Service and Maintenance Manual

Model
340AJ

PVC 2001

31215004

December 16, 2019 - Rev A

ANSI

CE

AS/NZS

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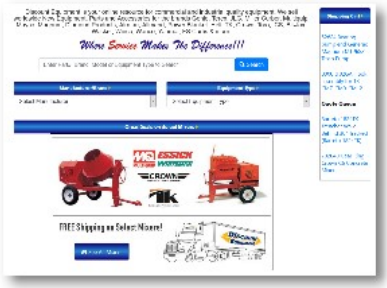

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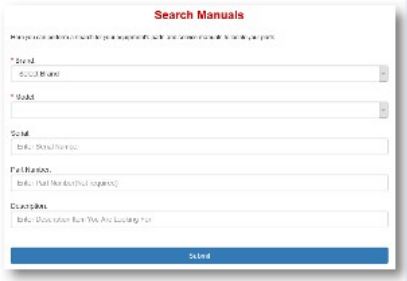

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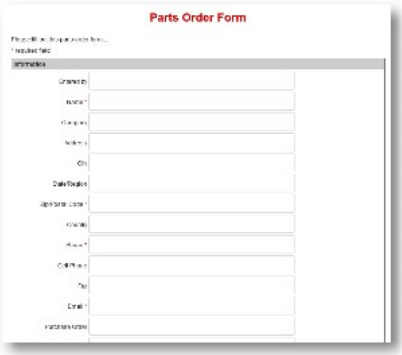

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

This section contains the general safety precautions which must be observed during maintenance of the mobile elevating work 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 A MOBILE ELEVATING 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.

- USE ONLY REPLACEMENT PARTS OR COMPONENTS THAT ARE APPROVED BY JLG. TO BE CONSIDERED APPROVED, REPL ACEMENT PARTS OR COMPONENTS MUST BE IDENTICAL OR EQUIVALENT TO ORIGINAL PAR TS 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.

REVISON LOG

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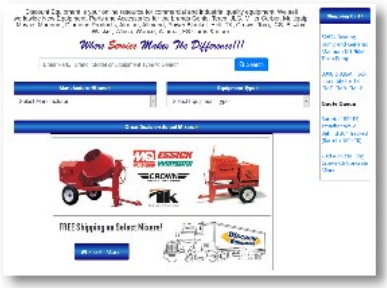

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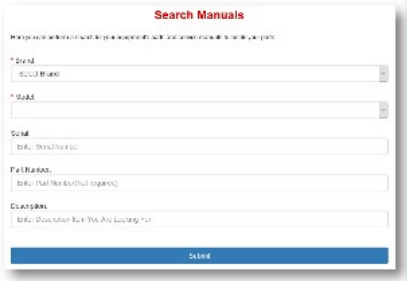

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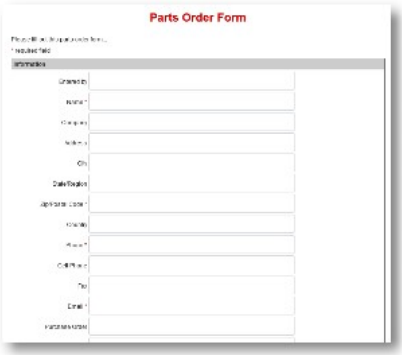

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Capacity: Unrestricted: ANSI CE & Australia	 500 lb (227 kg) 507 lb (230 kg)
Maximum Travel Grade, stowed Position (Gradeability)	45%
Maximum Travel Grade, stowed Position (Side Slope)	3°
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 lb (4263 kg) 9700 lb (4400 kg)
Ground Bearing Pressure Foam Filled Solid Non-Marking Solid	 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

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' 2" (4.02 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 cm)
Platform Height (w/LSS)	33' 10.5" (10.33 m)
Ground Clearance	10.1" (23.7 cm)

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. (5.9L)
*Drive hubs should be one half full of lubricant.	

1.4 TIRES

Size	**IN265/50D20 (20"x 9")**
Maximum Tire Load	4800 lb (2177 kg)
Type	Foam-Filled
Size	**7" x 18"**
Maximum Tire Load	4800 lb (2177 kg)
Type	Solid
Size	**33" x 12"**
Maximum Tire Load	4800 lb (2177 kg)
Type	Turf/Sand (Foam-Filled)

1.5 ENGINE DATA

Table 1-1. 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 1-2. 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

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, 10W 30
+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 Standard UTTO 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 Premium Hydraulic Fluid.*

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 1-3. Mobilfluid 424 Specs

SAE Grade	10W 30
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 1-4. 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	6.63cSt
at 100° F	32.7 cSt
at 212° F	6.63 cSt
Viscosity Index	164

Table 1-5. 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 1-6. 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.

Components	LB	KG
Counterweight	1875 ± 75	850.5 ± 34
Tire and Wheel - 20x9 Foam-Filled	220	99.8
Tire and Wheel - 7x18	230	104.3
Tire and Wheel - 33x12 Foam-Filled	227	125.6
Platform & Console - 30x60	242.5	110
Platform & Console - 30x48	216	98
Battery	66	30

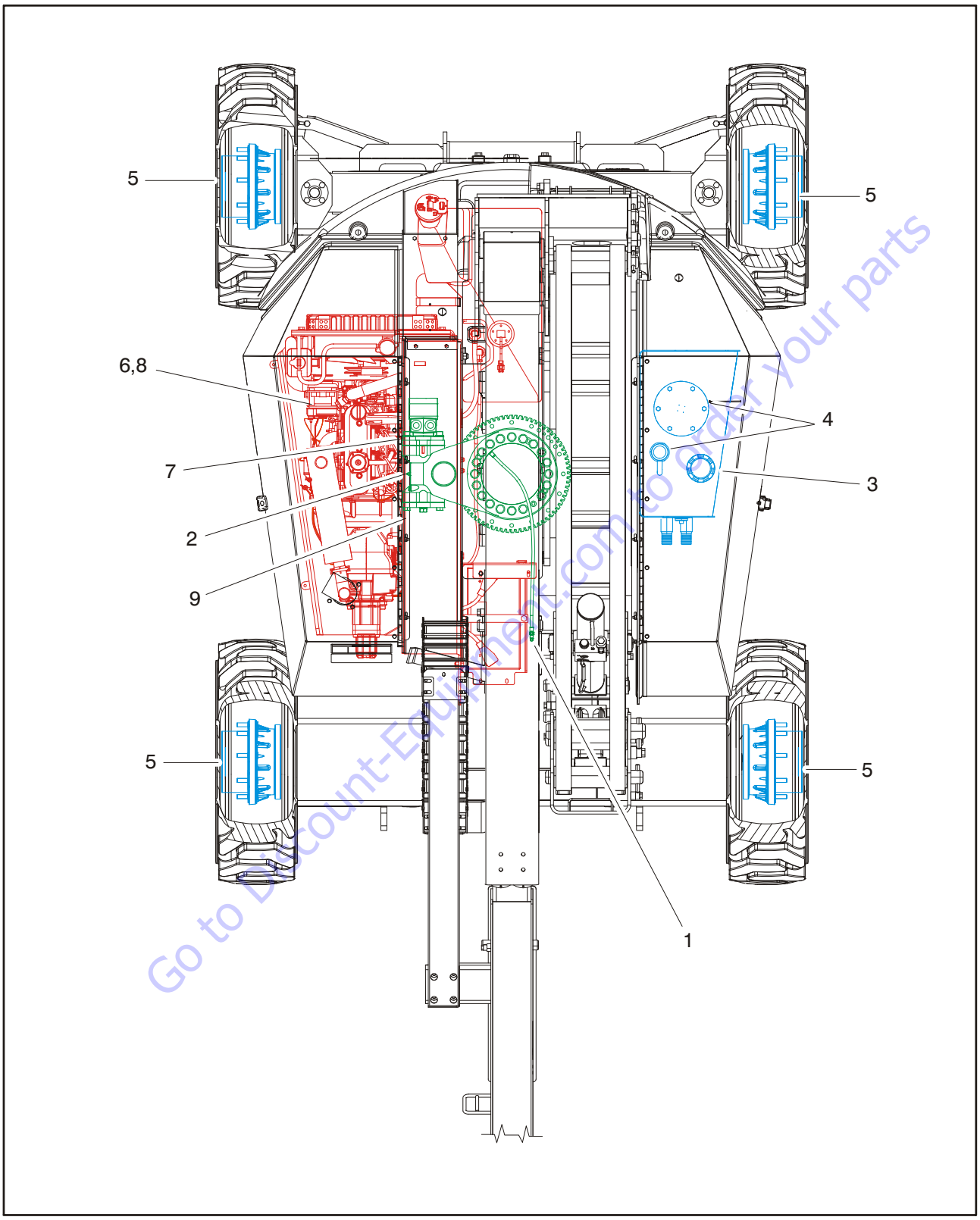


Figure 1-1. Operator Maintenance and Lubrication Diagram

1.7 OPERATOR MAINTENANCE

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

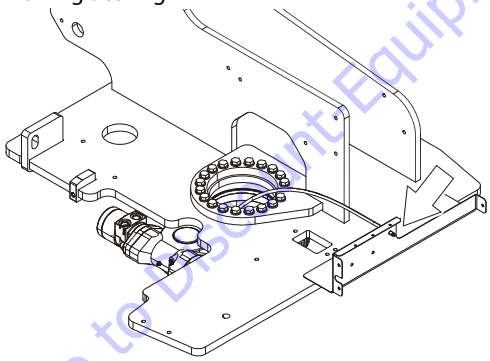
Table 1-7. Lubrication Specifications

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

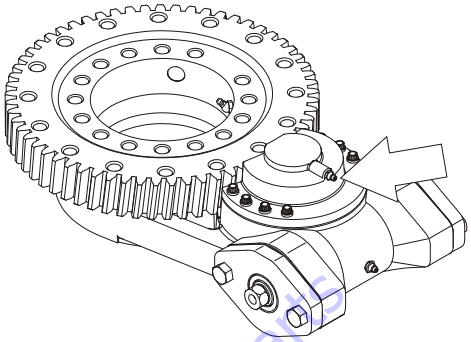
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

1. Swing Bearing

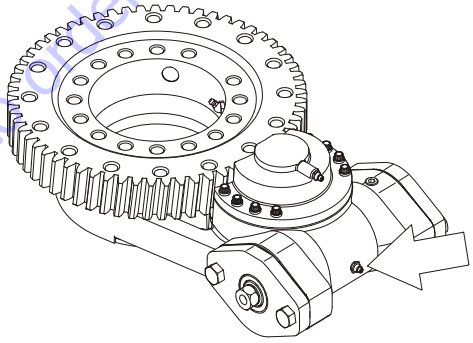


Lube Point(s) - Remote Fitting
Capacity - A/R
Lube - BG
Interval - Every 3 months or 150 hrs of operation
Comments - Apply grease and rotate in 90 degree intervals until bearing is completely lubricated

2. Swing Bearing/Worm Gear Teeth



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

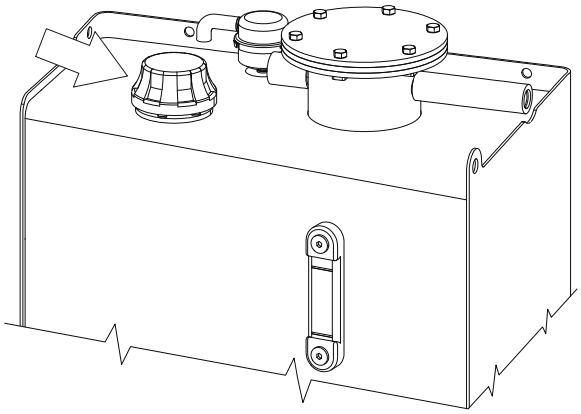


Lube Point(s) - Grease Fitting
Capacity - A/R
Lube - Mobil SHC 460
Interval - A/R

⚠ CAUTION

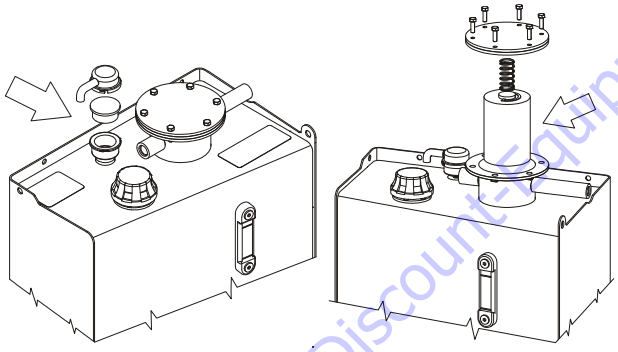
DO NOT OVERGREASE BEARINGS. OVERGREASING BEARINGS WILL RESULT IN DAMAGE TO OUTER SEAL IN HOUSING.

3. Hydraulic Tank



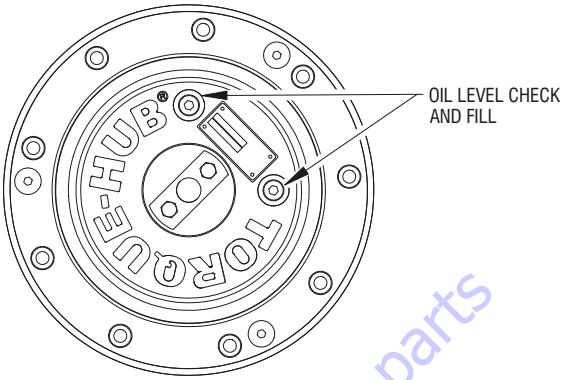
Lube Point(s) - Fill Cap
Capacity - 24.8 Gal. (93.9 L), 20.6 Gal. (77.9 L) to Full Level; 17.8 Gal (67.4 L) to Low Level
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.
Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate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

4. Hydraulic Tank Return Filter and Breather



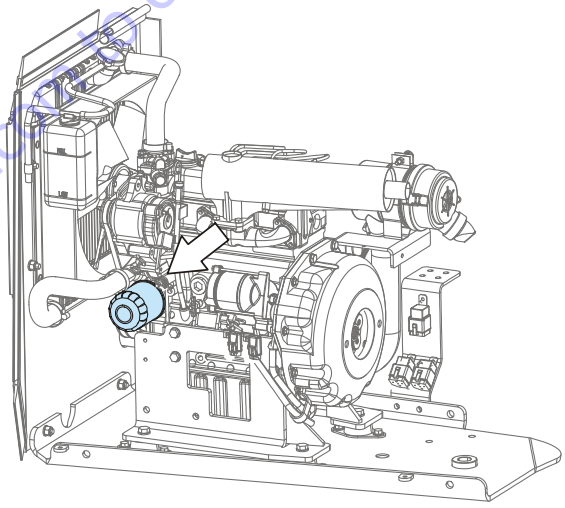
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.
Comments - For breather element, twist top to replace.

5. Wheel Drive Hub



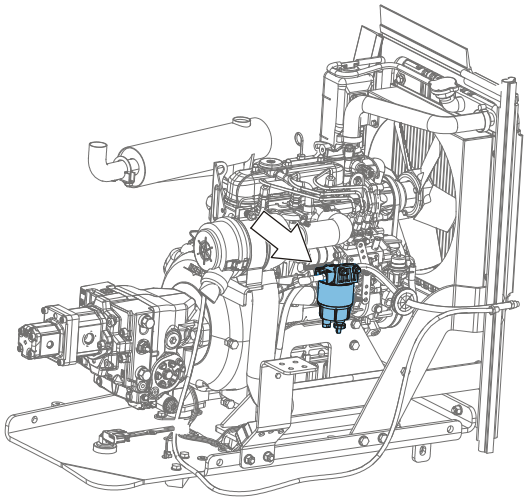
Lube Point(s) - Level/Fill Plug
Capacity - 25.5 oz. (0.75 L)(1/2 Full)
Lube - EPGL
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

6. Oil Change with Filter - Kubota



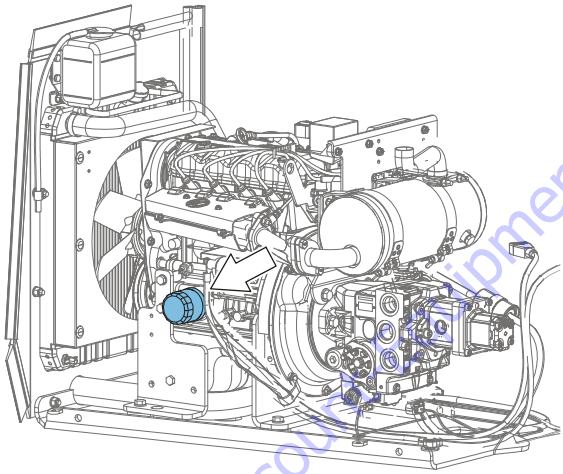
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 5.4 Quarts (5.1 L) w/Filter
Lube - EO
Interval - Check level daily; change every 500 hours or six months, whichever comes first. Adjust final oil level by mark on dipstick.

7. Fuel Filter/Water Separator - Kubota



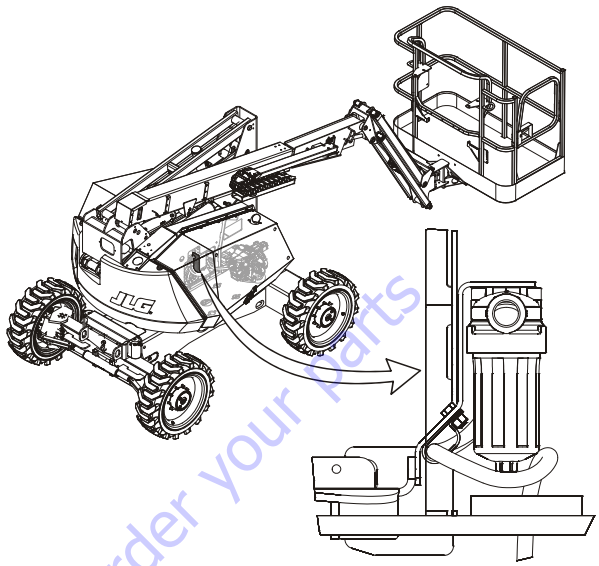
Lube Point(s) - Replaceable Element
Interval - Every year or 600 hours of operation

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

1.8 THREADLOCKING COMPOUND

JLG PN	Loctite®	ND Industries	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
1001095650	243™	Vibra-TITE™ 122	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

NOTE: *Loctite® 243™ can be substituted in place of Loctite® 242™. Vibra-TITE™ 122 can be substituted in place of Vibra-TITE™ 121.*

1.9 TORQUE CHARTS

SAE Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 111)	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	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				
	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				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
11/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
11/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
13/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
11/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

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 (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8				
	48	0.1120	0.00661	420	8	0.9				
6	32	0.1380	0.00909	580	14	1.5				
	40	0.1380	0.01015	610	14	1.6				
8	32	0.1640	0.01400	900	25	2.8				
	36	0.1640	0.01474	940	26	2.9				
10	24	0.1900	0.01750	1120	36	4.1				
	32	0.1900	0.02000	1285	42	4.7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9		
	28	0.2500	0.0364	2320	99	11.1	95	11		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20
	24	0.3125	0.0580	3700	15	20	15	21	15	20
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34
	24	0.3750	0.0878	5600	30	40	28	38	25	34
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48
	20	0.4375	0.1187	7550	45	60	44	60	40	54
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75
	20	0.5000	0.1599	10700	75	100	71	97	65	88
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109
	18	0.5625	0.2030	12950	105	145	97	132	90	122
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156
	18	0.6250	0.2560	16300	145	195	136	185	125	170
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272
	16	0.7500	0.3730	23800	255	345	238	324	225	306
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435
	14	0.8750	0.5090	32400	400	545	378	514	355	483
1	8	1.0000	0.6060	38600	545	740	515	700	480	653
	12	1.0000	0.6630	42200	600	815	563	765	530	721
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809
	12	1.1250	0.8560	47500	755	1025	713	969	670	911
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237

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

5000059K

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	37	4				
10	24	0.1900	0.01750	1580	51	6				
	32	0.1900	0.02000	1800	58	7				
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

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.

SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*										
SOCKET HEAD CAPSCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
11/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
11/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
13/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
11/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

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.

Metric Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*							
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS							
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™)	Torque (Lube)	Torque (Loctite® 262™ or 271™ or Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 141)
		Sq mm	KN	[N.m]		[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

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
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.

5000059K

Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS, CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAPSCREWS M3 - M5*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.20	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25	23	19
8	1.25	36.60	22.8	37	33	27
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	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
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.

5000059K

Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube 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]
3	0.5	5.03	2.19	1.1	1.1	1.0
3.5	0.6	6.78	2.95	1.8	1.7	1.5
4	0.7	8.78	3.82	2.6	2.4	2.3
5	0.8	14.20	6.18	5.3	4.9	4.6
6	1	20.10	8.74	9	8.4	7.9
7	1	28.90	12.6	15	14	13
8	1.25	36.60	15.9	22	20	19
10	1.5	58.00	25.2	43	40	38
12	1.75	84.30	36.7	75	70	66
14	2	115	50.0	119	110	105
16	2	157	68.3	186	175	165
18	2.5	192	83.5	256	240	225
20	2.5	245	106.5	362	340	320
22	2.5	303	132.0	494	465	435
24	3	353	153.5	627	590	555
27	3	459	199.5	916	860	810
30	3.5	561	244.0	1245	1170	1100
33	3.5	694	302.0	1694	1595	1495
36	4	817	355.5	2176	2050	1920
42	4.5	1120	487.0	3477	3275	3070

NOTES:

1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS

5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER
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.

Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS, CLASS 12.9 SOCKET HEAD CAPSCREWS M6 AND ABOVE*						
Size	**Pitch**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry or Loctite® 263™) K=0.17**	**Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18**	**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**
		Sq mm	**KN**	**[N.m]**	**[N.m]**	**[N.m]**
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	55
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	222.0	905	850	800
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

NOTES:

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2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER
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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PARTS FINDER

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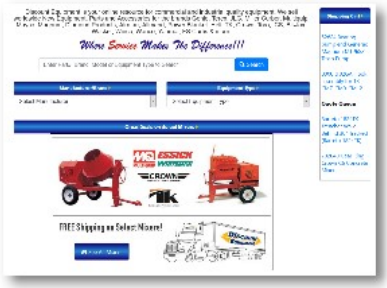

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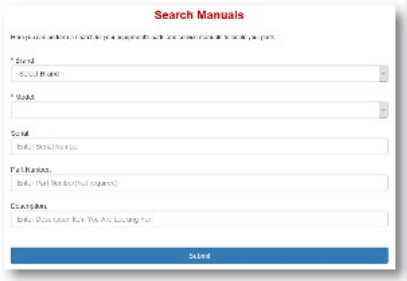

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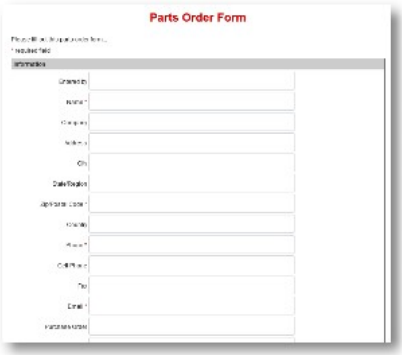

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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, 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 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 mobile elevating 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 Operation 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 Table 1-7, Lubrication Specifications

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 Table 1-7, Lubrication Specifications. 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.

2.3 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.

2.4 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, pealing, 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.

2.5 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
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	1, 2, 4, 5
Oscillating Axle/Lockout Cylinder Systems	1, 2, 4, 5	1, 2, 4, 5
Steer Components	1, 2	1, 2
Spindle Thrust Bearing/Washers	1, 2	1, 2
Drive Hubs	1, 4	1, 4

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	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

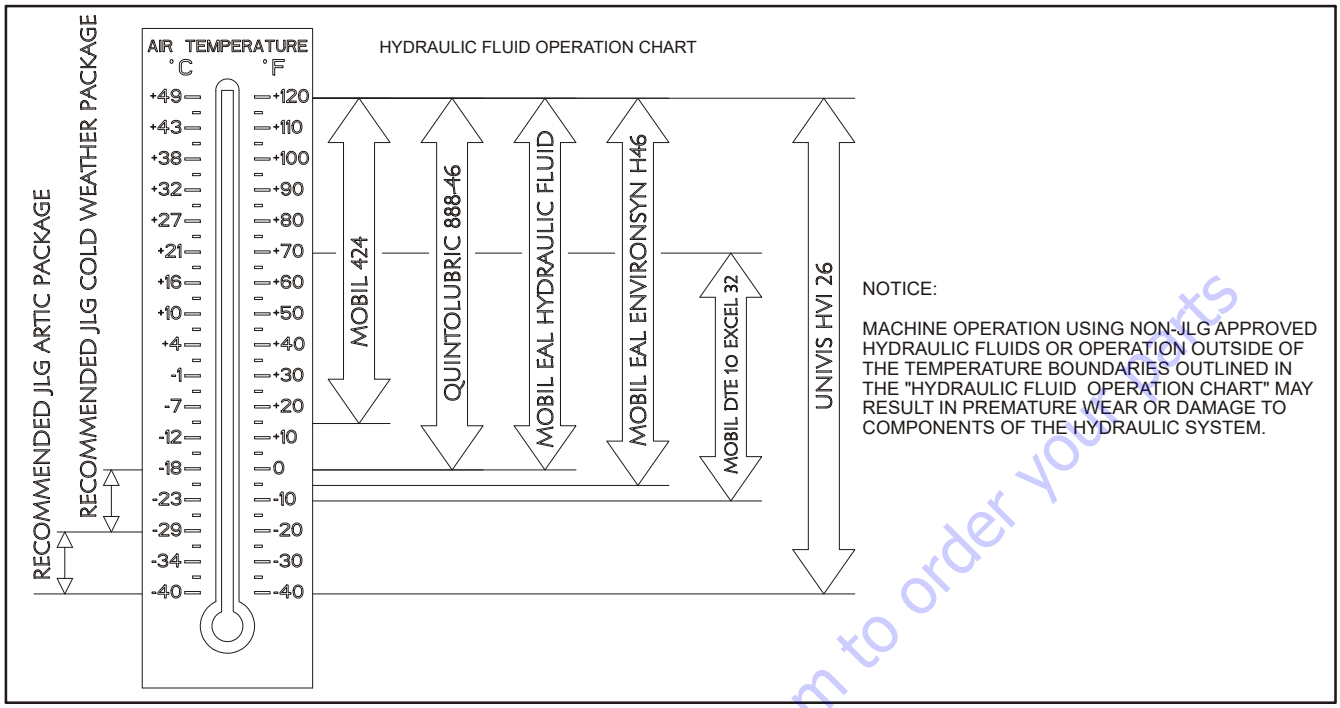
[3] Annually, no later than 13 months from the date of the prior inspection, Includes all daily and quarterly inspections, mandated by regulating body

[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



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

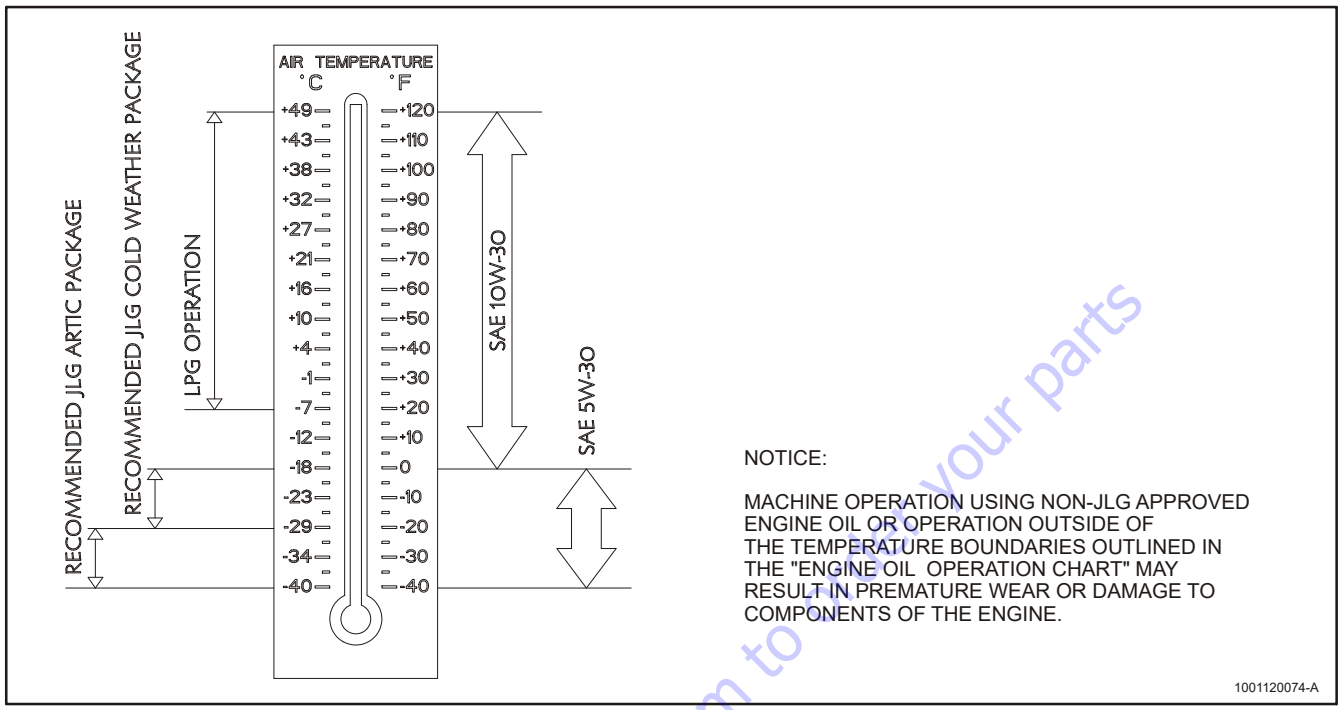


Figure 2-2. Engine Oil Operation Chart - GM

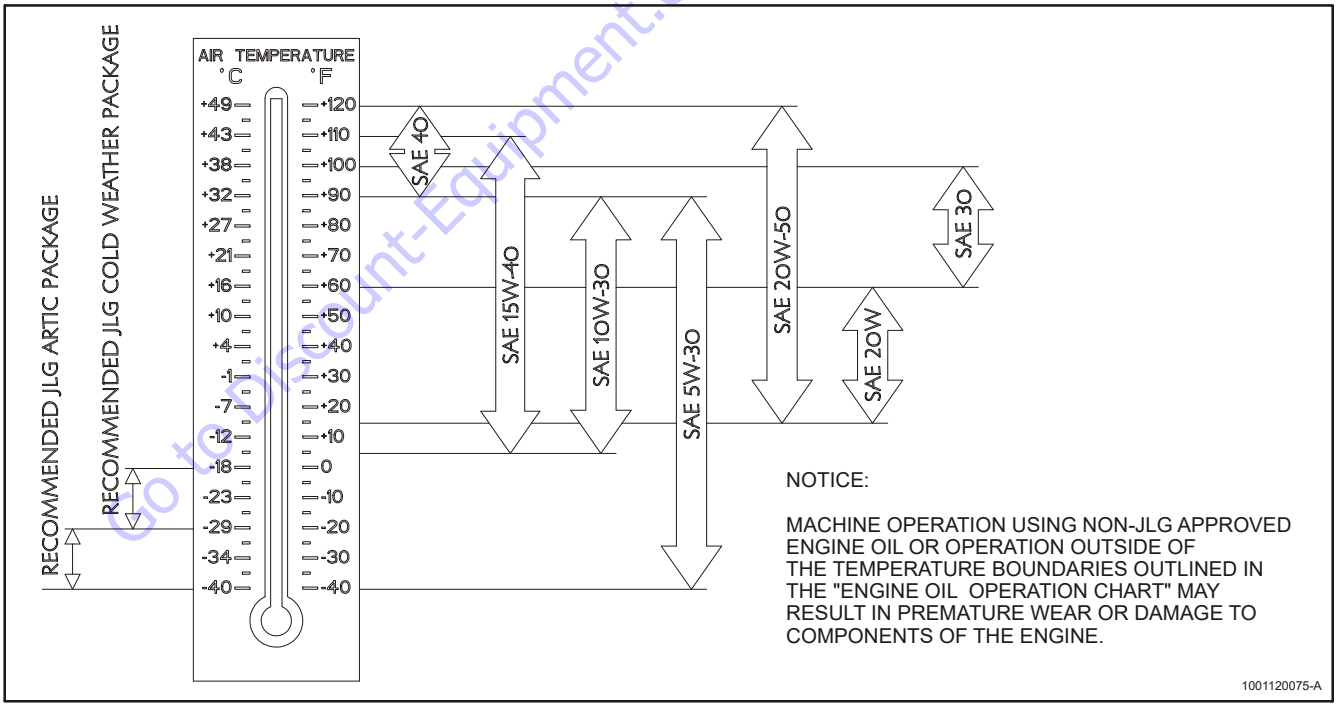
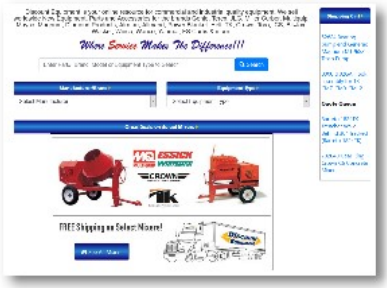


Figure 2-3. Engine Oil Operation Chart - Kubota

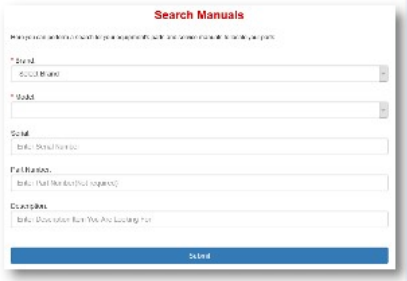
PARTS FINDER

Search Website by Part Number

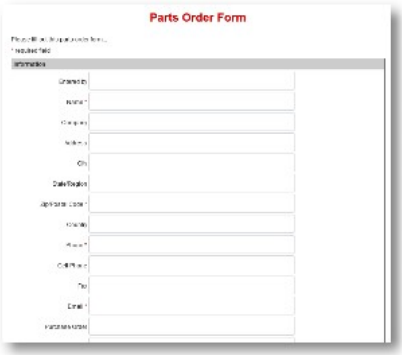
Discount Equipment



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



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



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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. 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

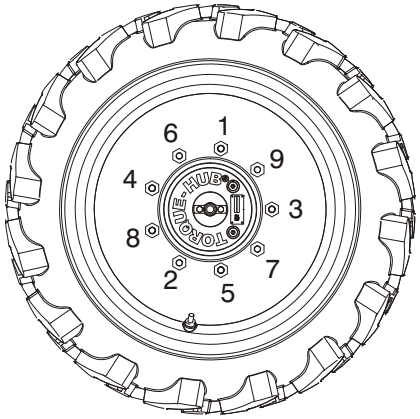
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ 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-tightening 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 0.6 mph (0.96 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 Section 4.7, Transport Position Sensing System 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

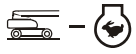
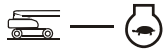
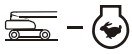
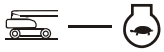
Boom Position	Drive Selection		Engine Speed when Drive is Actuated	Drive Pump Displacement	Flow Dividers	Max. Speed MPH (KPH)
In Transport	Max Speed		High-3000 RPM	91%	Bypassed	3.1 (4.9)
	Mid Engine		Mid-1800 RPM	59%	Engaged	0.96 (1.5)
	Max Torque		High-3000 RPM	56%	Engaged	1.5 (2.4)

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	17%	Engaged	0.6 (1.0)
	Mid-Engine		Mid-1800 RPM	3.7%	Engaged	0.6 (1.0)
	Max Torque		High-3000 RPM	17%	Engaged	0.6 (1.0)

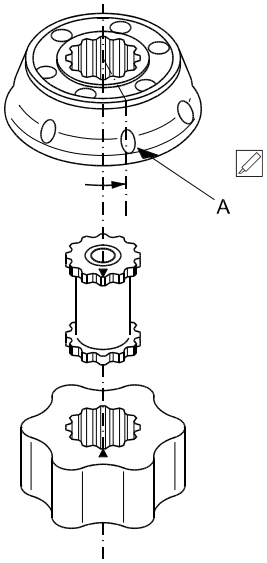
3.6 DRIVE MOTOR

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).

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 dame 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).

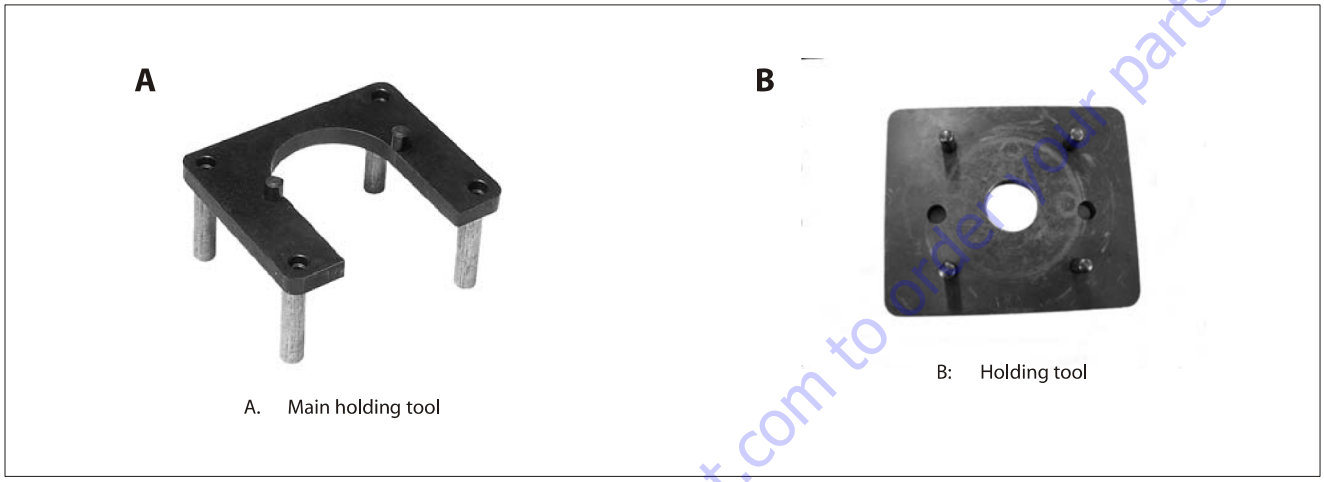
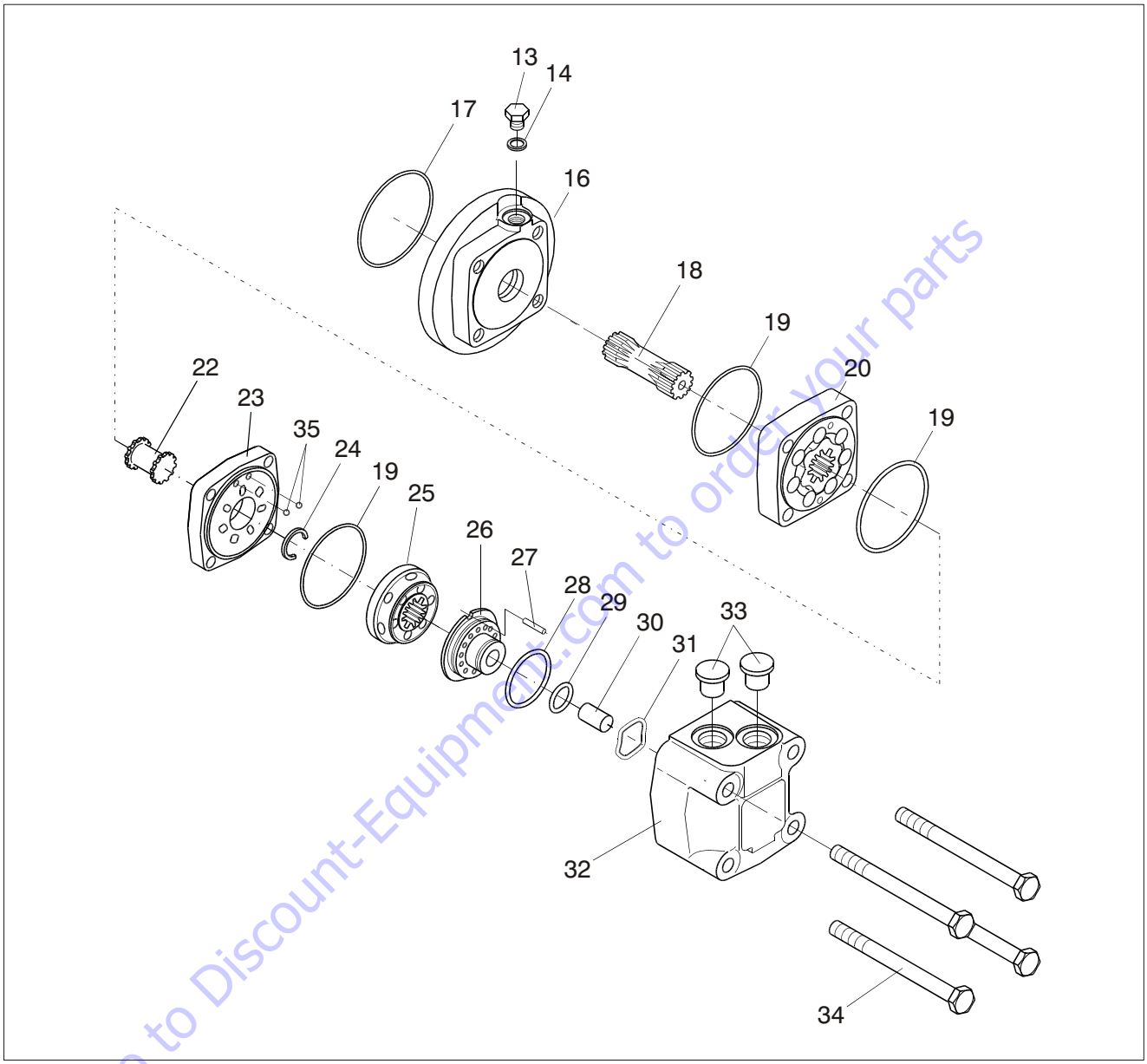


Figure 3-1. Drive Motor Special Tools



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

Figure 3-2. Drive Motor

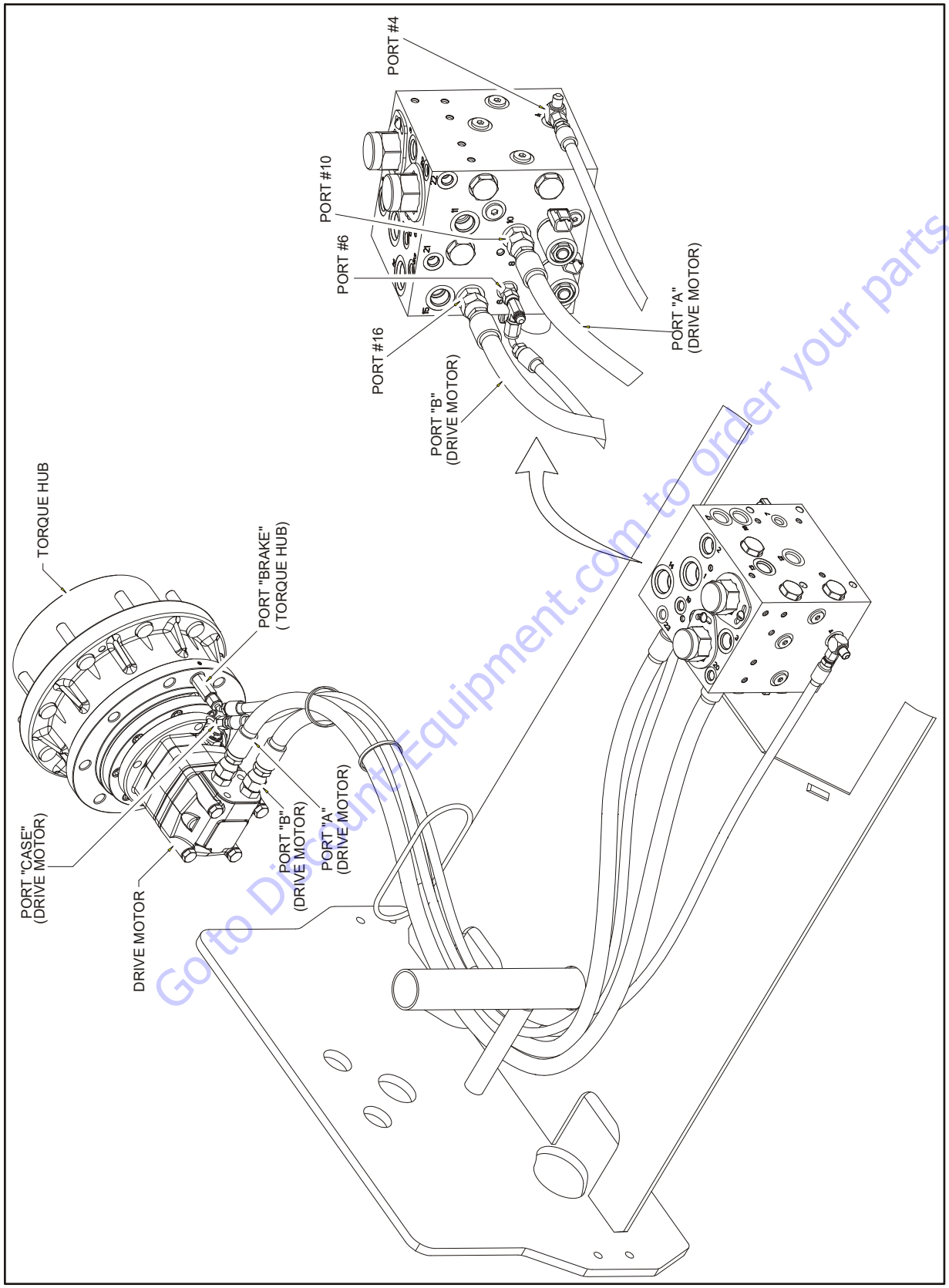


Figure 3-3. Right Front Drive Hydraulic Lines

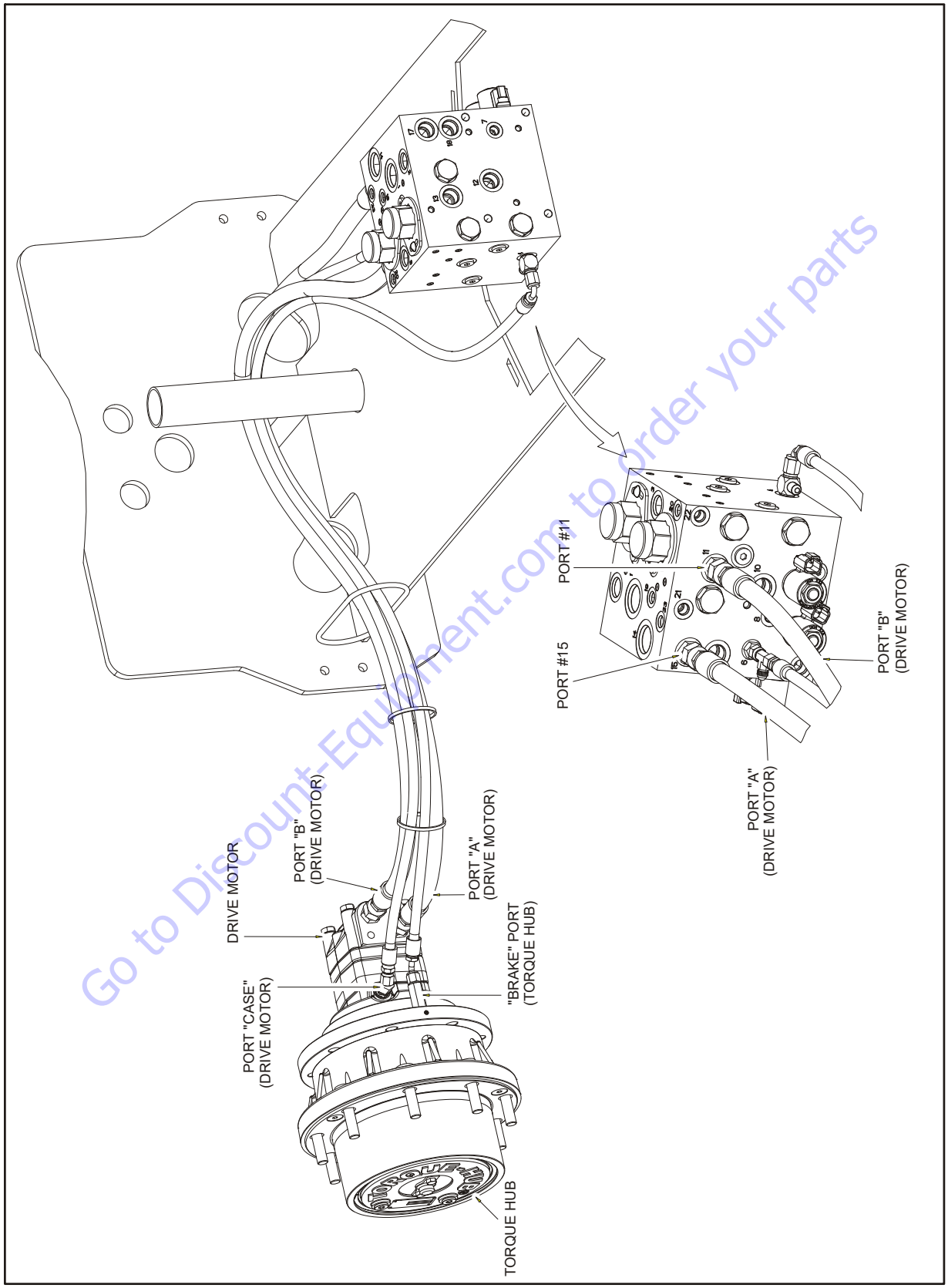


Figure 3-4. Left Front Drive Hydraulic Lines

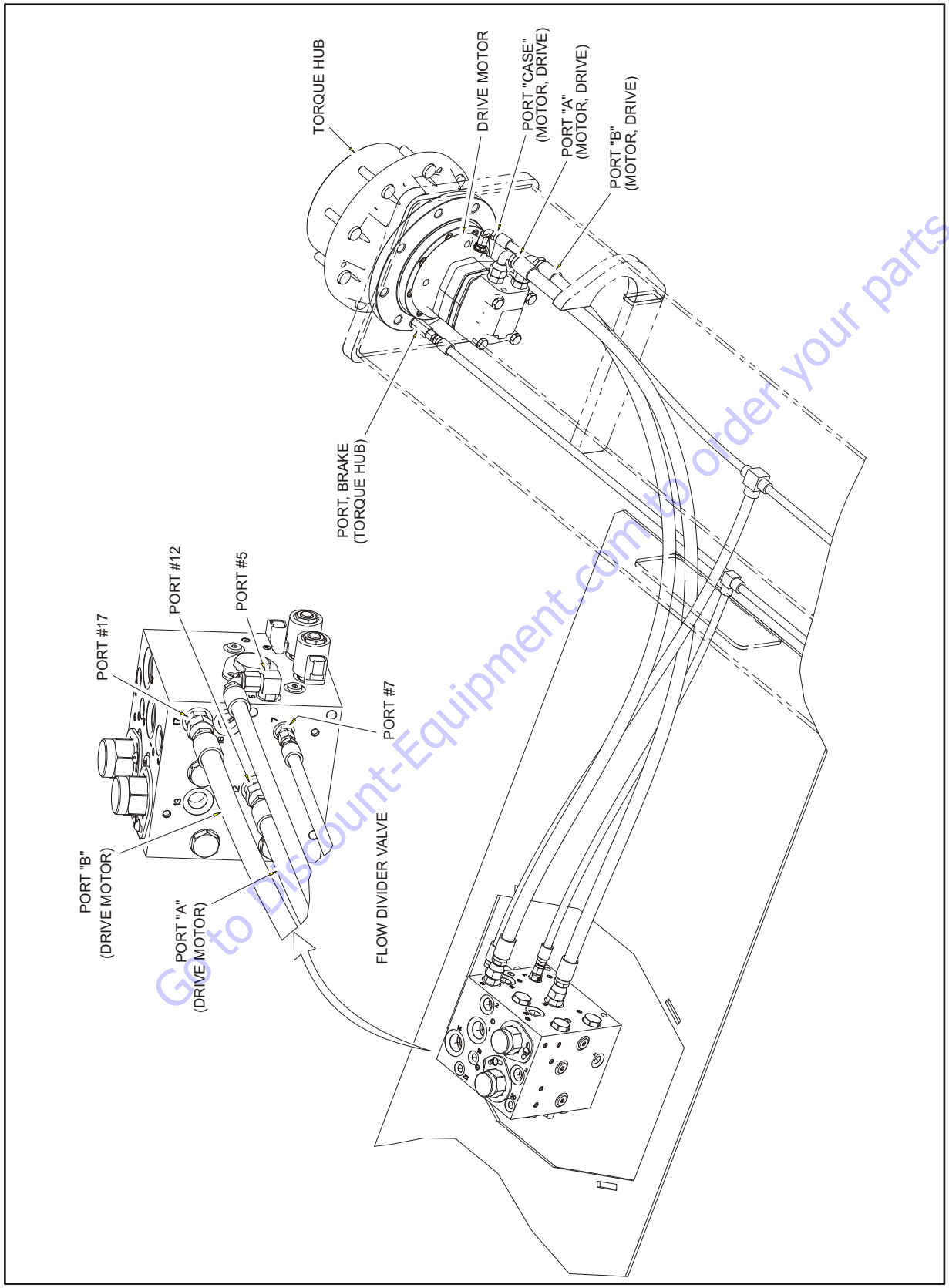


Figure 3-5. Right Rear Drive Hydraulic Lines

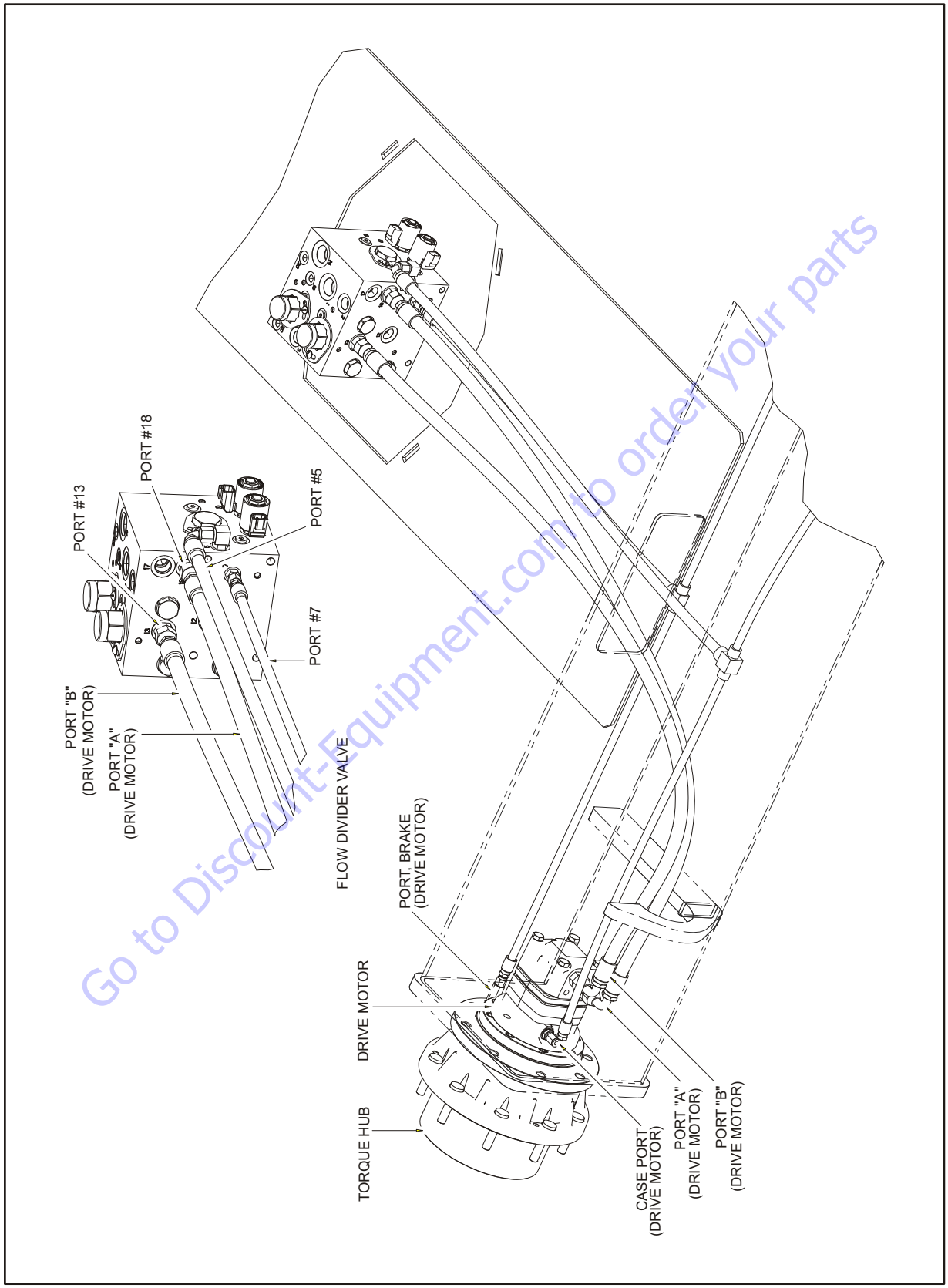


Figure 3-6. Left Rear Drive Hydraulic Lines

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.

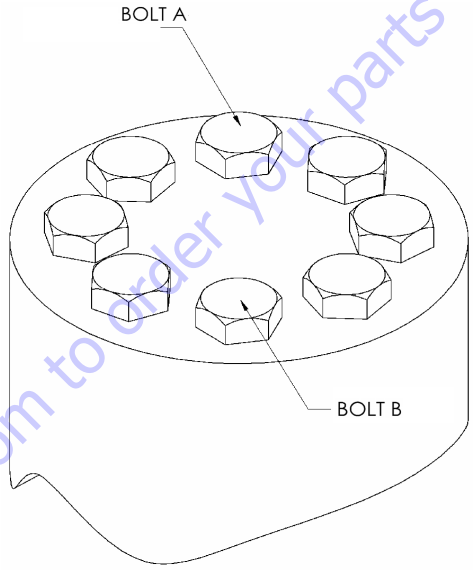
NOTE: *Failure to perform this test may result in damaged or ineffective brake parts.*

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 capscrews in a bolt circle.

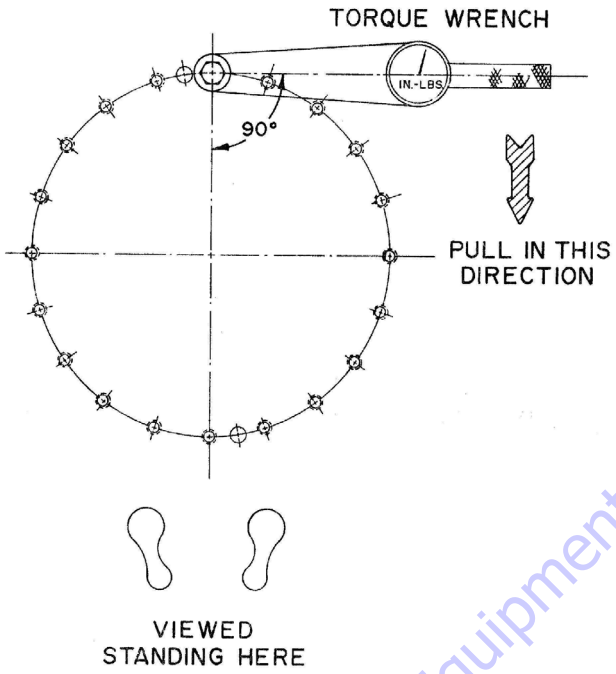
1. Tighten (but do not torque) bolt "A" until snug.



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.



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.
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 (1 A).
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).

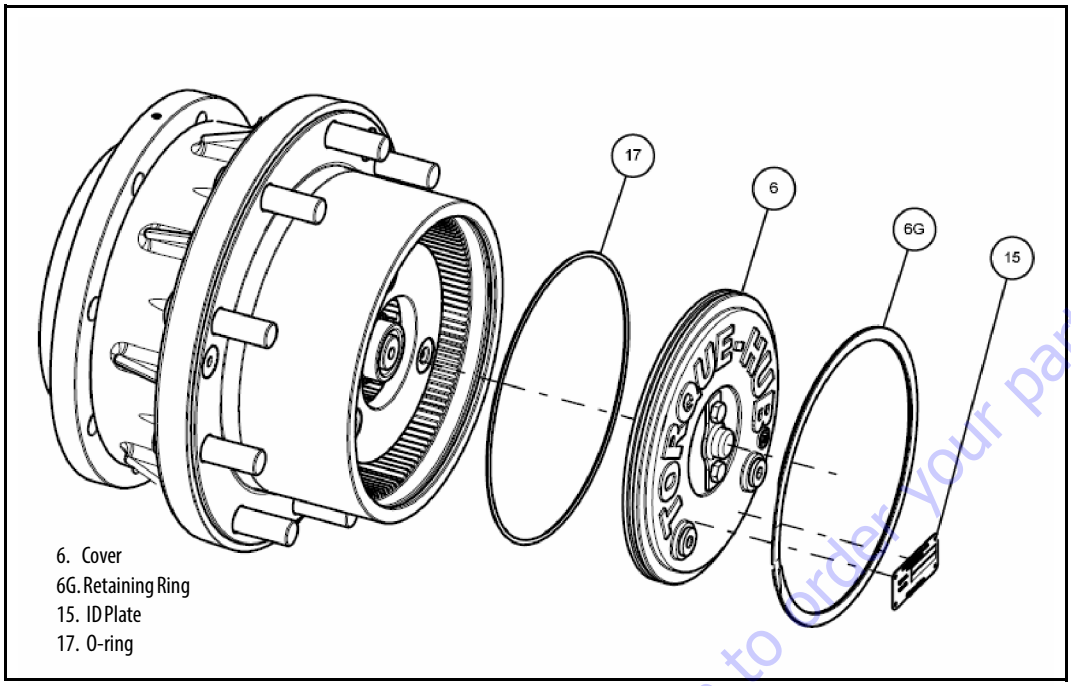


Figure 3-7. Main Disassembly - Figure 1

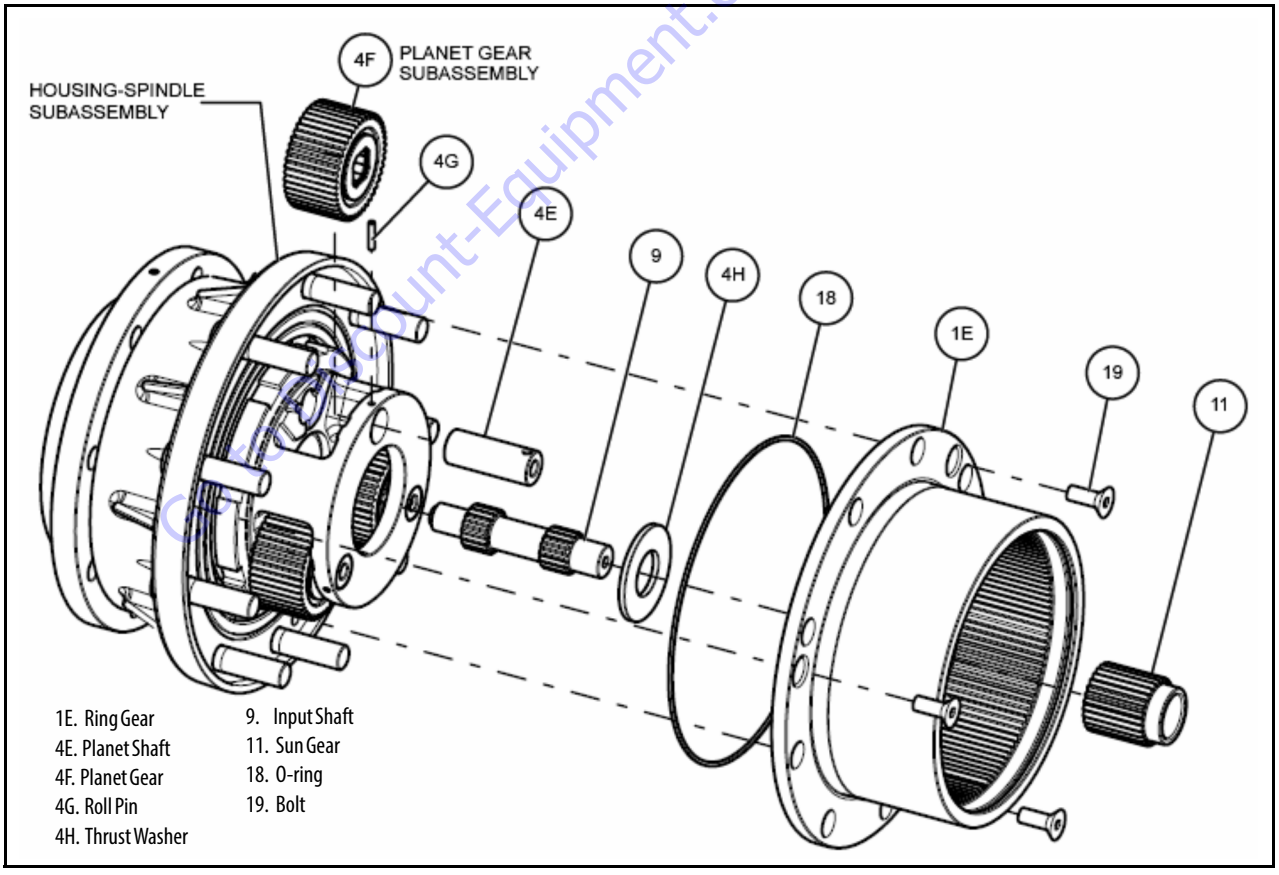


Figure 3-8. Main Disassembly - Figure 2

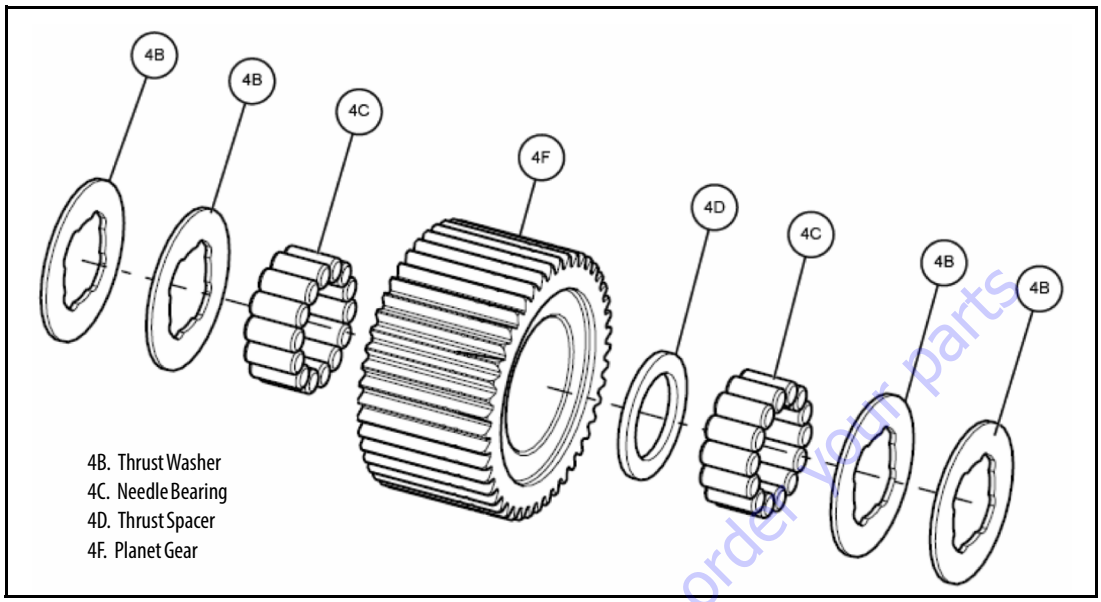


Figure 3-9. Main Disassembly - Figure 3

15. Repeat Steps 12 though 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 threadlocking compound 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).

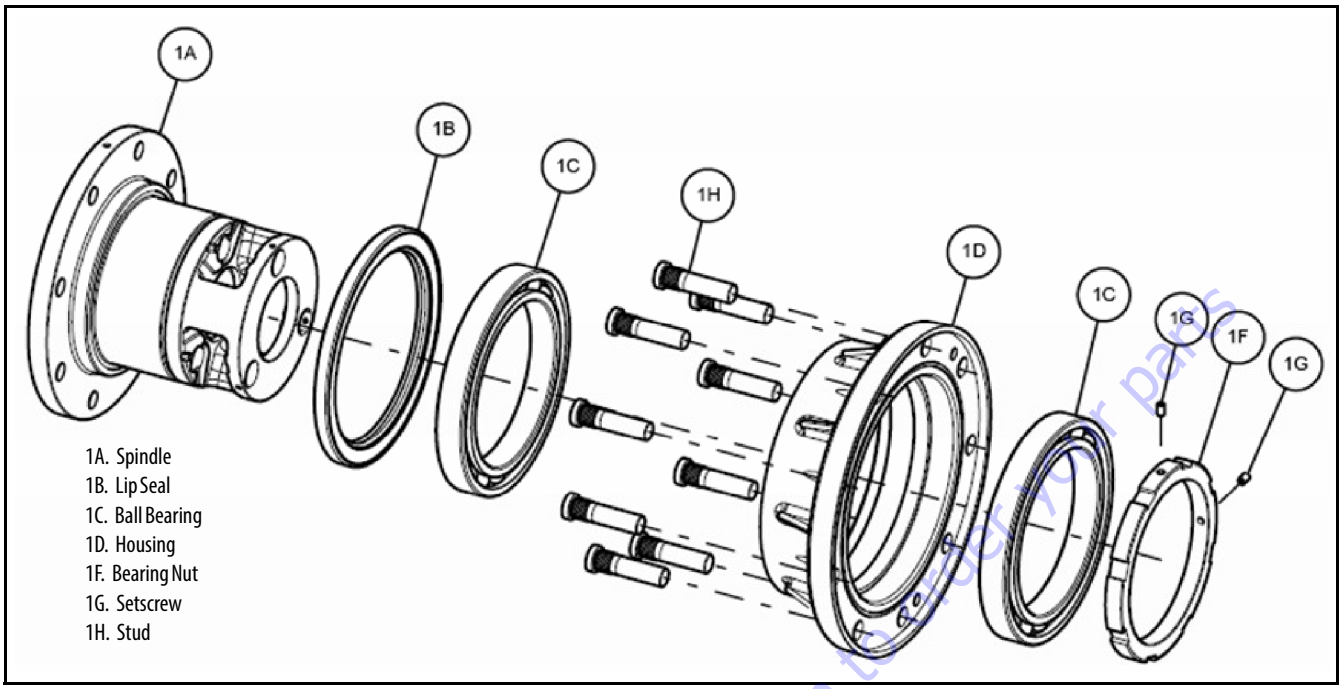


Figure 3-10. Housing-Spindle

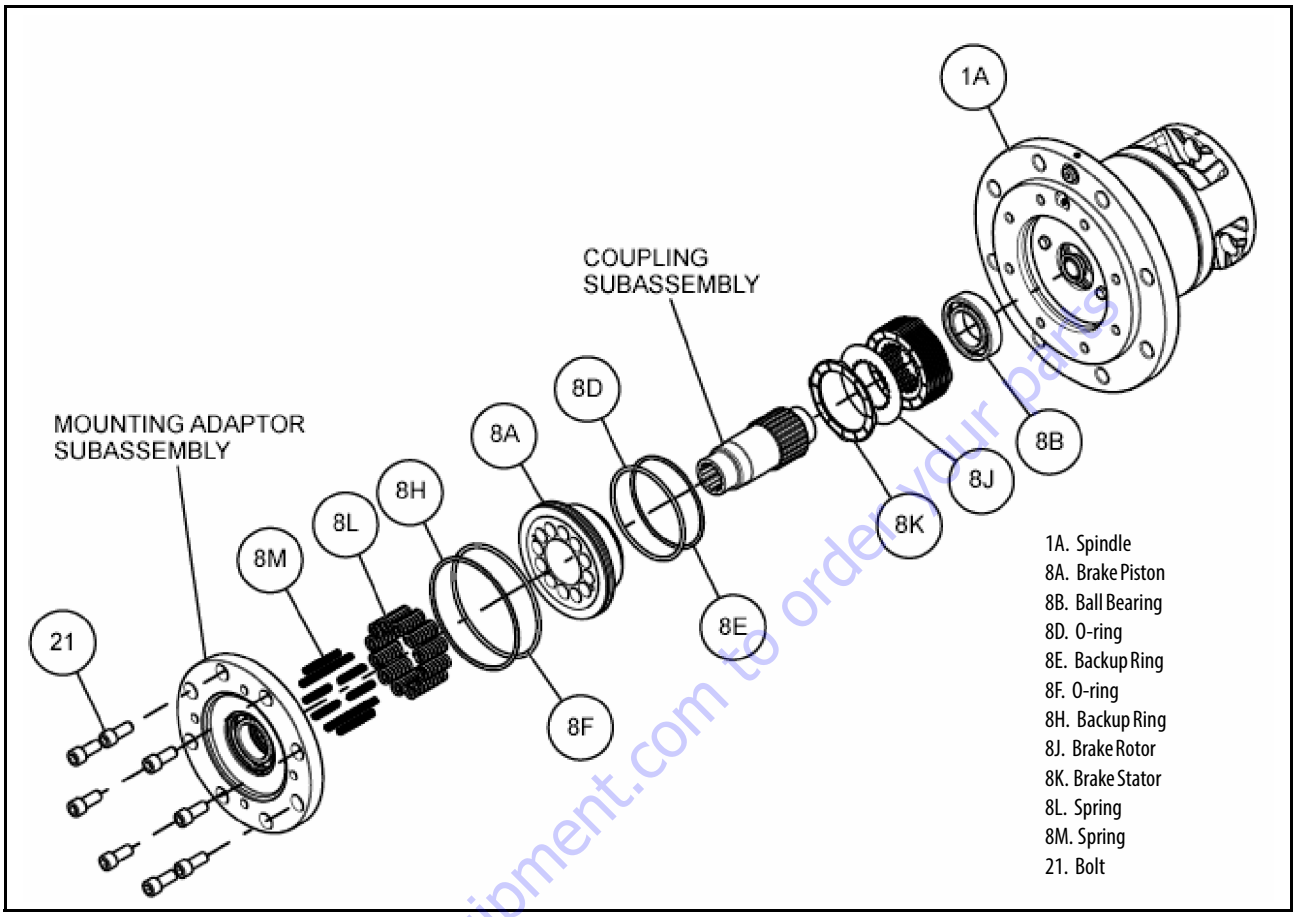


Figure 3-11. Spindle-Brake Subassembly - Figure 1

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).

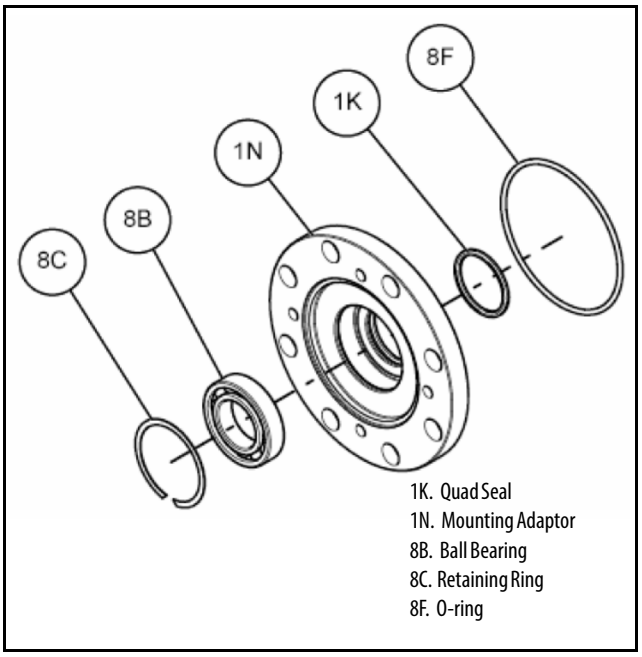


Figure 3-12. Spindle-Brake Subassembly - Figure 2

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.

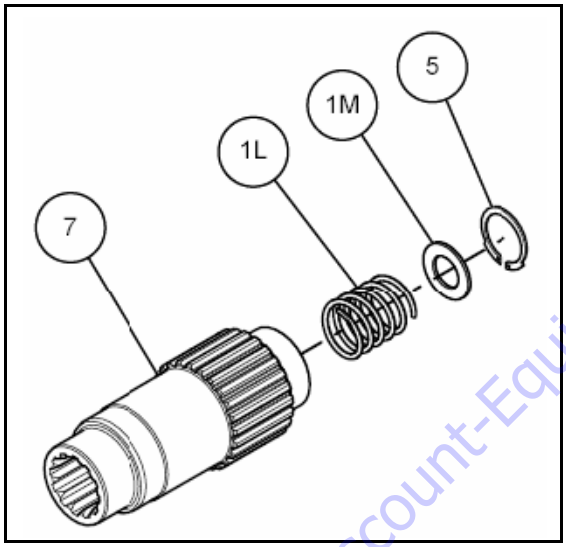
4. Remove Backup Ring (8H) and O-Ring (8F) from grooves in Spindle (1A) and Brake Piston (8A).

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.

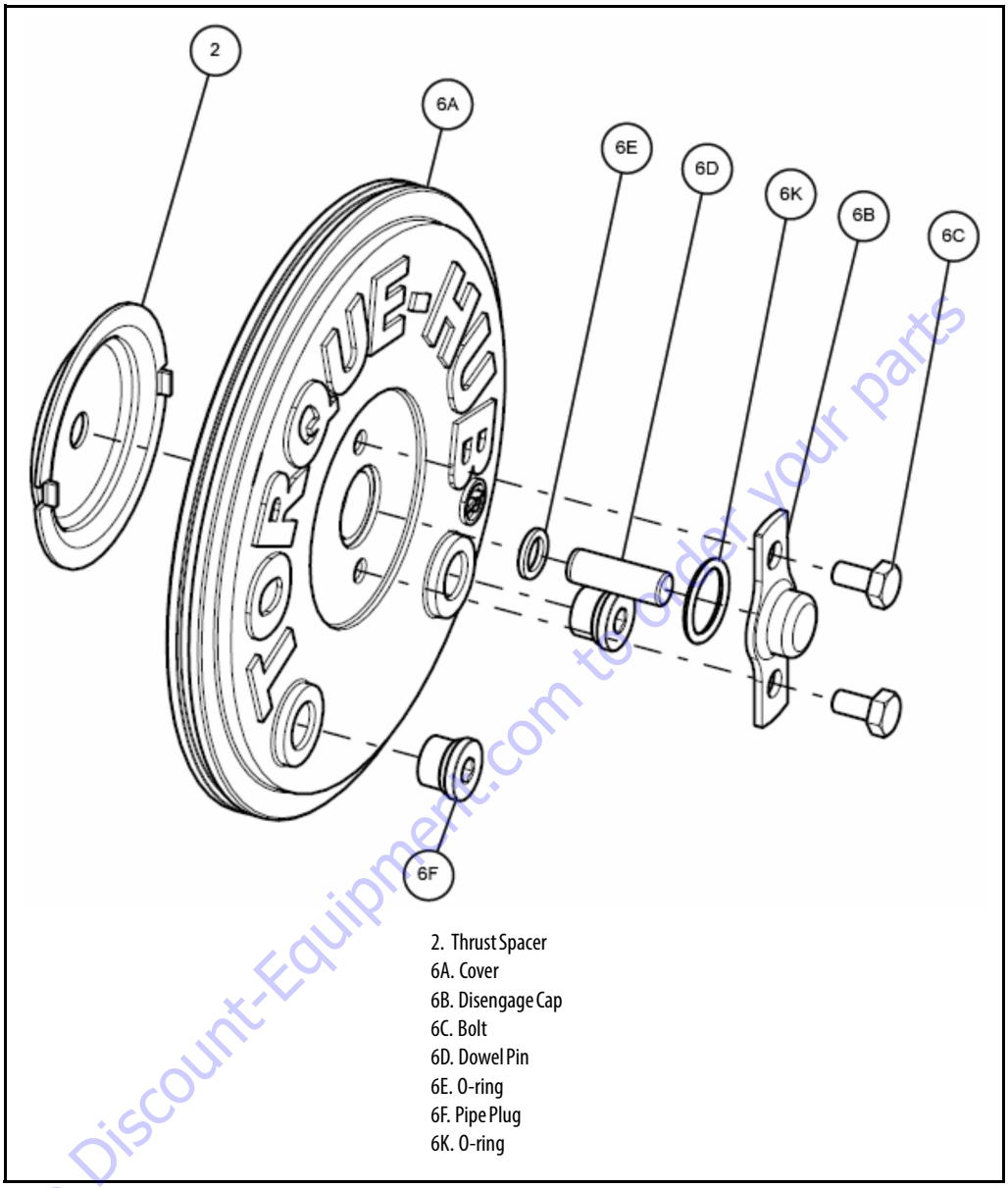
2. Unscrew Hex Head Bolts (6C) and remove Disengage Cap (6B) from Cover (6A).

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.*



2. Thrust Spacer
6A. Cover
6B. Disengage Cap
6C. Bolt
6D. Dowel Pin
6E. O-ring
6F. Pipe Plug
6K. O-ring

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).

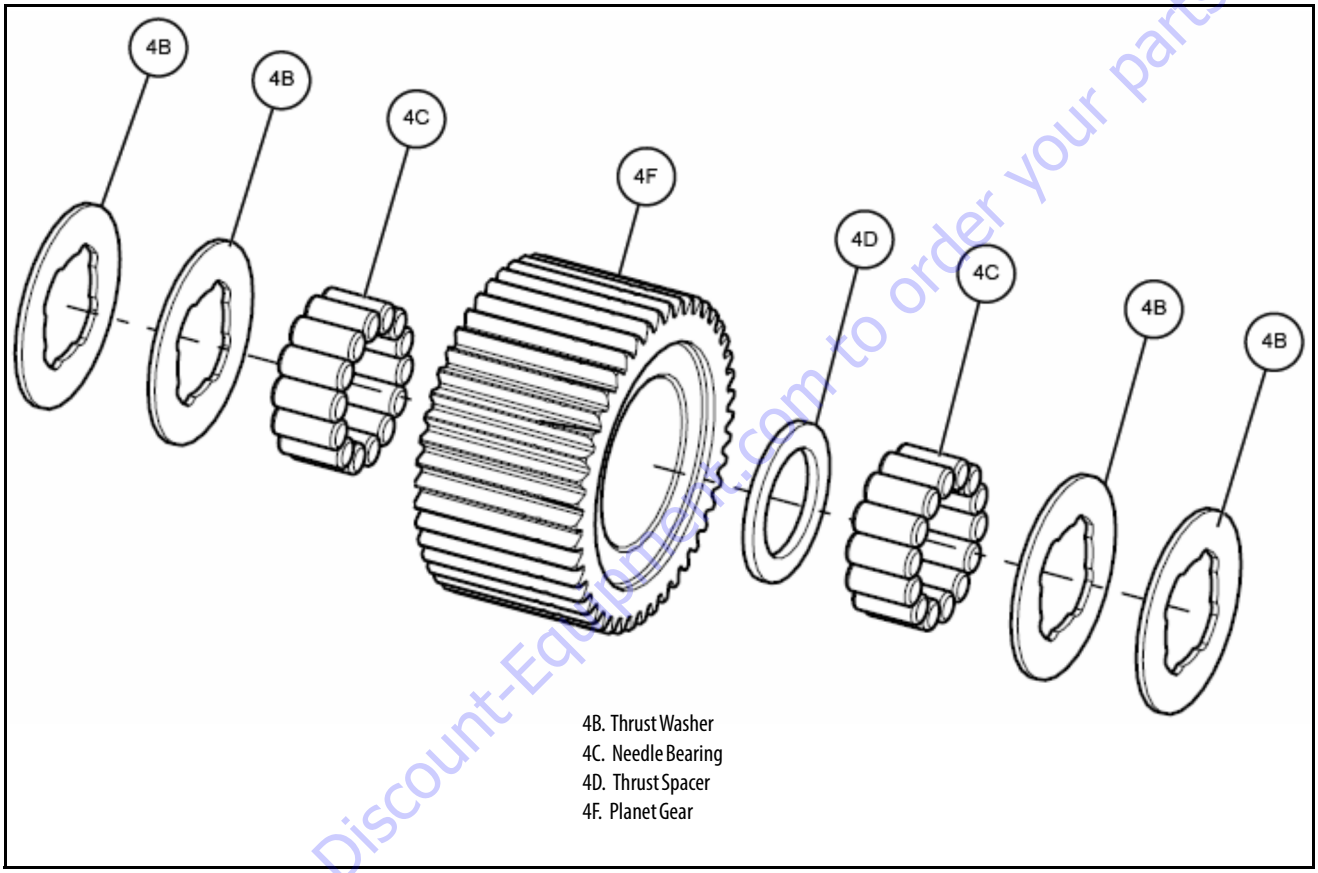


Figure 3-15. Planet Gear

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.

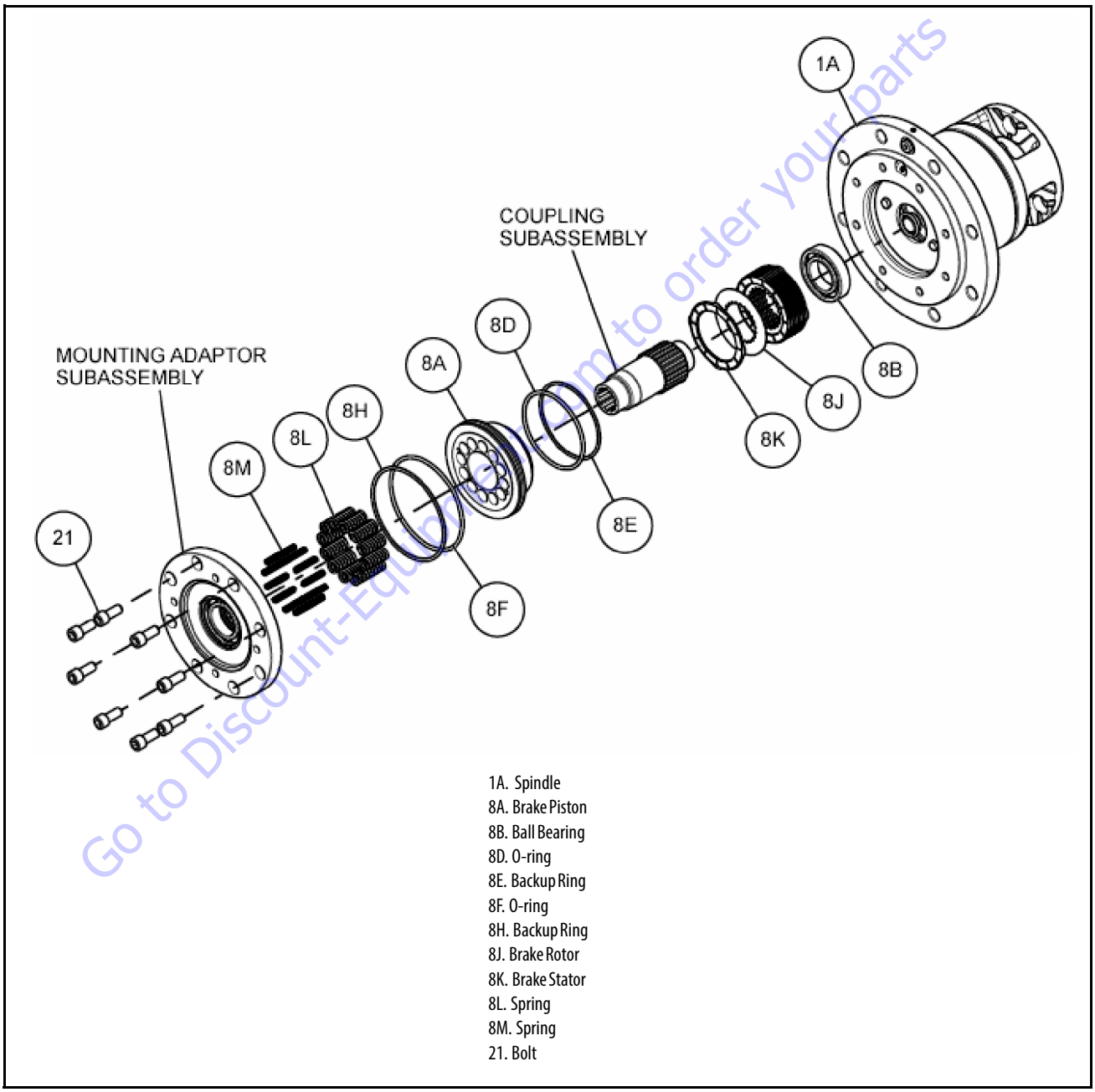


Figure 3-16. Spindle-Brake Figure 1

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

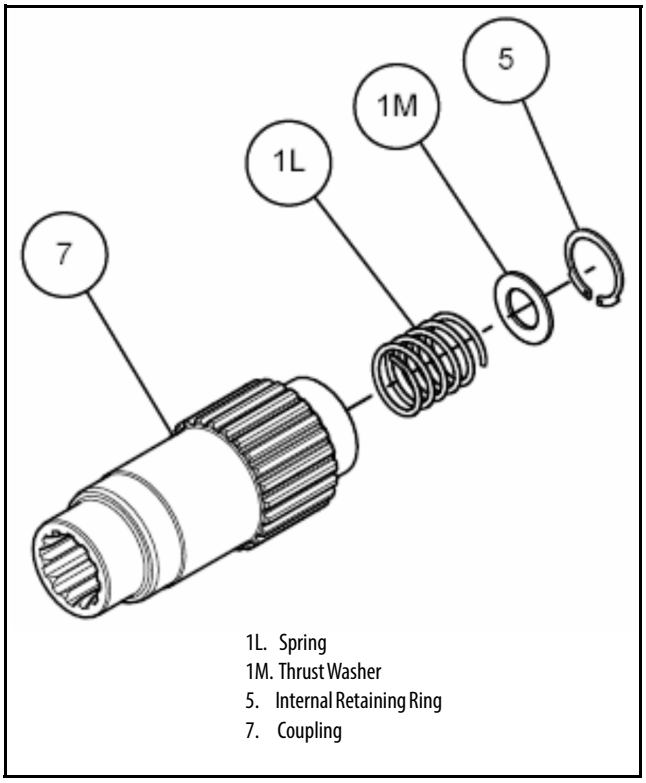


Figure 3-17. Spindle-Brake Figure 2

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.

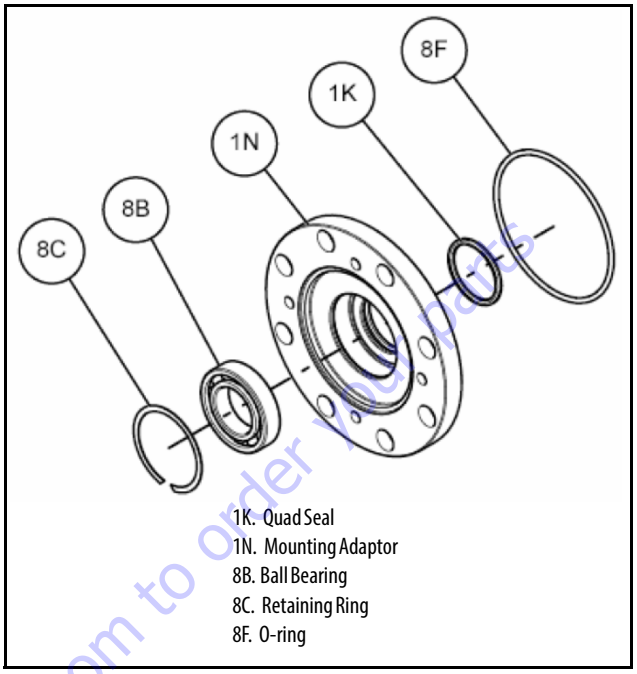


Figure 3-18. Spindle-Brake Figure 3

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.

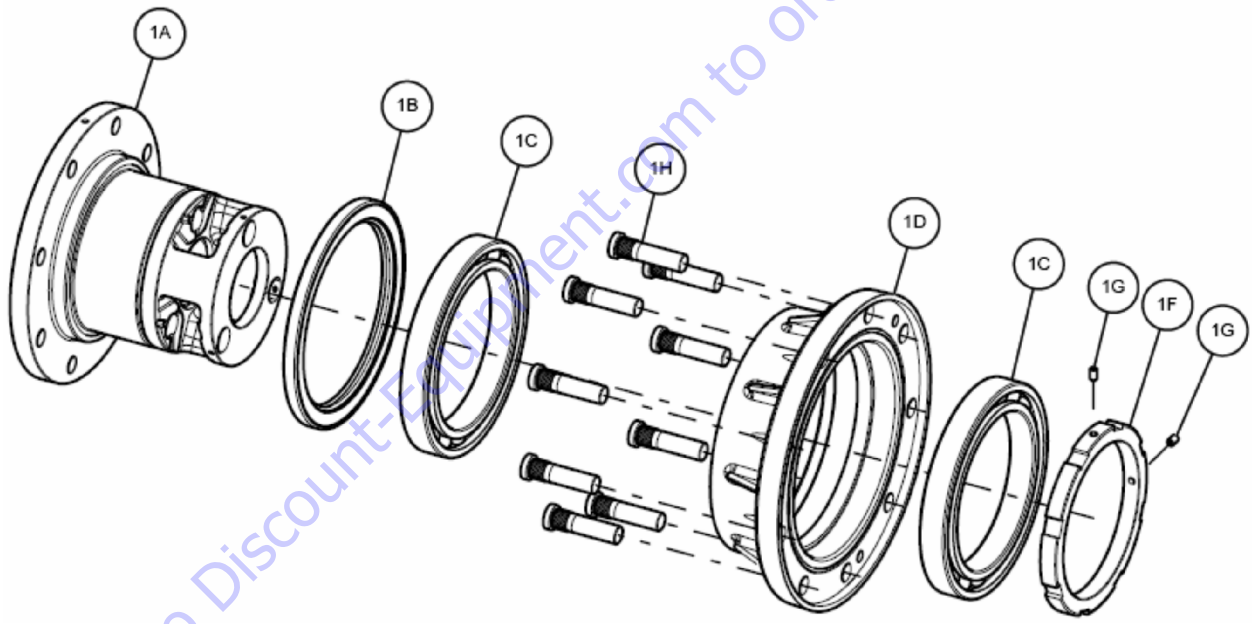
Housing-Spindle Subassembly

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 High Strength ThreadLocking Compound on Bearing Nut (1F) threads. Install the Bearing Nut (1F) onto Spindle (1 A) 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.



1A. Spindle
1B. Lip Seal
1C. Ball Bearing
1D. Housing
1F. Bearing Nut
1G. Setscrew
1H. Stud

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).

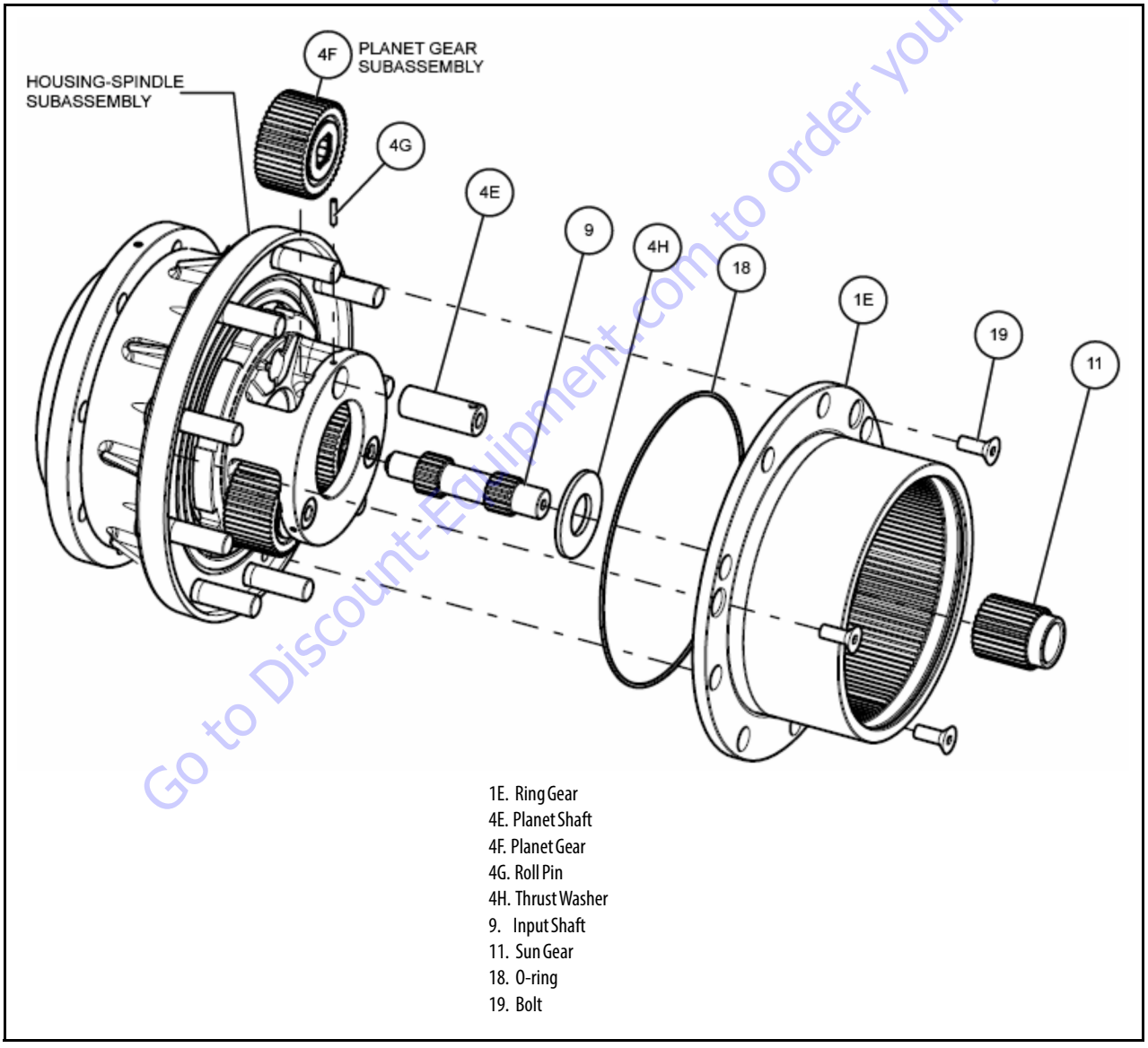
2. Place one of the Planet Gear Subassemblies (4F) into Spindle (1 A) through gap between two Studs (1H). Align the planet gear bore with one of the planet shaft holes on the Spindle-Brake Subassembly using the Drift Pin Assembly Tool.

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.



1E. Ring Gear
4E. Planet Shaft
4F. Planet Gear
4G. Roll Pin
4H. Thrust Washer
9. Input Shaft
11. Sun Gear
18. O-ring
19. Bolt

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).

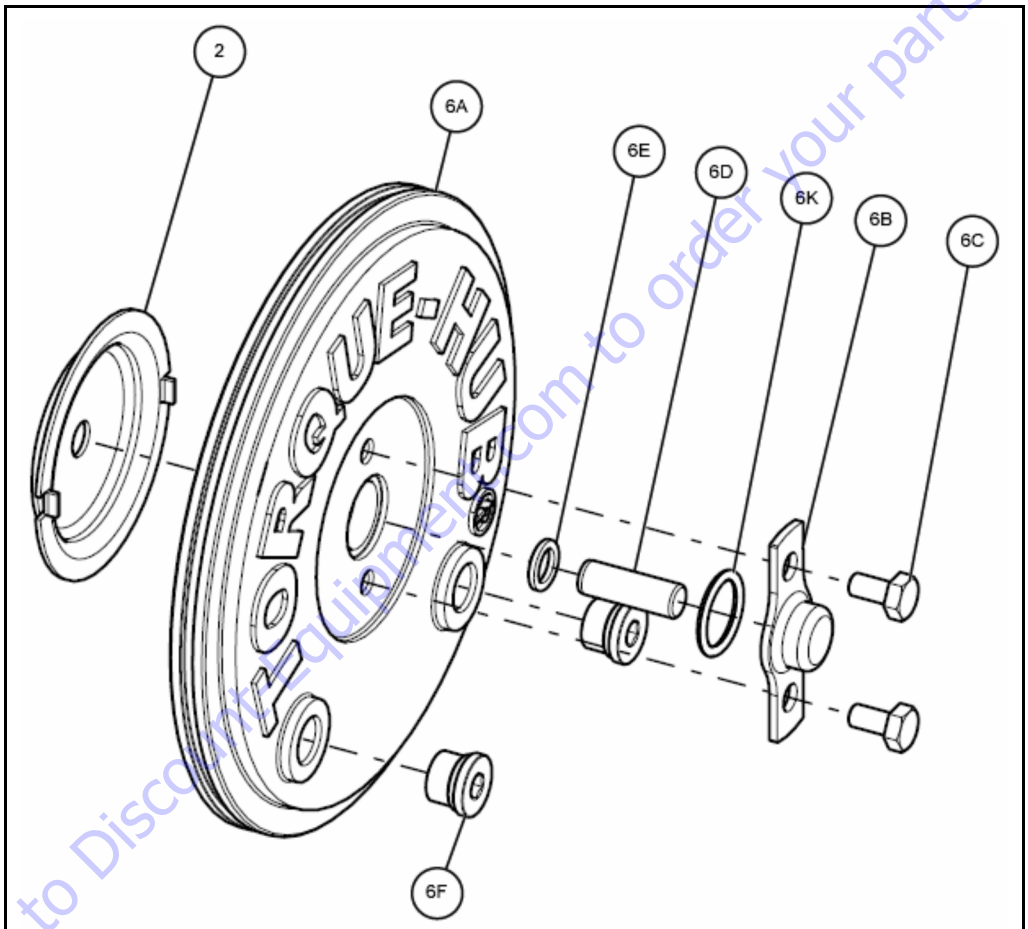
8. Place Ring Gear (1E) onto Housing (1D). Align the three shipping capscrew holes on Housing (1D) and Ring Gear (1E).

9. Install three Shipping capscrews (19) into Ring Gear (1E) and Housing (1G). Torque them to15-20 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).



2. Thrust Spacer
6A. Cover
6B. Disengage Cap
6C. Bolt
6D. Dowel Pin
6E. O-ring
6F. Pipe Plug
6K. O-ring

Figure 3-21. Cover

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.

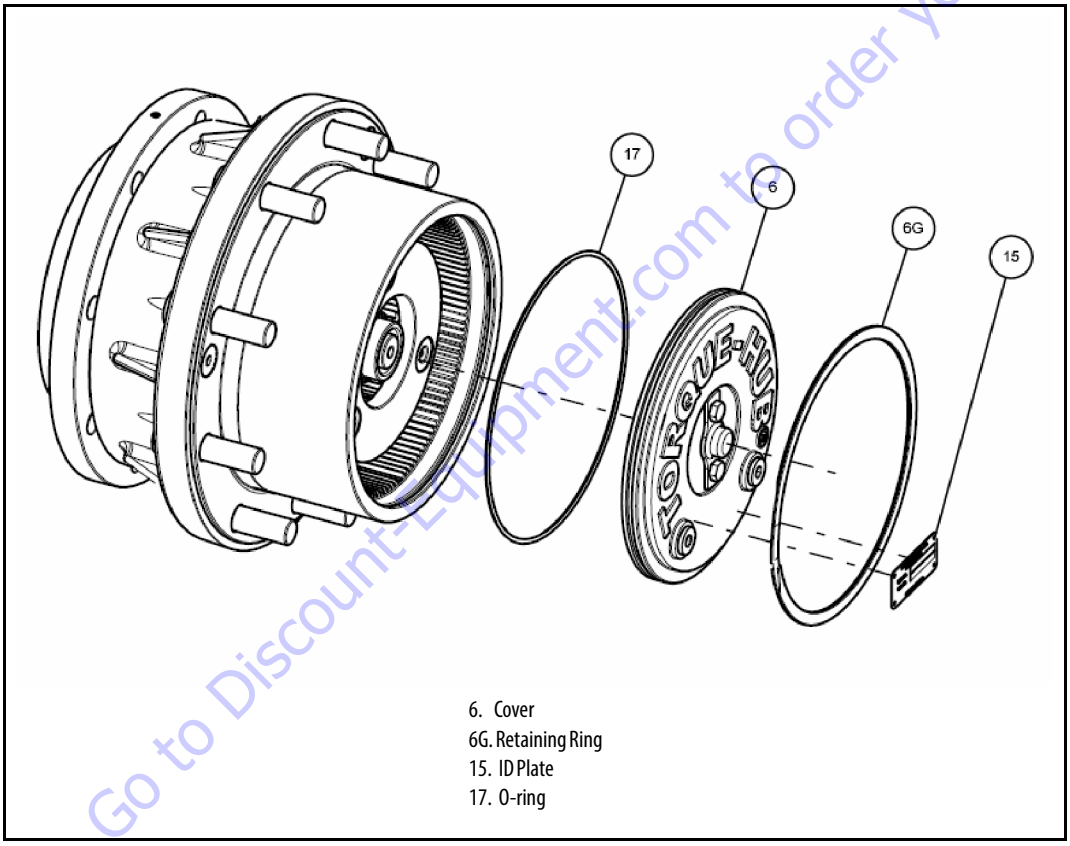
Main Assembly

1. Grease O-Ring (17) and insert into groove in Cover Subassembly (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.



6. Cover
6G. Retaining Ring
15. ID Plate
17. O-ring

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).

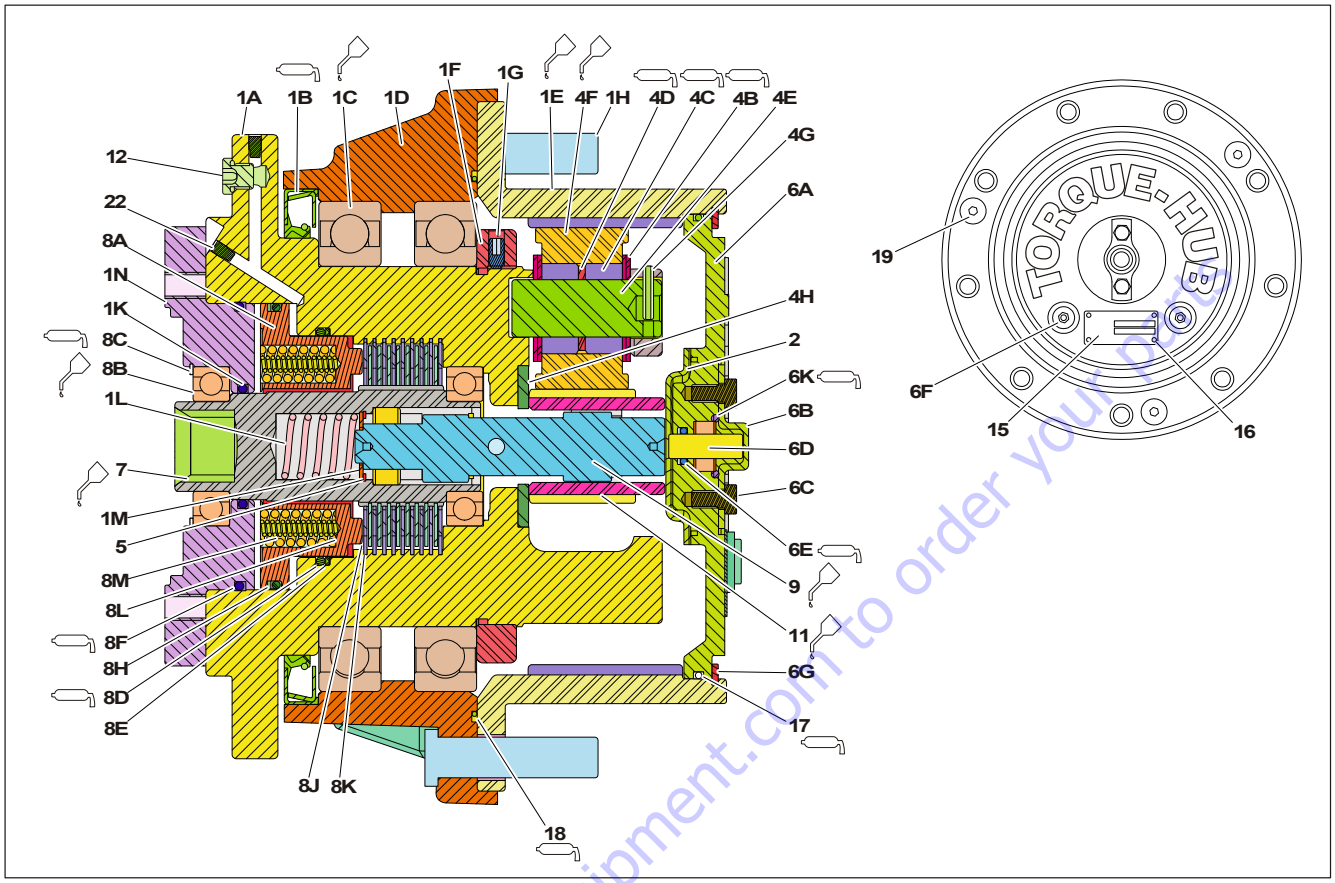
3. Bleed brake. Increase hydraulic pressure gradually while trying to rotate the input until brake just starts to release. Note this pressure. Make sure the pressure falls into the appropriate range below.

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.*



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

Figure 3-23. Drive Hub Assembly

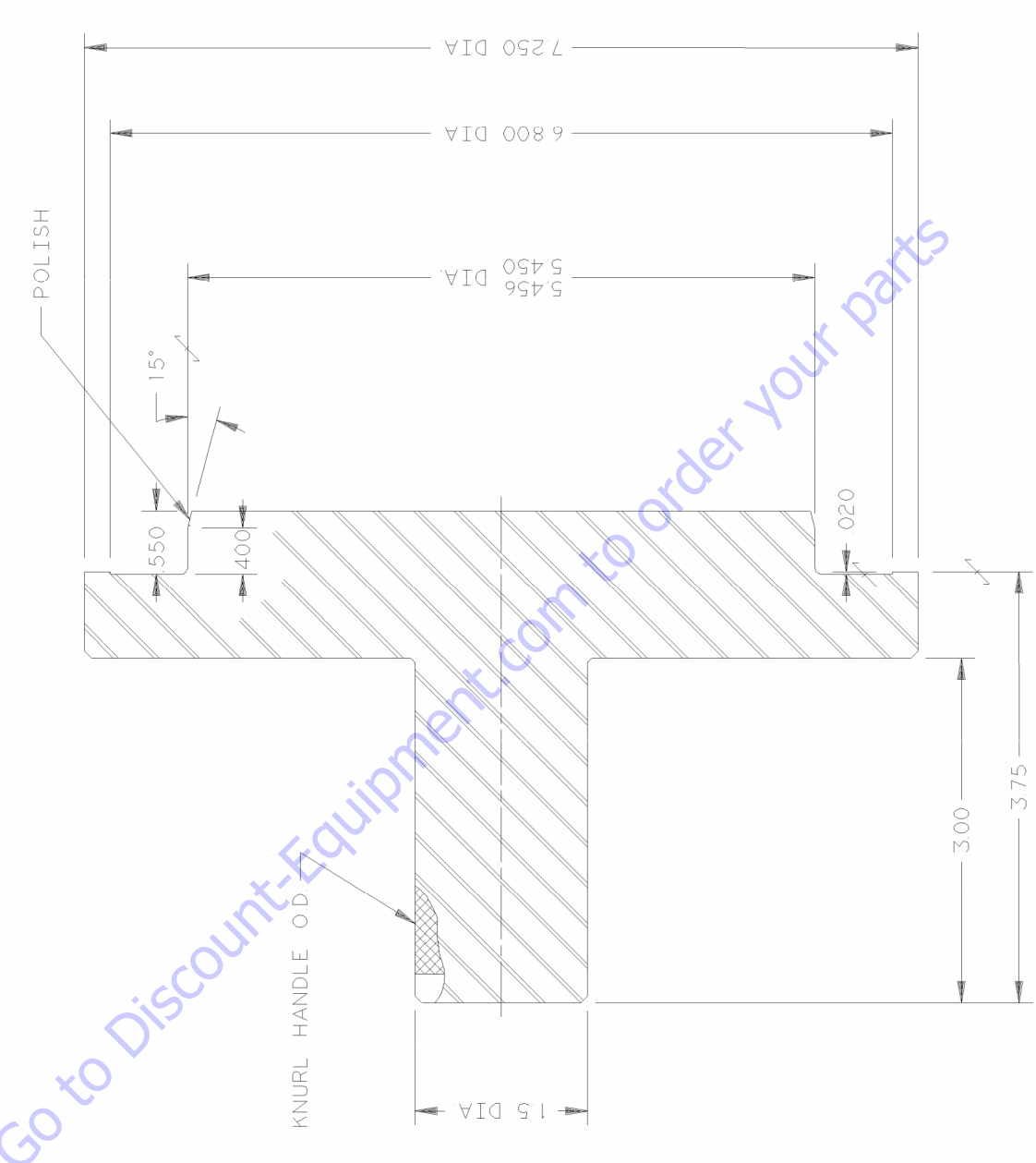


Figure 3-24. Bearing Pressing Tool

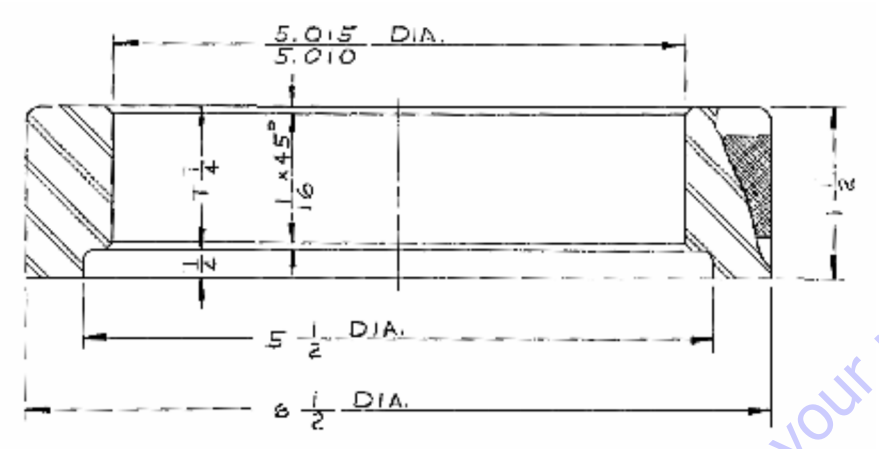


Figure 3-25. Seal Pressing Tool

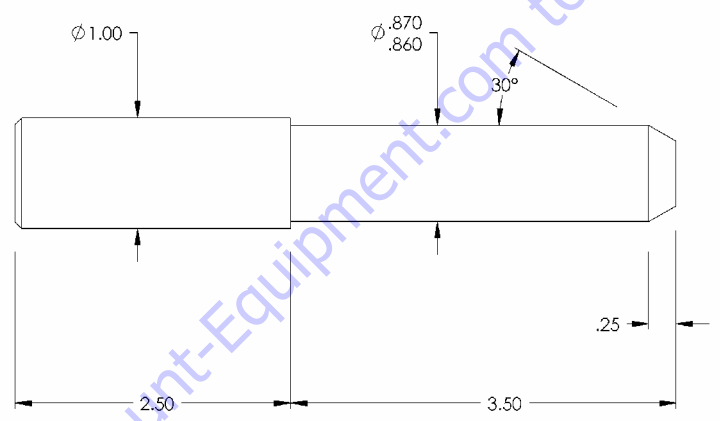


Figure 3-26. Drift Pin for Lining Up Thrustwashers with Output Planet Gear

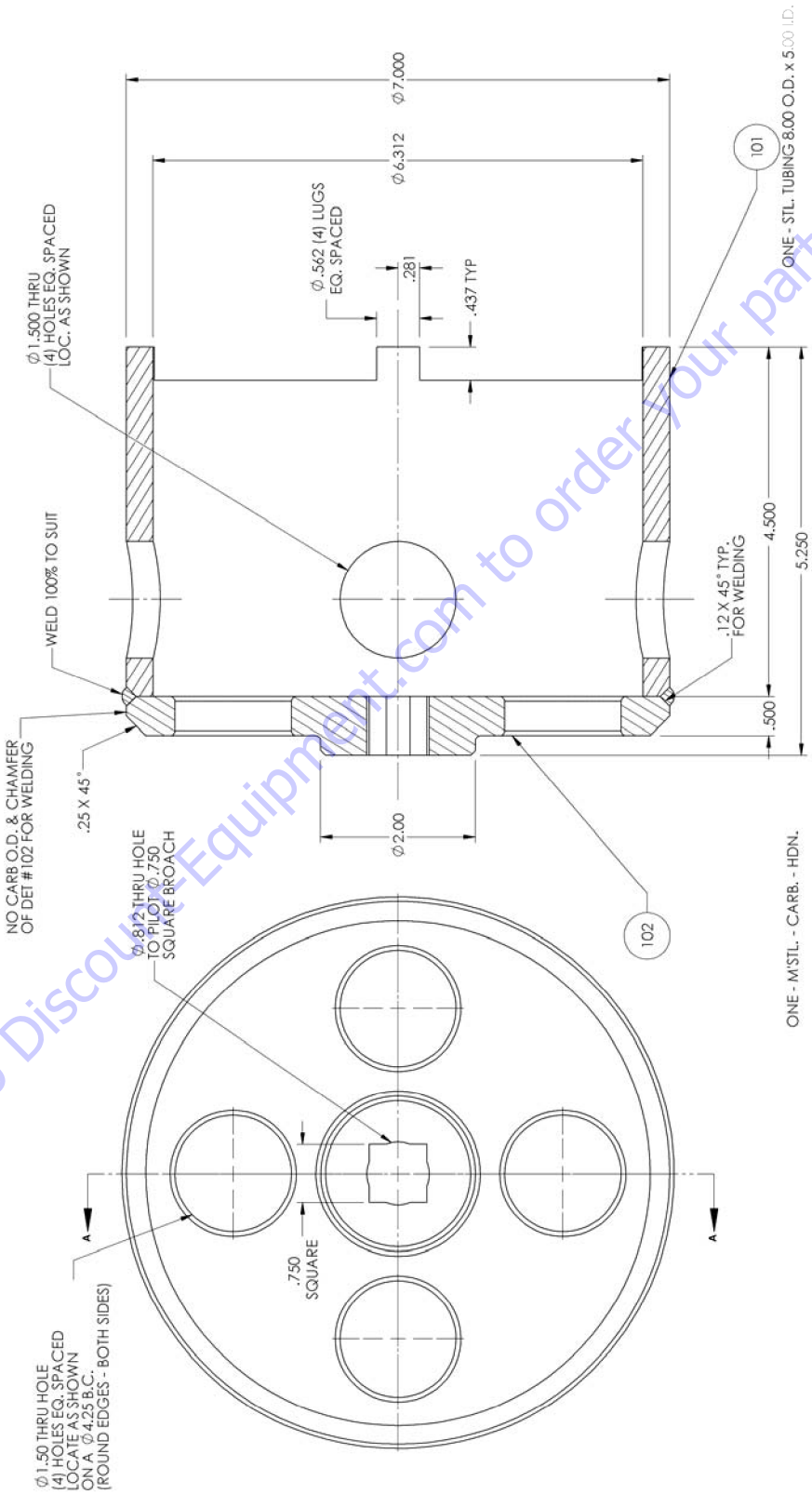


Figure 3-27. Bearing Nut Wrench

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 Section 4.7, Transport Position Sensing System 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 Section 4.7, Transport Position Sensing System 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. The Ground Control Module supplies power to and monitors the state of the boom elevation and oscillating axle switches. If the switch states are not congruent, the Ground Control Module will remove power, thereby causing the oscillating axle to lock in the fail safe position until power is cycled.

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.

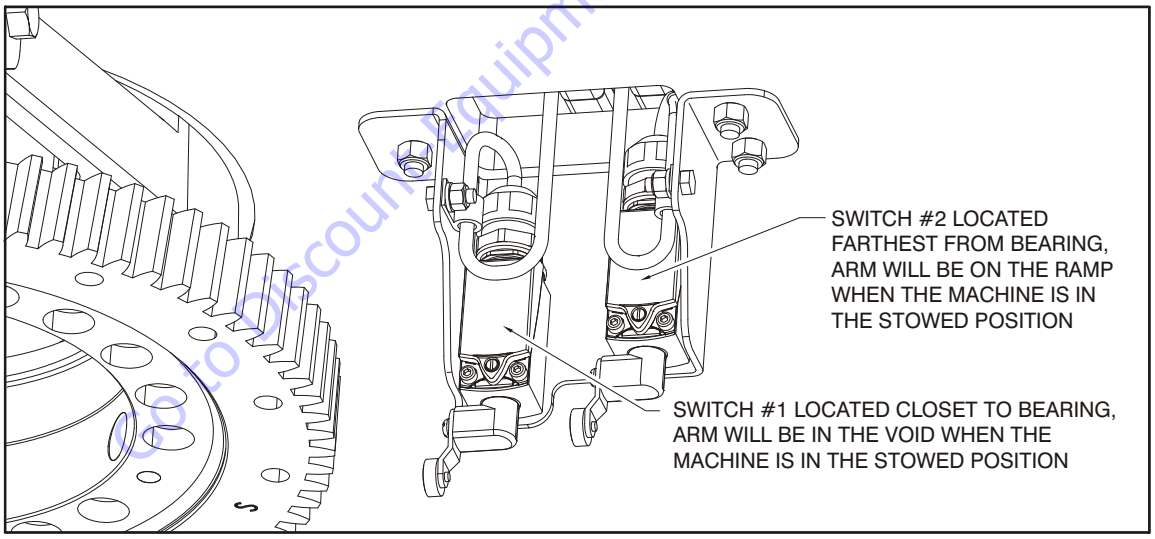


Figure 3-28. Axle Oscillation Switches

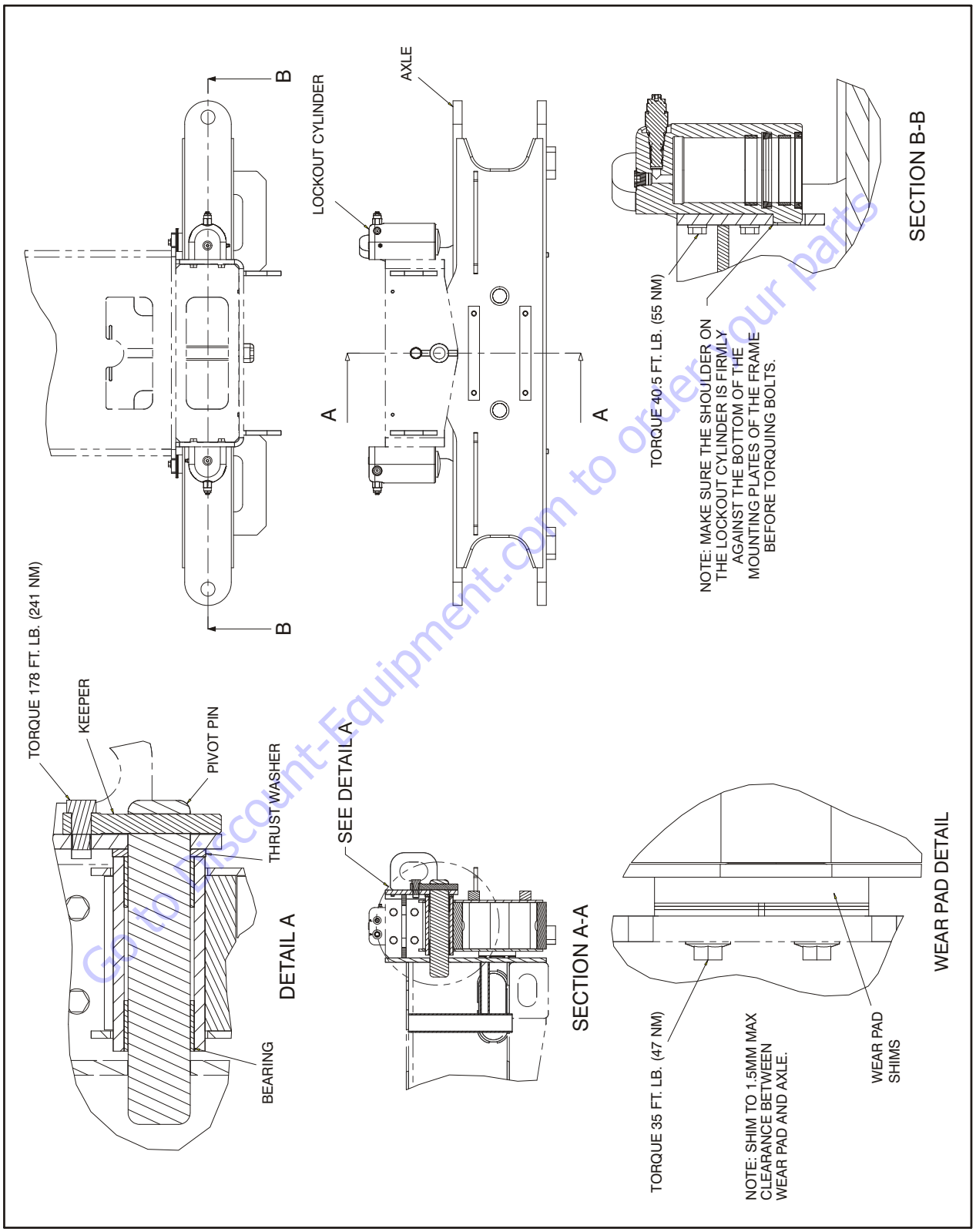


Figure 3-29. Oscillating Axle

3.9 CHASSIS TILT INDICATOR SYSTEM

The Chassis Tilt Indicator System measures the turntable angle with respect to level ground. The tilt sensor (which is an integral part of the ground module) 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 (Market based machine setup on the JLG Analyzer).

The 5.0°/3.0° angle is used for the purpose of warning the operator of the inclined condition, illuminating the chassis tilt light in the platform display panel.

However, when the machine is out of transport position and the turntable tilts more than the 5.0°/3.0° pre-set value, the boom functions can only operate in creep speed mode, and the drive function is disabled. The operator must return the machine into transport mode in order to continue to drive the machine.

When used in conjunction with the Beyond Transport - Drive Speed Cutback System (item 11), 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 attaining an unstable position.

The 6° angle is used exclusively 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 Position (see item 17 for more information on Transport Position), and the chassis is at or above 6°, the drive system will automatically switch into Max Torque mode (see item #17 for more information on Max Torque mode).

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

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.

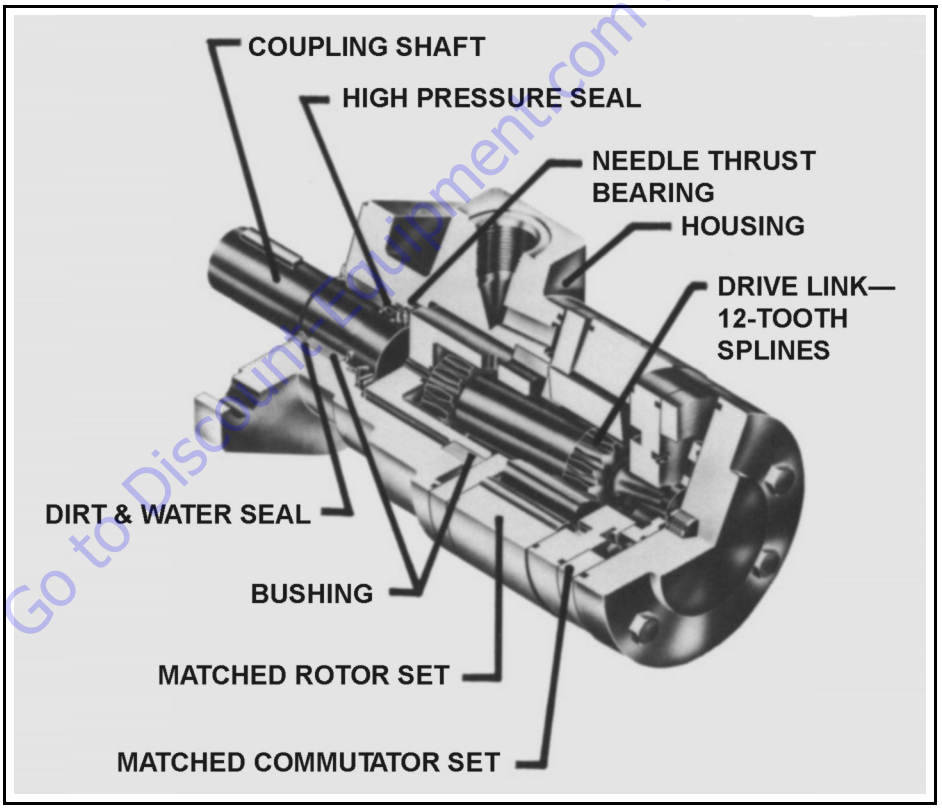


Figure 3-30. Swing Motor - Cutaway

Table 3-3. Swing Motor Troubleshooting

Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged.	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (4) deteriorated by excess heat.	Replace oil seal rings by disassembling unit.
	3. Special bolt (1, 1 A, 1B or 1C) loose or its sealing area deteriorated by corrosion.	(a) Loosen then tighten single bolt to torque specification. (b) Replace bolt.
	4. Internal shaft seal (16) worn or damaged.	Replace seal. Disassembly of motor unit necessary.
	5. Worn coupling shaft (12) and internal seal (16).	Replace coupling shaft and seal by disassembling unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(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. Replace worn rotor set by disassembling unit.
	2. High internal motor leakage	Replace rotor set, drive link and coupling shaft by disassembling unit.
	3. Severely worn or damaged internal splines.	Locate excessive heat source (usually a restriction) in the system and correct the condition.
	4. Excessive heat.	
Low mechanical efficiency or undue high pressure required to operate unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble unit, identify and remedy cause and repair, replacing parts as necessary.
	3. Lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system external to motor unit.	Locate source and eliminate cause.

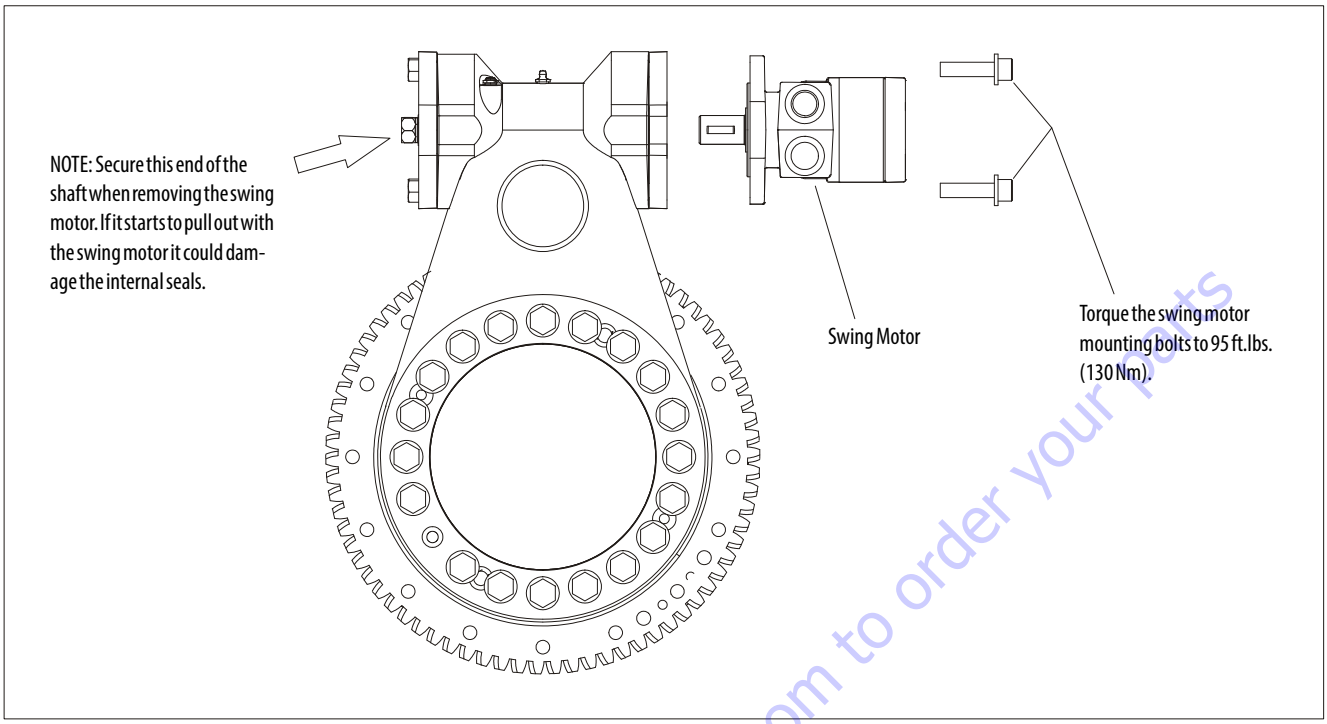


Figure 3-31. Swing Motor Removal and Installation

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.

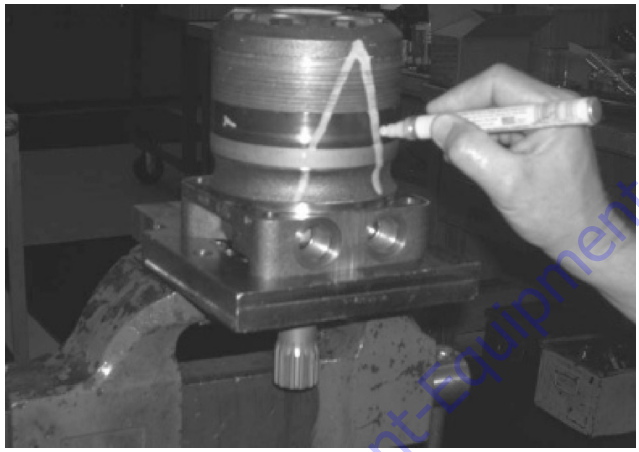
⚠ CAUTION

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

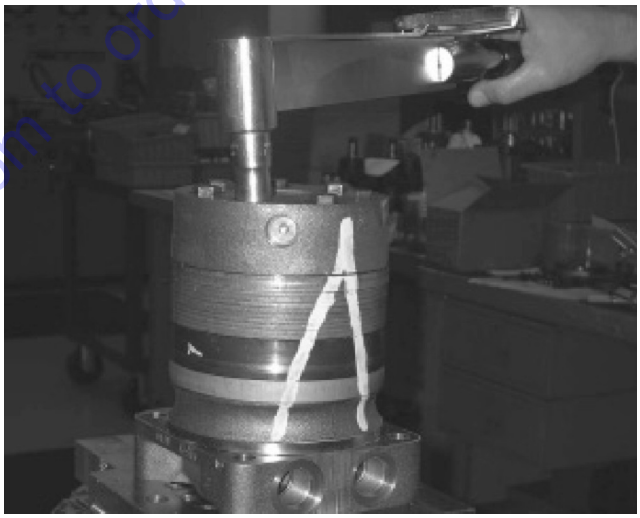
1. Place the motor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings if applicable.



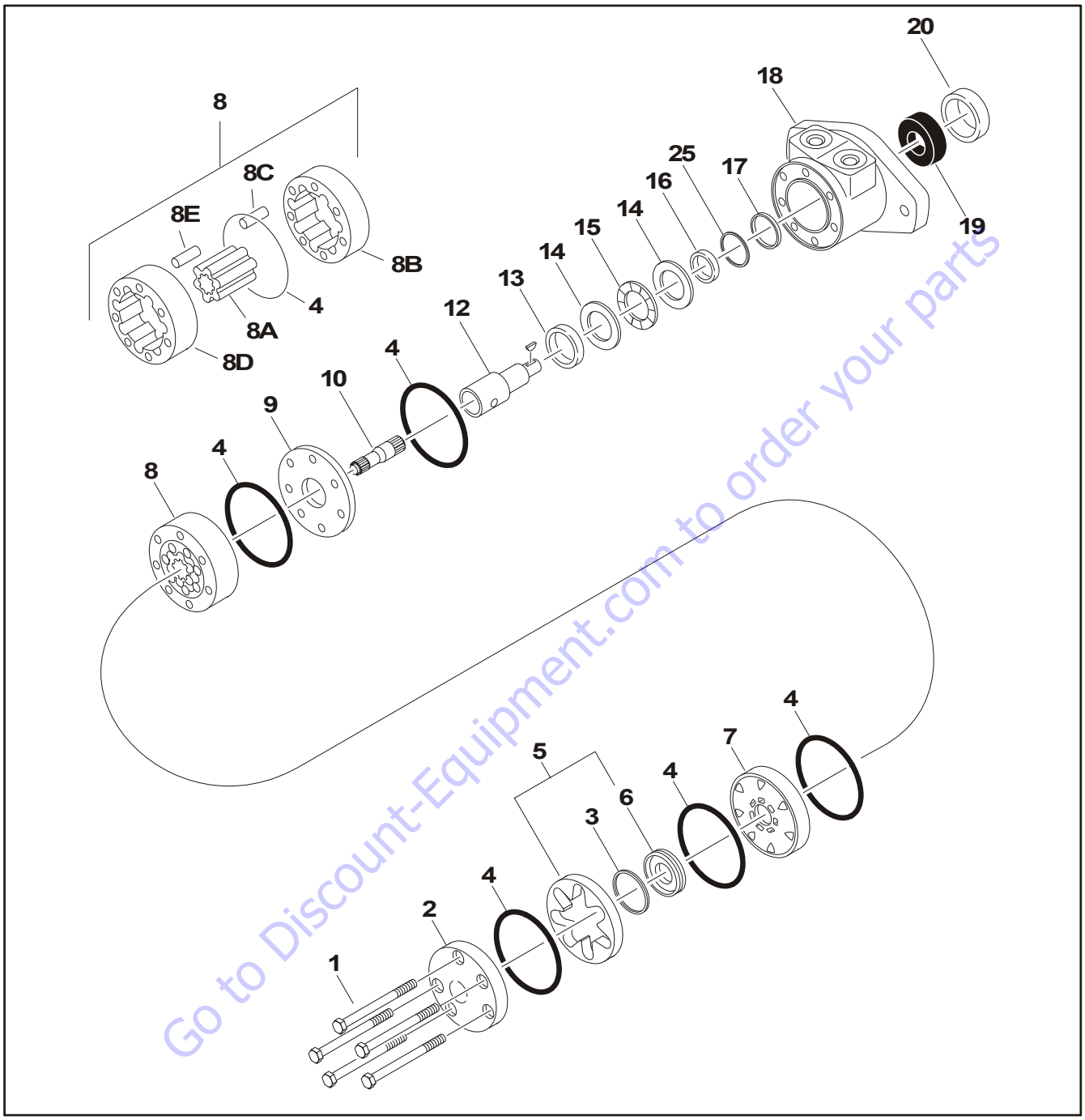
⚠ WARNING

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.



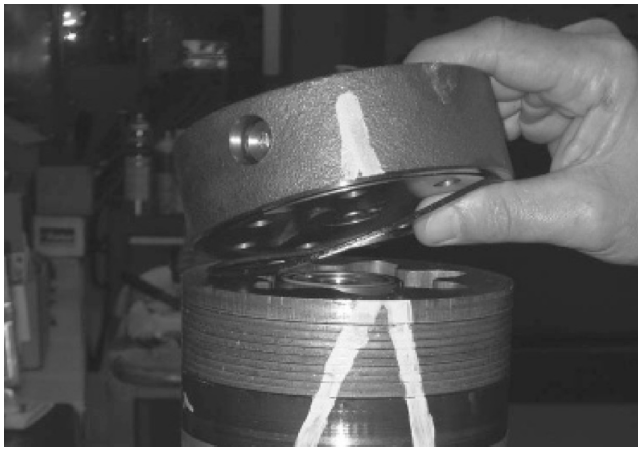
3. Remove the special ring head bolts (1) using an appropriate 1/2 or 9/16 inch size socket. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts.



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

Figure 3-32. Swing Motor - Exploded View

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



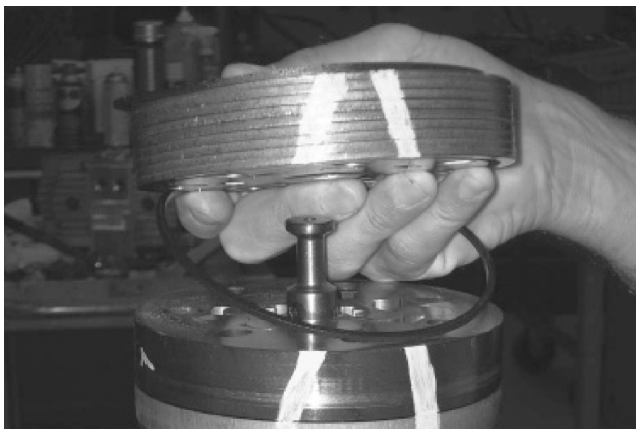
5. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary.

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.

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.



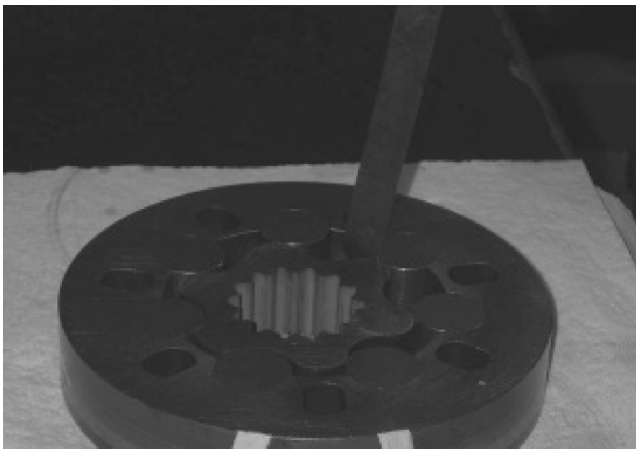
NOTE: *The manifold is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to ensure that same surface is reassembled against the rotor set.*

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.*

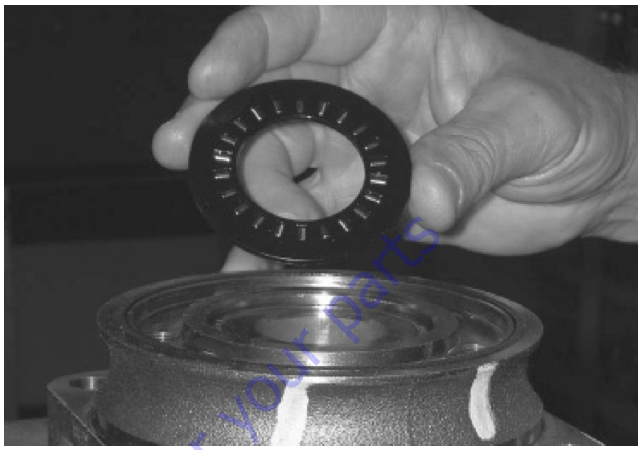
10. Place rotor set (8) and wear plate (9) on a flat surface and center rotor in stator such that two rotor lobes (180 degrees apart) and a roller vane centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is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



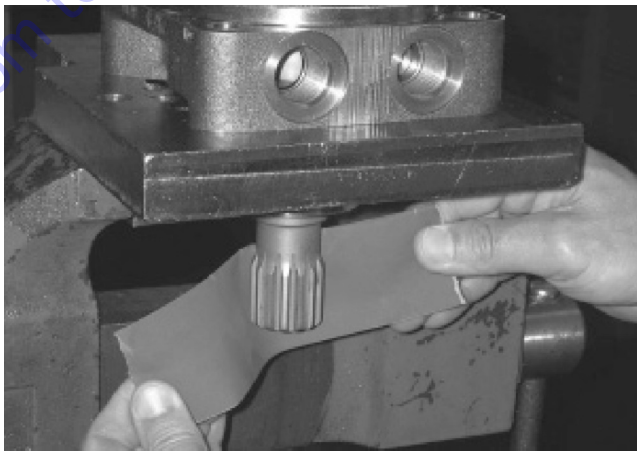
NOTE: *If rotor set (8) has two stator halves and two sets of seven vanes as shown, check the rotor lobe to roller vane clearance at both ends of rotor.*

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.



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.*

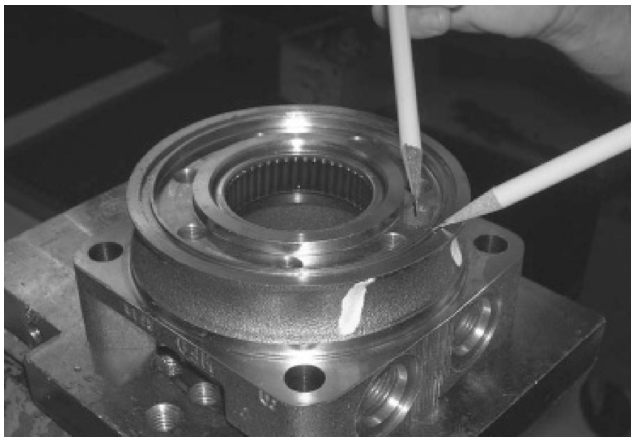
15. Remove and discard seal ring (4) from housing (18).

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

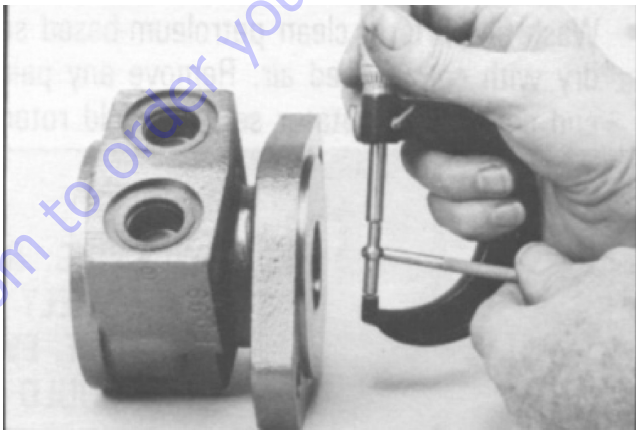
17. Remove seal (16) and backup ring (17) from housing (18) and backup washer (25). Discard both.

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 counterbore 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.

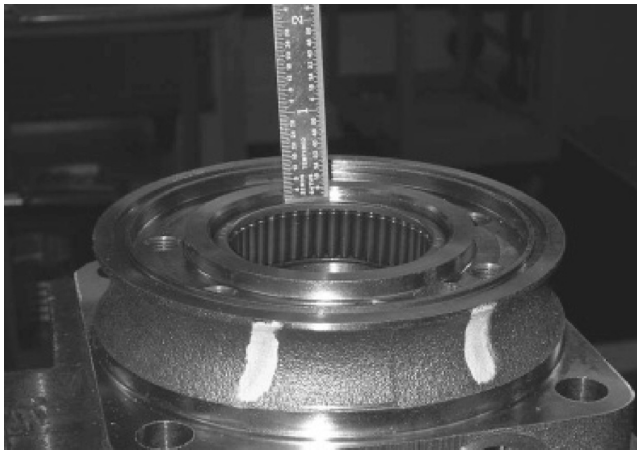
1. If the housing (18) bearing components were removed for replacement, thoroughly coat and pack a new outer bearing/bushing (19) with clean corrosion resistant grease recommended in the material section. Press the new bearing/bushing into the counterbore at the mounting flange end of the housing, using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

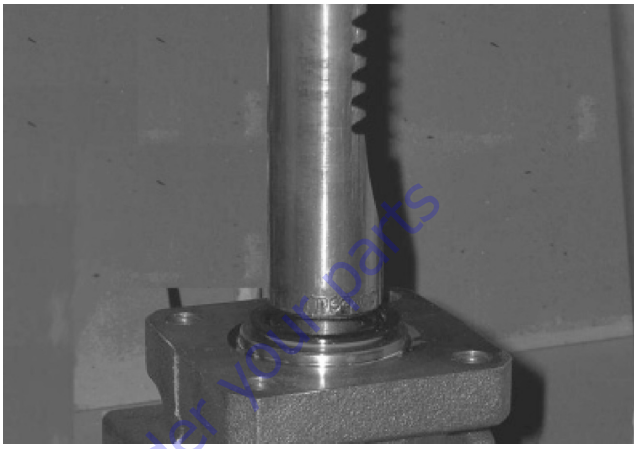


⚠ CAUTION

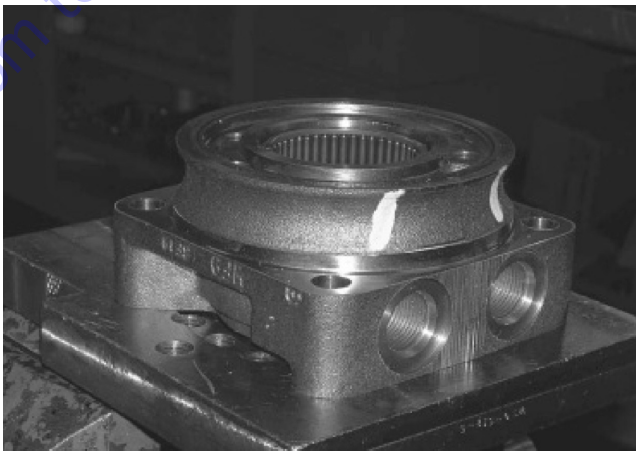
BECAUSE THE BEARING/BUSHINGS (13) AND (19) HAVE A PRESS FIT INTO THE HOUSING THEY MUST BE DISCARDED WHEN REMOVED. THEY MUST NOT BE REUSED.

2. The inner housing bearing/bushing (13) can now be pressed into its counterbore 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).

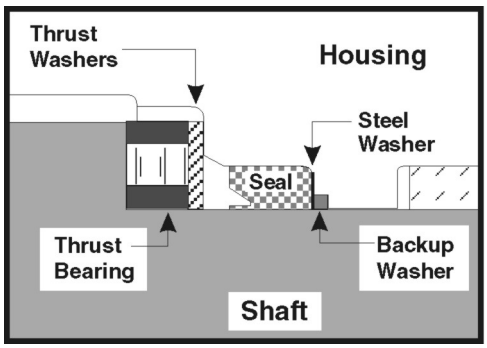
3. Press a new dirt and water seal (20) into the housing (18) outer bearing counterbore. The dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



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



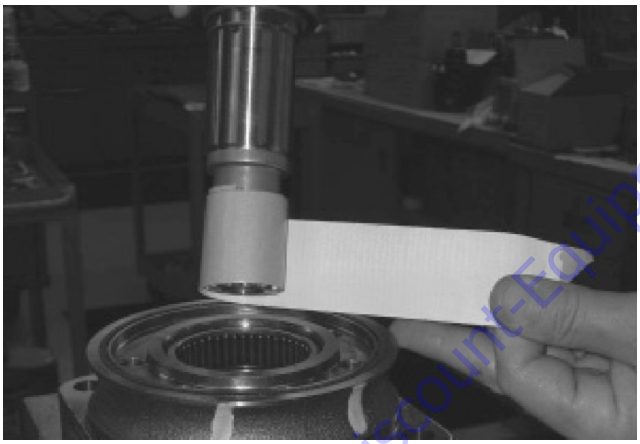
5. Assemble a new backup ring (17), new backup washer (25) and new seal (16) with the seal lip facing toward the inside of the motor, into their respective counterbores in housing (18).



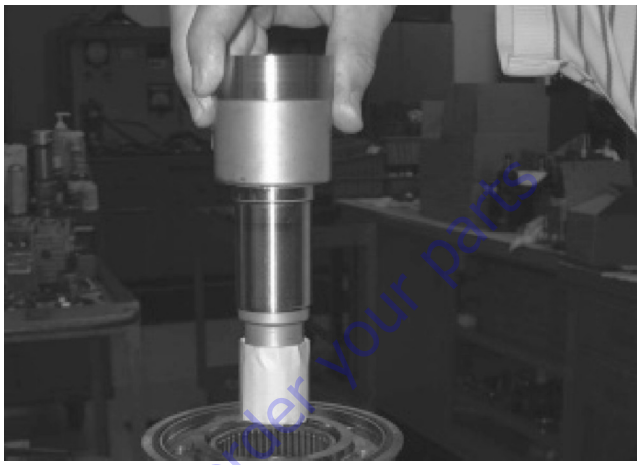
6. Assemble thrust washer (14) then thrust bearing (15) that was removed from the motor.

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.



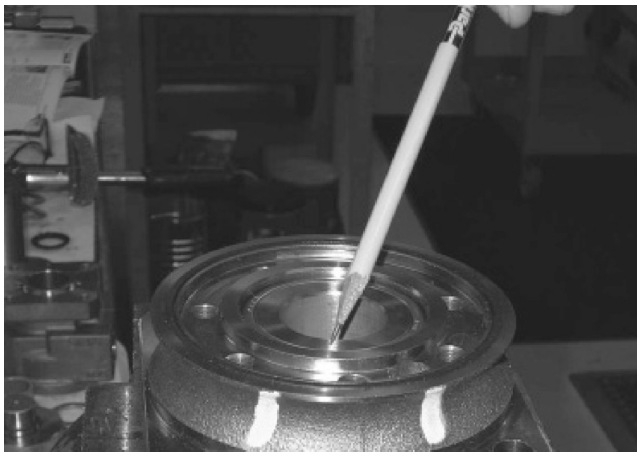
8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12) into housing (18), seating it against the thrust bearing (15).



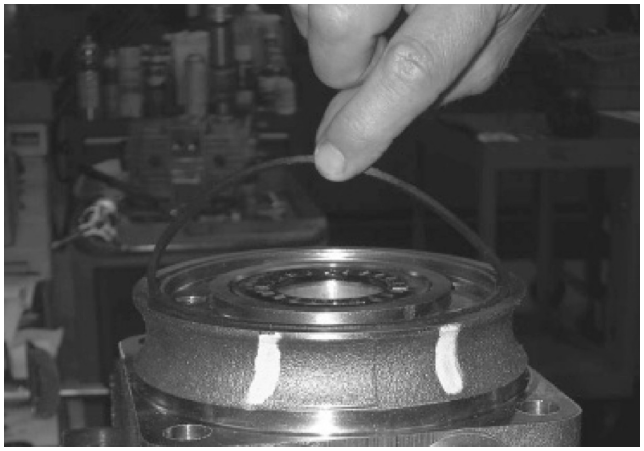
⚠ CAUTION

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.



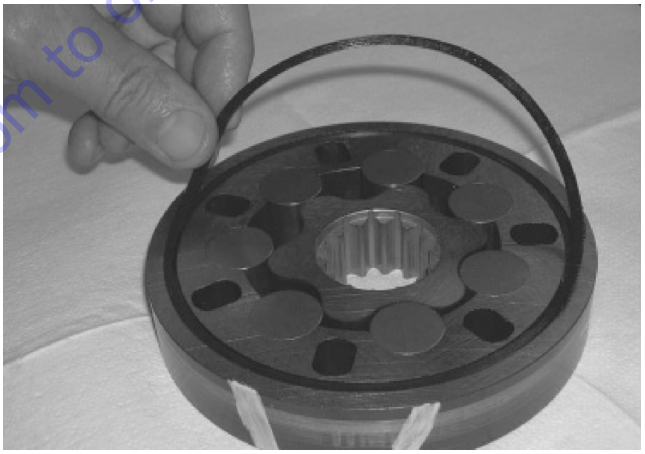
NOTE: *One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF 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.



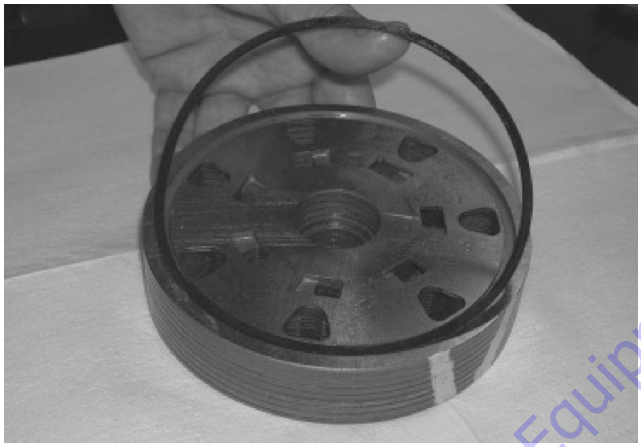
13. Install the assembled rotor set (8) onto wear plate (9) with rotor counterbore and seal ring side down and the splines into mesh with the drive link splines.

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).*

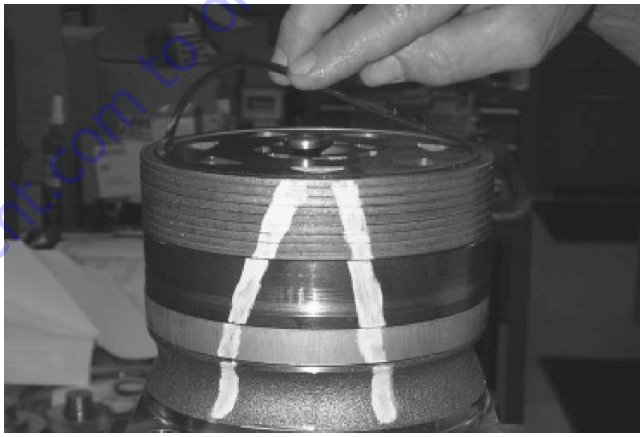
14. Apply clean grease to a new seal ring (4) and assemble it in the seal ring groove in the rotor set contact side of manifold (7).



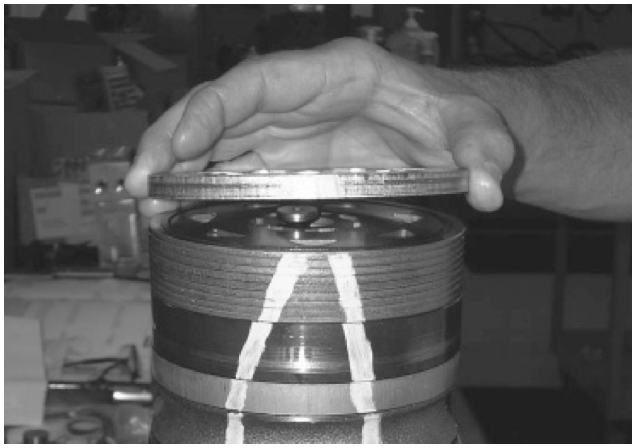
NOTE: *The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression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

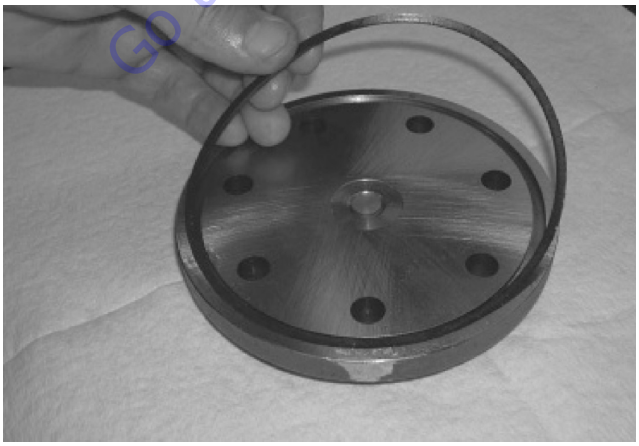


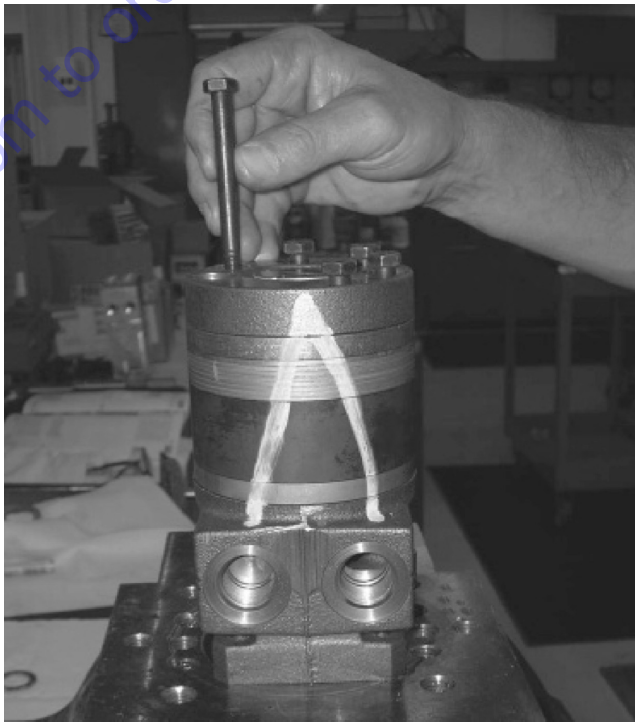
17. Assemble the commutator ring (6) over alignment studs onto the manifold.



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.

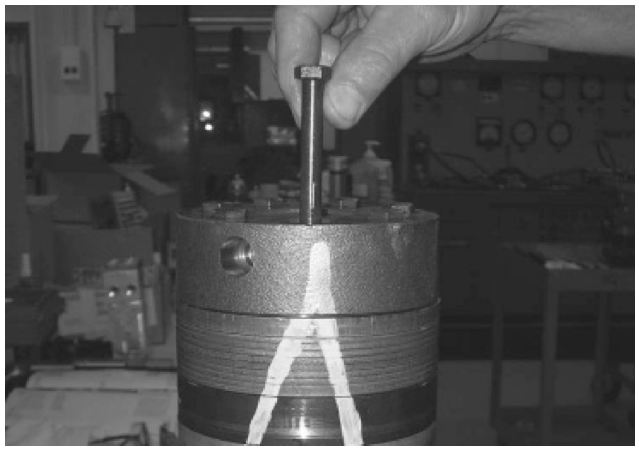
19. Assemble a new seal ring (4) into end cover (2) and assemble end cover over the alignment studs and onto the commutator set. If the end cover has only 5 bolt holes be sure the cover holes are aligned with the 5 threaded holes in housing (18). The correct 5 bolt end cover bolt hole relationship to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

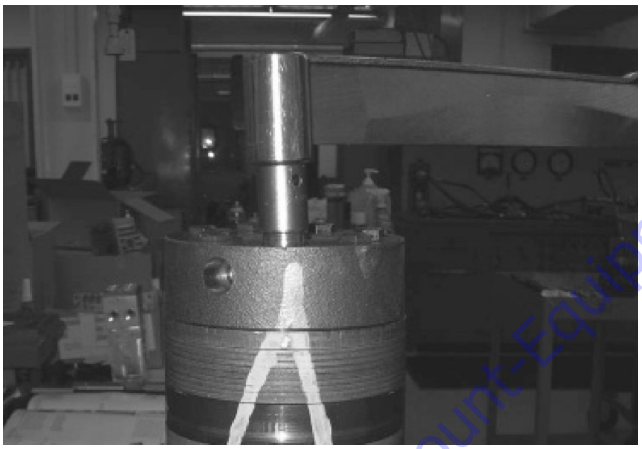


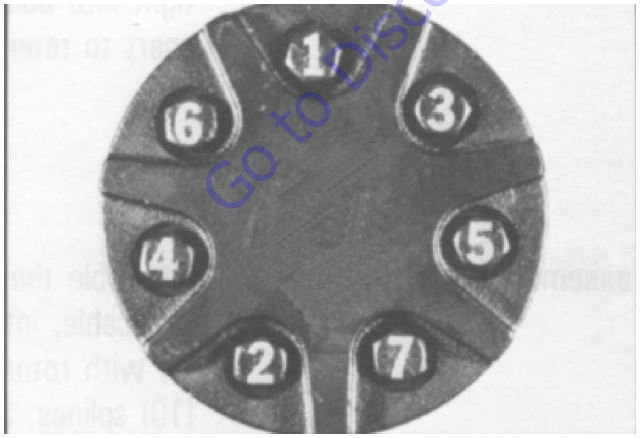


NOTE: *If the end cover has a valve (24) or has five bolt holes, use the line you previously scribed on the cover to radially align the end cover into its original position.*

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.

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

9. 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

1. Pressurize the motor with 100 p.s.i. dry air or nitrogen and submerge in solvent to check for external leaks.

2. Check motor for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 N m)

3. 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 counterclockwise coupling shaft rotation.

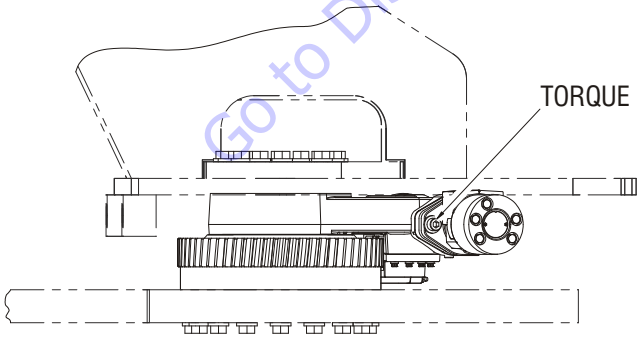
4. Use test stand if available, to check operation of the motor.

Installation

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

1. Carefully insert the swing motor into the swing drive, making sure the swing motor shaft key is aligned correctly.

2. Secure the swing motor to the swing drive assembly with the retaining bolts. Apply High Strength Threadlocking Compound to the threads of the retaining bolts and torque to 85 ft.lbs. (115 Nm).



3. Connect the hydraulic lines running to the swing motor as tagged during removal.

4. 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

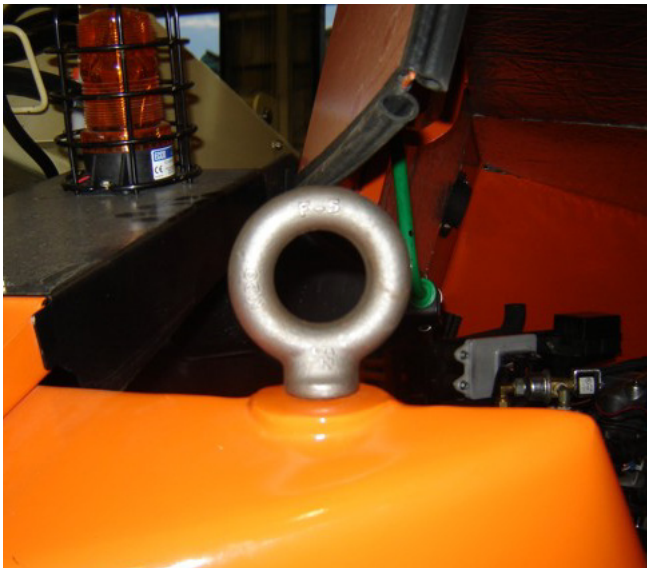
1. Remove the hardware securing the battery cover and remove the battery cover.

2. Disconnect the negative terminal on the battery.

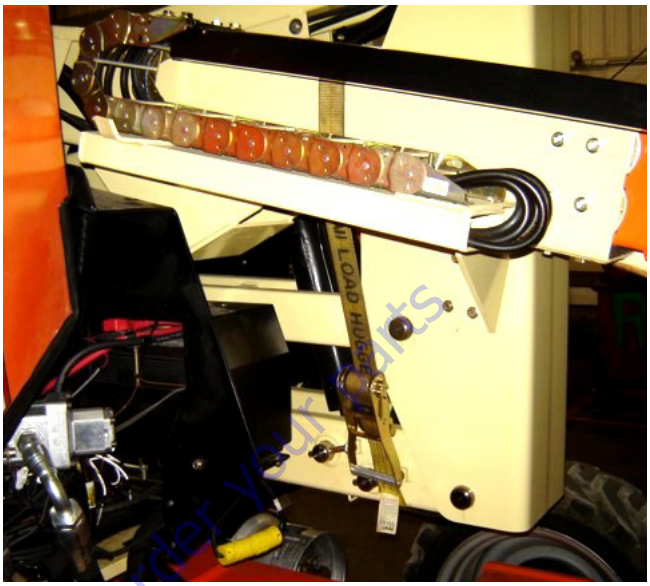
NOTICE

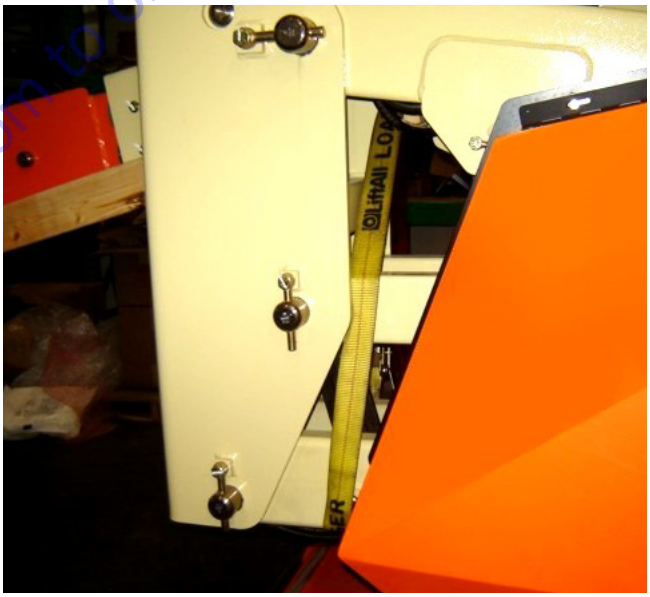
MAKE SURE THE EYEBOLTS HAVE A RATED WORK LOAD SUFFICIENT TO HANDLE THE LOAD OF THE UPPERSTRUCTURE OF THE MACHINE. THE UPPERSTRUCTURE WEIGHS APPROXIMATELY 7,000 LB (3175 KG).

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



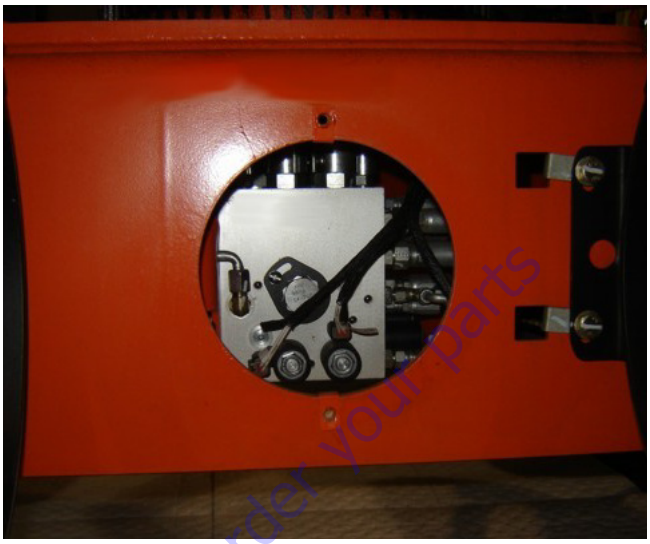
4. Securely strap the booms together to prevent any movement during the lifting process.



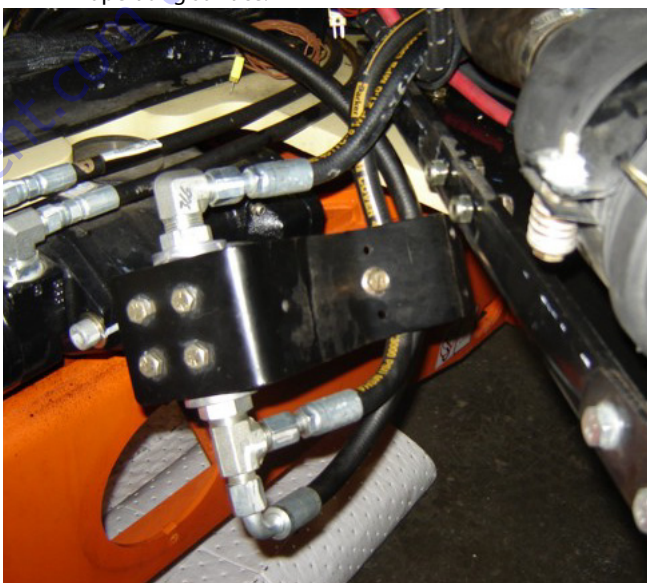


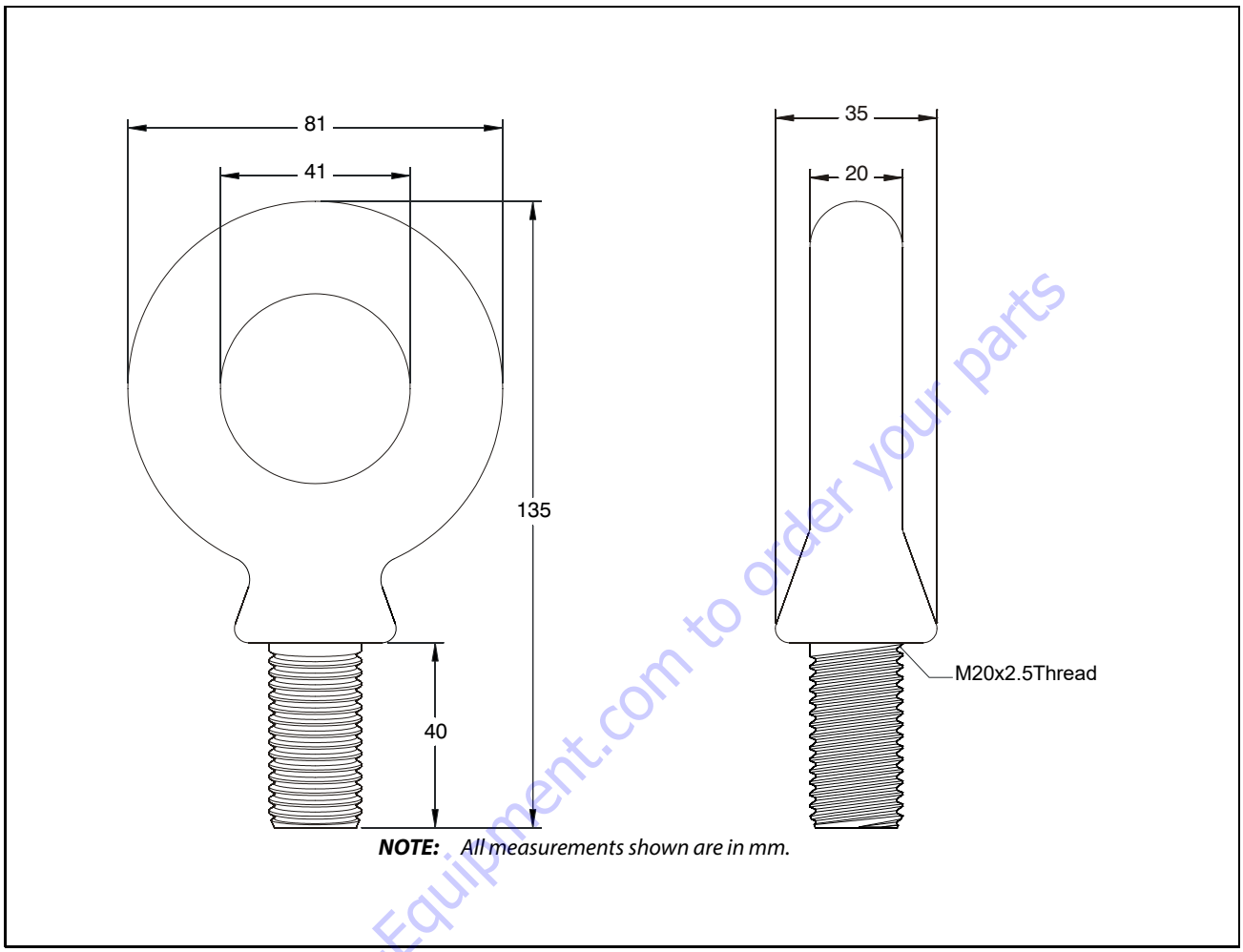
5. If equipped, remove the LP fuel tank on the side of the frame. It may also be desirable to remove the tank retaining brackets to gain additional clearance to work.

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



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 operating surface.



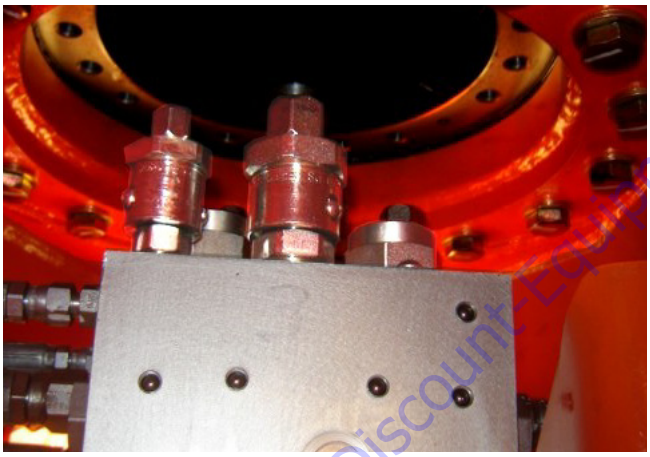


NOTE: *All measurements shown are in mm.*

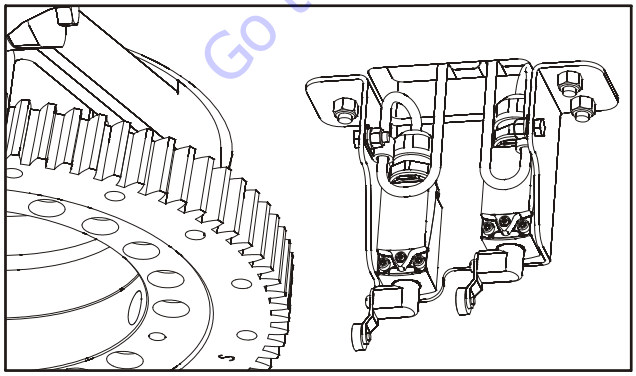
Figure 3-33. Eyebolt for Counterweight

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

9. 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.

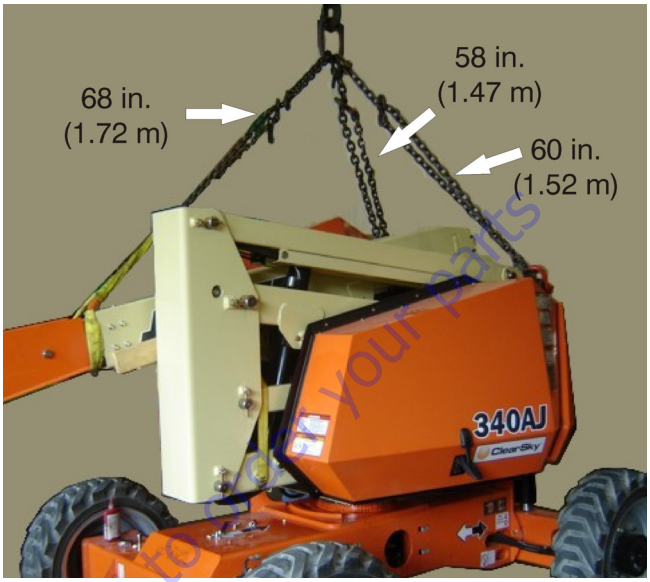


10. Remove the drive orientation and lockout switches so they don't get broken during the removal procedure.



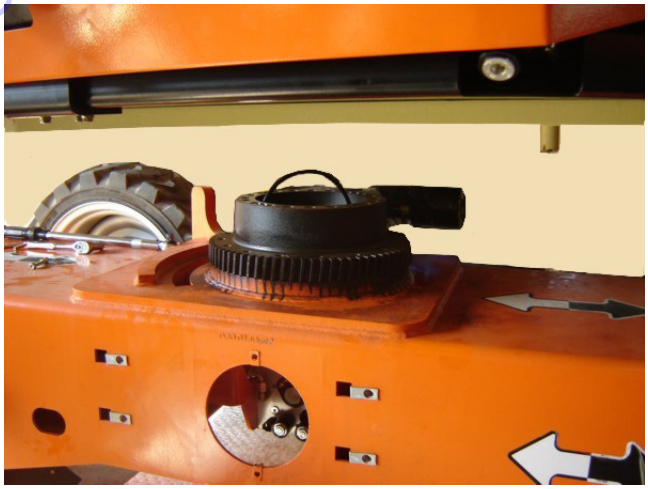
11. Swing the engine tray back into position and secure it in place with the retaining bolt.

12. 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 lifiting.



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

14. 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 lb (56.6 kg).*

16. Remove the bearing assembly from the frame.

Installation

NOTE: *The swing bearing assembly weighs approximately 125 lb (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 High Strength Threadlocking Compound 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 lb (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 snuggly 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 High Strength Threadlocking Compound 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* High Strength Threadlocking Compound. *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 degrees 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.

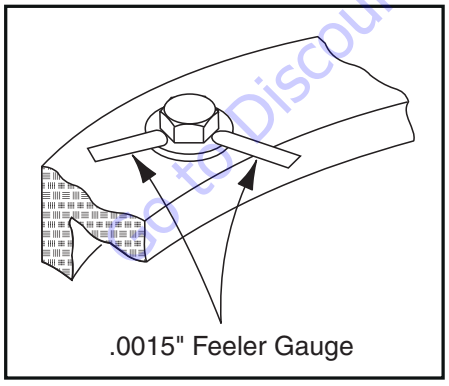


Figure 3-34. Swing Bearing Feeler Gauge Check

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

Wear Tolerance

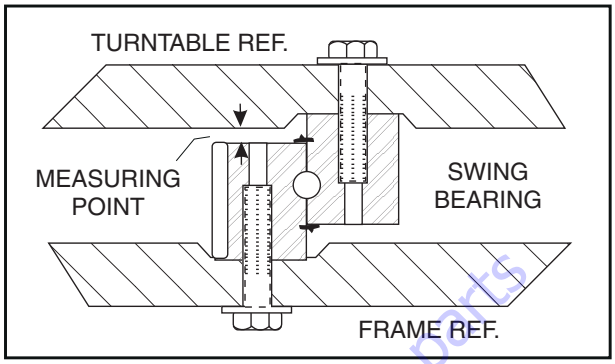


Figure 3-35. Swing Bearing Tolerance Measuring Point

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 High Strength Threadlocking Compound; Torque to 133 ft.lbs. (180 Nm).

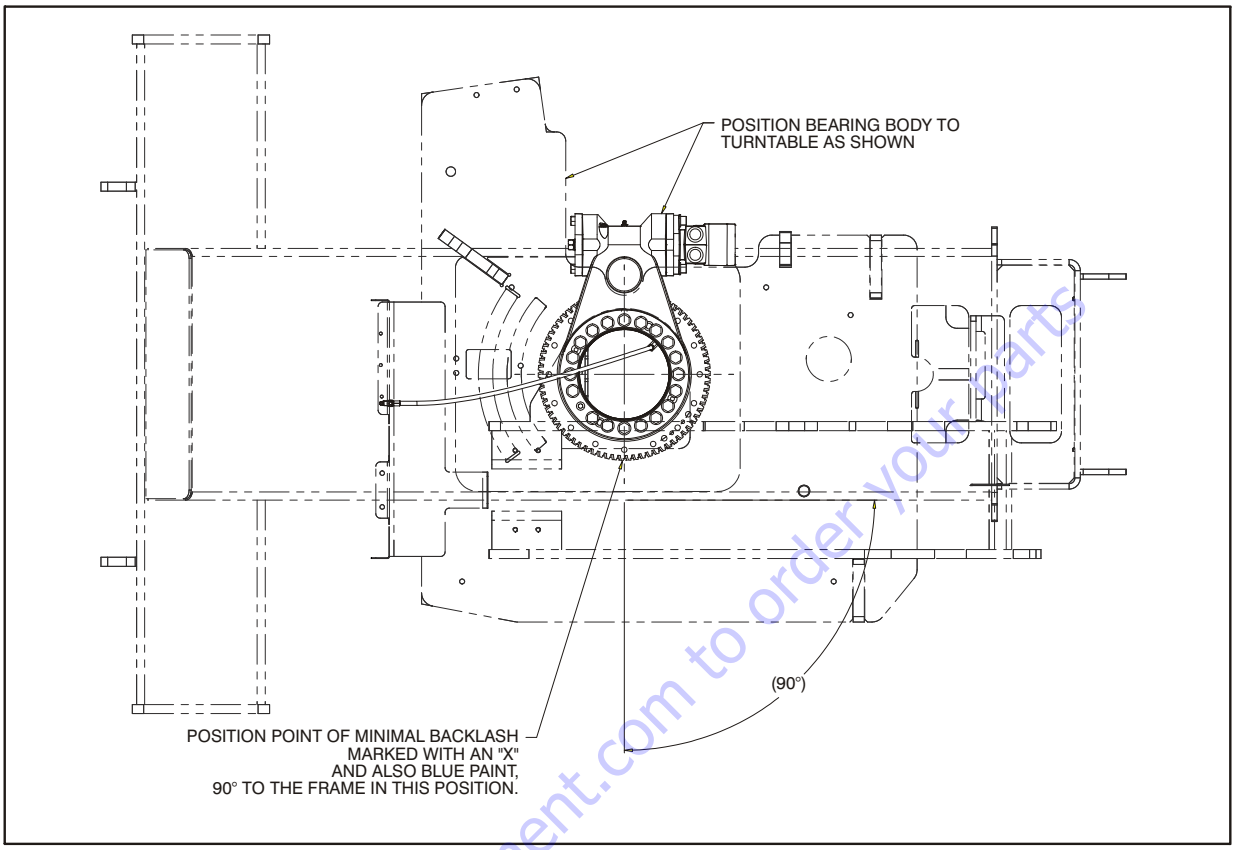


Figure 3-36. Bearing Placement

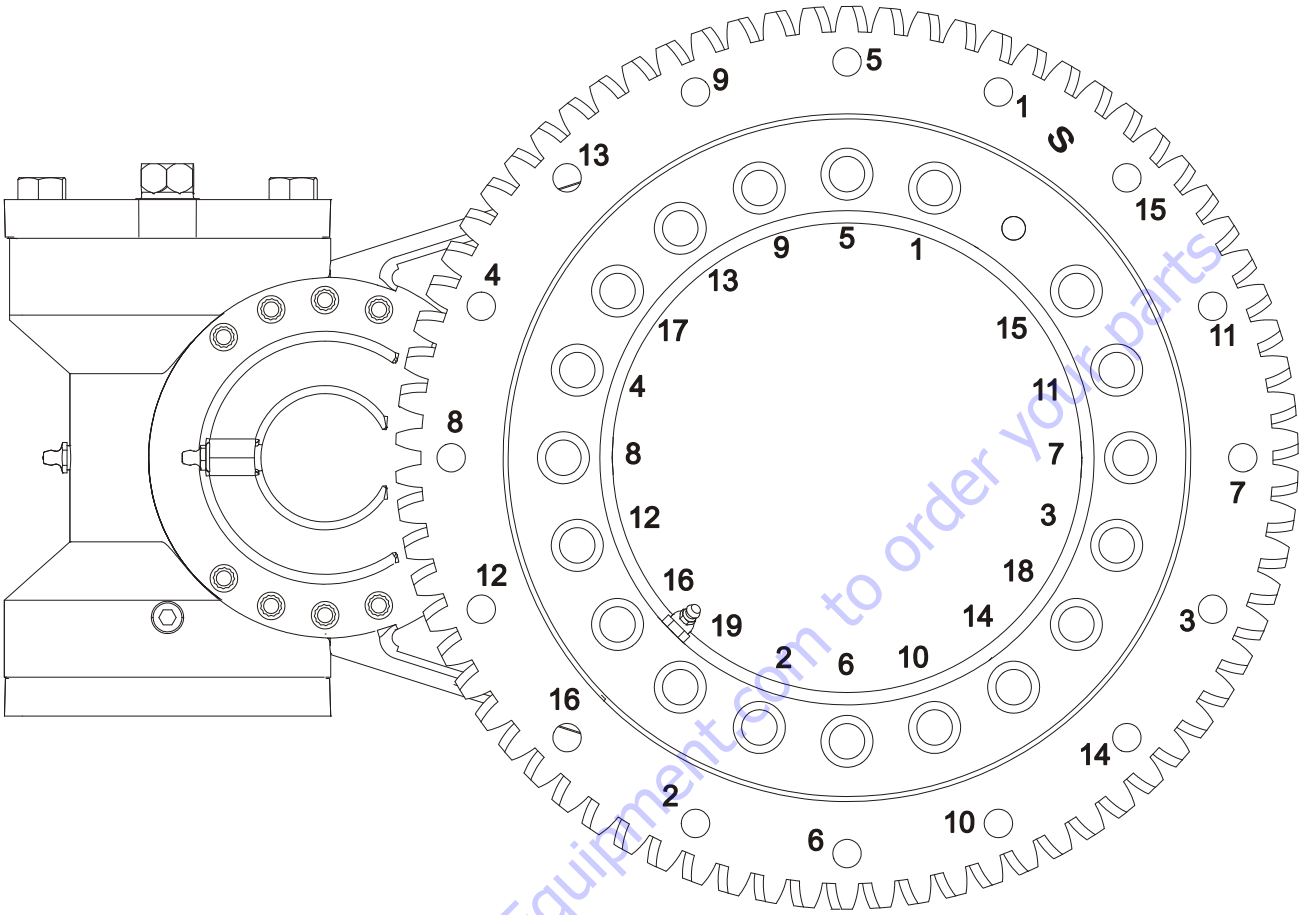
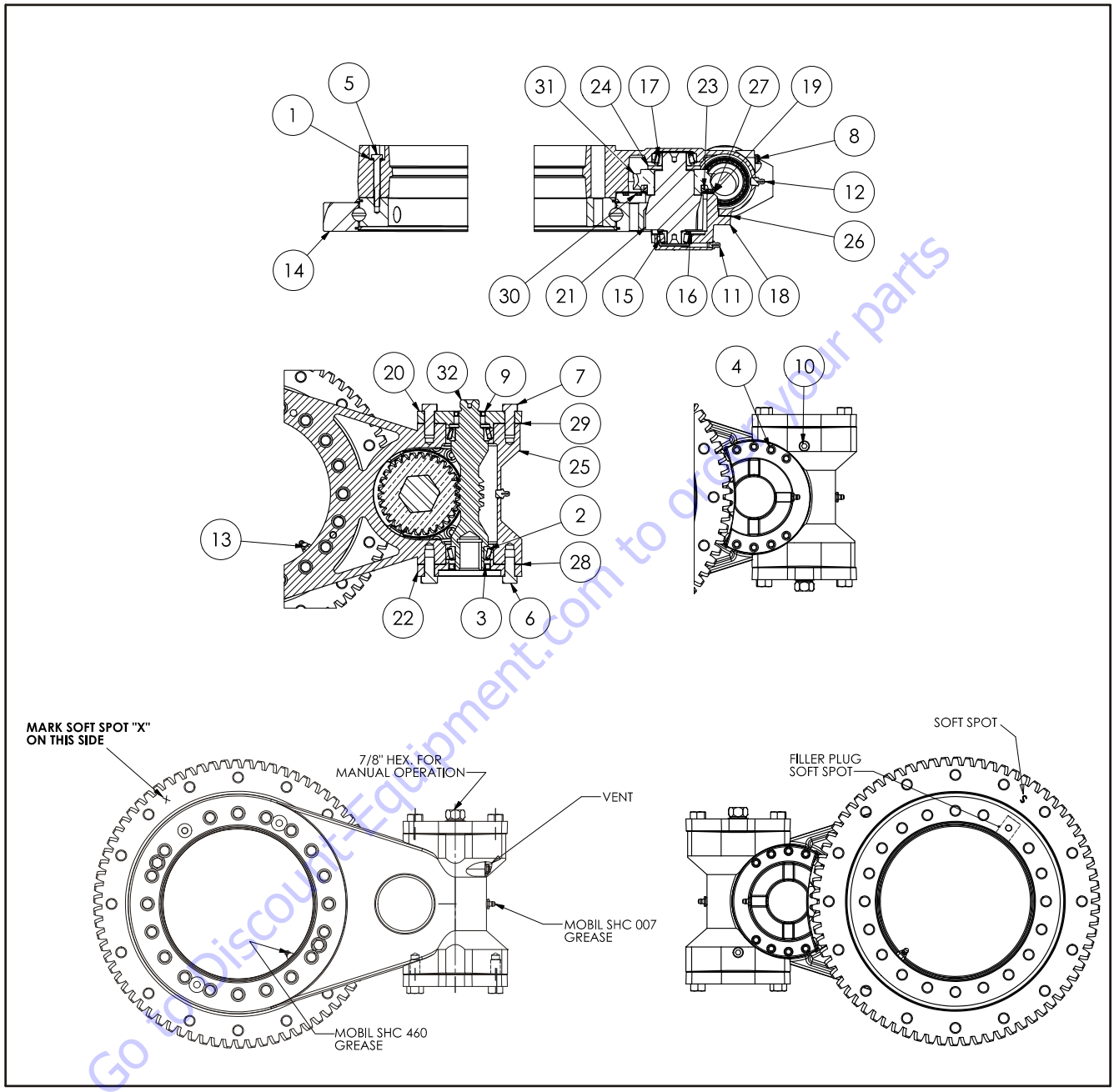


Figure 3-37. Swing Bearing Torque Sequence

Disassembly

The servicing of these units requires a press, a 5/16" 12 point socket, a 7/16" socket, a ¾" 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), ¾" steel rod at least 10" long, Threadlocking Compound, Mobil SHC 007 grease, Mobil SHC 460 grease, Medium Strength Threadlocking Compound 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 capscrews (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
2. Bearing
3. Oil Seal
4. Capscrew
5. Bolt
6. Bolt
7. Bolt
8. Pressure Vent
9. Oil Seal
10. Pipe Plug
11. Grease Fitting
12. Grease Fitting
13. Grease Fitting
14. Slew Ring
15. Bearing
16. Grease Ring
17. Bearing
18. Gear Cap
19. Cover Plate
20. Worm Cap
21. Output Pinion
22. Motor Adapter
23. Face Seal
24. Washer Spacer
25. Housing
26. Cap Shim
27. Cover Shim
28. Gasket
29. Gasket
30. Screw
31. Worm Gear
32. Worm

Figure 3-38. Swing Gear Assembly

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 ¾" bolts (7) from Worm Cap (20) using ¾" 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.

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 (Threadlocking Compound) 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.
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 ¾-13 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 Medium Strength Threadlocking Compound to end of ¾-13 x 1.25" grade 5 bolts (7) and Threadlocking Compound 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.
13. Apply Threadlocking Compound 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 Medium Strength Threadlocking Compound 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.

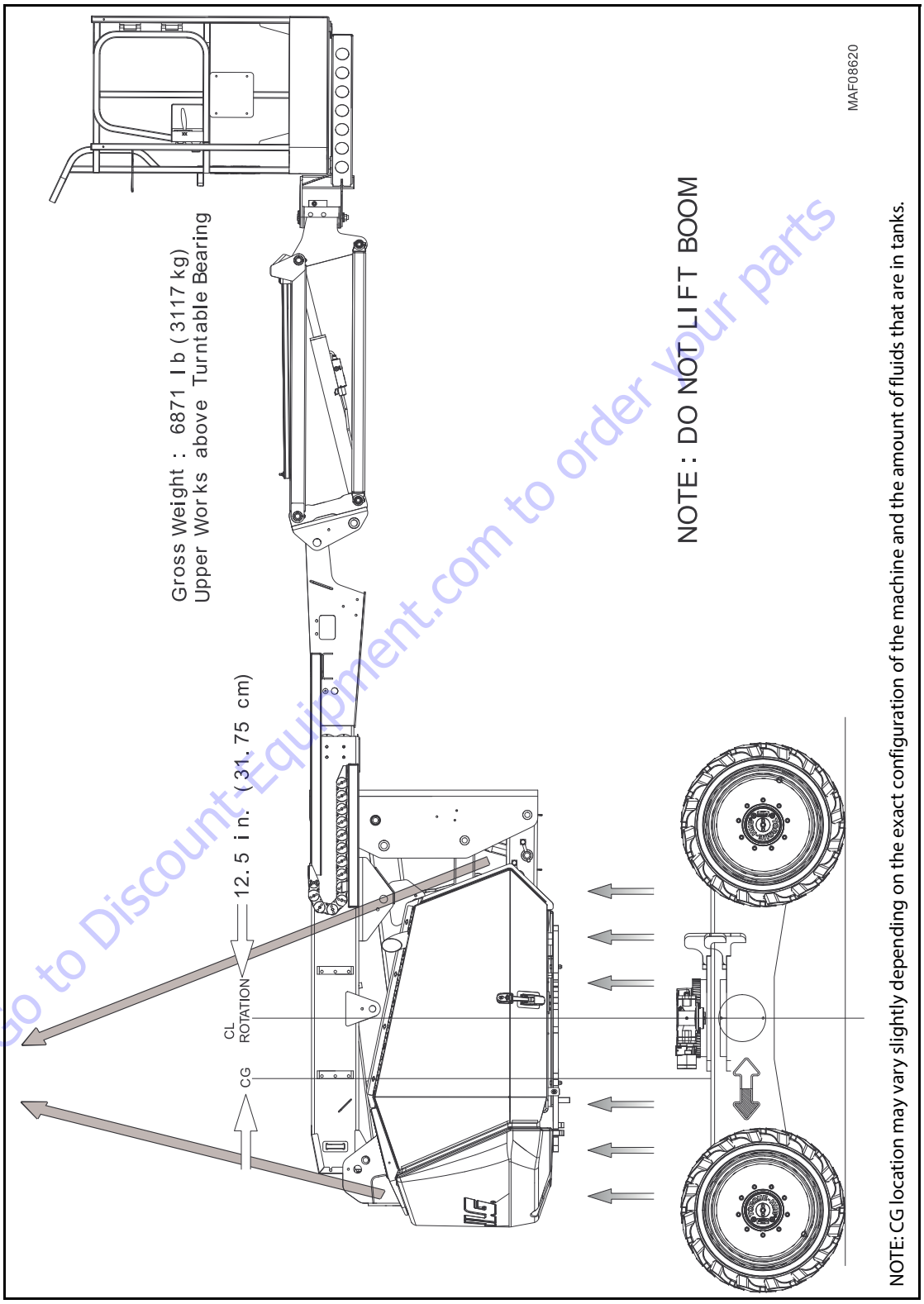
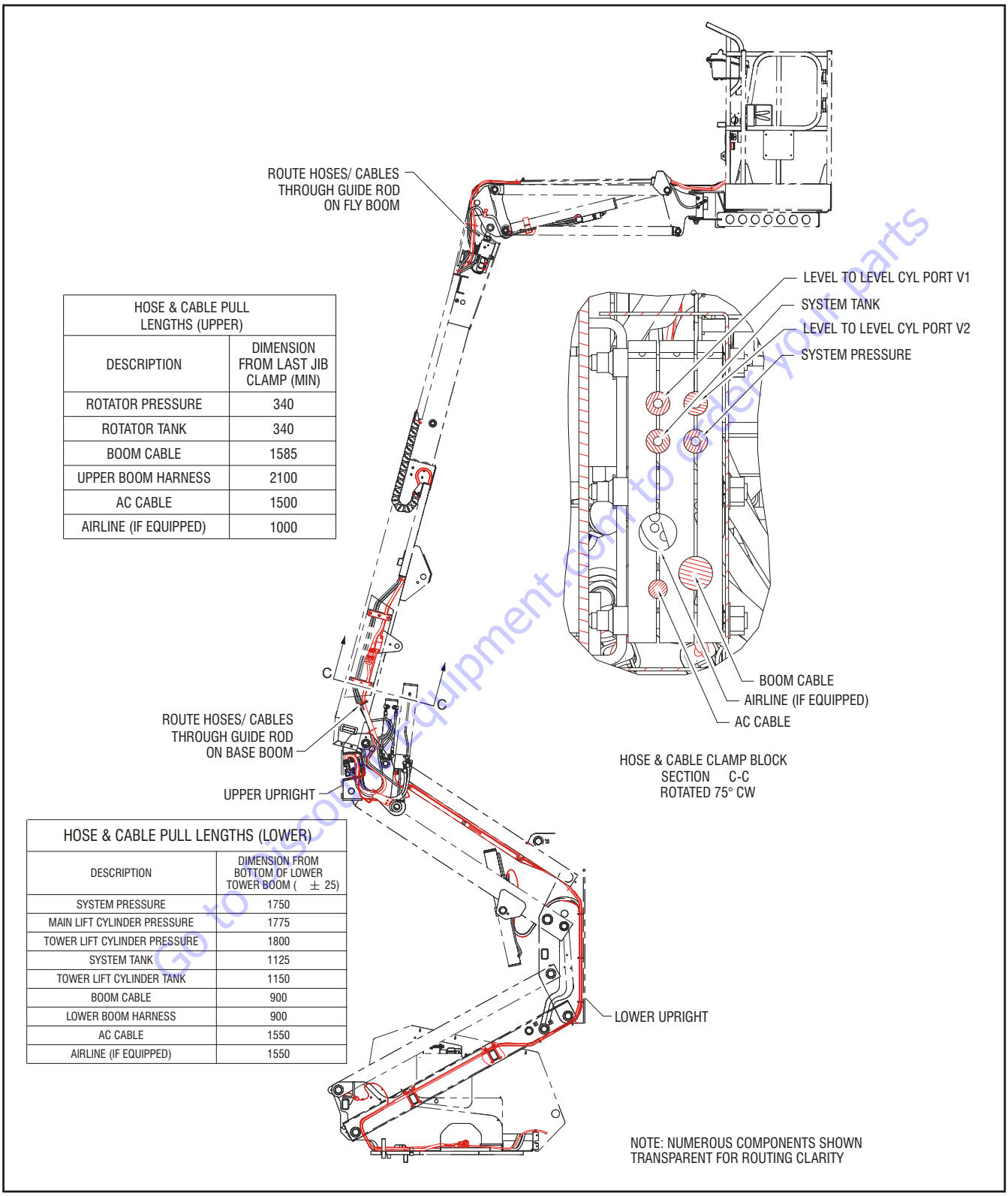


Figure 3-39. Swing Bearing Removal



HOSE & CABLE PULL LENGTHS (UPPER)	
DESCRIPTION	DIMENSION FROM LAST JIB CLAMP (MIN)
ROTATOR PRESSURE	340
ROTATOR TANK	340
BOOM CABLE	1585
UPPER BOOM HARNESS	2100
AC CABLE	1500
AIRLINE (IF EQUIPPED)	1000

HOSE & CABLE PULL LENGTHS (LOWER)	
DESCRIPTION	DIMENSION FROM BOTTOM OF LOWER TOWER BOOM (± 25)
SYSTEM PRESSURE	1750
MAIN LIFT CYLINDER PRESSURE	1775
TOWER LIFT CYLINDER PRESSURE	1800
SYSTEM TANK	1125
TOWER LIFT CYLINDER TANK	1150
BOOM CABLE	900
LOWER BOOM HARNESS	900
AC CABLE	1550
AIRLINE (IF EQUIPPED)	1550

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

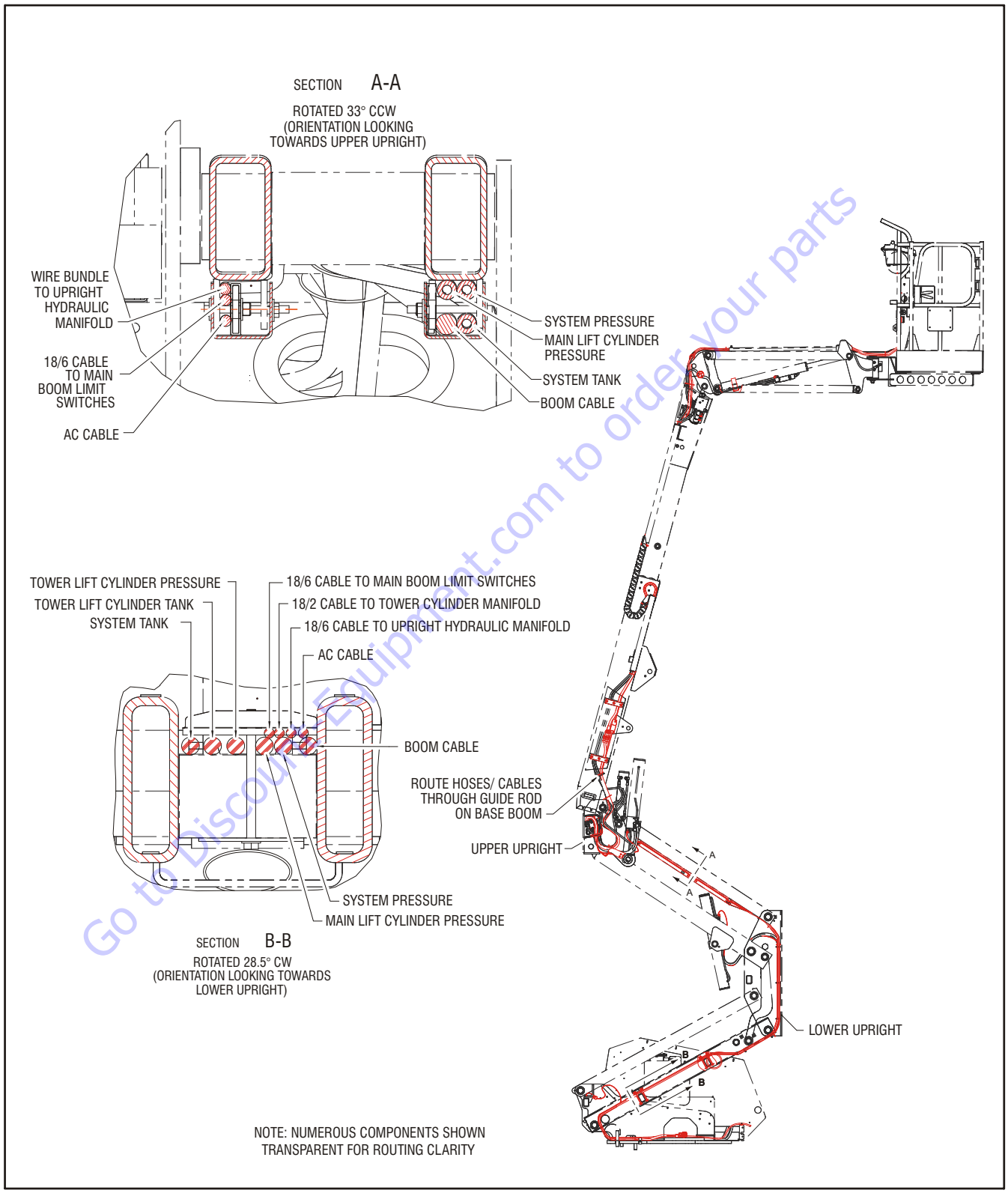


Figure 3-41. Cable Installation and Identification - Sheet 2 of 8

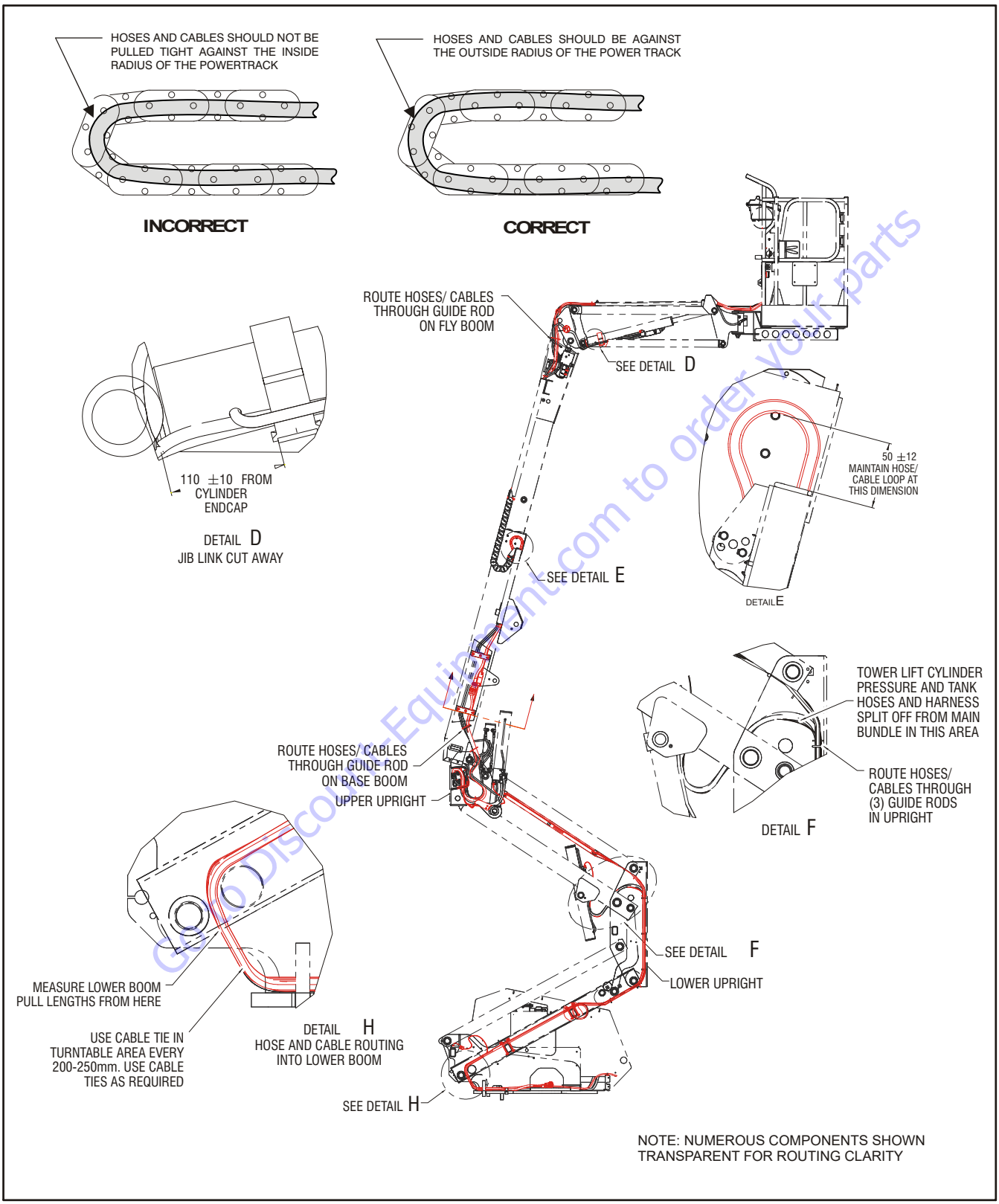
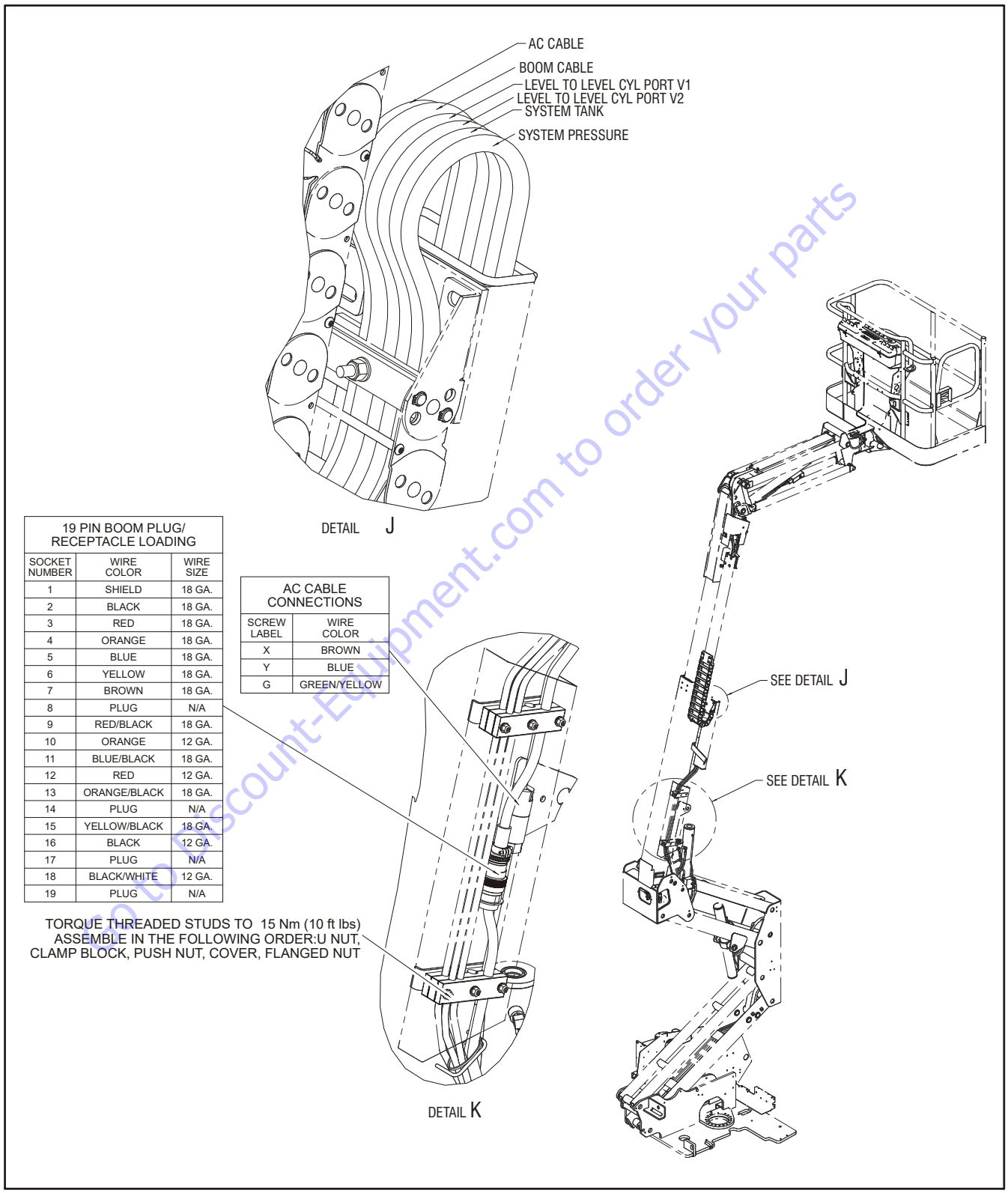


Figure 3-42. Cable Installation and Identification - Sheet 3 of 8



19 PIN BOOM PLUG/ RECEPTACLE LOADING		
SOCKET NUMBER	WIRE COLOR	WIRE SIZE
1	SHIELD	18 GA.
2	BLACK	18 GA.
3	RED	18 GA.
4	ORANGE	18 GA.
5	BLUE	18 GA.
6	YELLOW	18 GA.
7	BROWN	18 GA.
8	PLUG	N/A
9	RED/BLACK	18 GA.
10	ORANGE	12 GA.
11	BLUE/BLACK	18 GA.
12	RED	12 GA.
13	ORANGE/BLACK	18 GA.
14	PLUG	N/A
15	YELLOW/BLACK	18 GA.
16	BLACK	12 GA.
17	PLUG	N/A
18	BLACK/WHITE	12 GA.
19	PLUG	N/A

AC CABLE CONNECTIONS	
SCREW LABEL	WIRE COLOR
X	BROWN
Y	BLUE
G	GREEN/YELLOW

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

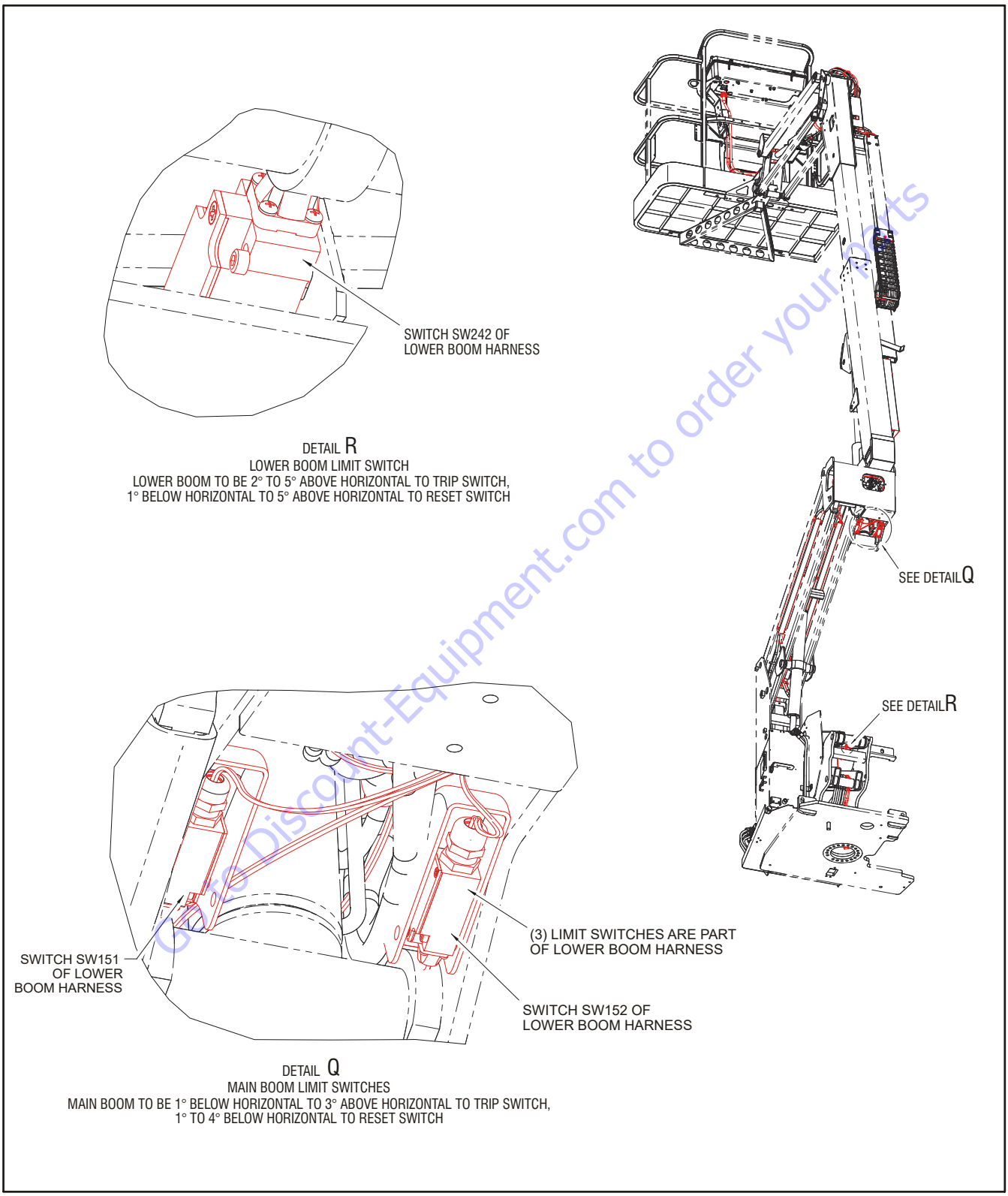


Figure 3-44. Cable Installation and Identification - Sheet 5 of 8

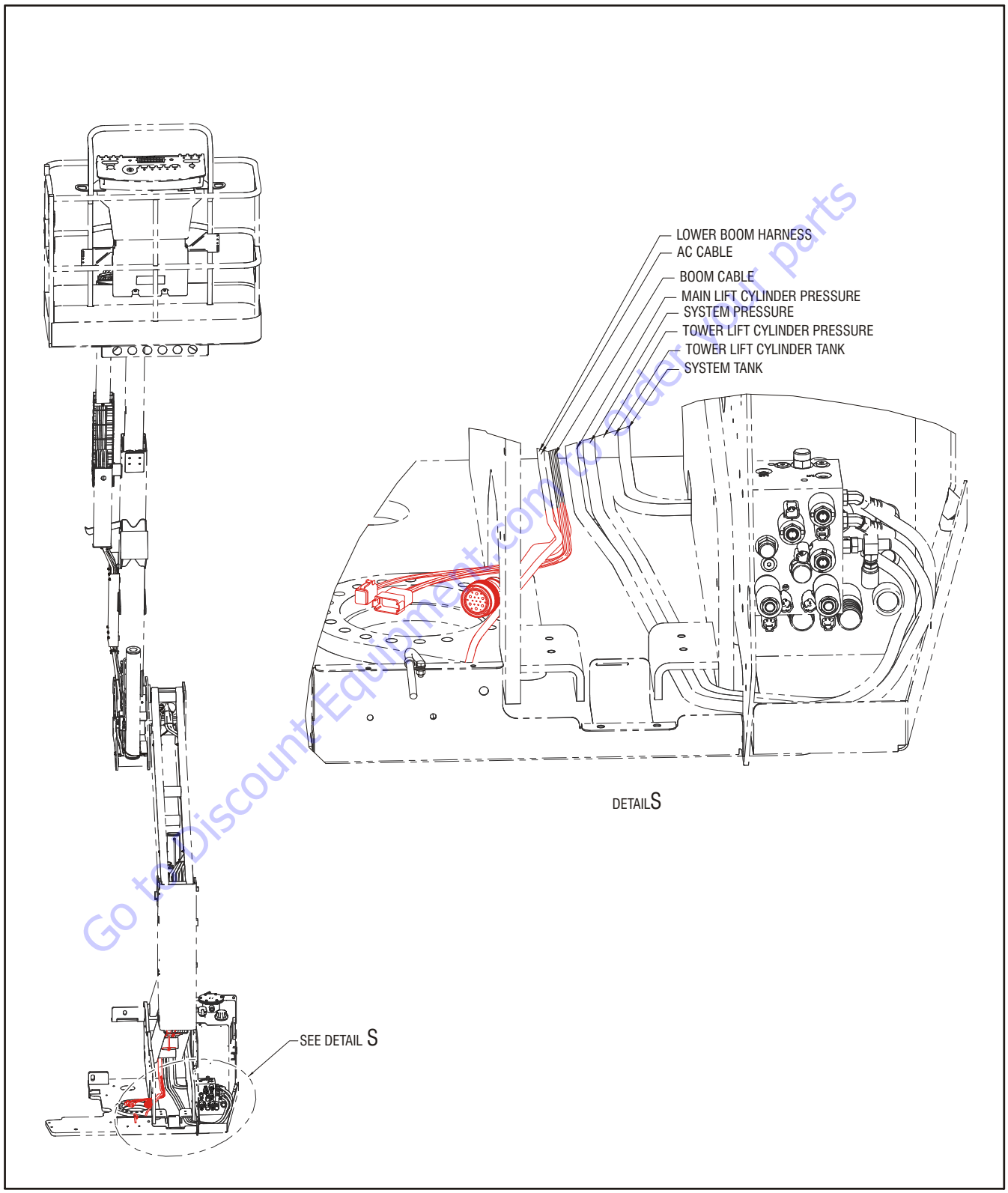


Figure 3-45. Cable Installation and Identification - Sheet 6 of 8

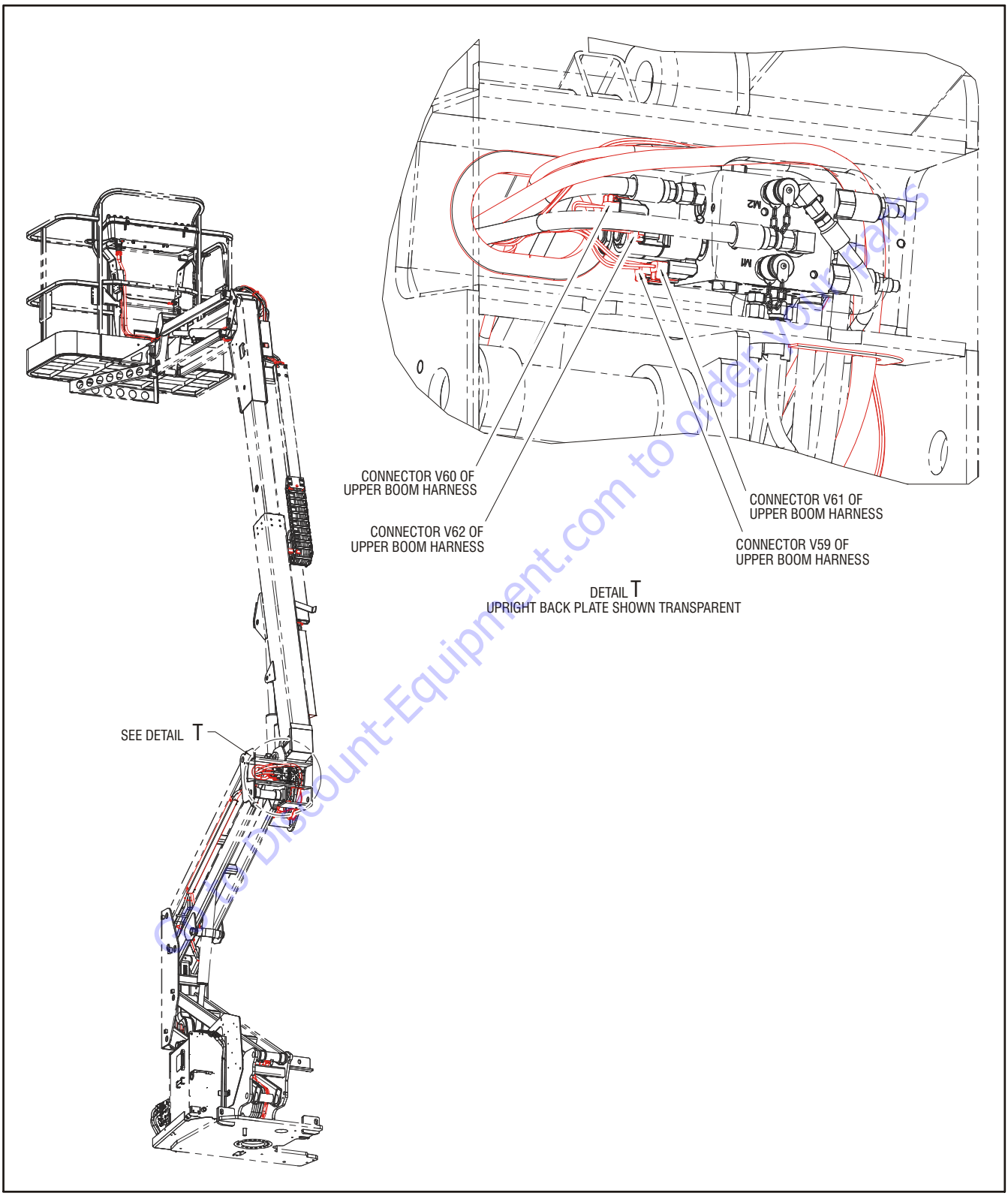


Figure 3-46. Cable Installation and Identification - Sheet 7 of 8

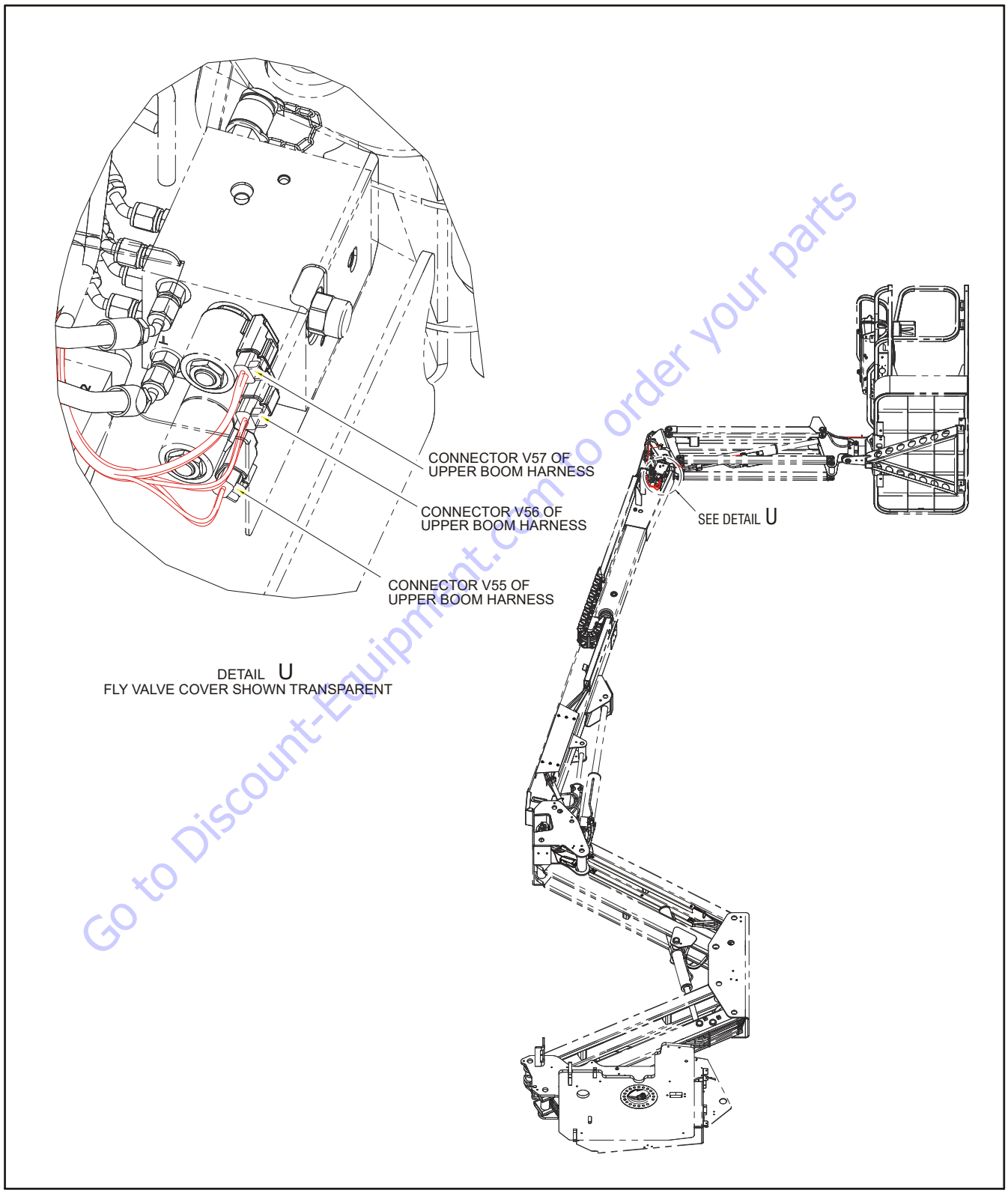


Figure 3-47. Cable Installation and Identification - Sheet 8 of 8

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

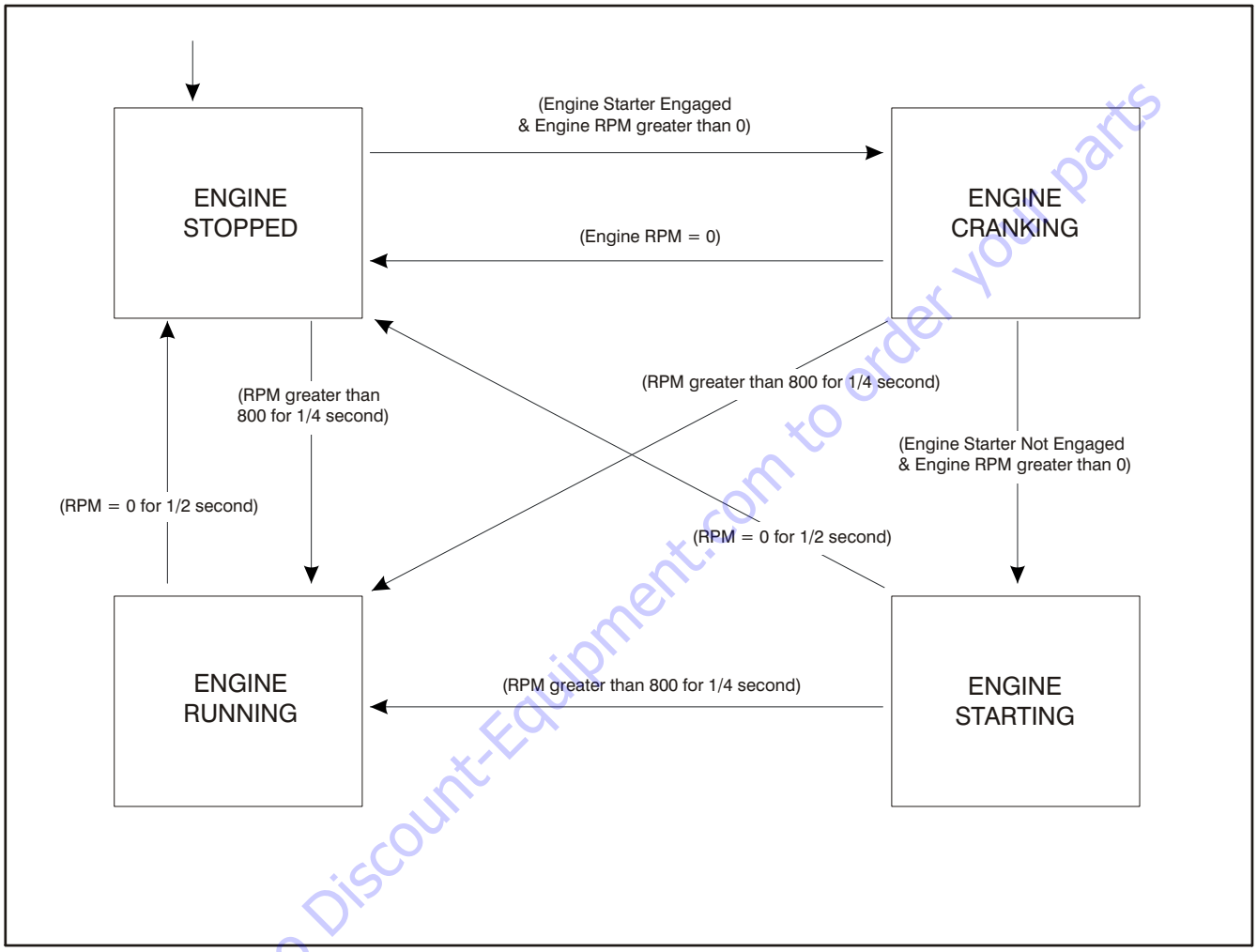


Figure 3-48. Engine Operating State Diagram

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.*

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.

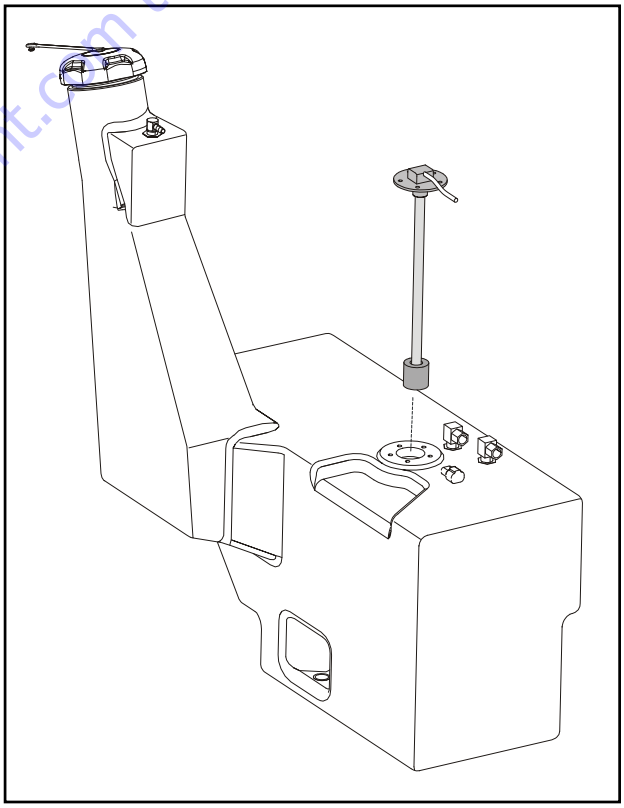


Figure 3-49. Fuel Level Sensor

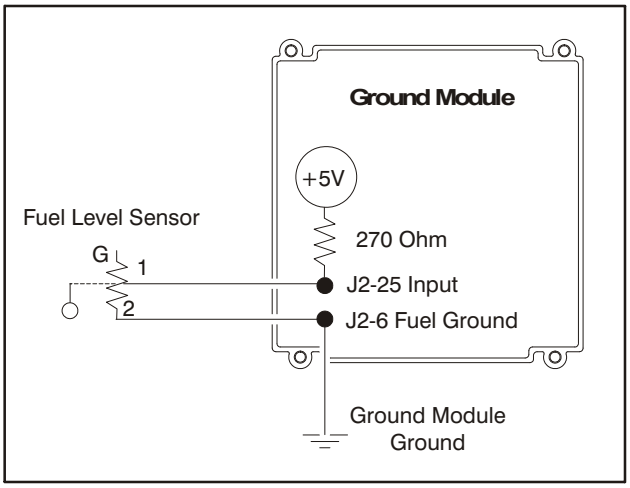


Figure 3-50. Fuel Level Sensor Schematic

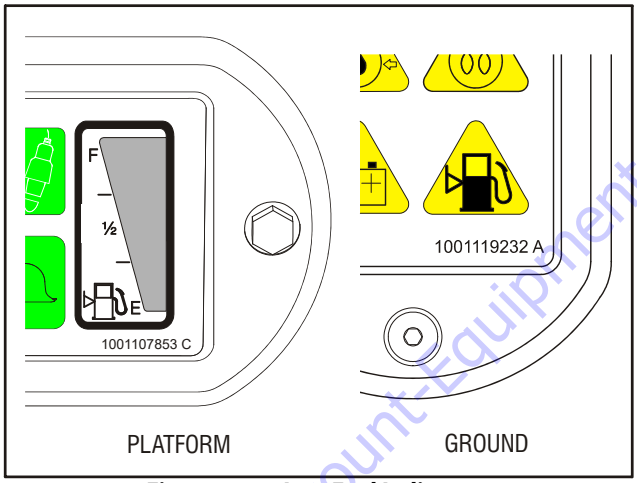
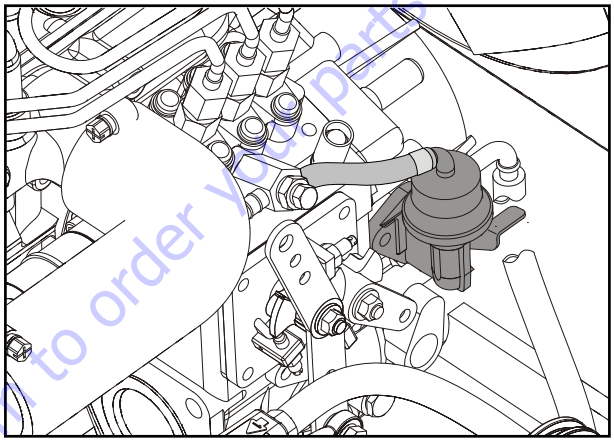


Figure 3-51. Low Fuel Indicators

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 connection 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 disconnected side 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.

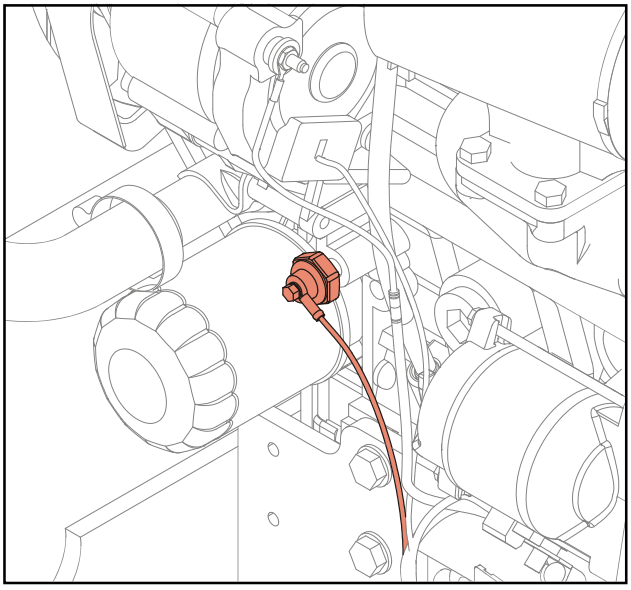


Figure 3-52. Engine Oil Pressure Switch

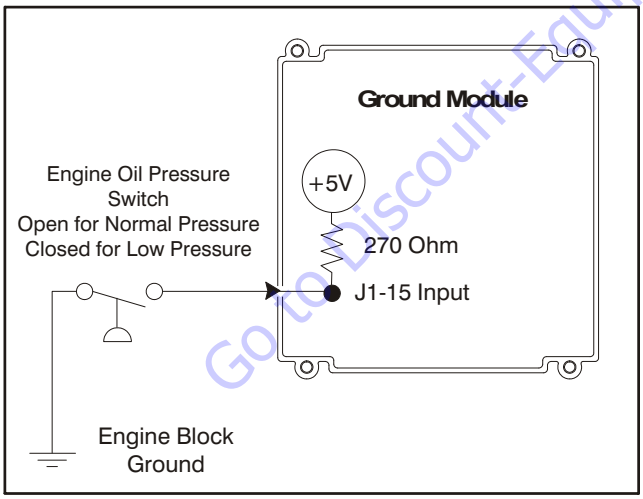


Figure 3-53. Engine Oil Pressure Switch Schematic

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.

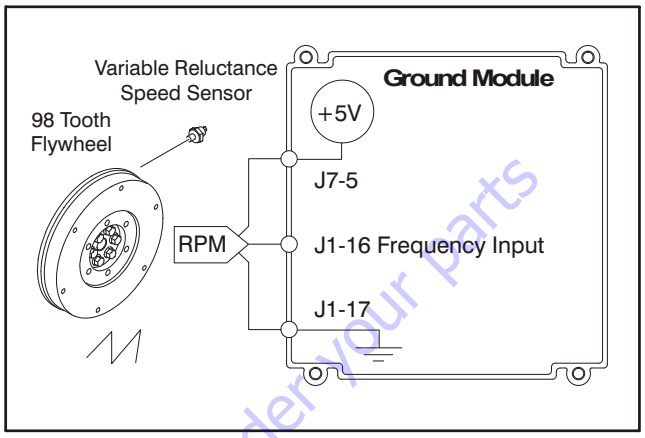


Figure 3-54. Engine Speed Sensor Schematic

Coolant Sensor

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

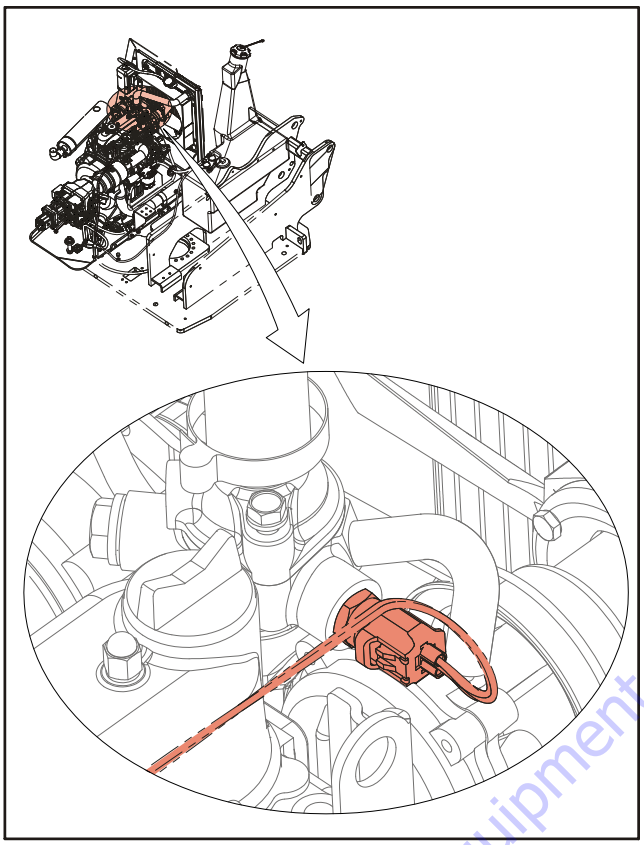


Figure 3-55. Engine Coolant Sensor

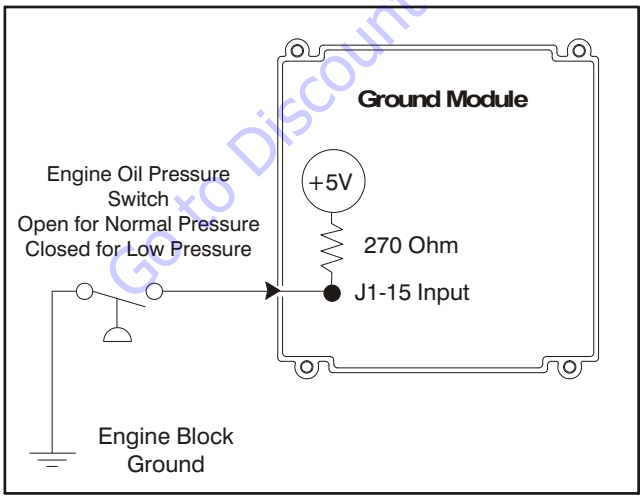


Figure 3-56. Engine Coolant Sensor Schematic

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.

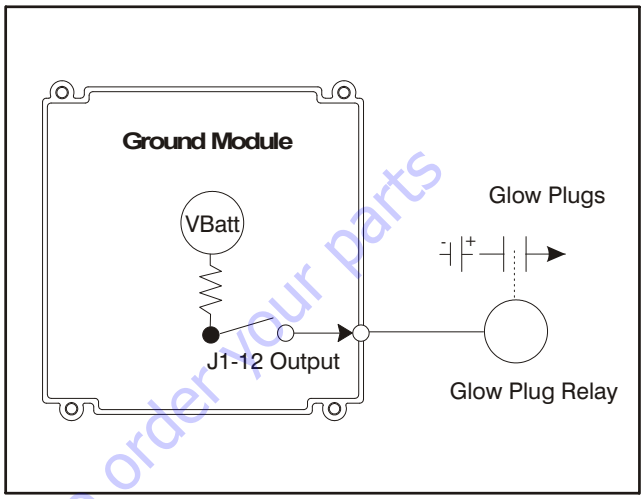


Figure 3-57. Engine Glow Plug Schematic

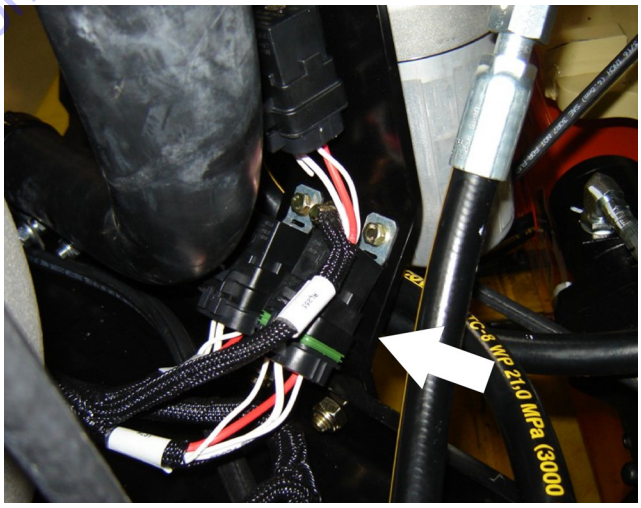


Figure 3-58. Glow Plug Relay

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 3-5, Glow Plug Conditions.

Table 3-5. 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 10 sec.
Less than 122°F (50°C)	Greater than 11V	Temp Between 5°F and 23°F (-15°C and -5°C)	On for 15 sec.
Less than 122°F (50°C)	Greater than 11V	Temp Less Than 5°F (-15°C)	On for 20 sec.

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 3-6, Engine Actuator Conditions.

Table 3-6. 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.

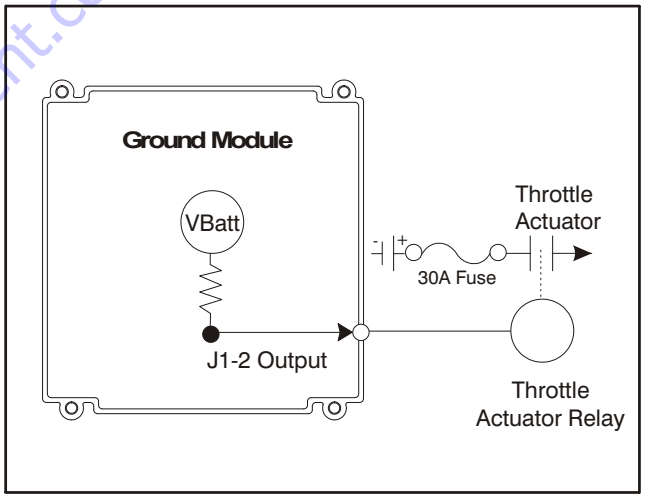


Figure 3-59. Engine Throttle Actuator Schematic

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.

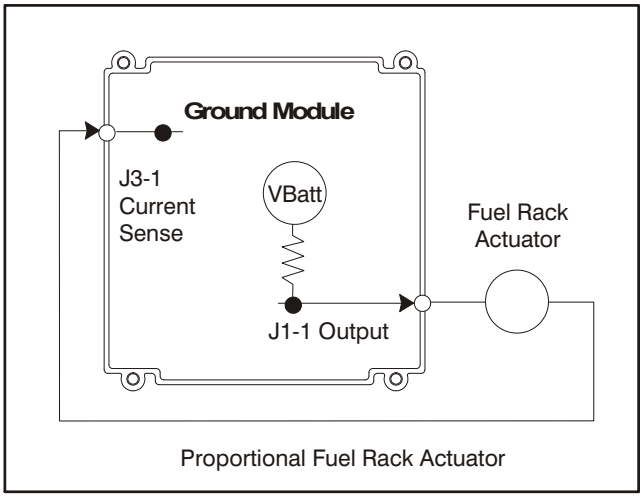


Figure 3-60. Proportional Fuel Rack Actuator Schematic

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.

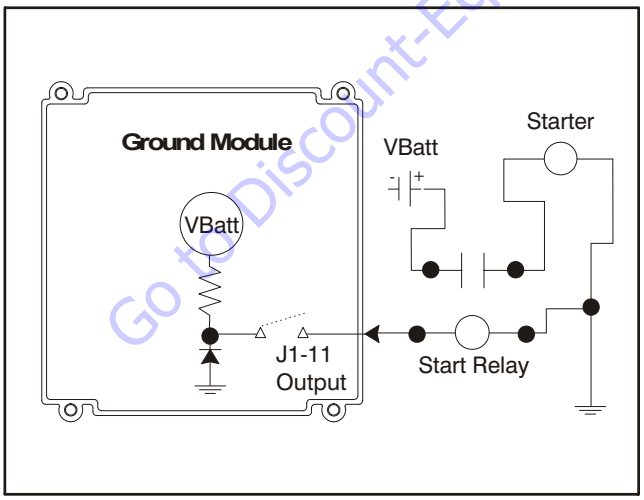


Figure 3-61. Engine Starter Schematic

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.

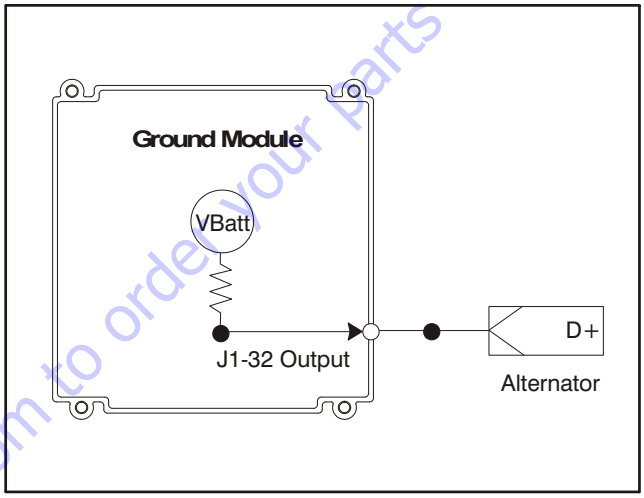


Figure 3-62. Alternator Schematic

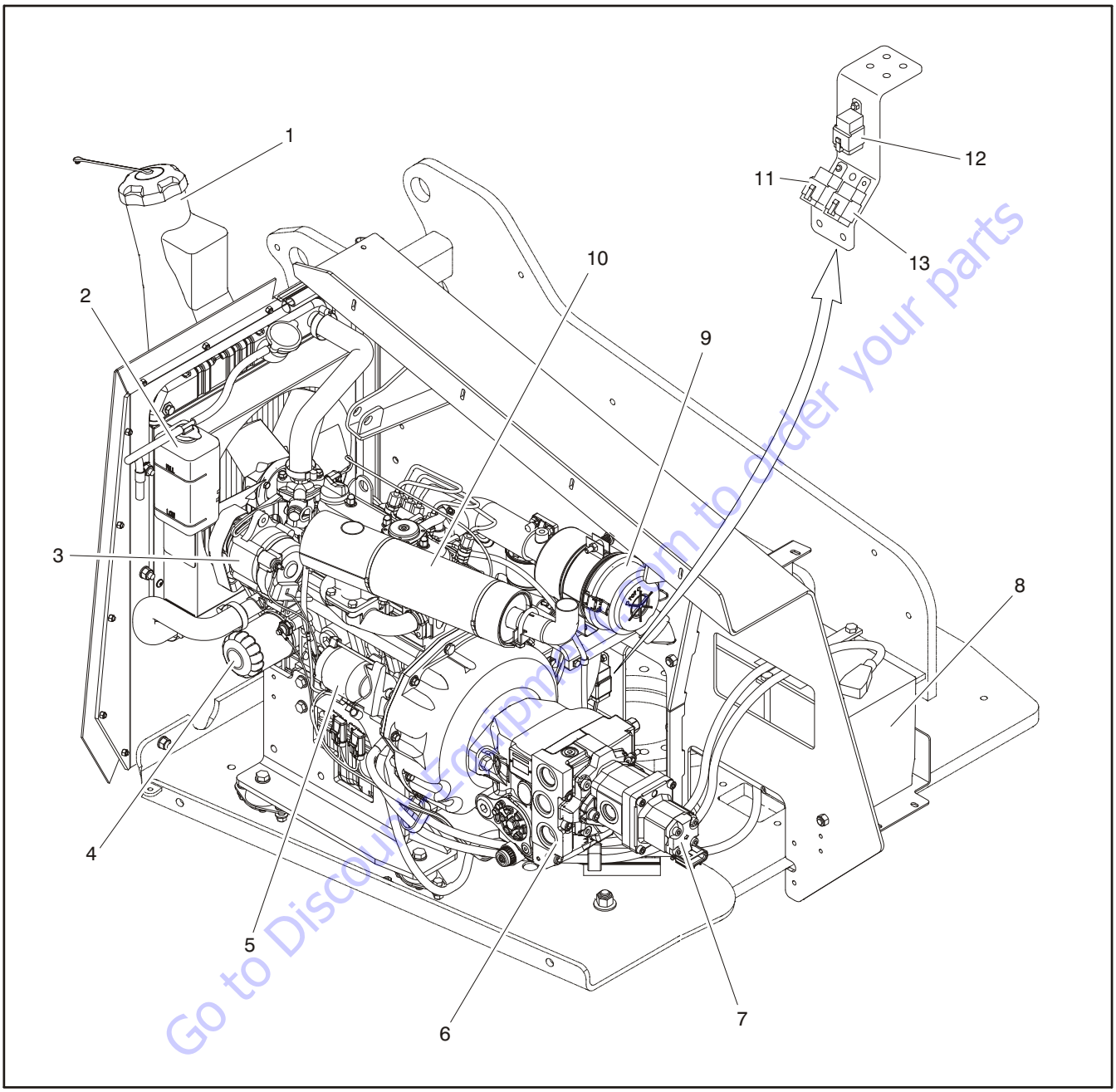
Fuel Pump

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

Shutdown

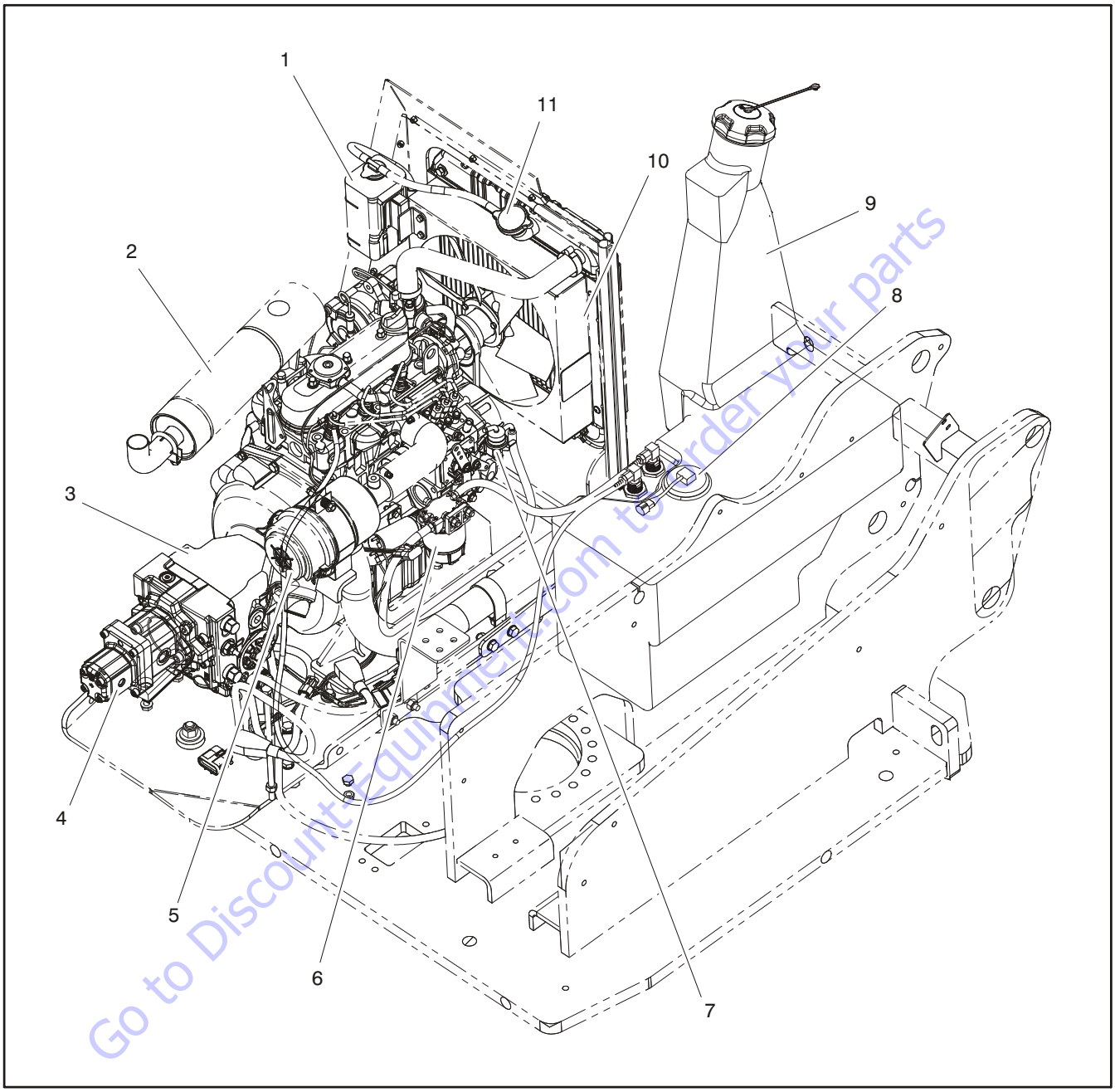
If the JLG Control System determines that the engine should be shut down and not allowed to run, the Ground Module takes the following steps to shut down the engine.

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.



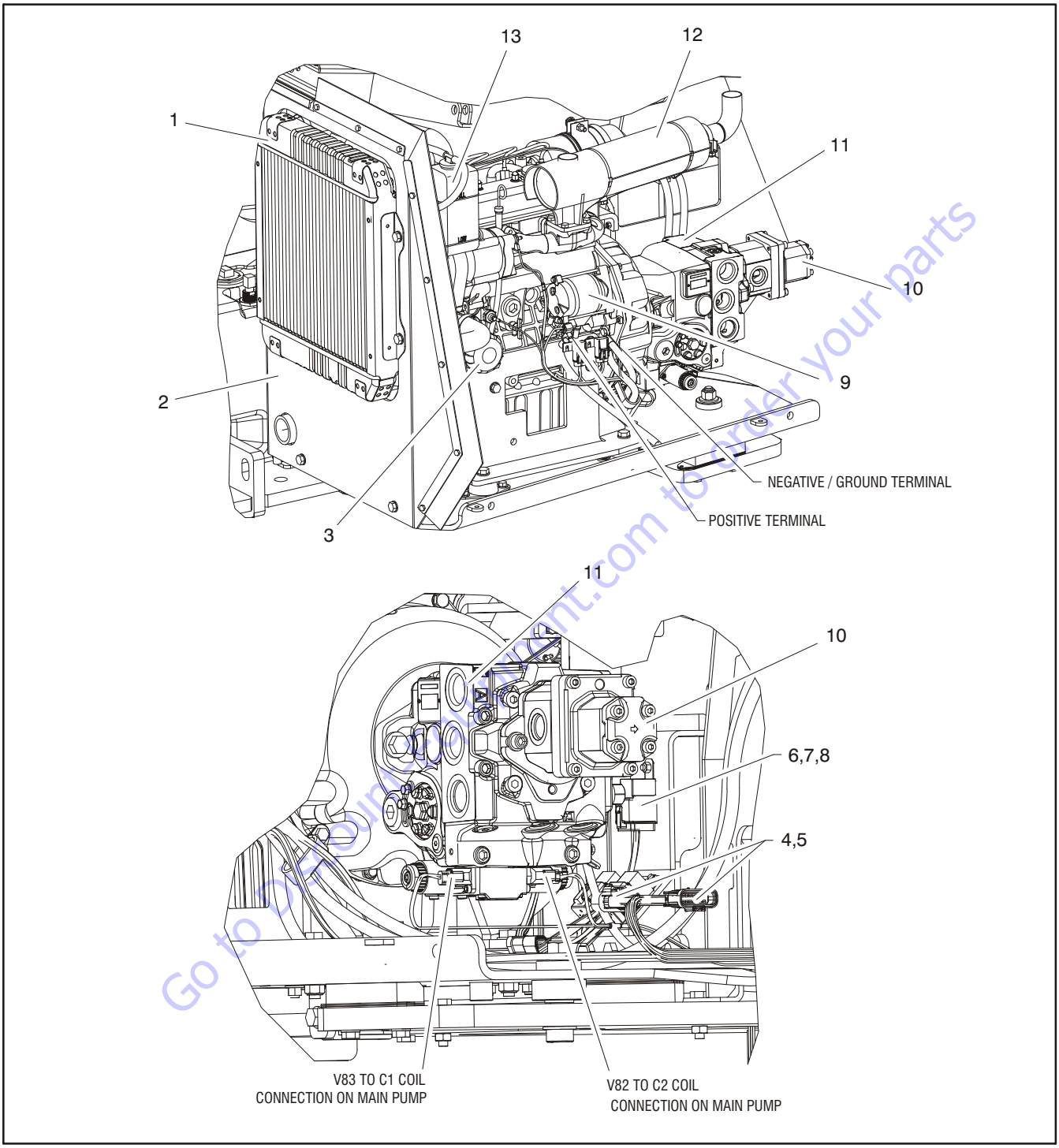
1. Fuel Tank
2. Coolant Recovery Tank
3. Alternator
4. Oil Filter
5. Starter
6. Main Pump
7. Gear Pump
8. Battery
9. Air Filter
10. Muffler
11. Starter Relay
12. Full Speed Relay
13. Glow Plug Relay

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



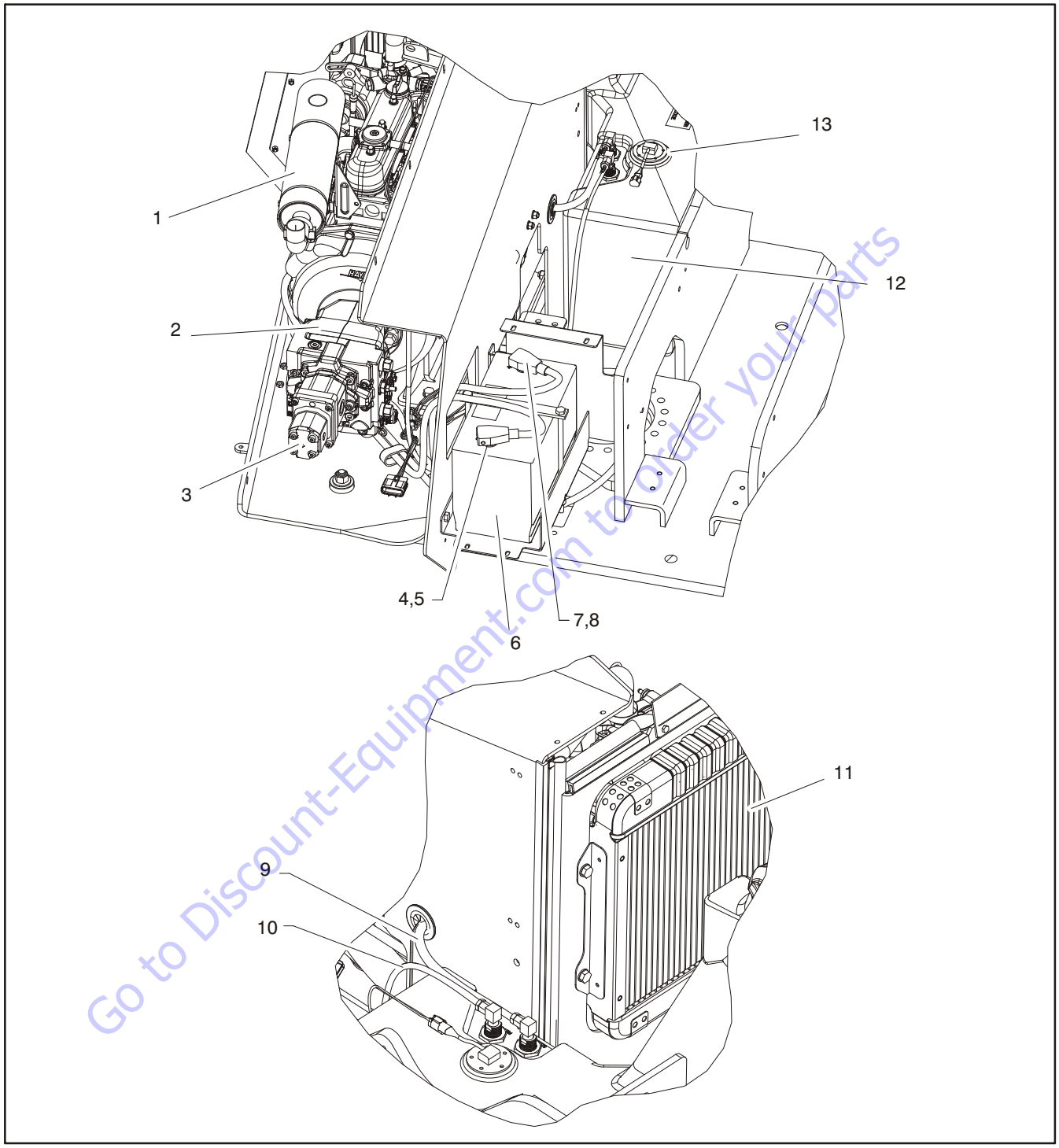
1. Coolant Recovery Tank
2. Muffler
3. Main Pump
4. Gear Pump
5. Air Filter
6. Fuel Filter/ Water Separator
7. Fuel Pump
8. Fuel Level Sending Unit
9. Fuel Tank
10. Radiator
11. Pressure Cap

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



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

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



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

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

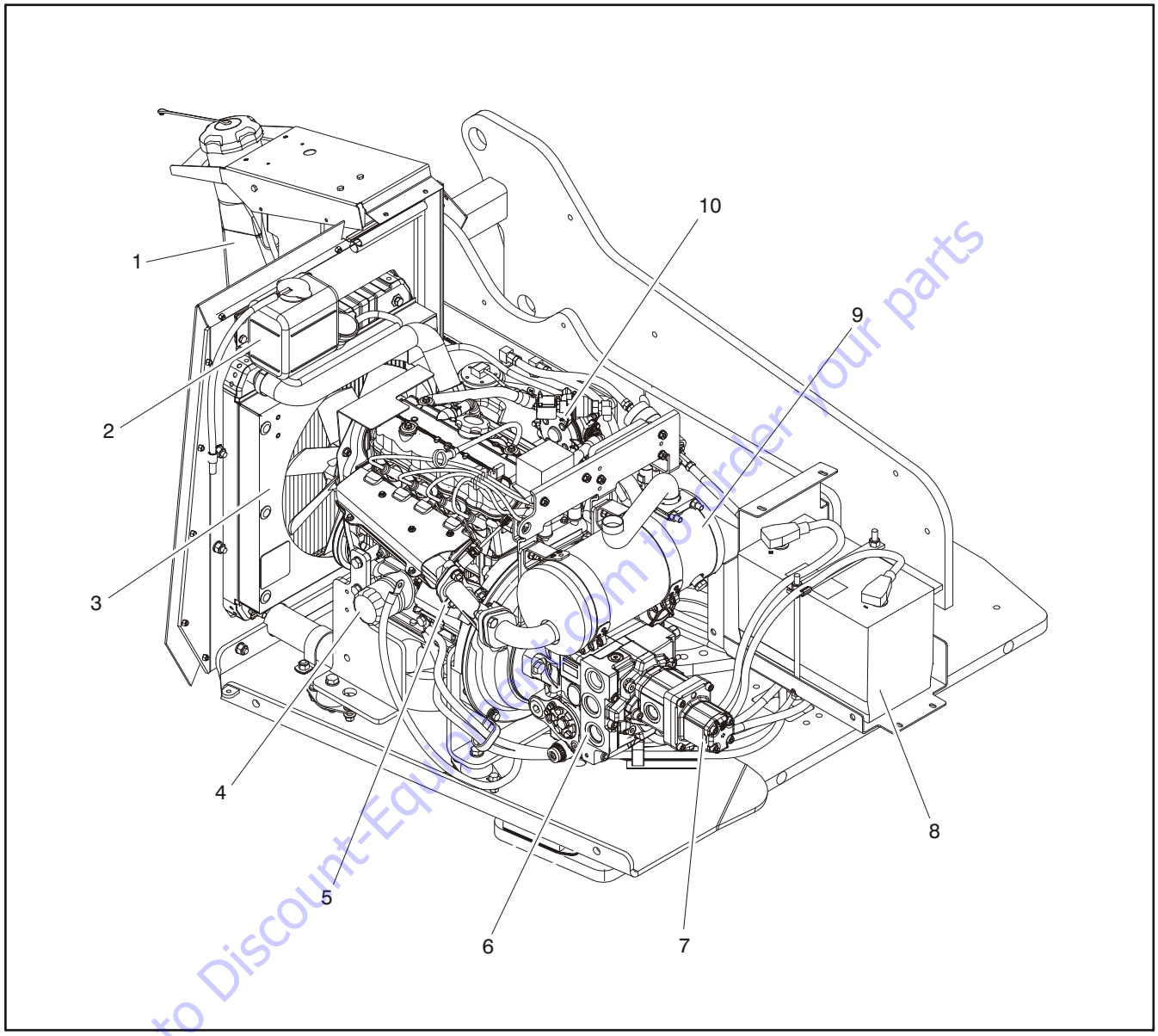
The Ground Module calculates the engine RPM based on information sent to it by the engine ECU.

Coolant Temperature

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

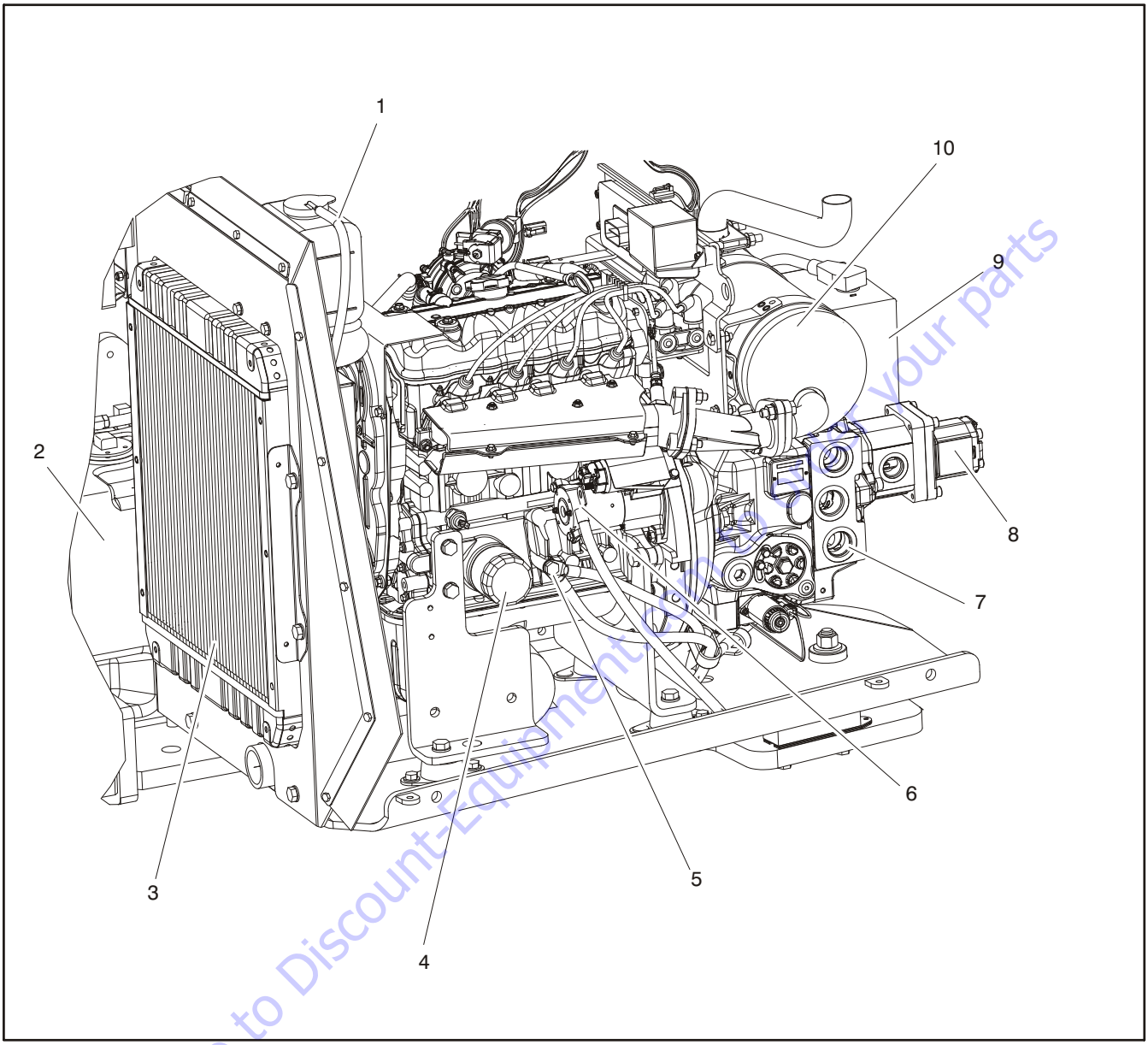
Fuel Select

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.



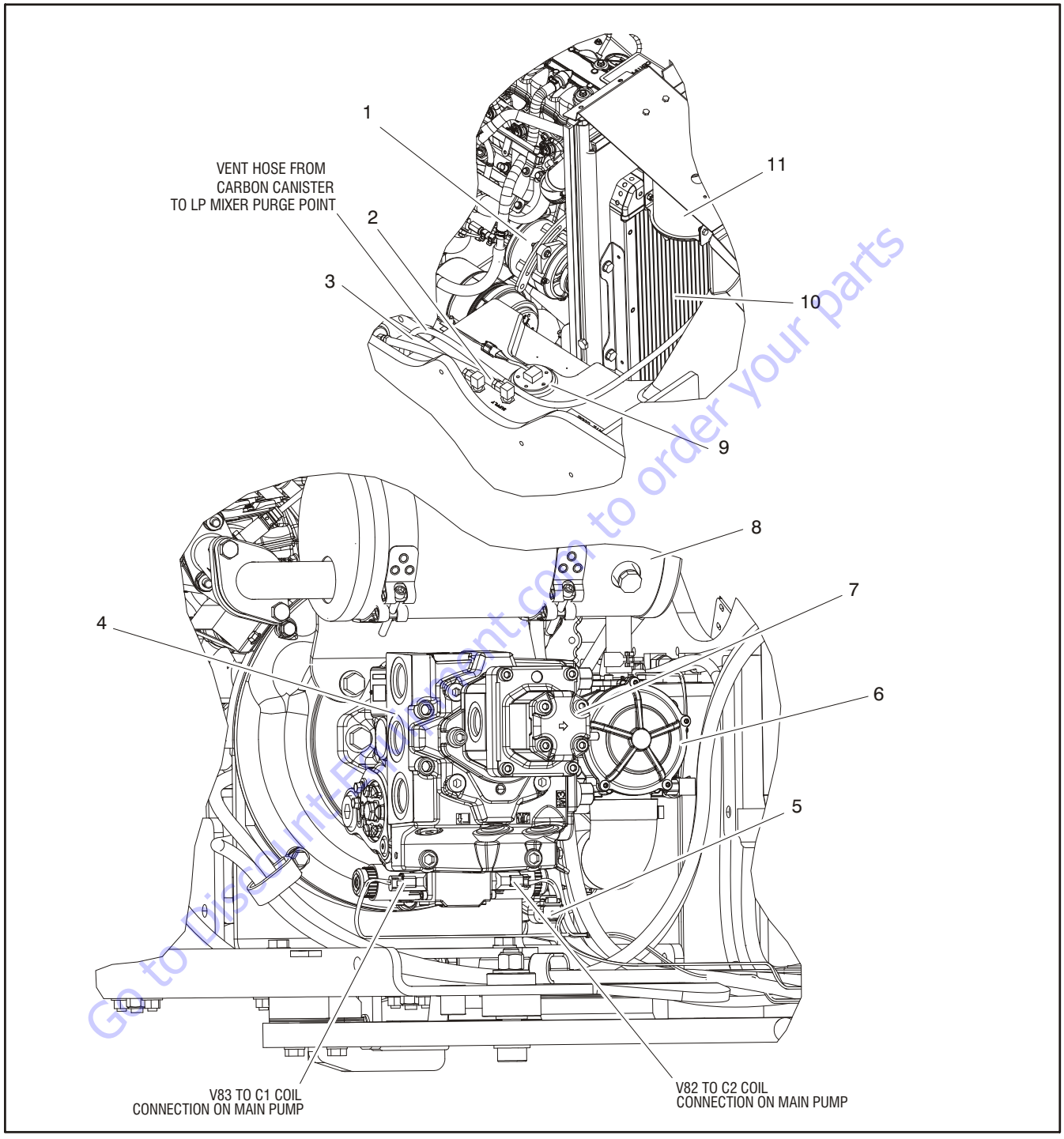
1. Fuel Tank
2. Coolant Recovery Tank
3. Radiator
4. Oil Filter
5. Starter
6. Main Pump
7. Gear Pump
8. Battery
9. Muffler
10. Fuel Mixer

Figure 3-67. GM Engine - 1 of 6



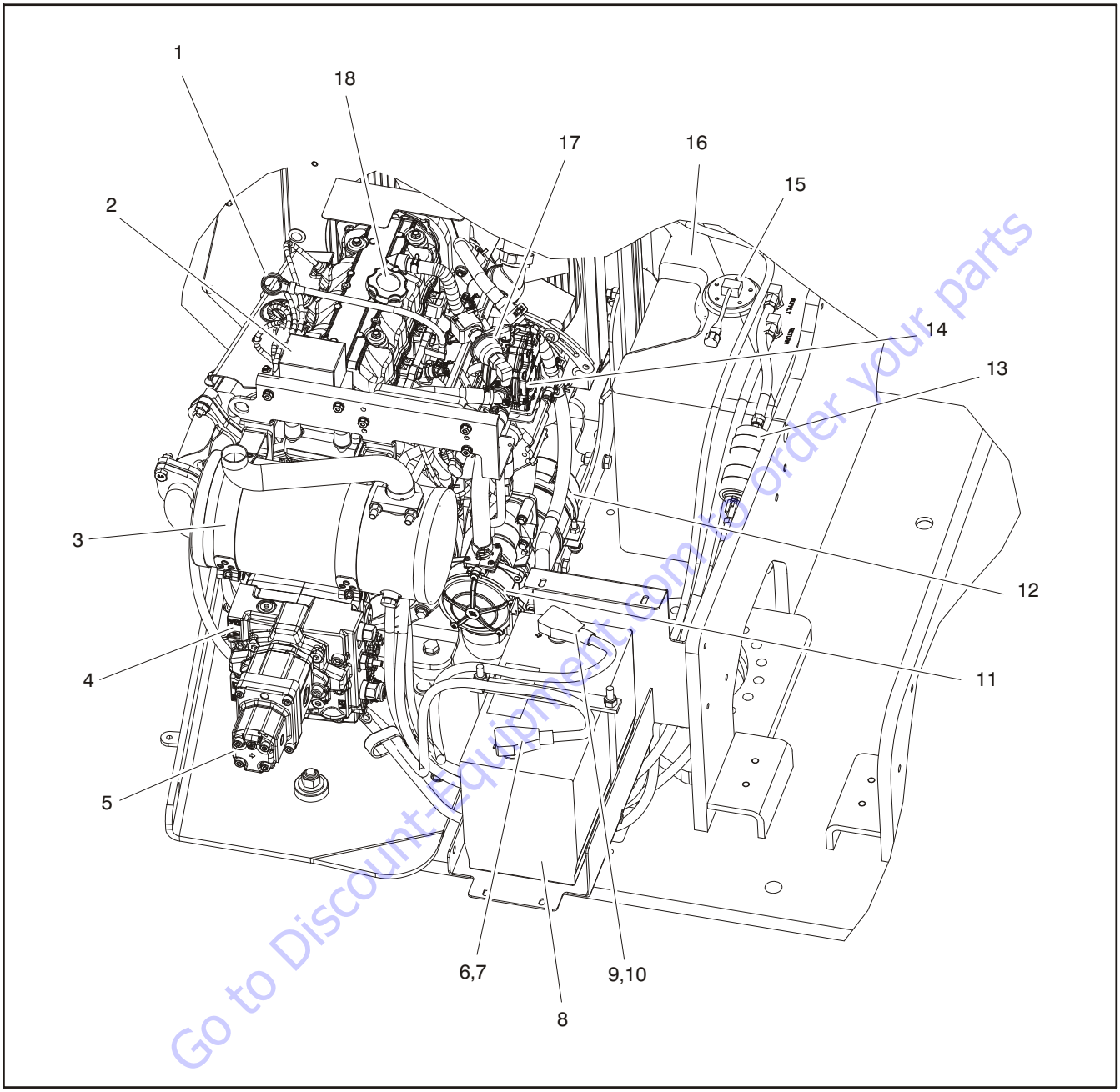
1. Coolant Recovery Tank
2. Fuel Tank
3. Radiator
4. Oil Filter
5. Negative/Ground Terminal
6. Positive Terminal
7. Main Pump
8. Gear Pump
9. Battery
10. Muffler

Figure 3-68. GM Engine - 2 of 6



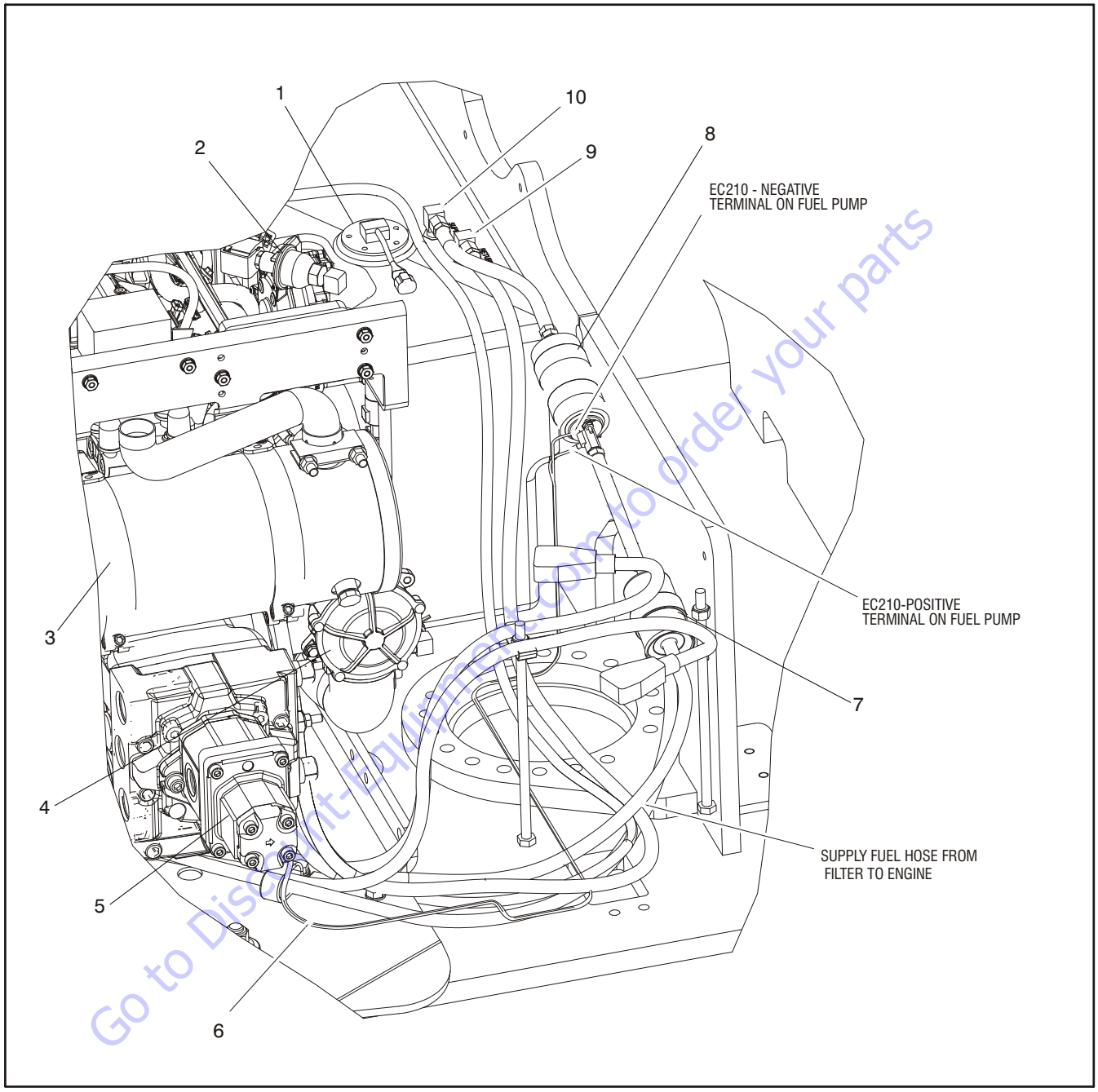
1. Alternator
2. Supply Fuel Hose
3. Return Fuel Hose
4. Main Pump
5. Fuel Pump Harness
6. Air/Fuel Mixer
7. Gear Pump
8. Muffler
9. Fuel Level Sensor
10. Radiator
11. Carbon Cannister

Figure 3-69. GM Engine - 3 of 6



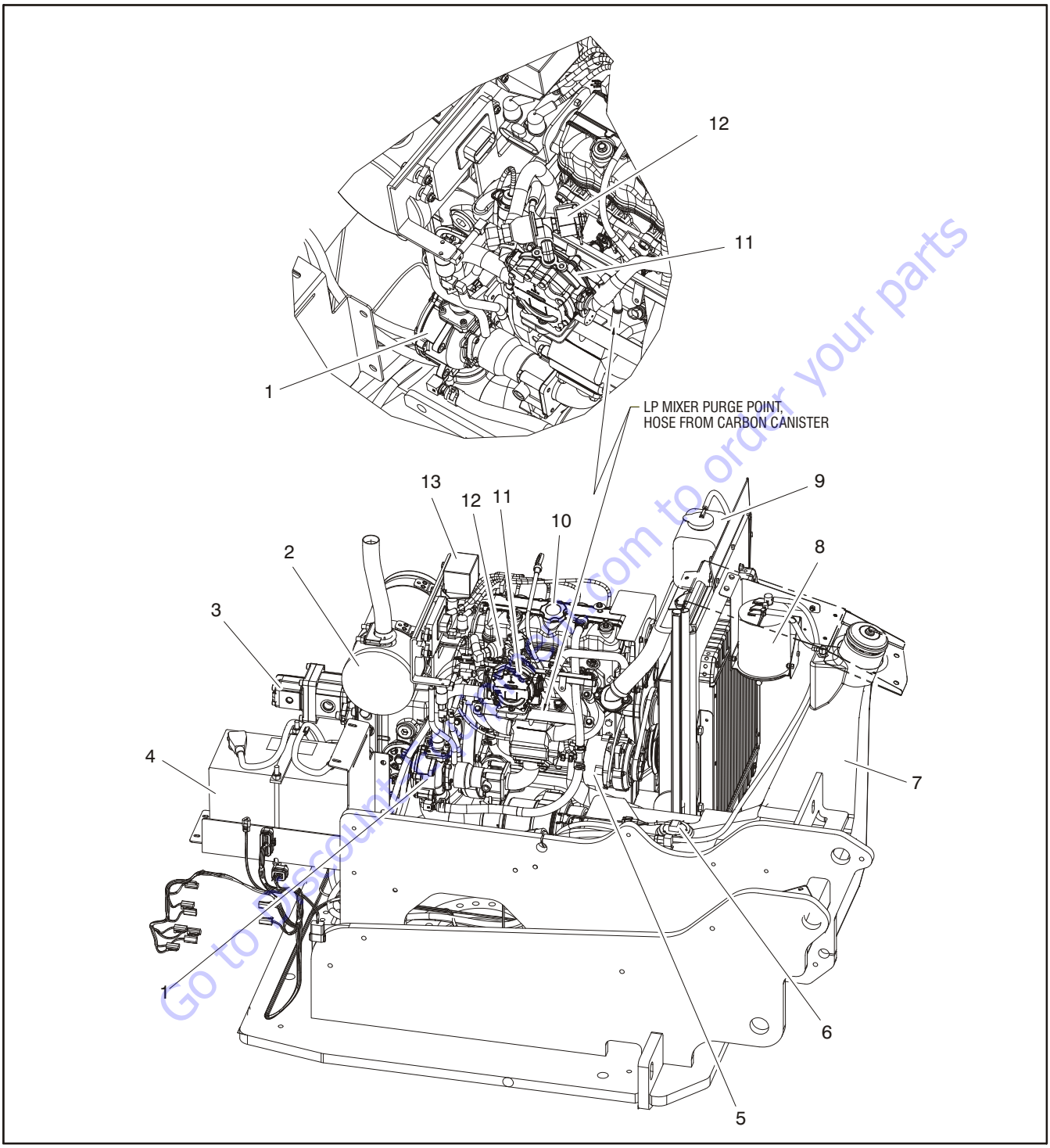
1. Dipstick
2. Relays
3. Muffler
4. Main Pump
5. Gear Pump
6. Negative Battery Cable
7. Negative Battery Post
8. Battery
9. Positive Battery Cable
10. Positive Battery Post
11. Air/Fuel Mixer
12. Air Filter
13. Fuel Pump
14. Fuel Mixer
15. Fuel Level Sensor
16. Fuel Tank
17. Fuel Lock-off Valve
18. Engine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

Figure 3-70. GM Engine - 4 of 6



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

Figure 3-71. GM Engine - 5 of 6



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

Figure 3-72. GM Engine - 6 of 6

Table 3-7. 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

Table 3-7. 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 leve
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 3-7. 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 3-7. 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	EGO1 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 3-7. 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 3-7. 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	EGO2 open / lazy
520209	10	140	EGO3 open / lazy
520210	10	160	EGO4 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 3-7. 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 0/0 "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 “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 “ONE START”, 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 Shutdown" 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.

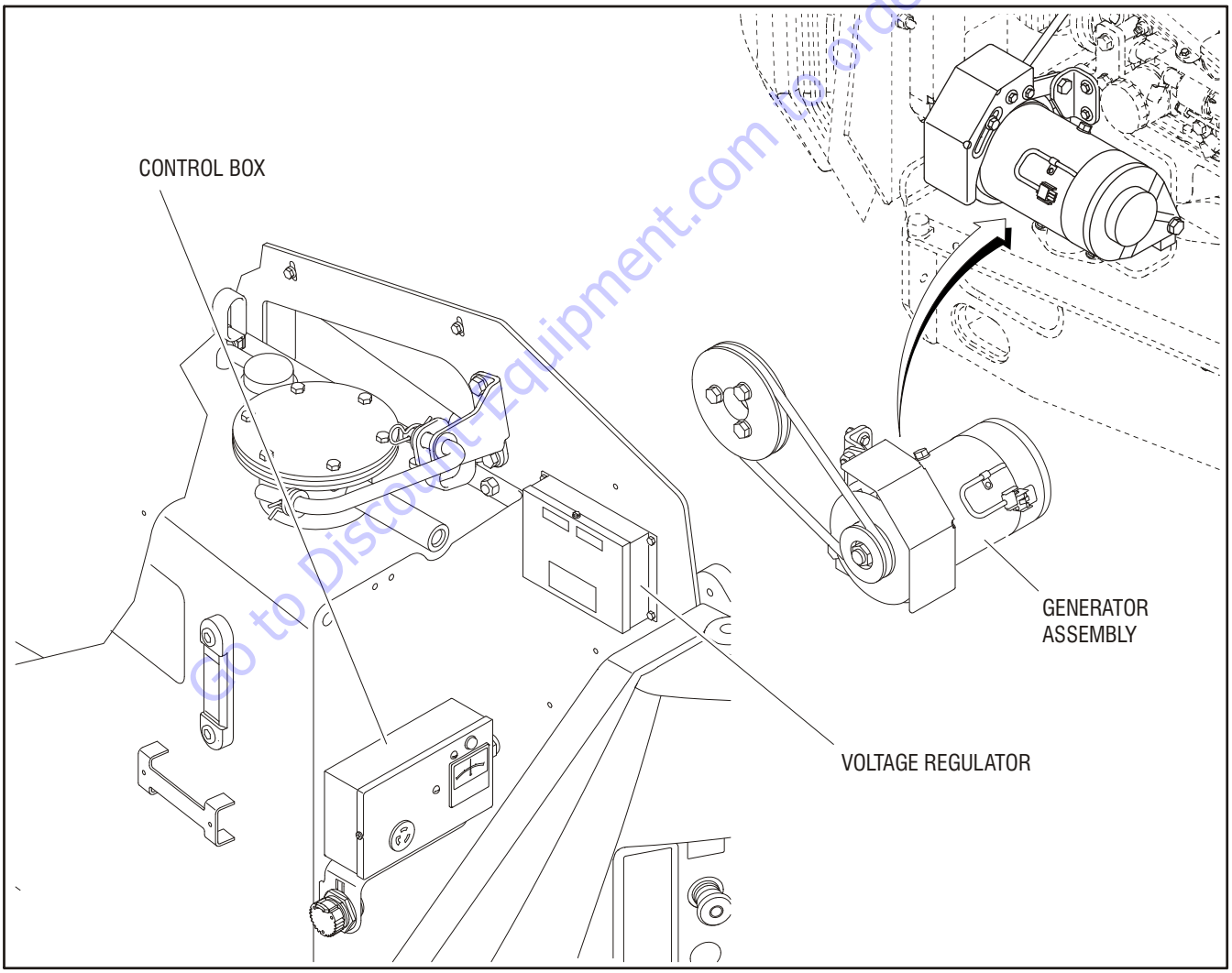


Figure 3-73. Generator