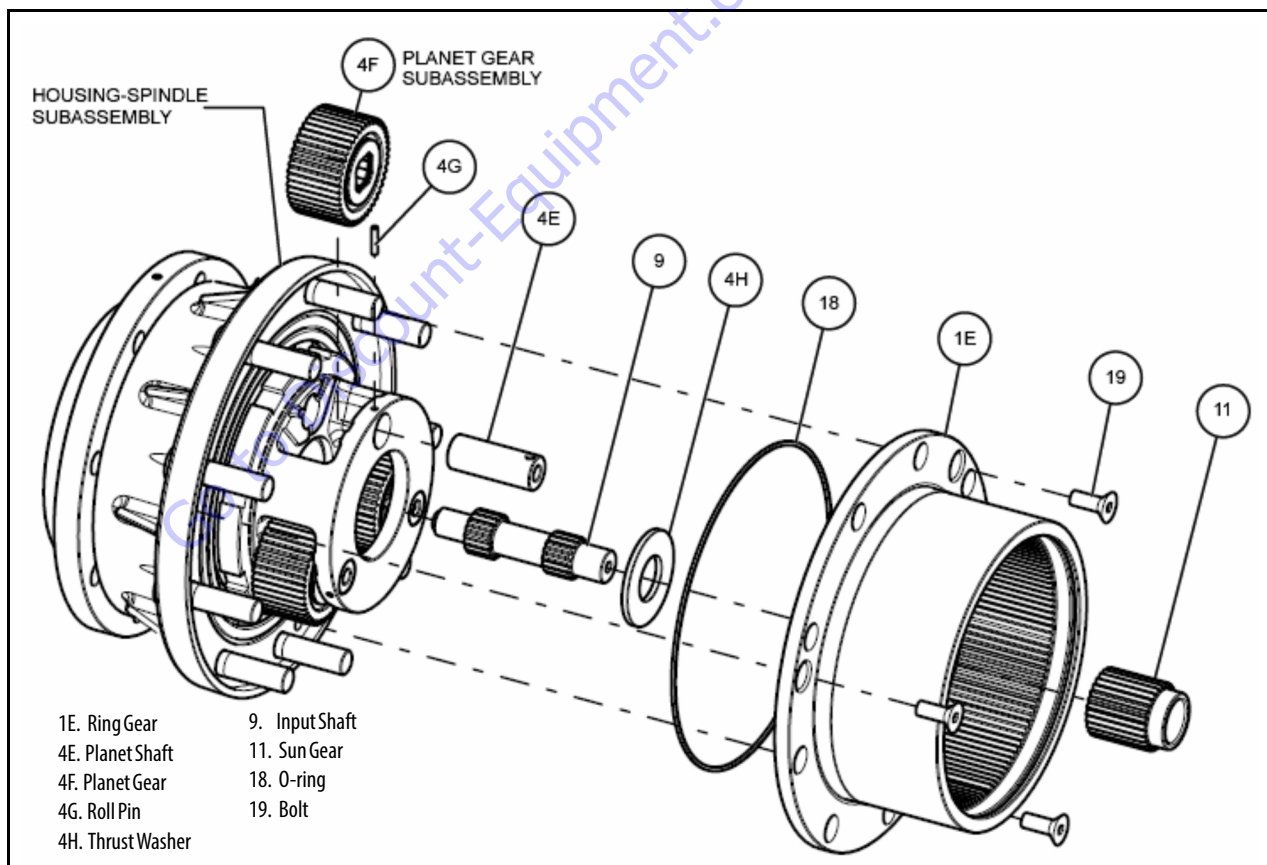


Figure 3-8. Main Disassembly - Figure 2

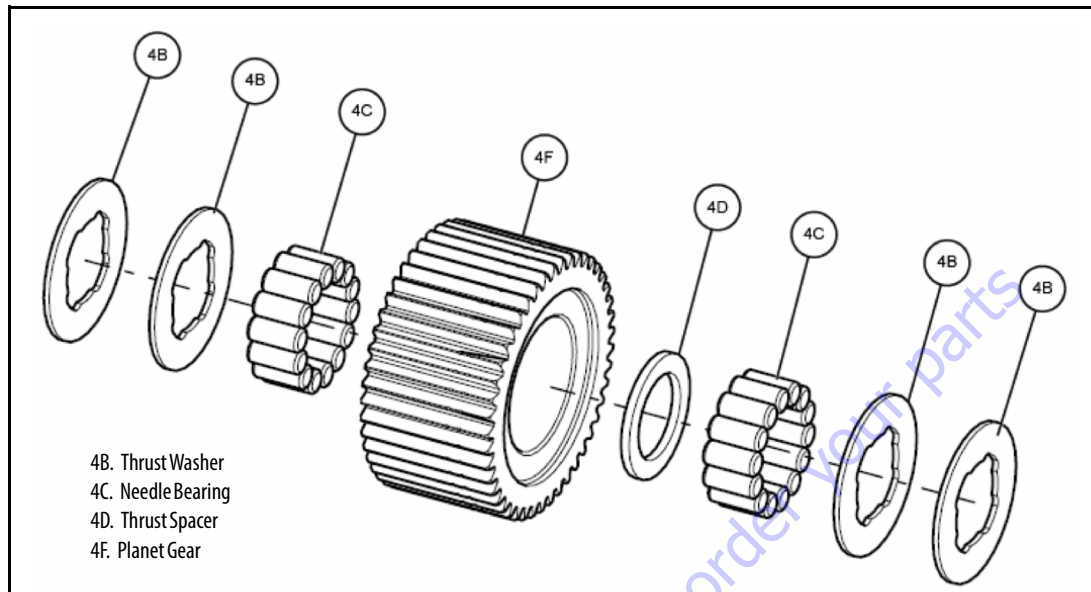


Figure 3-9. Main Disassembly - Figure 3

15. Repeat Steps 12 through 14 for the remaining two Planet Gears Subassemblies (4F).
16. Remove the Thrust Washer (4H) from the counterbore in the Spindle (1 A).
17. Remove the Input Shaft (9).

Housing-Spindle Disassembly

1. Secure the unit in a fixture with Spindle (1 A) flange end down.
2. Remove the Set Screws (1G) from Bearing Nut (1F). Then loosen the Bearing Nut (1F) using the Bearing Nut Wrench. It may be necessary to heat the Bearing Nut (1F) to break down the Loctite that was used to secure the bearing nut on to the Spindle (1 A).

NOTE: The holes in the bearing nut for the set screws were staked for retention of the set screws. The holes will need to be cleaned up prior to removing the set screws.

3. While supporting the unit on Housing (1D) flange, press Spindle (1 A) out of housing.

4. Lift Housing (1D) off of Spindle (1 A).
5. If necessary, press Studs (1H) out of Housing (1D).
6. Remove Lip Seal (1B) from Housing (1D).

NOTE: The lip seal should NOT be reused when reassembling the unit.

7. Using a soft steel rod, carefully knock both Ball Bearings (1C) out of Housing (1D).

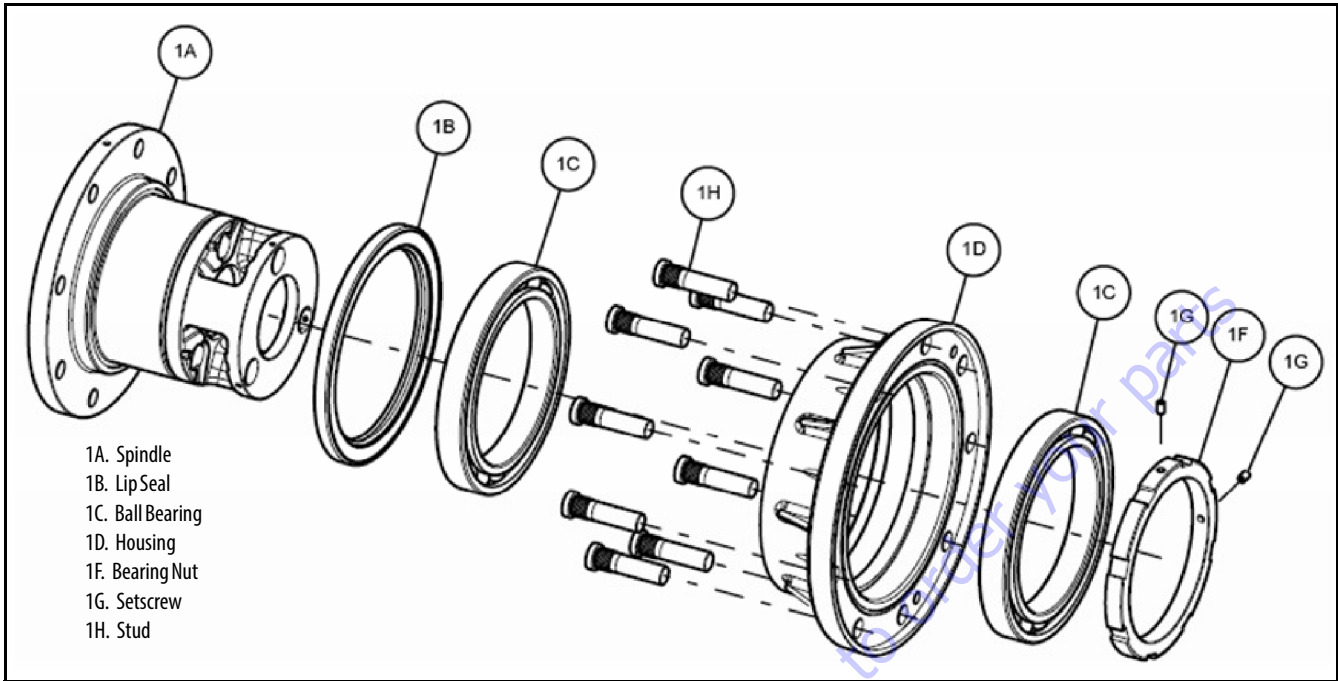


Figure 3-10. Housing-Spindle

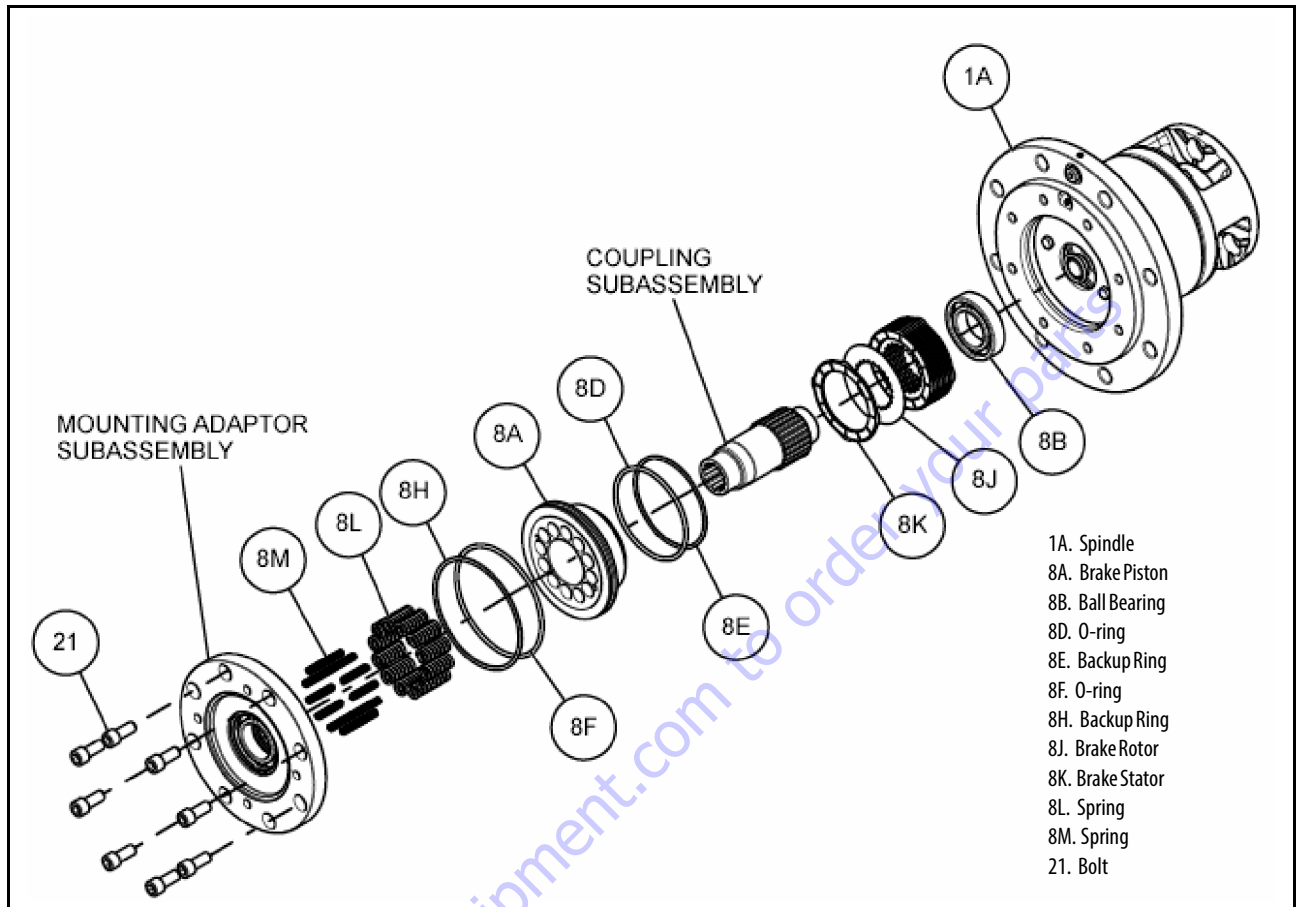


Figure 3-11. Spindle-Brake Subassembly - Figure 1

Spindle-Brake Subassembly Disassembly

NOTE: This procedure applies only to units with integral input brake.

CAUTION

EYE PROTECTION MUST BE WORN WHILE PERFORMING THE STEPS 1-3 IN THIS PROCEDURE.

1. Place Spindle (1 A) with the flange side up. Remove the Bolts (21) in an X pattern by backing each bolt half way out, and then finish backing them out. Remove Motor Adaptor (1N). If necessary, remove Retaining Ring (8C), knock Ball Bearing (8B) out of mounting adaptor counterbore, and check Quad Seal (1K) and O-Ring (8F).

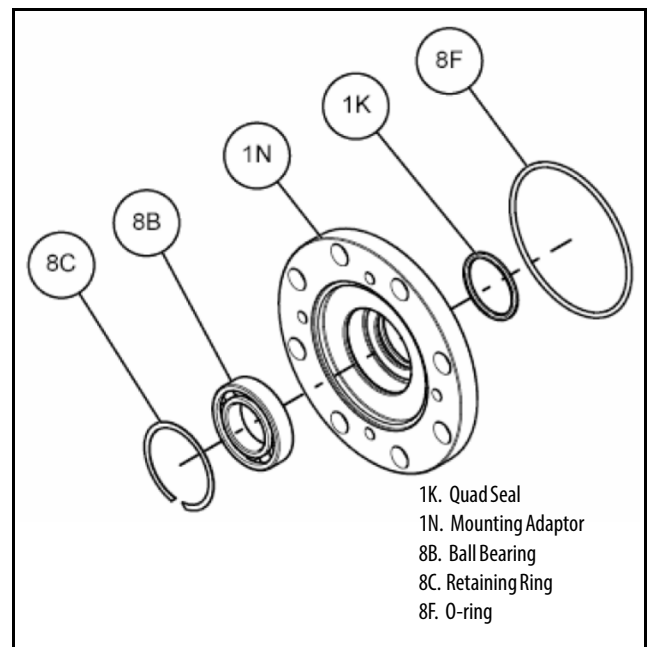
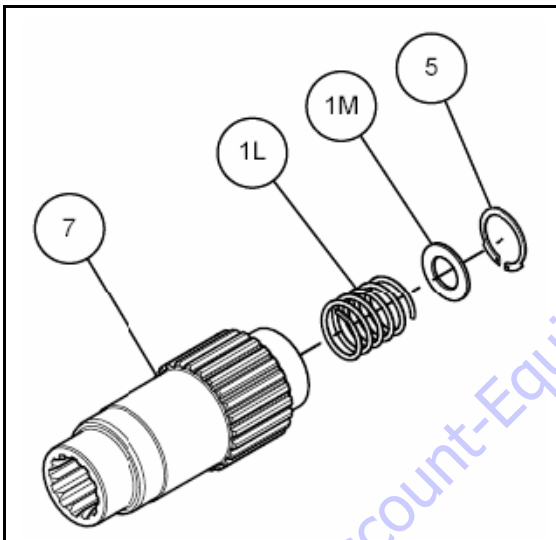


Figure 3-12. Spindle-Brake Subassembly - Figure 2

2. Remove Compression Springs (8L) and (8M) from Brake Piston (8A).
3. Using an air hose, slowly and carefully pressurize the brake port in the Spindle (1 A) until the Brake Piston (8A) comes out of brake piston bore of Spindle (1 A), then pull the Brake Piston (8A) out of the Spindle (1A) by hand.
4. Remove Backup Ring (8H) and O-Ring (8F) from grooves in Spindle (1A) and Brake Piston (8A).
5. Remove Coupling (7) from brake cavity in Spindle (1A).
6. Remove Backup Ring (8E) and O-Ring (8D) from grooves in Spindle (1A).
7. Remove Brake Rotors (8J) and Brake Stators (8K) from brake cavity in Spindle (1A).
8. Remove Retaining Ring (5) out of the internal groove of Coupling (7) using Truarc #0100 or equivalent pliers.



1L. Spring
 1M. Thrust Washer
 5. Internal Retaining Ring
 7. Coupling

Figure 3-13. Spindle-Brake Subassembly - Figure 3

9. Remove the Thrust Washer (1M) and Spring (1L) out of the bore of Coupling (7).
10. Knock Ball Bearing (8B) out of Spindle (1A) counterbore if needed.
11. Remove Pressure Plug (22) and Pipe Plug (12) from Spindle (1 A) if applicable. This completes the Spindle-Brake Subassembly Disassembly.

Cover Disassembly

1. Remove Thrust Washer (2) from pocket side of the Cover (6A), if necessary.
2. Unscrew Hex Head Bolts (6C) and remove Disengage Cap (6B) from Cover (6A).
3. Pull Disengage Rod (6D) out from Cover (6A).
4. Use appropriate tool to remove O-Ring (6E) from internal groove in Cover (6A).
5. Remove O-Ring Pipe Plugs (6F) from Cover (6A).

NOTE: O-Ring (6K) can be discarded unless cover subassembly needs to be repainted.

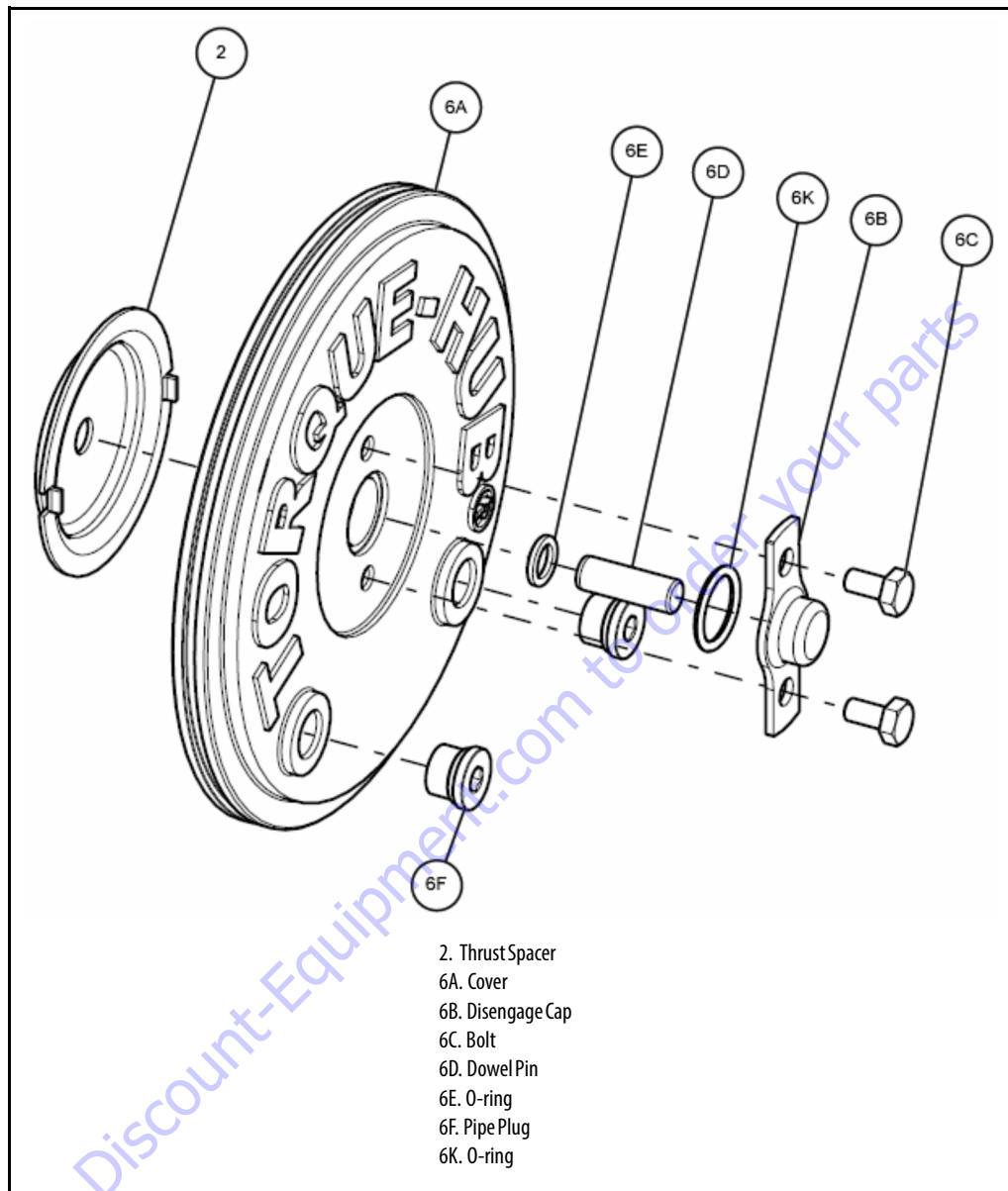


Figure 3-14. Cover

Planet Gear Subassembly

1. Apply a liberal coat of grease to the bore of one of Planet Gears (4F).
2. Line the inside of the Planet Gear (4F) with Needle Rollers (4C).

NOTE: The last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers which form the space, and then slid, parallel to the other rollers, into place.

3. Place Spacer (4D) into the bore of the Planet Gear (4F).
4. Repeat Step 2 to put in second roll of Needle Rollers (4C).
5. Apply grease to hold Thrust Washers (4B) together and onto Planet Gear (4F) counterbore. Do the same to the other side.
6. Repeat Steps 1-5 to finish the assembly of the two remaining Planet Gears Subassemblies (4F).

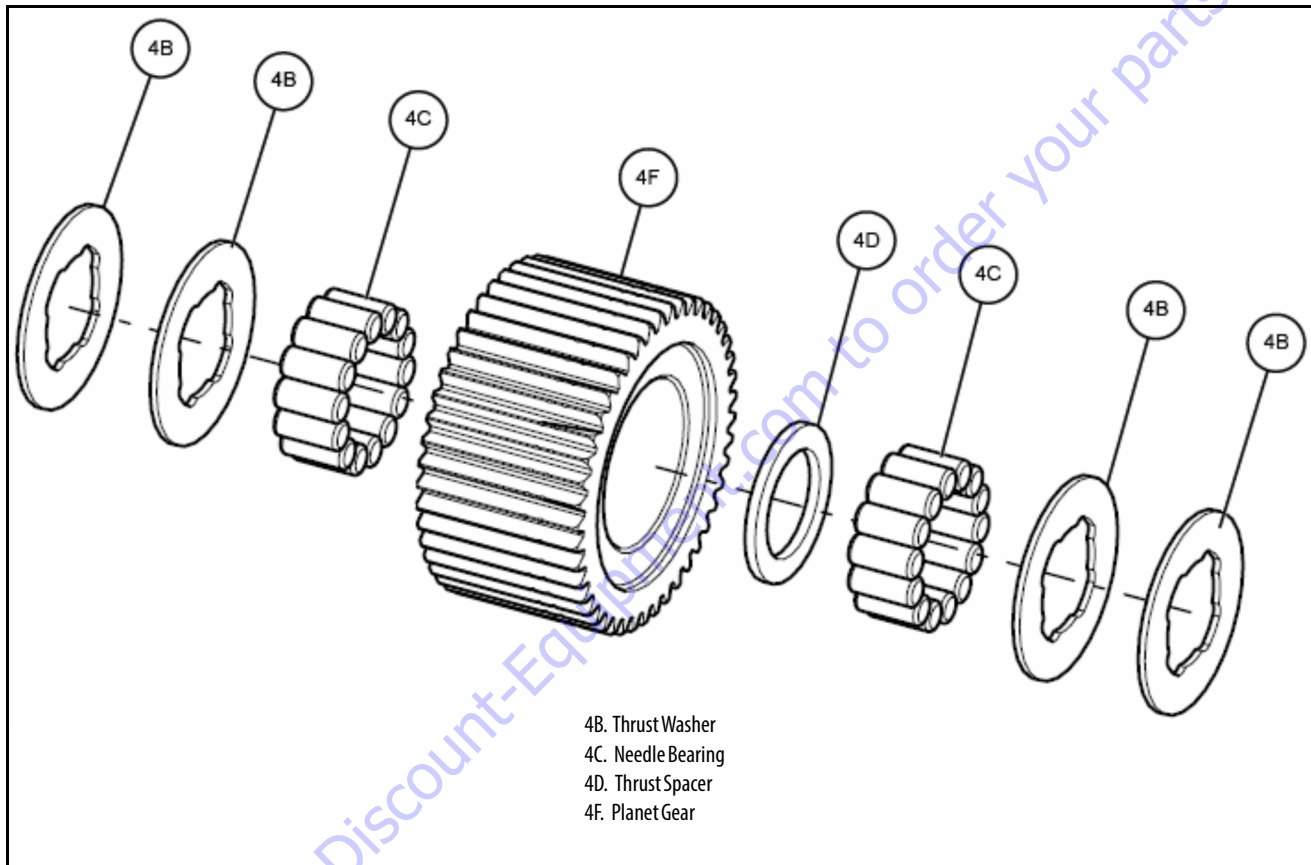


Figure 3-15. Planet Gear

Spindle-Brake Subassembly

NOTE: Use an air gun to clean the brake port and make sure there is no debris inside.

1. Place Spindle (1 A) with the flange side up. Press Ball Bearing (8B) into the small counterbore of the spindle.
2. Place Brake Stator (8K) into the Spindle (1A) aligning with the scallop cuts.
3. Place Brake Rotor (8J) on top of Brake Stator (8K).
4. Repeat steps 2 and 3 until there are a total of nine Brake Stators (8K) and eight Brake Rotors (8J) installed.
5. Place Spring (1L) into counterbore of the Coupling (7), then place Thrust Washer (1M) on top of the spring.

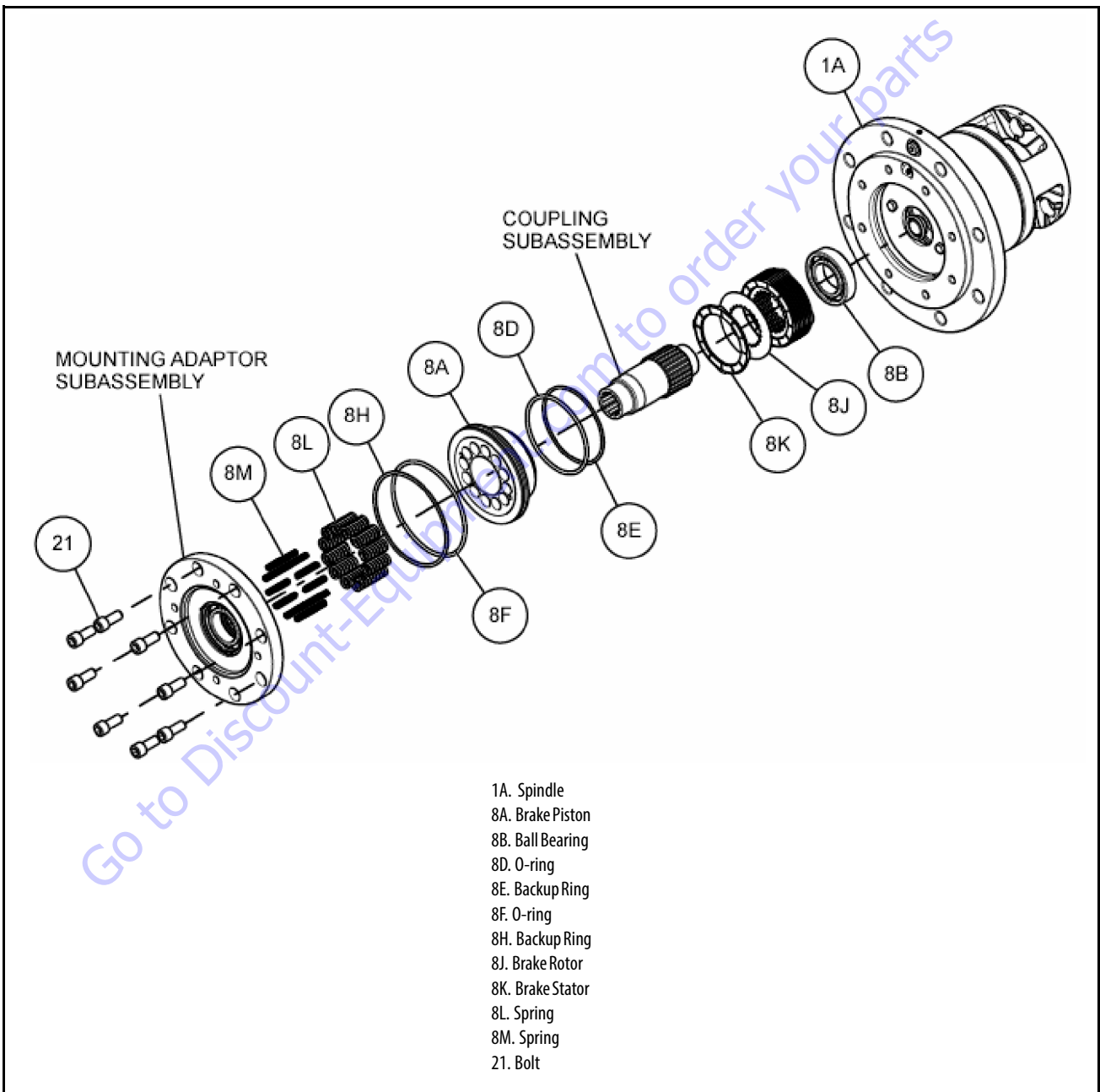


Figure 3-16. Spindle-Brake Figure 1

6. Use Truarc #0100 or equivalent pliers to install Retaining Ring (5) into the retaining ring groove in the counter-bore the Coupling (7).

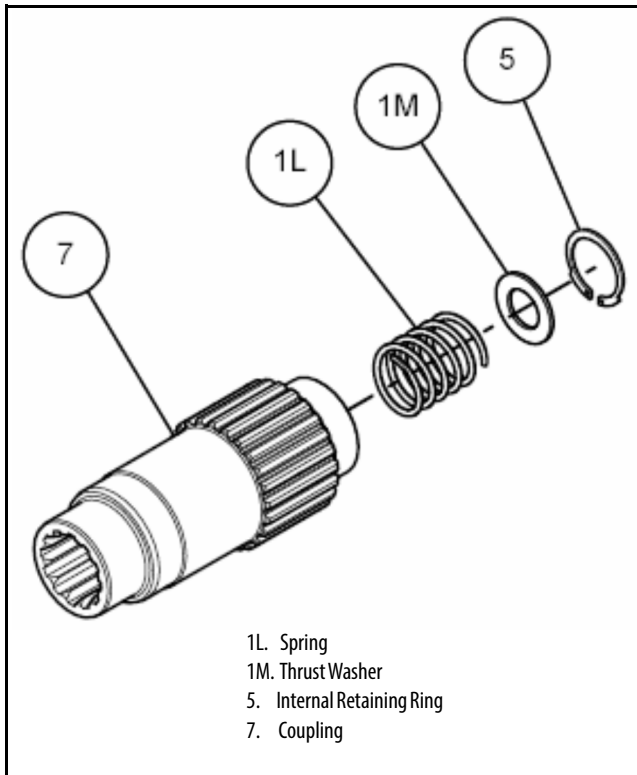


Figure 3-17. Spindle-Brake Figure 2

7. Insert Coupling Subassembly (7) through Brake Rotors (8J).
8. Grease the O-Rings (8F) and (8D) and the Backup Rings (8H) and (8E).
9. Install small O-Ring (8D) into the o-ring groove of Spindle (1A).
10. Install small Backup Ring (8E) into the o-ring groove of Spindle (1A), on bottom of the small O-Ring (8D).
11. Set the Brake Piston (8A) so that the large diameter end is down. Install large Backup Ring (8H) in the large diameter groove at the bottom of the Brake Piston (8A).
12. Install large O-Ring (8F) in the large-diameter groove at the bottom of the Brake Piston (8A), on top of the large Backup Ring (8H).
13. Use appropriate tool to insert Brake Piston (8A) with backup ring and o-ring into Spindle (1A) until it contacts Brake Stator (8K).
14. Insert twelve Springs (8L) into Brake Piston (8A) holes and then install the smaller twelve Springs (8M) into the Springs (8L) already installed into the brake piston.

15. Press Ball Bearing (8B) in the Mounting Adaptor (1N) and then install Retaining Ring (8C) into the retaining ring groove of the mounting adaptor.

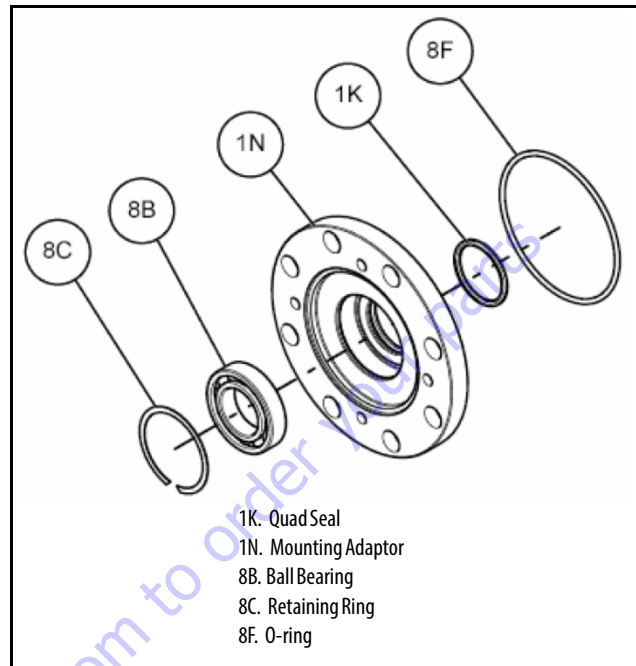


Figure 3-18. Spindle-Brake Figure 3

16. Before installing the Quad Seal (1K) into groove of Mounting Adaptor (1N) grease internal diameter of the quad seal.
17. Install O-Ring (8F) into the outside o-ring groove of the Mounting Adaptor (1N).
18. Insert the Adaptor Subassembly onto Spindle (1A) with the o-ring port on the spindle flange centered between the two motor mounting holes on the Mounting Adaptor (1N).
19. Secure the Mounting Adaptor (1N) to the Spindle (1 A) with 8 bolts (21). Torque the bolts to 36-38 ft-lbs in X pattern.
20. Use the Integral Brake Check Procedure to leak check the brake, record initial release pressure.
21. Disconnect Brake Tester and install O-Ring Plug (12) and tighten according to DIN standard if applicable.

Housing-Spindle Subassembly

NOTE: Spray a light film of oil on all component parts during assembly. Spray a generous amount of oil on bearings during installation.

1. With housing flange side up and press outbound Ball Bearing (1C) into Housing (1D) using Bearing Pressing Tool.
2. Turn housing over and press inbound Ball Bearing (1C) into Housing (1D) using Bearing Pressing Tool.
3. Grease Lip Seal (1B) and then press lip seal into Housing (1D) using Seal Pressing Tool until seal is flush with end of housing.
4. Secure Housing (1D) and press Studs (1H) into housing.

NOTE: Use enough pressure to press in studs. Don't use excessively high pressures to press in studs or the housing may crack.

5. Secure Spindle-Brake Subassembly with the flange down and then lower the Housing (1D) onto Spindle (1A).
6. Apply Loctite 272 on Bearing Nut (1F) threads. Install the Bearing Nut (1F) onto Spindle (1A) with a nut torque of 100-110 in-lbs. Make sure the bearings have 0.001 - 0.005 inches end play with a dial indicator sitting on the spindle and dial on the housing with prying bars.
7. Install Set Screws (1G) into Bearing Nut (1F) threaded holes. Make sure Set Screw (1G) is driven into the spindle threads. Tighten the set screws to damage the threads and stake the edge of the nut around the Set Screws (1G) so the nut will not loosen.

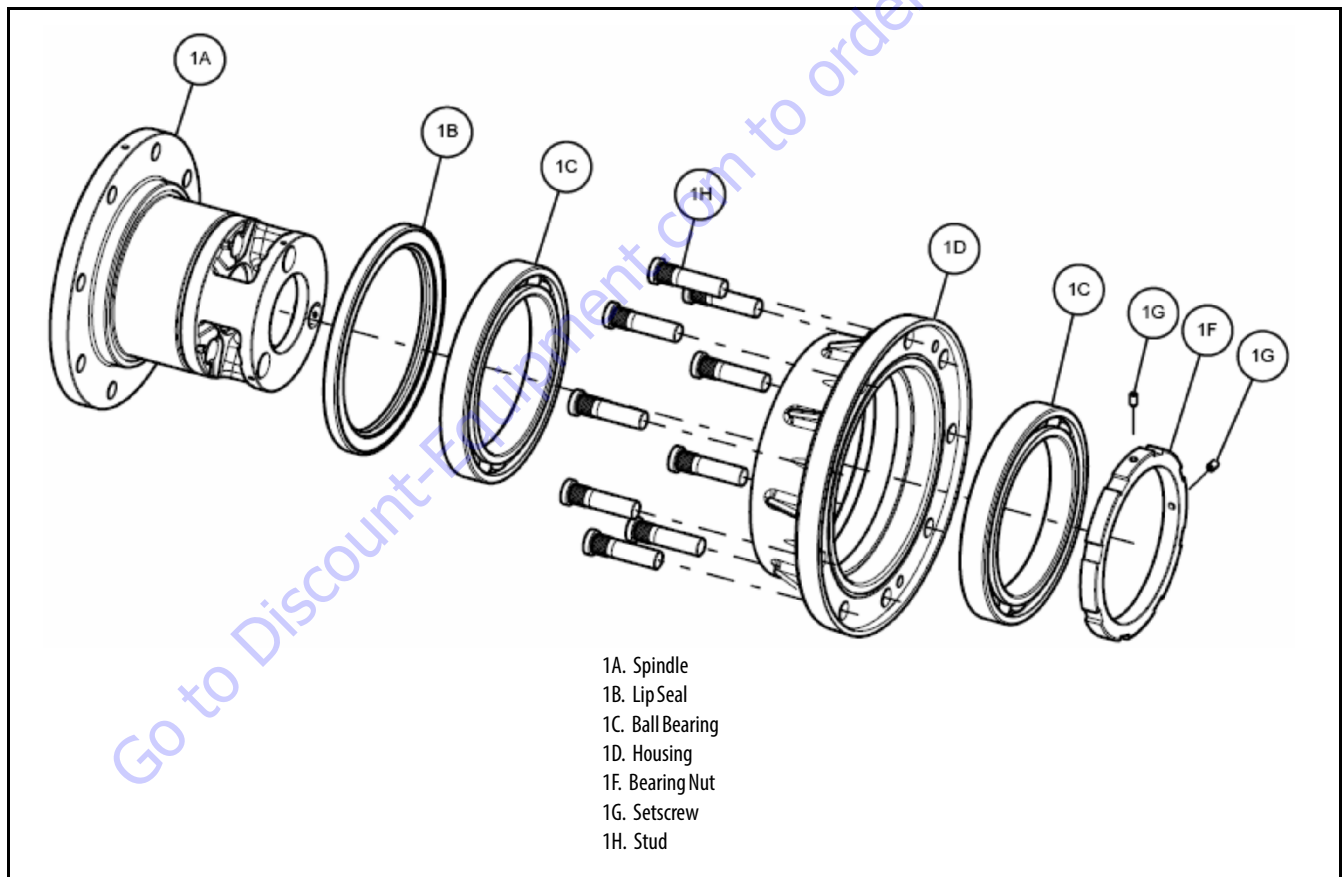


Figure 3-19. Housing-Spindle

Housing-Ring Gear Subassembly

1. Insert Input Shaft (9) into mesh with Coupling's (7) internal splines and place the Thrust Washer (4H) into counterbore of Spindle (1A).
2. Place one of the Planet Gear Subassemblies (4F) into Spindle (1 A) through gap between two Studs (1H). Align the planet gear bore with one of the planet shaft holes on the Spindle-Brake Subassembly using the Drift Pin Assembly Tool.
3. Insert Planet Shaft (4E) into the planet shaft hole described in Step (2) on Spindle (1A). The end of the

planet shaft that does NOT have the roll pin hole should be inserted into the spindle FIRST.

4. Now insert Planet Shaft (4E) through the first set of Thrust Washers (4B), Planet gear, then the second set of Thrust Washers (4B). Use an alignment punch or similar tool to align roll pin holes on Spindle (1A) and Planet Shaft (4E).

NOTE: Be sure not to hit the planet gears when driving in the roll pins.

5. Drive Roll Pin (4G) down into the aligned roll pin holes. Pin should be flush with OD of spindle.

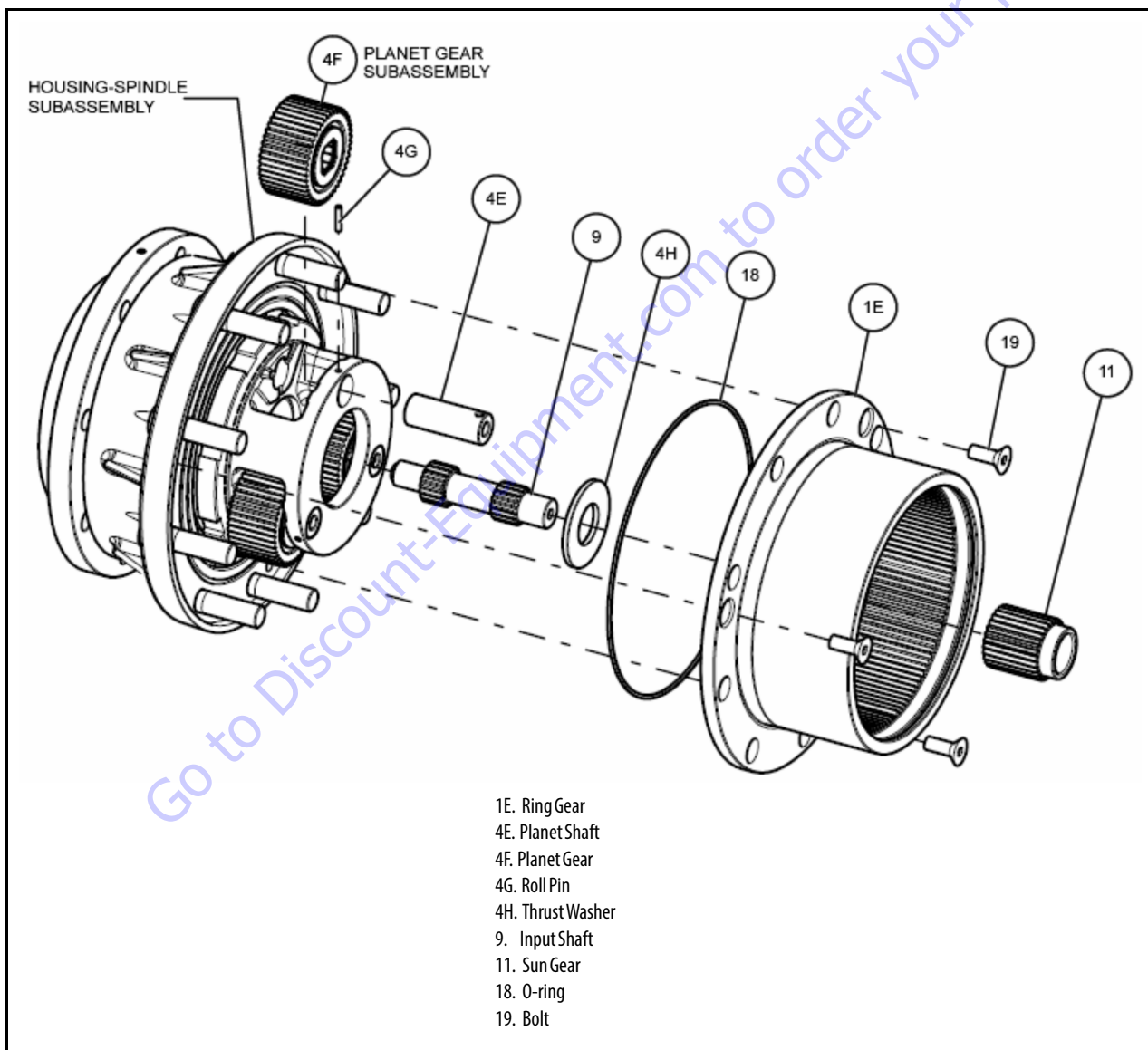


Figure 3-20. Housing Ring Gear Subassembly

6. Repeat Steps (2-6) for the installation of the two remaining Planet Gears (4F).

NOTE: All components should receive a generous amount of lubricant oil as they are being assembled.

7. Grease O-Ring (18) and place it into groove of Housing (1D).
8. Place Ring Gear (1E) onto Housing (1D). Align the three shipping cap screw holes on Housing (1D) and Ring Gear (1E).

9. Install three Shipping Cap Screws (19) into Ring Gear (1E) and Housing (1G). Torque them to 15-20 ft-lbs.
10. With the non-toothed end facing up, place the Sun Gear (11) into mesh with the planet gears from the Housing-Spindle Subassembly.

Cover Subassembly

1. Grease O-Ring (6E) and insert into internal groove in Cover (6A).

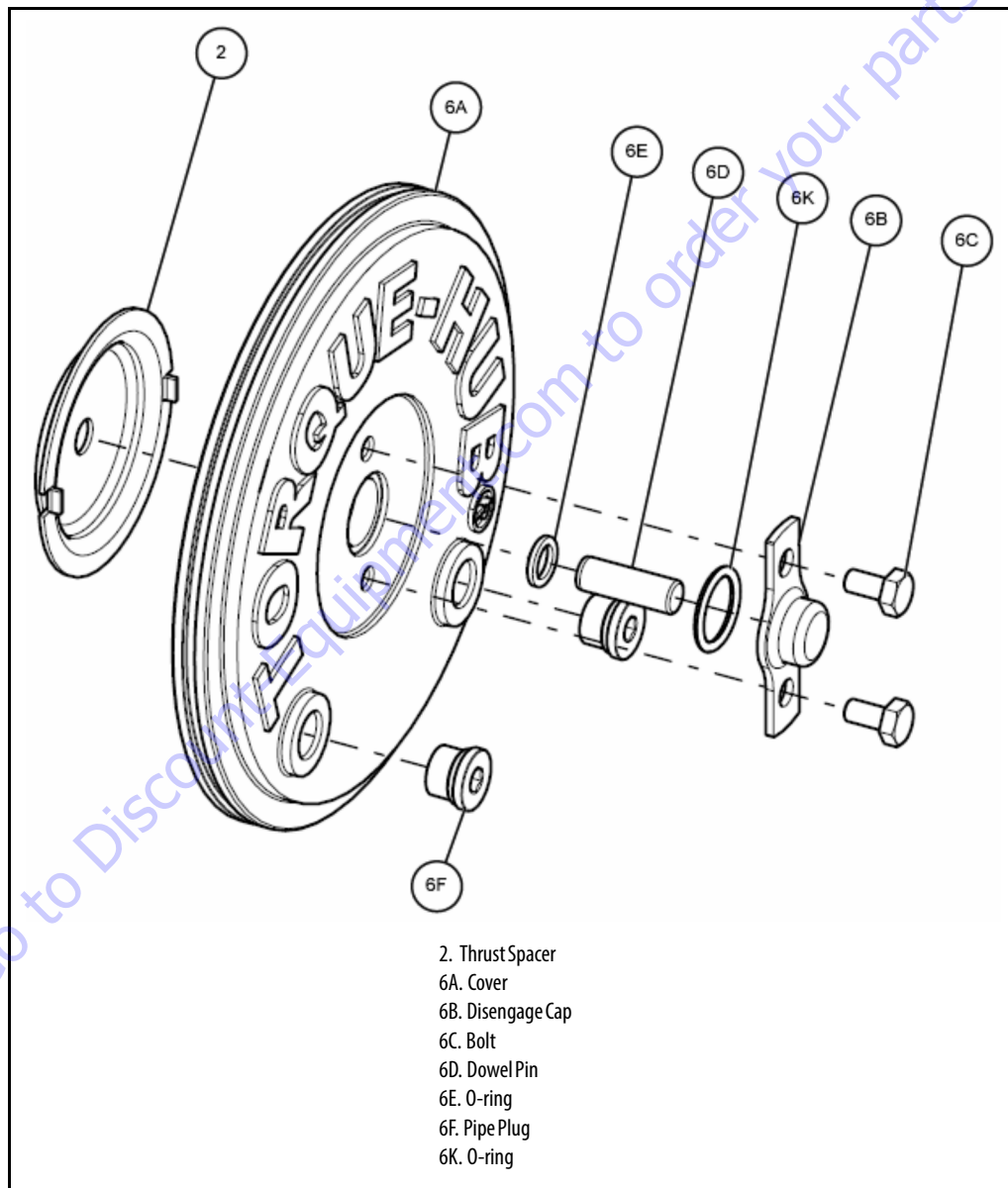


Figure 3-21. Cover

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2. Assemble Disengage Cap (6B) onto Cover (6A) using two Hex Head Bolts (6C). Torque bolts to 70-80 in-lbs.

NOTE: It is not necessary to reinstall the larger O-Ring (6K) unless cover subassembly needs repainted.

3. Insert Disengage Rod (6D) into hole in Cover (6A) until it touches the inside of the Disengage Cap (6B).

NOTE: The disengage rod can be inserted in either end first.

4. Grease face of Thrust Washer (2) that mates with pocket side of the Cover (6A), making sure that tangs on washer seats into pockets.
5. Install O-Ring Pipe Plugs (6F) into Cover (6A). The plugs should be hand tight. The Cover Subassembly is now complete.

Main Assembly

1. Grease O-Ring (17) and insert into groove in Cover Sub-assembly (6).
2. Install Cover Subassembly (6) into Ring Gear (1E) counterbore and install Retaining Ring (6G) into groove in Ring Gear (1E).
3. Attach ID Plate (15) onto unit using Drive Screws (16) if needed.
4. Check disconnect, roll and air check unit. The Main Assembly is now complete.

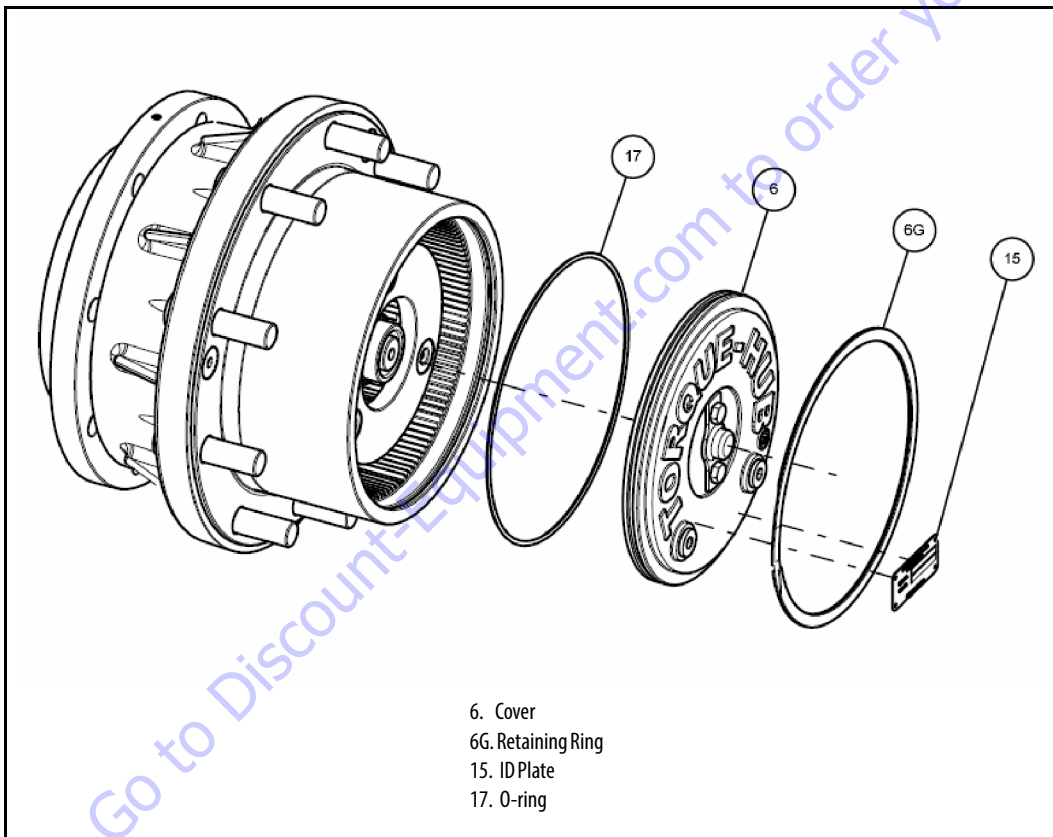


Figure 3-22. Main Assembly

Integral Brake Check Procedure

1. Using appropriate fittings to connect hydraulic line from hand pump to the brake port.
2. Check to see that brake is set by trying to rotate Input Shaft (9). This can be accomplished by installing an appropriate tool (any tool that can locate on the splines of the Input Coupling (7), such as a mating splined shaft) into Input Coupling (7).
3. Bleed brake. Increase hydraulic pressure gradually while trying to rotate the input until brake just starts to release. Note this pressure. Make sure the pressure falls into the appropriate range below.

BRAKE CODE	INITIAL RELEASE PRESSURE RANGE (psi)
K	240-260

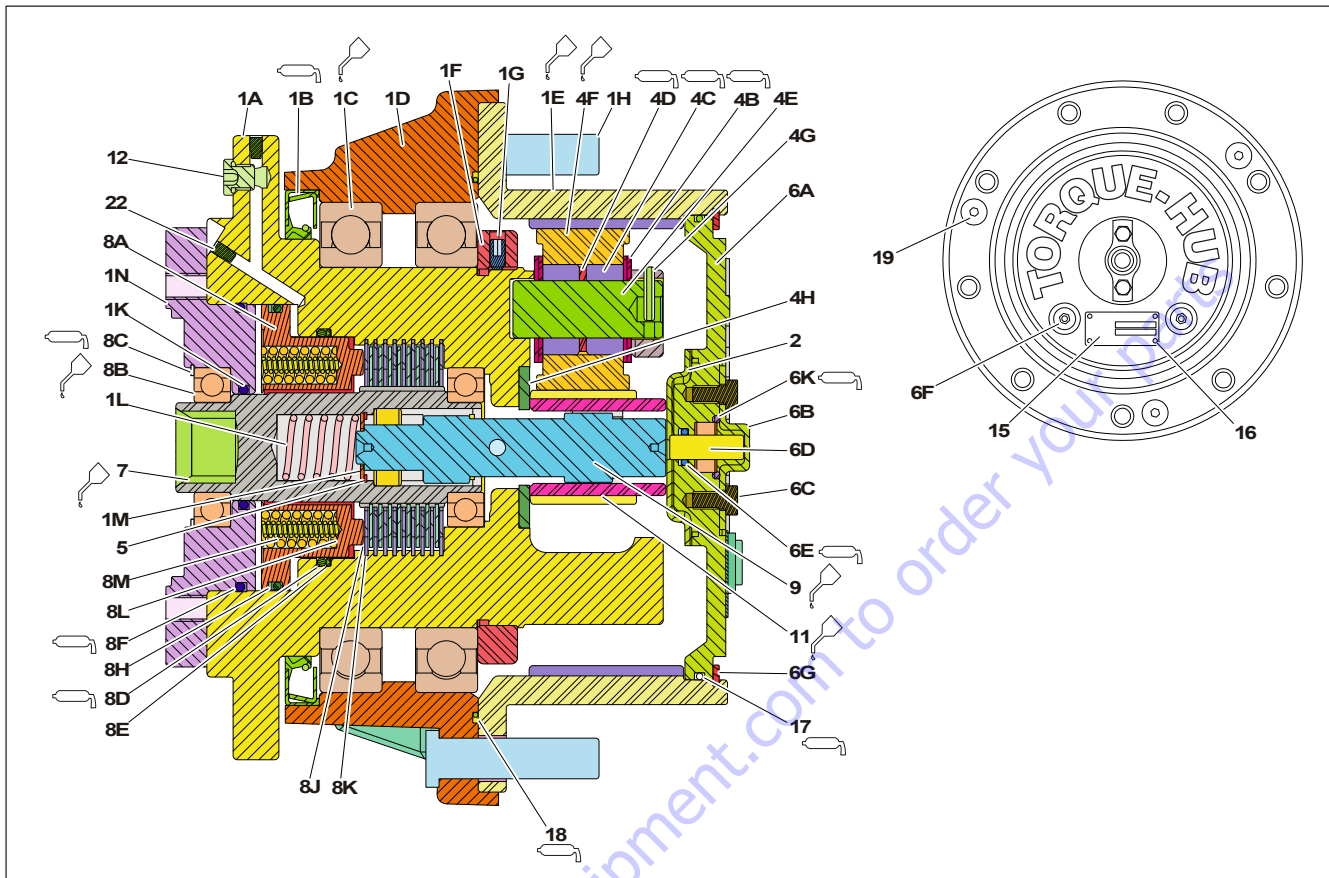
4. Increase pressure to 3,625 psi and hold for 60 seconds to check for leaks. Repair leaks if necessary.

NOTE: Make sure that brake re-engages when pressure is released.

NOTE: When done, make sure input coupling is centered in the spindle to make installation of motor possible without release of brake.

Go to Discount-Equipment.com to order your parts

SECTION 3 - CHASSIS & TURNTABLE



- | | | | |
|---------------------|-----------------------------|-------------------|------------------|
| 1A SPINDLE | 4B THRUST WASHER | 6F PIPEPLUG | 8L SPRING |
| 1B LIPSEAL | 4C NEEDLE BEARING | 6G RETAININGRING | 8M SPRING |
| 1C BALL BEARING | 4D THRUST SPACER | 6K O-RING | 9 INPUT SHAFT |
| 1D HOUSING | 4E PLANET SHAFT | 7 COUPLING | 11 SUN GEAR |
| 1E RING GEAR | 4F PLANET GEAR | 8A BRAKE PISTON | 12 O-RING PLUG |
| 1F BEARING NUT | 4G ROLL PIN | 8B BALL BEARING | 15 ID PLATE |
| 1G SET SCREW | 4H THRUST WASHER | 8C RETAINING RING | 16 DRIVE SCREW |
| 1H STUD | 5 RETAINING RING - INTERNAL | 8D O-RING | 17 O-RING |
| 1K QUAD SEAL | 6A COVER | 8E BACK-UP RING | 18 O-RING |
| 1L SPRING | 6B DISENGAGE CAP | 8F O-RING | 19 BOLT |
| 1M THRUST WASHER | 6C BOLT | 8H BACK-UP RING | 21 BOLT |
| 1N MOUNTING ADAPTOR | 6D DOWEL PIN | 8J BRAKE ROTOR | 22 PRESSURE PLUG |
| 2 THRUST SPACER | 6E O-RING | 8K BRAKE STATOR | |

Figure 3-23. Drive Hub Assembly

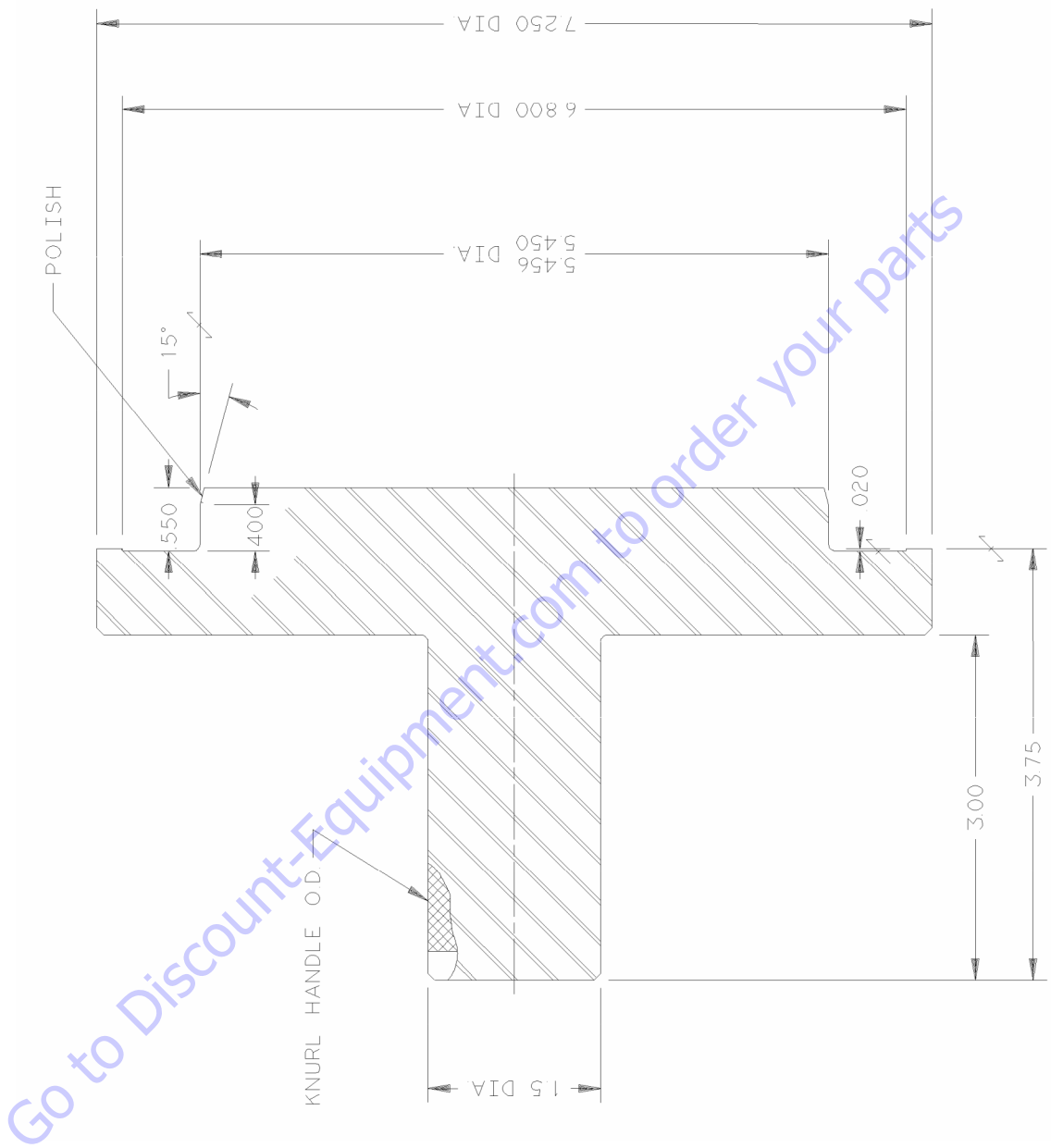


Figure 3-24. Bearing Pressing Tool

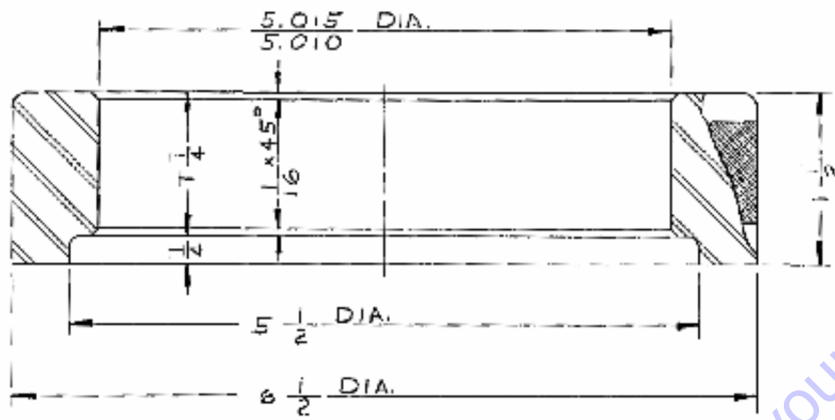


Figure 3-25. Seal Pressing Tool

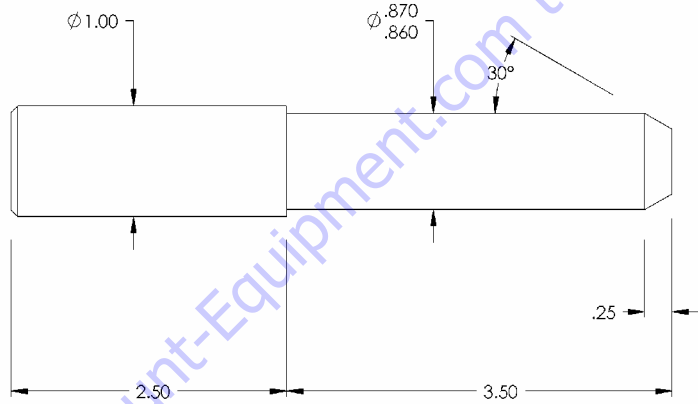


Figure 3-26. Drift Pin for Lining Up Thrustwashers with Output Planet Gear

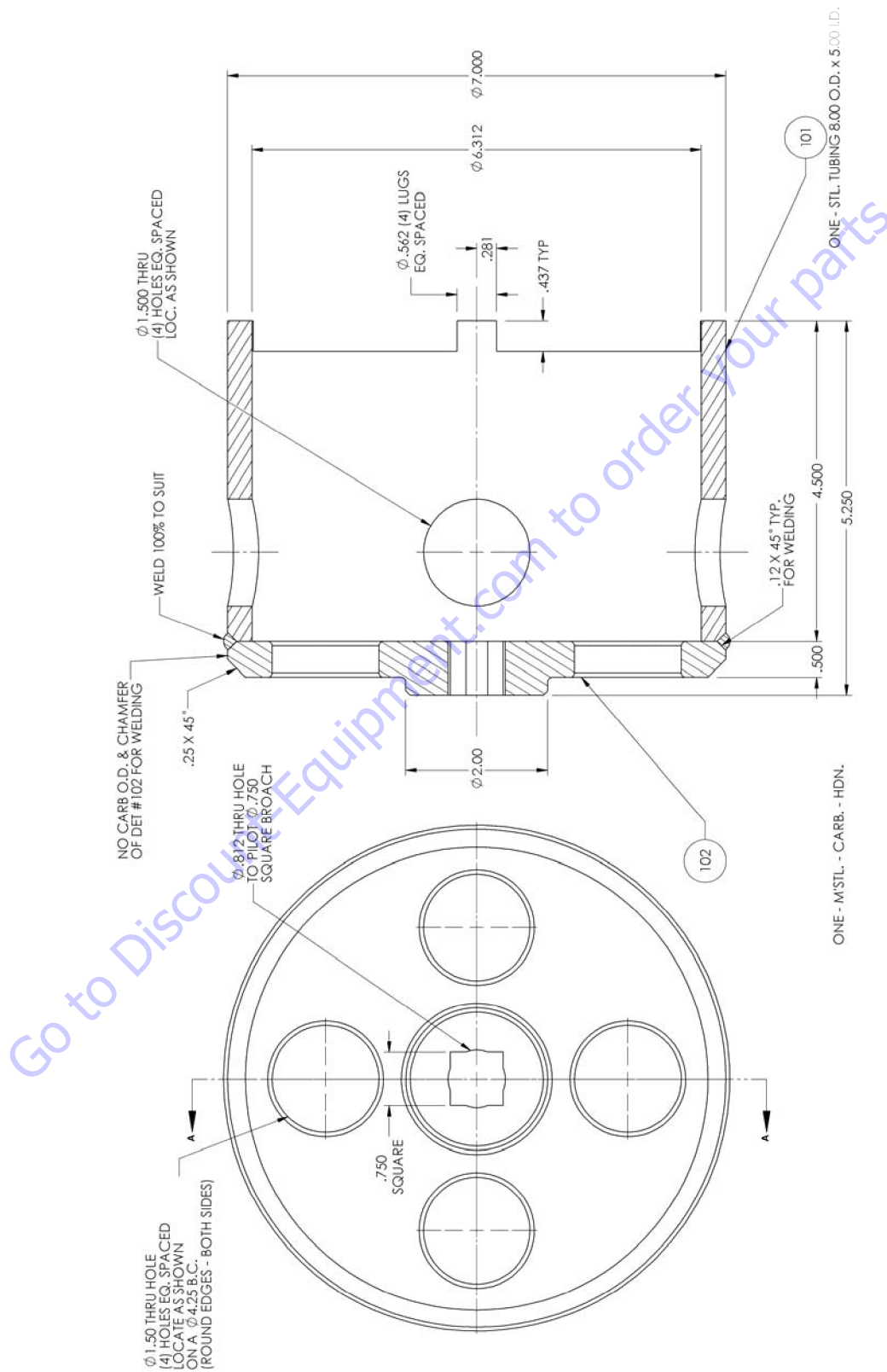


Figure 3-27. Bearing Nut Wrench

3.8 OSCILLATING AXLE SYSTEM

The oscillating front axle is attached to the frame by a pivot pin, which allows all four wheels to remain on the ground when traveling on rough terrain. The oscillating axle incorporates two lockout cylinders connected between the frame and the axle. The lockout cylinders permit axle oscillation when the main boom is in Transport Position (see Section 4), and when the boom is oriented between the rear tires as described under Drive Orientation System. In this system, both of these boom positions (swing and main boom elevation) are sensed by two switches. One switch in each position is normally closed and positively opens in the unsafe state (these are the same switches described in the Transport Position Sensing System (see Section 4) and in the Drive Orientation System. The other switch for each position is normally open and closes in the safe state.

The lockout cylinders will lock and hold the axle when the boom is in a position as described above (Main boom above horizontal or swung beyond the rear tires). The cylinders unlock when pilot pressure is applied to the holding valves mounted on the cylinders and lock when pilot pressure is removed.

Pilot pressure is supplied via Drive Pump charge pressure. When the control system detects that the Main Boom is below horizontal and swung between the rear tires, two control

valves are actuated to supply charge pressure to the lock-out cylinder holding valves. This allows the cylinders to unlock which allows the axle to float. The first valve is normally closed and opens when actuated to allow flow to the lock-out cylinder circuit. The second valve (located between the first valve and the lock-out cylinders) is normally open to tank. This valve closes when actuated to block the tank path and force the flow to the lock-out cylinders. If either of these valves is in its normal state, the axle will be locked.

Oscillating Axle Bleeding Procedure

1. Start the engine.
2. Position the turntable to the normal stowed position.
3. Position a small container suitable for containing hydraulic oil in front of the lockout cylinder bleeder.
4. Using a 3/8" wrench, loosen the bleeder by slowly turning counterclockwise.
5. Bleed approximately 2 cups (0.2 L) of fluid from the bleeder in the cylinder. Tighten the bleeder while the machine is running.
6. Locate the bleeder on the opposite lockout cylinder and repeat steps 3 thru 5.

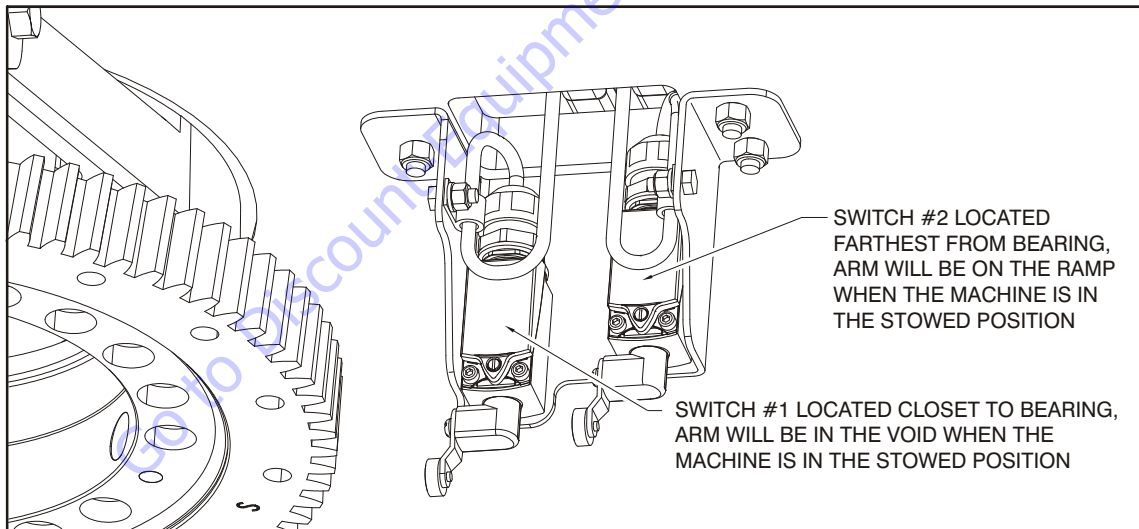


Figure 3-28. Axle Oscillation Switches

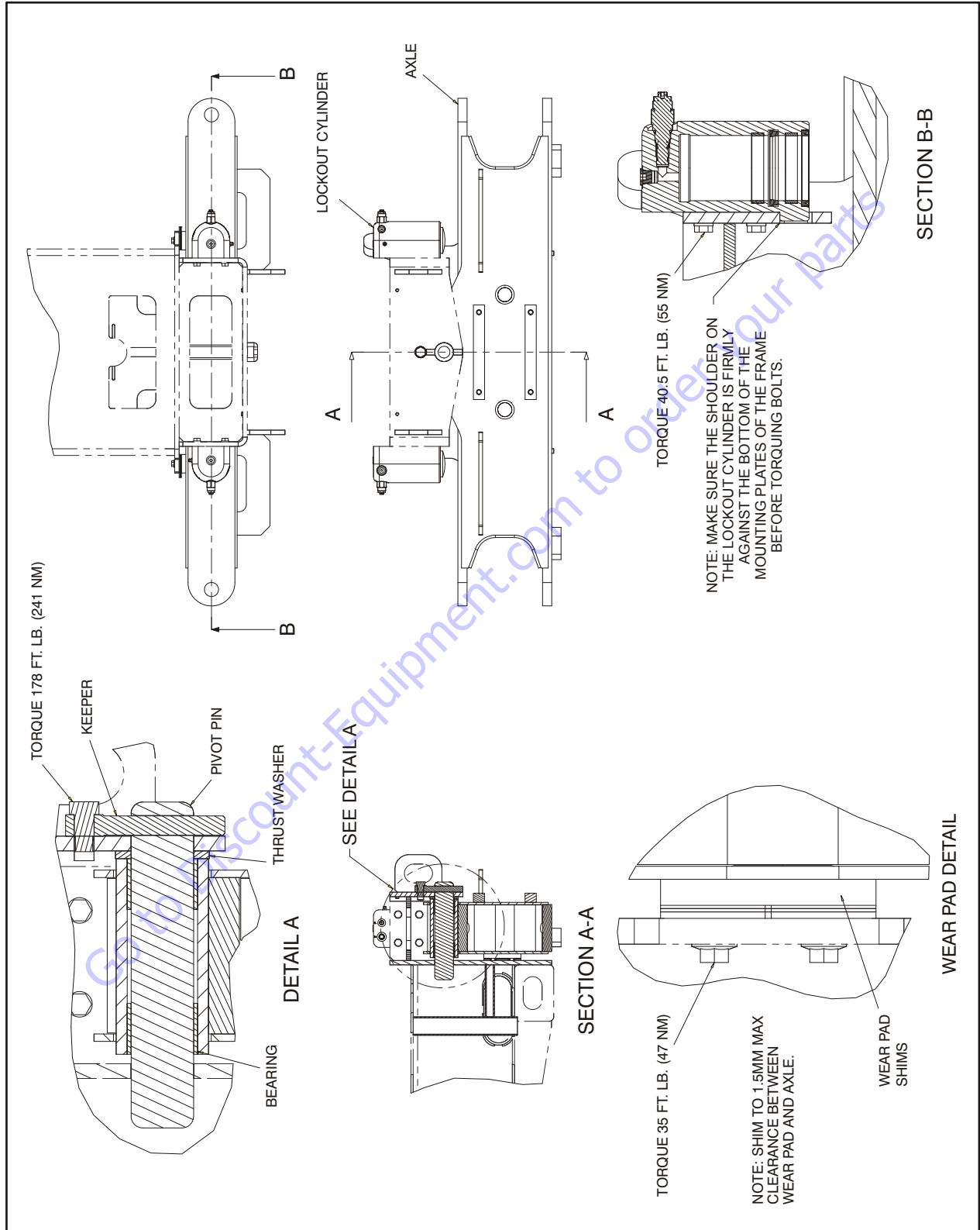


Figure 3-29. Oscillating Axle

3.9 CHASSIS TILT INDICATOR SYSTEM

The Chassis Tilt Indicator System measures the turntable angle with regard to level ground. The tilt sensor has two settings; 5.0°/3.0° (depending on market) and 6.0° degrees. The 5.0°/3.0° angle is set by choosing the desired market selection for the machine based on machine setup using the JLG Analyzer.

The 5.0°/3.0° angle is used to warn the operator of an excessive slope by means of the chassis tilt light on the platform display panel. The tilted condition exists when the chassis tilt reading is greater than or equal to the setting selected in the analyzer for a period of 4 seconds or longer. The tilted condition will be cleared if the tilt reading is less than the selected setting for a period of 1 second. When used in conjunction with the Beyond Transport - Drive Speed Cutback System, the tilt sensor will cause an alarm to sound and automatically put all functions in the creep speed mode. The operator is responsible for preventing the machine from reaching an unstable position. The tilt angle is dependent on market, Refer Table 6-7, Machine Configuration Programming Information (Software Version P2.1) (SoftwareVersion P2.1).

The 6° angle is used only for the purpose of automatically slowing drive speed when this angle is reached and the boom is in Transport position. When the boom is in Transport Posi-

tion and the chassis is at or above 6° for a period of 1 second or longer, the drive system will automatically switch into Max Torque mode. This condition will be cleared if the chassis tilt reading is less than 5 degrees for a period of 1 second or longer.

The JLG Control System responds to indicated angle readings 0.5 degree smaller than the required angles to account for calibration and sensor variation.

The machine's chassis tilt is measured by a pair of fluid-based sensors imbedded within the Ground Module. These sensors measure chassis tilt from side-to-side and from front-to-back. The ground module uses one tilt sensor to measure machine angle and uses the second sensor to compare against the first one to ensure the angle reading is reliable.

3.10 SWING MOTOR

⚠ CAUTION

IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED [IN EXCESS OF 200°F (93.3°C)], SEALS IN THE SYSTEM CAN SHRINK, HARDEN OR CRACK, THUS LOSING THEIR SEALING ABILITY.

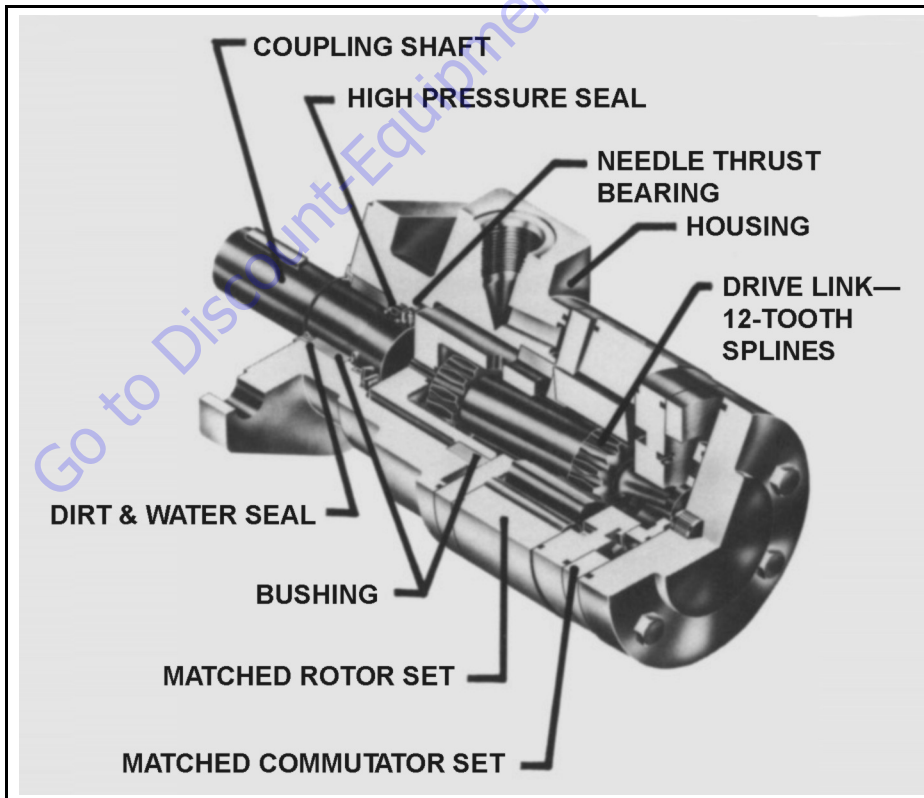


Figure 3-30. Swing Motor - Cutaway

Table 3-3. Swing Motor Troubleshooting

Trouble	Cause	Remedy
Oil Leakage	<ol style="list-style-type: none"> Hose fittings loose, worn or damaged. Oil seal rings (4) deteriorated by excess heat. Special bolt (1, 1A, 1B or 1C) loose or its sealing area deteriorated by corrosion. Internal shaft seal (16) worn or damaged. Worn coupling shaft (12) and internal seal (16). 	<p>Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.</p> <p>Replace oil seal rings by disassembling unit.</p> <p>(a) Loosen then tighten single bolt to torque specification. (b) Replace bolt.</p> <p>Replace seal. Disassembly of motor unit necessary.</p> <p>Replace coupling shaft, and seal by disassembling unit.</p>
Significant loss of speed under load	<ol style="list-style-type: none"> Lack of sufficient oil supply High internal motor leakage Severely worn or damaged internal splines. Excessive heat. 	<p>(a) Check for faulty relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.</p> <p>Replace worn rotor set by disassembling unit.</p> <p>Replace rotor set, drive link and coupling shaft by disassembling unit.</p> <p>Locate excessive heat source (usually a restriction) in the system and correct the condition.</p>
Low mechanical efficiency or undue high pressure required to operate unit	<ol style="list-style-type: none"> Line blockage Internal interference Lack of pumping pressure Excessive binding or loading in system external to motor unit. 	<p>Locate blockage source and repair or replace.</p> <p>Disassemble unit, identify and remedy cause and repair, replacing parts as necessary.</p> <p>Check for and repair worn pump.</p> <p>Locate source and eliminate cause.</p>

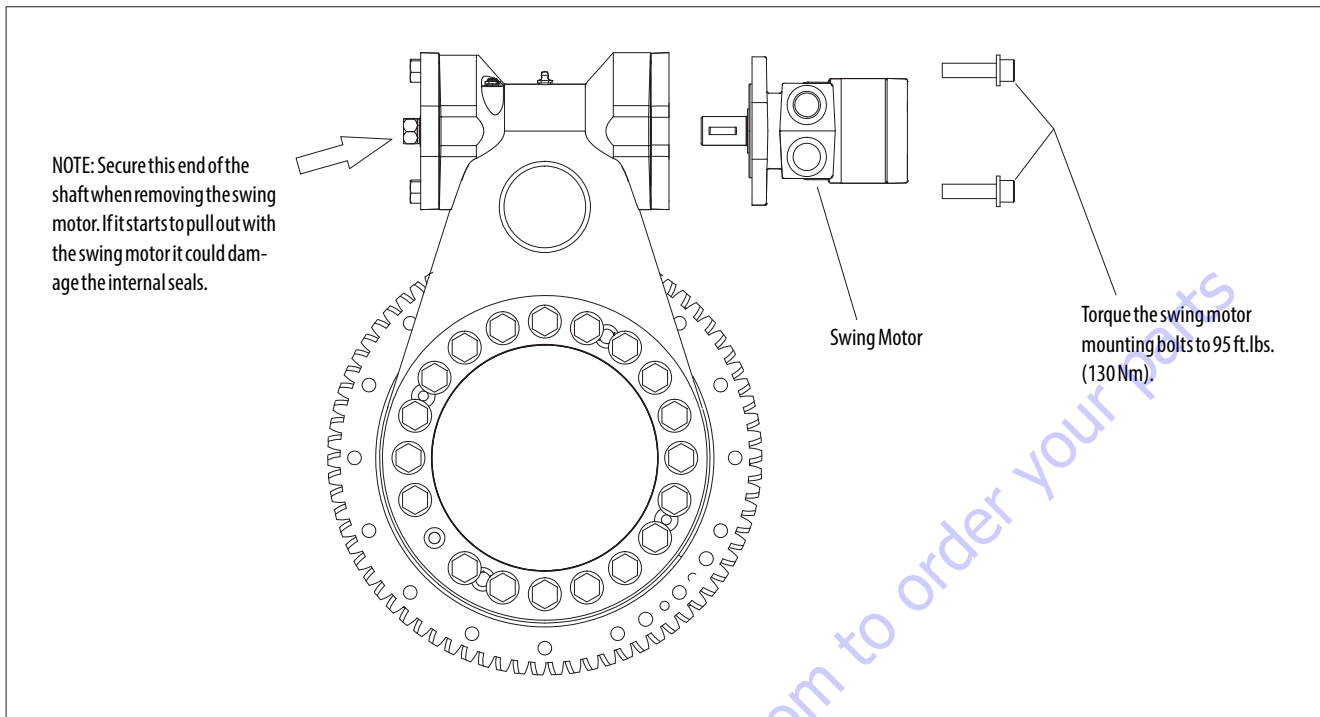


Figure 3-31. Swing Motor Removal and Installation

Removal

Refer to Figure 3-31., *Swing Motor Removal and Installation*.

1. Thoroughly clean the area around the swing motor to prevent any dirt from entering the system.
2. Tag and disconnect the hydraulic lines running to the swing motor. Cap or plug all openings.
3. Secure the worm gear shaft so it does not pull out any when removing the swing motor. Failure to do so could damage the worm gear seals.
4. Remove the bolts securing the swing motor to the swing drive assembly.
5. Carefully pull the swing motor from the swing drive.

Preparation Before Disassembly

- Before you disassemble the motor unit or any of its components read this entire section. It provides important information on parts and procedures you will need to know to service the motor.
- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the motor. Remove rust or corrosion from coupling shaft.
- Remove coupling shaft connections and hose fittings and immediately plug port holes and fluid lines.
- Remove the motor from system, drain it of fluid and take it to a clean work surface.
- Clean and dry the motor before you start to disassemble the unit.
- As you disassemble the motor clean all parts, except seals, in clean petroleum-based solvent, and blow them dry.

⚠ WARNING

PETROLEUM-BASE SOLVENTS ARE FLAMMABLE. BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

⚠ WARNING

WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

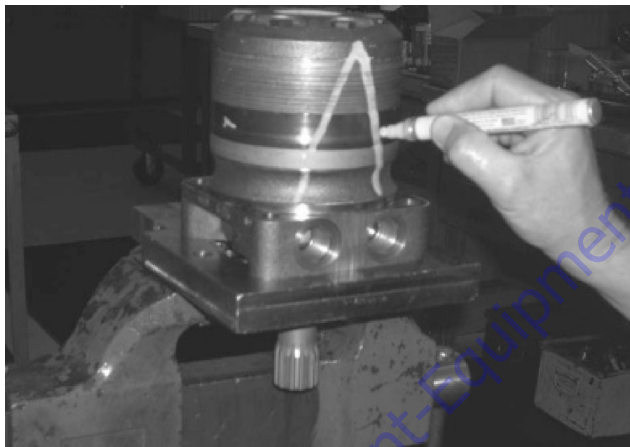
⚠ CAUTION

NEVER STEAM OR HIGH PRESSURE WASH HYDRAULIC COMPONENTS. DO NOT FORCE OR ABUSE CLOSELY FITTED PARTS.

- Keep parts separate to avoid nicks and burrs.
- Discard all seals and seal rings as they are removed from the motor. Replace all seals, seal rings and any damaged or worn parts with OEM approved service parts.

Disassembly and Inspection

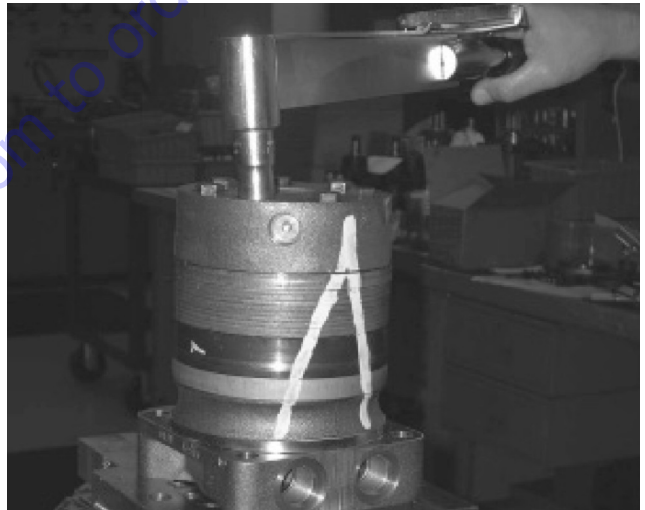
1. Place the motor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings if applicable.



⚠ WARNING

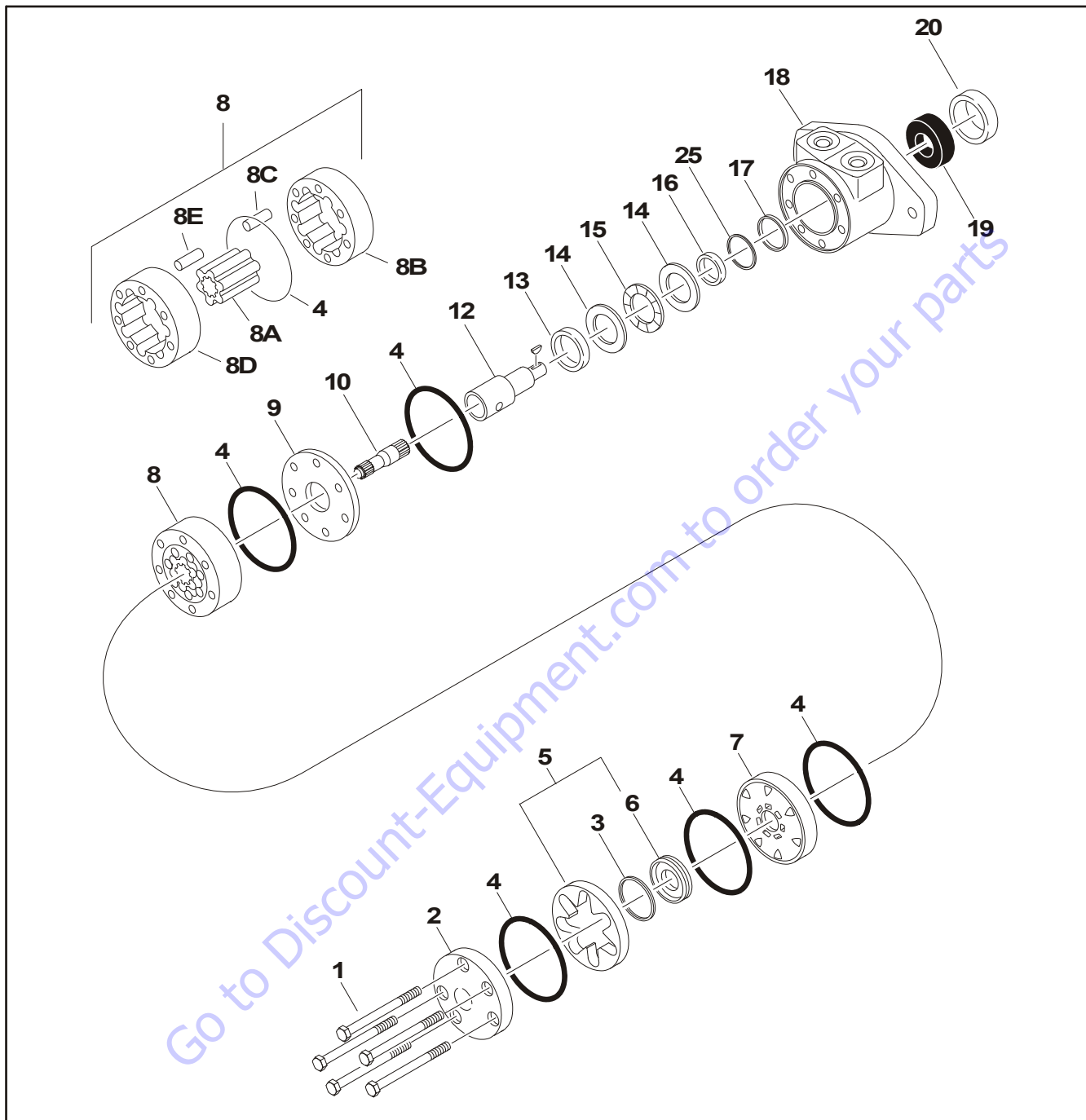
IF THE MOTOR IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

2. Scribe an alignment mark down and across the motor components from end cover (2) to housing (18) to facilitate reassembly orientation where required.



3. Remove the special ring head bolts (1) using an appropriate 1/2 or 9/16 inch size socket. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts.





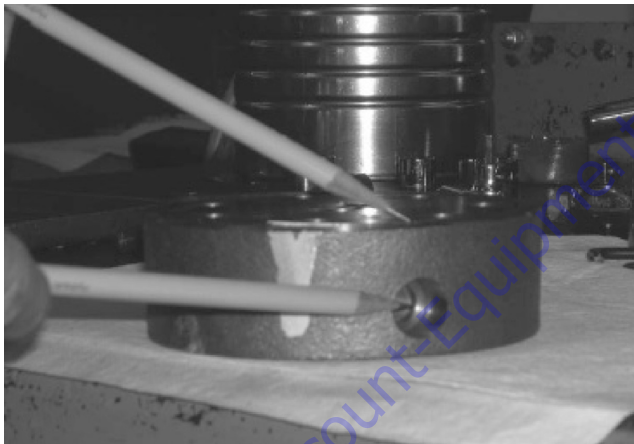
- | | | | | | |
|---------------|--------------------|--------------------|--------------------|-----------------------|-------------------|
| 1. Bolt | 6. Commutator Ring | 8C. Stator Vane | 12. Coupling Shaft | 17. Backup Ring | 22. Not Used |
| 2. End Cover | 7. Manifold | 8D. Stator Half | 13. Inner Bushing | 18. Housing | 23. Not Used |
| 3. Seal Ring | 8. Rotor Set | 9. Wear Plate | 14. Thrust Washer | 19. Outer Bushing | 24. Not Used |
| 4. Seal Ring | 8A. Rotor | 10. Drive Link | 15. Thrust Bearing | 20. Dirt & Water Seal | 25. Backup Washer |
| 5. Commutator | 8B. Stator Half | 11. Thrust Bearing | 16. Seal | 21. Not Used | |

Figure 3-32. Swing Motor - Exploded View

4. Remove end cover assembly (2) and seal ring (4). Discard seal ring.



5. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary.



NOTE: A polished pattern (not scratches) on the cover from rotation of the commutator (5) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, and rotor set.

6. Remove commutator ring (6). Inspect commutator ring for cracks, or burrs.



7. Remove commutator (5) and seal ring (3). Remove seal ring from commutator, using an air hose to blow air into ring groove until seal ring is lifted out and discard seal ring. Inspect commutator for cracks or burrs, wear, scoring, spalling or brinelling. If any of these conditions exist, replace commutator and commutator ring as a matched set.



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8. Remove manifold (7) and inspect for cracks surface scoring, brinelling or spalling. Replace manifold if any of these conditions exist. A polished pattern on the ground surface from commutator or rotor rotation is normal. Remove and discard the seal rings (4) that are on both sides of the manifold.



NOTE: The manifold is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to ensure that same surface is reassembled against the rotor set.

9. Remove rotor set (8) and wearplate (9), together to retain the rotor set in its assembled form, maintaining the same rotor vane to stator contact surfaces. The drive link (10) may come away from the coupling shaft (12) with the rotor set, and wearplate. You may have to shift the rotor set on the wearplate to work the drive link out of the rotor and wearplate. Inspect the rotor set in its assembled form for nicks, scoring, or spalling on any surface and for broken or worn splines. If the rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set. Inspect the

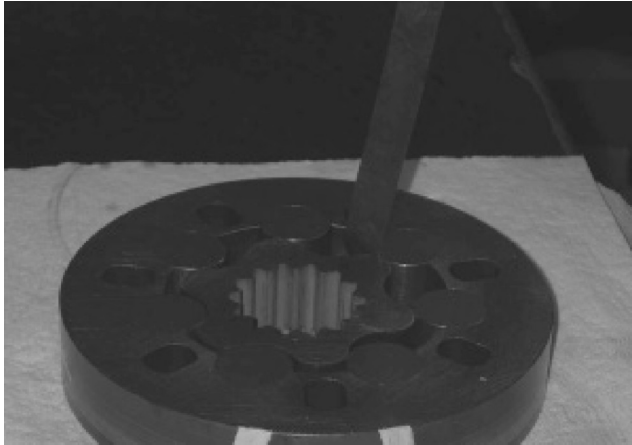
wearplate for cracks, brinelling, or scoring. Discard seal ring (4) that is between the rotor set and wearplate.



NOTE: The rotor set (8) components may become disassembled during service procedures. Marking the surface of the rotor and stator that is facing UP, with etching ink or grease pencil before removal will ensure correct reassembly of rotor into stator and rotor set into motor. Marking all rotor components and mating spline components for exact repositioning at assembly will ensure maximum wear life and performance of rotor set and motor.

NOTE: A polished pattern on the wear plate from rotor rotation is normal.

10. Place rotor set (8) and wear plate (9) on a flat surface and center rotor in stator such that two rotor lobes (180 degrees apart) and a roller vane centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is more than 0.005 inches (0.13 mm) of clearance, replace rotor set.

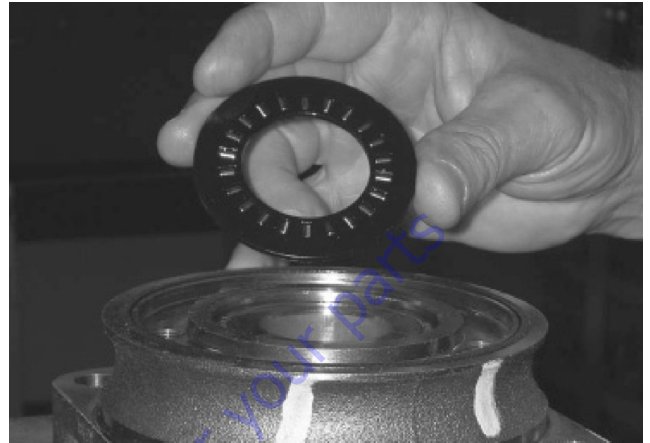


NOTE: If rotor set (8) has two stator halves and two sets of seven vanes as shown, check the rotor lobe to roller vane clearance at both ends of rotor.

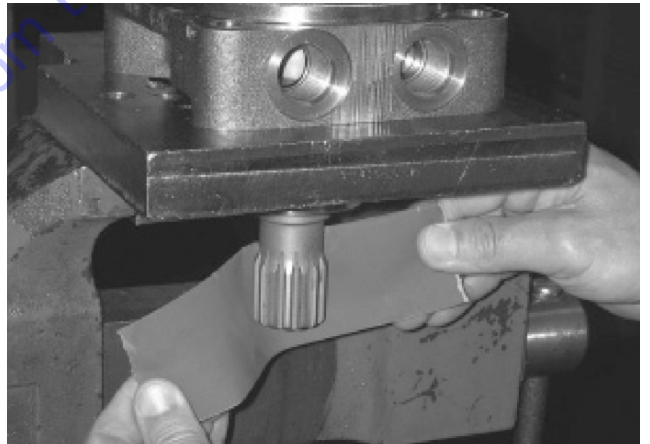
11. Remove drive link (10) from coupling shaft (12) if it was not removed with rotor set and wear plate. Inspect drive link for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. Remove and discard seal ring (4) from housing (18).



12. Remove thrust bearing (11) from top of coupling shaft (12). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.



13. Check exposed portion of coupling shaft (12) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the seal and bearing. Crocus cloth or fine emery paper may be used.



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14. Remove coupling shaft (12), by pushing on the output end of shaft. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. Inspect for damaged or worn internal and external splines or keyway. Replace coupling shaft if any of these conditions exist.



NOTE: Minor shaft wear in seal area is permissible. If wear exceeds 0.020 inches (0.51 mm) diametrically, replace coupling shaft.

NOTE: A slight "polish" is permissible in the shaft bearing areas. Anything more would require coupling shaft replacement.

15. Remove and discard seal ring (4) from housing (18).

16. Remove thrust bearing (15) and thrust washer (14). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.



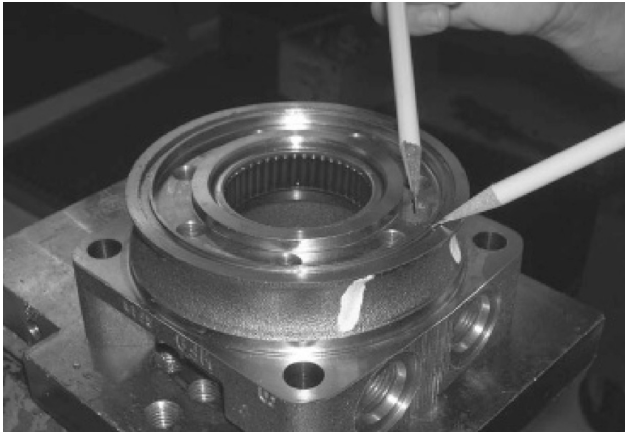
17. Remove seal (16) and back up ring (17) from housing (18) and backup washer (25). Discard both.



18. Remove housing (18) from vise, invert it and remove and discard seal (20). A blind hole bearing or seal puller is required.

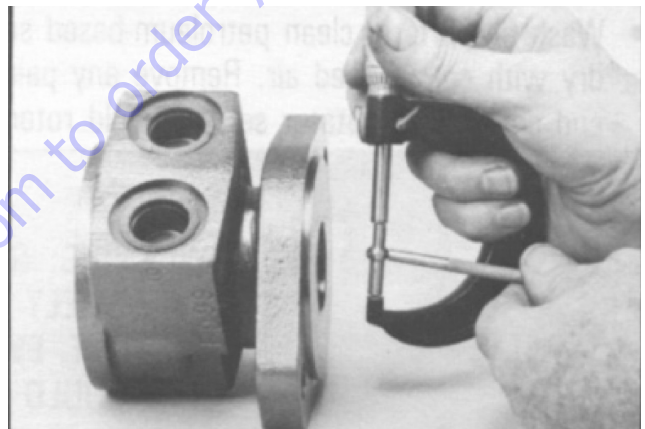


19. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly.



20. If the housing (18) assembly has passed inspection to this point, inspect the housing bearings/bushings (19) and (13) and if they are captured in the housing cavity the two thrust washers (14) and thrust bearing (15). The bearing rollers must be firmly retained in the bearing cages, but must rotate and orbit freely. All rollers and thrust washers must be free of brinelling and corrosion. The bushing (19) or (13) to coupling shaft diameter clearance must not exceed 0.010 inch (0.025 mm). A bearing, bushing, or thrust washer that does not pass inspection must be replaced. If the housing has passed

this inspection the disassembly of the motor is completed.



NOTE: The depth or location of bearing/bushing (13) in relation to the housing wear plate surface and the depth or location of bearing/bushing (19) in relation to the beginning of bearing/bushing counter bore should be measured and noted before removing the bearings/bushings. This will facilitate the correct reassembly of new bearings/bushings.



21. If the bearings, bushing or thrust washers must be replaced use a suitable size bearing puller to remove bearing/bushings (19) and (13) from housing (18) without damaging the housing. Remove thrust washers (14) and thrust bearing (15) if they were previously retained in the housing by bearing (13).



Assembly

Replace all seals and seal rings with new ones each time you reassemble the motor unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.

NOTE: Unless otherwise indicated, do not oil or grease parts before assembly.

Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces of the end cover, commutator set, manifold rotor set, wear plate and housing and from port and sealing areas.

⚠ WARNING

SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

⚠ WARNING

WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

1. If the housing (18) bearing components were removed for replacement, thoroughly coat and pack a new outer bearing/bushing (19) with clean corrosion resistant grease recommended in the material section. Press the new bearing/bushing into the counterbore at the mounting flange end of the housing, using the appropriate sized bearing mandrel as described which will control the bearing/ bushing depth.

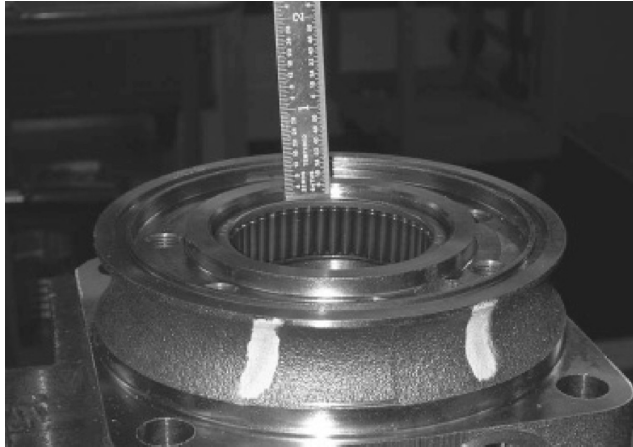
The housing requires the use of bearing mandrel to press bearing/ bushing (19) into the housing to a required depth of 0.151/0.161 inches (3.84/4.09 mm) from the end of the bearing counterbore.



NOTE: Bearing mandrel must be pressed against the lettered end of bearing shell. Take care that the housing bore is square with the press base and the bearing/ bushing is not cocked when pressing a bearing/ bushing into the housing.

⚠ CAUTION

IF A BEARING MANDREL IS NOT AVAILABLE AND ALTERNATE METHODS ARE USED TO PRESS IN BEARING/BUSHING (13) AND (19) THE BEARING/BUSHING DEPTHS SPECIFIED MUST BE ACHIEVED TO INSURE ADEQUATE BEARING SUPPORT AND CORRECT RELATIONSHIP TO ADJACENT COMPONENTS WHEN ASSEMBLED.



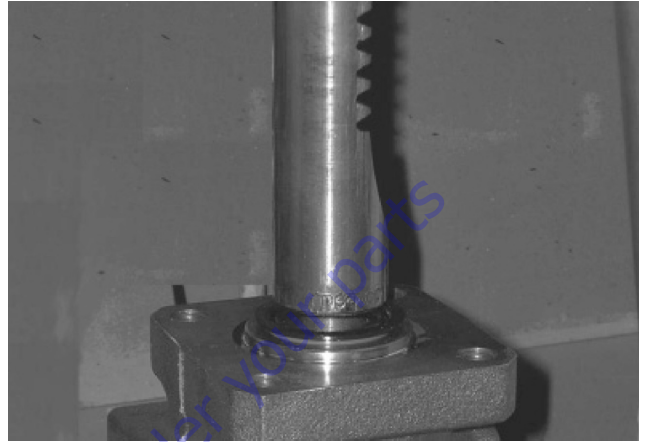
⚠ CAUTION

BECAUSE THE BEARING/BUSHINGS (13) AND (19) HAVE A PRESS FIT INTO THE HOUSING THEY MUST BE DISCARDED WHEN REMOVED. THEY MUST NOT BE REUSED.

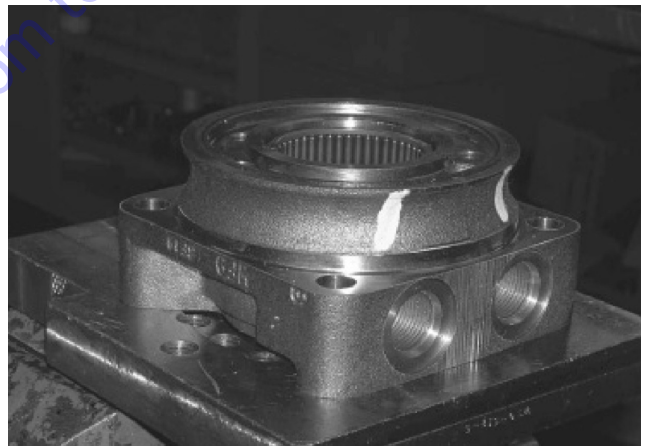
2. The inner housing bearing/bushing (13) can now be pressed into its counter-bore in housing (18) flush to 0.03 inch (0.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19).



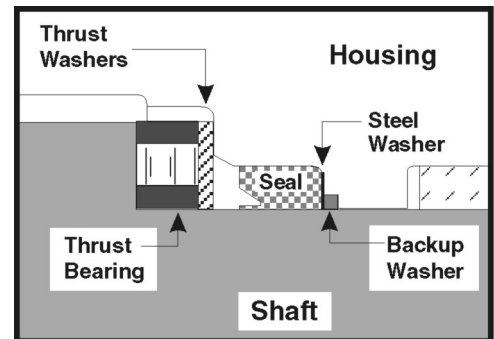
3. Press a new dirt and water seal (20) into the housing (18) outer bearing counterbore. The dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



4. Place housing (18) assembly into a soft jawed vise with the coupling shaft bore down, clamping against the mounting flange.



5. Assemble a new backup ring (17), new backup washer (25) and new seal (16) with the seal lip facing toward the inside of the motor, into their respective counterbores in housing (18).



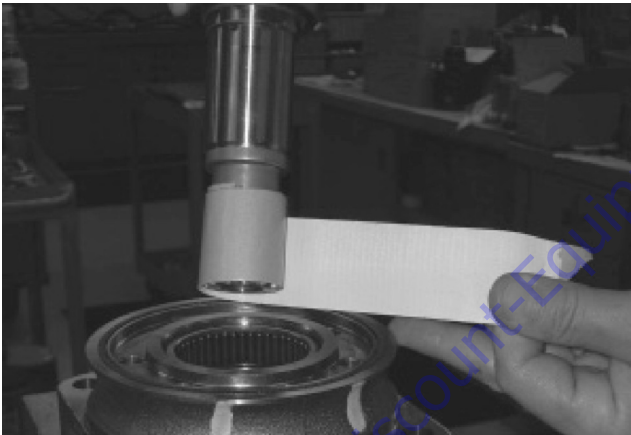
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6. Assemble thrust washer (14) then thrust bearing (15) that was removed from the motor.



NOTE: The motor requires one thrust washer (14) with thrust bearing (15). The coupling shaft will be seated directly against the thrust bearing.

7. Apply masking tape around splines or keyway on shaft (12) to prevent damage to seal.



8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12)

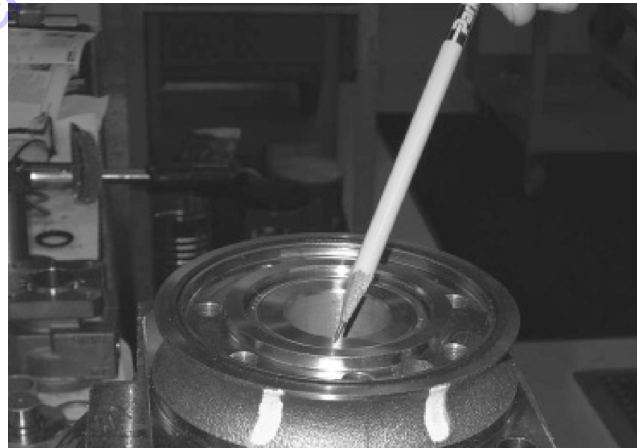
into housing (18), seating it against the thrust bearing (15).



CAUTION

THE OUTER BEARING (19) IS NOT LUBRICATED BY THE SYSTEM'S HYDRAULIC FLUID. BE SURE IT IS THOROUGHLY PACKED WITH THE RECOMMENDED GREASE.

NOTE: The coupling shaft (12) will be flush or just below the housing wear surface when properly seated while the coupling shaft (12). The coupling shaft must rotate smoothly on the thrust bearing package.



9. Apply a small amount of clean grease to a new seal ring (4) and insert it into the housing (18) seal ring groove.



NOTE: One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF 2A bolts as required that are over 0.5 inch (12.7 mm) longer than the bolts (1) used in the motor.

10. Install drive link (10) the long splined end down into the coupling shaft (12) and engage the drive link splines into mesh with the coupling shaft splines.

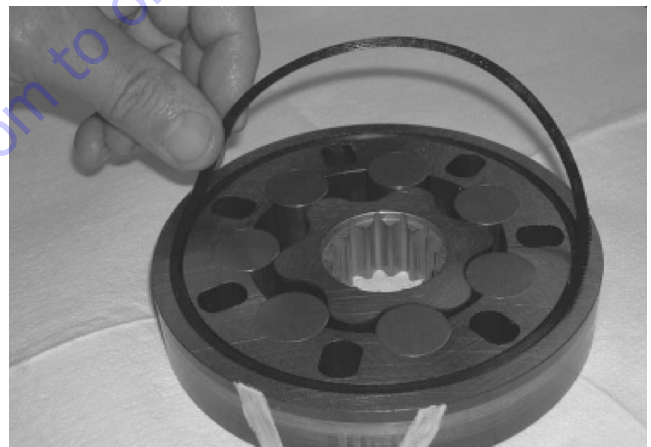


NOTE: Use any alignment marks put on the coupling shaft and drive link before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

11. Assemble wear plate (9) over the drive link (10) and alignment studs onto the housing (18).



12. Apply a small amount of clean grease to a new seal ring (4) and assemble it into the seal ring groove on the wear plate side of the rotor set stator.



13. Install the assembled rotor set (8) onto wear plate (9) with rotor counterbore and seal ring side down and the splines into mesh with the drive link splines.



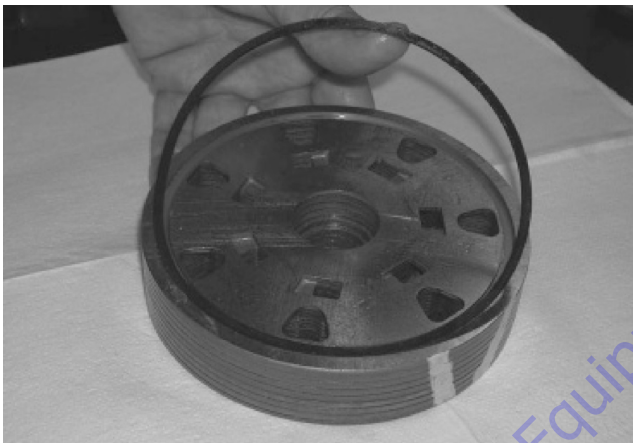
SECTION 3 - CHASSIS & TURNTABLE

NOTE: It may be necessary to turn one alignment stud out of the housing (18) temporarily to assemble rotor set (8) or manifold (7) over the drive link.

NOTE: If necessary, go to the appropriate, "Rotor Set Component Assembly Procedure."

NOTE: The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the rotor splines if apparent, to determine which side was down. The rotor set seal ring groove faces toward the wear plate (9).

14. Apply clean grease to a new seal ring (4) and assemble it in the seal ring groove in the rotor set contact side of manifold (7).



NOTE: The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left on the manifold by the rotor set is another indication of which surface must contact the rotor set.

15. Assemble the manifold (7) over the alignment studs and drive link (10) and onto the rotor set. Be sure the correct manifold surface is against the rotor set.



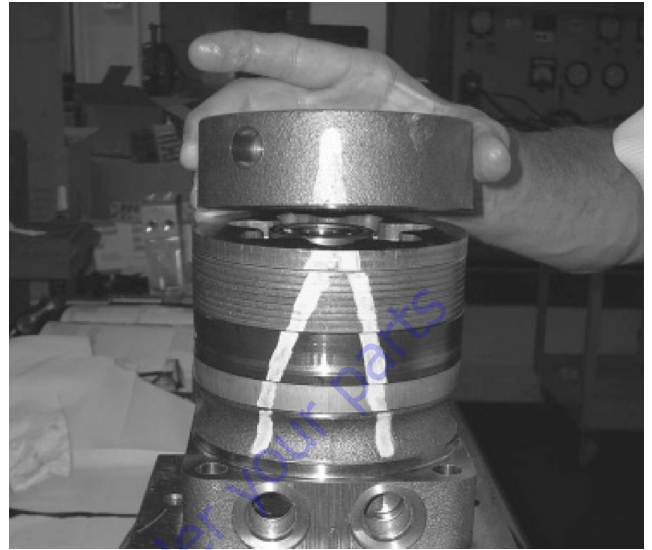
16. Apply grease to a new seal ring (4) and insert it in the seal ring groove exposed on the manifold.



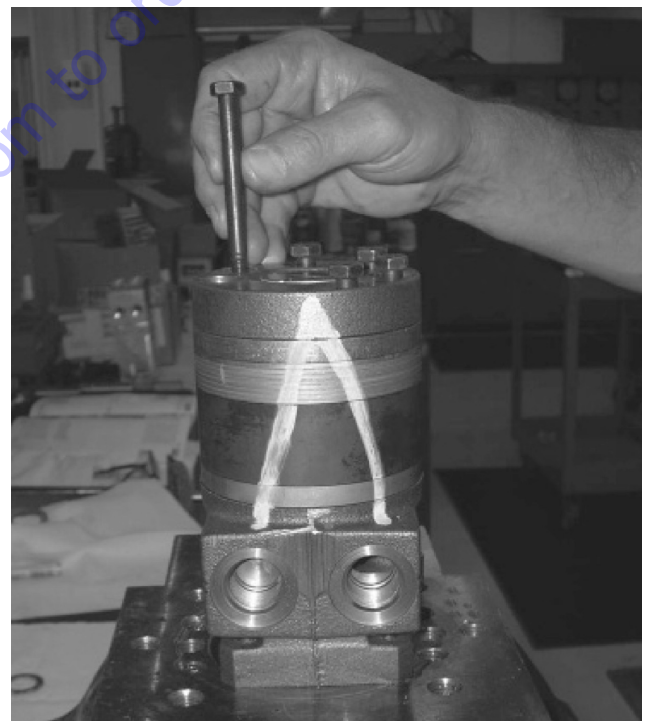
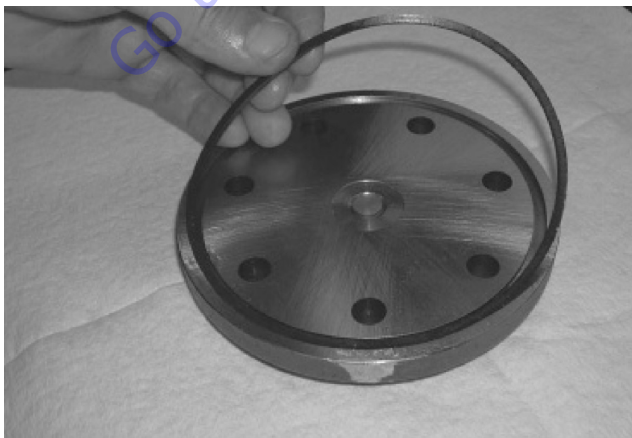
17. Assemble the commutator ring (6) over alignment studs onto the manifold.



18. Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.

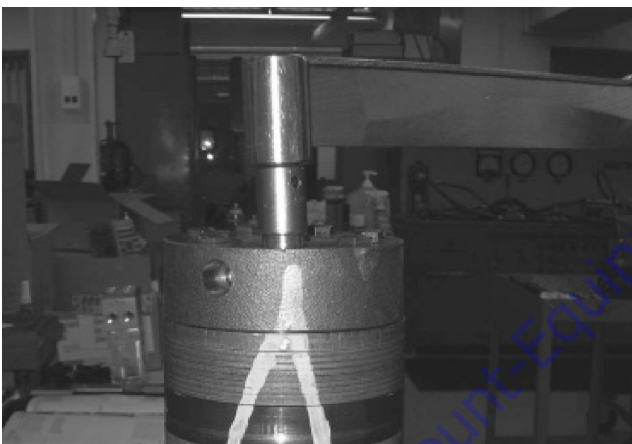
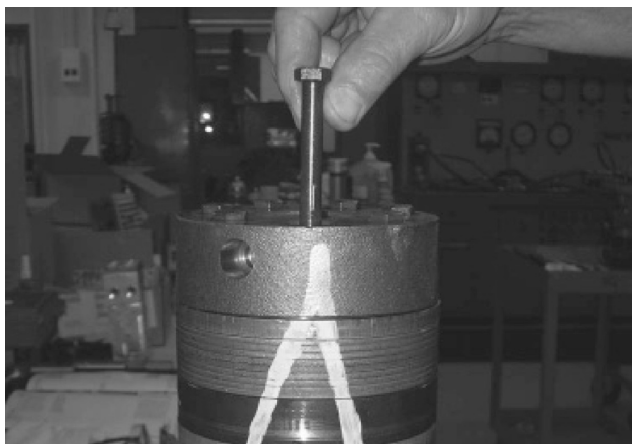


19. Assemble a new seal ring (4) into end cover (2) and assemble end cover over the alignment studs and onto the commutator set. If the end cover has only 5 bolt holes be sure the cover holes are aligned with the 5 threaded holes in housing (18). The correct 5 bolt end cover bolt hole relationship to housing port bosses is shown below.



NOTE: If the end cover has a valve (24) or has five bolt holes, use the line you previously scribed on the cover to radially align the end cover into its original position.

20. Assemble the bolts (1) and screw in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 25-30 ft. lbs. (34-41 N m).



One Piece Stator Construction

A disassembled rotor stator and vanes that cannot be readily assembled by hand can be assembled by the following procedures.

1. Place stator onto wear plate (9) with seal ring (4) side down, after following assembly procedures 1 through 13. Be sure the seal ring is in place.



2. If assembly alignment studs are not being utilized, align stator bolt holes with wear plate and housing bolt holes and turn two bolts (1) finger tight into bolt holes approximately 180 degrees apart to retain stator and wear plate stationary.

3. Assemble the rotor, counterbore down if applicable, into stator, and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.



4. Assemble six vanes, or as many vanes that will readily assemble into the stator vane pockets.



⚠ CAUTION

EXCESSIVE FORCE USED TO PUSH THE ROTOR VANES INTO PLACE COULD SHEAR OFF THE COATING APPLIED TO THE STATOR VANE POCKETS.

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes into stator, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.



6. Remove the two assembled bolts (1) if used to retain stator and wear plate.

Go to assembly procedure #15, to continue assembly.

Two Piece Stator Construction

A disassembled rotor set (8) that cannot be readily assembled by hand and has a two piece stator can be assembled by the following procedures.

1. Place stator half onto wear plate (9) with seal ring (4) side down, after following motor assembly procedures 1 through 13. Be sure the seal ring is in place.
2. Align stator bolt holes with wear plate and housing bolts and turn two alignment studs finger tight into bolt holes approximately 180 degrees apart to retain stator half and wear plate stationary.
3. Assemble rotor, counterbore down if applicable, into stator half, and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.

NOTE: Use any marking you applied to rotor set components to reassemble the components in their original relationship to ensure ultimate wear life and performance.

4. Assemble six vanes, or as many vanes that will readily assemble into the stator vane pockets.

⚠ CAUTION

EXCESSIVE FORCE USED TO PUSH THE ROTOR VANES INTO PLACE COULD SHEAR OFF THE COATING APPLIED TO THE STATOR VANE POCKETS.

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8C) into stator half, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.
6. Place second stator half on a flat surface with seal ring groove up. Apply a small amount of grease to a new seal ring (4) and assemble it into stator half ring groove.
7. Assemble the second stator half over the two alignment studs and rotor with seal ring side down onto the first stator half aligning any timing marks applied for this purpose.

⚠ CAUTION

IF THE STATOR HALF (8B) IS A DIFFERENT HEIGHT (THICKNESS) THAN STATOR HALF (8D) THE STATOR VANES (8C) OR (8E) OF THE SAME LENGTH (HEIGHT) AS THE STATOR HALF MUST BE REASSEMBLED IN THEIR RESPECTIVE STATOR HALF FOR THE ROTOR SET TO FUNCTION PROPERLY.

- Assemble six vanes, or as many vanes that will readily assemble into the stator vane pockets.
- Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes into stator, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

Go to assembly procedure #15, to continue assembly.

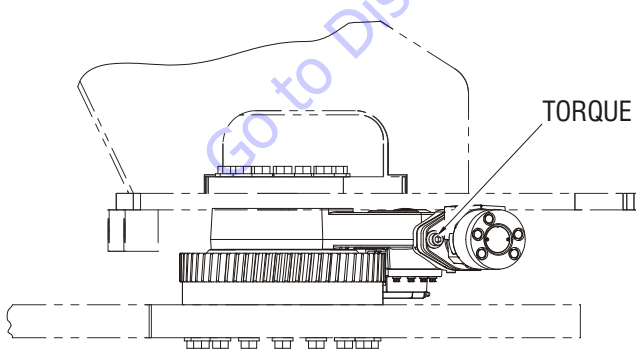
Final Checks

- Pressurize the motor with 100 p.s.i. dry air or nitrogen and submerge in solvent to check for external leaks.
- Check motor for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 N m)
- Pressure port with "A" cast under it on housing (18) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "B" cast under it is for counter clockwise coupling shaft rotation.
- Use test stand if available, to check operation of the motor.

Installation

Refer to Figure 3-31., Swing Motor Removal and Installation.

- Carefully insert the swing motor into the swing drive, making sure the swing motor shaft key is aligned correctly.
- Secure the swing motor to the swing drive assembly with the retaining bolts. Apply threadlocker JLG P/N 0100019 to the threads of the retaining bolts and torque to 85 ft.lbs. (115 Nm).



- Connect the hydraulic lines running to the swing motor as tagged during removal.
- Operate the swing function in both directions to ensure proper operation. Inspect the hose connections for any leakage.

3.11 SWING DRIVE

The swing drive assembly has five major components. They are the housing, worm, worm gear, output pinion and gear / pinion cap. The unit cannot be serviced while mounted on the machine.

Removal

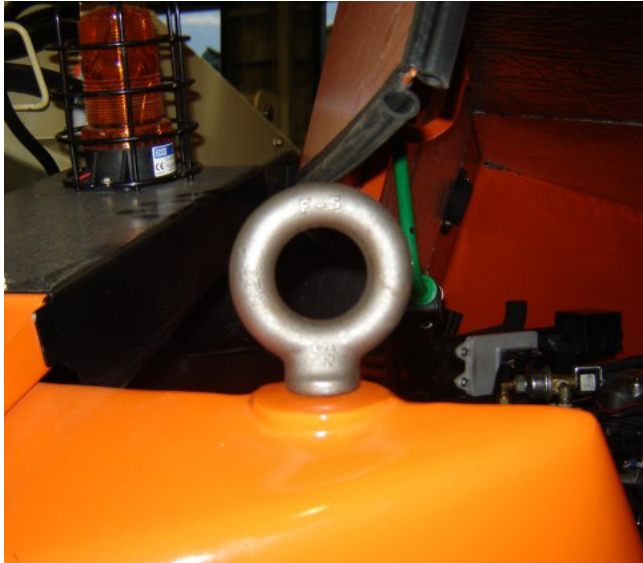
- Remove the hardware securing the battery cover and remove the battery cover.
- Disconnect the negative terminal on the battery.



NOTICE

MAKE SURE THE EYEBOLTS HAVE A RATED WORK LOAD SUFFICIENT TO HANDLE THE LOAD OF THE UPPERSTRUCTURE OF THE MACHINE. THE UPPERSTRUCTURE WEIGHS APPROXIMATELY 7,000 LBS. (3175 KG).

3. Install eyebolts as specified in Figure 3-33., Eyebolt for Counterweight in the counterweight.



4. Securely strap the booms together to prevent any movement during the lifting process.



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5. If equipped, remove the LP fuel tank on the side of the frame. It may also be desirable to remove the tank retaining brackets to gain additional clearance to work.



6. Remove the access covers on either side of the frame to gain entry to the flow divider valve.



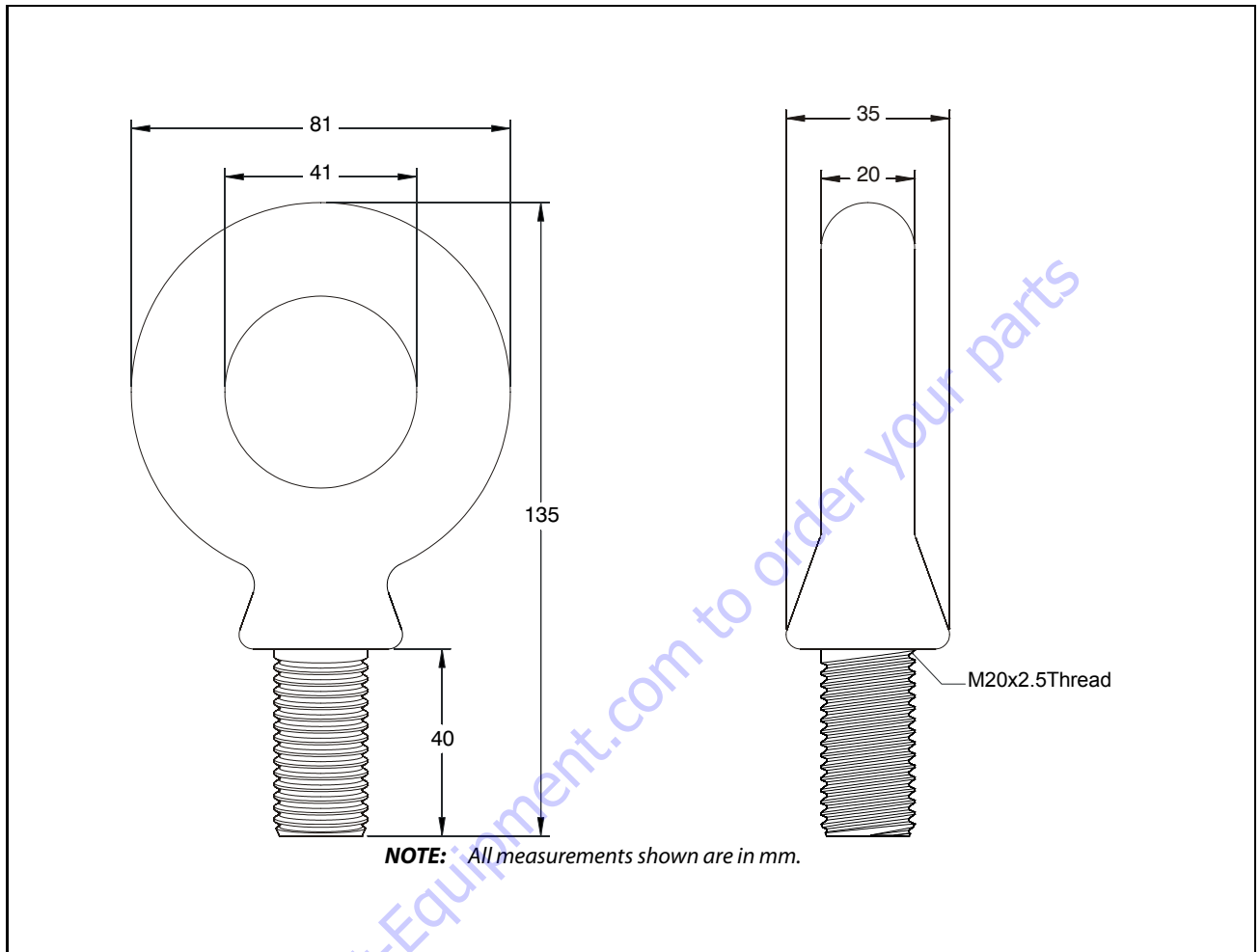
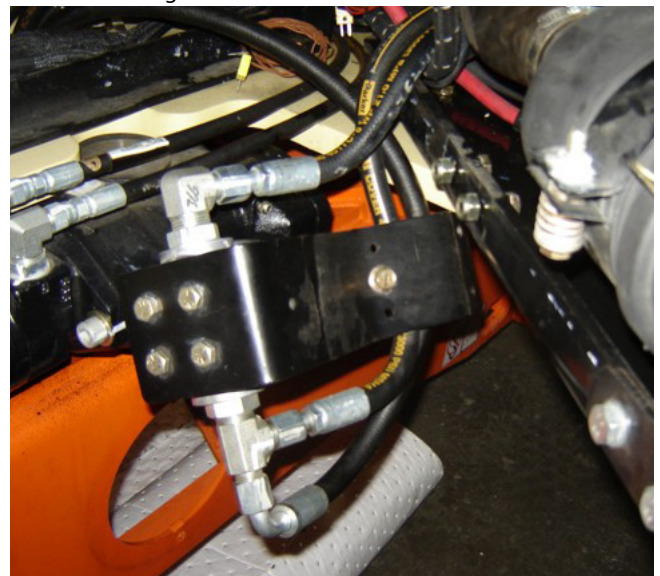


Figure 3-33. Eyebolt for Counterweight

7. Pull out the engine tray as far as it will go. Unbolt the charge filter bracket so it can be moved aside for more

working area.

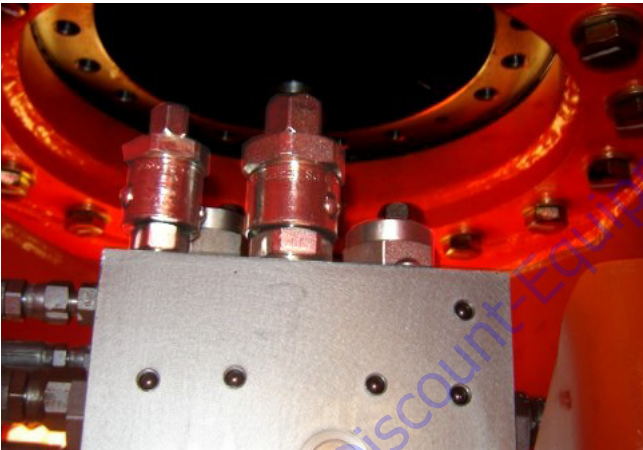


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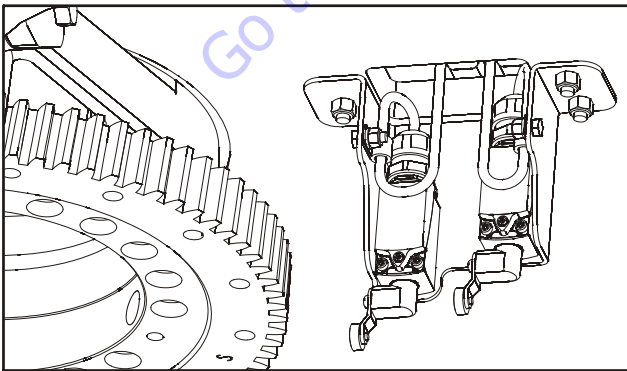
- Loosen and remove all but a few of the bolts securing the turntable to the swing bearing.



- Place a drain pan under the flow divider valve to catch any escaping hydraulic oil. Tag and disconnect the hoses from the flow divider valve that go up through the turntable. Cap or plug all openings so no dirt enters the system.

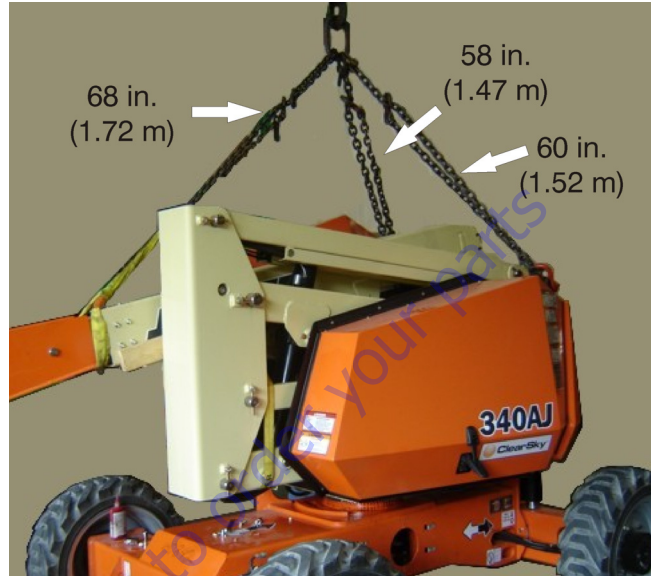


- Remove the drive orientation and lockout switches so they don't get broken during the removal procedure.



- Swing the engine tray back into position and secure it in place with the retaining bolt.

- Attach chains and slings to support the upperstructure. Begin with the chain at the approximate lengths as shown below and adjust as necessary to maintain the turntable in a level position during lifting.



- Remove the remaining turntable bolts that were left in place earlier in the procedure.

- Lift the turntable off of the bearing and place it out of the way on adequate blocking.





15. Remove the bolts securing the bearing to the frame. It may be necessary to disconnect more hoses on the flow divider valve. If so, tag and disconnect all hoses and cap or plug all openings to prevent dirt from entering the hydraulic system.

NOTE: The swing bearing assembly weighs approximately 125 lbs. (56.6 kg).

16. Remove the bearing assembly from the frame.

Installation

NOTE: The swing bearing assembly weighs approximately 125 lbs. (56.6 kg).

1. Using an adequate lifting device, place the bearing assembly onto the frame.
2. Install the bearing in the position shown in Figure 3-36., Bearing Placement. Coat the bearing bolts with JLG Threadlocker P/N 0100019 and secure the bearing assembly to the frame with the bolts. Following the torque sequence diagram in Figure 3-37., Swing Bearing Torque Sequence, tighten the bolts to an initial torque of 95 ft.lbs. (130 Nm). Next, following the same sequence, tighten to a final torque of 133 ft.lbs. (180 Nm).
3. If any hydraulic hoses were disconnected to remove the swing bearing assembly, reconnect them as tagged during removal.

NOTE: The turntable assembly weighs approximately 7000 lbs. (3175 kg).

4. Using an adequate lifting device, lift the turntable assembly from the blocking it is resting on and lower it down onto the swing bearing assembly. Refer to the removal instructions for chain placement.

5. Install several bearing bolts snugly to secure the turntable's position on the swing bearing assembly, but do not torque them at this time and keep the lifting device in place to support the weight of the turntable.
6. Coat the bearing bolts with JLG Threadlocker P/N 0100019 and install the remaining bolts securing the turntable to the swing bearing. Tighten the bolts snugly but do not torque them at this time. Remove the bolts installed to secure the turntable's position and apply threadlocker to them. Reinstall them in the same manner as the other bolts.
7. Following the torque sequence diagram in Figure 3-37., Swing Bearing Torque Sequence, tighten the bolts to an initial torque of 95 ft.lbs. (130 Nm). Next, following the same sequence, tighten to a final torque of 133 ft.lbs. (180 Nm).
8. Install the drive orientation and lockout switches.
9. Route the hydraulic hoses down through the turntable and reconnect them as they were tagged during removal.
10. Secure the charge filter bracket.
11. Install the access covers on the side of the frame.
12. If removed, install the LP tank retaining brackets and LP fuel tank.
13. Remove the lifting device from the machine.
14. Remove any straps that had been on the boom to prevent movement of the boom sections.
15. Remove the eyebolts from the counterweight.
16. Connect the negative terminal on the battery.
17. Install the battery cover.
18. Push the engine tray back into place and secure it.
19. Start the machine and run it through several operating cycles. Swing the machine in both directions.
20. Check for any leaks and that all functions are operating properly. Top off the hydraulic oil level if necessary.

Turntable Bearing Mounting Bolt Condition Check

NOTE: This check is designed to replace the existing bearing bolt torque checks on JLG Lifts in service. This check must be performed after the first 50 hours of machine operation and every 600 hours of machine operation thereafter. If during this check any bolts are found to be missing or loose, replace missing or loose bolts with new bolts and torque to the value specified in the torque chart, after lubricating the bolt threads with loctite #271. After replacing and retorquing bolt or bolts recheck all existing bolts for looseness.

Check the frame to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to 70 degrees (full elevation).
2. At the positions indicated on the figure titled Swing Bearing Tolerance Boom Placement. Try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
3. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
4. Swing the turntable 90 degrees, and check some selected bolts at the new position.
5. Continue rotating the turntable at 90 degree intervals until a sampling of bolts have been checked in all quadrants.

Check the turntable to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to 70 degrees (full elevation).
2. At the positions indicated in the figure below, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

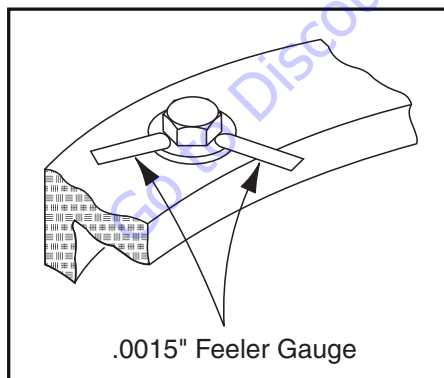


Figure 3-34. Swing Bearing Feeler Gauge Check

3. Lower the boom to horizontal and fully extend the boom.
4. At the position indicated on Figure 2-30. try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

Wear Tolerance

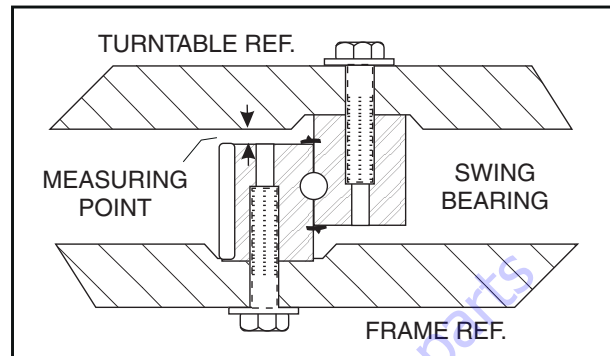


Figure 3-35. Swing Bearing Tolerance Measuring Point

1. With the boom positioned over the side of the machine, the Upper Boom horizontal with telescope fully extended and Mid/Lower Boom stowed, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable.
2. At the same point, with the boom positioned over the side of the machine, the Upper Boom fully elevated and the Mid/Lower Boom fully elevated, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable.
3. If a difference greater than 0.057 in. (1.40 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.057 in. (1.40 mm) is determined, and any of the following conditions exist, the bearing should be removed.
 - a. Metal particles in the grease.
 - b. Increased drive power.
 - c. Noise.
 - d. Rough rotation.
5. If bearing inspection shows no defects, reassemble bearing and return to service.

Swing Bearing Torque Value

Install bolts with JLG Threadlocker P/N 0100019; Torque to 133 ft.lbs. (180 Nm).

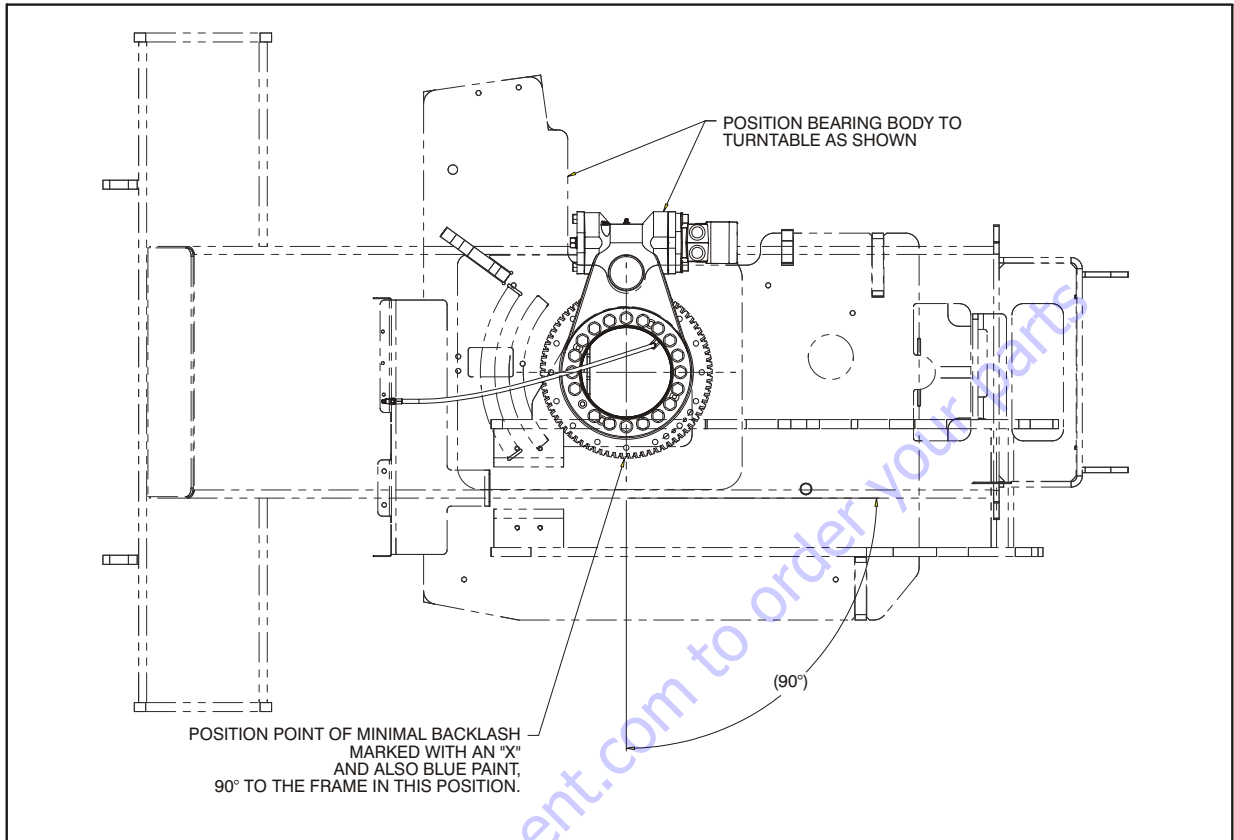


Figure 3-36. Bearing Placement

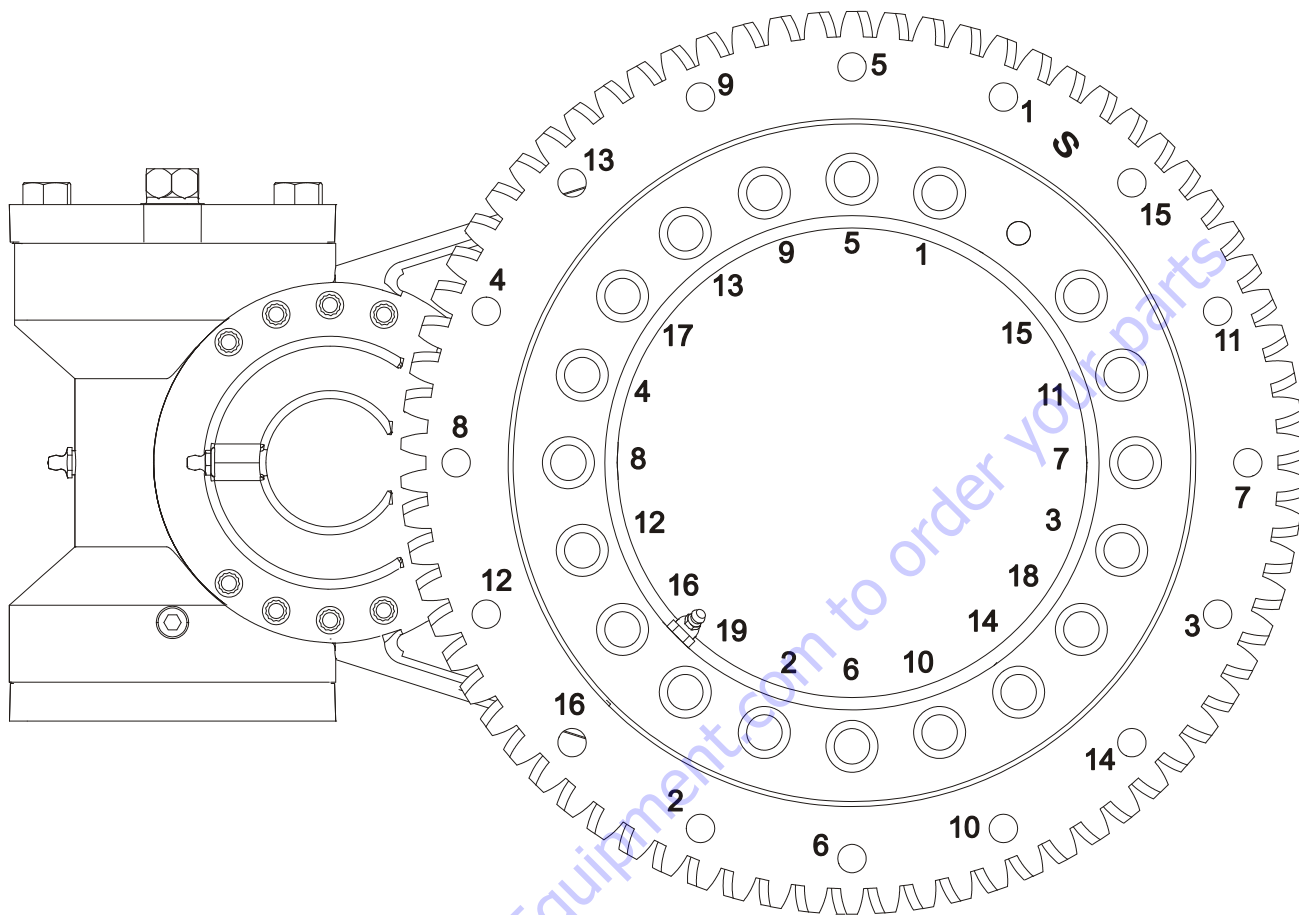


Figure 3-37. Swing Bearing Torque Sequence

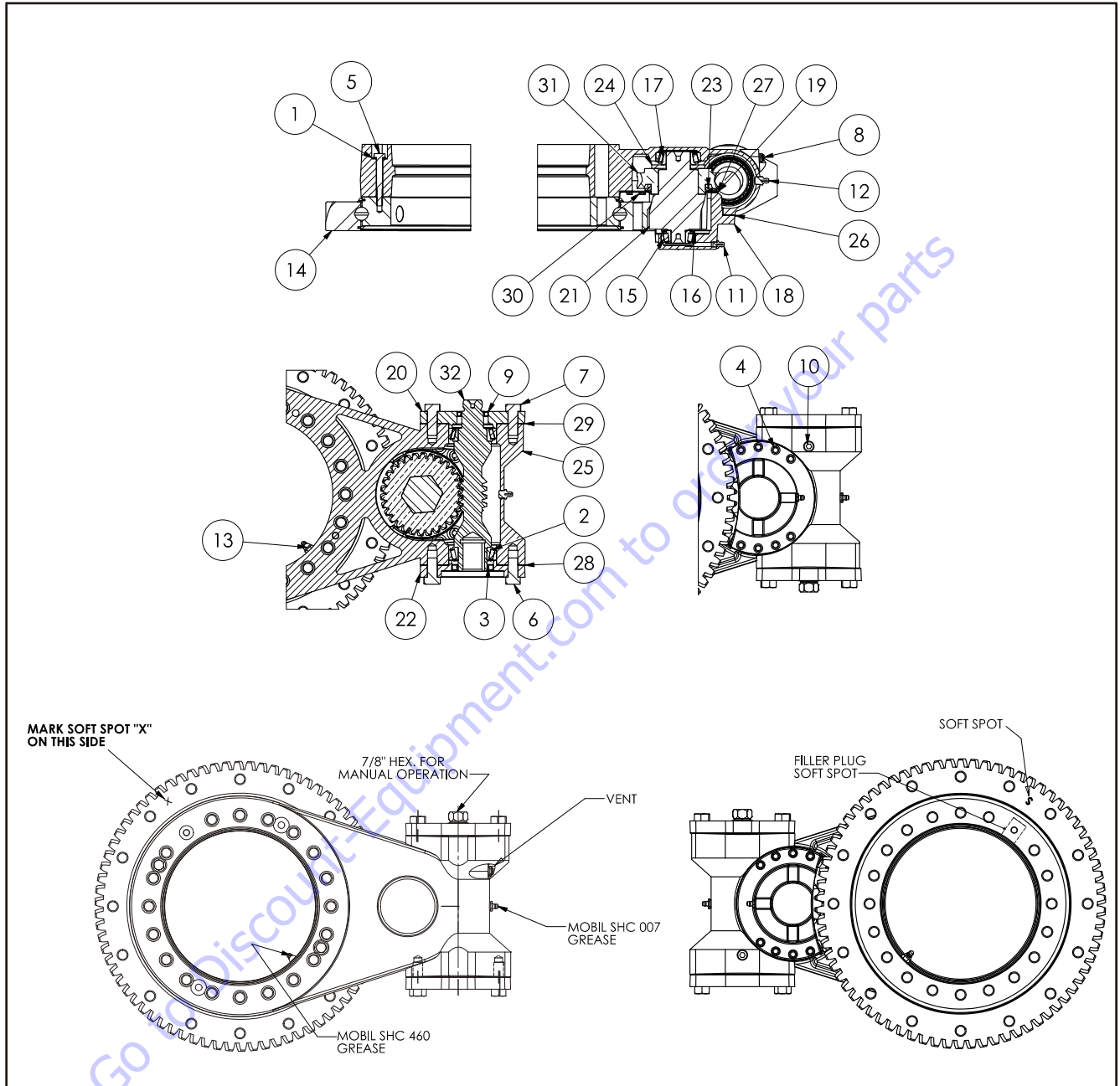
Disassembly

The servicing of these units requires a press, a 5/16" 12 point socket, a 7/16" socket, a 3/4" socket, torque wrench (80 lb-ft), steel hammer, soft face hammer, bearing puller (external and internal), large flat blade screw driver. Also needed are a shim and seal kit (available from the JLG Parts Department), 3/4" steel rod at least 10" long, LocTite #515, Mobil SHC 007 grease, Mobil SHC 460 grease, LocTite 242/243 for bolts, and any replacement parts.

1. Remove the swing bearing assembly from the machine.
2. To remove the slew ring (14), remove two 1/4" (5) bolts and washers (1) that hold the slew ring to the housing.
3. Remove four #6 machine screws (13) that are located on the cover plate (19) immediately in front of the Pinion (21).
4. Remove eight 5/16" 12 point cap screws (4) from gear/pinion cap (18). Pry cap from housing. Cover plate (19) will come off with cap. Note where sealant is on Cover

and plate so when assembling can put sealant in same place. Note number and color of shims (26) between cap and housing. Remove 6 small screws (13) from cover plate. Pry cover plate (19) from cap (18) and discard cover plate. Note number and color of shims between cover plate and cap.

5. Remove Pinion and Gear assembly (15, 16, 17, 21, 23, 24, and 31) from housing. These lift directly upward from the housing.
6. Disassemble pinion and gear assembly using a press. Support worm gear (31) on press with pinion (21) down allowing room for pinion to be pressed out of gear. Press pinion out of bearing (17) spacer (24) and worm gear (31) Pressing on end of pinion. Remove face seal (23) from face of worm gear (31). Note how the seal is assembled.



- | | | | | | |
|-------------|--------------------|--------------------|-------------------|----------------|---------------|
| 1. Washer | 7. Bolt | 13. Grease Fitting | 19. Cover Plate | 25. Housing | 31. Worm Gear |
| 2. Bearing | 8. Pressure Vent | 14. Slew Ring | 20. Worm Cap | 26. Cap Shim | 32. Worm |
| 3. Oil Seal | 9. Oil Seal | 15. Bearing | 21. Output Pinion | 27. Cover Shim | |
| 4. Capscrew | 10. Pipe Plug | 16. Grease Ring | 22. Motor Adapter | 28. Gasket | |
| 5. Bolt | 11. Grease Fitting | 17. Bearing | 23. Face Seal | 29. Gasket | |
| 6. Bolt | 12. Grease Fitting | 18. Gear Cap | 24. Washer Spacer | 30. Screw | |

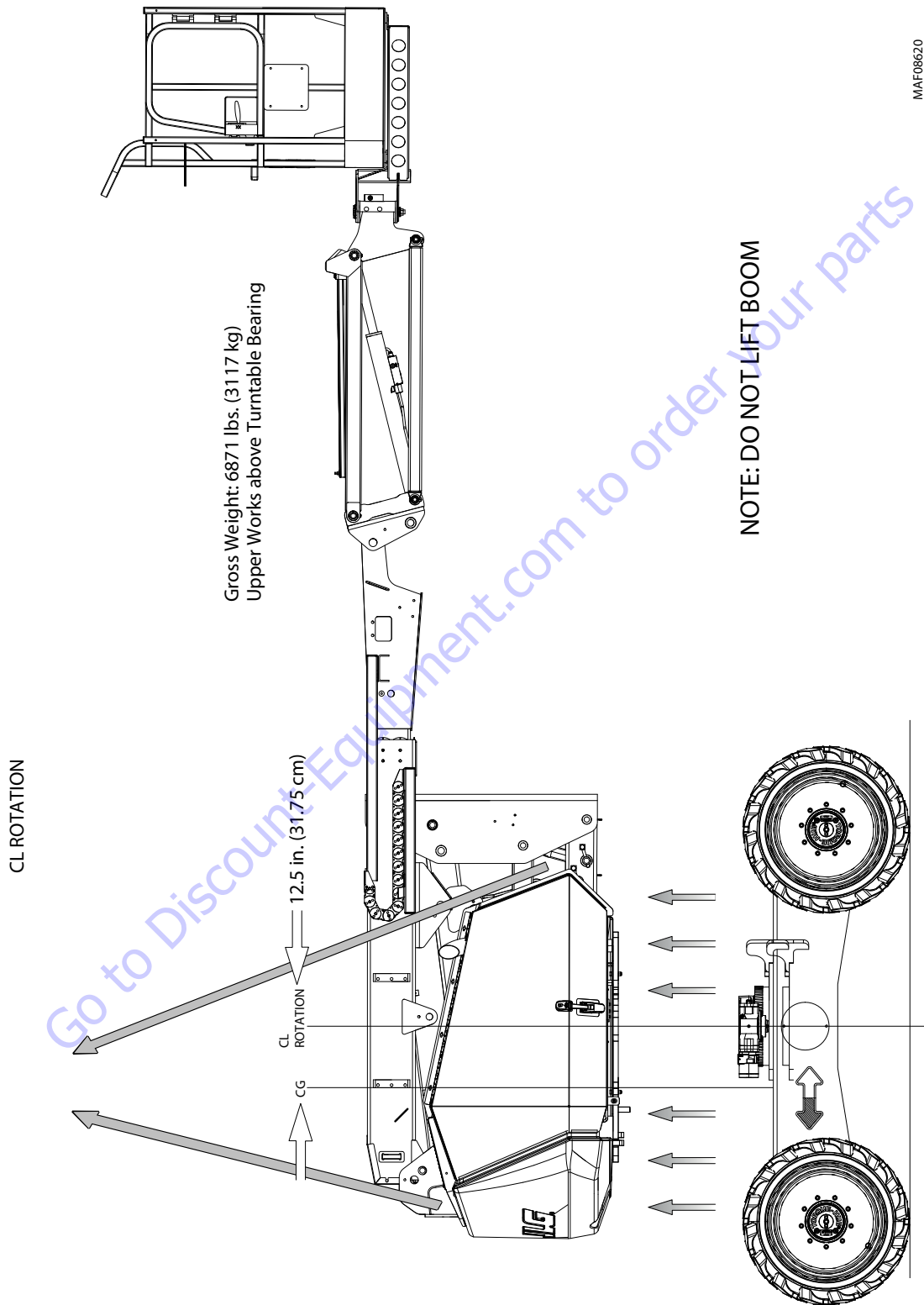
Figure 3-38. Swing Gear Assembly

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7. Remove bearing (15) and Nilos Ring (16) from pinion (21) using external bearing puller or press.
8. Remove motor and motor adapter (22) and shims (28).
9. Remove $\frac{3}{4}$ " bolts (7) from Worm Cap (20) using $\frac{3}{4}$ " socket. Remove shim (29) and seal (9) and discard.
10. Remove worm (32) from housing (25) by pushing worm from motor end using steel rod and hammer. Bearing cup (3) on hex end of worm will be forced out of housing. Once the bearing cup (2) has come out of housing use soft hammer to tap worm on hex end to remove other bearing cup (2) out the other end of housing.
11. Remove both bearings (2) from worm (32) from worm using external bearing puller or press.
12. Bearing cup (17) can be removed from housing (25) by lifting out (this is not a press fit just a close slip fit).
13. Bearing cup (15) can be removed from cap (18) using small pry bar. Or by welding a small bead of weld on internal diameter of cup, this is a press fit.
7. Install bearing (2) on bore end of worm (32) only. This is almost a slip fit, may have to be lightly tapped with soft hammer.
8. Install worm (32) into housing (25), hex end first.
9. On bore end of worm, install bearing cup (2) into worm bore of housing. Also on bore end of worm (32) install motor adapter (22) and 1 shim (28 yellow) to housing using $\frac{3}{4}$ -13 x 1" bolts (6) and sealant. Torque to 75 ft-lbs. (3.1 Nm) (these bolts will be replaced with motor bolts when motor is mounted).
10. Install bearing cone (2) on hex end of worm (32). Place bearing cup (2) over bearing and lightly tap cup into bore using soft hammer.
11. Install worm cap (20) using proper shims (29) to achieve 0.000 to 0.001" (0.0000 to 0.0254 mm) end play. Apply Loctite 242 to end of $\frac{3}{4}$ -13 x 1.25" grade 5 bolts (7) and Loctite #515 sealant to shims. Torque bolts to 75 ft-lbs. (3.1 Nm).
12. Place pinion/gear assembly into housing so gear teeth mesh with worm gear teeth. May have to turn worm or gear set by hand to achieve this.

Assembly

1. Press bearing cup (15) into cap (18).
2. Place bearing cup (17) into housing (25).
3. Put face seal (23) on to hub of worm gear (31) with flap of seal pointing away from gear.
4. Place worm gear (31) on press with face seal up and press pinion (21) into worm gear. Place Nilos Ring (16) on to pinion so that cup shape is up and press bearing (15) on to pinion tight to Nilos Ring.
5. Turn assembly over and place spacer (24) on pinion against gear hub so that large chamfer on I.D. of spacer is against Bronze gear. Press Bearing (17) on to pinion tight to spacer and gear.
6. Place pinion/gear assembly into housing. Place gear cap (18) and shims (26) over gear/pinion assembly to achieve a slight preload on pinion bearings. Remove cap and shims and set shims aside. Install new cover plate (19) on to cap using 6 screws (30) and shims (26) equal to or close to equal to total thickness of shims just set aside. Apply sealant (Loctite #515) to both sides of each of these shims and tighten screws take care not to twist these screws off. Clean extra sealant from surfaces of cover plate. Apply a small amount of grease to this flap. Set this assembly to the side.
13. Apply Loctite #515 to surfaces of housing where cap assembly will touch. This includes the vertical surfaces.
14. Place gear cap assembly and shims set aside in step 6, over pinion assembly.
15. Apply Loctite 242 to end of eight 5/16" 12 point screws (4) and torque to 20 ft-lbs. (0.84 Nm)
16. Install 4 small screws (30) through cover plate (18) and into housing (25) tighten screws take care not the twist these screws off.
17. Install seal (9) in worm cap at hex end of worm.
18. Install slew ring (14) using two 1/4" bolts (5) and washer (1). Adjust backlash with pinion to 0.008/0.012" (0.203/0.305 mm) and torque bolts to 10 ft-lbs. (0.42 Nm).
19. Fill unit with SHC 007 grease and grease pinion bearing (15) thru fitting (11) with Mobil SHC 460 grease.



NOTE: CG location may vary slightly depending on the exact configuration of the machine and the amount of fluids that are in tanks.

Figure 3-39. Swing Bearing Removal

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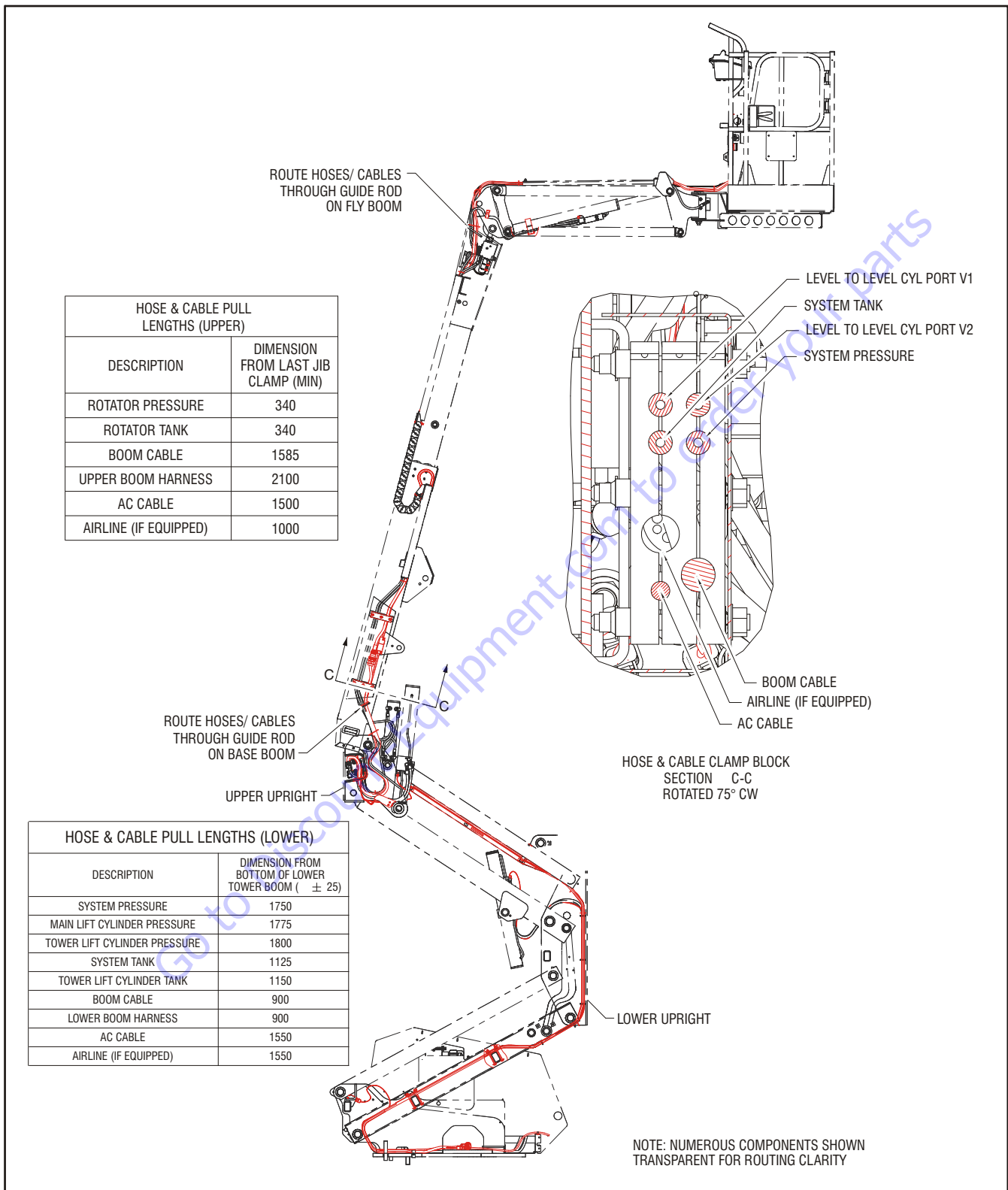


Figure 3-40. Cable Installation and Identification - Sheet 1 of 8

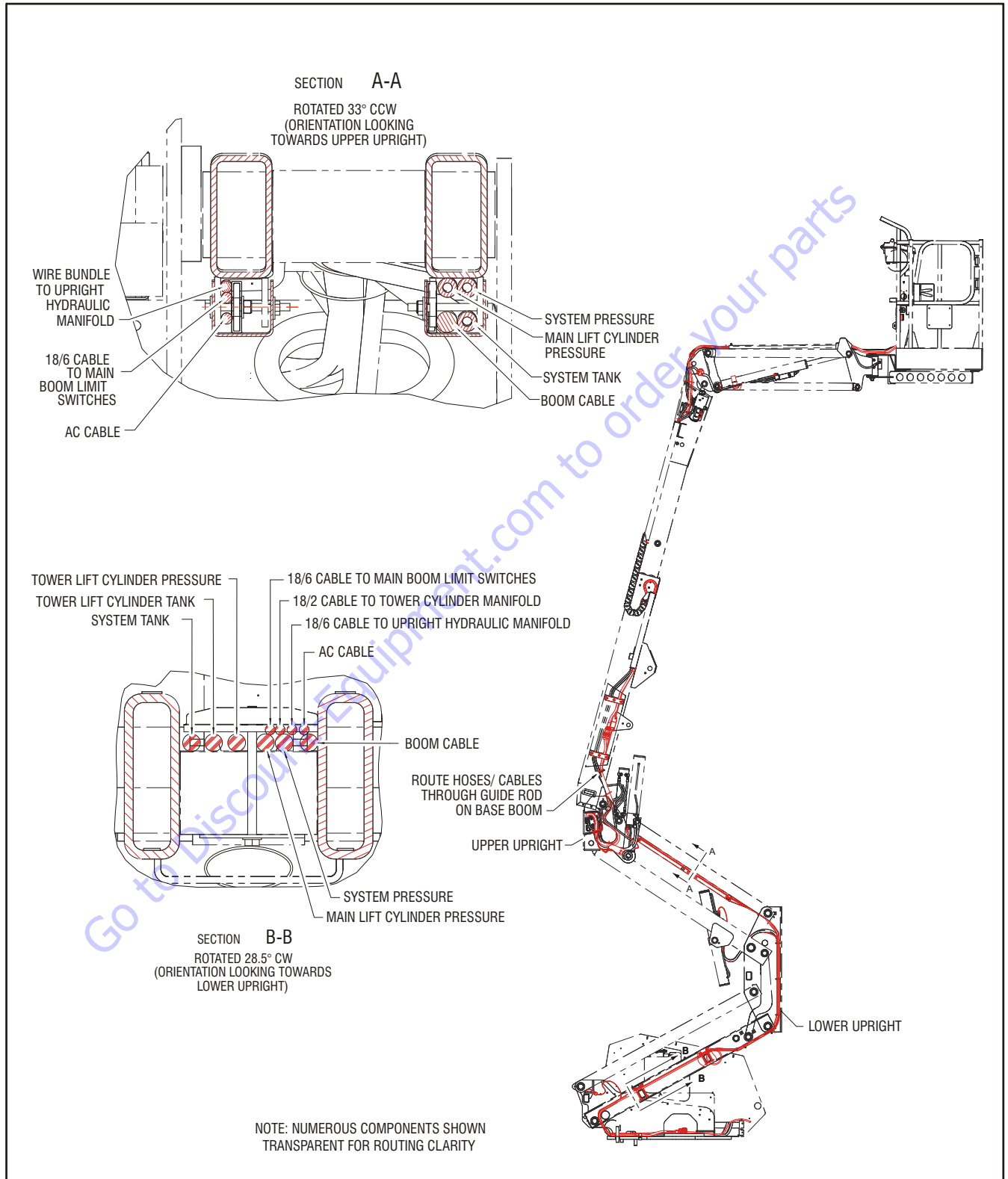


Figure 3-41. Cable Installation and Identification - Sheet 2 of 8

SECTION 3 - CHASSIS & TURNTABLE

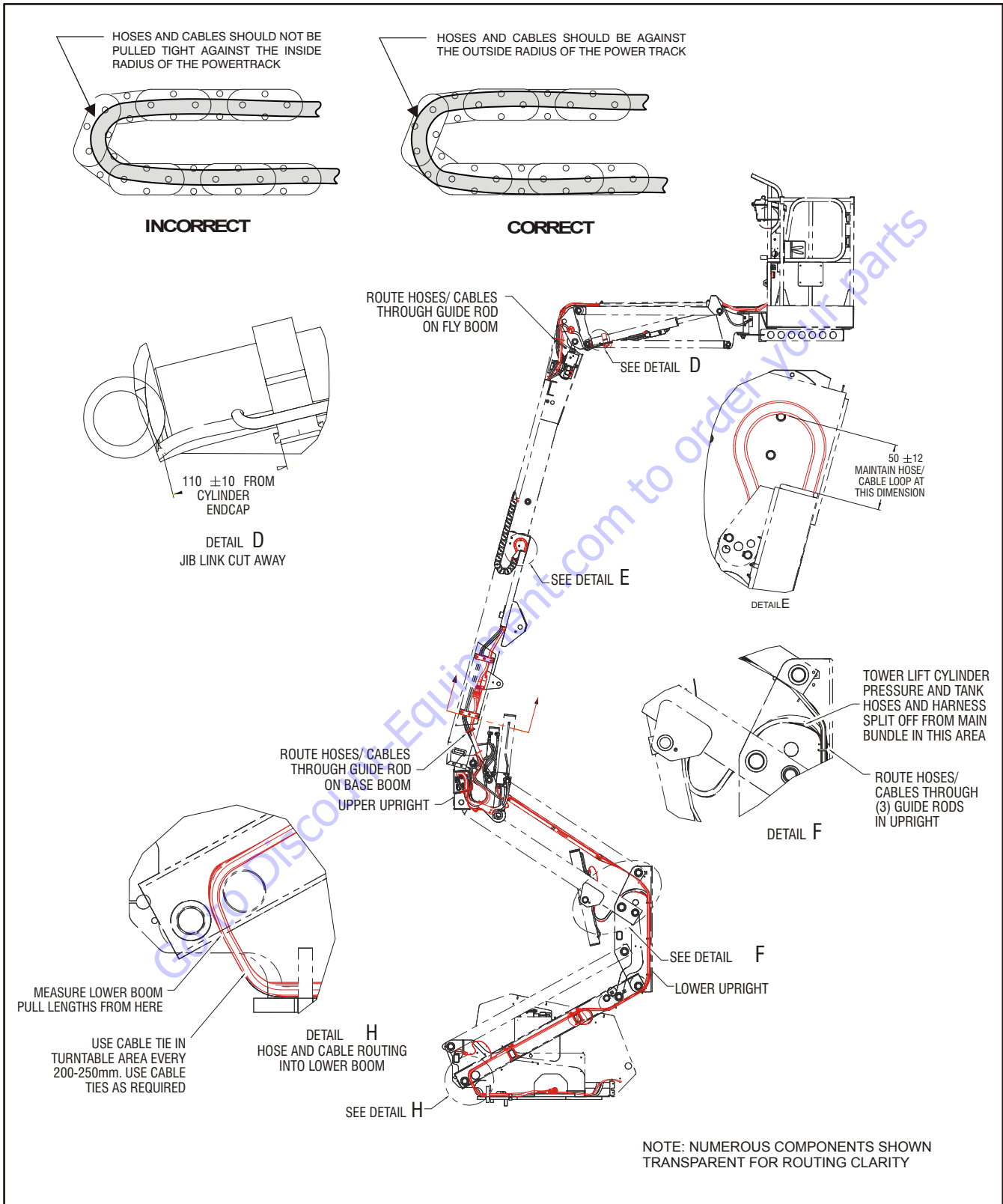


Figure 3-42. Cable Installation and Identification - Sheet 3 of 8

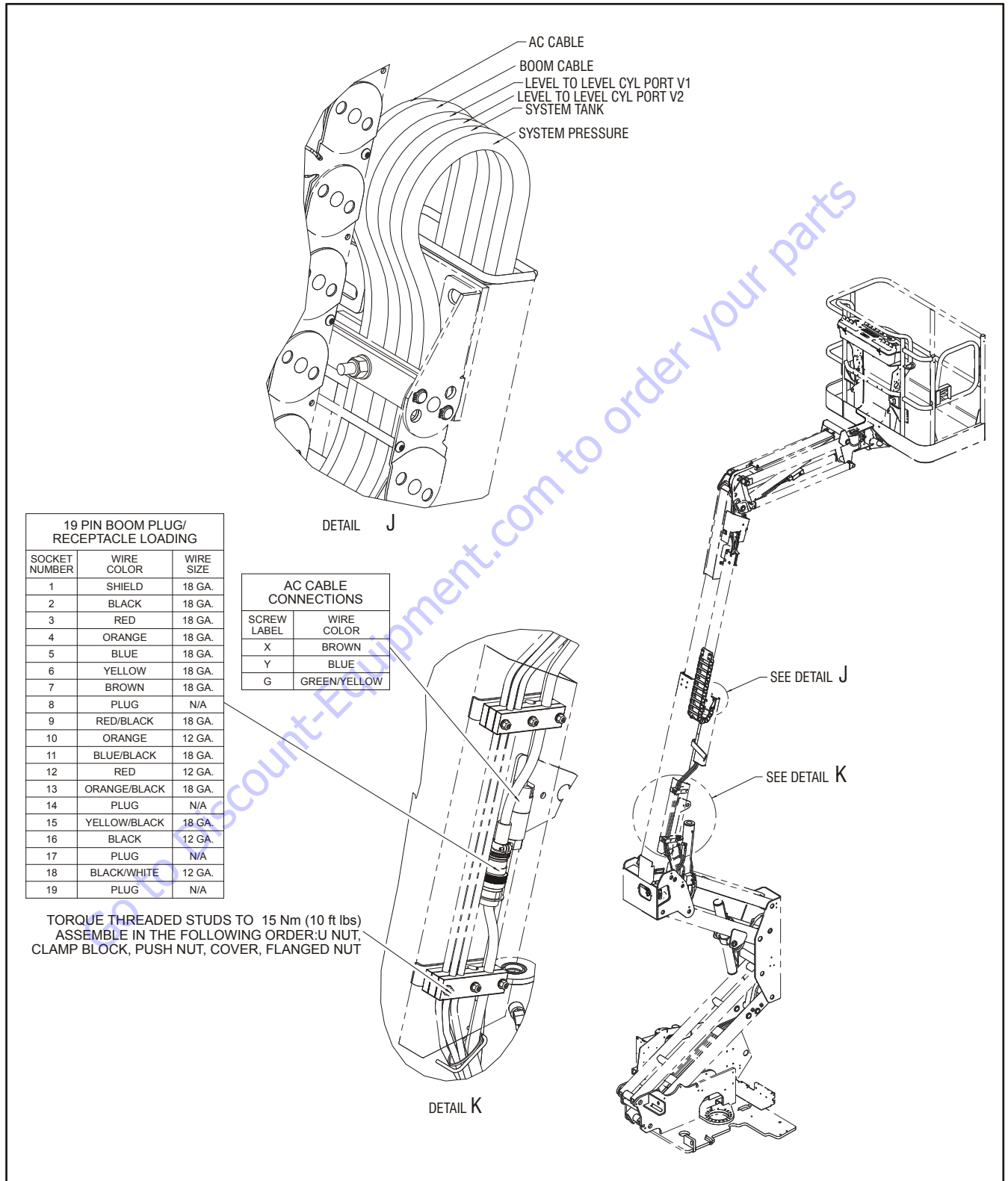


Figure 3-43. Cable Installation and Identification - Sheet 4 of 8

SECTION 3 - CHASSIS & TURNTABLE

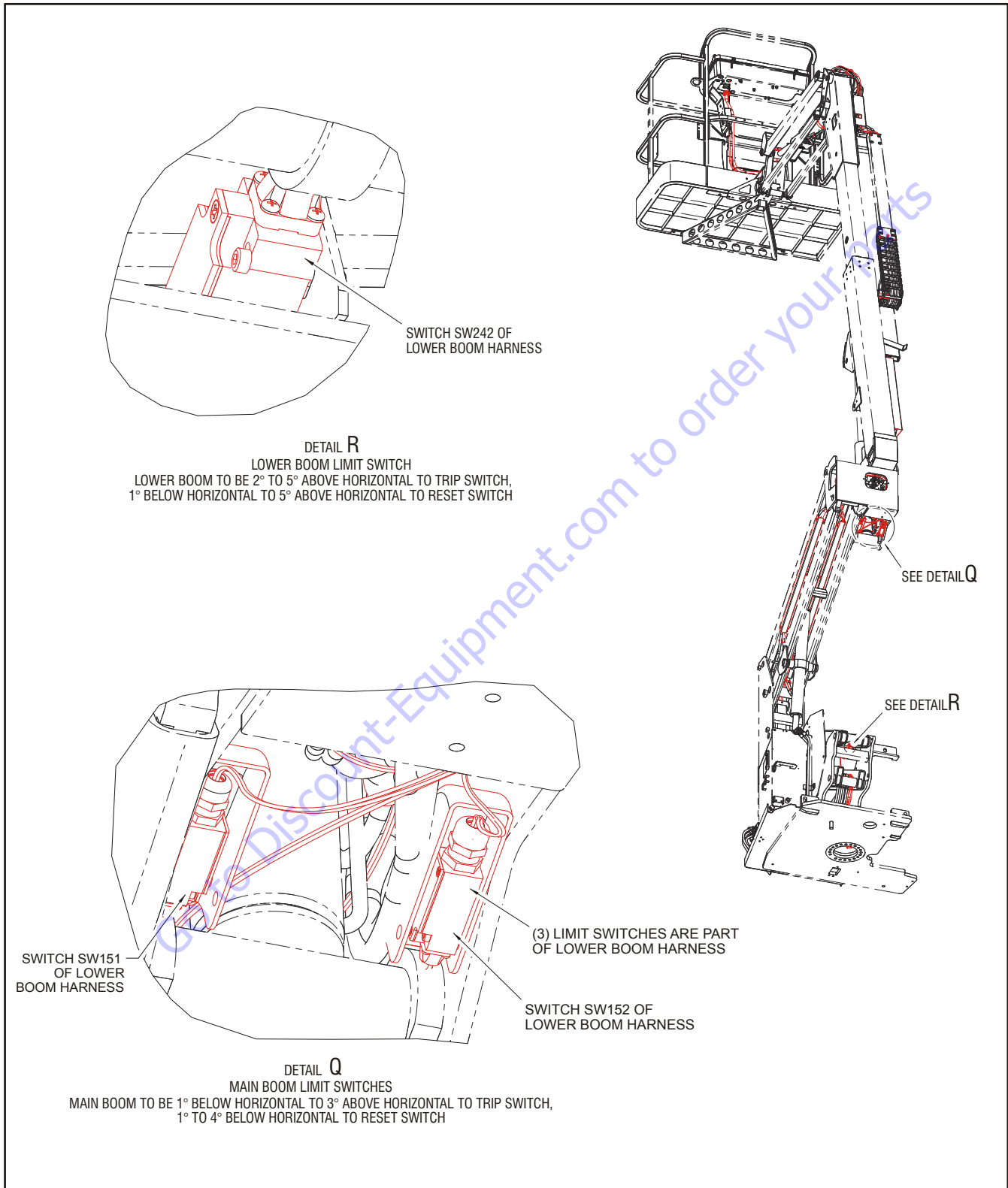


Figure 3-44. Cable Installation and Identification - Sheet 5 of 8

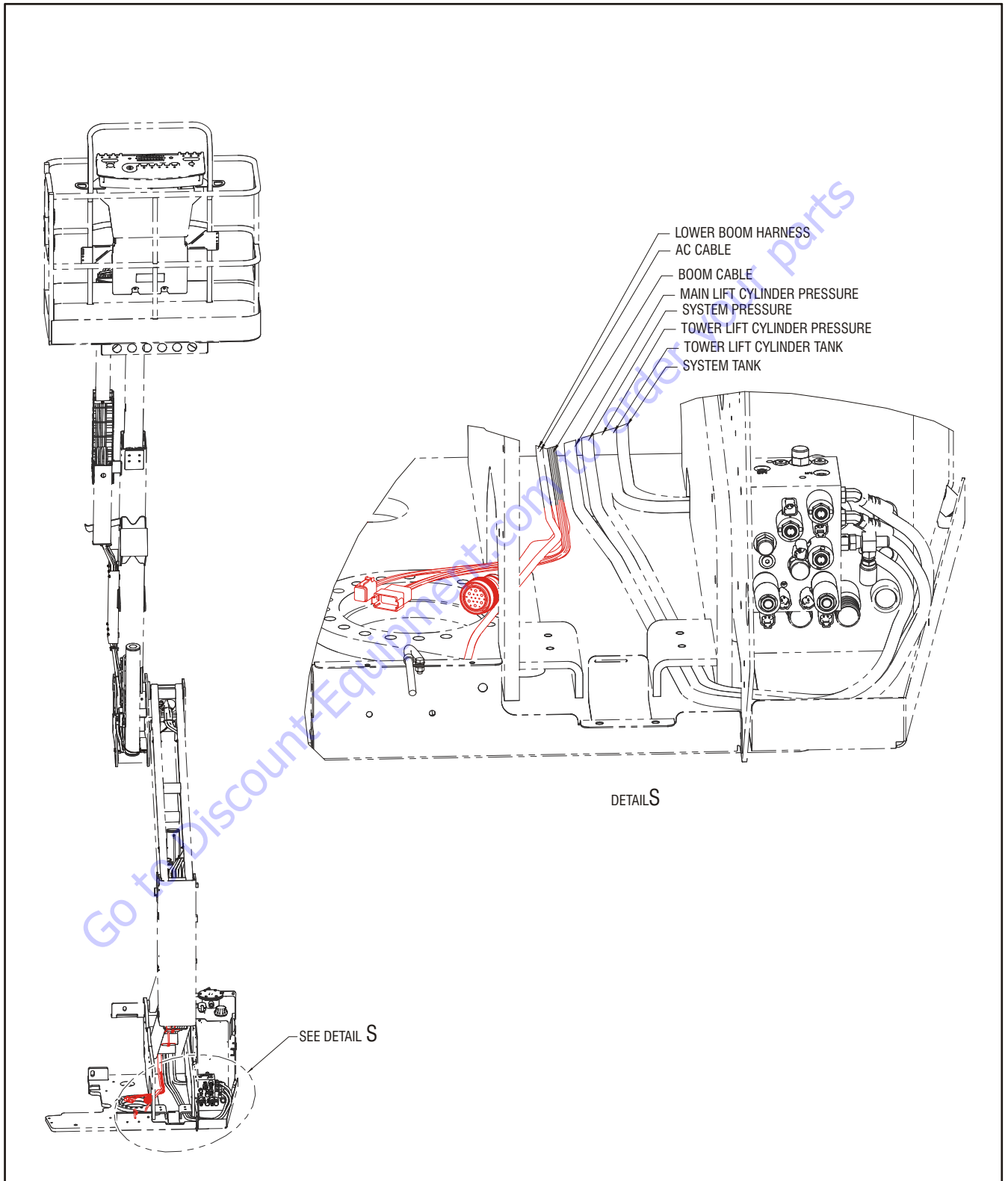


Figure 3-45. Cable Installation and Identification - Sheet 6 of 8

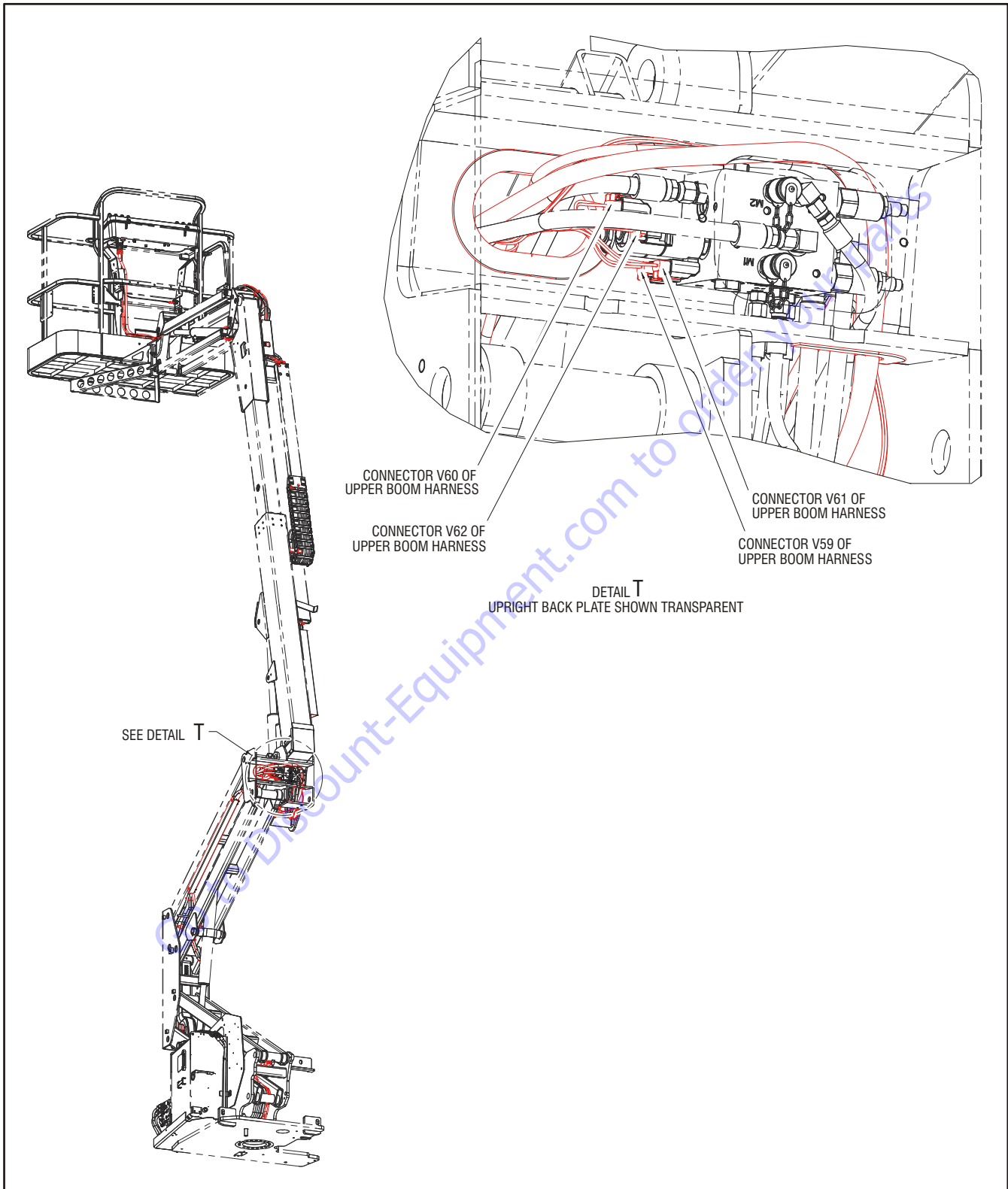


Figure 3-46. Cable Installation and Identification - Sheet 7 of 8

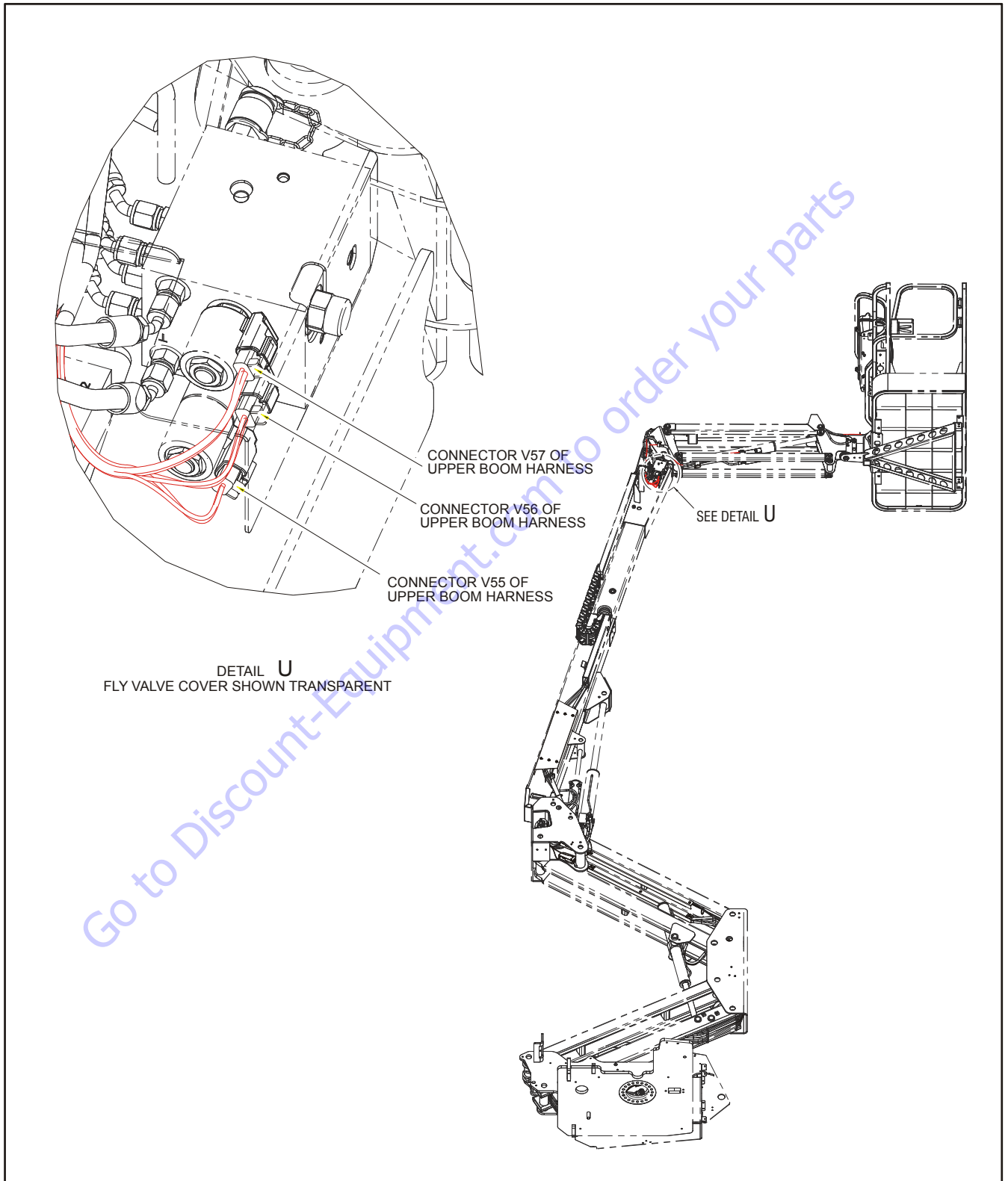


Figure 3-47. Cable Installation and Identification - Sheet 8 of 8

3.12 ENGINE OPERATING STATES

The Engine Operating State is determined by the Ground Module. There are four different Engine Operating States which include;

- Engine Stopped

- Engine Cranking
- Engine Starting
- Engine Running

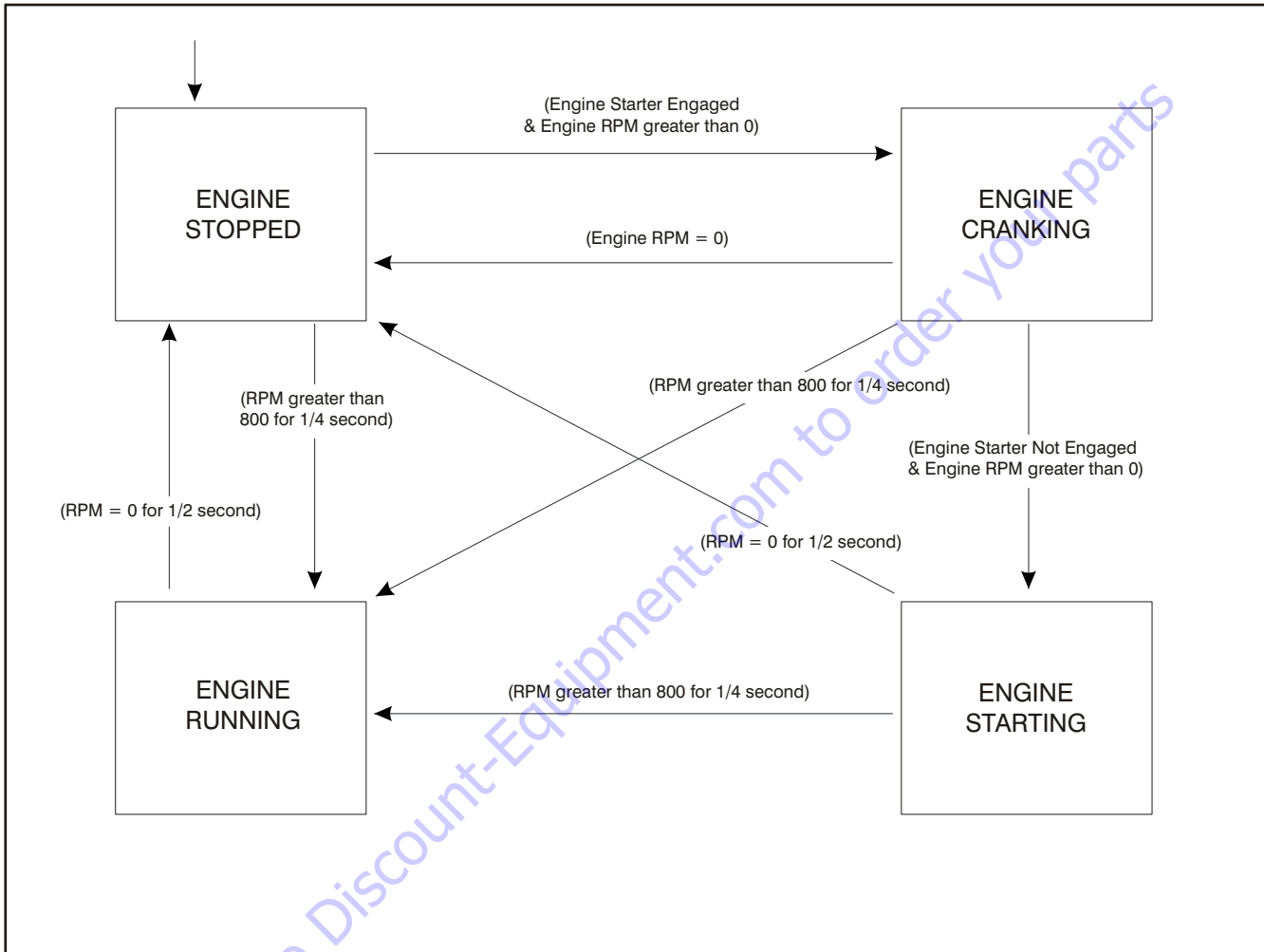


Figure 3-48. Engine Operating State Diagram

3.13 ENGINE START CONDITIONS

Engine starting is controlled by the Ground Module. The Ground Module will allow the starter to be engaged and keep the starter energized if all of the following conditions are satisfied.

1. The Start Switch is selected.
 - a. Ground Mode is active with Ground Module input J4-4 energized
or
 - b. Platform Mode is active with Platform Module input J1-14 energized.
2. The selected Operating Station must have all of its control switches in the neutral position since power up and remain in the neutral position prior to selecting the Start Switch.
3. If operating from the Platform Station, the footswitch must not be depressed (Ground Module J7-15 deenergized; Platform Module J7-8 energized) before selecting the Start Switch.
4. If operating from the platform, the Auxiliary Power Switch must not be selected before selecting the Start Switch.
5. If operating from the ground station, the Function Enable Switch must not be selected before selecting the Start Switch.
6. If the Engine Starter was disengaged because the Start Switch was released, more than 3 seconds must pass with the Start Switch in the released position.
7. If the Engine Starter has been cranking without the engine starting for the Engine Starter Engaged Time Limit, the control system deenergizes the Engine Starter for the Engine Restart Wait Period. The Start Switch must be in the deselected position after the Wait Period is over.

Table 3-4. Engine Starter Limits

Engine	Starter Engage Time Limit	Restart Attempt Wait Time
Kubota	20	10
GM	Indefinite	Indefinite

8. The engine must be in the Engine Stopped or Engine Cranking state.
9. The Engine Shutdown switch must not be activated.
10. The Start Switch has been in the deselected position after the Engine State changes to Engine Stopped from Engine Running or Engine Starting.

3.14 ENGINE RPM LEVELS

NOTE: The RPM levels are set in the Analyzer Personalities menu.

Table 3-5. Engine RPM Levels

Engine	Idle RPM	Mid Engine RPM	Multi-Function RPM	High Engine RPM
Kubota	1200	1800	2400	3000
GM	1200	1800	2400	3000

The engine operates at different RPM levels in order to properly operate the machine and the functions commanded by the operator. The following lists the possible RPM levels and the operating conditions that control them.

Engine Stop RPM

Engine Stop RPM is always zero (0) and occurs when the engine operating state is Engine Stopped or when the operator shuts down the engine.

Idle RPM

Idle RPM occurs when all of the following conditions exist;

1. The Engine State is Engine Running, Engine Cranking, or Engine Starting.
2. The operator is not shutting down the engine.
3. The control system is not commanding a higher engine RPM (Mid-Engine, Multi-function, or High Engine).
4. The control system is not calling for Generator RPM.

Mid Engine RPM

Mid Engine RPM occurs when all of the following conditions exist;

1. The Engine State is Engine Running.
2. The operator is not shutting down the engine.
3. The control system is not commanding a higher engine RPM (Multi-function or High Engine).
4. The control system is not calling for Generator RPM.
5. Platform mode is active with the controls enabled or Ground mode is active with any function enabled except for Lift Down, Tower Lift Down, or Jib Lift Down.

Multi-Function RPM

Multi-Function RPM occurs when all of the following conditions exist;

1. The Engine State is Engine Running.
2. The operator is not shutting down the engine.
3. High Engine RPM is not being commanded.
4. The control system is not calling for Generator RPM.
5. One of the following conditions exist;
 - a. Two of the following functions are being operated: Lift Up, Tower Lift Up, Swing.
 - b. Telescope is functioning at the same time as one of the following functions: Jib Lift Up, Platform Rotate, Platform Level.

High Engine RPM

High Engine RPM occurs when all of the following conditions exist;

1. The Engine State is Engine Running.
2. The operator is not shutting down the engine.
3. The control system is not calling for Generator RPM.
4. The operator is operating the Drive function at Max Torque or Max Speed.
5. Drive Forward or Drive Reverse is being operated.

Generator RPM

Generator RPM occurs when all of the following conditions exist;

1. The Engine State is Engine Running.
2. The operator is not shutting down the engine.
3. The Control System is configured for a generator.
4. The Platform Generator Switch is Enabled and Selected.

3.15 ENGINE CONTROLS

The Kubota and GM engines are both controlled electronically, but in different manners. The Kubota engine is controlled primarily by the JLG Control System and the GM engine is controlled primarily by its own Engine Control Unit (ECU). The following sections describe engine controls that are common to both engines.

Ambient Air Temperature Sensor

The ambient air temperature sensor is integrated within the Ground Module. The sensor provides temperature information the engine control system uses to set its fuel, spark, and air settings for engine starting in cold environments.

Fuel Level Sensor

The fuel level sensor is mounted in the fuel tank and consists of a float device guided by a rod. This rod provides a variable resistance to ground which is communicated to the ground module, which in turn, communicates the information to the operator by way of the fuel level indicator on the platform console and the low fuel indicator on the ground console.

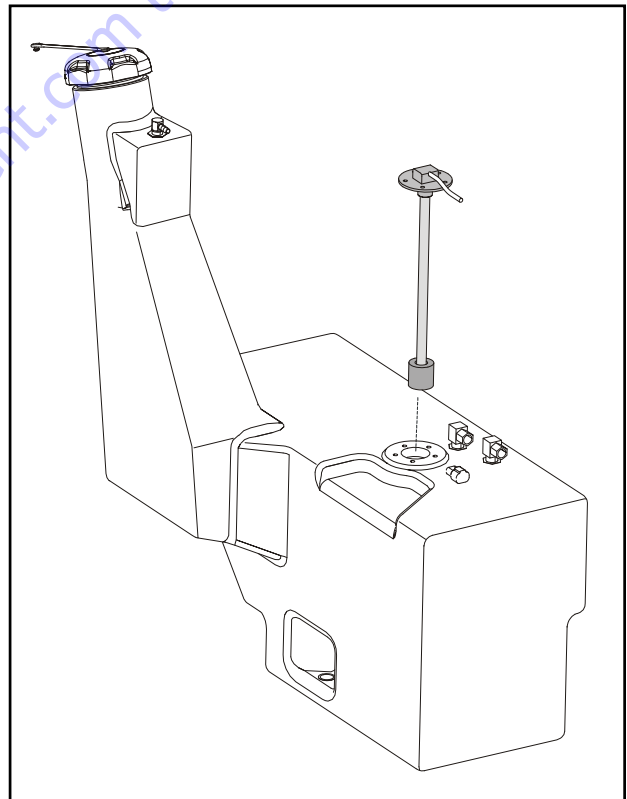


Figure 3-49. Fuel Level Sensor

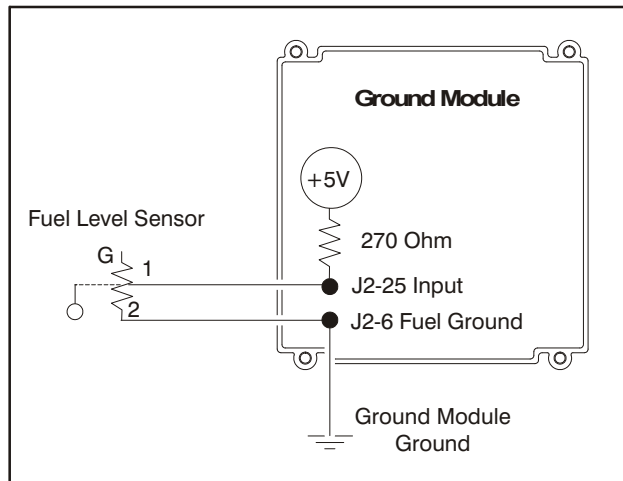


Figure 3-50. Fuel Level Sensor Schematic

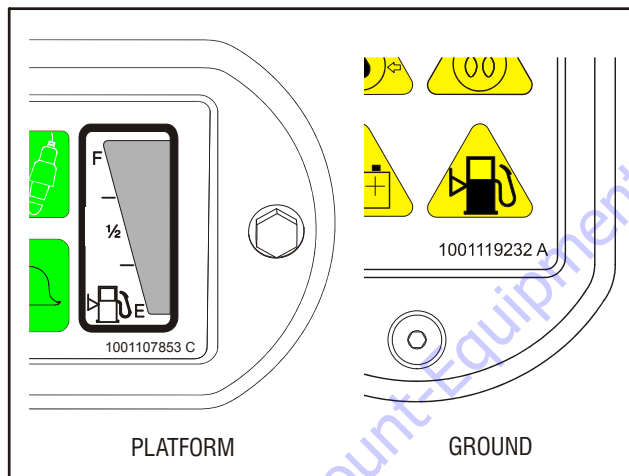
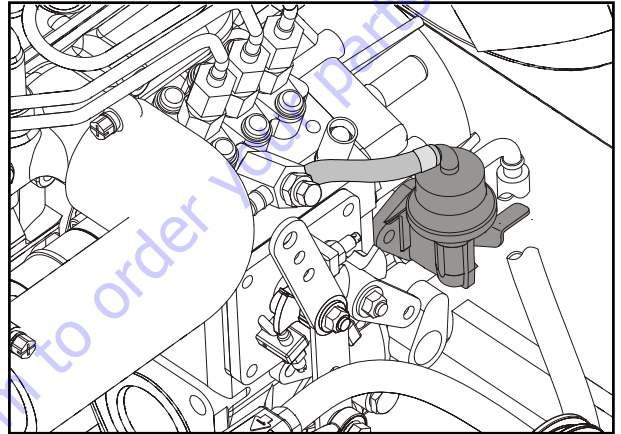


Figure 3-51. Low Fuel Indicators

3.16 ENGINE STARTUP PROCEDURE (KUBOTA)

NOTE: The following procedure is necessary when engine or fuel system maintenance has been performed that will require the fuel system to be primed.

1. With the engine off, disconnect the fuel line at the engine's fuel injection pump. This is a short hose between the mechanical lift pump and the injection pump.



2. Actuate the priming lever on the mechanical lift pump until fuel comes out of the fuel hose.
3. Attach the fuel hose and secure it in place with the existing hose clamp.
4. Start the engine and ensure it runs properly and the fuel line does not leak.

3.17 KUBOTA ENGINE

Engine Oil Pressure Switch

The engine oil pressure switch monitors oil pressure and sends an electronic message to the control system. This is accomplished by creating an open electrical circuit for normal oil pressure and a closed electrical circuit for low pressure.

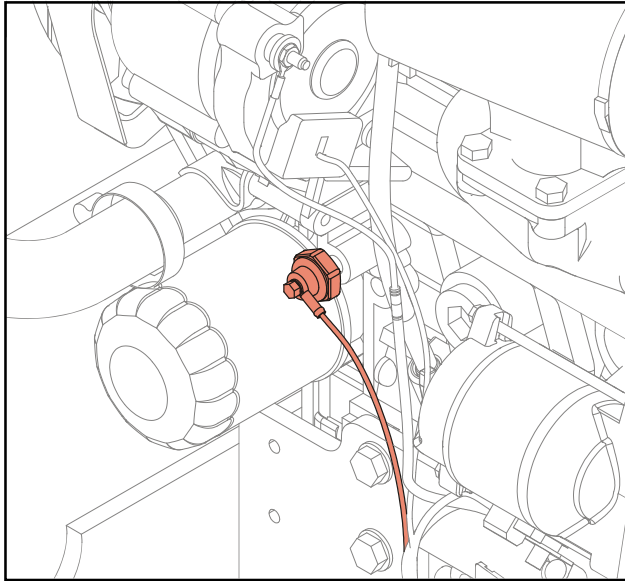


Figure 3-52. Engine Oil Pressure Switch

Engine Speed Sensor

The engine speed sensor is a variable reluctance sensor used to measure engine speed by monitoring the flywheel teeth while the engine is running.

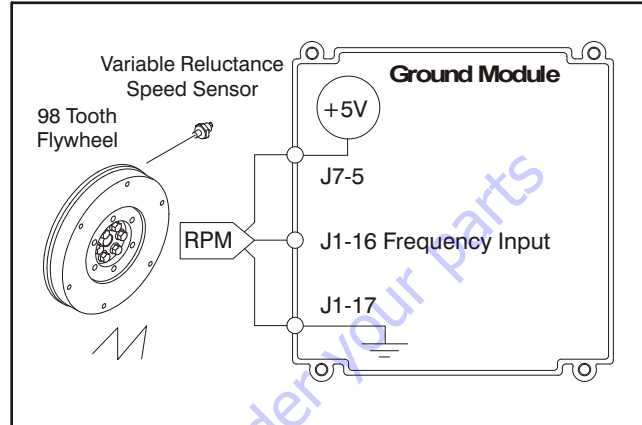


Figure 3-54. Engine Speed Sensor Schematic

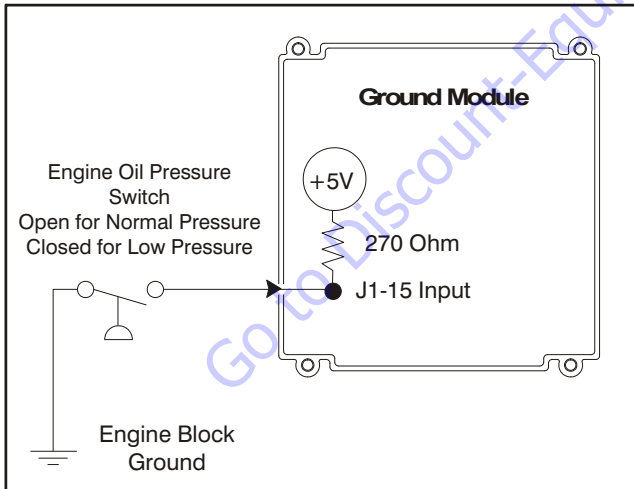


Figure 3-53. Engine Oil Pressure Switch Schematic

Coolant Sensor

The coolant sensor operates by providing variable resistance to ground based on coolant temperature.

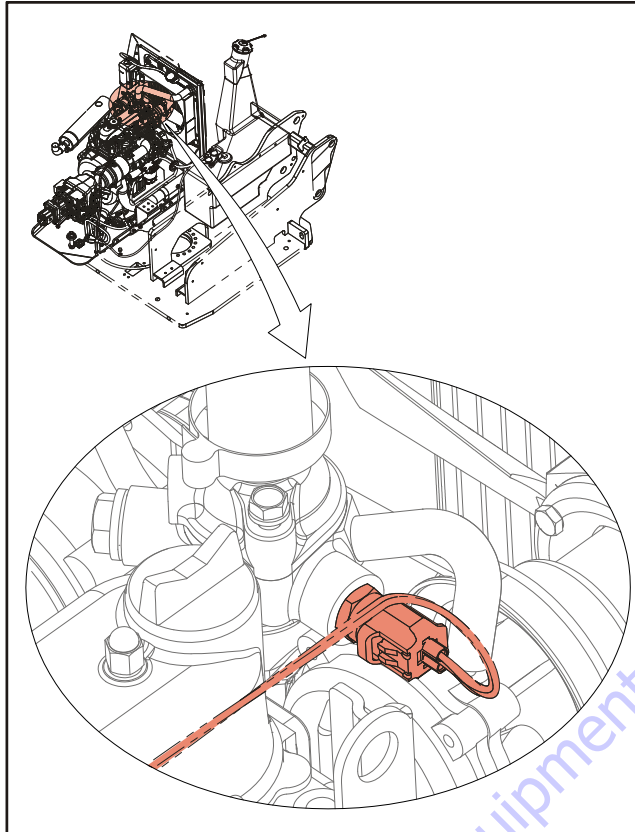


Figure 3-55. Engine Coolant Sensor

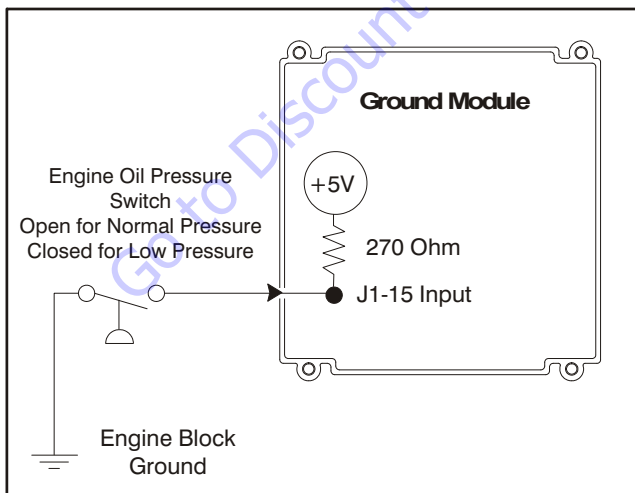


Figure 3-56. Engine Coolant Sensor Schematic

Glow Plugs

The diesel engine has three in-cylinder glow plugs to assist in cold starting. The ground module controls the glow plugs and uses a relay to switch battery current.

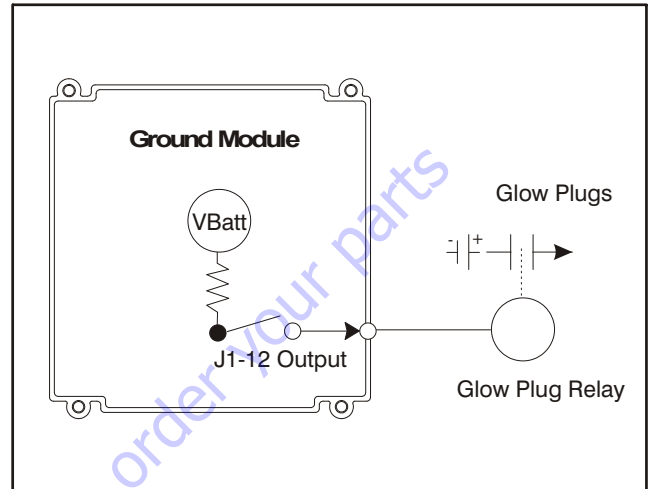


Figure 3-57. Engine Glow Plug Schematic

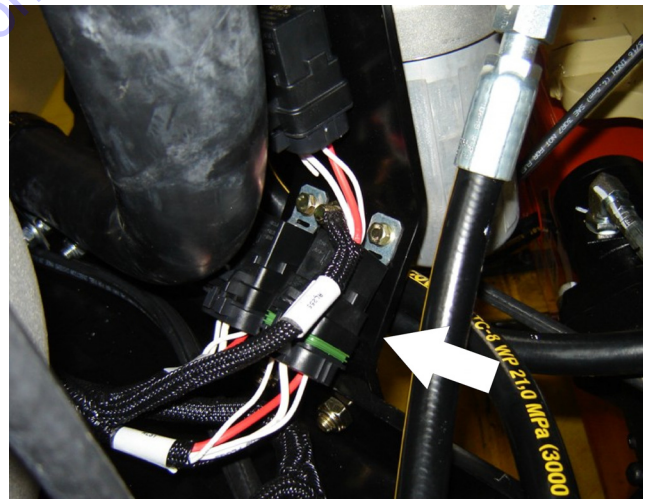


Figure 3-58. Glow Plug Relay

The Ground Module calculates the length of time the glow plugs are energized prior to startup based upon ambient temperature, engine coolant temperature, and battery voltage. Refer to Table 3-6, Glow Plug Conditions.

Table 3-6. Glow Plug Conditions

Engine Coolant Temperature	Battery Voltage	Ambient Temperature	Glow Plug Time On
Greater than or equal to 122°F (50°C)	--	--	Off
--	Less than 11V	--	Off
Less than 122°F (50°C)	Greater than 11V	Greater than 59°F (15°C)	Off
Less than 122°F (50°C)	Greater than 11V	Temp Between 23°F and 59°F (-5°C and 15°C)	On for 10sec.
Less than 122°F (50°C)	Greater than 11V	Temp Between 5°F and 23°F (-15°C and -5°C)	On for 15sec.
Less than 122°F (50°C)	Greater than 11V	Temp Less Than 5°F (-15°C)	On for 20sec.

The glow plugs are deenergized if:

- The Engine State is Engine Cranking, Engine Starting, Engine running
- or
- The Emergency Descent Mode is activated and Lift Down, Tower Lift Down, or Jib Lift Down are active.

If the STARTER LOCKOUT option is enabled in the Machine Setup, the Ground Module will not allow an engine start attempt until the glow plug time has expired. If this option is not enabled, the glow plug time can be interrupted and an engine start attempt can be made. Starter Lockout is only applicable for the first glow plug cycle.

Engine Speed Actuators

Engine speed on the Kubota engine is controlled by two actuators; a throttle actuator that is On/Off operated (moves the throttle arm between the Idle and High Engine positions) and a proportional fuel rack actuator that limits the opening of the fuel rack to control speeds between the Idle and High Engine positions. The two actuators function together to achieve smooth engine speed transitions. Refer to Table 3-7, Engine Actuator Conditions.

Table 3-7. Engine Actuator Conditions

Engine RPM Level	Throttle Actuator	Fuel Rack Actuator
Idle	Off	Energized/Fully Retracted
Between Idle RPM and High Engine RPM	On	Energized/Control Loop
High Engine	On	Energized/Fully Retracted

ENGINE THROTTLE ACTUATOR

The Ground Module energizes the Throttle Actuator Relay through terminal J1-2 if the engine is cranking or starting and the Control System is calling for Idle RPM.

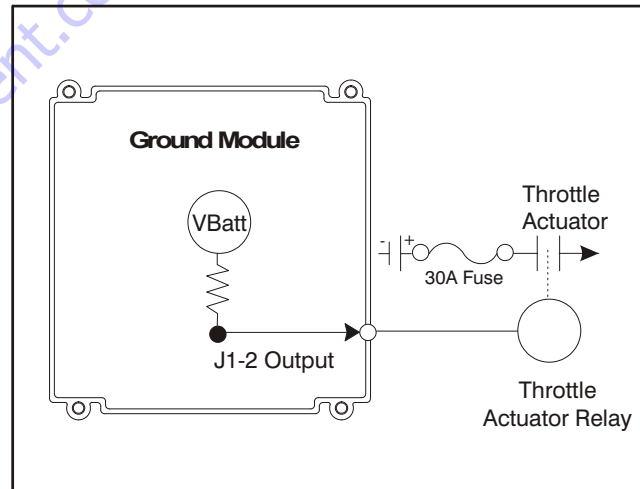


Figure 3-59. Engine Throttle Actuator Schematic

PROPORTIONAL FUEL RACK ACTUATOR

The Proportional Fuel Rack Actuator controls engine speed whenever the Control System calls for an engine RPM between Idle and High Engine. It is energized by the J1-1 terminal on the Ground Control Module. When the terminal is de-energized, the actuator fully extends and shuts down the engine.

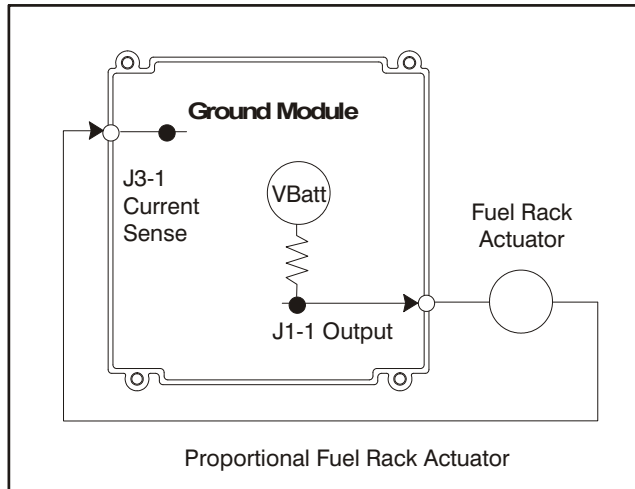


Figure 3-60. Proportional Fuel Rack Actuator Schematic

Engine Start

To engage the engine starter, the Ground Module energizes the J1-11 terminal to activate the start relay, which in turn, energizes the starter solenoid.

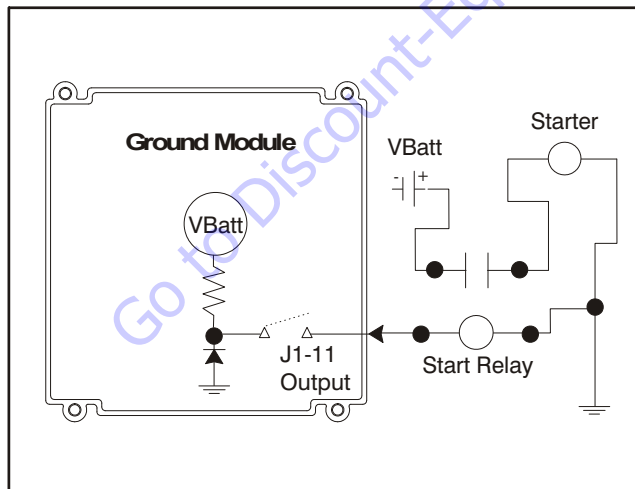


Figure 3-61. Engine Starter Schematic

Alternator Excitation

For the alternator to charge, it must be rotating and the alternator excitation terminal must be energized by an external power source. This power is supplied by the Ground Module through terminal J1-32 to the D+ terminal on the alternator. This terminal includes a one-way blocking diode that prevents reverse energy flow into the Ground Module during engine power-down. This terminal is continuously energized after startup.

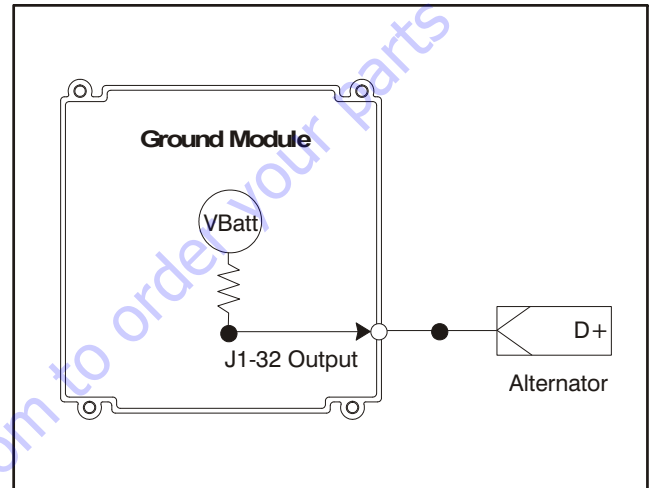


Figure 3-62. Alternator Schematic

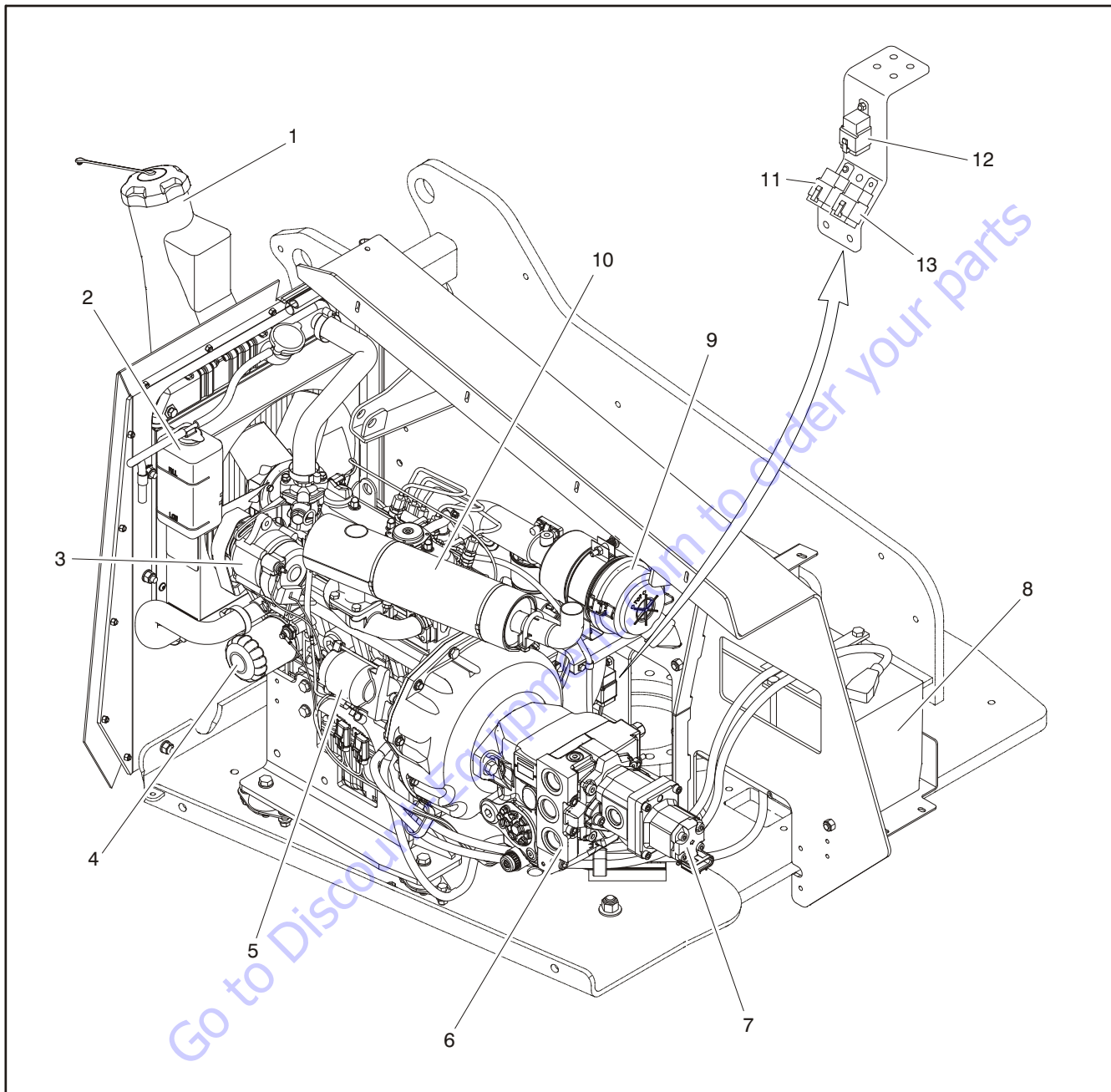
Fuel Pump

The Kubota fuel pump is mechanical and has no interaction with the JLG Control System.

Shutdown

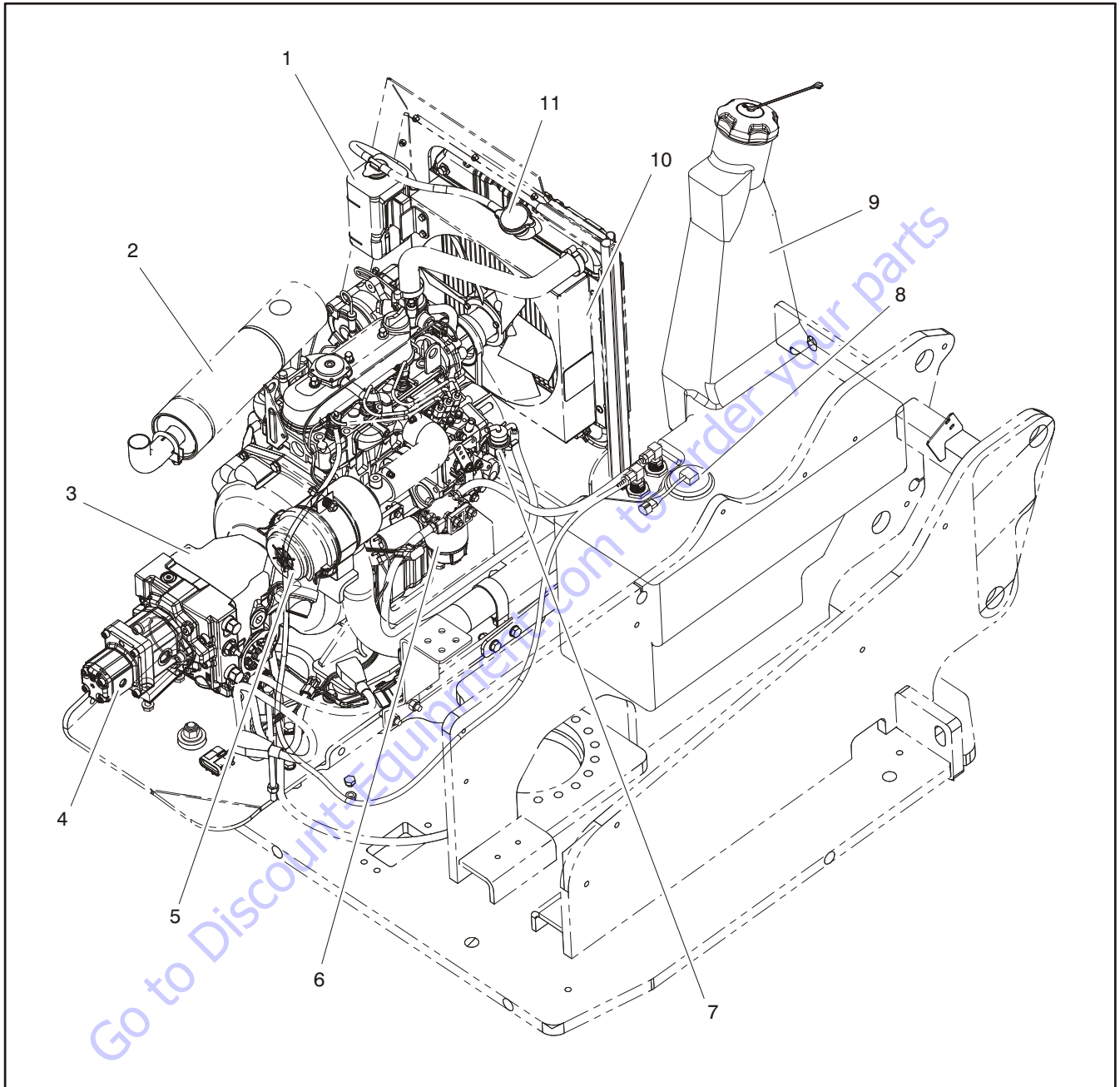
If the JLG Control System determines that the engine should be shut down and not allowed to run, the Ground Module takes the following steps to shut down the engine.

1. Remove power and prevent power from flowing to the Proportional Fuel Rack Actuator by turning off output terminal J1-1.
2. Remove power and prevent power from flowing to the Engine Throttle Actuator by turning off output terminal J1-2.



- | | | | |
|--------------------------|--------------|---------------|----------------------|
| 1. Fuel Tank | 5. Starter | 8. Battery | 11. Starter Relay |
| 2. Coolant Recovery Tank | 6. Main Pump | 9. Air Filter | 12. Full Speed Relay |
| 3. Alternator | 7. Gear Pump | 10. Muffler | 13. Glow Plug Relay |
| 4. Oil Filter | | | |

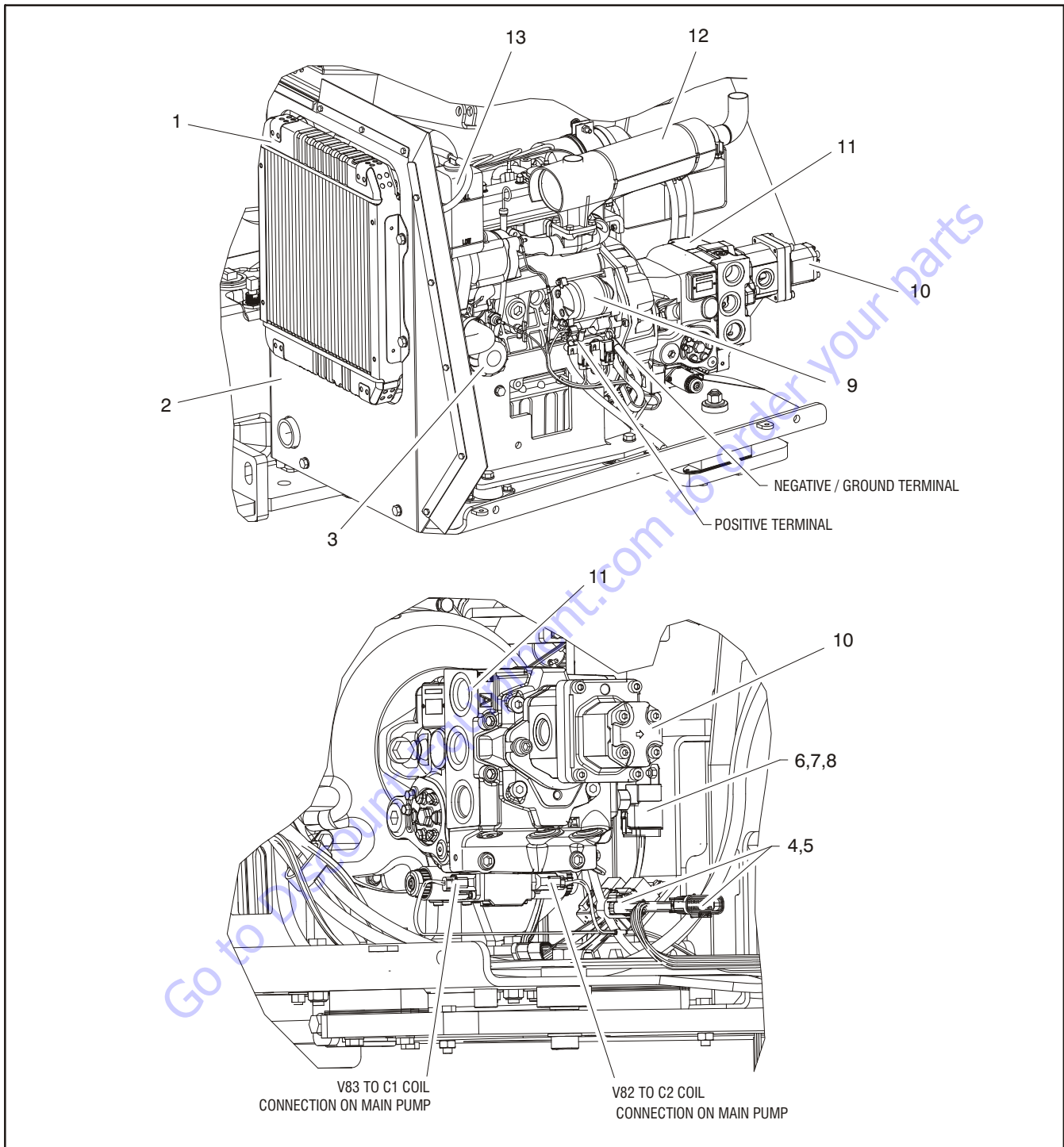
Figure 3-63. Kubota Engine - Sheet 1 of 4



- | | | | |
|--------------------------|------------------------------------|-------------------------------|------------------|
| 1. Coolant Recovery Tank | 5. Air Filter | 7. Fuel Pump | 9. Fuel Tank |
| 2. Muffler | 6. Fuel Filter/
Water Separator | 8. Fuel Level
Sending Unit | 10. Radiator |
| 3. Main Pump | | | 11. Pressure Cap |
| 4. Gear Pump | | | |

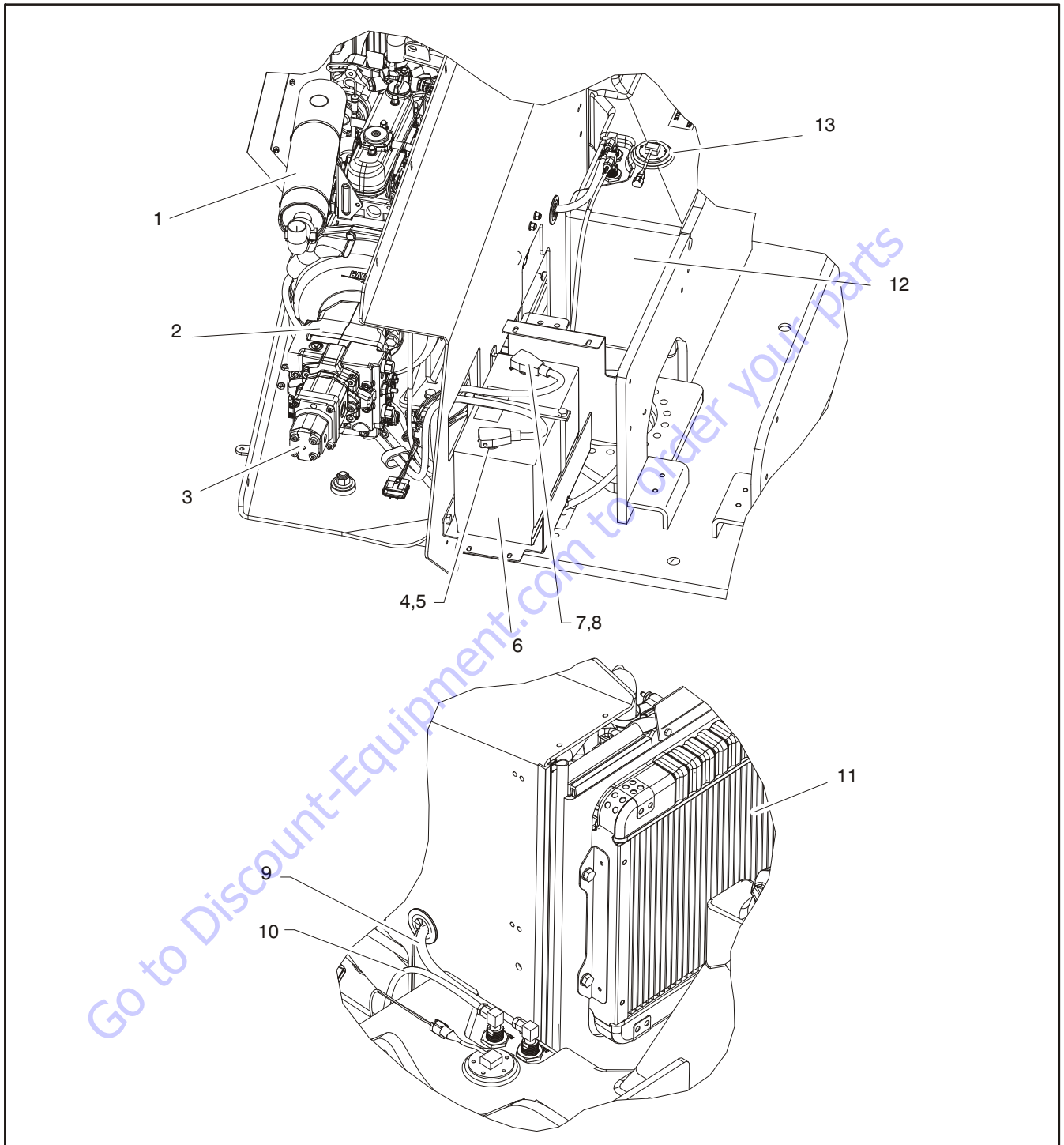
Figure 3-64. Kubota Engine - Sheet 2 of 4

SECTION 3 - CHASSIS & TURNTABLE



- | | | | | |
|----------------------|-----------------------|---------------------|---------------|---------------------------|
| 1. Radiator | 4. Mid Engine Harness | 7. Full Speed Relay | 10. Gear Pump | 12. Muffler |
| 2. Radiator Mount | 5. Engine Harness | 8. Glow Plug Relay | 11. Main Pump | 13. Coolant Recovery Tank |
| 3. Engine Oil Filter | 6. Starter Relay | 9. Starter | | |

Figure 3-65. Kubota Engine - Sheet 3 of 4



- | | | | |
|------------------------------|------------------------------|--------------------------|-----------------------|
| 1. Muffler | 5. Negative Battery Post | 8. Positive Battery Post | 11. Radiator |
| 2. Main Pump | 6. Battery | 9. Fuel Supply Line | 12. Fuel Tank |
| 3. Gear Pump | 7. Positive Battery Terminal | 10. Fuel Return Line | 13. Fuel Level Sensor |
| 4. Negative Battery Terminal | | | |

Figure 3-66. Kubota Engine - Sheet 4 of 4

3.18 GM DUAL FUEL ENGINE

Unlike the Kubota engine, the GM Dual Fuel engine is controlled by its own Electronic Control Unit (ECU). The engine uses gasoline as its primary fuel, but can also be switched to run on Liquid Propane (LP) as an alternate fuel. This fuel selection is made by the operator at the machine platform control. The Platform Control Module communicates this selection to the ECU which controls the transition between the two fuels.

Communications with the JLG Control System

The JLG Control System communicates with the GM engine by sending the following control messages from the Ground Module to the engine's ECU:

- Fuel Type and Engine Start
- Engine Speed Request
- Engine Shutdown Request

The engine's ECU sends the following communications to the Ground Module:

- Engine RPM
- Engine Oil Pressure
- Engine Coolant Temperature

Engine Start

The Ground Module energizes terminal J1-11 to engage the starter. The engine ECU considers the engine started when RPMs are greater than 800 and continues in the Run mode unless engine RPM drops below 200. The ECU establishes a maximum crank time of 7.5 seconds before a 20 second wait time is required. The ECU also requires that power is cycled after 60 seconds of cranking time.

Oil Pressure

The Ground Module calculates the engine oil pressure based on information sent to it by the engine ECU.

Engine Speed

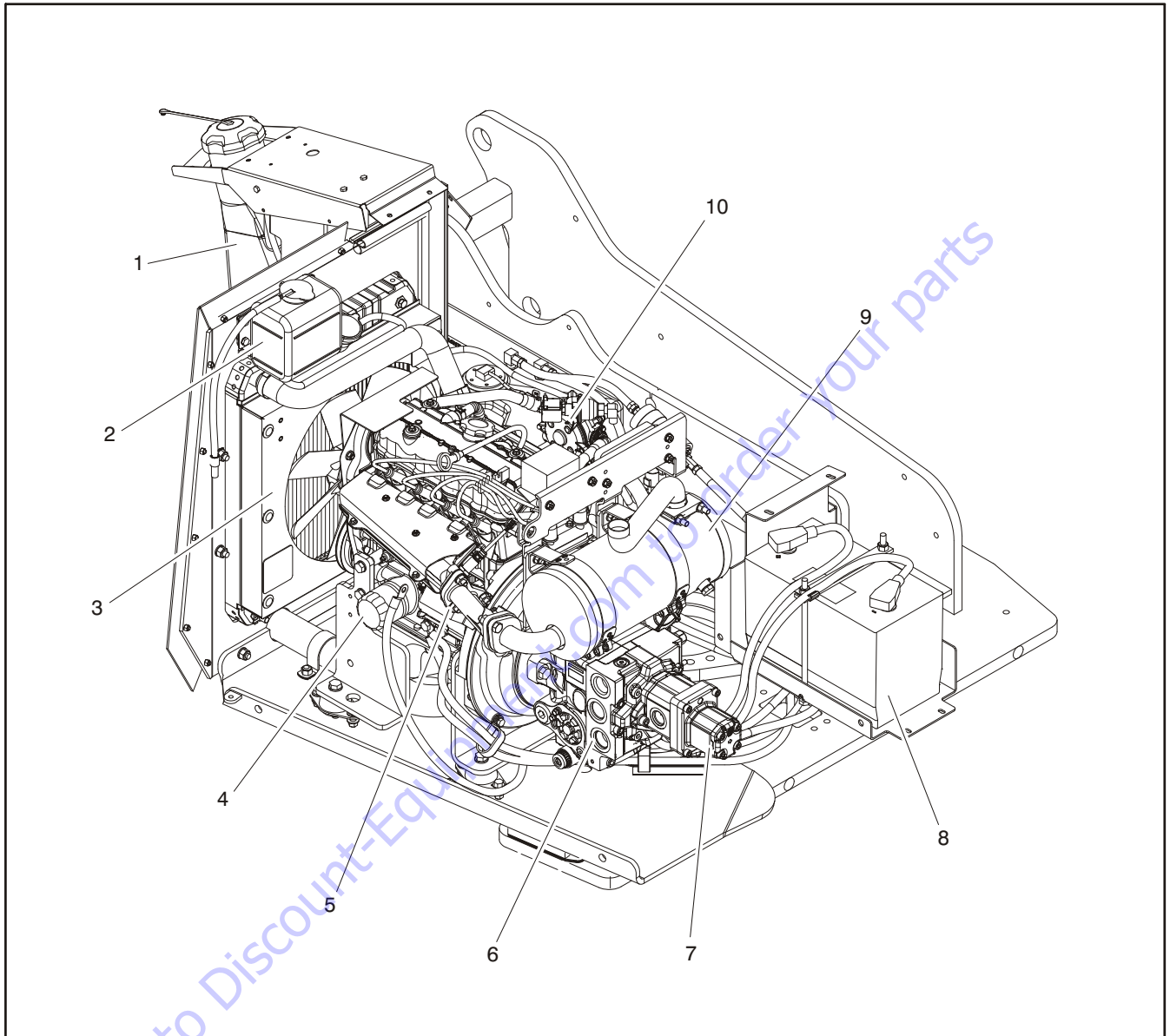
The Ground Module calculates the engine RPM based on information sent to it by the engine ECU.

Coolant Temperature

The Ground Module calculates the engine coolant temperature based on information sent to it by the engine ECU.

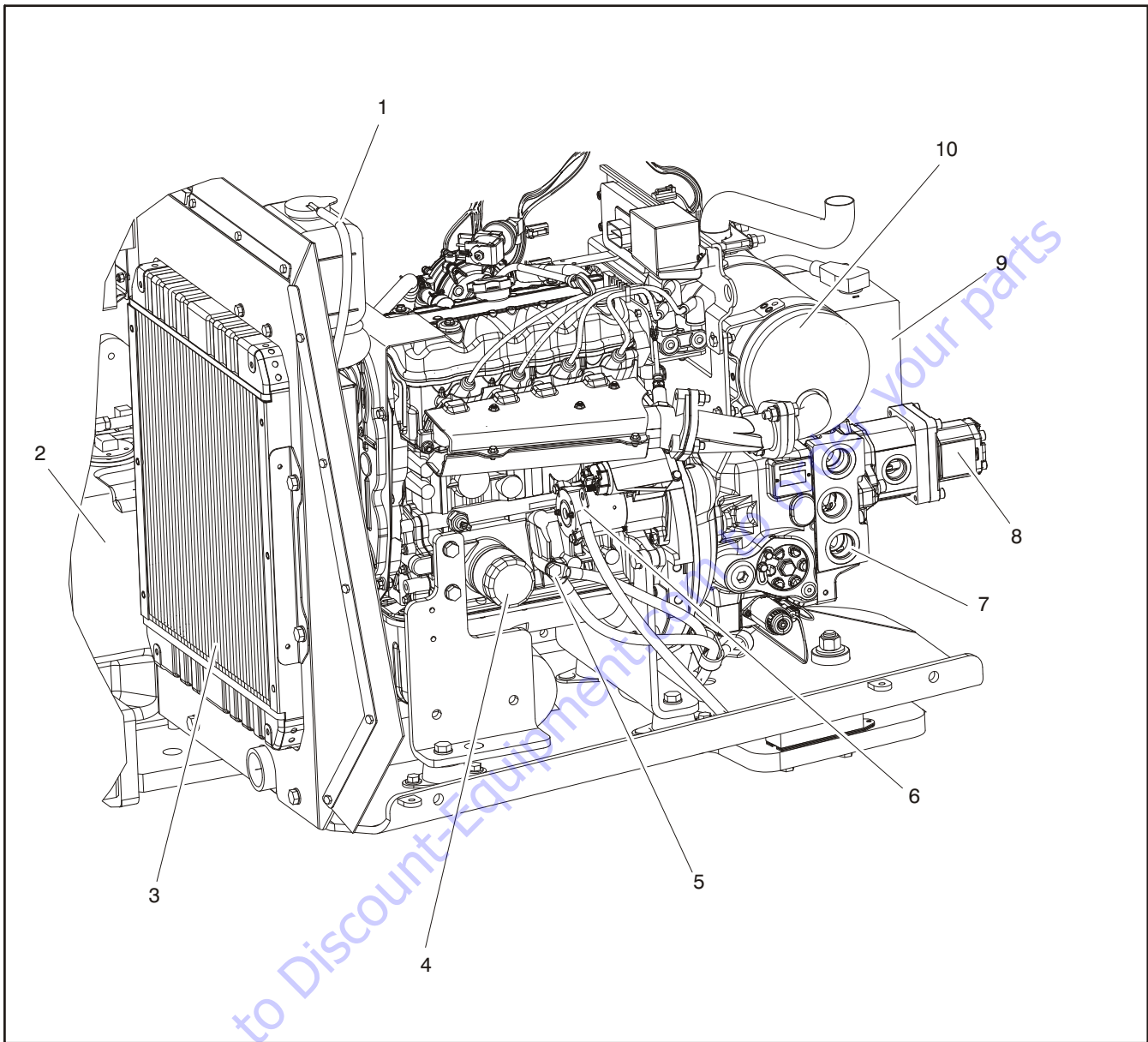
Fuel Select

If the Fuel Select input J1-33 on the Platform Module is energized, the Ground Module communicates to the ECU that the engine should be calibrated for LP fuel. If the Fuel Select input J1-33 on the Platform Module is not energized, the Ground Module communicates to the ECU that the engine should be calibrated for gasoline.



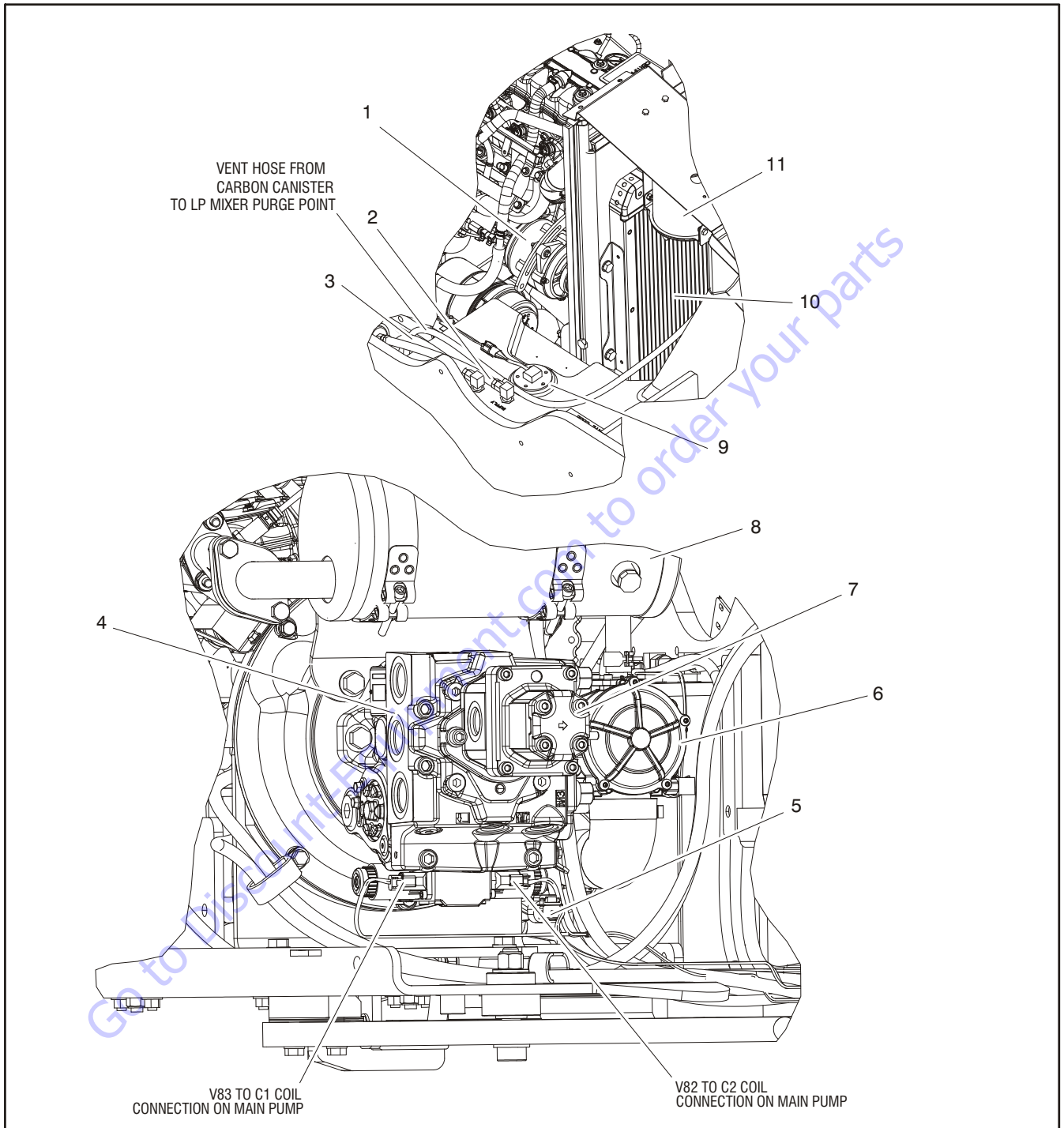
- | | | |
|--------------------------|--------------|----------------|
| 1. Fuel Tank | 5. Starter | 8. Battery |
| 2. Coolant Recovery Tank | 6. Main Pump | 9. Muffler |
| 3. Radiator | 7. Gear Pump | 10. Fuel Mixer |
| 4. Oil Filter | | |

Figure 3-67. GM Engine - 1 of 6



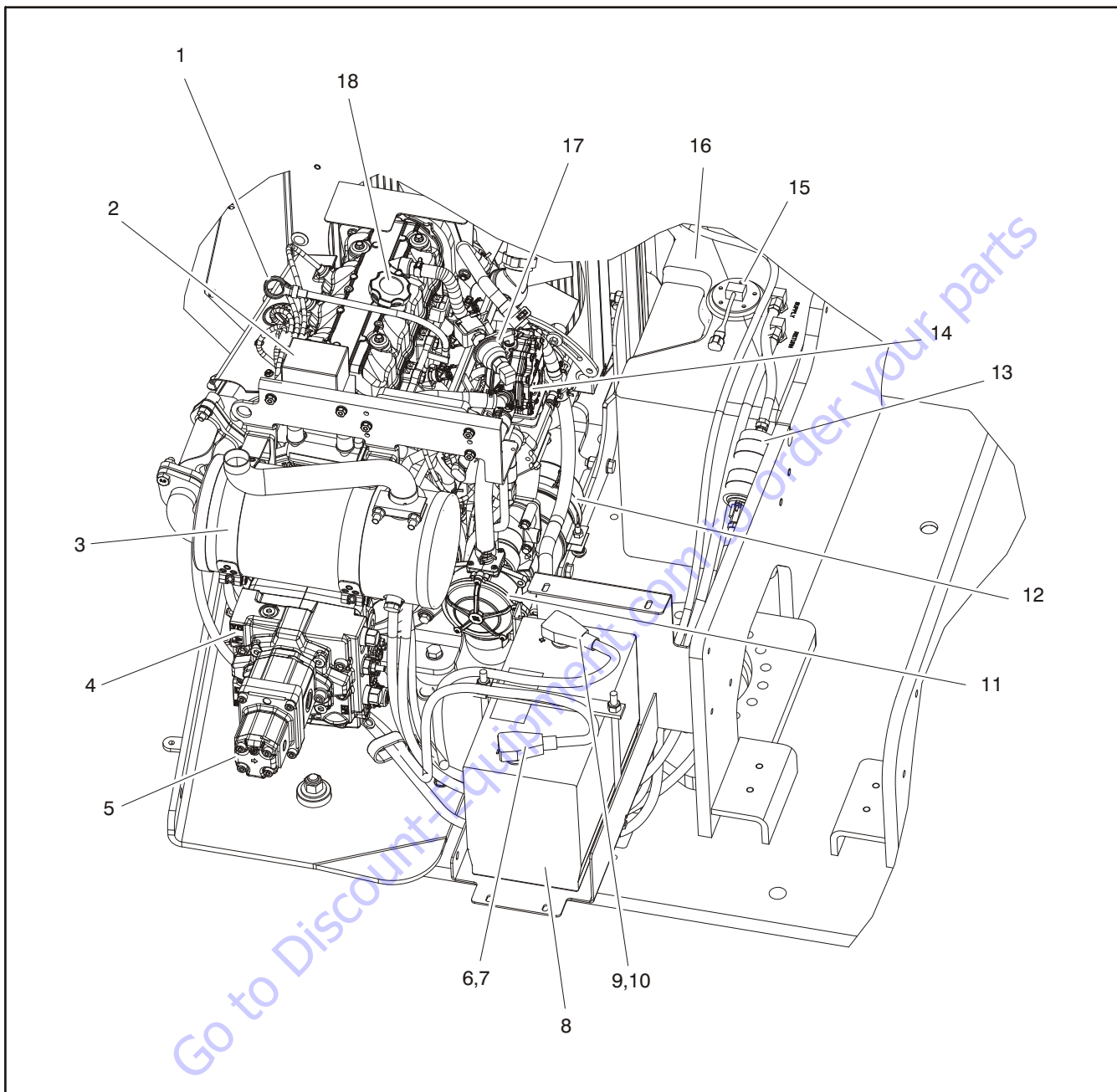
- | | | |
|--------------------------|-----------------------------|--------------|
| 1. Coolant Recovery Tank | 5. Negative/Ground Terminal | 8. Gear Pump |
| 2. Fuel Tank | 6. Positive Terminal | 9. Battery |
| 3. Radiator | 7. Main Pump | 10. Muffler |
| 4. Oil Filter | | |

Figure 3-68. GM Engine - 2 of 6



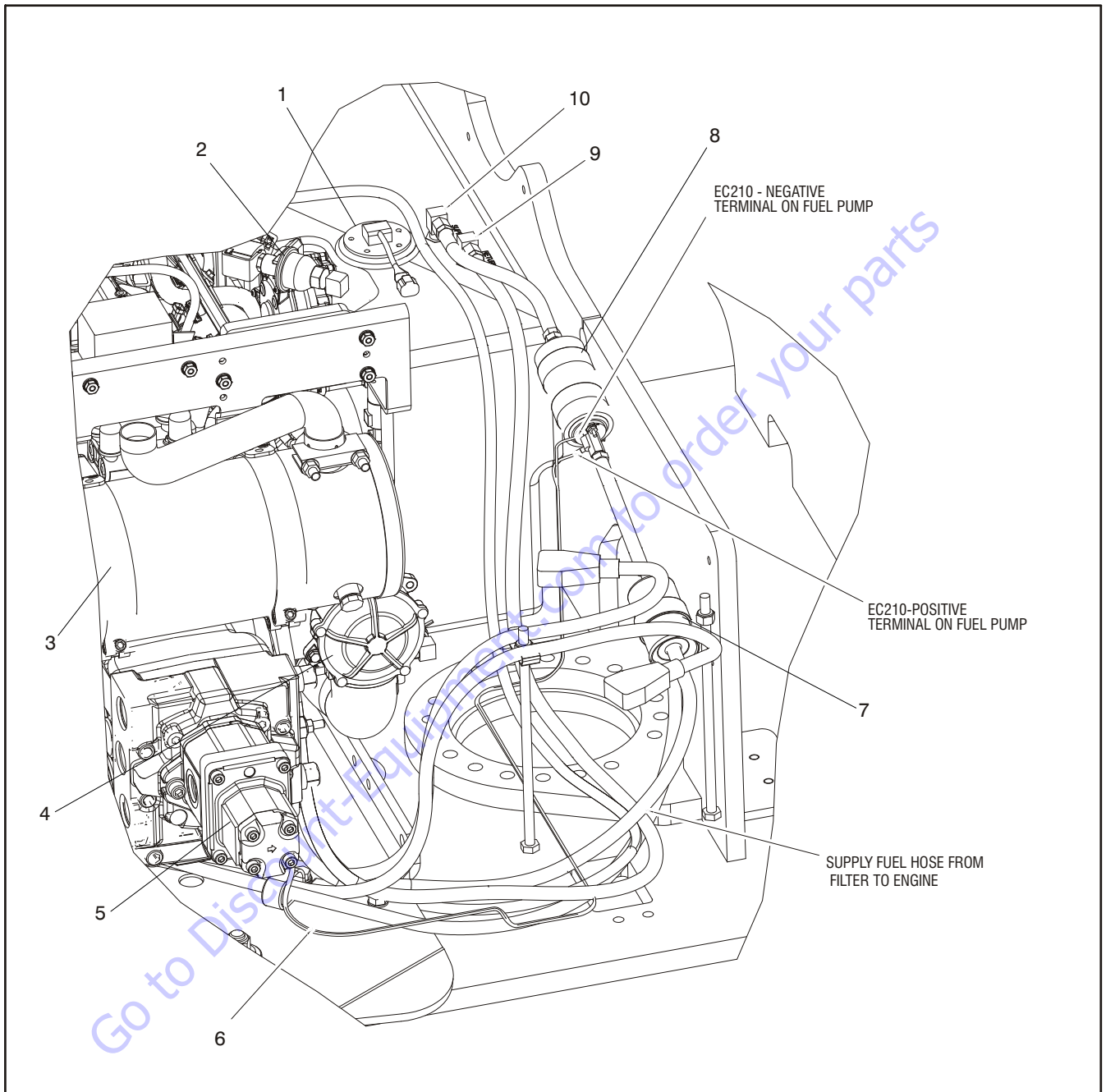
- | | | | |
|---------------------|----------------------|----------------------|----------------------|
| 1. Alternator | 4. Main Pump | 7. Gear Pump | 10. Radiator |
| 2. Supply Fuel Hose | 5. Fuel Pump Harness | 8. Muffler | 11. Carbon Cannister |
| 3. Return Fuel Hose | 6. Air/Fuel Mixer | 9. Fuel Level Sensor | |

Figure 3-69. GM Engine - 3 of 6



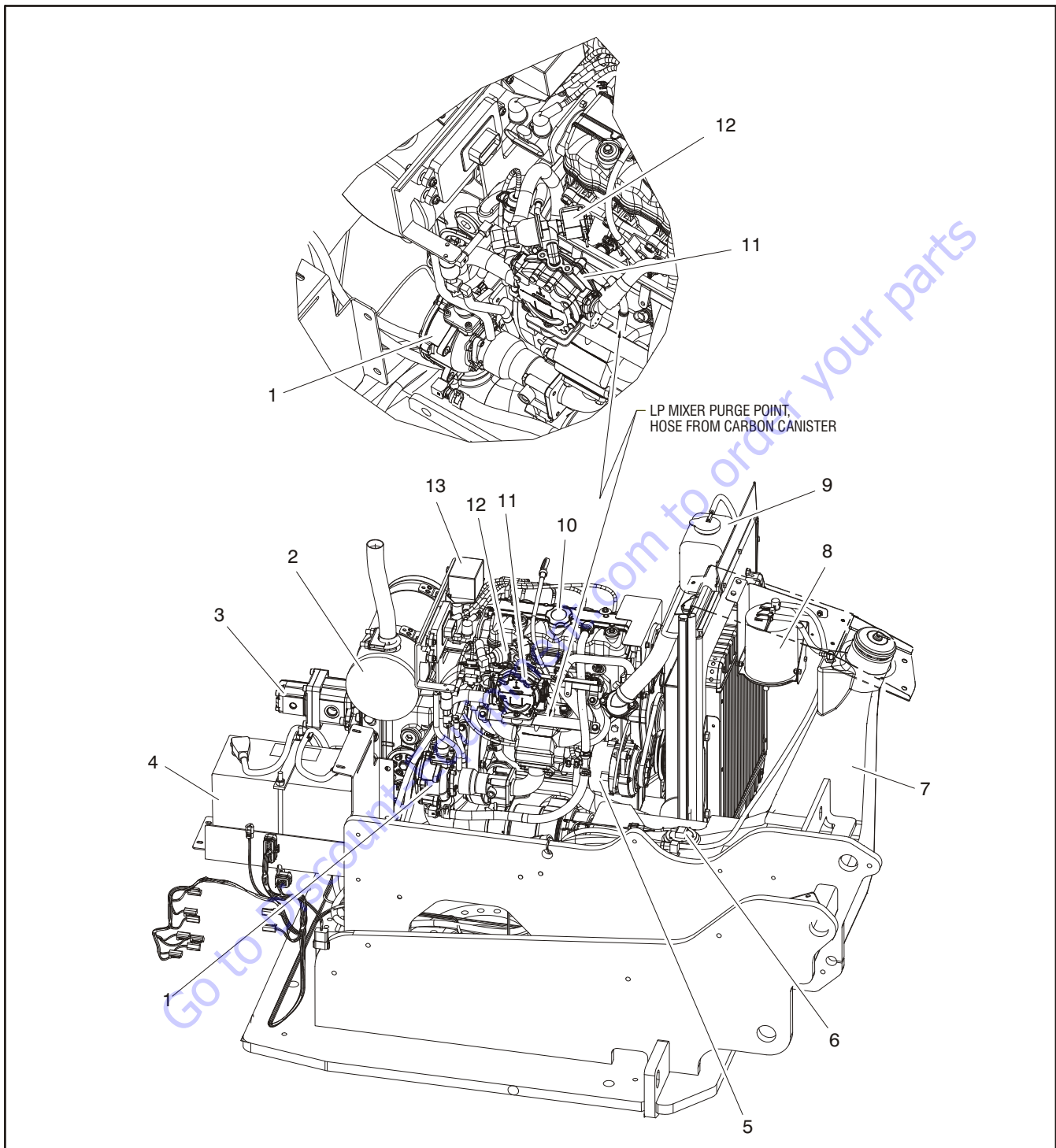
- | | | | |
|--------------|---------------------------|-----------------------|-------------------------|
| 1. Dipstick | 6. Negative Battery Cable | 11. Air/Fuel Mixer | 16. Fuel Tank |
| 2. Relays | 7. Negative Battery Post | 12. Air Filter | 17. Fuel Lock-off Valve |
| 3. Muffler | 8. Battery | 13. Fuel Pump | 18. Engine Oil Fill Cap |
| 4. Main Pump | 9. Positive Battery Cable | 14. Fuel Mixer | |
| 5. Gear Pump | 10. Positive Battery Post | 15. Fuel Level Sensor | |

Figure 3-70. GM Engine - 4 of 6



- | | | |
|------------------------|----------------------|-----------------|
| 1. Fuel Level Sensor | 5. Gear Pump | 8. Fuel Pump |
| 2. Fuel Lock-off Valve | 6. Fuel Pump Harness | 9. Return Port |
| 3. Muffler | 7. Fuel Filter | 10. Supply Port |
| 4. Air Mixer Valve | | |

Figure 3-71. GM Engine - 5 of 6



- | | | | |
|--------------------|----------------------|---------------------------|-------------------------|
| 1. Air Mixer Valve | 5. Alternator | 8. Carbon Cannister | 11. Fuel Mixer |
| 2. Muffler | 6. Fuel Level Sensor | 9. Coolant Recovery Tank | 12. Fuel Lock-off Valve |
| 3. Gear Pump | 7. Fuel Tank | 10. Engine Oil Filler Cap | 13. Relays |
| 4. Battery | | | |

Figure 3-72. GM Engine - 6 of 6

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
0	3	1561	AUX analog Pull-Down 2 high voltage
0	3	1561	AUX analog Pull-Down 3 high voltage
0	4	1561	AUX analog Pull-Down 2 low voltage
0	4	1561	AUX analog Pull-Down 3 low voltage
0	31	1621	RS-485 Rx inactive
0	31	1622	RS-485 Rx noise
0	31	1623	RS-485 Rx bad packet format
0	31	1624	RS-485 remote shutdown request
0	31	Undefined DTC	Index 10297
0	31	Undefined DTC	Index 10298
0	31	Undefined DTC	Index 10299
29	0	2116	FPP2 higher than IVS
29	1	2140	FPP2 lower than IVS
29	3	2128	FPP2 voltage high
29	4	2127	FPP2 voltage low
51	0	221	TPS1-2 higher than expected
51	1	121	TPS1-2 lower than expected
51	3	123	TPS1 voltage high
51	4	122	TPS1 voltage low
51	7	2112	Unable to reach higher TPS
51	7	2111	Unable to reach lower TPS
51	31	2135	TPS1/2 simultaneous voltages out-of-ran
84	1	502	Roadspeed input loss of signal
91	0	2115	FPP1 higher than IVS
91	1	2139	FPP1 lower than IVS
91	2	1630	J1939 ETC message receipt loss
91	3	2122	FPP1 voltage high
91	4	2123	FPP1 voltage low
91	9	1651	J1939 ETC message receipt loss while in
91	16	2126	FPP1-2 higher than expected
91	18	2121	FPP1-2 lower than expected
91	31	1121	FPP1/2 simultaneous voltages out-of-ran
94	0	88	Fuel pressure higher than expected
94	1	87	Fuel pressure lower than expected
94	3	92	FP high voltage
94	4	91	FP low voltage
100	0	521	Oil pressure sender high pressure
100	1	524	Oil pressure low
100	1	524	Oil pressure sender low pressure
100	3	523	Oil pressure sender high voltage
100	4	522	Oil pressure sender low voltage
100	18	520	Oil pressure sender low pressure stage 1
105	0	127	IAT higher than expected stage 2

SECTION 3 - CHASSIS & TURNTABLE

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
105	3	113	IAT voltage high
105	4	112	IAT voltage low
105	15	111	IAT higher than expected stage 1
106	4	107	MAP voltage low
106	16	108	MAP pressure high
108	0	2229	BP pressure high
108	1	129	BP pressure low
110	0	1522	CHT higher than expected stage 2
110	0	217	ECT higher than expected stage 2
110	3	118	ECT voltage high
110	4	117	ECT voltage low
110	15	116	ECT higher than expected stage 1
110	16	1521	CHT higher than expected stage 1
168	15	563	Vbat voltage high
168	17	562	Vbat voltage low
173	0	2428	VEGT temperature high
174	3	183	FT high voltage
174	4	182	FT low voltage
441	0	1417	EMWT1 higher than expected stage 2
441	3	1411	EMWT1 voltage high
441	4	1413	EMWT1 voltage low
441	15	1415	EMWT1 higher than expected stage 1
442	0	1418	EMWT2 higher than expected stage 2
442	3	1412	EMWT2 voltage high
442	4	1414	EMWT2 voltage low
442	15	1416	EMWT2 higher than expected stage 1
443	0	1425	ERWT1 higher than expected stage 2
443	3	1419	ERWT1 voltage high
443	4	1421	ERWT1 voltage low
443	15	1423	ERWT1 higher than expected stage 1
444	0	1426	ERWT2 higher than expected stage 2
444	3	1420	ERWT2 voltage high
444	4	1422	ERWT2 voltage low
444	15	1424	ERWT2 higher than expected stage 1
515	0	1112	RPM above spark rev limit level
515	15	219	RPM higher than max allowed govern speed
515	16	1111	RPM above fuel rev limit level
558	5	2130	IVS stuck at-idle, FPP1/2 match
558	6	2131	IVS stuck off-idle, FPP1/2 match
628	13	601	Microprocessor failure - FLASH
629	31	606	Microprocessor failure - COP
629	31	1612	Microprocessor failure - RTI 1
629	31	1613	Microprocessor failure - RTI 2

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
629	31	1614	Microprocessor failure - RTI 3
629	31	1615	Microprocessor failure - A/D
629	31	1616	Microprocessor failure - Interrupt
630	12	604	Microprocessor failure - RAM
636	2	336	CRANK input signal noise
636	4	337	Crank signal loss
636	8	16	Crank and/or cam could not synchronize du
639	9	1629	J1939 TSC1 message receipt loss
639	12	1626	CAN-J1939 Tx fault
639	12	1627	CAN-J1939 Rx fault
639	13	1628	J1939 CAN address / engine-number co
645	3	2619	Tach output short to power
645	4	2618	Tach output ground short
651	5	261	Injector 1 open or short to ground
651	6	262	Injector 1 coil shorted
652	5	264	Injector 2 open or short to ground
652	6	265	Injector 2 coil shorted
653	5	267	Injector 3 open or short to ground
653	6	268	Injector 3 coil shorted
654	5	270	Injector 4 open or short to ground
654	6	271	Injector 4 coil shorted
655	5	273	Injector 5 open or short to ground
655	6	274	Injector 5 coil shorted
656	5	276	Injector 6 open or short to ground
656	6	277	Injector 6 coil shorted
657	5	279	Injector 7 open or short to ground
657	6	280	Injector 7 coil shorted
658	5	282	Injector 8 open or short to ground
658	6	283	Injector 8 coil shorted
659	5	285	Injector 9 open or short to ground
659	6	286	Injector 9 coil shorted
660	5	288	Injector 10 open or short to ground
660	6	289	Injector 10 coil shorted
697	5	1631	PWM1-Gauge1 open / ground short
697	6	1632	PWM1-Gauge1 short to power
698	5	1633	PWM2-Gauge2 open / ground short
698	6	1634	PWM2-Gauge2 short to power
699	5	1635	PWM3-Gauge3 open / ground short
699	6	1636	PWM3-Gauge3 short to power
700	5	1637	PWM4 open / ground short
700	6	1638	PWM4 short to power
713	3	1547	AUX analog Pull-Up/Down 4 high voltage
713	4	1548	AUX analog Pull-Up/Down 4 low voltage

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
723	2	341	CAM input signal noise
723	4	342	Loss of CAM input signal
724	10	134	EG01 open / lazy
731	2	326	Knock1 excessive or erratic signa
731	4	327	Knock1 sensor open or not present
920	3	1643	Buzzer control short to power
920	4	1641	Buzzer control ground short
920	5	1642	Buzzer open
925	3	1662	PWM6 short to power
925	5	1661	PWM6 open / ground short
926	2	1664	PWM7 short to power
926	5	1663	PWM7 open / ground short
1079	3	643	Sensor supply voltage 1 high
1079	4	642	Sensor supply voltage 1 low
1079	31	1611	Sensor supply voltage 1 and 2 out-of-range
1080	3	653	Sensor supply voltage 2 high
1080	4	652	Sensor supply voltage 2 low
1127	3	238	TIP high voltage
1127	4	237	TIP low voltage
1192	3	1131	WGP voltage high
1192	4	1132	WGP voltage low
1213	3	1645	MIL control short to power
1213	4	1644	MIL control ground short
1213	5	650	MIL open
1239	7	359	Fuel run-out longer than expected
1268	5	2300	Spark coil 1 primary open or short to ground
1268	6	2301	Spark coil 1 primary shorted
1269	5	2303	Spark coil 2 primary open or short to ground
1269	6	2304	Spark coil 2 primary shorted
1270	5	2306	Spark coil 3 primary open or short to ground
1270	6	2307	Spark coil 3 primary shorted
1271	5	2309	Spark coil 4 primary open or short to ground
1271	6	2310	Spark coil 4 primary shorted
1272	5	2312	Spark coil 5 primary open or short to ground
1272	6	2313	Spark coil 5 primary shorted
1273	5	2315	Spark coil 6 primary open or short to ground
1273	6	2316	Spark coil 6 primary shorted
1274	5	2318	Spark coil 7 primary open or short to ground
1274	6	2319	Spark coil 7 primary shorted
1275	5	2321	Spark coil 8 primary open or short to ground
1275	6	2322	Spark coil 8 primary shorted
1276	5	2324	Spark coil 9 primary open or short to ground
1276	6	2325	Spark coil 9 primary shorted

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
1277	5	2327	Spark coil 10 primary open or short to ground
1277	6	2328	Spark coil 10 primary shorted
1321	3	617	Start relay coil short to power
1321	4	616	Start relay ground short
1321	5	615	Start relay coil open
1323	11	1311	Cylinder 1 misfire detected
1323	31	301	Cylinder 1 emissions/catalyst damaging misfire
1324	11	1312	Cylinder 2 misfire detected
1324	31	302	Cylinder 2 emissions/catalyst damaging misfire
1325	11	1313	Cylinder 3 misfire detected
1325	31	303	Cylinder 3 emissions/catalyst damaging misfire
1326	11	1314	Cylinder 4 misfire detected
1326	31	304	Cylinder 4 emissions/catalyst damaging misfire
1327	11	1315	Cylinder 5 misfire detected
1327	31	305	Cylinder 5 emissions/catalyst damaging misfire
1328	11	1316	Cylinder 6 misfire detected
1328	31	306	Cylinder 6 emissions/catalyst damaging misfire
1329	11	1317	Cylinder 7 misfire detected
1329	31	307	Cylinder 7 emissions/catalyst damaging misfire
1330	11	1318	Cylinder 8 misfire detected
1330	31	308	Cylinder 8 emissions/catalyst damaging misfire
1347	5	628	Fuel-pump high-side open or short to group
1347	6	629	Fuel-pump high-side short to power
1348	3	629	Fuel pump relay coil short to power
1348	4	628	Fuel pump relay control ground short
1348	5	627	Fuel pump relay coil open
1384	31	1625	J1939 shutdown request
1485	3	687	Power relay coil short to power
1485	4	686	Power relay ground short
1485	5	685	Power relay coil open
1692	0	234	Boost control overboost failure
1692	1	299	Boost control underboost failure
1692	2	236	TIP active
2646	3	1666	PWM8 short to power
2646	5	1665	PWM8 open / ground short
2647	3	1670	PWM9 short to power
2647	5	1669	PWM9 open / ground short
3056	3	8906	UEGO return voltage shorted high
3056	4	8907	UEGO return voltage shorted low
3217	3	8910	UEGO sense cell voltage high
3217	4	8911	UEGO sense cell voltage low
3218	3	8908	UEGO pump voltage shorted high
3218	4	8909	UEGO pump voltage shorted low

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
3221	3	8904	UEGO cal resistor voltage high
3221	4	8905	UEGO cal resistor voltage low
3221	31	8901	UEGO microprocessor internal fault
3222	0	8916	UEGO sense cell impedance high
3222	3	8902	UEGO heater supply high voltage
3222	4	8903	UEGO heater supply low voltage
3222	10	8914	UEGO sense cell slow to warm up
3225	0	8917	UEGO pump cell impedance high
3225	1	8918	UEGO pump cell impedance low
3225	3	8912	UEGO pump voltage at high drive limit
3225	4	8913	UEGO pump voltage at low drive limit
3225	10	8915	UEGO pump cell slow to warm up
520200	0	171	Adaptive-learn gasoline bank1 high
520200	1	172	Adaptive-learn gasoline bank1 low
520201	0	174	Adaptive-learn gasoline bank2 high
520201	1	175	Adaptive-learn gasoline bank2 low
520202	0	1161	Adaptive-learn LPG high
520202	1	1162	Adaptive-learn LPG low
520203	0	1163	Adaptive-learn NG high
520203	1	1164	Adaptive-learn NG low
520204	0	1155	Closed-loop gasoline bank1 high
520204	1	1156	Closed-loop gasoline bank1 low
520205	0	1157	Closed-loop gasoline bank2 high
520205	1	1158	Closed-loop gasoline bank2 low
520206	0	1151	Closed-loop LPG high
520206	1	1152	Closed-loop LPG low
520207	0	1153	Closed-loop NG high
520207	1	1154	Closed-loop NG low
520208	10	154	EG02 open / lazy
520209	10	140	EG03 open / lazy
520210	10	160	EG04 open / lazy
520211	10	420	Catalyst inactive on gasoline (Bank 1)
520212	10	430	Catalyst inactive on gasoline (Bank 2)
520213	10	1165	Catalyst inactive on LPG
520214	10	1166	Catalyst inactive on NG
520215	3	1515	AUX analog Pull-Down 1 high voltage
520215	4	1516	AUX analog Pull-Down 1 low voltage
520216	3	1511	AUX analog Pull-Up 1 high voltage
520216	4	1512	AUX analog Pull-Up 1 low voltage
520217	3	1513	AUX analog Pull-Up 2 high voltage
520217	4	1514	AUX analog Pull-Up 2 low voltage
520218	3	1517	AUX analog Pull-Up 3 high voltage
520218	4	1518	AUX analog Pull-Up 3 low voltage

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
520219	3	1541	AUX analog Pull-Up/Down 1 high voltage
520219	4	1542	AUX analog Pull-Up/Down 1 low voltage
520220	3	1543	AUX analog Pull-Up/Down 2 high voltage
520220	4	1544	AUX analog Pull-Up/Down 2 low voltage
520221	3	1545	AUX analog Pull-Up/Down 3 high voltage
520221	4	1546	AUX analog Pull-Up/Down 3 low voltage
520222	3	1551	AUX digital 1 high voltage
520222	4	1552	AUX digital 1 low voltage
520223	3	1553	AUX digital 2 high voltage
520223	4	1554	AUX digital 2 low voltage
520224	3	1555	AUX digital 3 high voltage
520224	3	1555	Water Intrusion Detection
520224	4	1556	AUX digital 3 low voltage
520226	3	916	Shift actuator feedback out-of-range
520226	7	919	Shift unable to reach desired gear
520226	31	920	Shift actuator or drive circuit failed
520230	5	1639	PWM5 open / ground short
520230	6	1640	PWM5 short to power
520240	3	188	Gaseous fuel temperature sender high voltage
520240	4	187	Gaseous fuel temperature sender low volt
520241	2	331	Knock2 excessive or erratic signal
520241	4	332	Knock2 sensor open or not present
520250	31	2120	FPP1 invalid voltage and FPP2 disagree
520250	31	2125	FPP2 invalid voltage and FPP1 disagree
520250	31	1122	FPP1/2 do not match each other or IVS
520251	3	223	TPS2 voltage high
520251	4	222	TPS2 voltage low
520252	5	509	IAC coil open/short
520252	6	508	IAC ground short
520260	0	1171	MegaJector delivery pressure higher than
520260	1	1172	MegaJector delivery pressure lower than
520260	3	1174	MegaJector voltage supply high
520260	4	1175	MegaJector voltage supply low
520260	12	1176	MegaJector internal actuator fault detection
520260	12	1177	MegaJector internal circuitry fault detection
520260	12	1178	MegaJector internal comm fault detection
520260	31	1173	MegaJector comm lost
520270	31	1531	Gov1/2/3 interlock failure
520401	0	1182	Fuel impurity level high
520800	7	11	Intake cam / distributor position error
520801	7	24	Exhaust cam position error
520803	31	1183	MegaJector autozero / lockoff failure

3.19 FUEL RESERVE / CUT-OUT SYSTEM

The Fuel Shutoff System senses when the fuel level is getting low and automatically shuts the engine down before the fuel tank is emptied. When the fuel level gets below 1.3 gallons (4.9 L), the fault light will flash at the platform controls and the control system will report fault 0031 "FUEL LEVEL LOW - ENGINE SHUTDOWN" on the analyzer.

There is an analyzer personality setting in the control system to control the machines response to this fault. If this personality setting is set to "ENGINE STOP", the machine will remain in this fault mode until the fuel level is returned to a level above 1.3 gallons (4.9 L). If the personality setting is set to "1 RESTART", the operator will be able to start the engine and run for 1 minute. After 1 minute, the engine will shut off for a second time and the machine will return to the "Engine Shut-down" fault mode. The machine will then stay in this mode until the fuel level is returned to a level above 1.3 gallons (4.9 L).

3.20 COLD START SYSTEM (DIESEL ENGINE)

The machine control system monitors the engine coolant and ambient temperature to make an estimate of cylinder preheating requirements. If the coolant temperature is below 50° C (122° F) and the battery has sufficient voltage when control power is turned on, the glow plugs will be automatically fired for a duration that is based on the ambient temperature. During this preheat period, the glow plug indicators will flash. The glow plugs will be turned off before the engine begins to crank.

3.21 GENERATOR

See Figure 3-73., Generator.

An optional generator is available to supply electrical power to the platform. It is controlled by a switch in the platform.

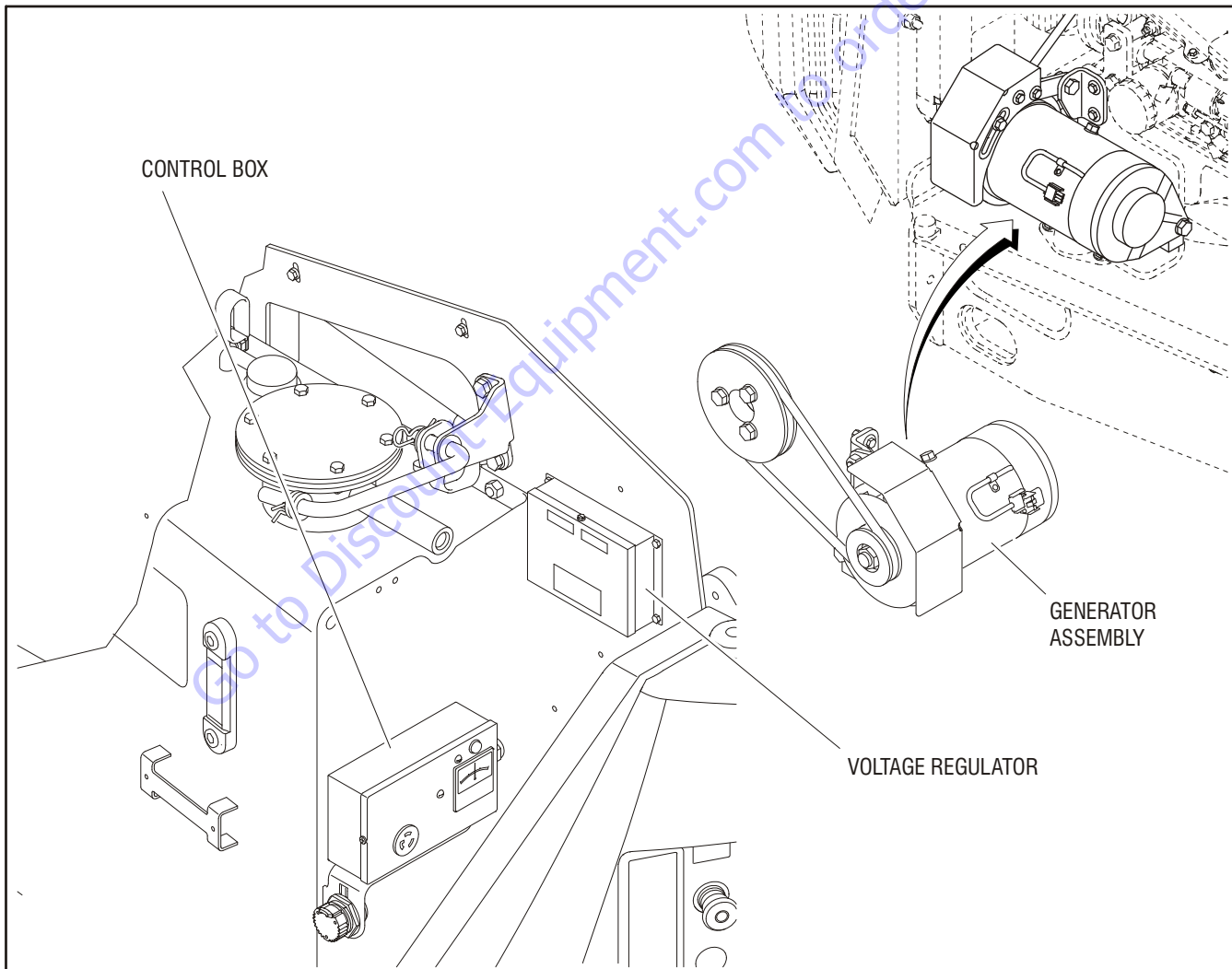


Figure 3-73. Generator

3.22 COUNTERWEIGHT

If the counterweight has been removed, ensure the retaining bolts are torqued to the proper value as shown in Figure 3-74., Counterweight Bolt Torque.

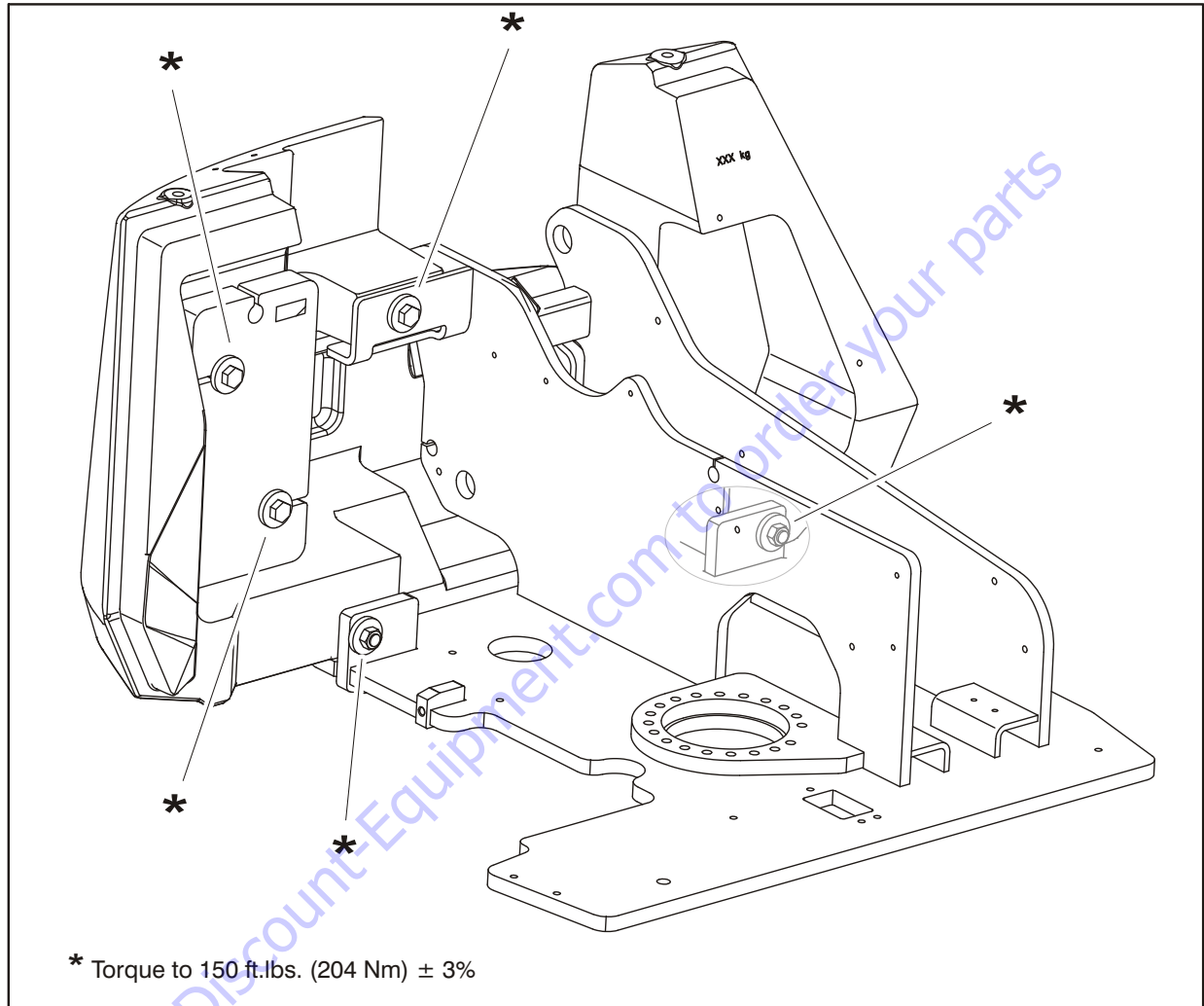


Figure 3-74. Counterweight Bolt Torque

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SECTION 4. BOOM & PLATFORM

4.1 PLATFORM CONTROL ENABLE SYSTEM

The platform controls use a time dependent enable circuit to limit the time availability of "live" or enabled controls. When the footswitch is depressed, the controls are enabled and the operator has 7 seconds to operate any control. The controls will remain enabled as long as the operator continues to use any function and will remain enabled 7 seconds after the last function has been used. While the controls are "live", the enabled light will be illuminated in the platform display panel. When the time limit has been reached, the enabled light will turn off and the controls will be disabled. To continue use of the machine the controls must be re-enabled to start the timer system over again. This is done by releasing all functions, then releasing and re-depressing the footswitch.

4.2 TRANSPORT POSITION SENSING SYSTEM

The transport position sensing system uses the two main boom angle switches (mounted on the upper upright at the lift cylinder pivot bushing) and the tower boom angle switch (mounted between the turntable sides at the lower boom link pivot bushing) to sense when the boom is in the position associated with high speed travel. These switches are normally closed and unactuated when in the transport position. Above transport angle is recognized when the main boom travels from the stowed position to 2° above horizontal (it resets at 2.5° below horizontal) or when the tower boom is sensed to be more than 6.5° above horizontal (it resets at 3.5°). The main boom may be telescoped to any position, and the articulating jib may be in any position without changing the transport state.

This system is used to control the following systems:

- Above Elevation - Drive Speed Cutback System

Drive/Steer - Boom Function Interlock System (CE Only)

4.3 PLATFORM

Platform/Support Removal

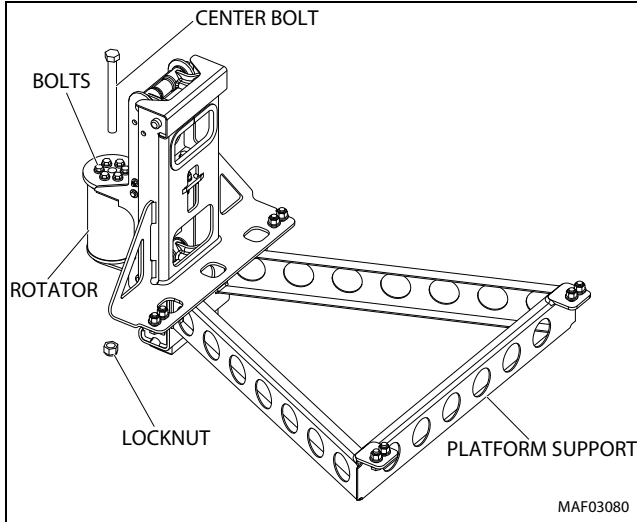
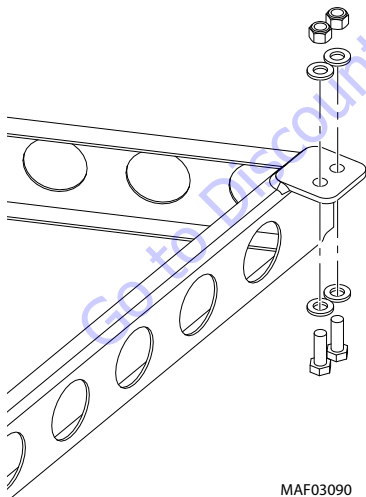


Figure 4-1. Location of Components Platform Support

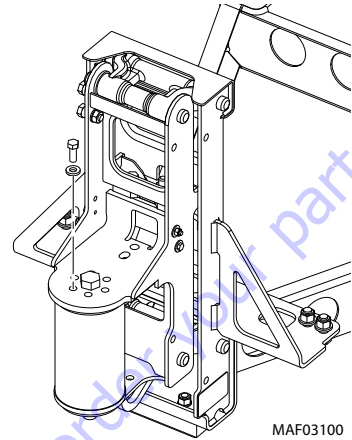
1. Disconnect electrical cable from control console.
2. Tag and disconnect the hydraulic lines from the rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove the bolts securing the platform to the platform support, then remove the platform.



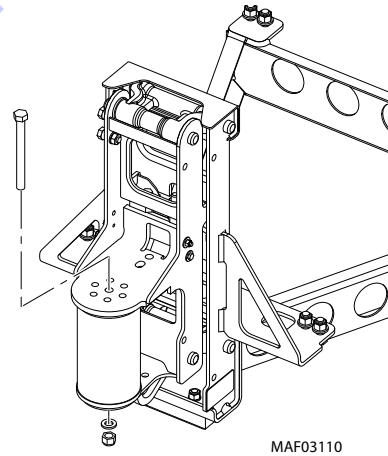
4. Using a suitable device, support the platform support.

NOTE: The platform support weighs approximately 42 lbs. (19 kg).

5. Remove the bolts and washers securing the support to the rotator.



6. Using a suitable brass drift and hammer, remove the center bolt and locknut.



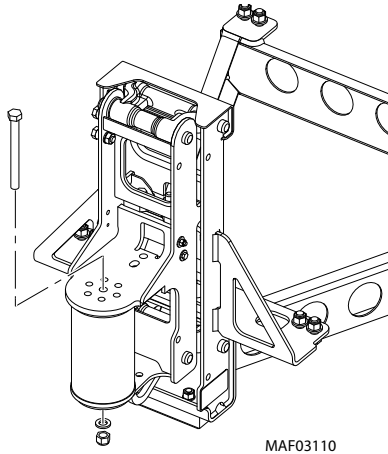
7. Remove the platform support from rotator.

Support Installation

1. Using a suitable device, support the platform support and position it on the rotator.

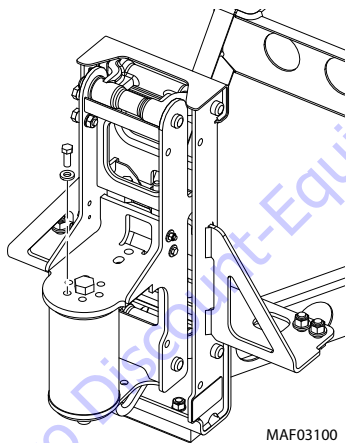
NOTE: The platform support weighs approximately 42 lbs. (19 kg).

2. Install the rotator center bolt and locknut.



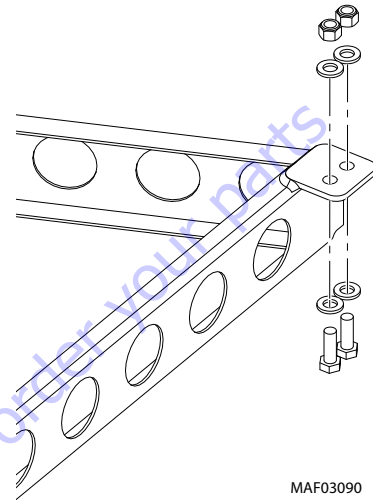
MAF03110

3. Apply JLG Threadlocker P/N 0100011 to the eight bolts securing the support to the rotator and install the bolts.



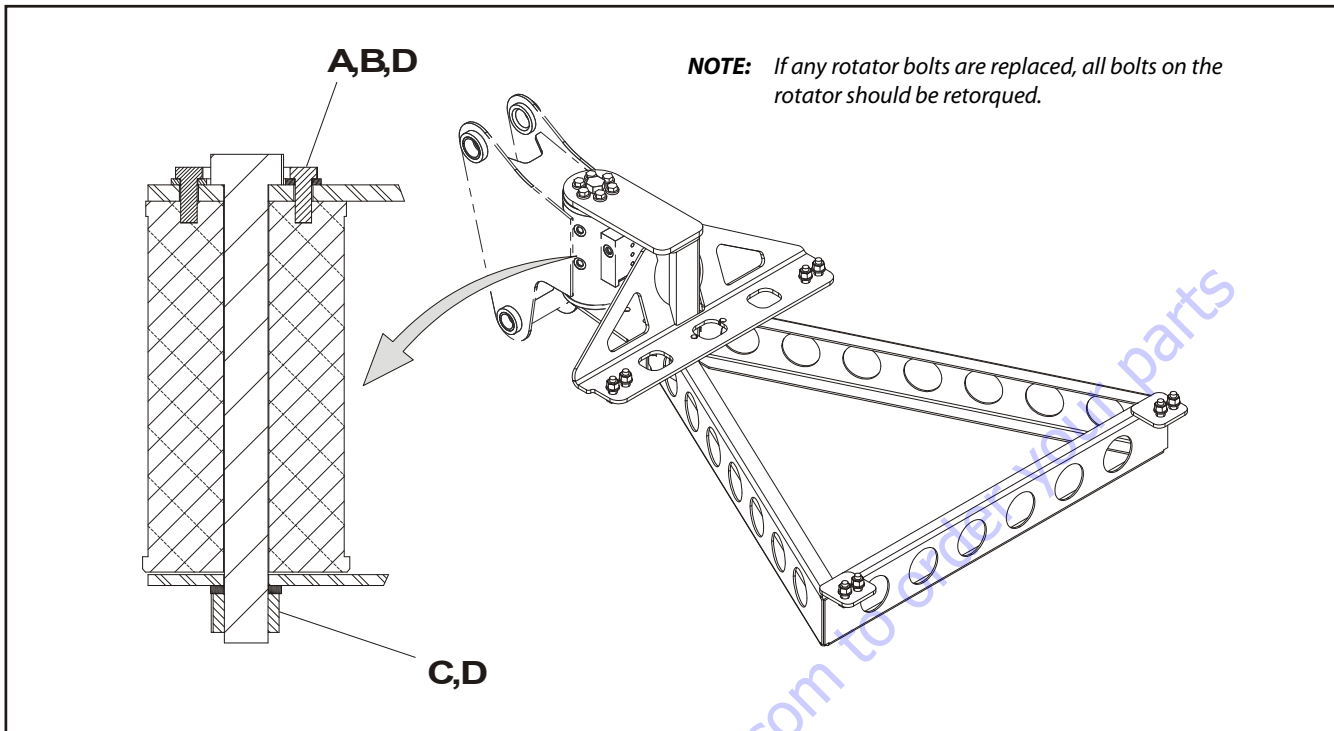
MAF03100

4. Torque the nut on the rotator center bolt and the retaining bolts. See Figure 4-2.
5. Position the platform on the platform support and install the bolts securing the platform to the platform support. See Figure 4-2.



MAF03090

6. Remove tag and reconnect the hydraulic lines to the rotator.
7. Connect the electrical harness to the platform control console.



- A Torque to 40 ft.lbs. (55 Nm)
- B JLG Threadlocker P/N 0100011
- C Torque 250-270 ft. lbs. (340-365 Nm)
- D Check torque every 150 hours of operation

Figure 4-2. Platform Support Torque Values

4.4 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness connectors located in turntable.

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

2. Tag and disconnect hydraulic lines from connectors at boom assembly. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove hydraulic lines and electrical cables from Powertrack.

NOTE: The powertrack weighs approximately 7 lbs. (3.2 kg).

4. Using suitable lifting device, adequately support Powertrack weight along entire length.

5. Remove hardware #1 securing the powertrack on the tube carrier.
6. Remove bolt #2 securing the powertrack on the base boom section. Remove the powertrack assembly.

Installation

1. Using suitable lifting device, adequately support the powertrack weight along entire length.

NOTE: The powertrack weighs approximately 7 lbs. (3.2 kg).

2. With powertrack supported and using all applicable safety precautions, install hardware #2 securing rail to the base boom.
3. Install hardware #1 to tube carrier.
4. Remove tag and reconnect all hydraulic lines and electrical cable from powertrack.
5. Remove tag and reconnect hydraulic lines from connectors at boom assembly.

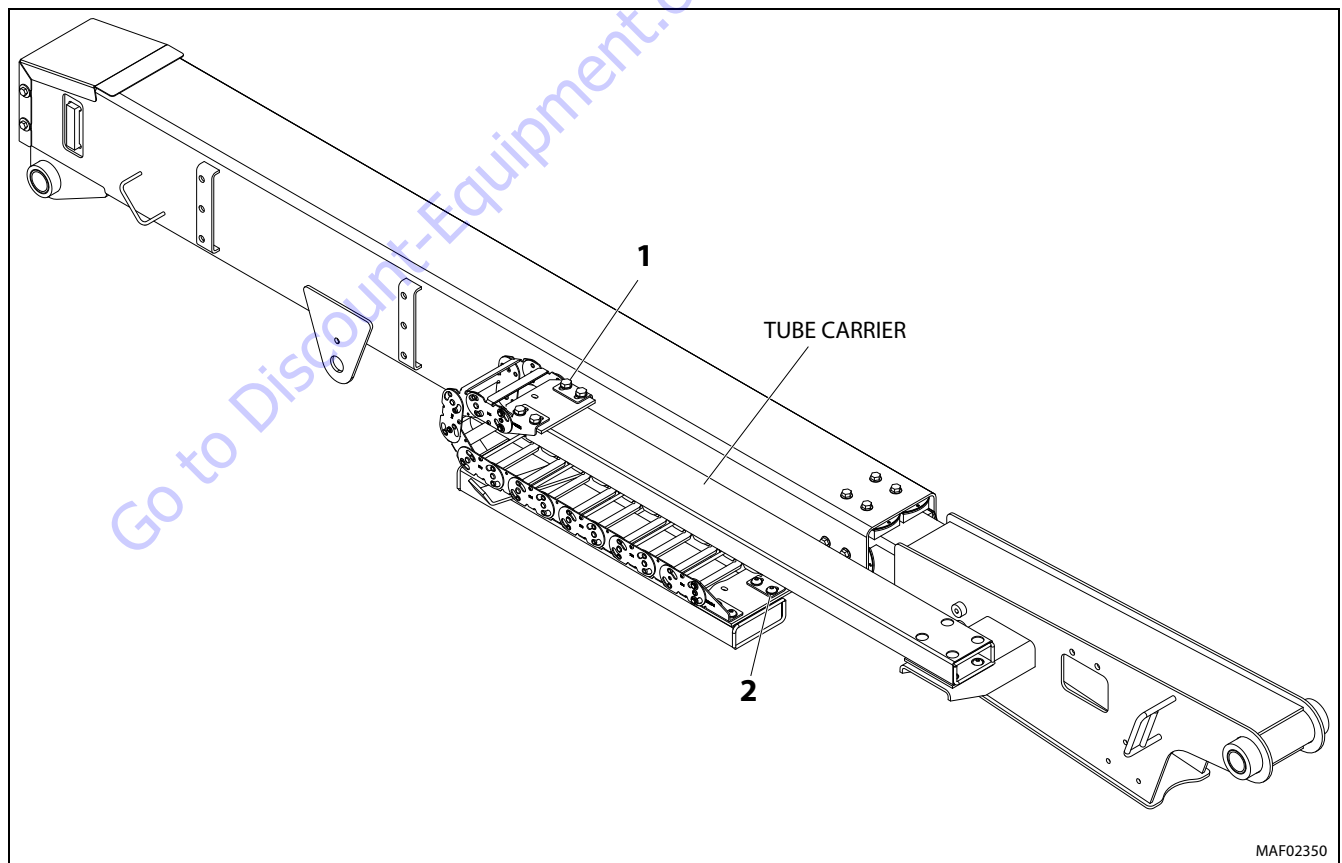


Figure 4-3. Location of Components - Powertrack

4.5 POWERTRACK MAINTENANCE

Remove Link

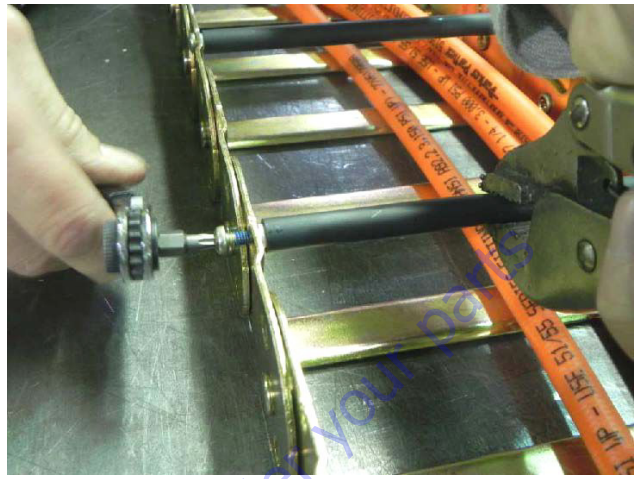
NOTE: Hoses shown in powertrack are for example only. Actual hose and cable arrangements are different.



1. Clamp bar and poly roller tightly so they do not spin when removing screw. With a small 1/4 in. ratchet and a T-20 torx bit, remove 8-32 x 0.500 screw from one side.



2. Repeat step 1 and remove screw from other side of track. Remove bar/poly roller from powertrack.



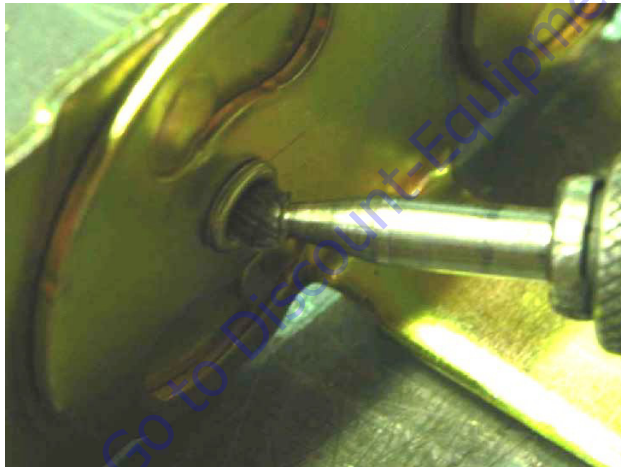
NOTICE

REPOSITION CABLES/HOSES AND KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

3. To remove a link, rivets holding links together must be removed. Use a right-angle pneumatic die grinder with a 1/4 in. ball double cut bur attachment.

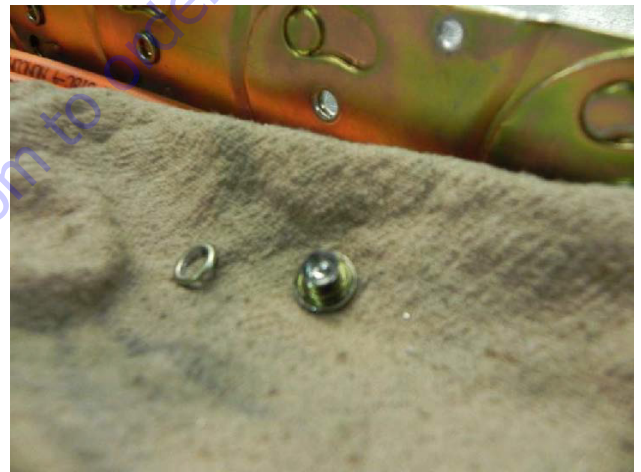


4. Insert tool into rolled over end of rivet. Grind out middle of rivet until rolled over part of rivet falls off. Repeat for all rivets to be removed.



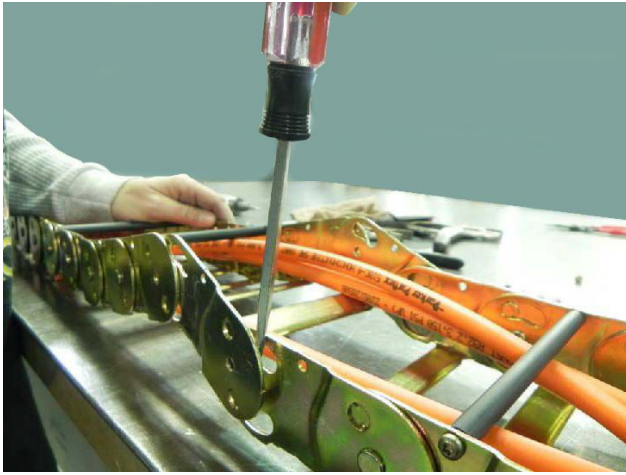
5. After grinding it may be necessary to use a center punch with a hammer to remove rivet.

NOTE: It may be necessary to loosen fixed end brackets from machine to move track section enough to disconnect links.



SECTION 4 - BOOM & PLATFORM

6. Insert flat head screwdriver between links. Twist and pull links apart.

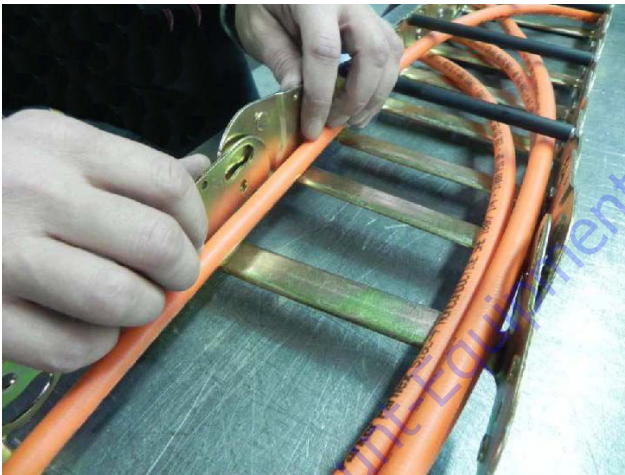


7. Remove link from other section of powertrack using screwdriver.

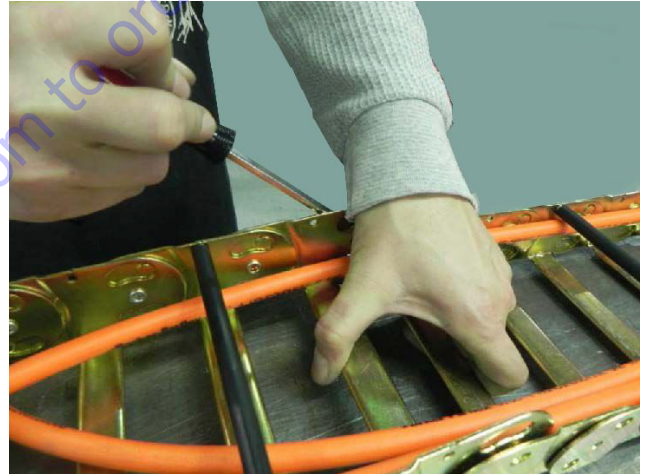
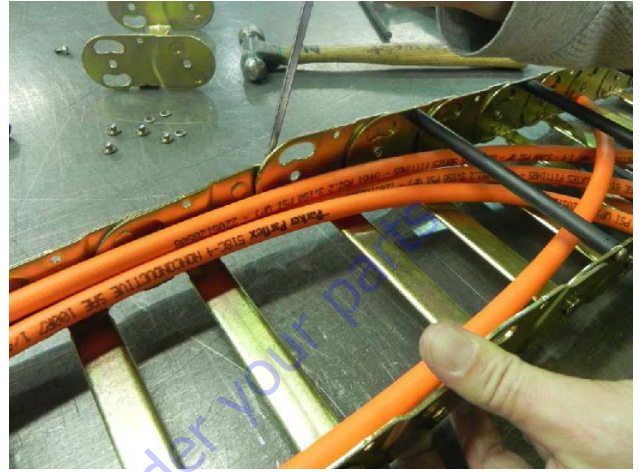


Install New Link

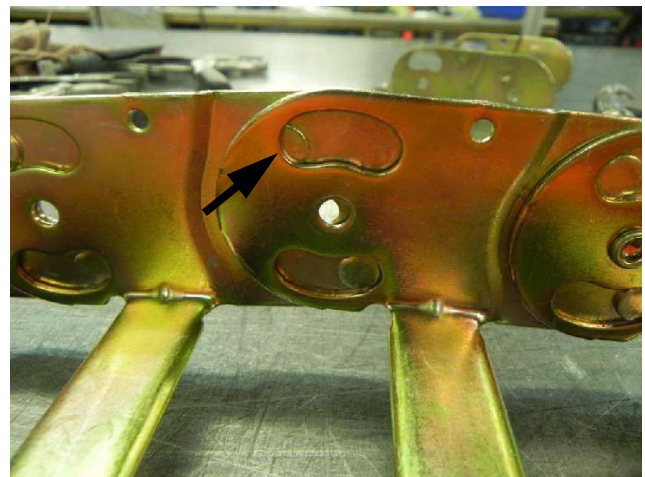
1. Squeeze cut-out end of new link into half-shear (female) end of track section.



2. Spread half-shear (female) end of new link and slide cut-out end of track section into it. Use a screwdriver if necessary.

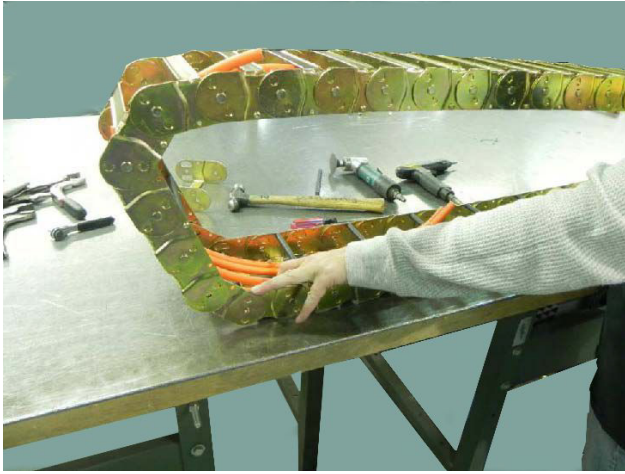


3. After new link is installed round half-shears do not fit properly in cut-outs.

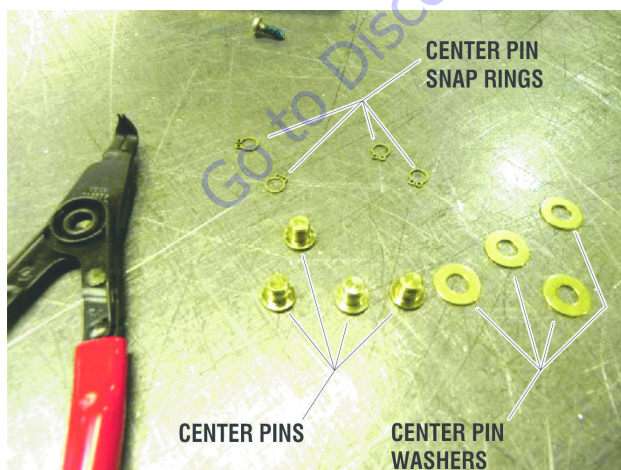


SECTION 4 - BOOM & PLATFORM

4. Pull moving end over track so new connection is positioned in curve of powertrack. Round half-shears will rotate into cut-outs.



5. Parts shown below connect new link to powertrack.



6. Push pin through center hole then slide washer on pin.



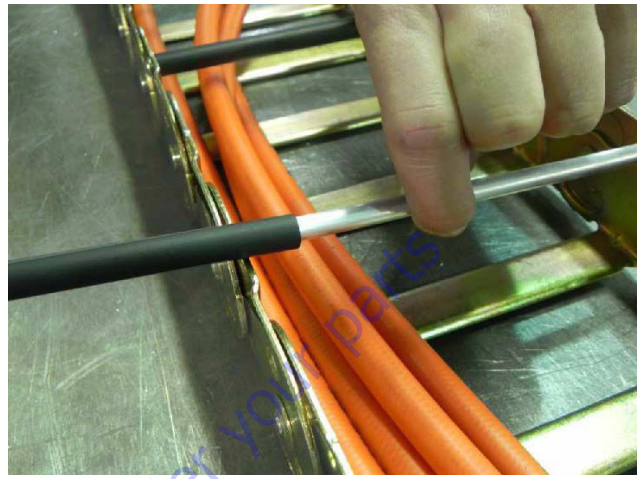
7. Install snap ring in groove on pin. Repeat pin installation steps for all center holes with rivets removed.



NOTE: Make sure snap rings are seated in pin groove and closed properly.



2. Pull up on other end of round bar and slide new poly roller on bar.



1. Install new 8-32 x 0.500 self-threading torx head screw in end of new aluminum round bar. Torque to 18-20 in. lbs. (2-2.25 Nm).



SECTION 4 - BOOM & PLATFORM

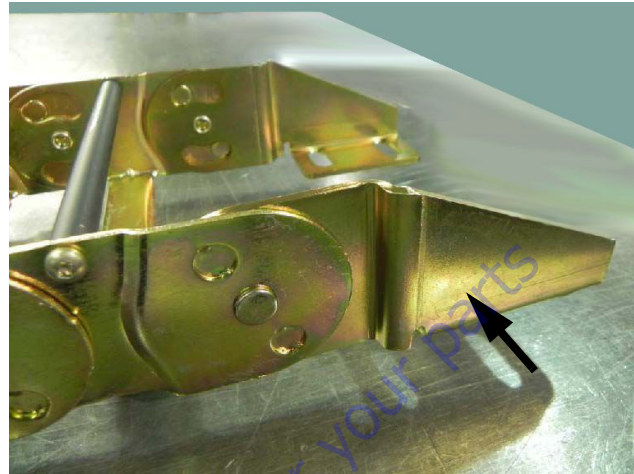
3. Install new 8-32 x 0.500 self threading screw on other side. Torque to 18-20 in. lbs. (2-2.25 Nm).



NOTE: When tightening screws make sure screw head is seated against link with no space in between link and underside of screw head.



Replace Fixed End Brackets



NOTICE

REPOSITION CABLES/HOSES AND KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

1. Remove rivets as shown in link removal instructions on page 4-7.



2. Parts used: Bracket Center Pin and Center Pin Snap Ring.



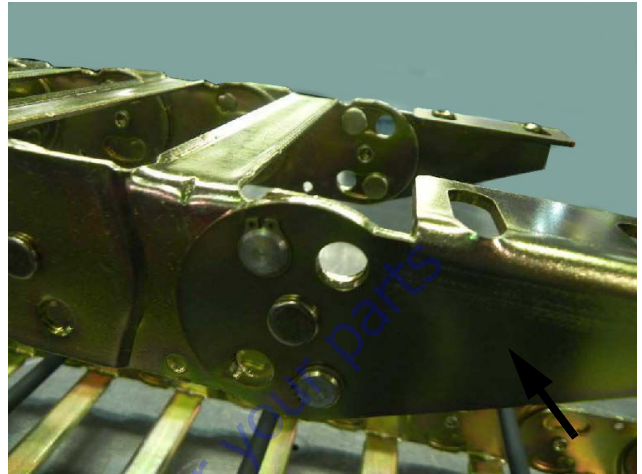
3. Take new bracket and install bracket center pin and snap ring. Repeat on other bracket if replacing it.



NOTE: When installing snap rings make sure they are seated in pin groove and closed properly.



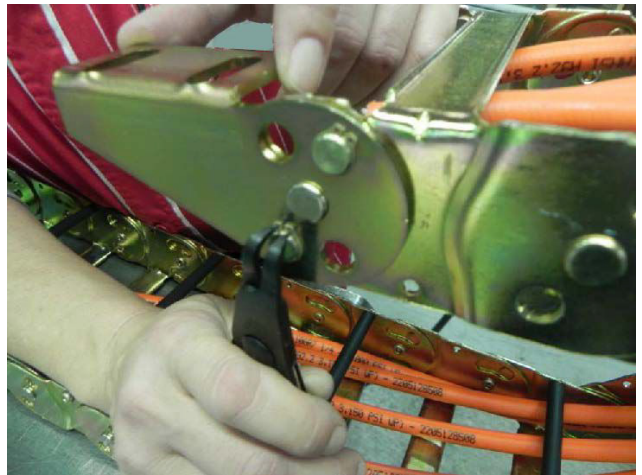
Replace Moving End Brackets



NOTICE

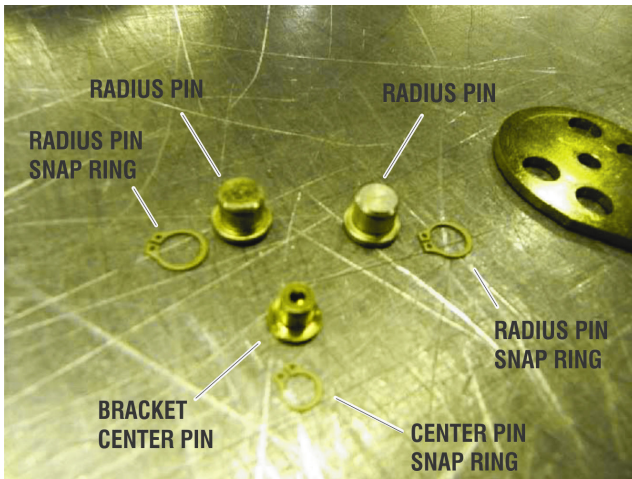
REPOSITION CABLES/HOSES AND KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

1. Remove existing pins and center rivet. Remove rivet as shown in link removal instructions on page 4-7. Repeat on other bracket if replacing it.



SECTION 4 - BOOM & PLATFORM

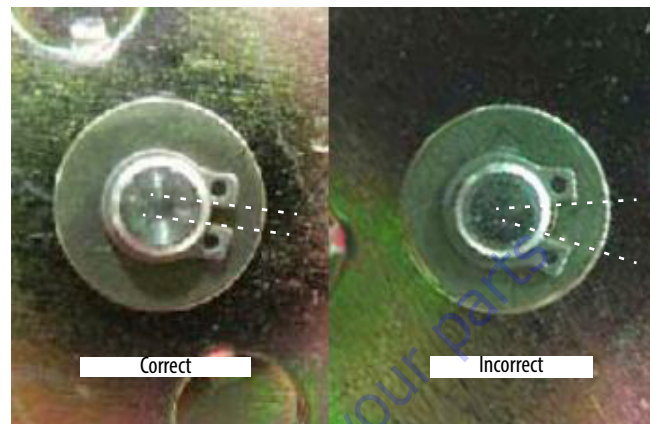
2. Install center pin with snap ring in new bracket.



3. Install radius pins and snap rings in original locations. Repeat with other moving end if replacing it.



NOTE: When installing snap rings make sure they are seated in pin groove and closed properly.



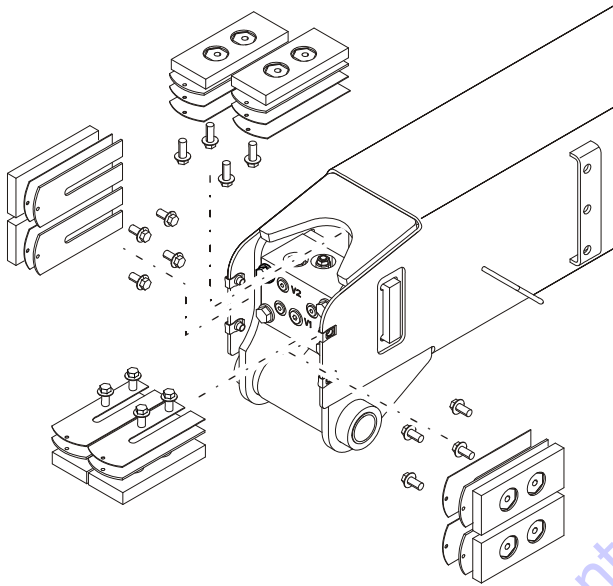
4. Make sure both brackets rotate correctly.



4.6 BOOM MAINTENANCE

Disassembly of the Main Boom

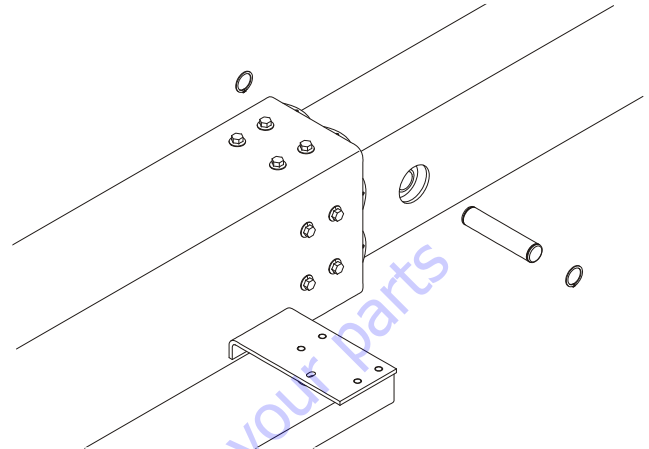
1. Loosen the wear pad retaining bolts at the rear of fly boom section and remove the shims and wear pads noting the location and amount of shims to aid in reassembly.



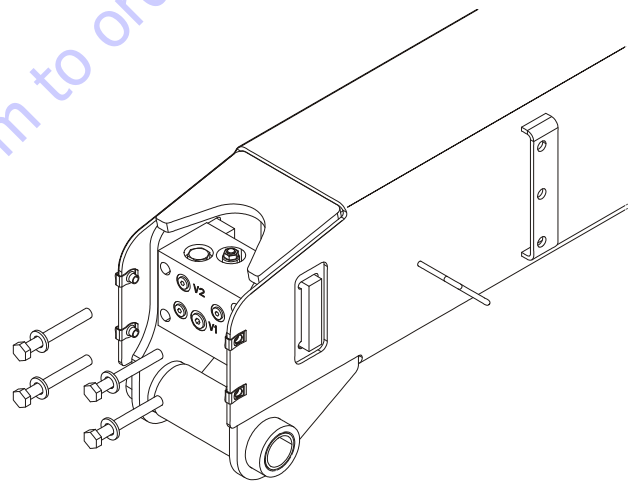
2. Using a portable power source, attach hose to telescope cylinder port block. Using all applicable safety precautions, activate hydraulic system and extend cylinder to gain access to cylinder rod retaining pin. Shut down the portable power source.
3. Carefully disconnect hydraulic hose from retract port of cylinder. There will be initial weeping of hydraulic fluid which can be caught in a suitable container. After initial discharge, there should be no further leakage from the retract port. Cap or plug all openings.

NOTE: When removing the retaining pin from the rod end of the telescope cylinder, make sure the cylinder is properly supported.

4. Remove the retaining ring and pin securing the telescope cylinder rod end to the fly boom section.



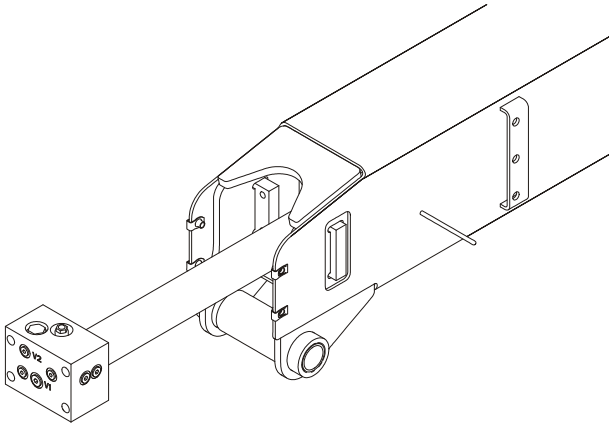
5. Remove the bolts and washers securing telescope cylinder to the rear of the base boom section.



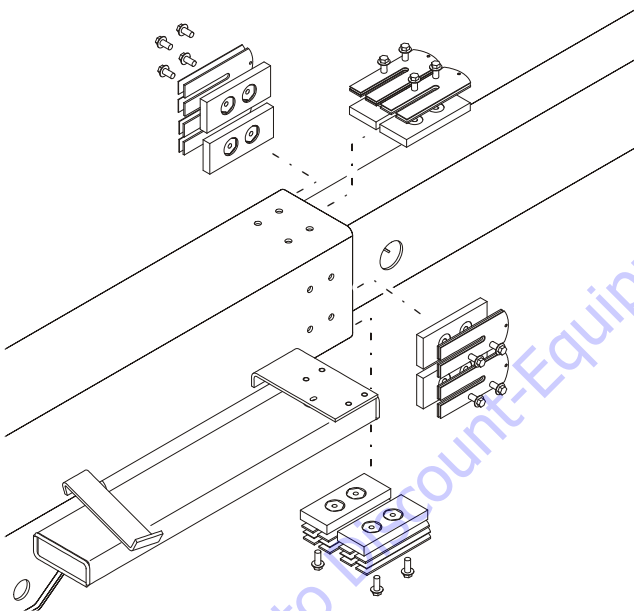
NOTE: The telescope cylinder weighs approximately 53 lbs. (24 kg).

SECTION 4 - BOOM & PLATFORM

- Using a suitable lifting device, remove telescope cylinder from the rear of the boom sections.



- Remove hardware securing the front wear pads on base boom section, remove wear pads and shims, noting the location and amount of shims to aid in reassembly.



NOTE: The fly boom section weighs approximately 188 lbs. (85 kg).

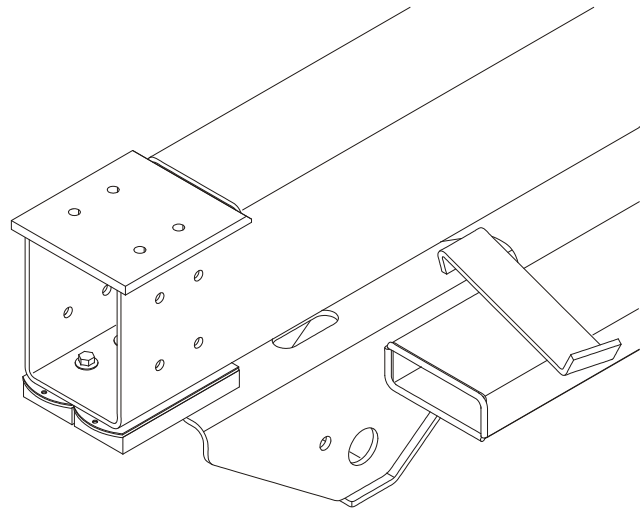
- Using a suitable lifting device, remove fly boom from boom section.

Inspection

- Inspect all boom pivot pins for wear, scoring or other damage, and for tapering or ovality. Replace pins as necessary.
- Inspect lift cylinder pins for wear, scoring or other damage, and for tapering or ovality. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
- Inspect telescope cylinder rod attach pin for wear, scoring or other damage. Replace pin as necessary.
- Inspect inner diameter of boom pivot bushings for scoring, distortion, wear or other damage. Replace bushings as necessary.
- Inspect wear pads for wear.
- Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
- Inspect structural units of boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

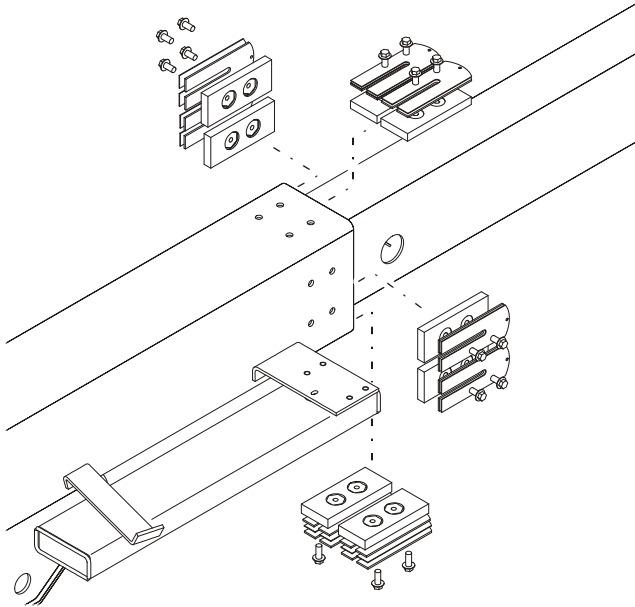
Assembly of the Main Boom

- Using JLG P/N 0100011 thread locking compound or equivalent, install the bottom wear pads and shims as noted during disassembly on the rear of the fly section. Torque the retaining bolts to 40 ft.lbs. (55 Nm). Install the rest of the wear pads on the rear of the fly section but do not install the shims or torque them at this time.

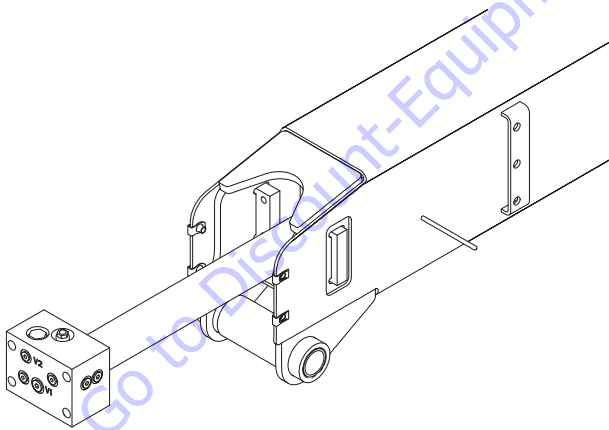


- Using an adequate lifting device, slide the fly boom section into the base boom section. Install the remaining shims on the rear of the fly section as noted during disassembly and torque the retaining bolts to 40 ft.lbs. (55 Nm). Pull the fly section out of the base section enough to install the pin that secures the telescope cylinder rod to the fly boom section.

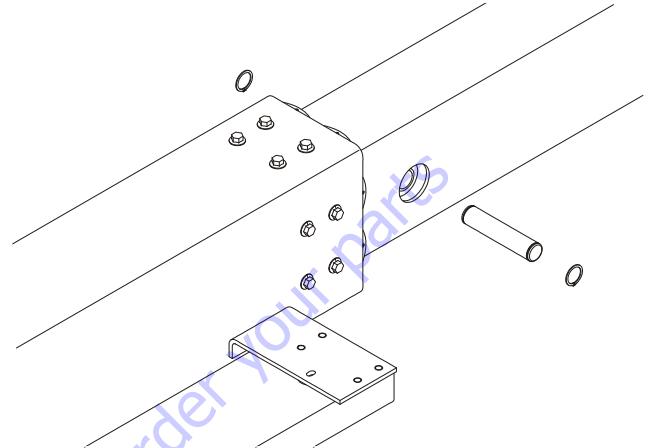
- Using JLG P/N 0100011 thread locking compound or equivalent, install the front wear pads and shims as noted during disassembly on the base boom section. Torque the retaining bolts to 40 ft.lbs. (55 Nm).



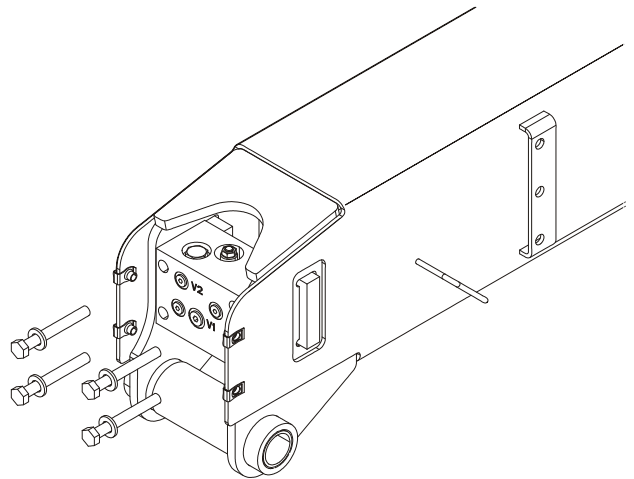
- Using an adequate lifting device, install the telescope cylinder into the boom assembly. It will aid assembly if the cylinder is extended to enable connection to the fly boom section.

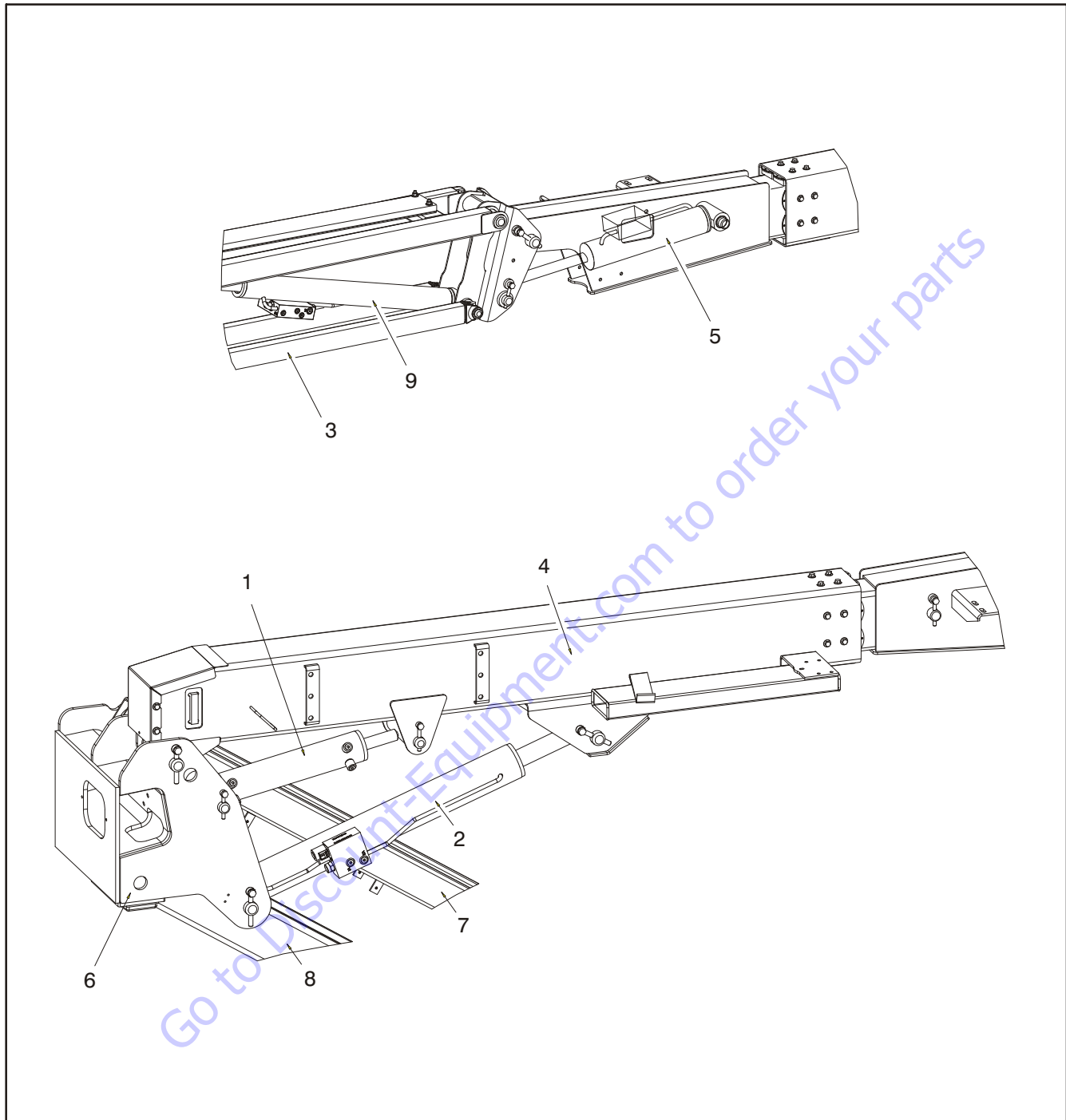


- Align the telescope cylinder rod end with the corresponding hole in the fly boom section. If necessary, attach a portable power supply to the cylinder to extend or retract the cylinder for alignment. Install the retaining pin and secure it in place with the retaining ring.



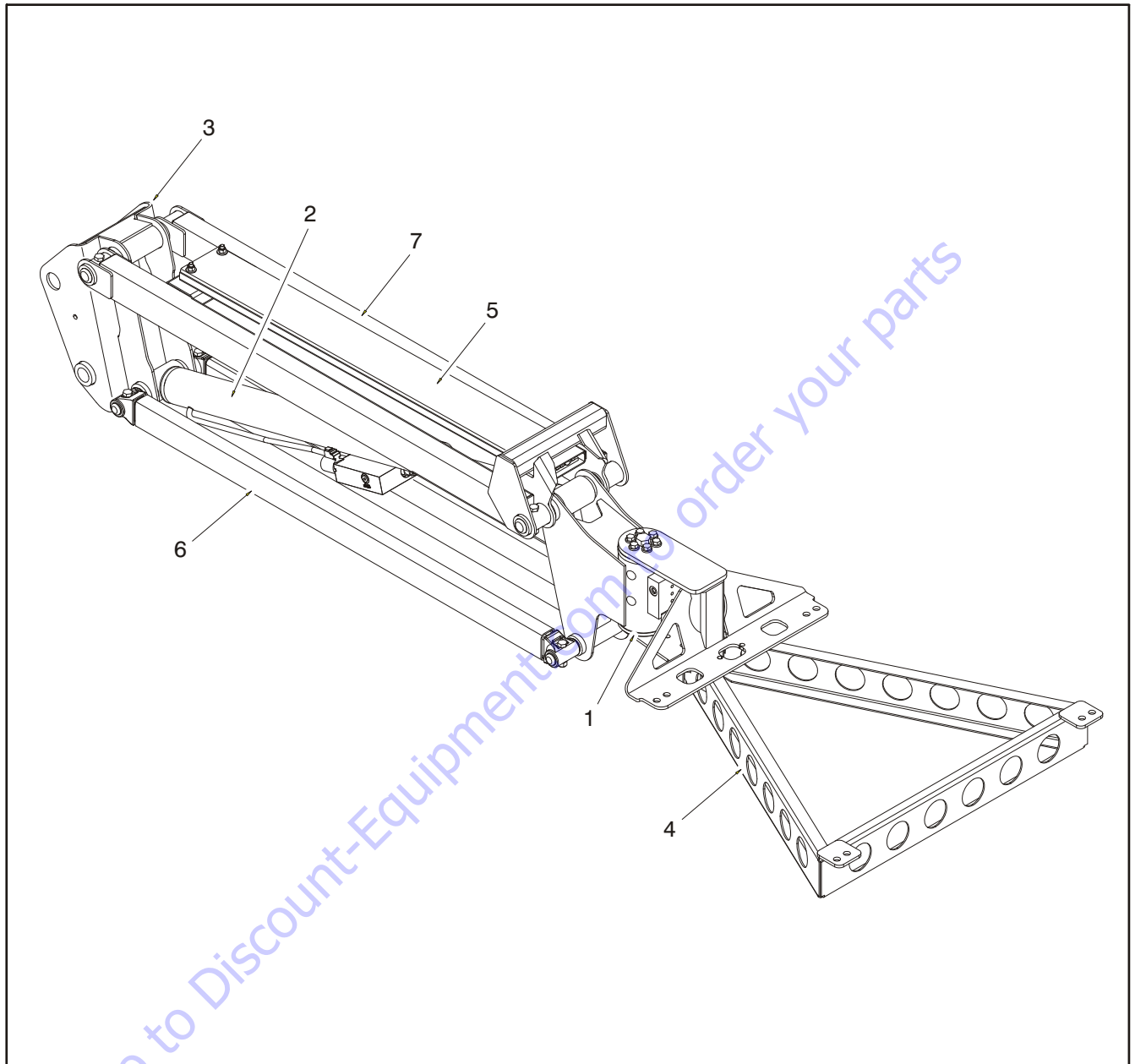
- Using JLG P/N 0100011 thread locking compound or equivalent, secure the rear of the telescope cylinder to the base boom section with the attaching bolts and washers. Torque the bolts 95 ft.lbs. (129 Nm).





- | | |
|------------------------|------------------|
| 1. Master Cylinder | 6. Upper Upright |
| 2. Upper Lift Cylinder | 7. Mid Boom Link |
| 3. Jib | 8. Mid Boom |
| 4. Main Boom | 9. Jib Cylinder |
| 5. Level Cylinder | |

Figure 4-4. Main Boom Assembly



- | | |
|---------------------|-------------------|
| 1. Rotator | 5. Hose Carrier |
| 2. Jib Cylinder | 6. Lower Jib Link |
| 3. Jib Pivot | 7. Upper Jib Link |
| 4. Platform Support | |

Figure 4-5. Jib/ Platform Support

4.7 BOOM CLEANLINESS GUIDELINES

The following are guidelines for internal boom cleanliness for machines that are used in excessively dirty environments.

1. JLG recommends the use of the JLG Hostile Environment Package if available to keep the internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.
2. JLG recommends that you follow all guidelines for servicing your equipment in accordance with the instructions outlined in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to the proper operation of the machine. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.
3. Debris and foreign matter inside of the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JLG Service & Maintenance Manuals.
4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow the debris toward the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.
5. If pressurized air cannot dislodge the debris, then water with mild solvents applied via a pressure washer can be used. Again the method is to wash the debris toward the nearest exiting point from the boom. Make sure that all debris is removed, that no "puddling" of water has occurred, and that the boom internal components are dry prior to operating the machine. Make sure you comply with all federal and local laws for disposing of the wash water and debris.
6. If neither pressurized air nor washing of the boom dislodges and removes the debris, then disassemble the boom in accordance to the instructions outlined in the JLG Service & Maintenance Manual to remove the debris.

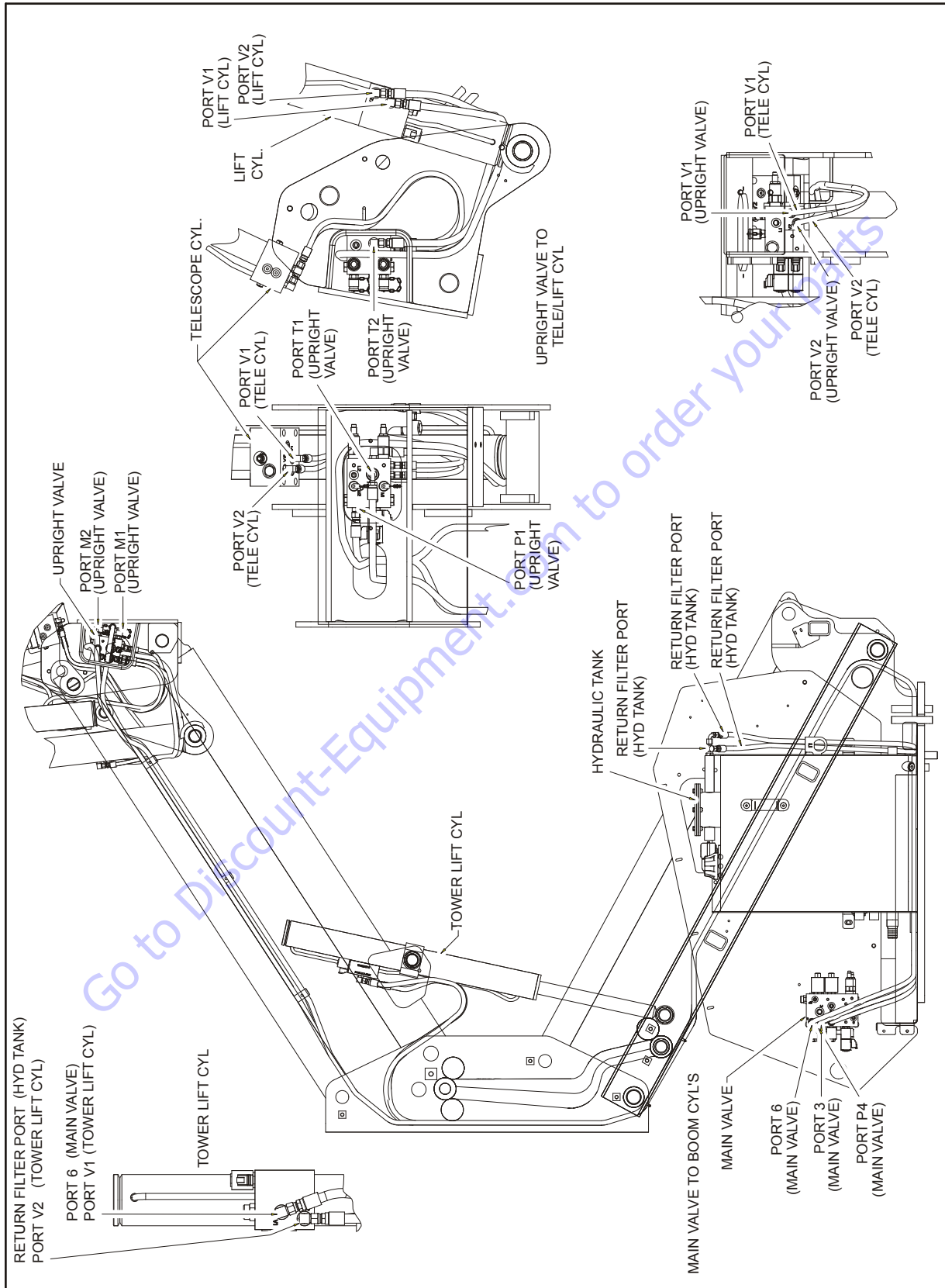


Figure 4-6. Boom Hydraulic Lines - Sheet 1 of 2

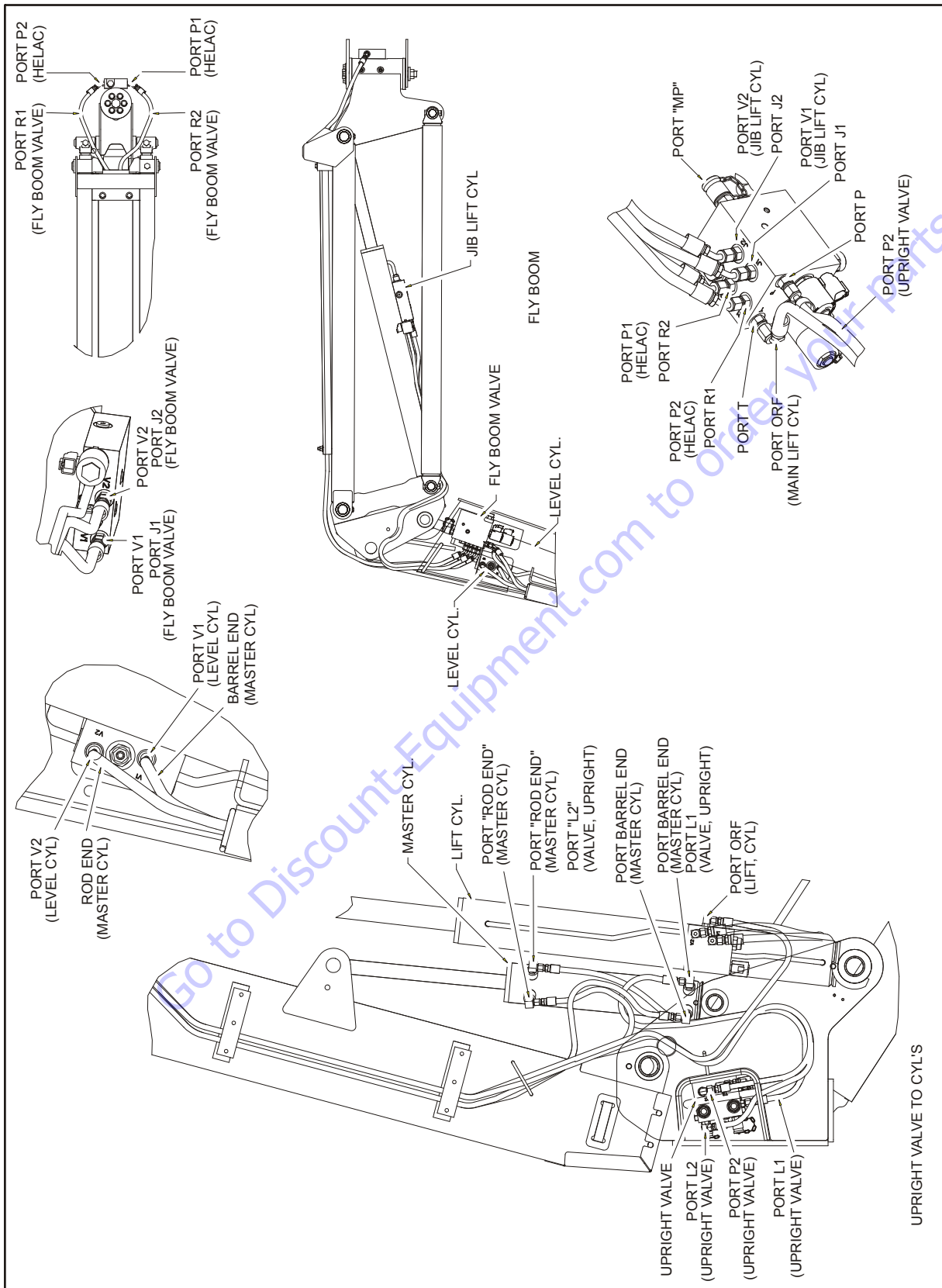


Figure 4-7. Boom Hydraulic Lines - Sheet 2 of 2

4.8 ROTARY ACTUATOR

Each actuator is individually serial numbered. The serial number is a five or six digit number and must be provided before parts and/ or service issues can be addressed.

The serial number can be found on the Identification (ID) Tag that is affixed to all actuators. The tag is a thin, silver colored, plastic material with a self-adhesive backing. Information is imprinted in black. The tag is located either on the side plate or on the housing tube of the actuator.

Additionally, the serial number of the actuator is stamped onto the side plate or the housing tube. It may be necessary to remove paint to expose the serial number.

Theory of Operation

The rotary actuator is a simple mechanism that uses Helac's sliding spline technology which converts axial piston motion into powerful shaft rotation. As seen in the illustration below left, each actuator is composed of a housing with an integral ring gear (1) and only two moving parts: the central shaft (2), and the annular piston sleeve (3). Note the actuator shaft features an integral mounting flange and bearing which are not shown in the illustration.

Helical spline teeth machined on the shaft engage matching splines on the inside diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage the matching splines of the housing's ring gear.

As hydraulic pressure is applied, the piston is displaced axially within the housing - similar to the operation of a hydraulic cylinder - while, simultaneously, the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the housing, preventing piston movement and locking the shaft firmly in position.

The shaft is supported radially by the large upper radial bearing and the lower radial bearing (see drawings on pages 8 and 9). Axially, the shaft is separated from the housing by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins. Configurations of parts may be slightly different depending on model.

Many actuators are equipped with counterbalance valves, which performs four major functions.

- Protects the actuator in the event of overload
- Enables the actuator to hold position without drifting when external loads are applied
- Reduces hydraulic backlash by pressuring the hydraulic fluid
- Provides a constant controlled rate of rotation in over-center load conditions

Applying fluid pressure will displace the piston axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston. Applying pressure to the opposite port will return the piston and shaft to their original starting positions.

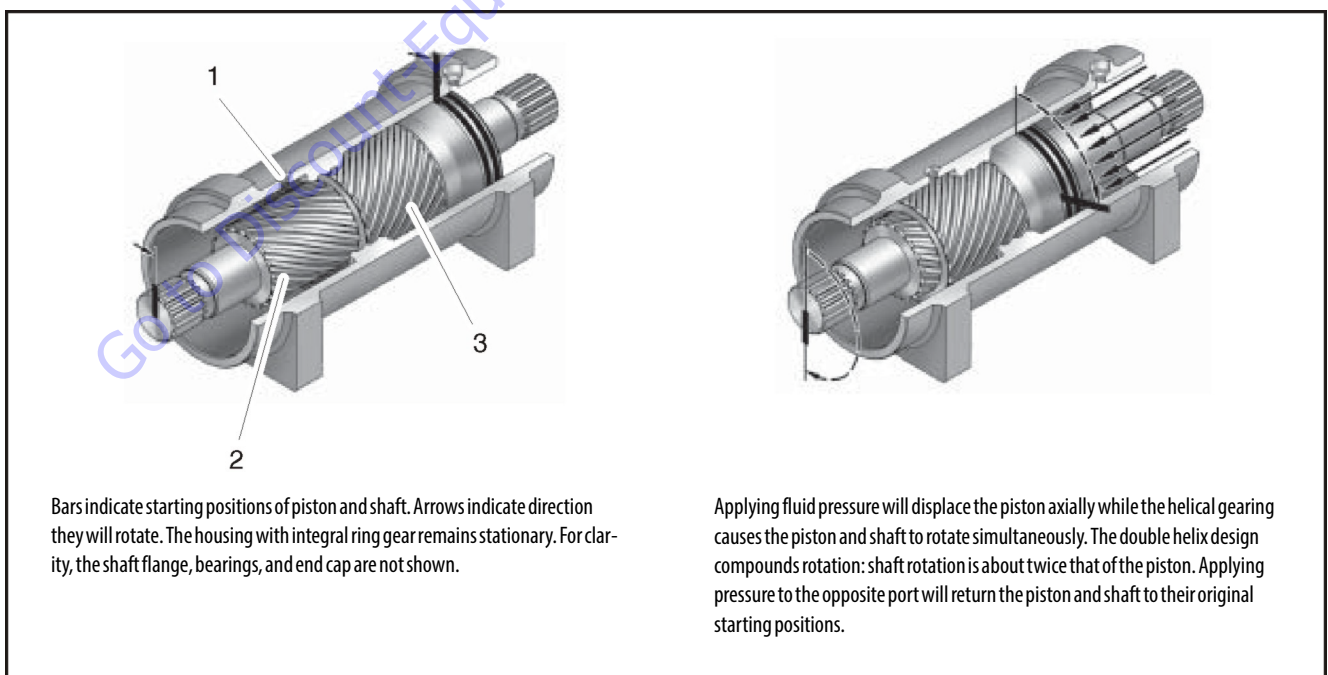


Figure 4-8. Actuator Theory of Operation

Tools Required



Several basic tools are required for the disassembly and reassembly of the actuator. The tools and their intended functions are outlined below:

- 1. PIPE VISE
- 2. HEXWRENCH
Removal and replacement of port plugs and set screws.
- 3. ASSORTED SCREWS
- 4. SAFETY GLASSES
- 5. END CAP REMOVAL TOOLS
(provided with seal kit)
- 6. DRILL
- 7. FLASHLIGHT
Helps in locating and examining timing marks, component failure and overall condition.
- 8. RUBBER MALLET
Removal and installation of shaft and piston sleeve assembly.

- 9. PLASTIC MANDREL
- 10. PRY BAR
Removal of end cap and manual rotation of shaft.
- 11. FELT MARKER
Highlights timing marks and outlines troubled areas. Permanent ink is recommended.
- 12. T-HANDLE SCREW EXTRACTOR
- 13. HEX WRENCH SET
Removal and replacement of port plugs and set screws (106,110).
- 14. SEAL TOOLS
Removal and installation of seals and wear guides. Directions on making a seal tool are provided at bottom
- 15. PUNCH
- 16. DOWEL PINS
Removal and installation of end cap.

MAKING A SEAL TOOL



The seal tool is merely a customized standard flat head screwdriver.

- 1. Heat the flat end with a torch until it glows.
- 2. Secure the heated end of the screwdriver in a vise and bend the heated end to a slight radius.
- 3. Round off all sharp edges of the heated screwdriver to a polished finish. The tool may be modified slightly to your own personal preference.

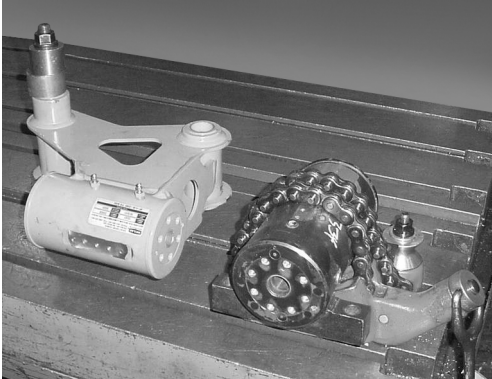
⚠ CAUTION

TO AVOID INJURY BE CAREFUL WHEN HANDLING THE SCREWDRIVER WHEN HOT.

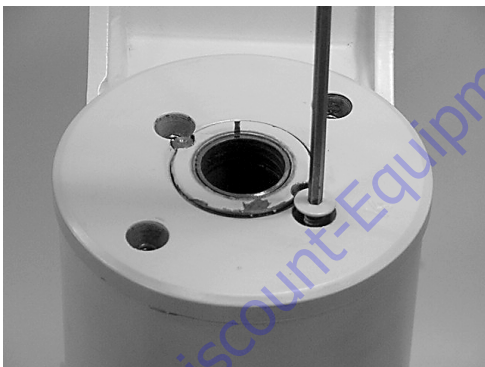
Disassembly

Inspect the actuator for corrosion prior to disassembly. Severe corrosion can make it difficult to remove the lock pins (109) and unthread the end cap (04). If corrosion is evident, soak the lock pins and end cap with penetrating oil for several hours before disassembling.

Disassembly is easier if the actuator is firmly secured to a work bench. A pipe vise or mounting fixture works well for this purpose.



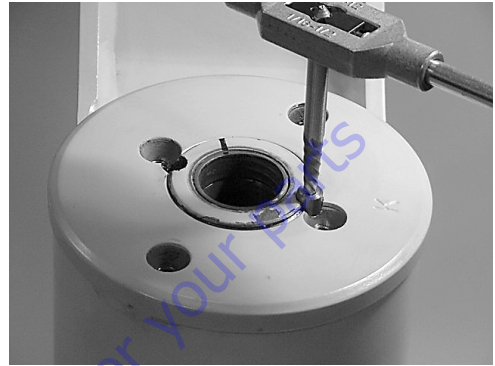
1. Remove port plugs (106.1) (106.2) and drain oil. Inspect oil for signs of contamination, i.e. water, metal shavings.



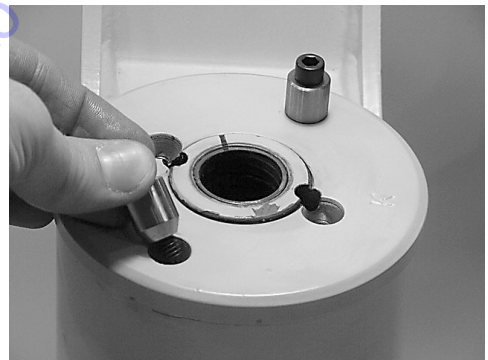
2. Remove the cap screws (113) that cover the end cap lock pins (109).
3. Using a 1/8" (3 mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/16" (5 mm).

4. Remove the lock pins using a screw extracting tool such as an "Easy Out" (a size #2 is shown).

If the pin cannot be removed with the screw extractor, use a 5/16" bit to drill out the entire pin. Do not drill deeper than 1/2" (12.7 mm).

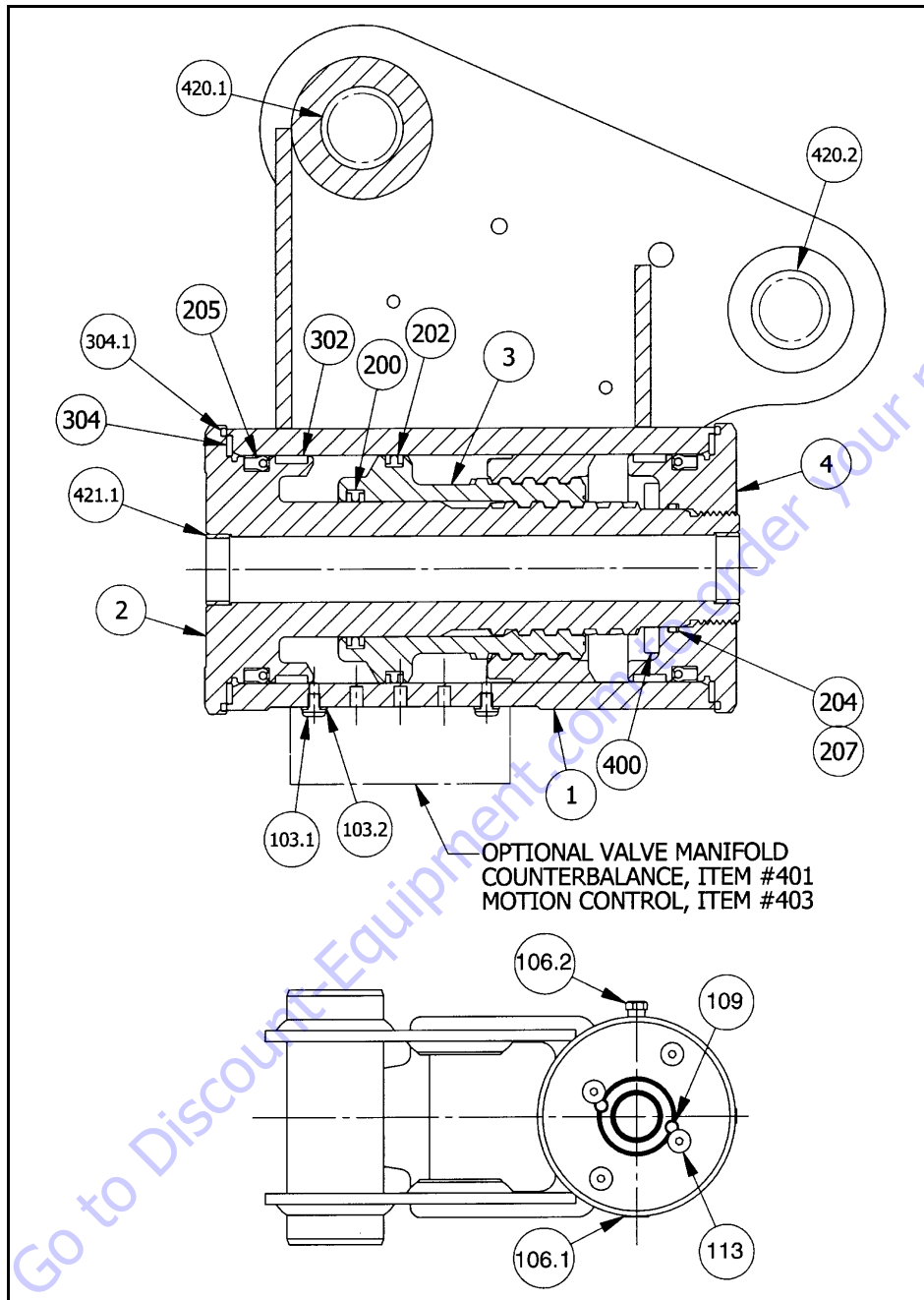


5. Install the end cap removal tools provided with the seal kit. (1/4-20)



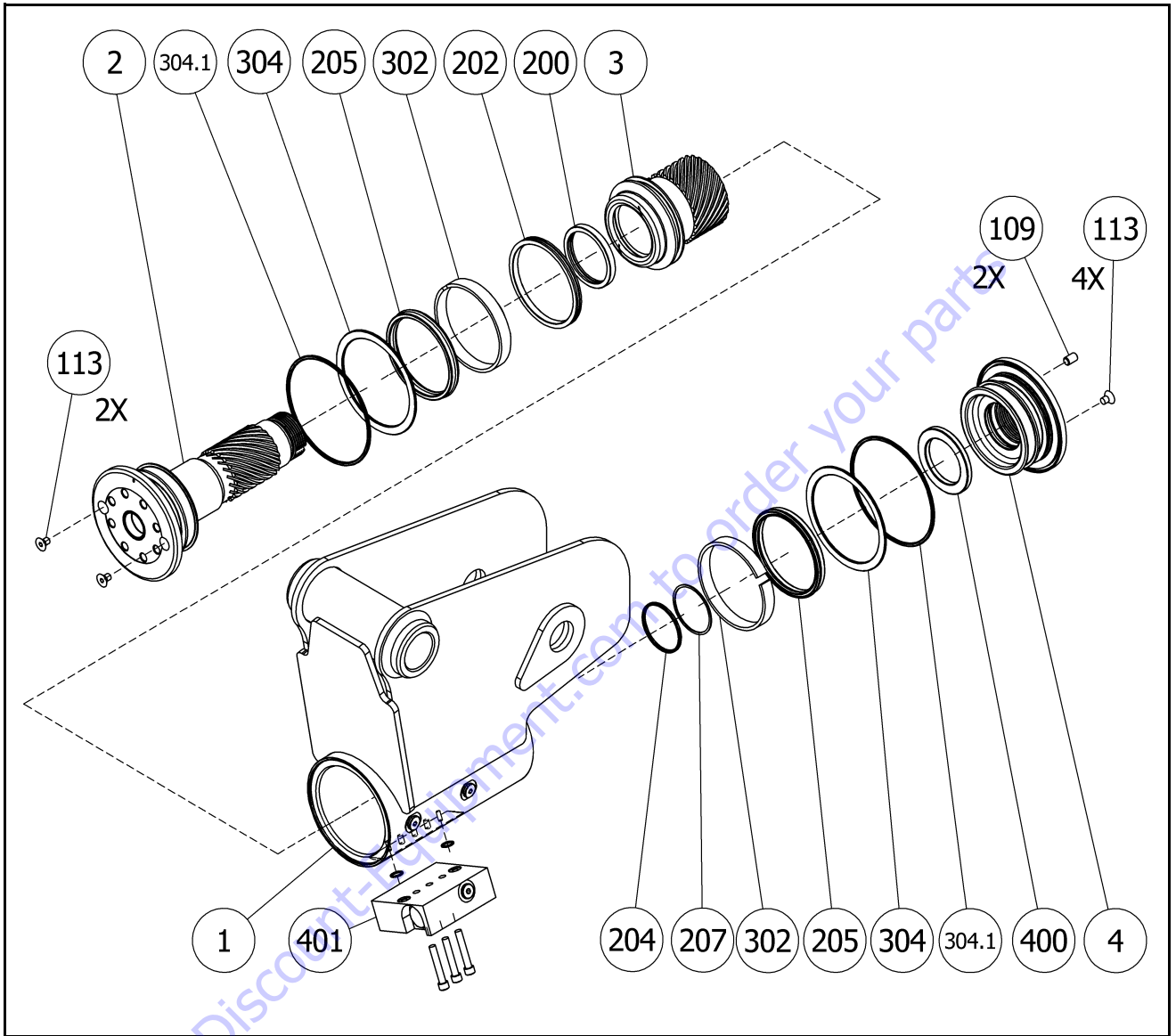
6. Using a metal bar or similar tool, unthread the end cap (4) by turning it counterclockwise.





PARTS	HARDWARE	SEALS	BEARINGS	ACCESSORIES
1. Housing	103.1. Screw	200. T-Seal	302. Wear Guide	400. Stop Tube
2. Shaft	103.2. Washer	202. T-Seal	304. Thrust Washer	420.1 Bushing
3. Piston Sleeve	106.1. Port Plug	204. O-ring		420.2 Bushing
4. End Cap	106.2. Port Plug	205. Cup Seal		421.1 Bushing
	109. Lock Pin	207. Backup Ring		
	113. Capscrew	304.1. Wiper Seal		

Figure 4-9. Rotary Actuator - Assembly Drawing



PARTS

- 1. Housing
- 2. Shaft
- 3. Piston Sleeve
- 4. End Cap

HARDWARE

- 103.1. Screw
- 103.2. Washer
- 106.1. Port Plug
- 106.2. Port Plug
- 109. Lock Pin
- 113. Capscrew

SEALS

- 200. T-Seal
- 202. T-Seal
- 204. O-ring
- 205. Cup Seal
- 207. Backup Ring
- 304.1. Exclusion Seal

BEARINGS

- 302. Wear Guide
- 304. Thrust Washer

ACCESSORIES

- 400. Stop Tube
- 401. Counterbalance Valve

Figure 4-10. Rotary Actuator - Exploded View

SECTION 4 - BOOM & PLATFORM

7. Remove the end cap (4) and carefully set aside for later inspection.

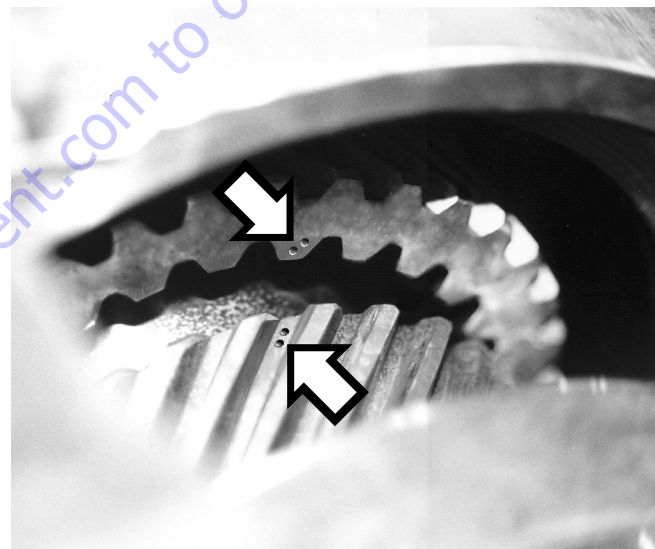
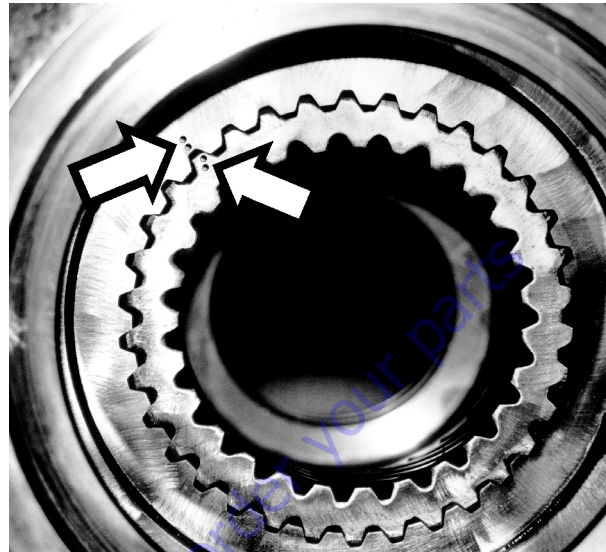


8. Remove the stop tube (400) if the actuator is equipped with one. The stop tube is an available option that limits the rotation of the actuator.



9. Every actuator has two sets of small punched timing marks that indicate timing between the gear sets. The location and appearance of the marks can vary slightly between models. One set indicates the timing between the piston sleeve (3) and the housing (1) (upper photo), the second set between the piston and the shaft (lower photo). To ensure correct rotation and accurate end positions, it is essential that the actuator be correctly timed when it is reassembled. The punched timing marks can be used, but it is easier to highlight punched

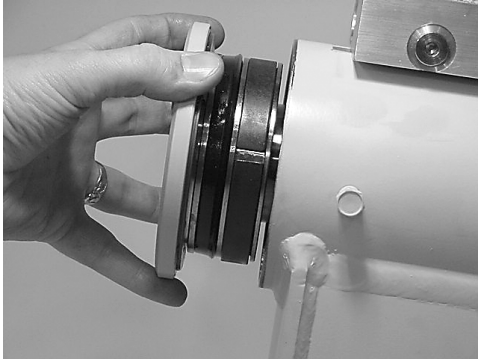
marks with a marker before disassembly as outlined in the steps below.



10. Prior to removing the shaft (2), use a felt marker to clearly indicate the timing between shaft and piston sleeve (3). This will greatly simplify timing when the actuator is reassembled.



- 11.** Remove the shaft (2) by rotating counterclockwise. As the shaft is rotated, it will disengage from the piston sleeve (3) and can be removed. It may be necessary to strike the threaded end of the shaft with a rubber mallet.



- 12.** As in step 9, before removing the piston (3), mark the housing (1) ring gear in relation to the piston outside diameter gear. There should now be timing marks on the housing (1) ring gear, the piston (3) and the shaft (2).



- 13.** To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston and housing bore are not damaged.



- 14.** At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.



- 15.** Remove the O-ring (204) and backup ring (207) from end cap (4).



NOTICE

TO AVOID DAMAGE TO MACHINED PARTS CAREFULLY REMOVE SEALS USING REMOVAL TOOLS WITH ROUNDED EDGES.

- 16.** Remove the wear guide (302) from the end cap (4) and shaft (2).

