An Oshkosh Corporation Company

Service and Maintenance Manual

Model
340AJ

3121259

January 29, 2019 - Rev F

ANSI

SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

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

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

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

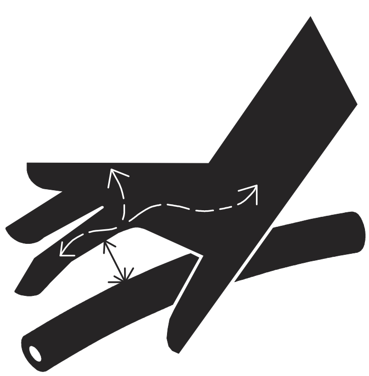
⚠ WARNING

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

B HYDRAULIC SYSTEM SAFETY

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

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



C MAINTENANCE

⚠ WARNING

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

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

REVISON LOG

Original Issue	A - May 6, 2011
Revised	B - January 17, 2012
Revised	C - July 9, 2013
Revised	D - June 27, 2017
Revised	E - June 29, 2018 - Revised Covers
Revised	F - January 29, 2019

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating Specifications

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

1.2 DIMENSIONAL DATA

Table 1-2. Dimensional Data

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

Table 1-2. Dimensional Data

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

1.3 CAPACITIES

Table 1-3. Capacities

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

1.4 TIRES

Table 1-4. Tires

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

1.5 ENGINE DATA

Table 1-5. Kubota D1105-E3

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

Table 1-6. GM 0.97L

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

1.6 HYDRAULIC OIL

Table 1-7. Hydraulic Oil

Hydraulic System Operating Temperature Range	S.A.E. Viscosity Grade
+0° to + 180° F (-18° to +83° C)	10W
+0° to + 210° F (-18° to +99° C)	10W-20, 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 Mobil EAL biodegradable and non-toxic hydraulic oil. This is a fully synthetic hydraulic oil that possesses the same anti-wear and rust protection characteristics as mineral oils, but will not adversely affect the ground water or the environment when spilled or leaked in small amounts.*

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

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

Table 1-8. Mobilfluid 424 Specs

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

Table 1-9. DTE 10 Excel 32 Specs

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

Table 1-10. Quintolubric 888-46

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

Table 1-11. Exxon Univis HVI 26 Specs

Specific Gravity	32.1
Pour Point	-76°F (-60°C)
Flash Point	217°F (103°C)
Viscosity	
at 40° C	25.8 cSt
at 100° C	9.3 cSt
Viscosity Index	376

NOTE: *Mobil/Exxon recommends that this oil be checked on a yearly basis for viscosity.*

Major Component Weights

⚠ WARNING

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

Table 1-12. Critical Stability Weights

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

1.7 FUNCTION SPEEDS

Test Notes

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

Table 1-13. Function Speed

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

Table 1-14. Function Speed Machine Position

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

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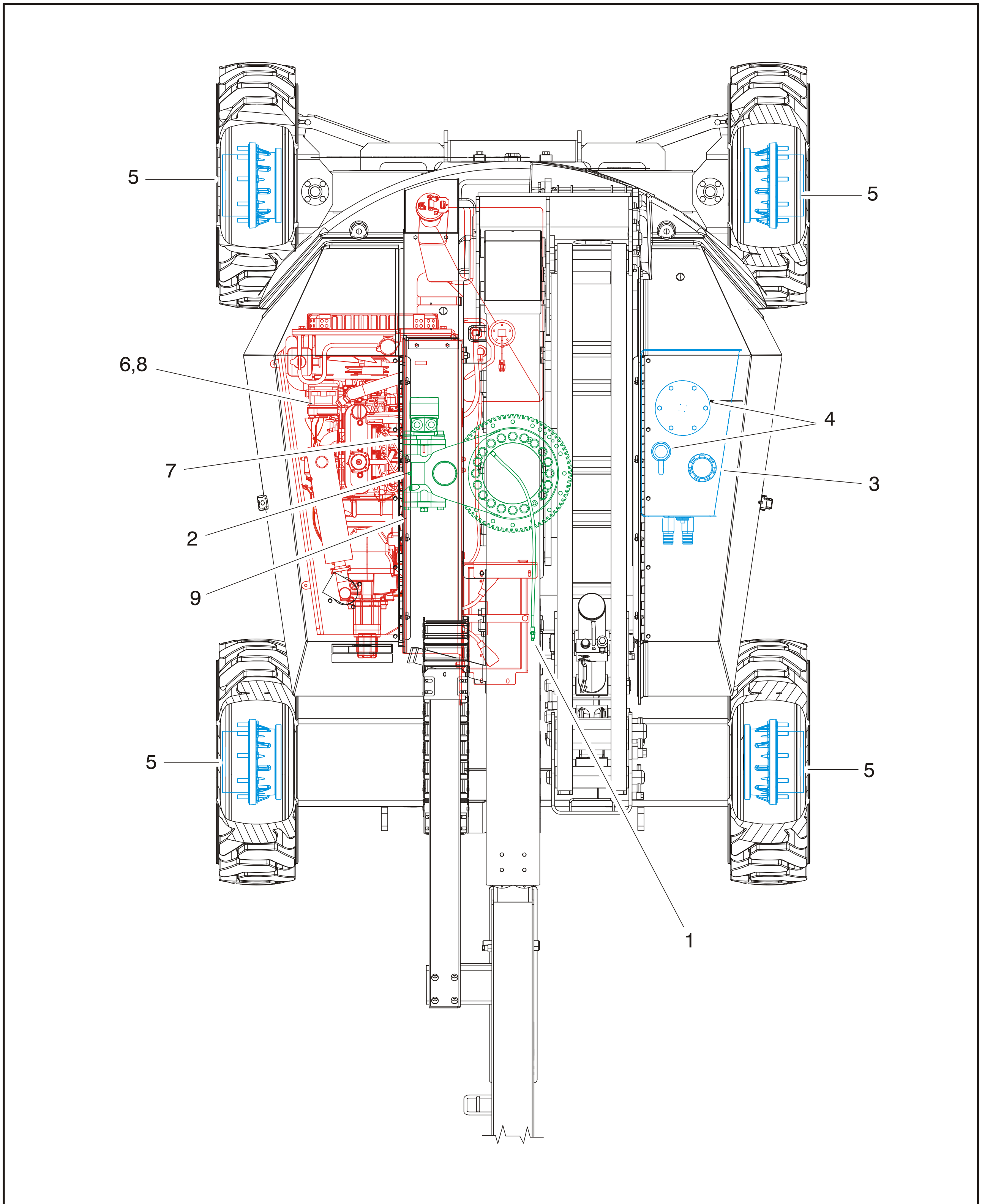


Figure 1-1. Operator Maintenance and Lubrication Diagram

1.8 OPERATOR MAINTENANCE

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

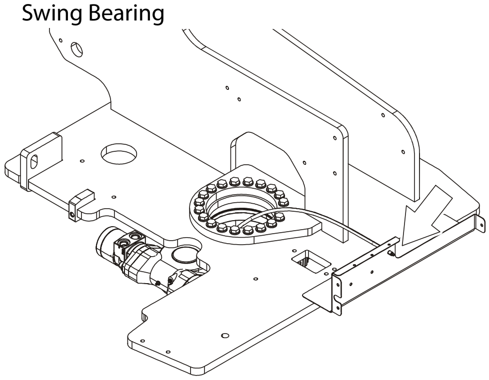
Table 1-15. Lubrication Specifications

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

NOTICE

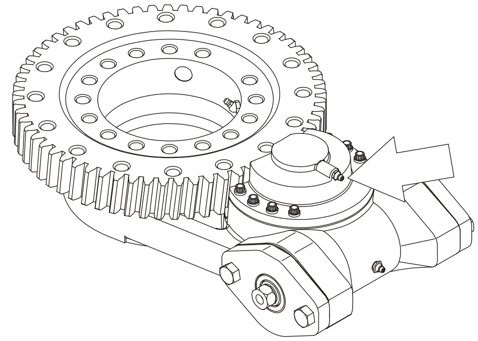
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

1. Swing Bearing

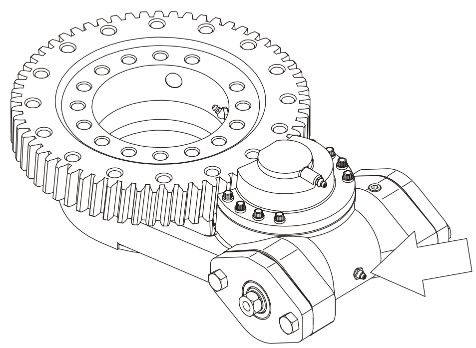


Lube Point(s) - Remote Fitting
Capacity - A/R
Lube - BG
Interval - Every 3 months or 150 hrs of operation
Comments - Apply grease and rotate in 90 degree intervals until bearing is completely lubricated

2. Swing Bearing/Worm Gear Teeth



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

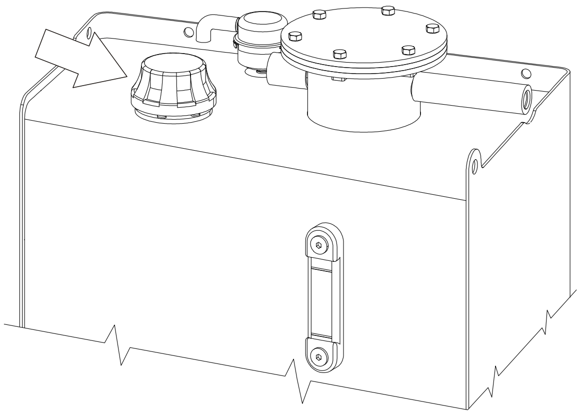


Lube Point(s) - Grease Fitting
Capacity - A/R
Lube - Mobil SHC 460
Interval - A/R

CAUTION

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

3. Hydraulic Tank



Lube Point(s) - Fill Cap

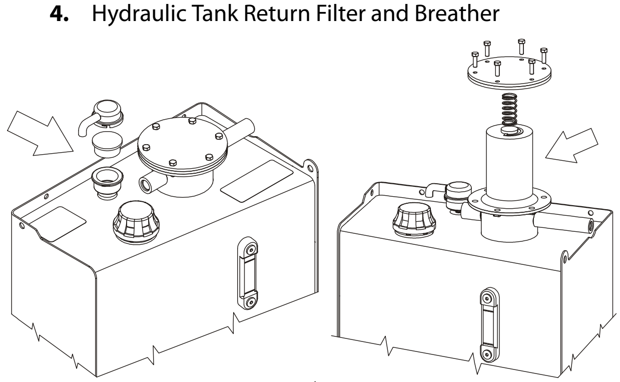
Capacity - 24.8 Gal. (93.9 L), 20.6 Gal. (77.9 L) to Full Level; 17.8 Gal (67.4 L) to Low Level

Lube - HO

Interval - Check Level daily; Change every 2 years or 1200 hours of operation.

Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate all systems a minimum of two complete cycles and recheck oil level in reservoir.

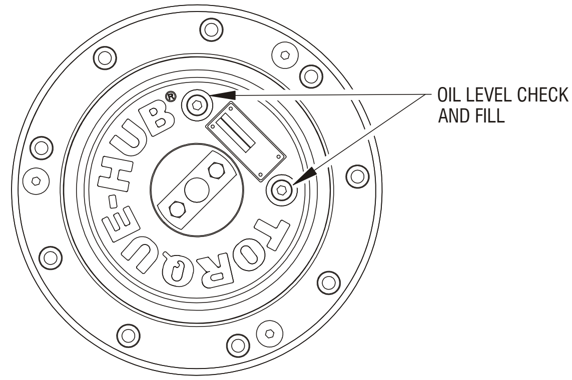
4. Hydraulic Tank Return Filter and Breather



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

Comments - For breather element, twist top to replace.

5. Wheel Drive Hub



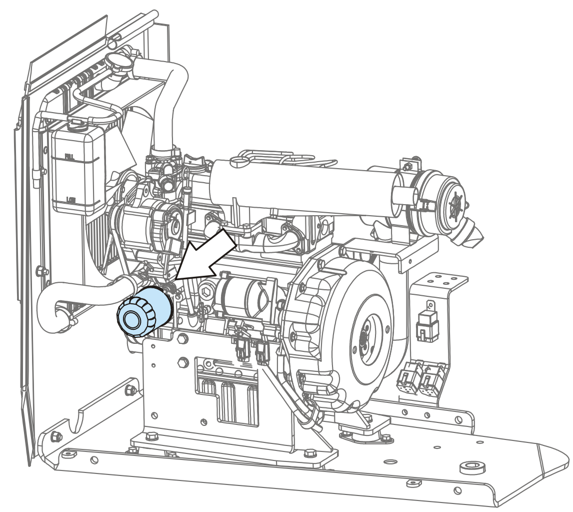
Lube Point(s) - Level/Fill Plug

Capacity - 25.5 oz. (0.75 L)(1/2 Full)

Lube - EPGL

Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

6. Oil Change with Filter - Kubota



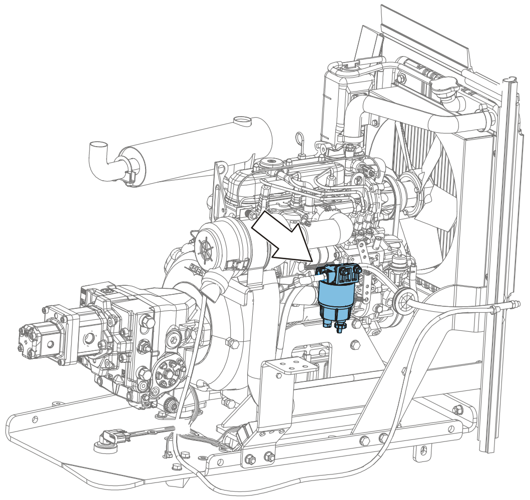
Lube Point(s) - Fill Cap/Spin-on Element

Capacity - 5.4 Quarts (5.1 L) w/Filter

Lube - EO

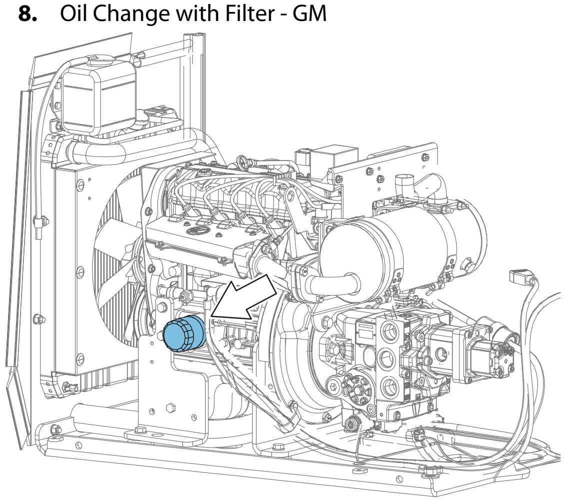
Interval - Check level daily; change every 500 hours or six months, whichever comes first. Adjust final oil level by mark on dipstick.

7. Fuel Filter/Water Separator - Kubota



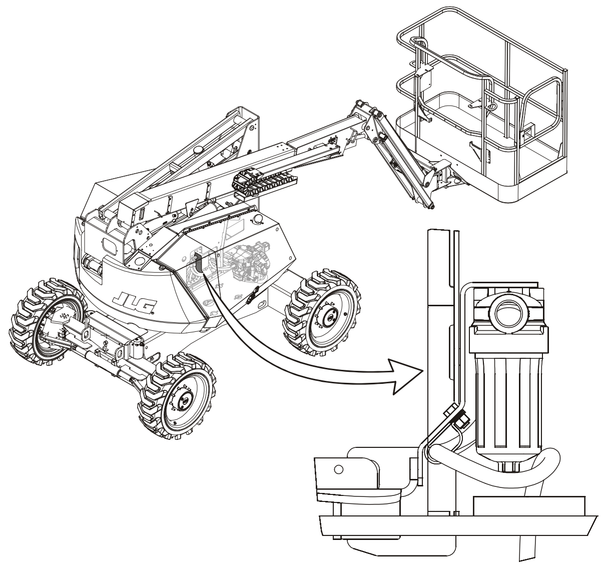
Lube Point(s) - Replaceable Element
Interval - Every year or 600 hours of operation

8. Oil Change with Filter - GM



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

9. Charge Filter



Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.
Comments - Remove the engine tray retaining bolt and pull out engine tray to gain access

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)																			
				SAE GRADE 5 BOLTS & GRADE 2 NUTS									SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)		Clamp Load	Torque (Dry or Loctite® 263) K= 0.20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.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]	IN-LB	[N.m]	LB	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					1320	43	5				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5					1580	60	7				
	32	0.1900	0.02000	1285	49	5.5	36	4					1800	68	8				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12			2860	143	16	129	15		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	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	4720	25	35	20	25	20	25
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38	7000	45	60	40	55	35	50
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61	9550	70	95	65	90	50	70
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92	12750	105	145	95	130	80	110
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133	16400	155	210	140	190	115	155
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183	20350	210	285	190	260	160	220
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	21300	260	353	200		285	388	240	325	30100	375	510	340	460	280	380
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523	41600	605	825	545	740	455	620
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676	142200	3555	4835	3200	4350	2665	3625

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

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REFERENCE JLG THREAD LOCKING COMPOUND			
JLG P/N	Loctite® P/N	ND Industries P/N	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

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

				Values for Magni Coating Fasteners (Ref 4150701)													
				SAE GRADE 5 BOLTS & GRADE 2 NUTS							SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 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		Clamp Load	Torque (Dry or Loctite® 263) K= 0.17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.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]	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					1320	37	4				
10	24	0.1900	0.01750	1120	36	4.1					1580	51	6				
	32	0.1900	0.02000	1285	42	4.7					1800	58	7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9			2860	122	14	114	13		
	28	0.2500	0.0364	2320	99	11.1	95	11			3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	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	4720	20	25	20	25	20	25
	24	0.3125	0.0580	3700	15	20	15	21	15	20	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34	7000	35	50	35	50	35	50
	24	0.3750	0.0878	5600	30	40	28	38	25	34	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48	9550	60	80	55	75	50	70
	20	0.4375	0.1187	7550	45	60	44	60	40	54	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75	12750	90	120	85	115	80	110
	20	0.5000	0.1599	10700	75	100	71	97	65	88	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109	16400	130	175	125	170	115	155
	18	0.5625	0.2030	12950	105	145	97	132	90	122	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156	20350	180	245	170	230	160	220
	18	0.6250	0.2560	16300	145	195	136	185	125	170	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272	30100	320	435	300	410	280	380
	16	0.7500	0.3730	23800	255	345	238	324	225	306	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435	41600	515	700	485	660	455	620
	14	0.8750	0.5090	32400	400	545	378	514	355	483	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	38600	545	740	515	700	480	653	51500	730	995	685	930	645	875
	12	1.0000	0.6630	42200	600	815	563	765	530	721	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	47500	755	1025	713	969	670	911	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237	142200	3020	4105	2845	3870	2665	3625

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

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

				SOCKET HEAD CAP SCREWS													
				Magni Coating (Ref 4150701)*							Zinc Yellow Chromate Fasteners (Ref 4150707)*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .17		Torque (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		Clamp Load See Note 4	Torque (Dry) K = .20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) 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]	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			2860	143	16	129	15		
	28	0.2500	0.0364	3280	139	16	131	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	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	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	320	435	300		280	380	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875	51500	860	1170	775	1055	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625	142200	3555	4835	3200	4350	2665	3625

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

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

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

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

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

			Values for Magni Coated Fasteners (Ref 4150701)							
			CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS				CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*			
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™) K=0.17	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.16	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.15	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K= 0.16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0	3.13			
3.5	0.6	6.78	2.95	1.8	1.7	1.5	4.22			
4	0.7	8.78	3.82	2.6	2.4	2.3	5.47			
5	0.8	14.20	6.18	5.3	4.9	4.6	8.85			
6	1	20.10	8.74	9	8.4	7.9	12.5	13	12	11
7	1	28.90	12.6	15	14	13	18.0	21	20	19
8	1.25	36.60	15.9	22	20	19	22.8	31	29	27
10	1.5	58.00	25.2	43	40	38	36.1	61	58	55
12	1.75	84.30	36.7	75	70	66	52.5	105	100	95
14	2	115	50.0	119	110	105	71.6	170	160	150
16	2	157	68.3	186	175	165	97.8	265	250	235
18	2.5	192	83.5	256	240	225	119.5	365	345	325
20	2.5	245	106.5	362	340	320	152.5	520	490	460
22	2.5	303	132.0	494	465	435	189.0	705	665	625
24	3	353	153.5	627	590	555	222.0	905	850	800
27	3	459	199.5	916	860	810	286.0	1315	1235	1160
30	3.5	561	244.0	1245	1170	1100	349.5	1780	1680	1575
33	3.5	694	302.0	1694	1595	1495	432.5	2425	2285	2140
36	4	817	355.5	2176	2050	1920	509.0	3115	2930	2750
42	4.5	1120	487.0	3477	3275	3070	698.0	4985	4690	4395

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

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

NOTES:

SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventive Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

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

Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.
2. At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.
3. Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

Components Removal and Installation

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

Component Disassembly and Reassembly

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

Pressure-Fit Parts

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

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

NOTICE

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

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

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.

2. The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in the Lubrication Chart in Section 1. Always examine filters for evidence of metal particles.

3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.

4. It is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

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

Hydraulic Oil

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

Changing Hydraulic Oil

1. Filter elements must be changed after the first 50 hours of operation and every 300 hours (unless specified otherwise) thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils.

2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.

3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

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

2.4 CYLINDER DRIFT

Theory

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

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

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

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

Cylinder Leakage Test

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

Measure drift at cylinder rod with a calibrated dial indicator.

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

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

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

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

Cylinder Thermal Drift

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
   a. Excessive sloppiness in joints.
   b. Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
   a. Frayed or separated fibers on the liner surface.
   b. Cracked or damaged liner backing.
   c. Bearings that have moved or spun in their housing.
   d. Debris embedded in liner surface.
3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):
   a. Detectable wear in the bearing area.
   b. Flaking, 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.

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

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

Do NOT Do the Following When Welding on JLG Equipment

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

NOTICE

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

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Table 2-3. Inspection and Preventive Maintenance Schedule

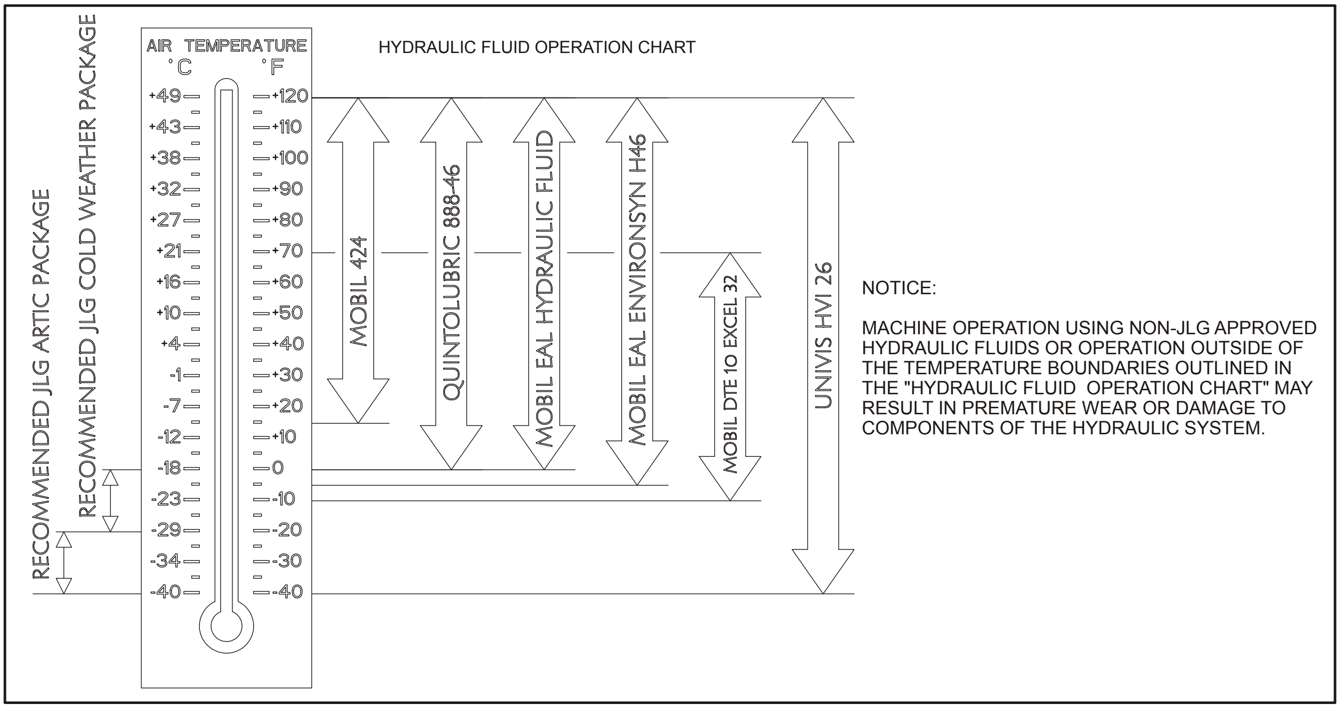
AREA	Inspections	
	Pre-Delivery[1] or Frequent [2] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
Functions/Controls		
Platform Controls return to neutral/off when released	1, 3, 6, 9	1, 3, 6, 9
Ground Controls return to neutral/off when released	1, 3, 6, 9	1, 3, 6, 9
Function Control Locks, Guards,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

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	Inspections	
	Pre-Delivery[1] or Frequent[2] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
General		
All Decals/Placards Installed, Secure, Legible	9	9
Annual Machine Inspection Due		9
No Unauthorized Modifications or Additions	9	9
All Relevant Safety Publications Incorporated	9	9
General Structural Condition and Welds	2	2
All Fasteners, Pins, Shields, and Covers	1, 2	1, 2
Grease and Lubricate to Specifications	9	9
Function Test of All Systems	9	9
Paint and Appearance	5	5
Stamp Inspection Date on Frame		9
Notify JLG of Machine Ownership		9

Footnotes:
[1] Prior to each sale, lease, or delivery
[2] In service for 3 months; Out of service for 3 months or more; Purchased used
[3] Annually, no later than 13 months from the date of the prior inspection, Includes all daily and quarterly inspections, mandated by regulating body
[4] Replace every 12 years or 7,000 hours
[50] Indicates a 50 hour interval required to perform task after initial use of machine. This only occurs once in machine life
[250] Indicates a 250 hour interval required to perform task after initial use of machine. This only occurs once in machine life

Performance Codes:
1 - Check for proper and secure: installation, adjustment, or torque
2 - Visual inspection for damage: (cracks, corrosion, abrasions, distortion, excessive wear, broken welds, gouges, chafing and threads showing)
3 - Proper operation
4 - Check for proper sealing, signs of leakage and fluid level
5 - Clean and free of debris
6 - Decals installed and legible
7 - Check for proper tolerances, routing, and lubrication
8 - Fully Charged
9 - Verify/Perform



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

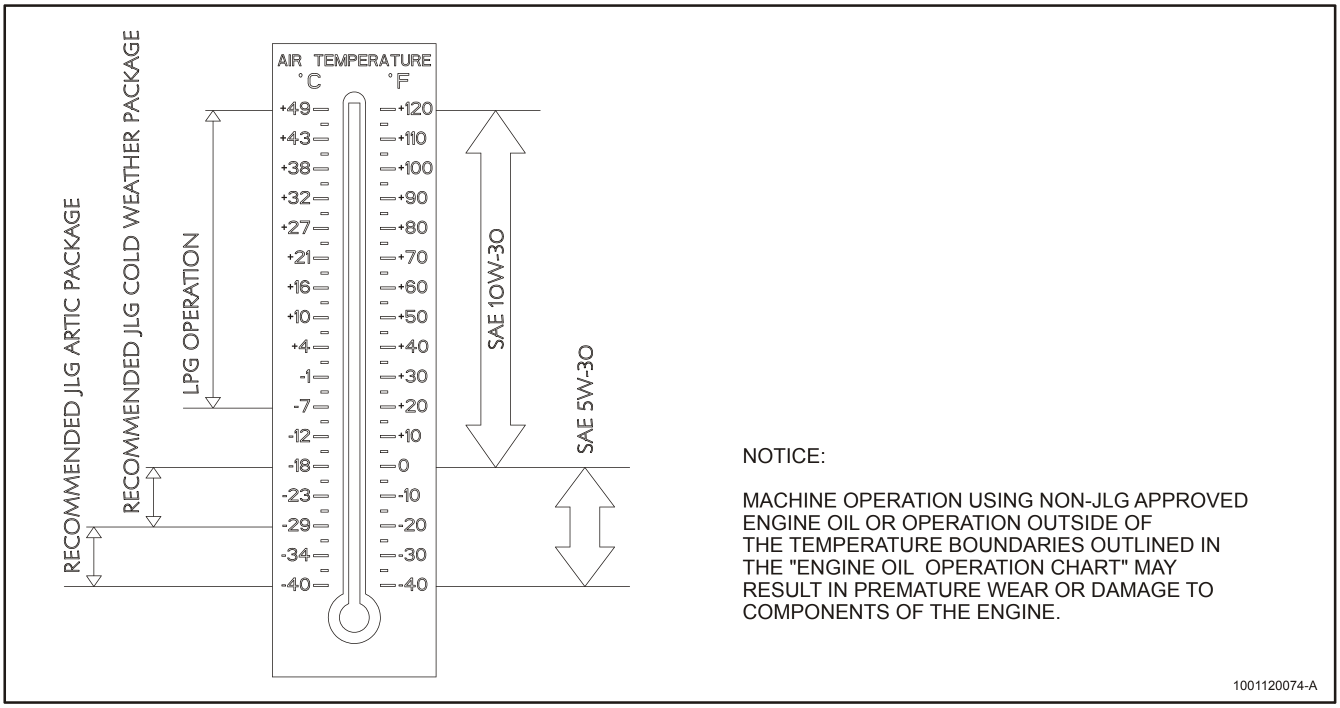


Figure 2-2. Engine Oil Operation Chart - GM

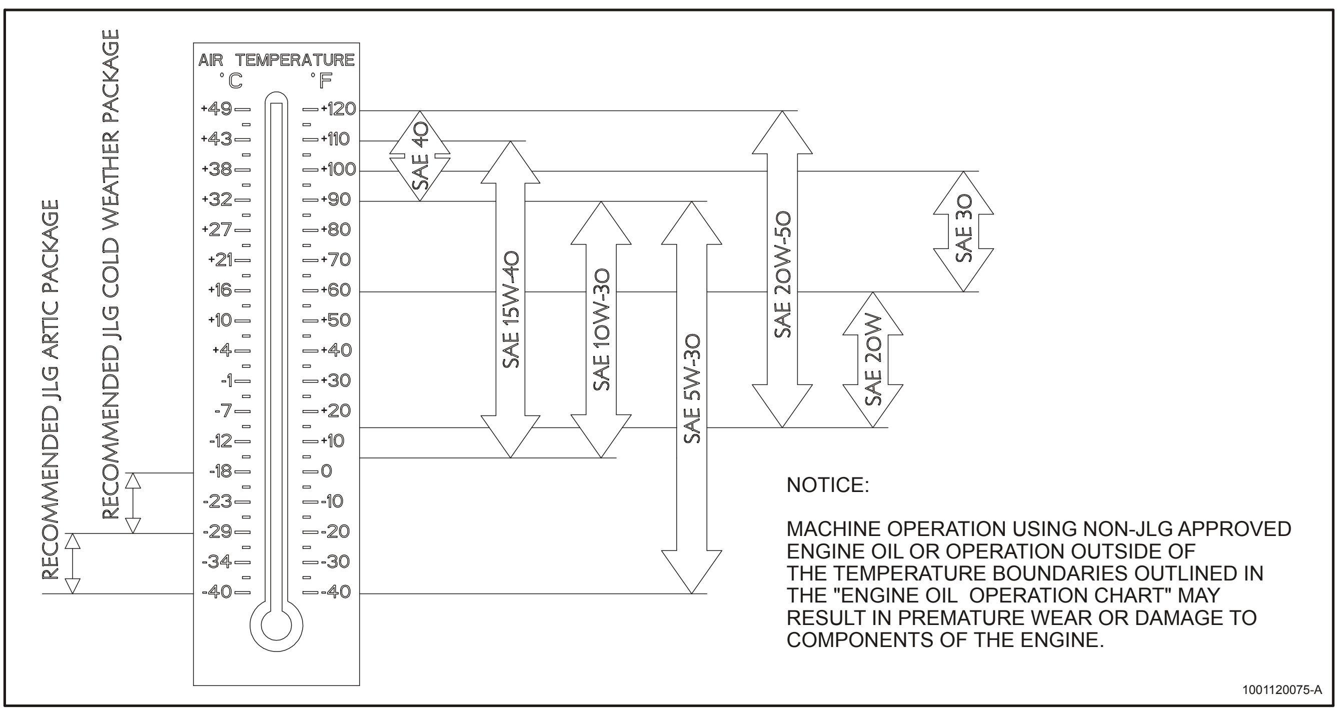


Figure 2-3. Engine Oil Operation Chart - Kubota

NOTES:

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES AND WHEELS

Tire Replacement

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

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

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

Wheel and Tire Replacement

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

Wheel Installation

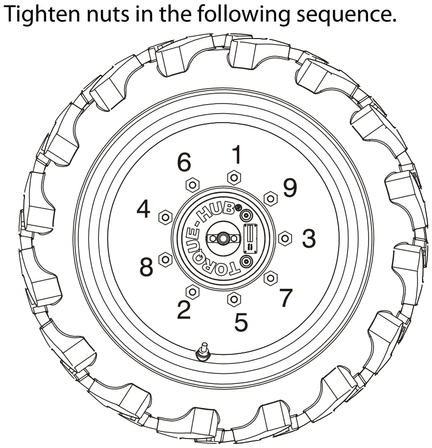
It is extremely important to apply and maintain proper wheel mounting torque.

WARNING

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

Tighten the lug nuts to the proper torque to prevent wheels from coming loose. Use a torque wrench to tighten the fasteners. If you do not have a torque wrench, tighten the fasteners with a lug wrench, then immediately have a service garage or dealer tighten the lug nuts to the proper torque. Over-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 0.75 mph (1.2 kph). See Drive System in this section for more detail on the drive speeds, and see Chassis Tilt Indicator System in this section for interaction with the tilt sensor.

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

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

3.5 DRIVE SYSTEM

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

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

Table 3-2. Drive System Mode Chart

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

Table 3-2. Drive System Mode Chart

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

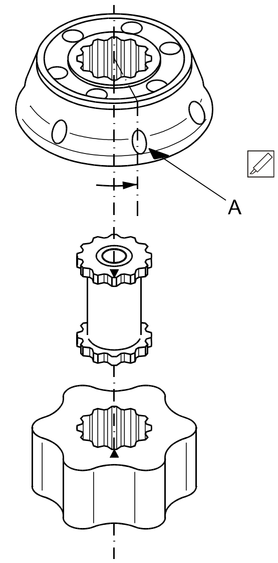
3.6 DRIVE MOTOR

Disassembly

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

Assembly

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



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

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).

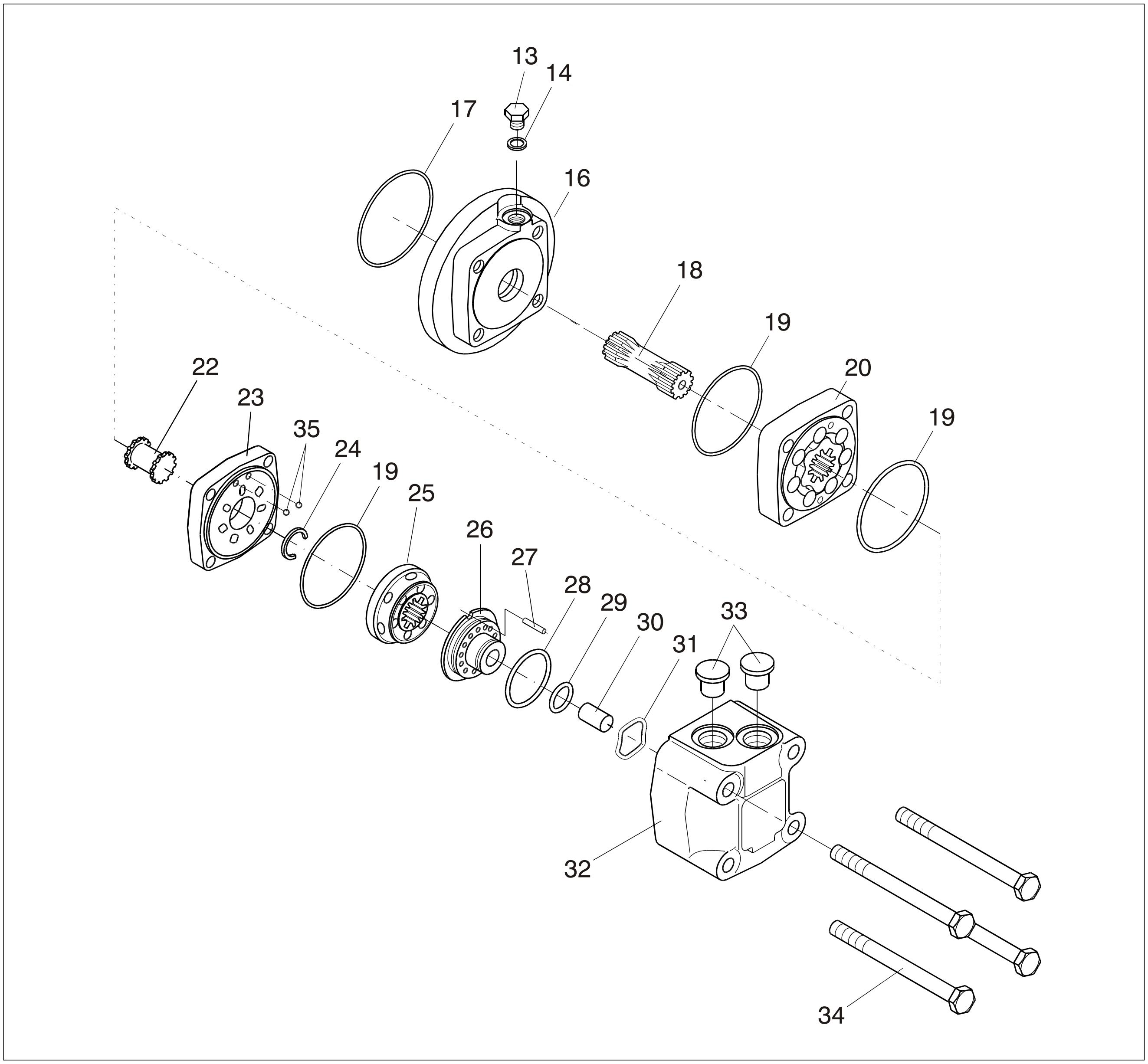
A

A. Main holding tool

B

B: Holding tool

Figure 3-1. Drive Motor Special Tools



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

Figure 3-2. Drive Motor

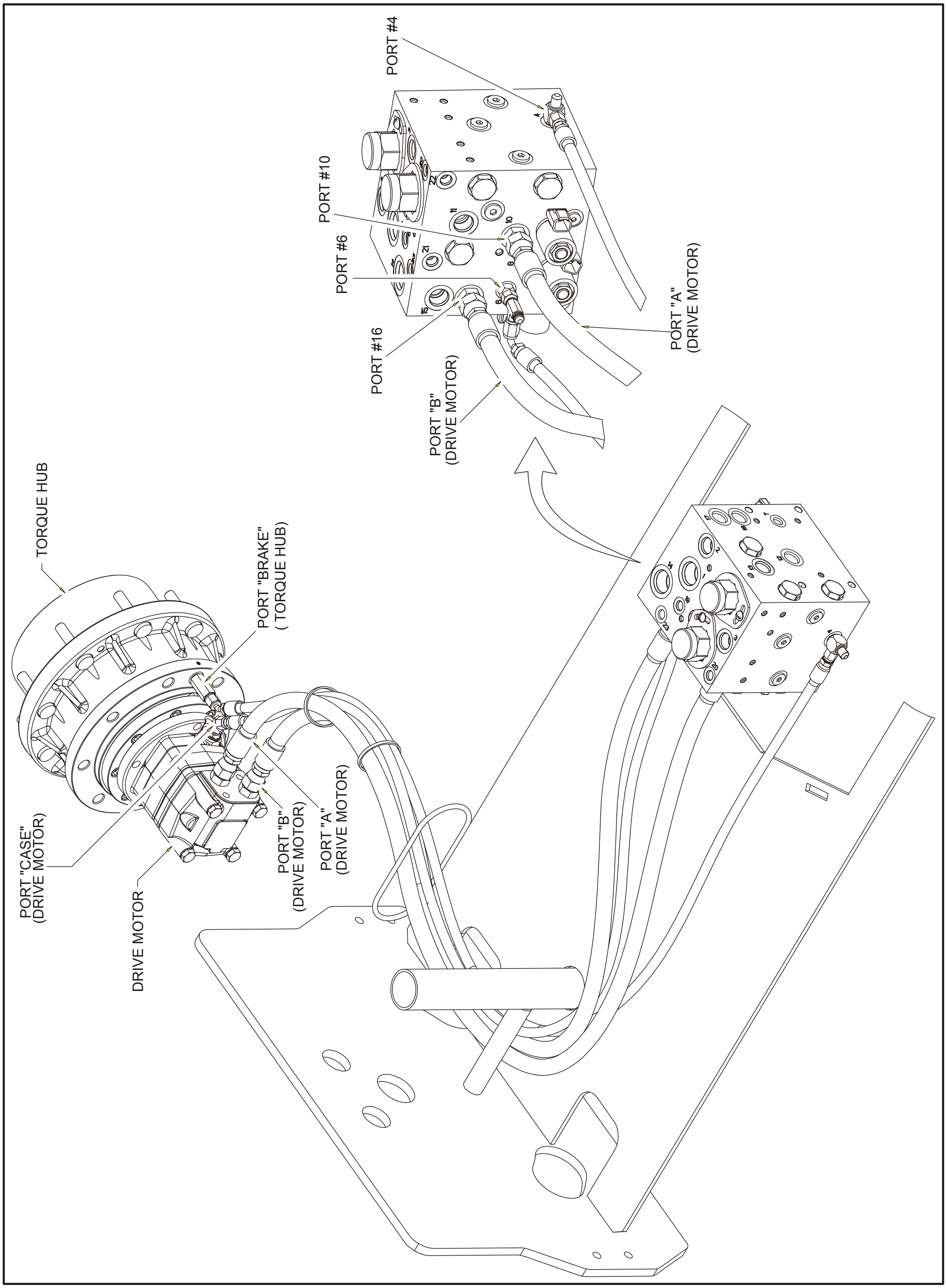


Figure 3-3. Right Front Drive Hydraulic Lines

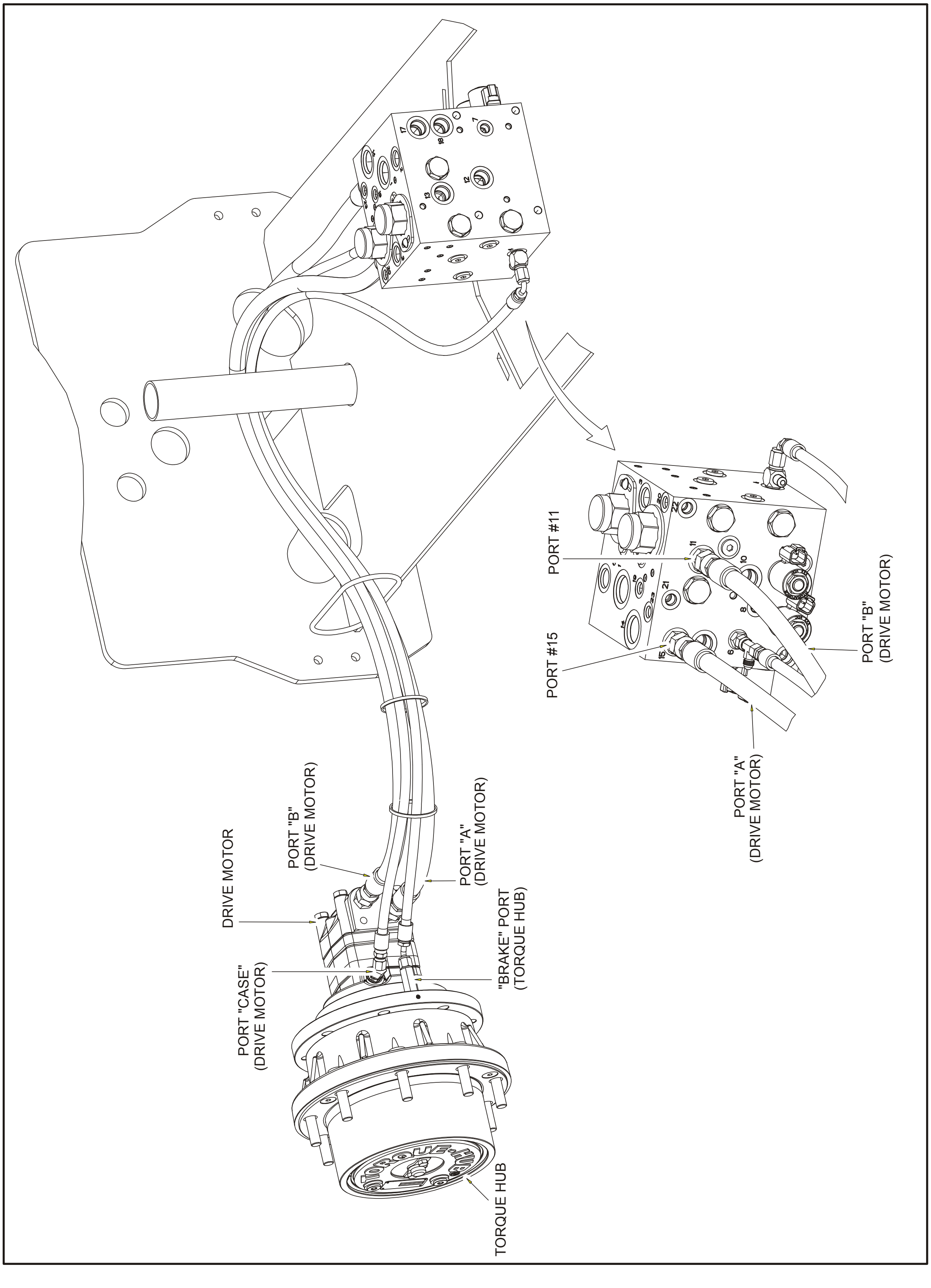


Figure 3-4. Left Front Drive Hydraulic Lines

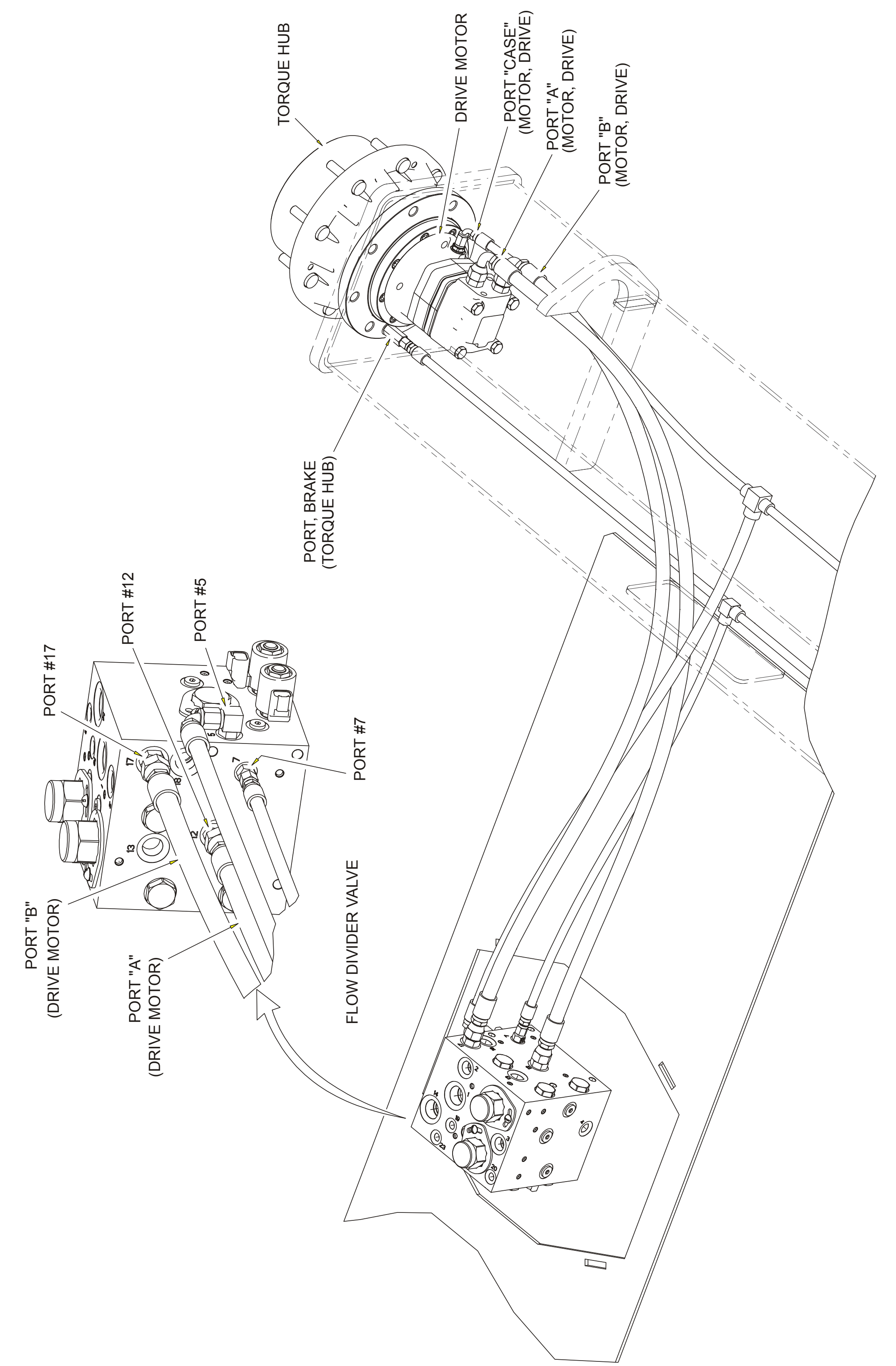


Figure 3-5. Right Rear Drive Hydraulic Lines

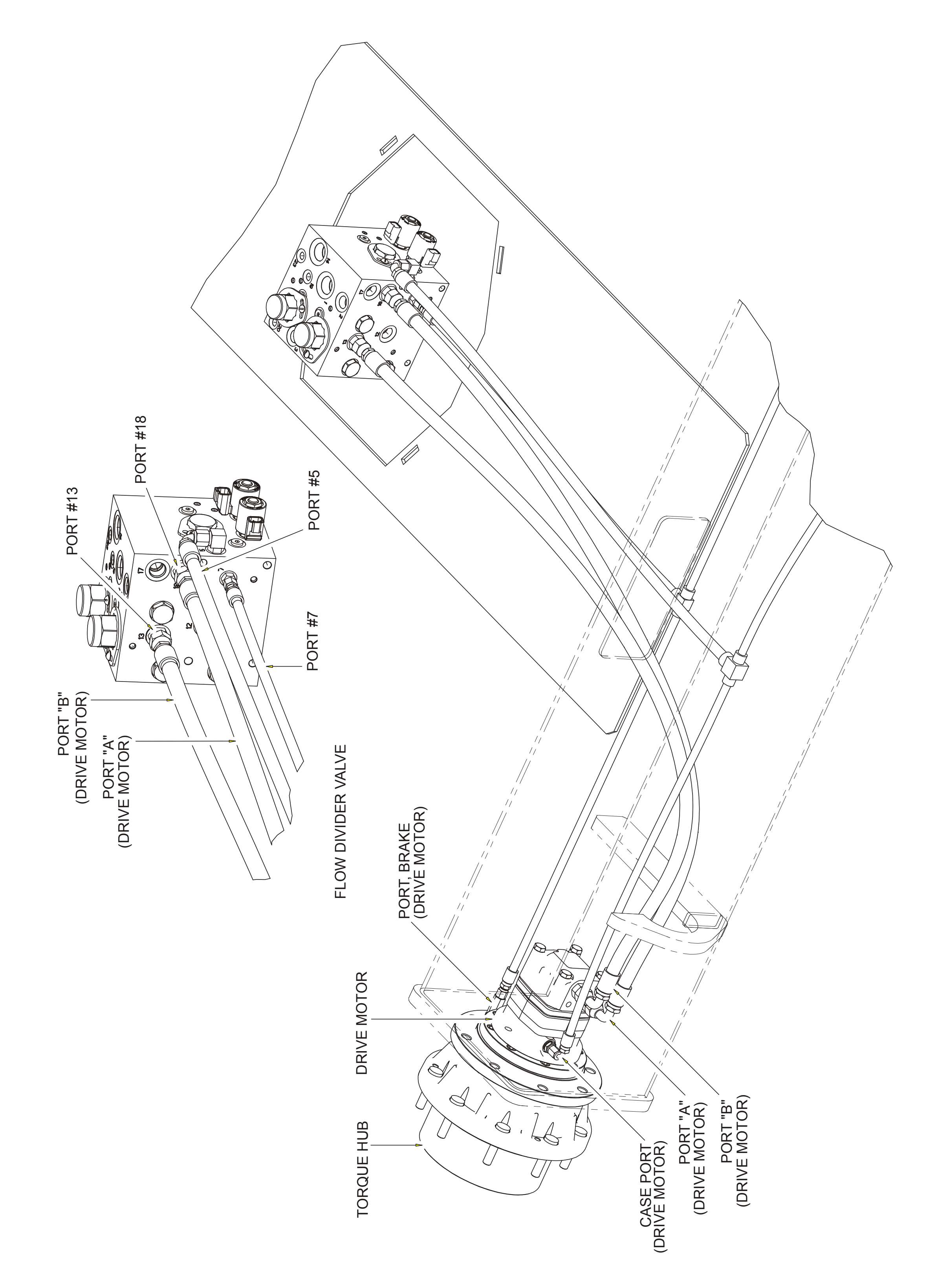


Figure 3-6. Left Rear Drive Hydraulic Lines

3.7 DRIVE HUB

Roll, Leak and Brake Testing

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

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

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

THE ROLL TEST

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

THE LEAK TEST (MAIN UNIT)

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

THE BRAKE TEST

Input Brake

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

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

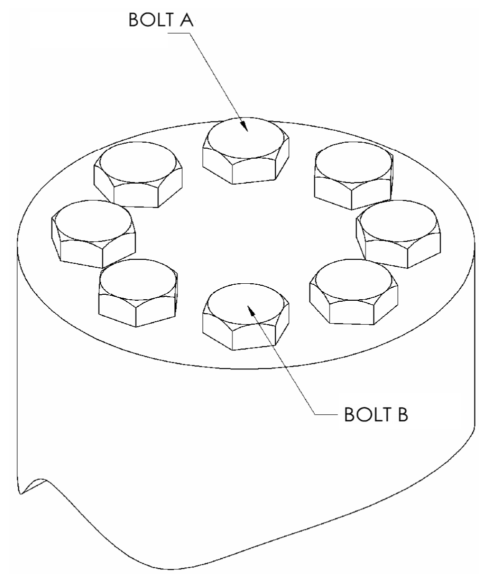
NOTE: *Failure to perform this test may result in damaged or ineffective brake parts.*

Tightening and Torquing Bolts

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

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

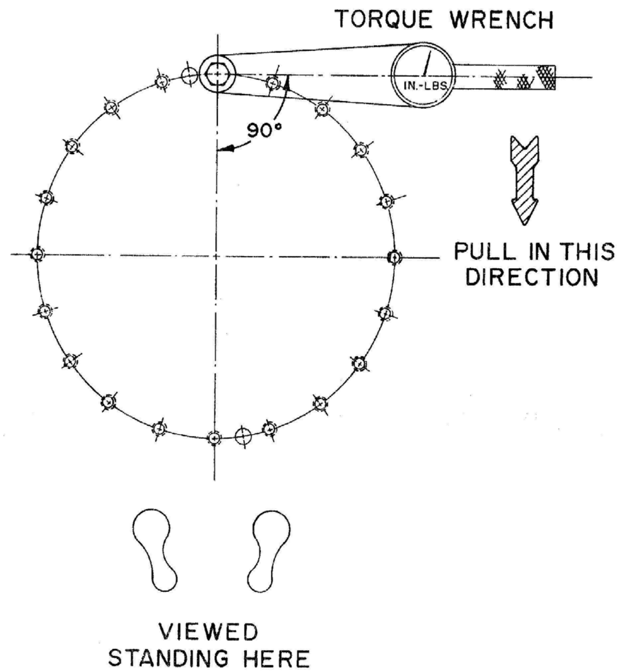
1. Tighten (but do not torque) bolt "A" until snug.



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

Measuring Rolling Torque

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



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).

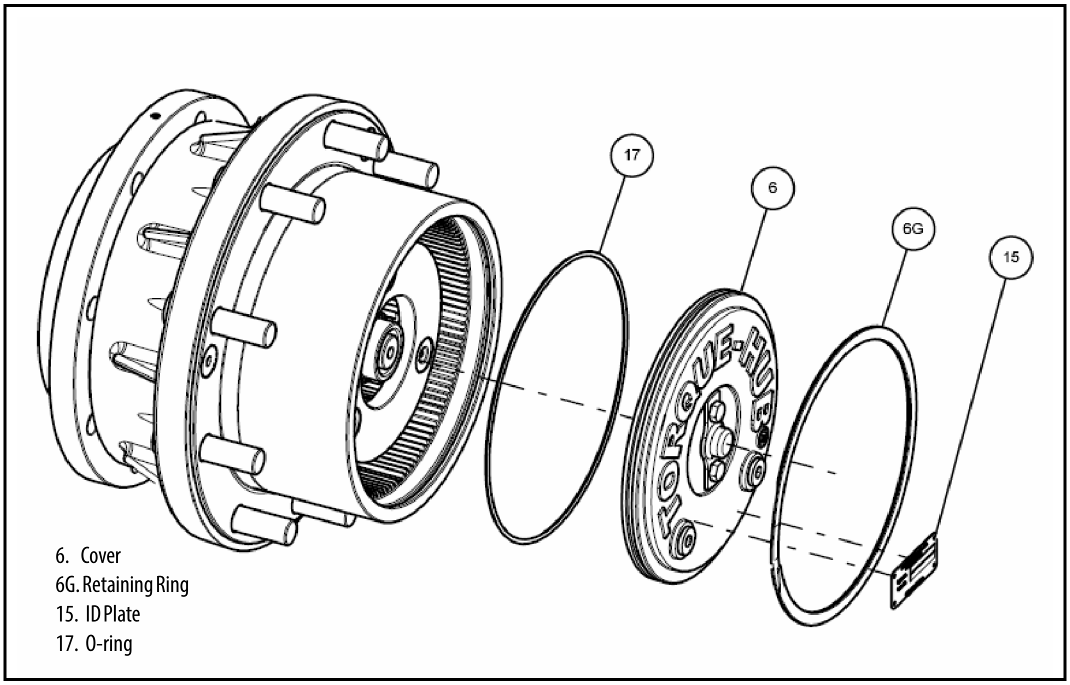


Figure 3-7. Main Disassembly - Figure 1

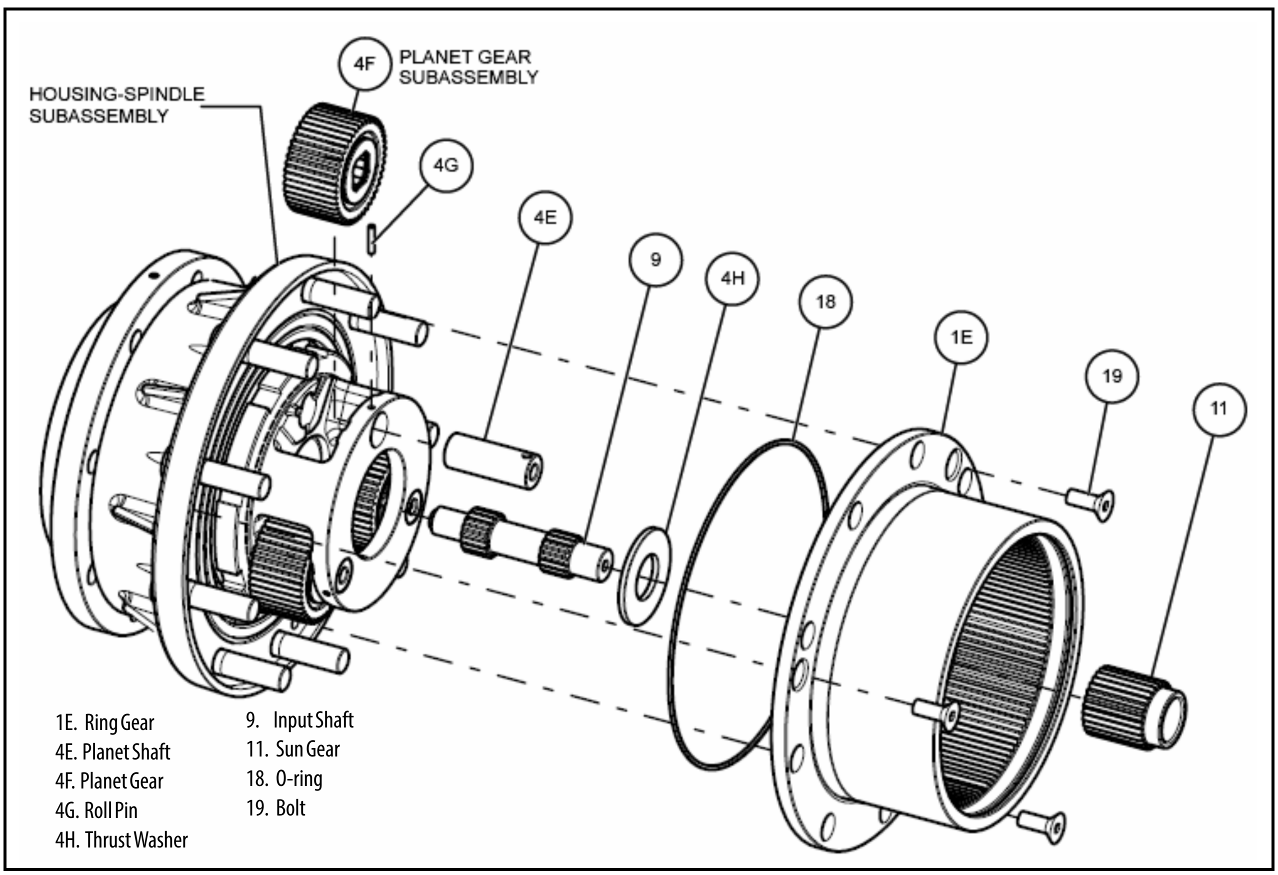


Figure 3-8. Main Disassembly - Figure 2

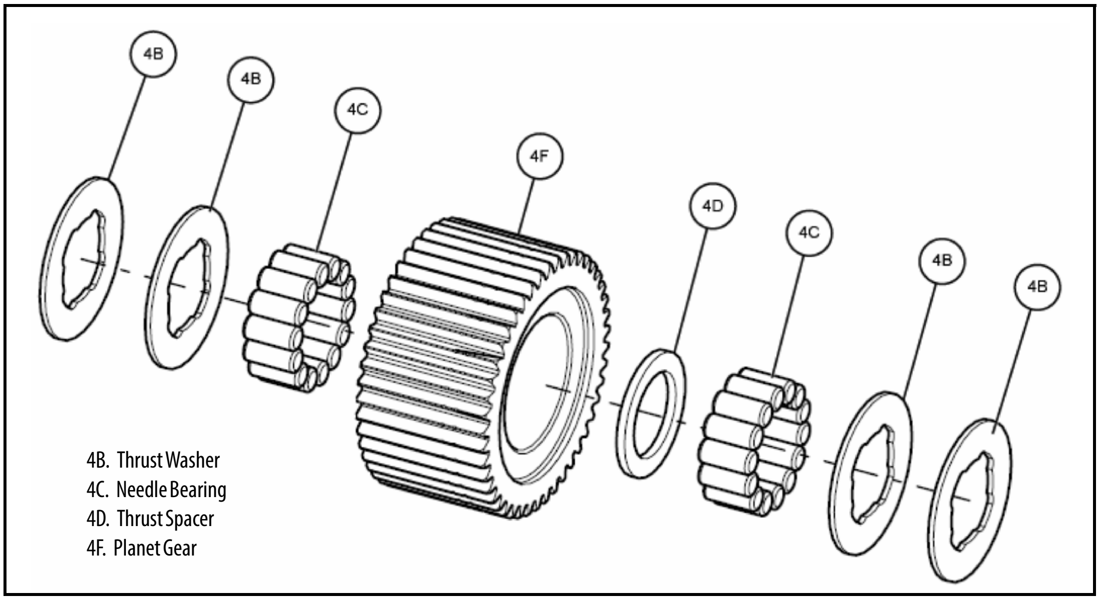


Figure 3-9. Main Disassembly - Figure 3

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 Loctite that was used to secure the bearing nut on to the Spindle (1 A).

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

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

4. Lift Housing (1D) off of Spindle (1 A).

5. If necessary, press Studs (1H) out of Housing (1D).

6. Remove Lip Seal (1B) from Housing (1D).

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

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

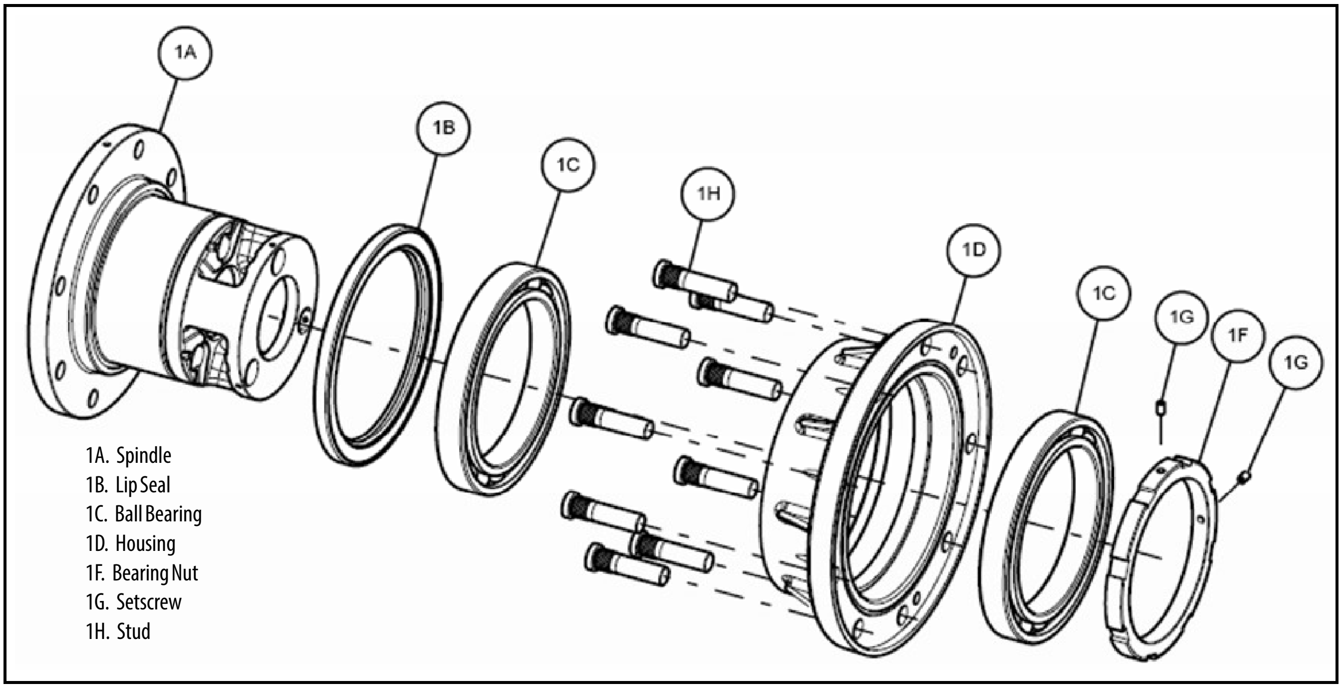


Figure 3-10. Housing-Spindle

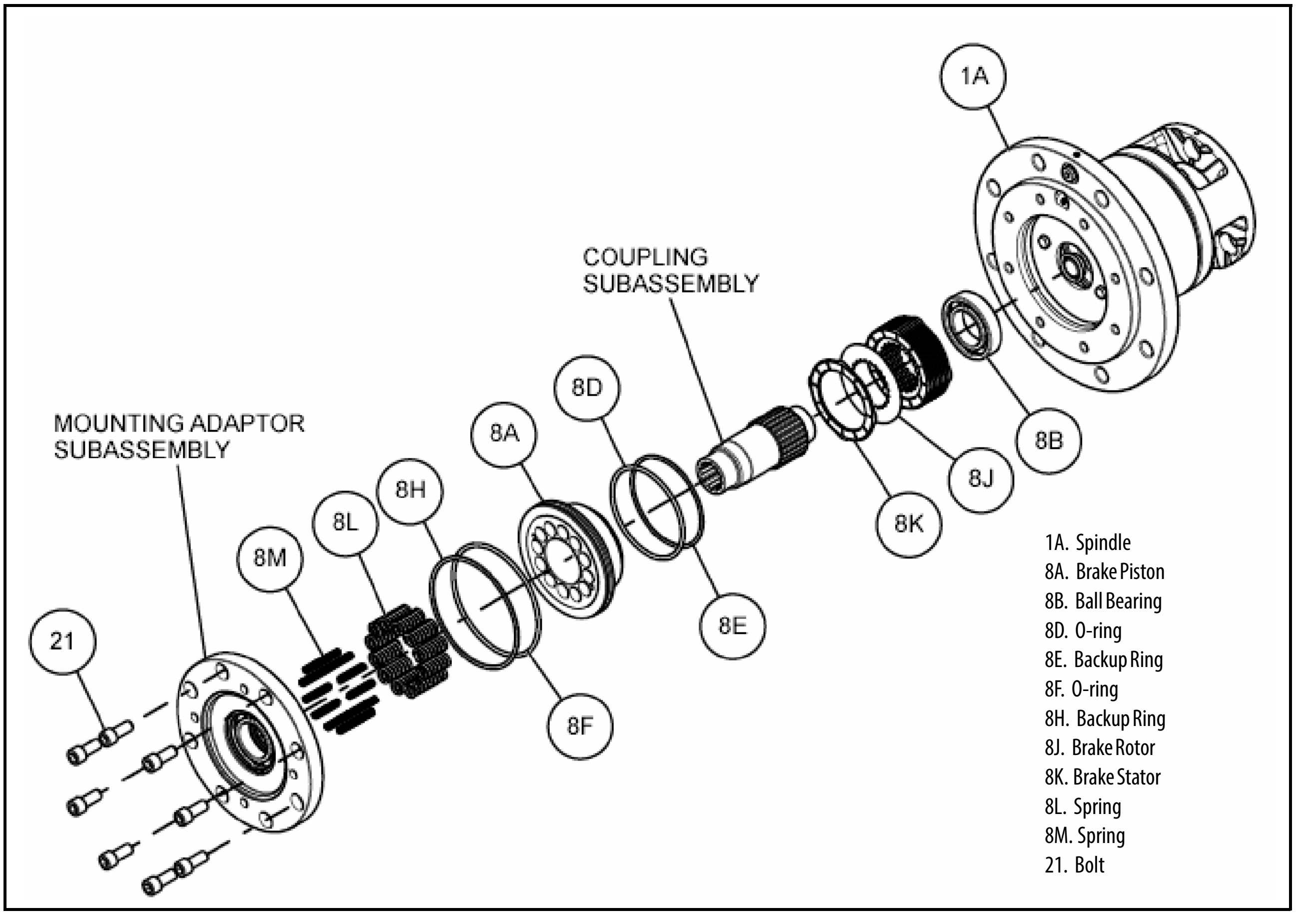


Figure 3-11. Spindle-Brake Subassembly - Figure 1

Spindle-Brake Subassembly Disassembly

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

CAUTION

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

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

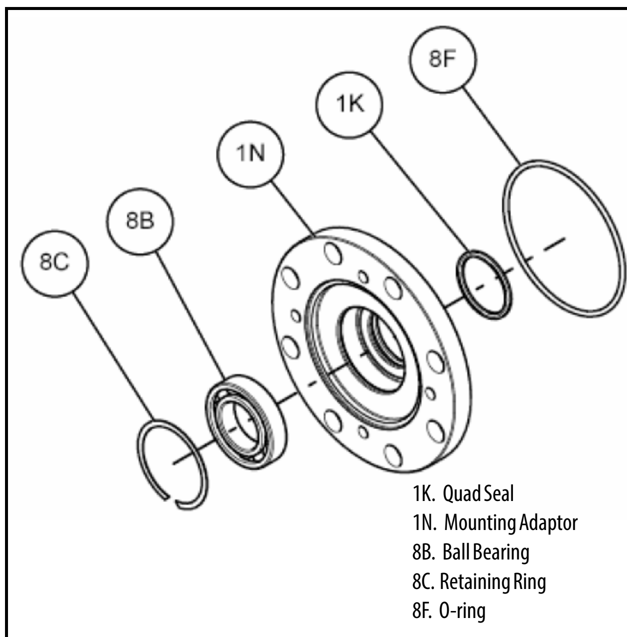
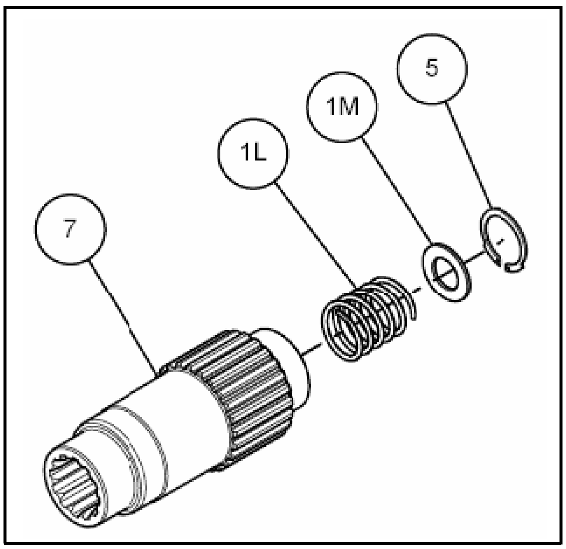


Figure 3-12. Spindle-Brake Subassembly - Figure 2

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



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

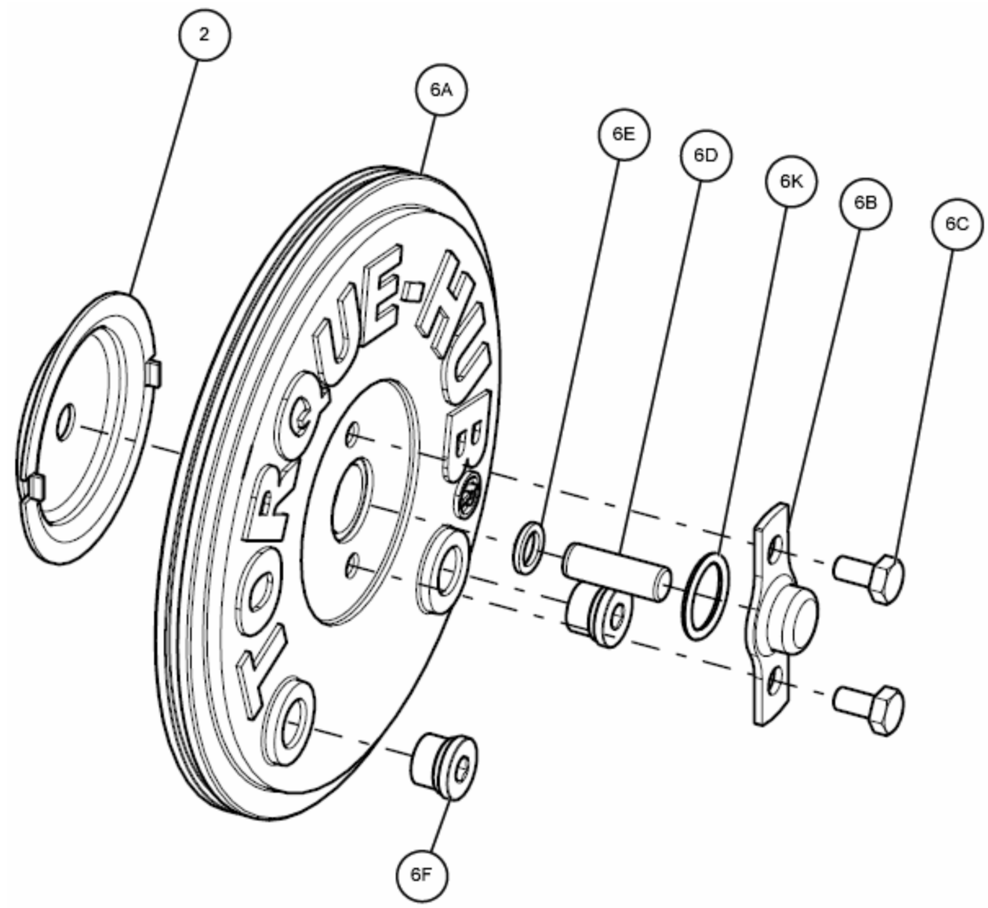
Figure 3-13. Spindle-Brake Subassembly - Figure 3

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

Cover Disassembly

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

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



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).

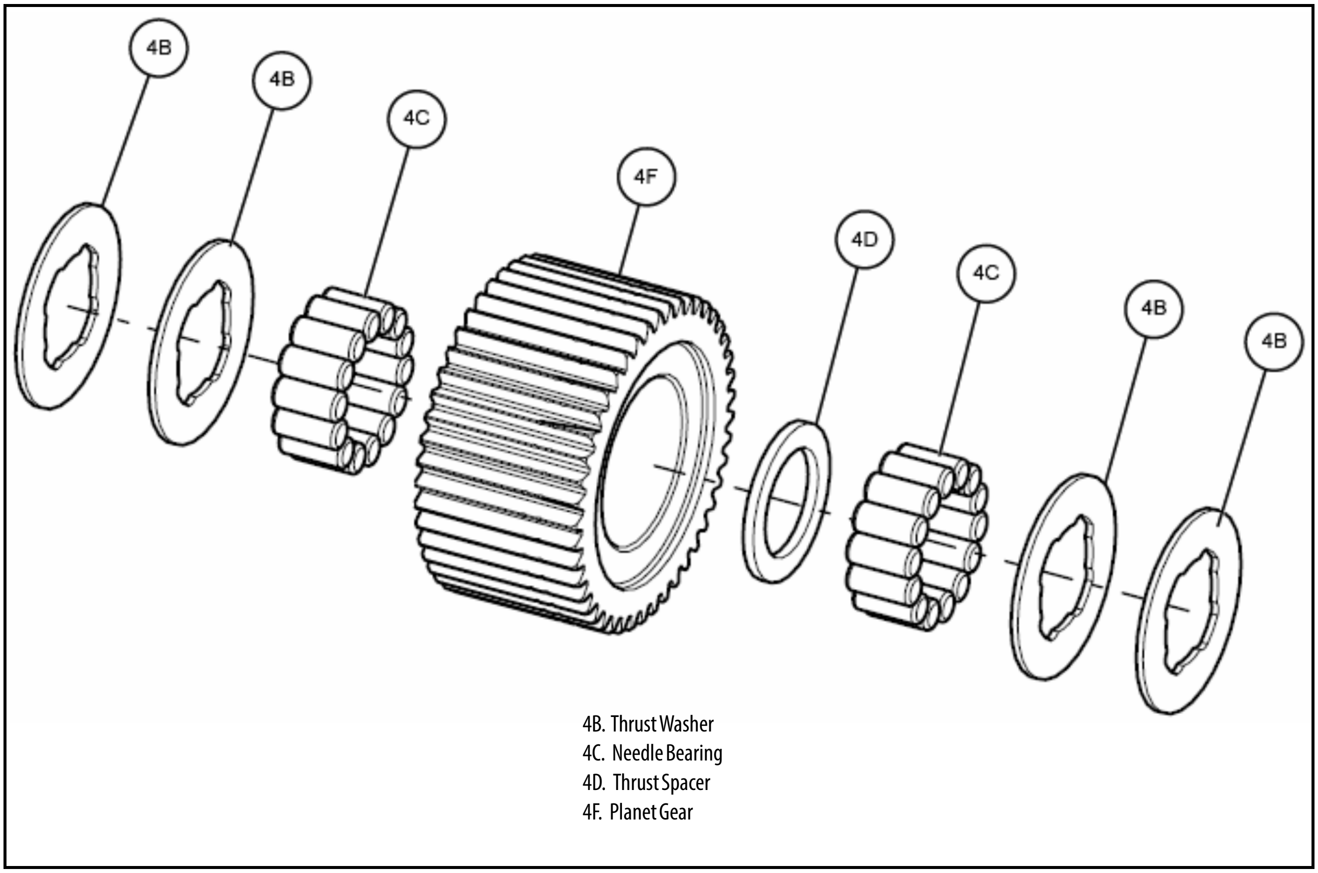
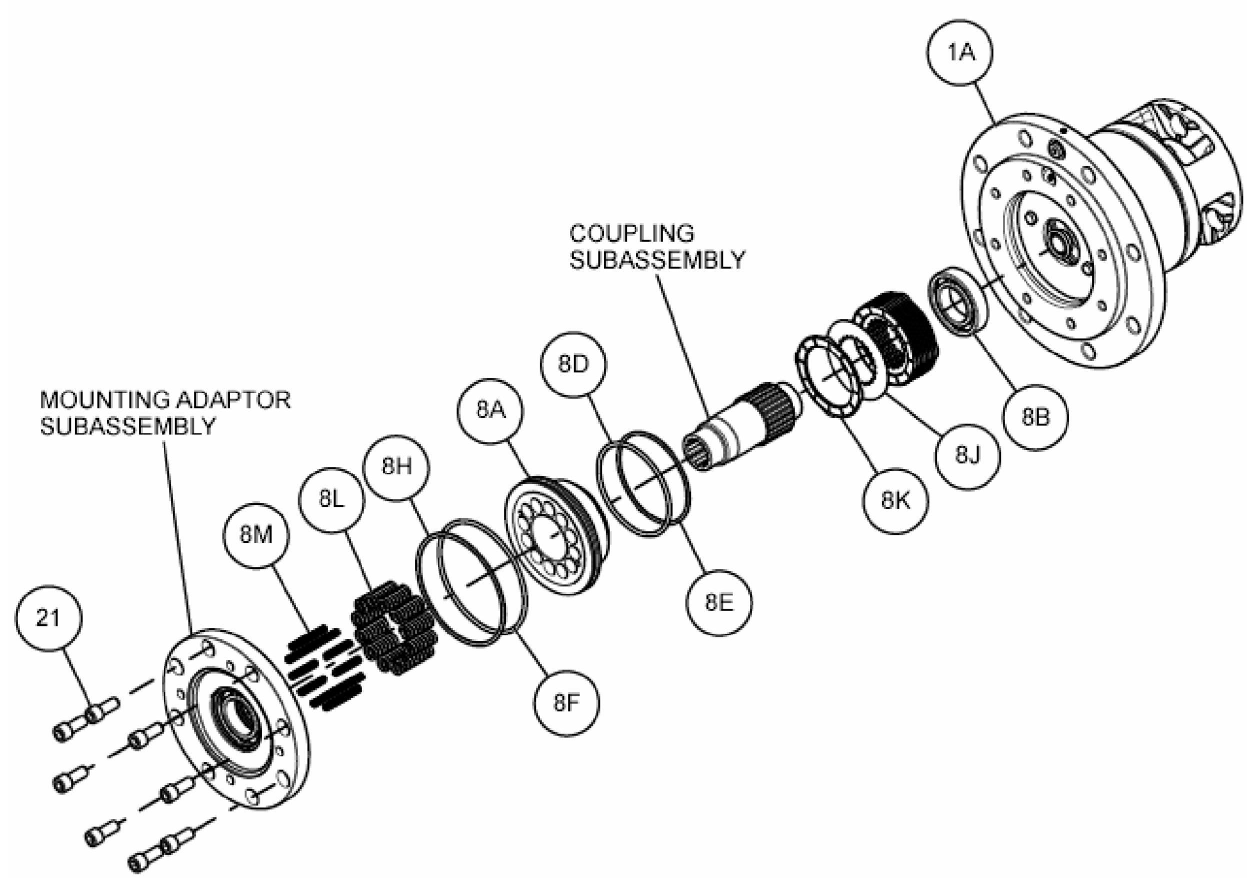


Figure 3-15. Planet Gear

Spindle-Brake Subassembly

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

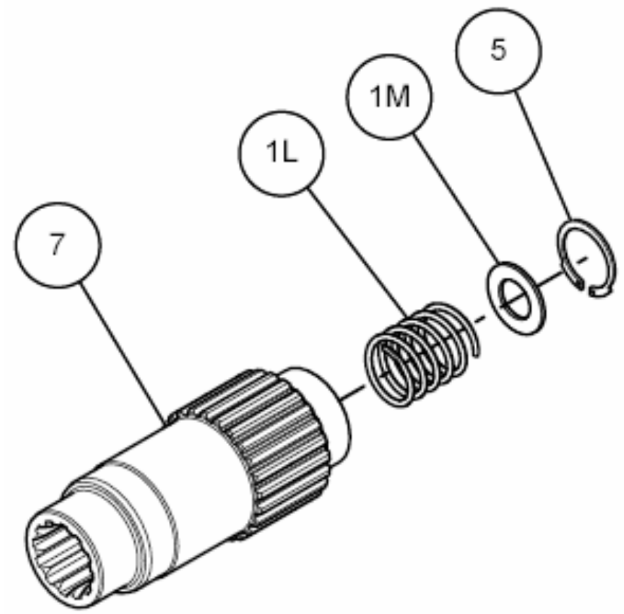
1. Place Spindle (1 A) with the flange side up. Press Ball Bearing (8B) into the small counterbore of the spindle.
2. Place Brake Stator (8K) into the Spindle (1A) aligning with the scallop cuts.
3. Place Brake Rotor (8J) on top of Brake Stator (8K).
4. Repeat steps 2 and 3 until there are a total of 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.



1A. Spindle
8A. Brake Piston
8B. Ball Bearing
8D. O-ring
8E. Backup Ring
8F. O-ring
8H. Backup Ring
8J. Brake Rotor
8K. Brake Stator
8L. Spring
8M. Spring
21. Bolt

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).



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

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).

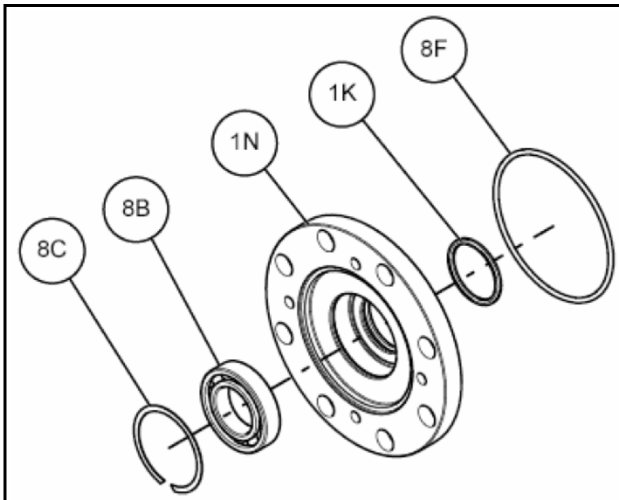
11. Set the Brake Piston (8A) so that the large diameter end is down. Install large Backup Ring (8H) in the large diameter groove at the bottom of the Brake Piston (8A).

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.



1K. Quad Seal
1N. Mounting Adaptor
8B. Ball Bearing
8C. Retaining Ring
8F. O-ring

Figure 3-18. Spindle-Brake Figure 3

16. Before installing the Quad Seal (1K) into groove of Mounting Adaptor (1N) grease internal diameter of the quad seal.

17. Install O-Ring (8F) into the outside o-ring groove of the Mounting Adaptor (1N).

18. Insert the Adaptor Subassembly onto Spindle (1A) with the o-ring port on the spindle flange centered between the two motor mounting holes on the Mounting Adaptor (1N).

19. Secure the Mounting Adaptor (1N) to the Spindle (1 A) with 8 bolts (21). Torque the bolts to 36-38 ft-lbs in X pattern.

20. Use the Integral Brake Check Procedure to leak check the brake, record initial release pressure.

21. Disconnect Brake Tester and install O-Ring Plug (12) and tighten according to DIN standard if applicable.

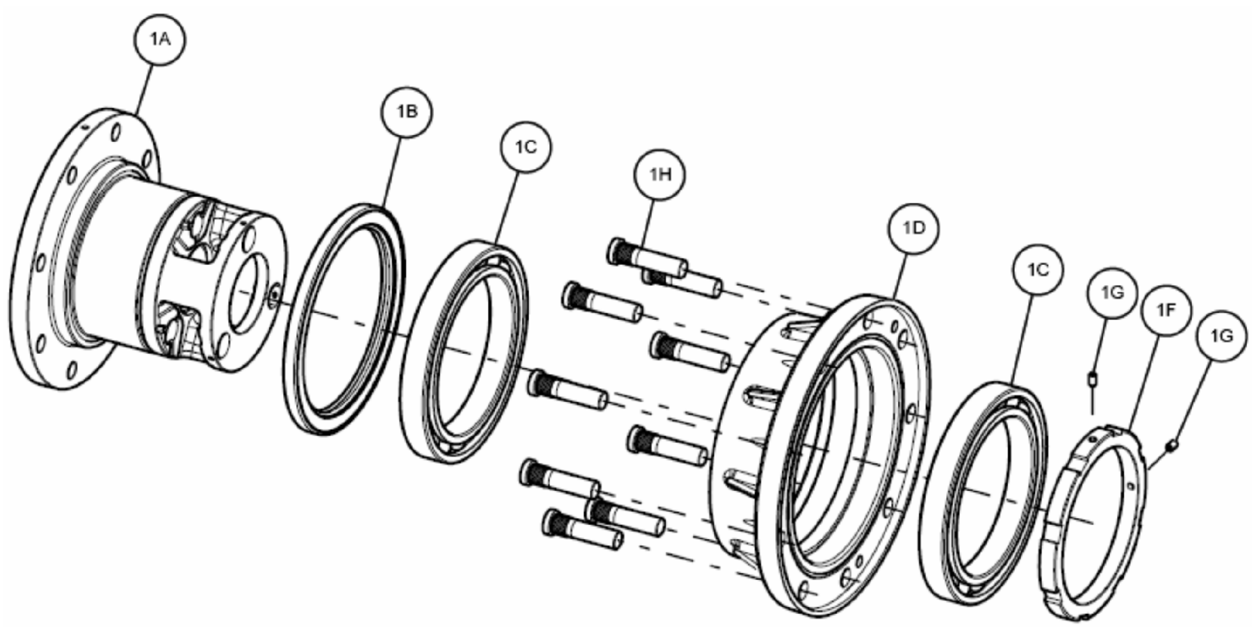
Housing-Spindle Subassembly

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

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

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

5. Secure Spindle-Brake Subassembly with the flange down and then lower the Housing (1D) onto Spindle (1A).
6. Apply Loctite 272 on Bearing Nut (1F) threads. Install the Bearing Nut (1F) onto Spindle (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).

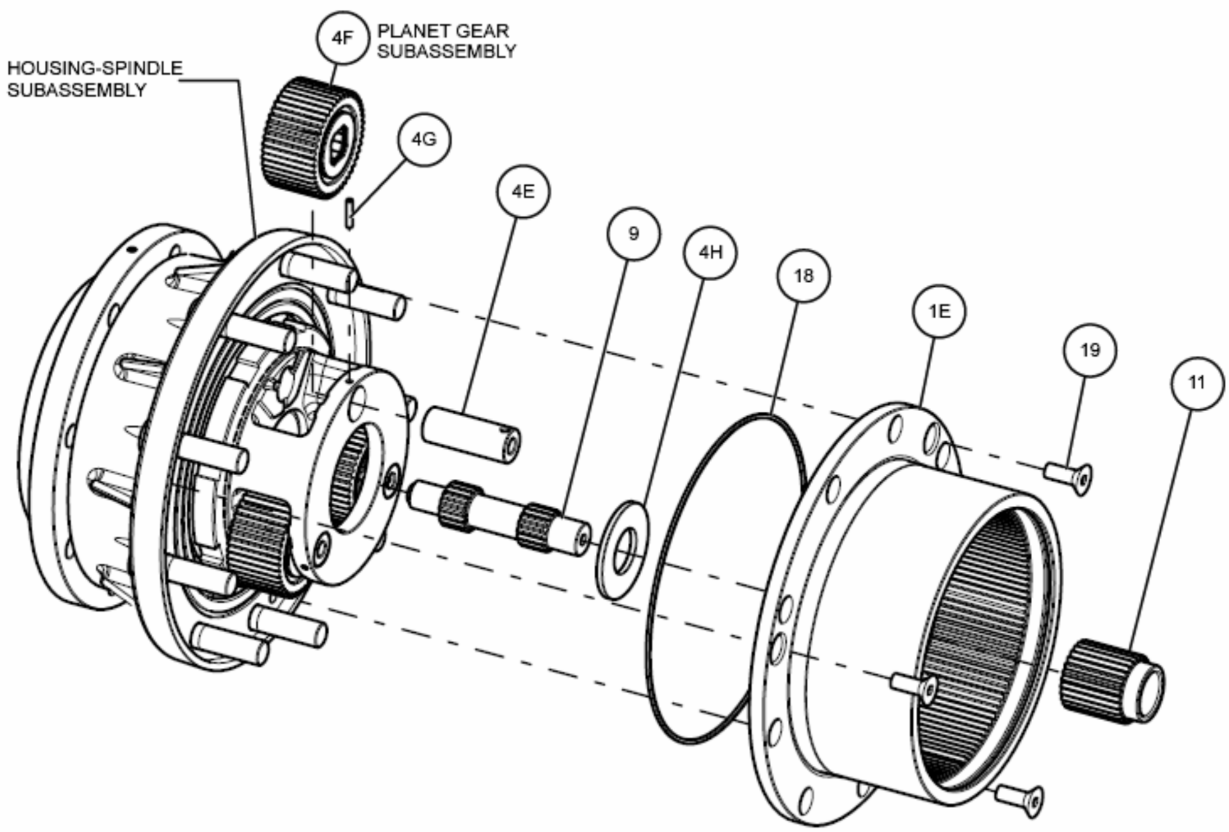
2. Place one of the Planet Gear Subassemblies (4F) into Spindle (1 A) through gap between two Studs (1H). Align the planet gear bore with one of the planet shaft holes on the Spindle-Brake Subassembly using the Drift Pin Assembly Tool.

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).

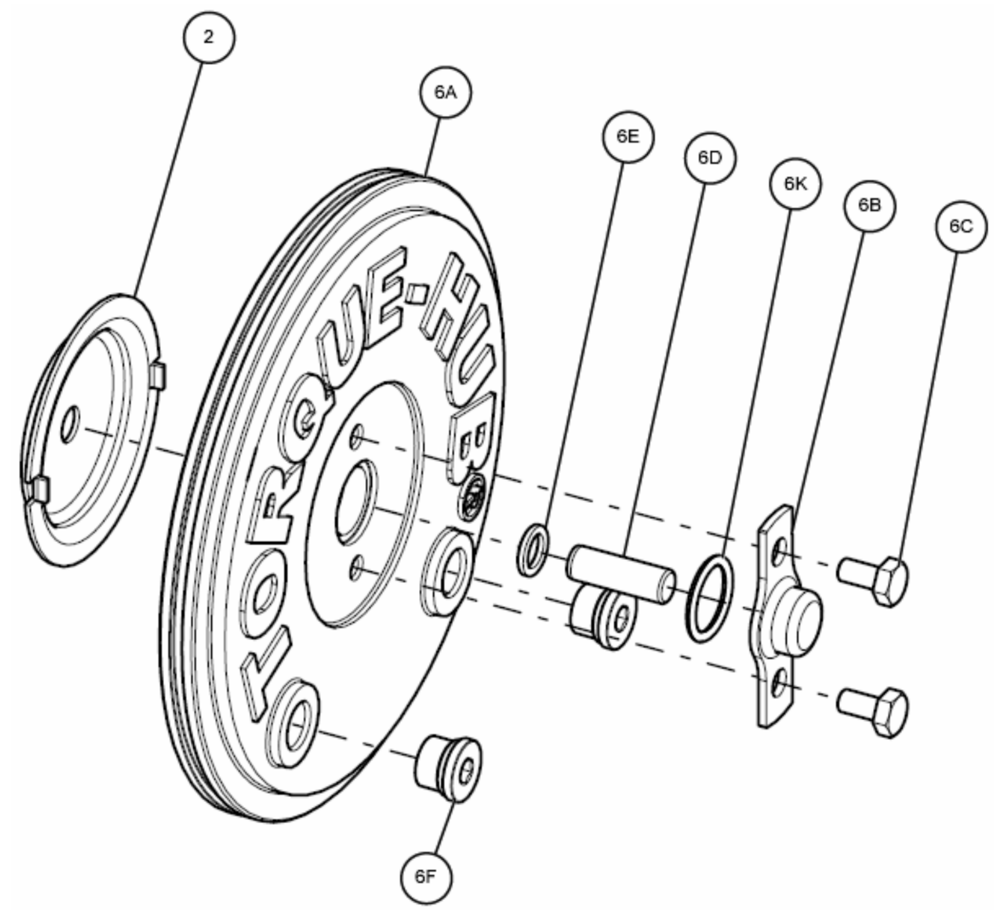
8. Place Ring Gear (1E) onto Housing (1D). Align the three shipping cap screw holes on Housing (1D) and Ring Gear (1E).

9. Install three Shipping Cap Screws (19) into Ring Gear (1E) and Housing (1G). Torque them 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.*

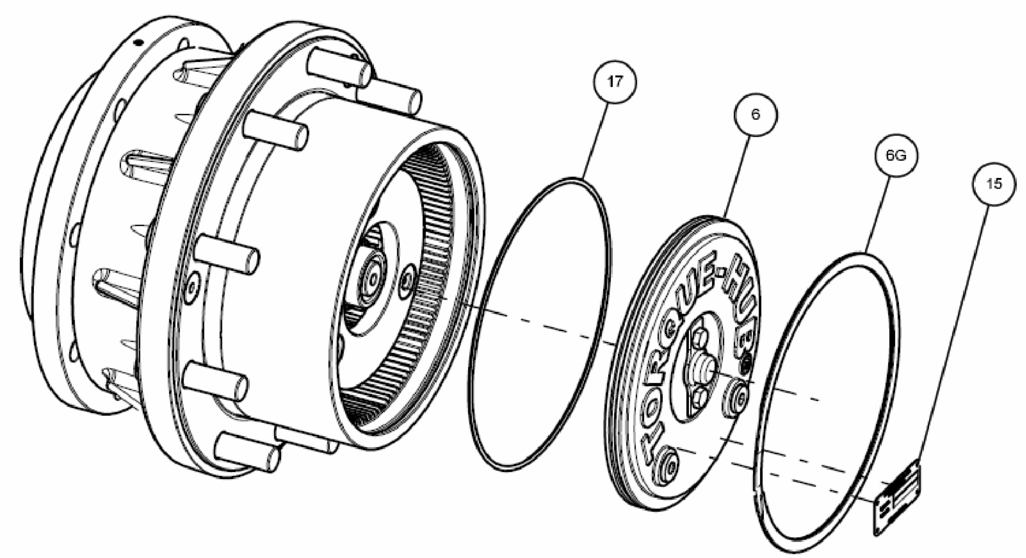
3. Insert Disengage Rod (6D) into hole in Cover (6A) until it touches the inside of the Disengage Cap (6B).

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).

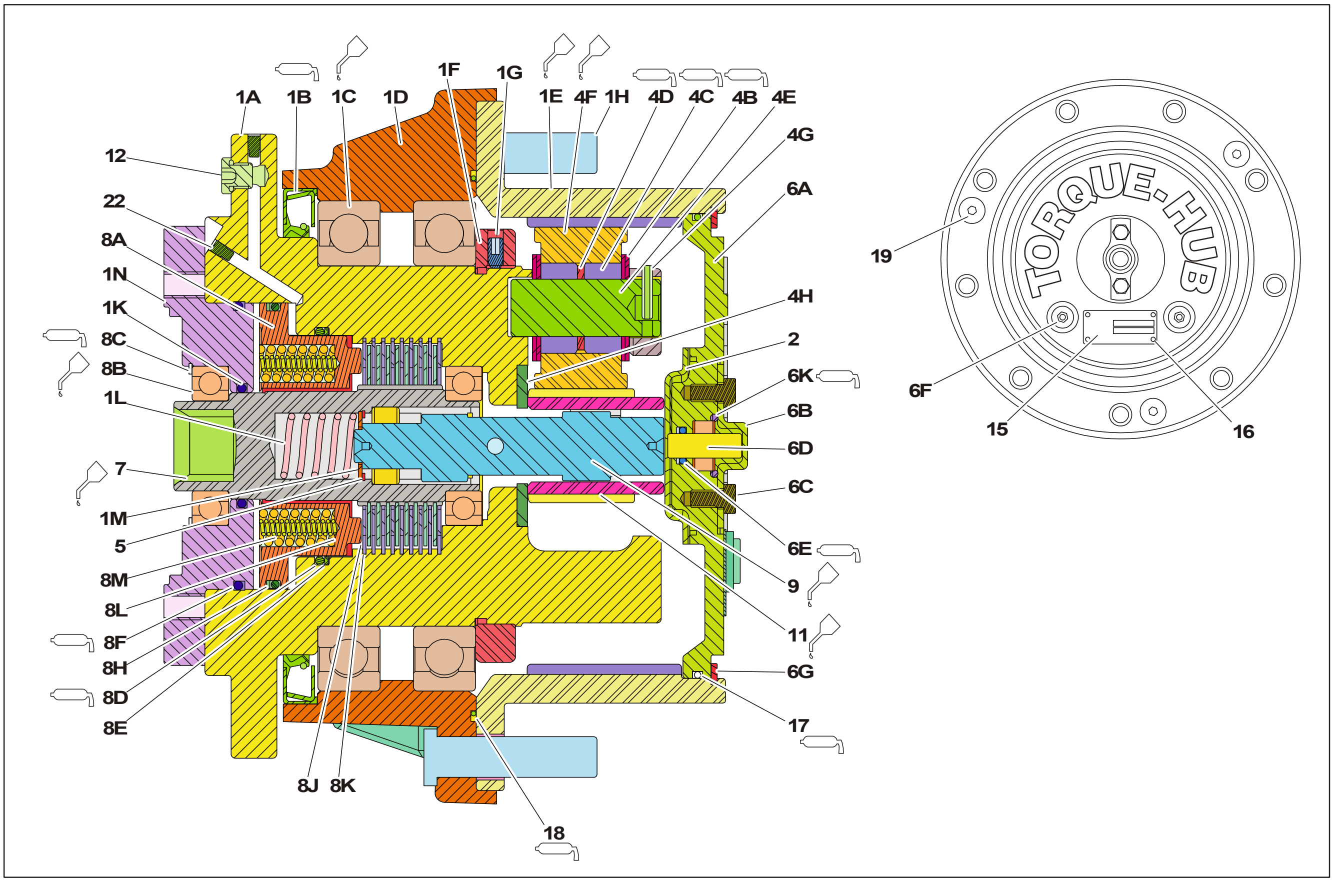
3. Bleed brake. Increase hydraulic pressure gradually while trying to rotate the input until brake just starts to release. Note this pressure. Make sure the pressure falls into the appropriate range below.

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

Figure 3-23. Drive Hub Assembly

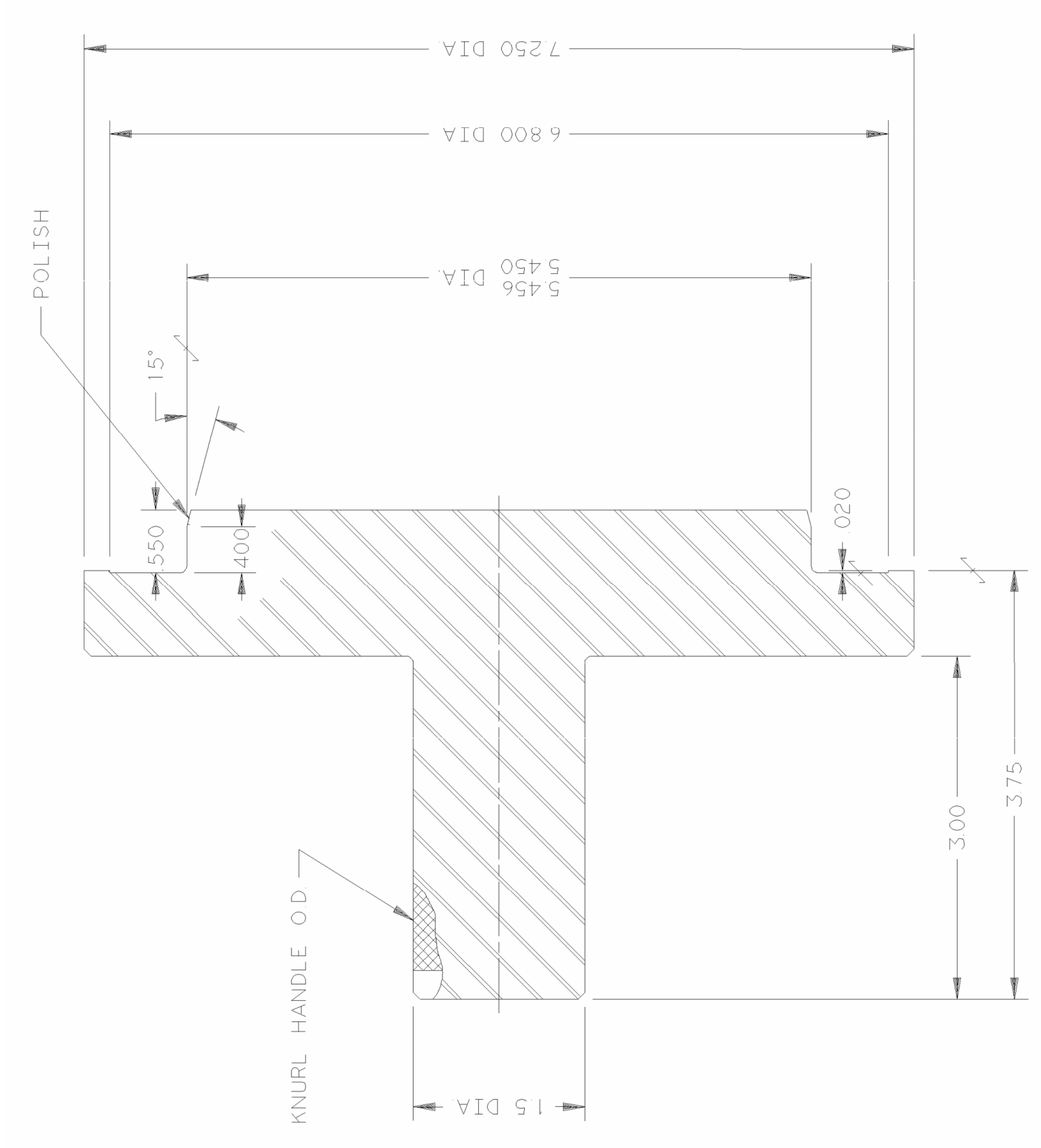


Figure 3-24. Bearing Pressing Tool

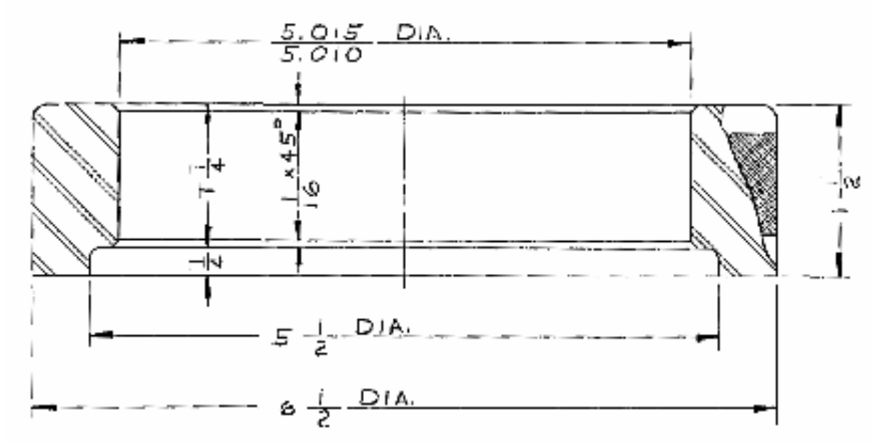


Figure 3-25. Seal Pressing Tool

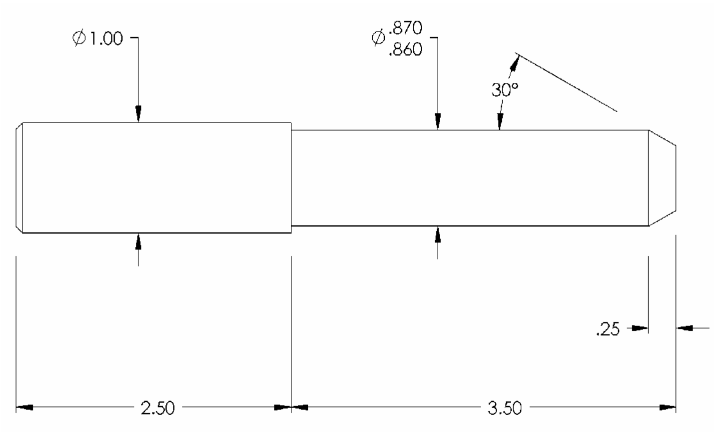


Figure 3-26. Drift Pin for Lining Up Thrustwashers with Output Planet Gear

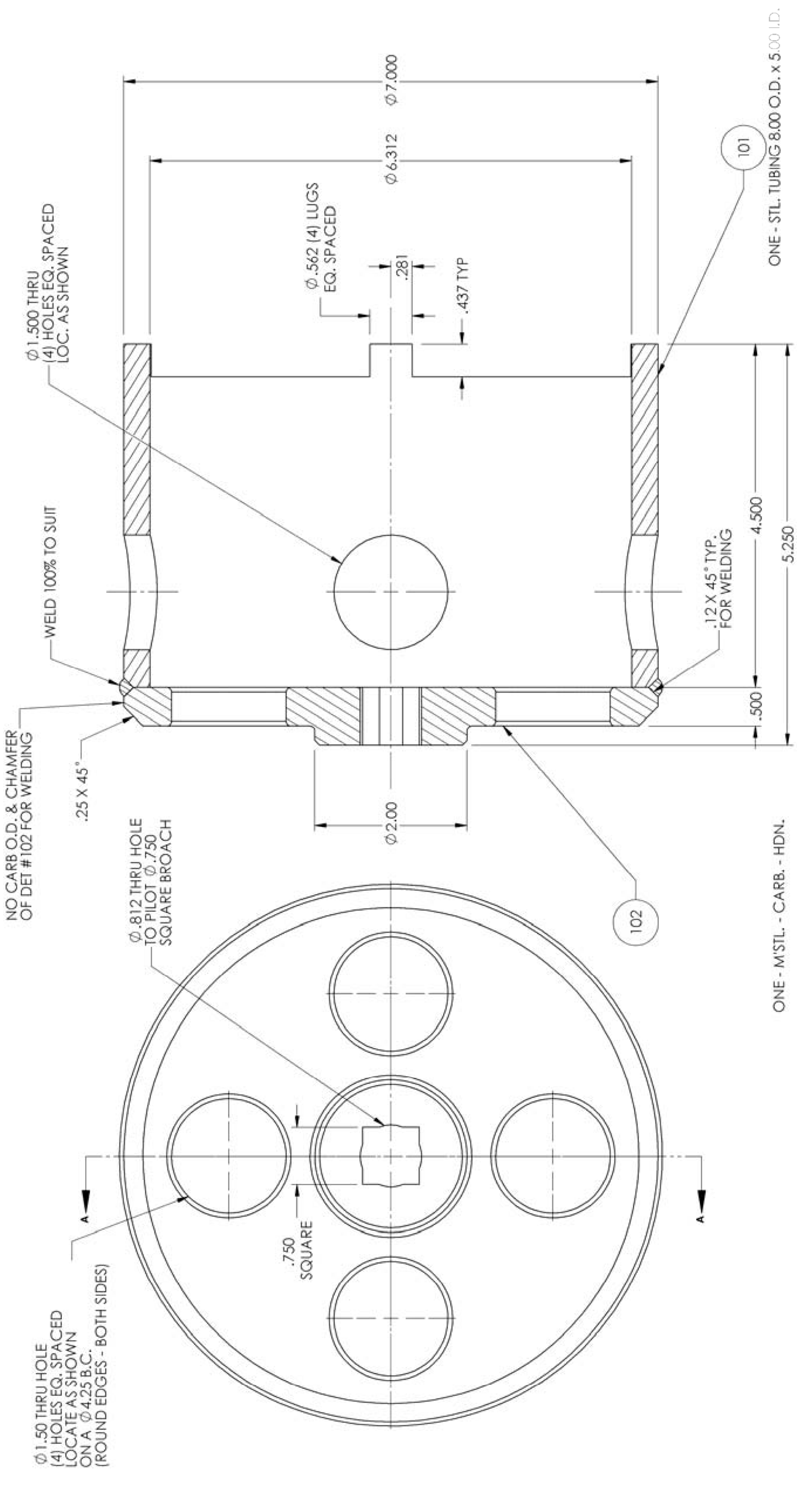


Figure 3-27. Bearing Nut Wrench

3.8 OSCILLATING AXLE SYSTEM

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

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

Pilot pressure is supplied via Drive Pump charge pressure. When the control system detects that the Main Boom is below horizontal and swung between the rear tires, two control valves are actuated to supply charge pressure to the lock-out cylinder holding valves. This allows the cylinders to unlock which allows the axle to float. The first valve is normally closed and opens when actuated to allow flow to the lock-out cylinder circuit. The second valve (located between the first valve and the lock-out cylinders) is normally open to tank. This valve closes when actuated to block the tank path and force the flow to the lock-out cylinders. If either of these valves is in its normal state, the axle will be locked.

Oscillating Axle Bleeding Procedure

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

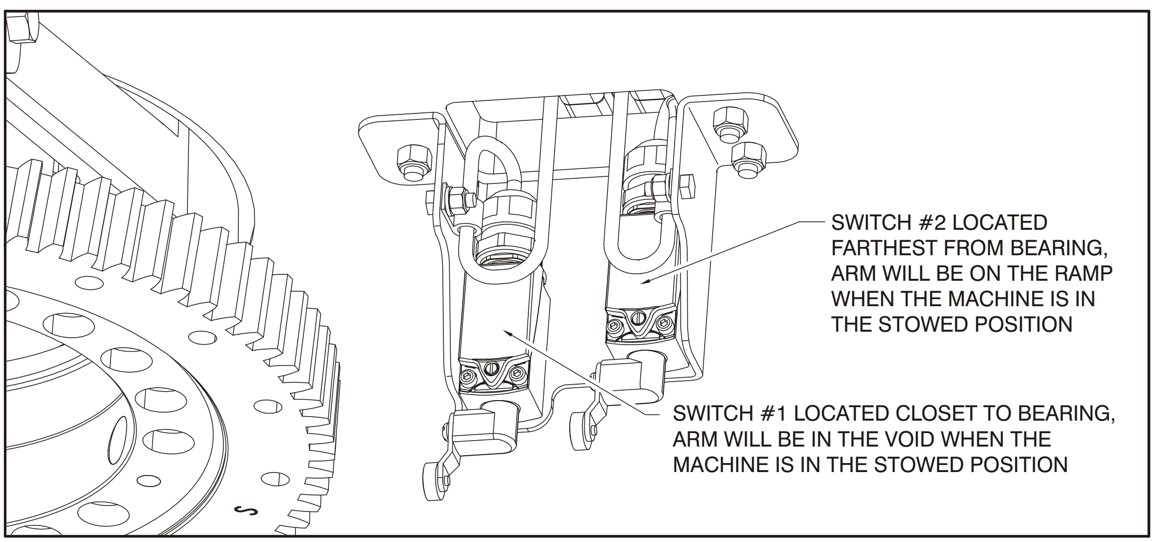


Figure 3-28. Axle Oscillation Switches

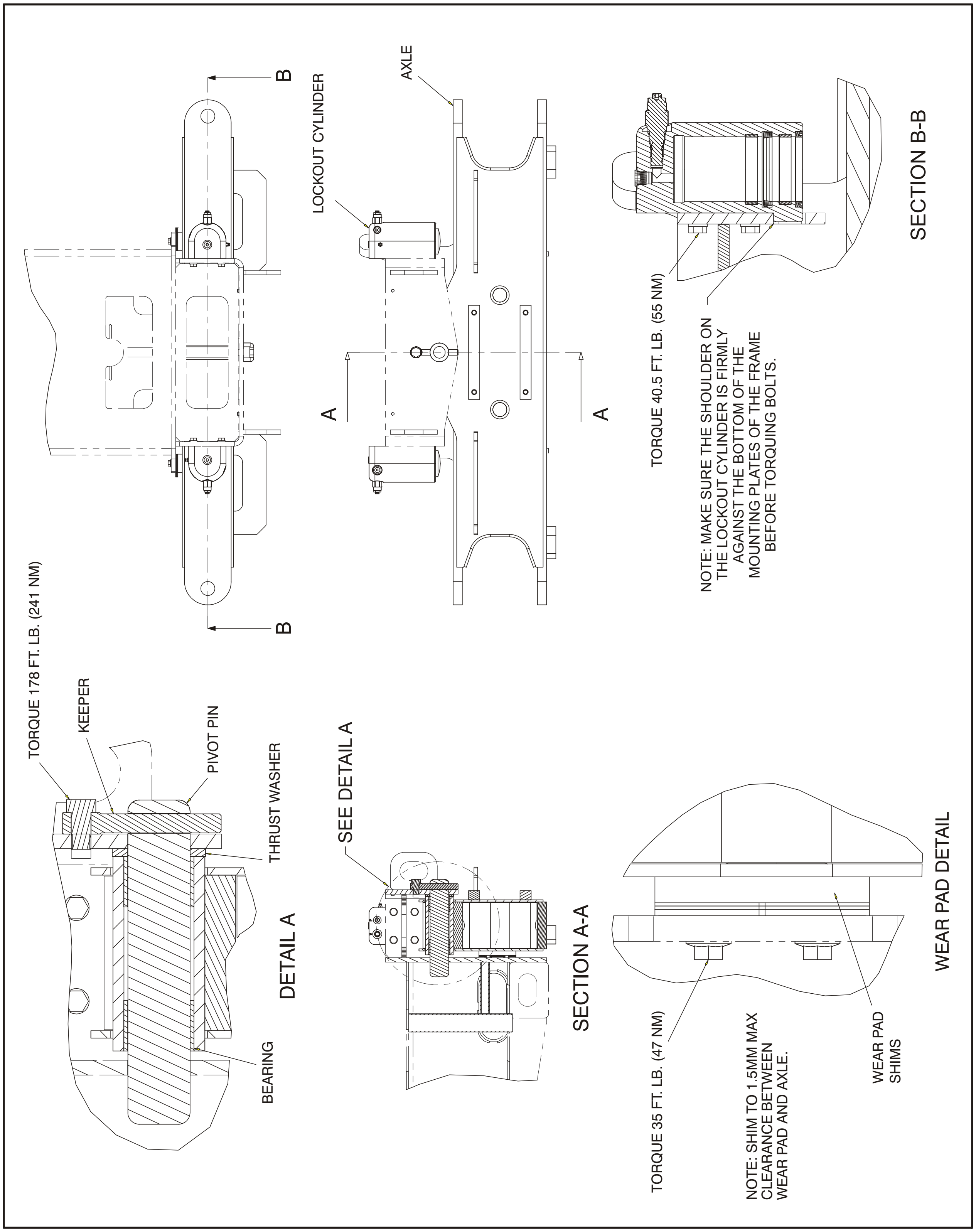


Figure 3-29. Oscillating Axle

3.9 CHASSIS TILT INDICATOR SYSTEM

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

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

The 6° angle is used only for the purpose of automatically slowing drive speed when this angle is reached and the boom is in Transport position. When the boom is in Transport Position and the chassis is at or above 6° for a period of 1 second or longer, the drive system will automatically switch into Max Torque mode. This condition will be cleared if the chassis tilt reading is less than 5 degrees for a period of 1 second or longer.

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

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

3.10 SWING MOTOR

CAUTION

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

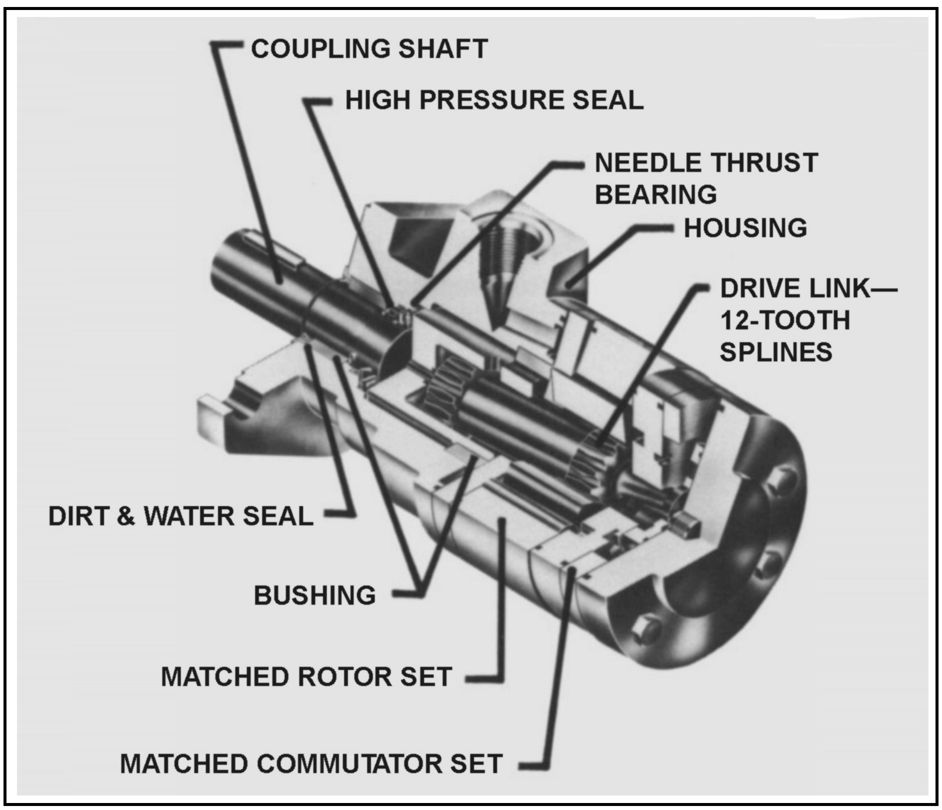


Figure 3-30. Swing Motor - Cutaway

Table 3-3. Swing Motor Troubleshooting

Trouble	Cause	Remedy
Oil Leakage	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.

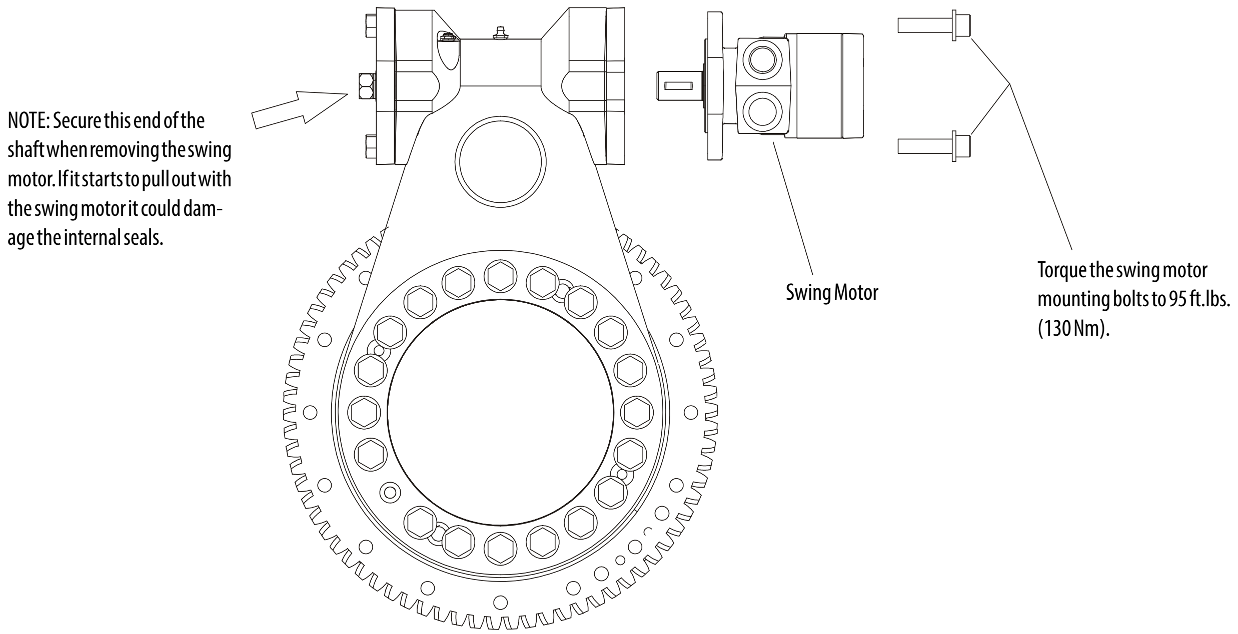


Figure 3-31. Swing Motor Removal and Installation

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.

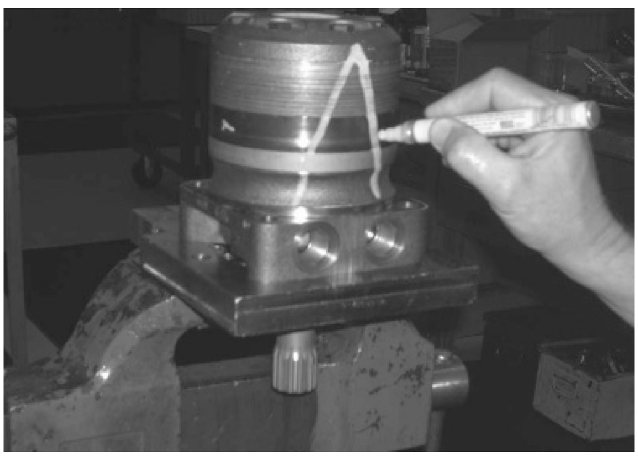
CAUTION

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

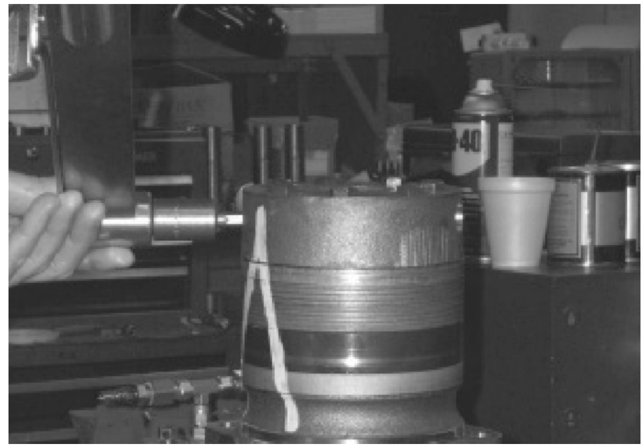
1. Place the motor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings if applicable.

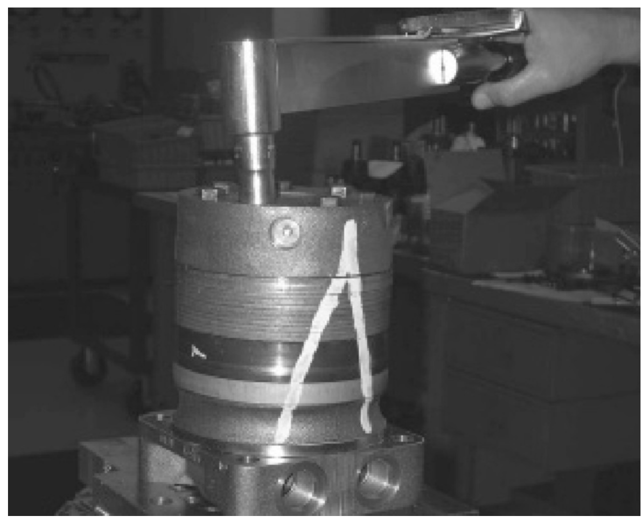


WARNING

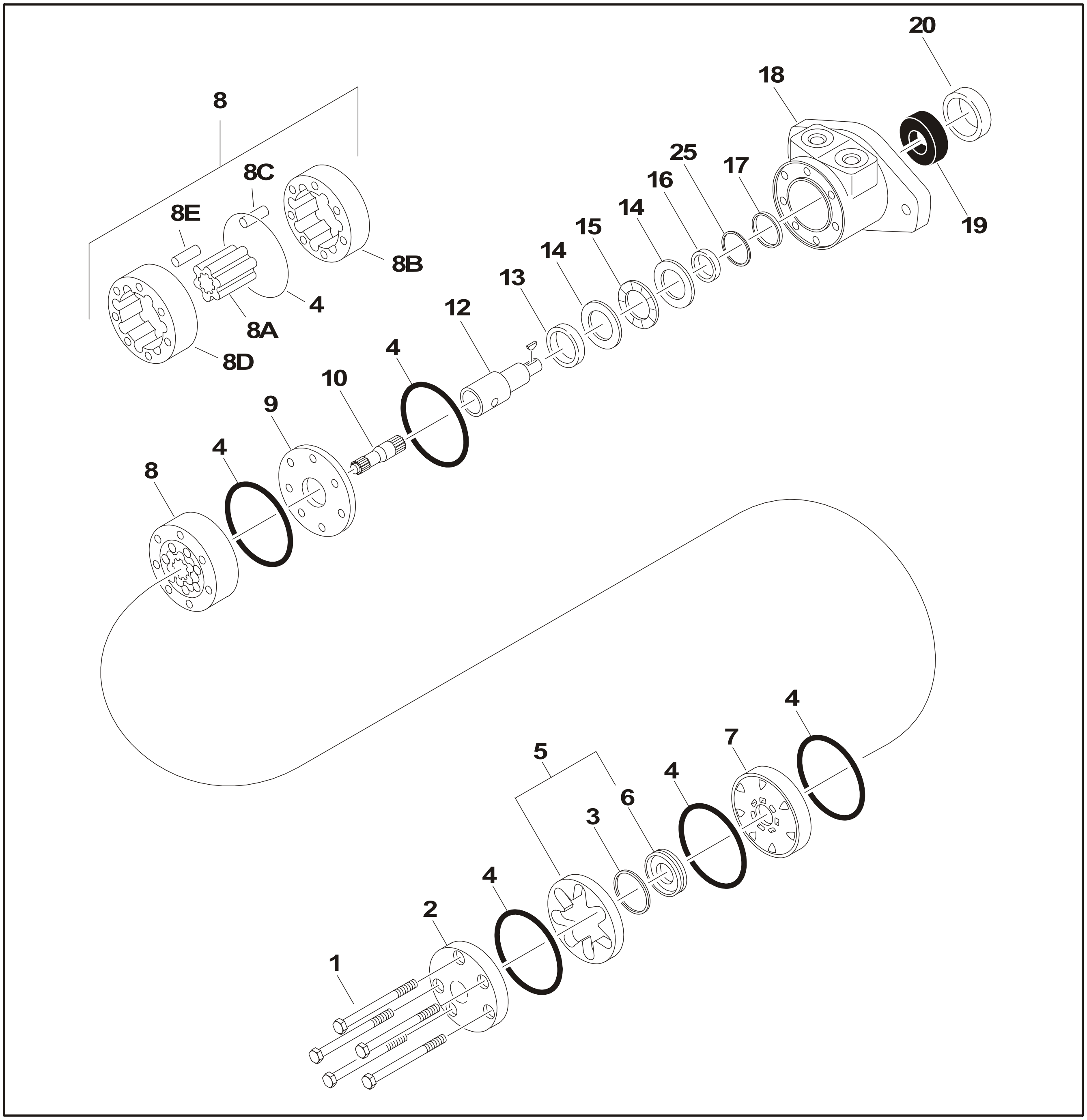
IF THE MOTOR IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

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





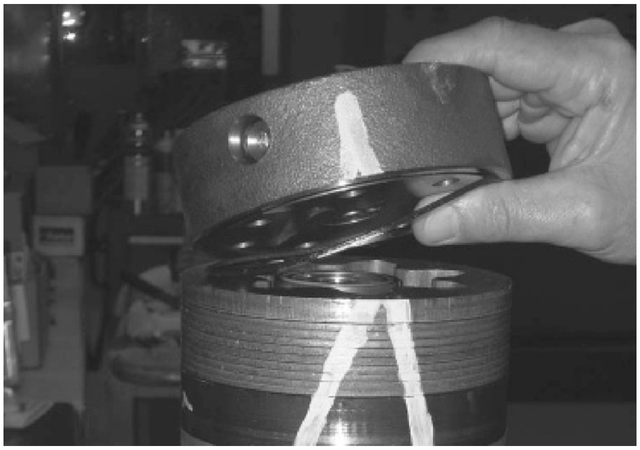
3. Remove the special ring head bolts (1) using an appropriate 1/2 or 9/16 inch size socket. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts.



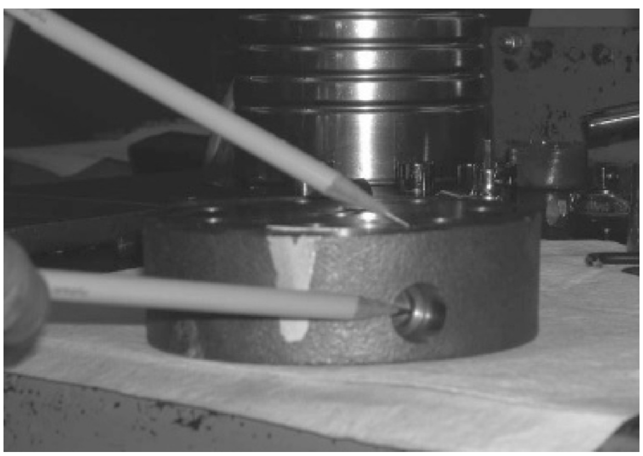
1. Bolt	6. Commutator Ring	8C. Stator Vane	12. Coupling Shaft	17. Backup Ring	22. Not Used
2. End Cover	7. Manifold	8D. Stator Half	13. Inner Bushing	18. Housing	23. Not Used
3. Seal Ring	8. Rotor Set	9. Wear Plate	14. Thrust Washer	19. Outer Bushing	24. Not Used
4. Seal Ring	8A. Rotor	10. Drive Link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

Figure 3-32. Swing Motor - Exploded View

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



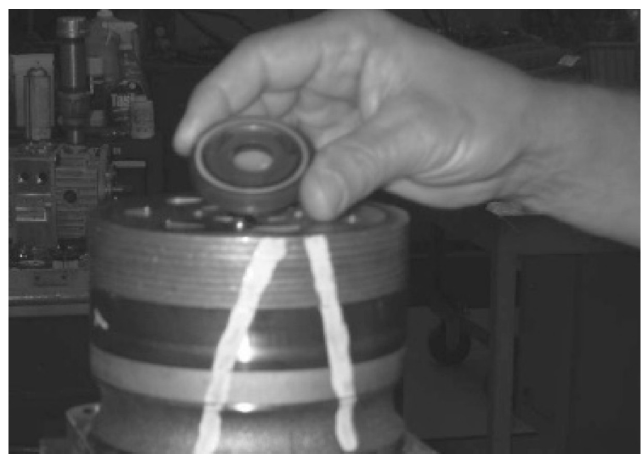
5. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary.



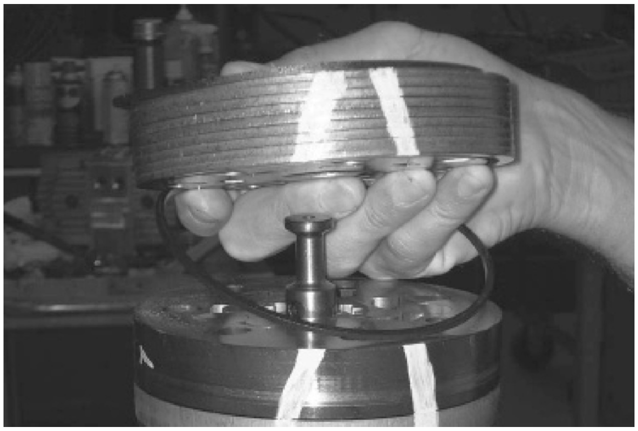
NOTE: *A polished pattern (not scratches) on the cover from rotation of the commutator (5) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, and rotor set.*

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

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



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.



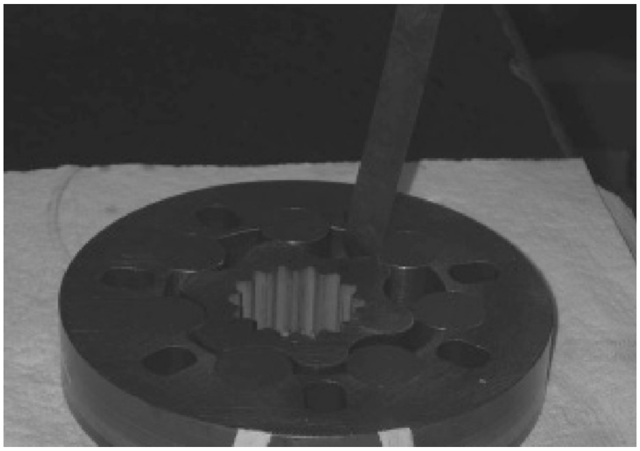
NOTE: *The manifold is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to ensure that same surface is reassembled against the rotor set.*

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.*

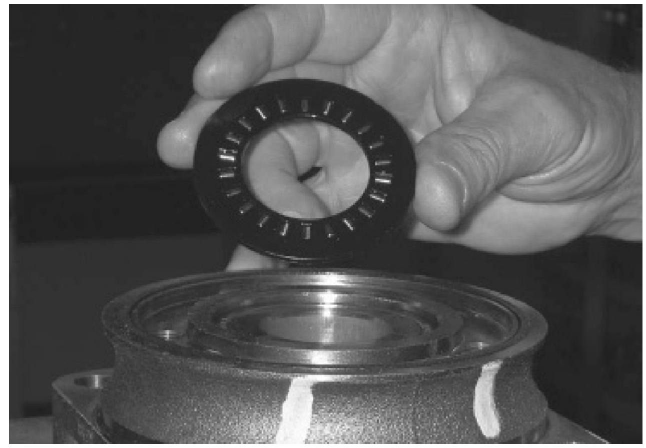
10. Place rotor set (8) and wear plate (9) on a flat surface and center rotor in stator such that two rotor lobes (180 degrees apart) and a roller vane centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is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



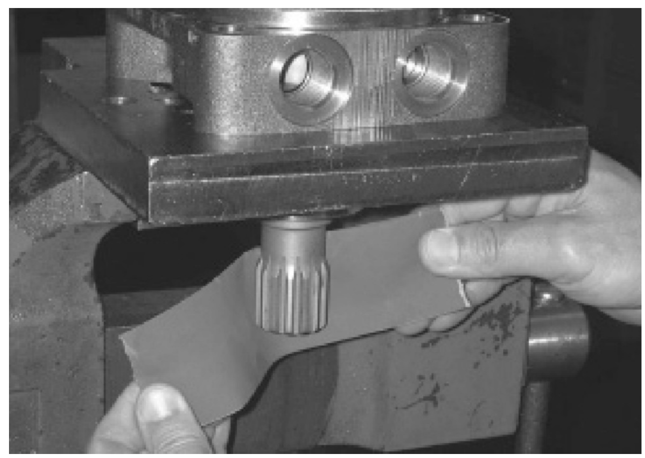
NOTE: *If rotor set (8) has two stator halves and two sets of seven vanes as shown, check the rotor lobe to roller vane clearance at both ends of rotor.*

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).

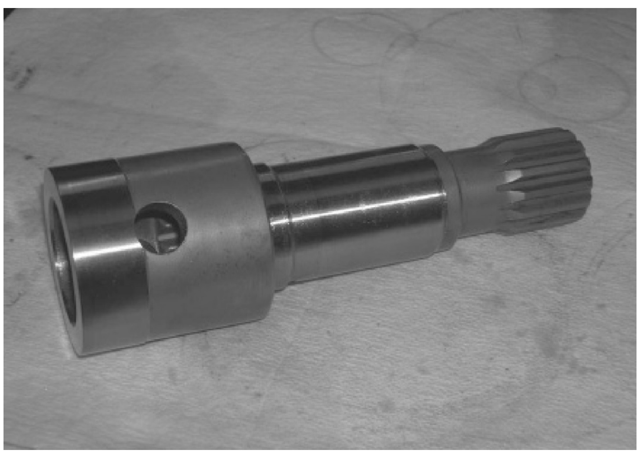
12. Remove thrust bearing (11) from top of coupling shaft (12). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.



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.*

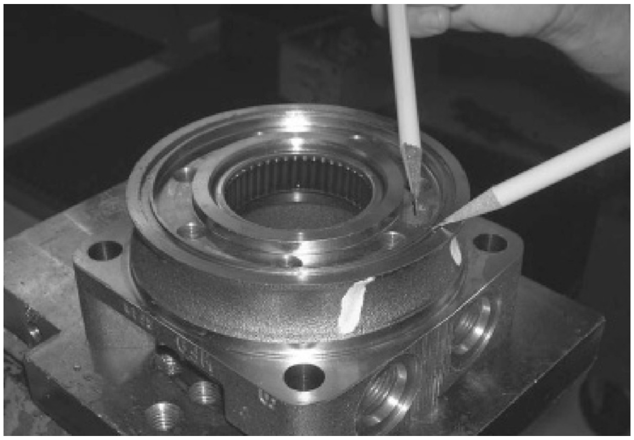
15. Remove and discard seal ring (4) from housing (18).

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

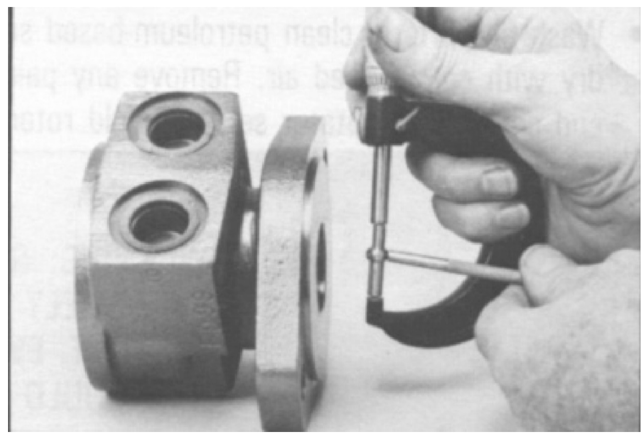
17. Remove seal (16) and back up ring (17) from housing (18) and backup washer (25). Discard both.

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

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



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



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

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

Assembly

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

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

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

⚠ WARNING

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

⚠ WARNING

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

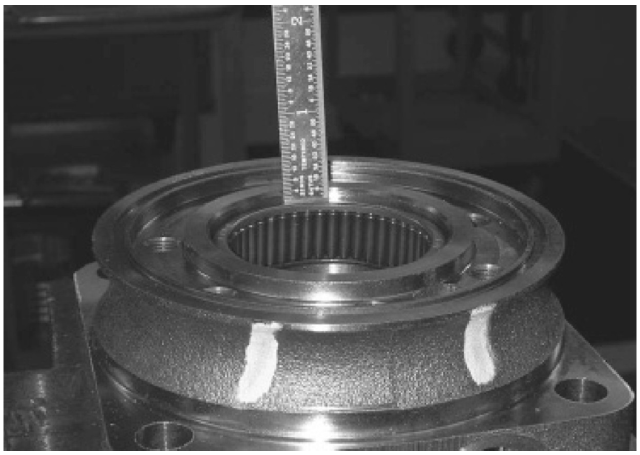
1. If the housing (18) bearing components were removed for replacement, thoroughly coat and pack a new outer bearing/bushing (19) with clean corrosion resistant grease recommended in the material section. Press the new bearing/bushing into the counterbore at the mounting flange end of the housing, using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

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

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

⚠ CAUTION

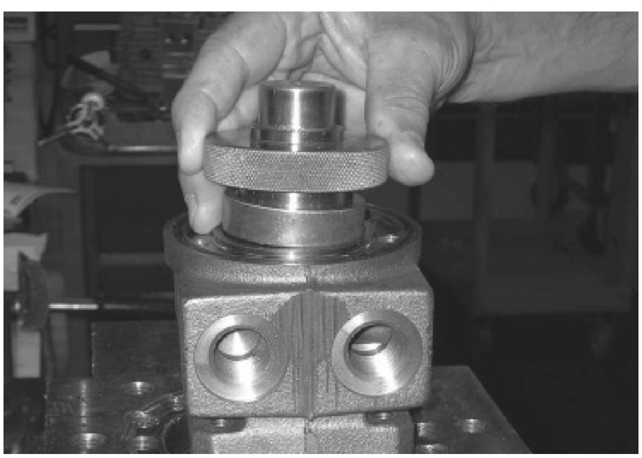
IF A BEARING MANDREL IS NOT AVAILABLE AND ALTERNATE METHODS ARE USED TO PRESS IN BEARING/BUSHING (13) AND (19) THE BEARING/BUSHING DEPTHS SPECIFIED MUST BE ACHIEVED TO INSURE ADEQUATE BEARING SUPPORT AND CORRECT RELATIONSHIP TO ADJACENT COMPONENTS WHEN ASSEMBLED.



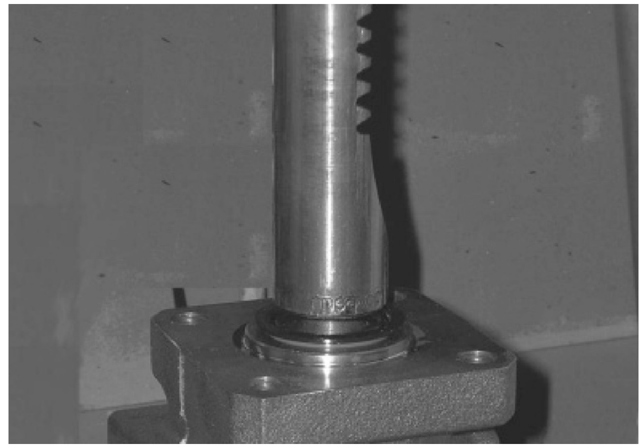
⚠ CAUTION

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

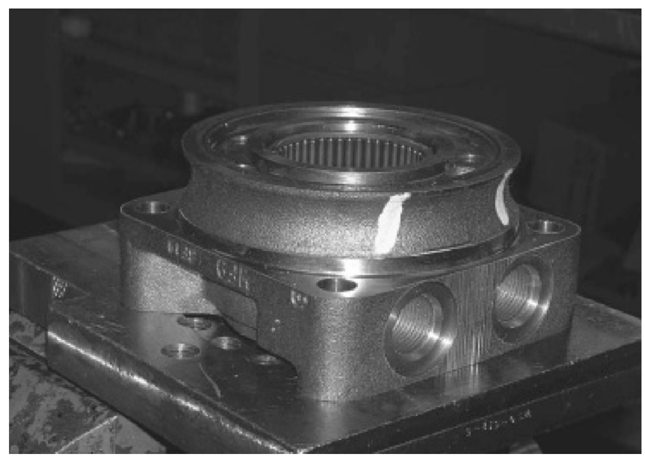
2. The inner housing bearing/bushing (13) can now be pressed into its counter-bore in housing (18) flush to 0.03 inch (0.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19).



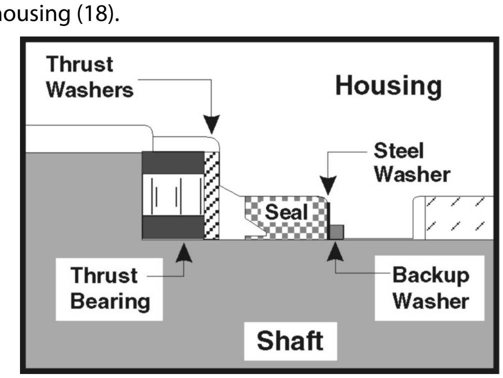
3. Press a new dirt and water seal (20) into the housing (18) outer bearing counterbore. The dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



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



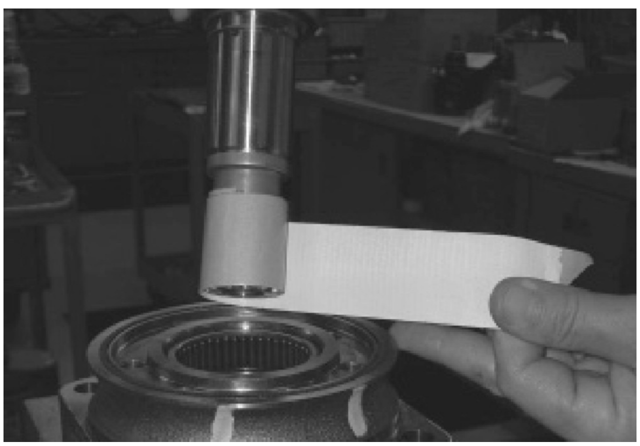
5. Assemble a new backup ring (17), new backup washer (25) and new seal (16) with the seal lip facing toward the inside of the motor, into their respective counterbores in housing (18).



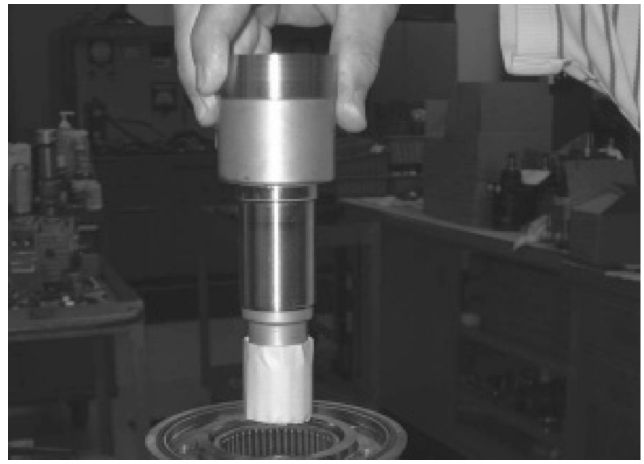
6. Assemble thrust washer (14) then thrust bearing (15) that was removed from the motor.

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.



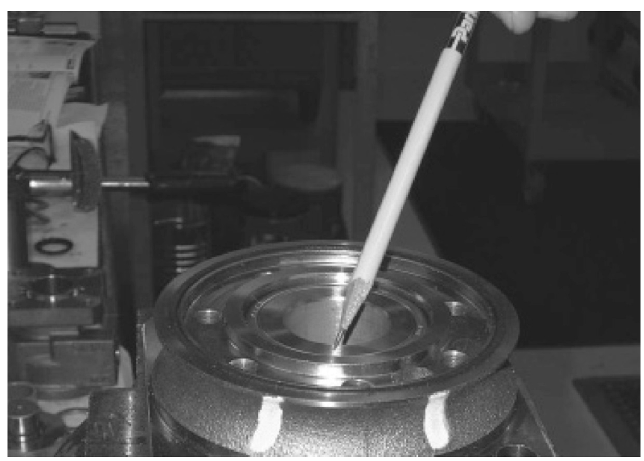
8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12) into housing (18), seating it against the thrust bearing (15).



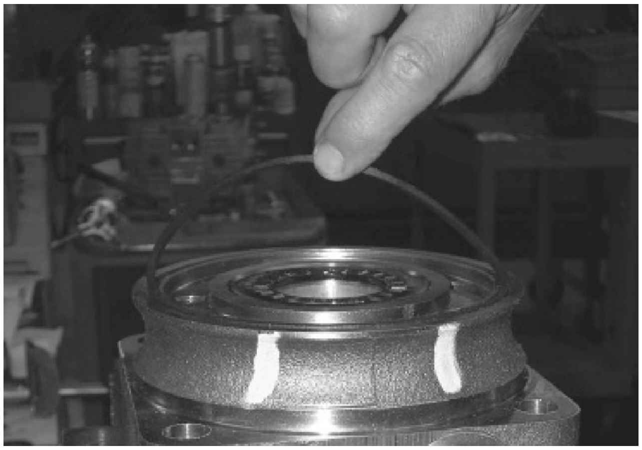
CAUTION

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.*

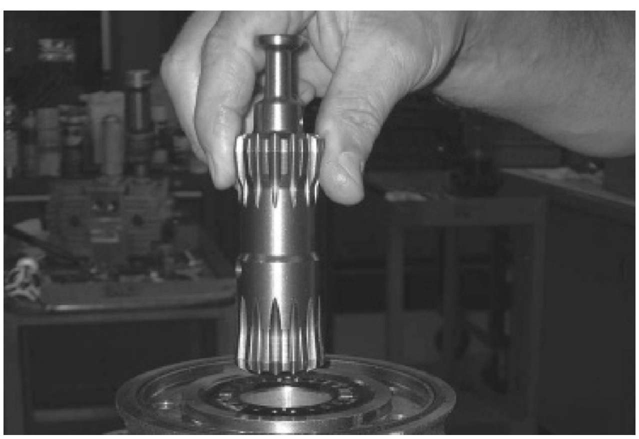


9. Apply a small amount of clean grease to a new seal ring (4) and insert it into the housing (18) seal ring groove.



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.*

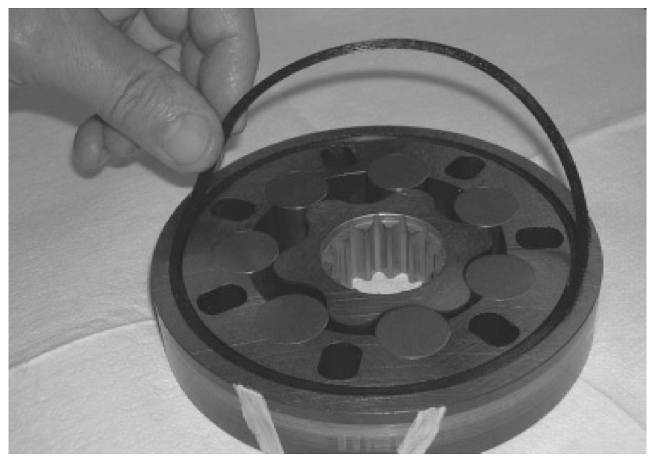
10. Install drive link (10) the long splined end down into the coupling shaft (12) and engage the drive link splines into mesh with the coupling shaft splines.



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.



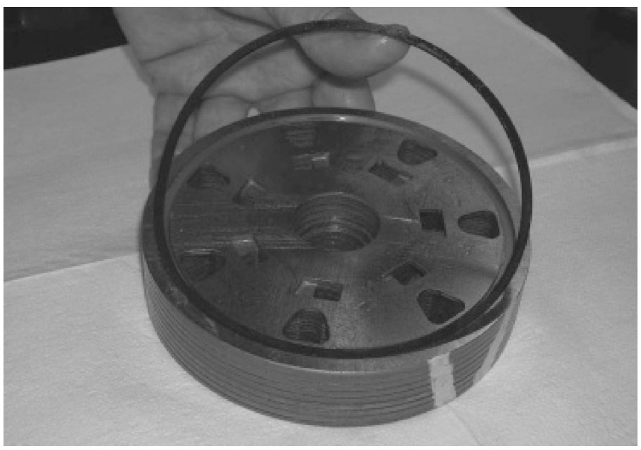
13. Install the assembled rotor set (8) onto wear plate (9) with rotor counterbore and seal ring side down and the splines into mesh with the drive link splines.

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).

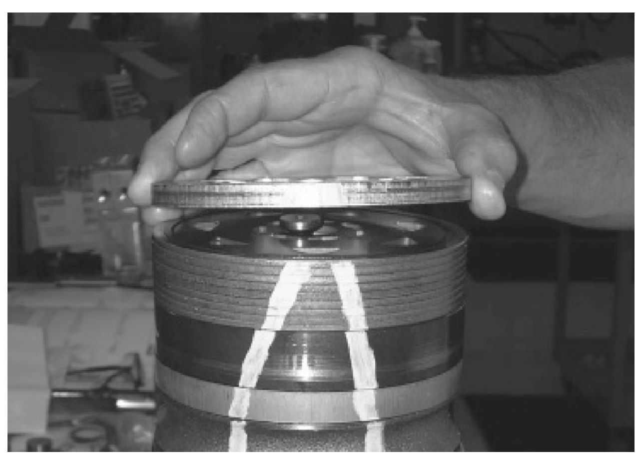


NOTE: *The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression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

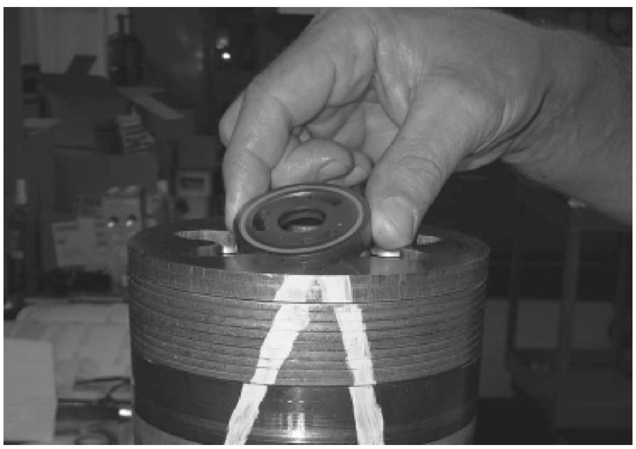
15. Assemble the manifold (7) over the alignment studs and drive link (10) and onto the rotor set. Be sure the correct manifold surface is against the rotor set.

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

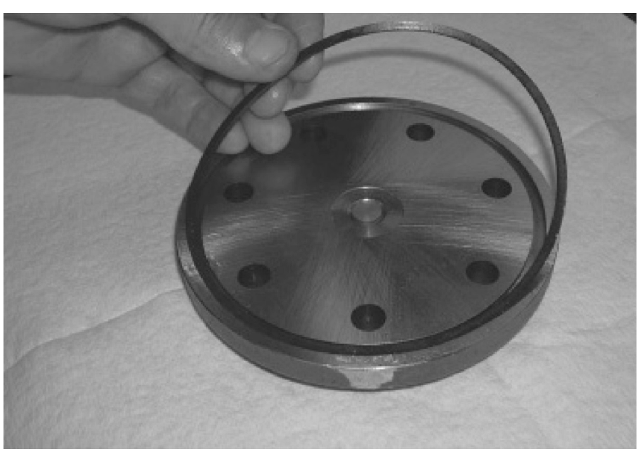
17. Assemble the commutator ring (6) over alignment studs onto the manifold.

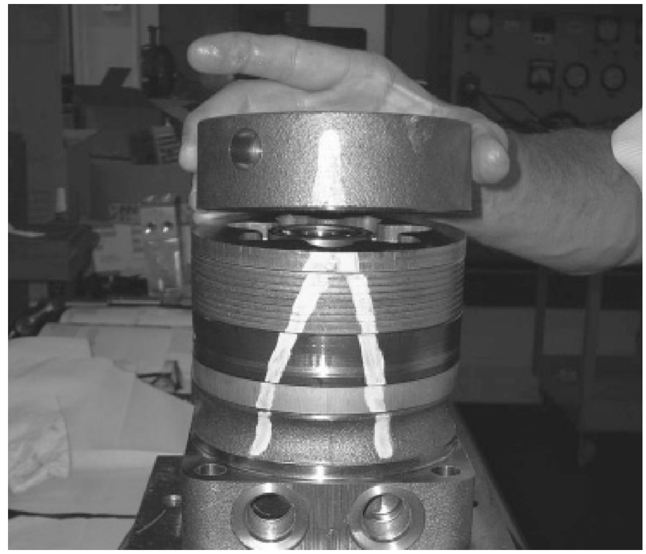


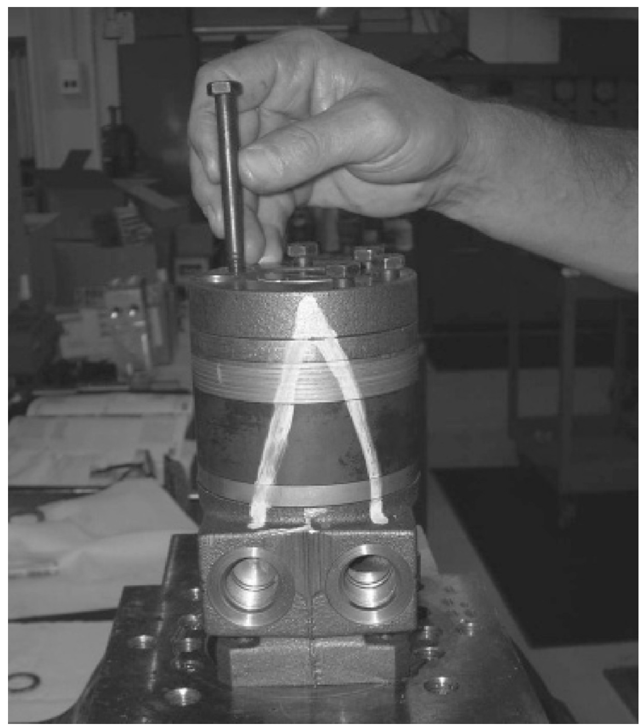
18. Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.



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.

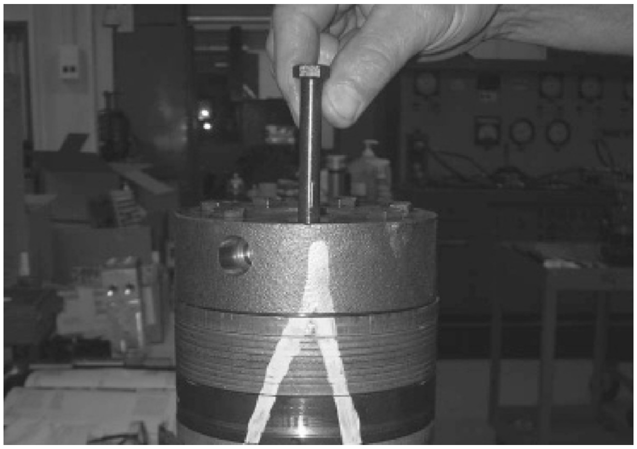


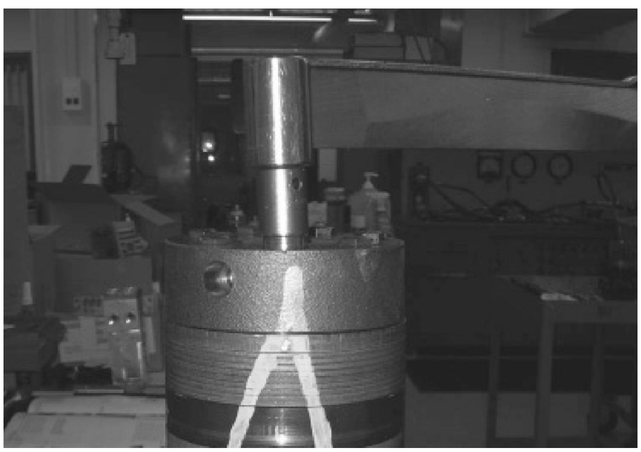


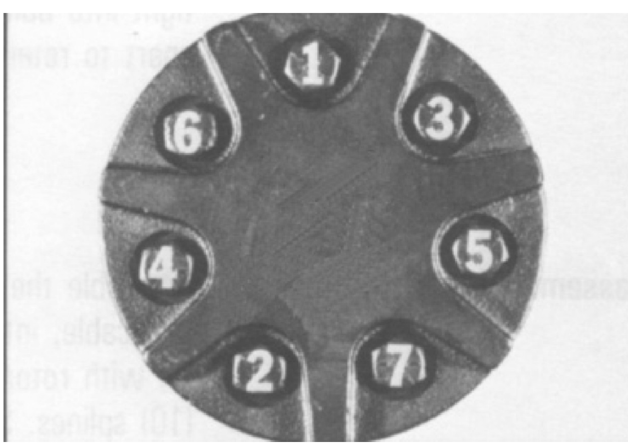


NOTE: *If the end cover has a valve (24) or has five bolt holes, use the line you previously scribed on the cover to radially align the end cover into its original position.*

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 counter clockwise coupling shaft rotation.

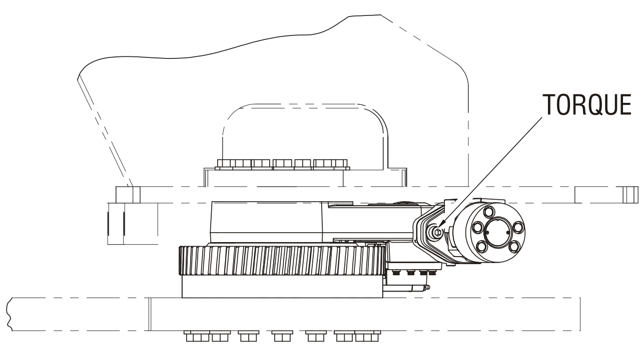
4. Use test stand if available, to check operation of the motor.

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 threadlocker JLG P/N 0100019 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.

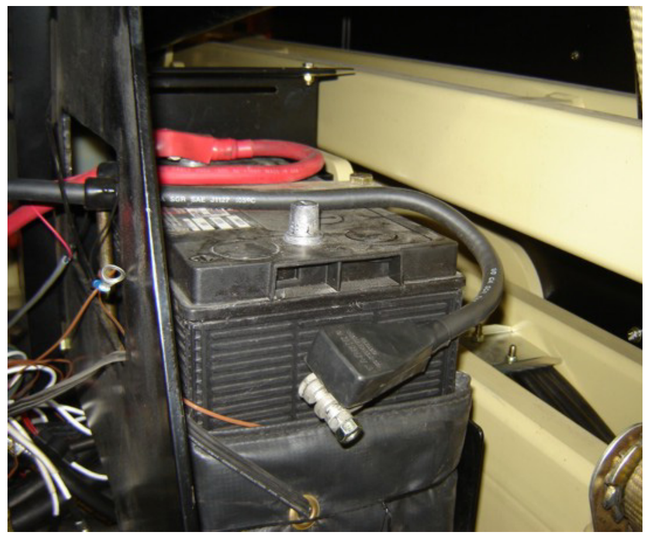
3.11 SWING DRIVE

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.

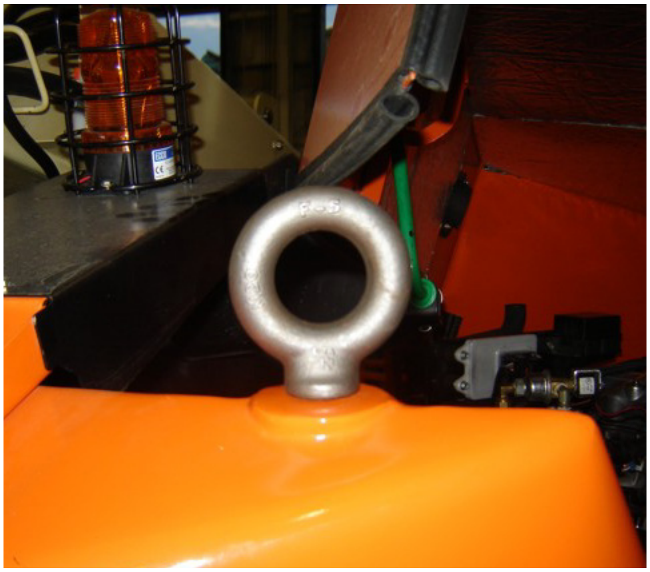
2. Disconnect the negative terminal on the battery.



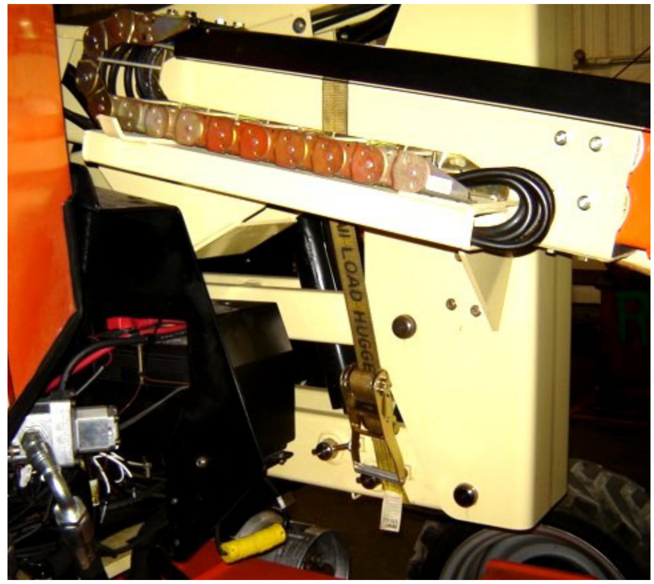
NOTICE

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 LBS. (3175 KG).

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

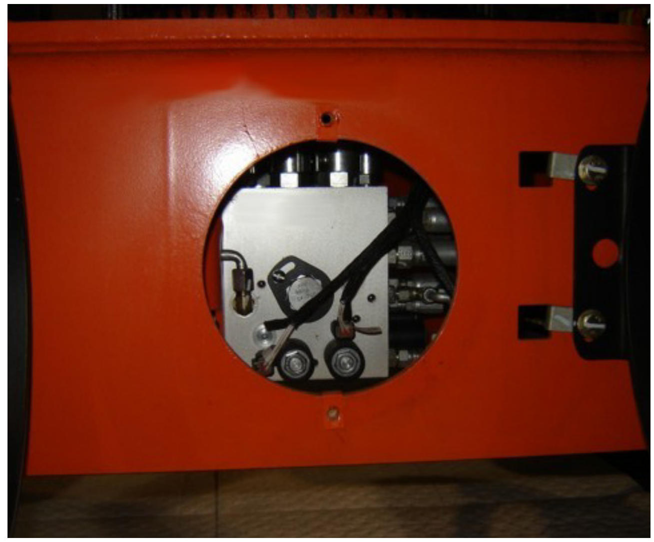


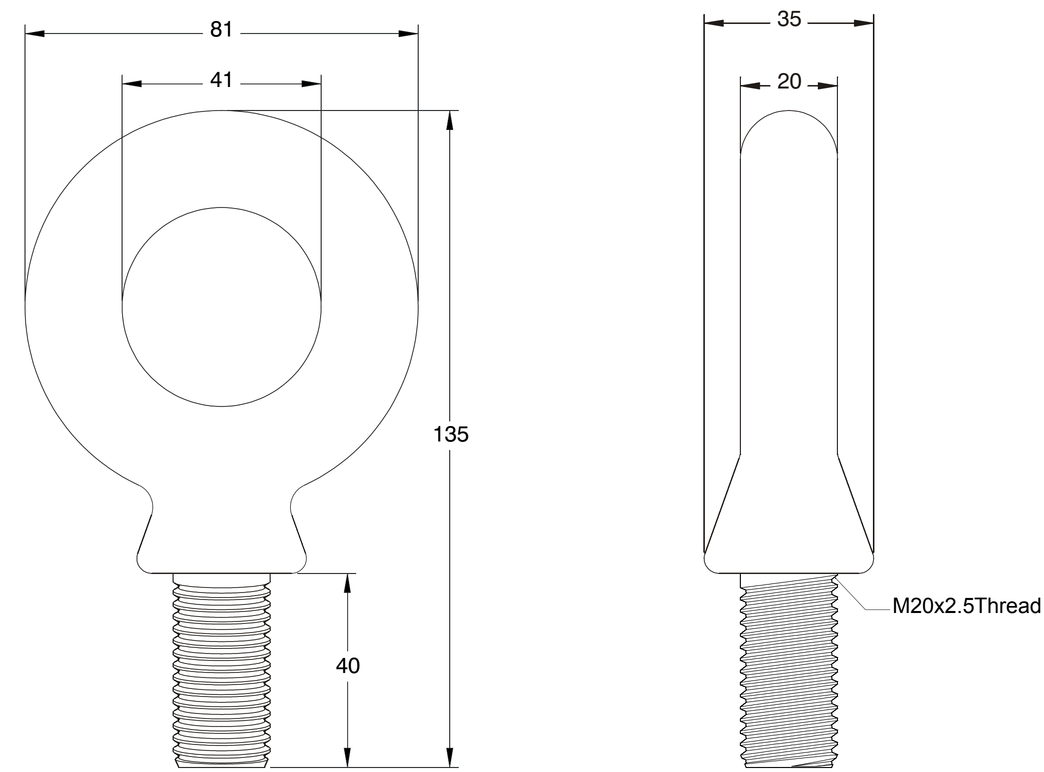
4. Securely strap the booms together to prevent any movement during the lifting process.



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.

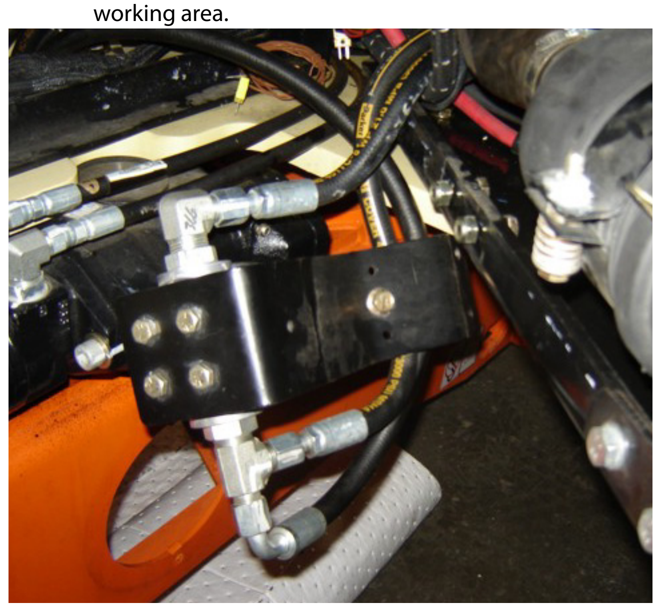




NOTE: *All measurements shown are in mm.*

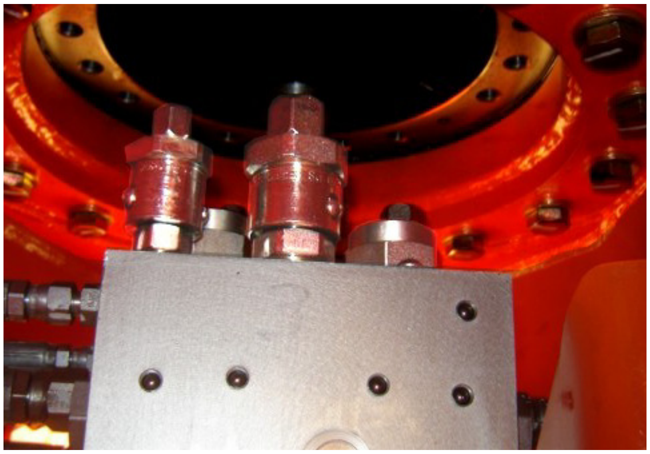
Figure 3-33. Eyebolt for Counterweight

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

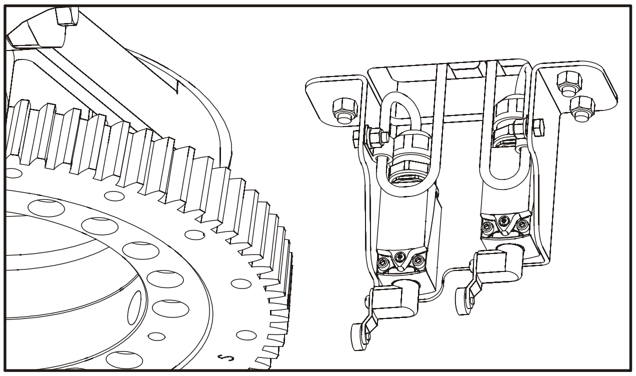


8. Loosen and remove all but a few of the bolts securing the turntable to the swing bearing.

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.

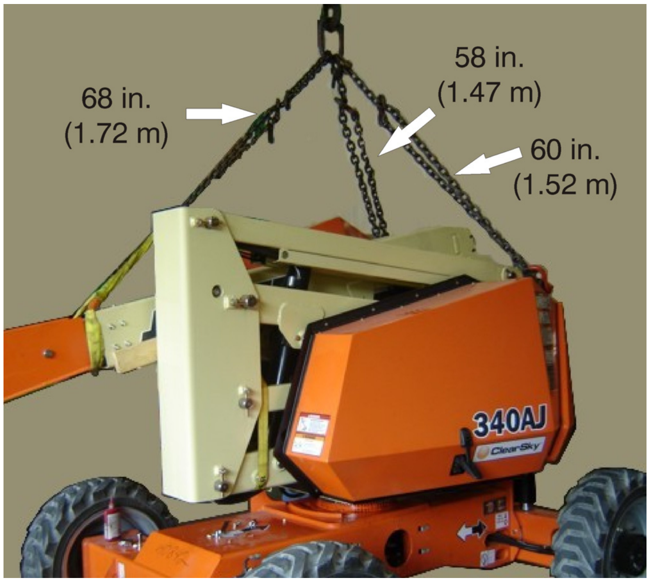


10. Remove the drive orientation and lockout switches so they don't get broken during the removal procedure.



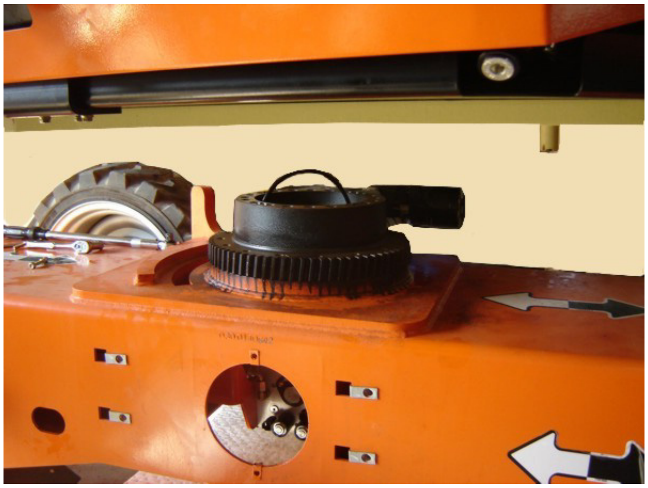
11. Swing the engine tray back into position and secure it in place with the retaining bolt.

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 lbs. (56.6 kg).*

16. Remove the bearing assembly from the frame.

Installation

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

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

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

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

Turntable Bearing Mounting Bolt Condition Check

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

Check the frame to bearing. Attach bolts as follows:

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

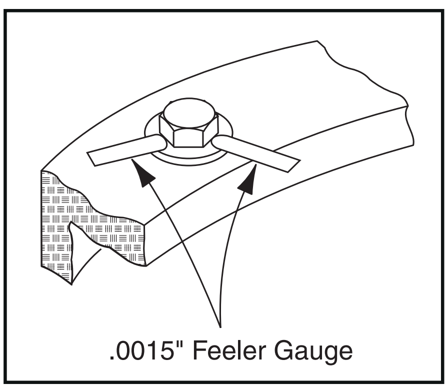


Figure 3-34. Swing Bearing Feeler Gauge Check

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

Wear Tolerance

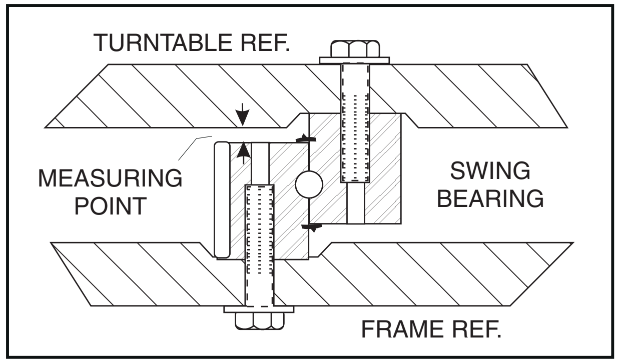


Figure 3-35. Swing Bearing Tolerance Measuring Point

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

Swing Bearing Torque Value

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

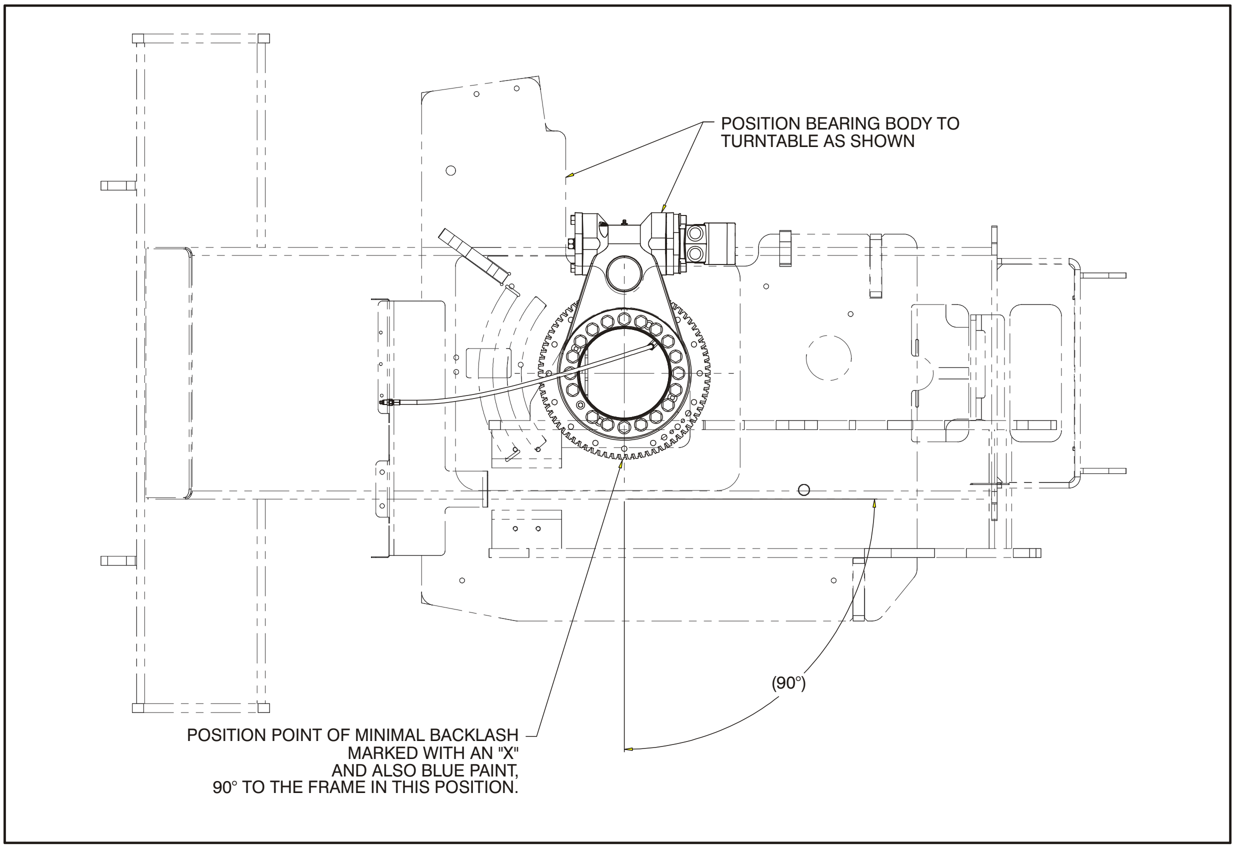


Figure 3-36. Bearing Placement

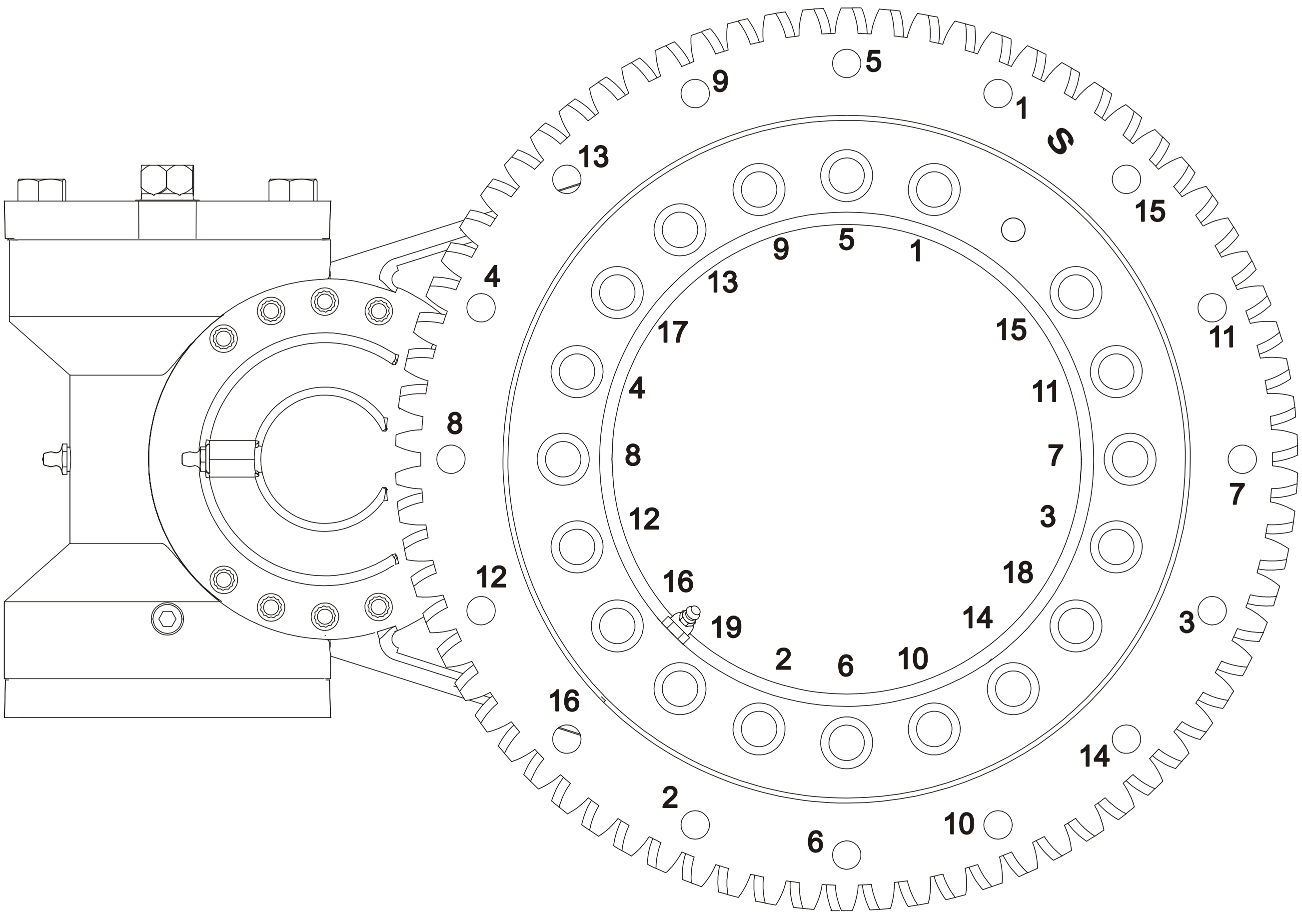
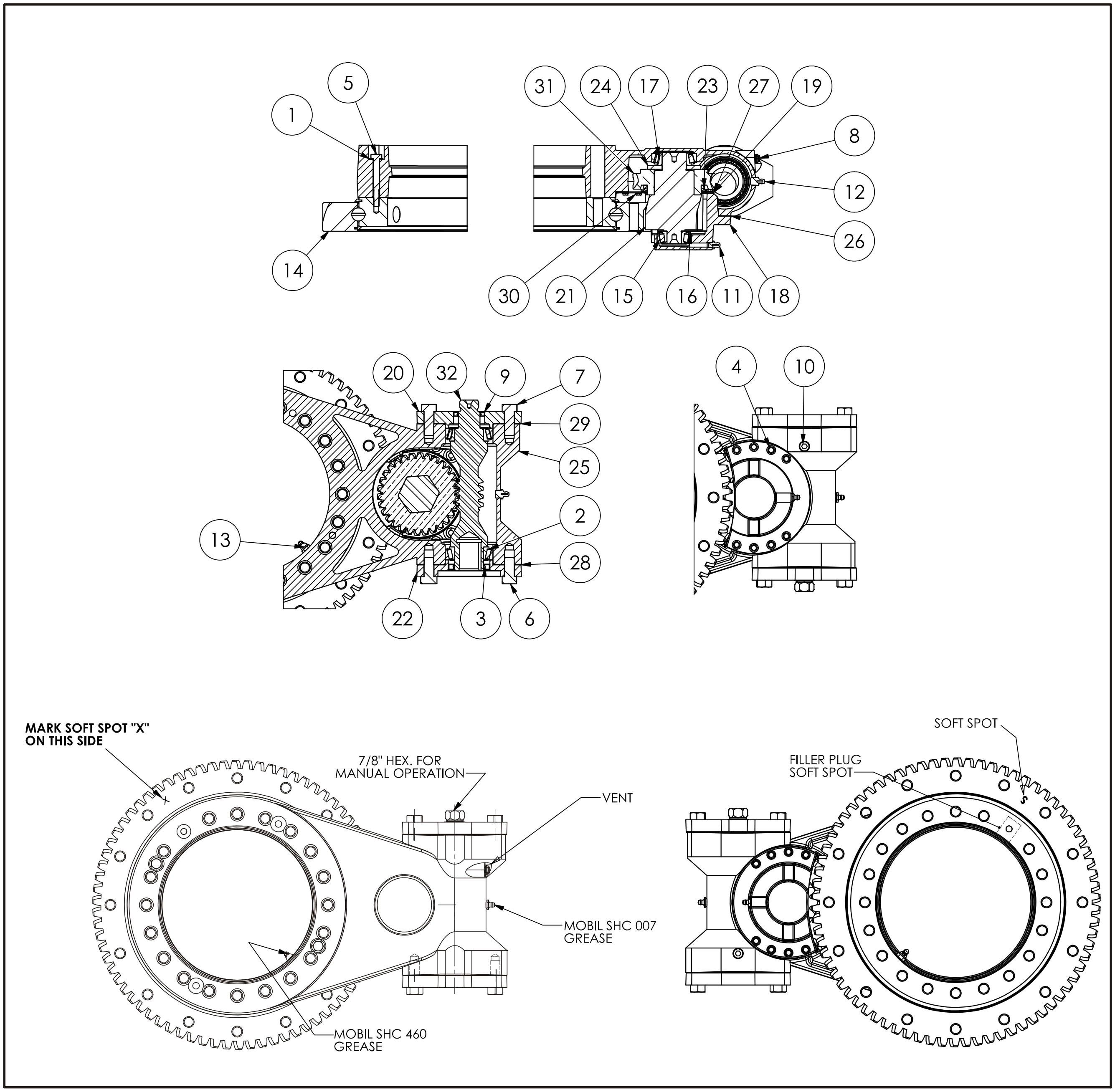


Figure 3-37. Swing Bearing Torque Sequence

Disassembly

The servicing of these units requires a press, a 5/16" 12 point socket, a 7/16" socket, a 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, LocTite #515, Mobil SHC 007 grease, Mobil SHC 460 grease, LocTite 242/243 for bolts, and any replacement parts.

1. Remove the swing bearing assembly from the machine.
2. To remove the slew ring (14), remove two 1/4" (5) bolts and washers (1) that hold the slew ring to the housing.
3. Remove four #6 machine screws (13) that are located on the cover plate (19) immediately in front of the Pinion (21).
4. Remove eight 5/16" 12 point cap screws (4) from gear/ pinion cap (18). Pry cap from housing. Cover plate (19) will come off with cap. Note where sealant is on Cover and plate so when assembling can put sealant in same place. Note number and color of shims (26) between cap and housing. Remove 6 small screws (13) from cover plate. Pry cover plate (19) from cap (18) and discard cover plate. Note number and color of shims between cover plate and cap.
5. Remove Pinion and Gear assembly (15, 16, 17, 21, 23, 24, and 31) from housing. These lift directly upward from the housing.
6. Disassemble pinion and gear assembly using a press. Support worm gear (31) on press with pinion (21) down allowing room for pinion to be pressed out of gear. Press pinion out of bearing (17) spacer (24) and worm gear (31) Pressing on end of pinion. Remove face seal (23) from face of worm gear (31). Note how the seal is assembled.



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

Figure 3-38. Swing Gear Assembly

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 (LocTite #515) to both sides of each of these shims and tighten screws take care not to twist these screws off. Clean extra sealant from surfaces of cover plate. Apply a small amount of grease to this flap. Set this assembly to the side.

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 LocTite 242 to end of ¾-13 x 1.25" grade 5 bolts (7) and LocTite #515 sealant to shims. Torque bolts to 75 ft-lbs. (3.1 Nm).

12. Place pinion/gear assembly into housing so gear teeth mesh with worm gear teeth. May have to turn worm or gear set by hand to achieve this.

13. Apply LocTite #515 to surfaces of housing where cap assembly will touch. This includes the vertical surfaces.

14. Place gear cap assembly and shims set aside in step 6, over pinion assembly.

15. Apply LocTite 242 to end of eight 5/16" 12 point screws (4) and torque to 20 ft-lbs. (0.84 Nm)

16. Install 4 small screws (30) through cover plate (18) and into housing (25) tighten screws take care not the twist these screws off.

17. Install seal (9) in worm cap at hex end of worm.

18. Install slew ring (14) using two 1/4" bolts (5) and washer (1). Adjust backlash with pinion to 0.008/0.012" (0.203/ 0.305 mm) and torque bolts to 10 ft-lbs. (0.42 Nm).

19. Fill unit with SHC 007 grease and grease pinion bearing (15) thru fitting (11) with Mobil SHC 460 grease.

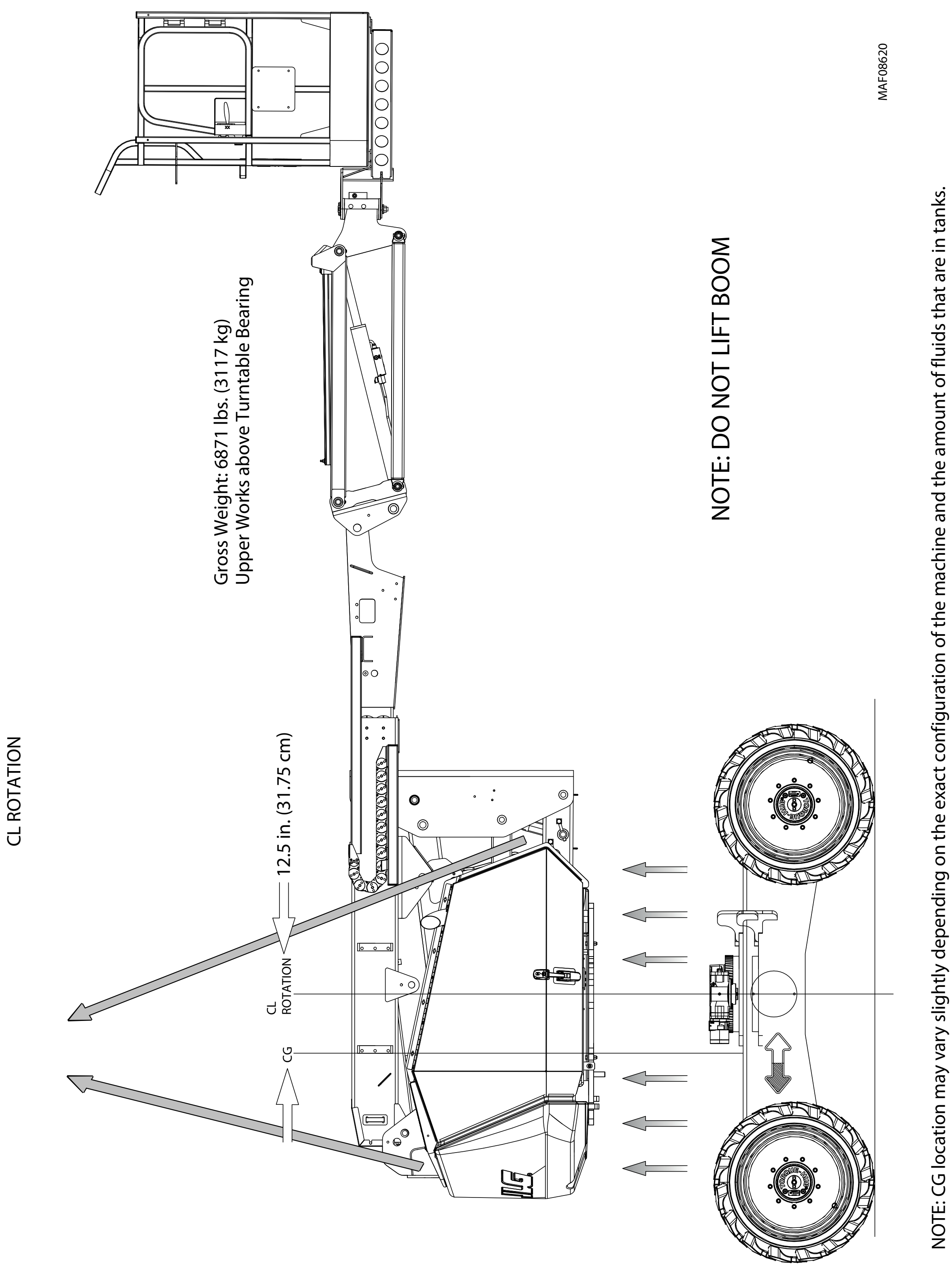
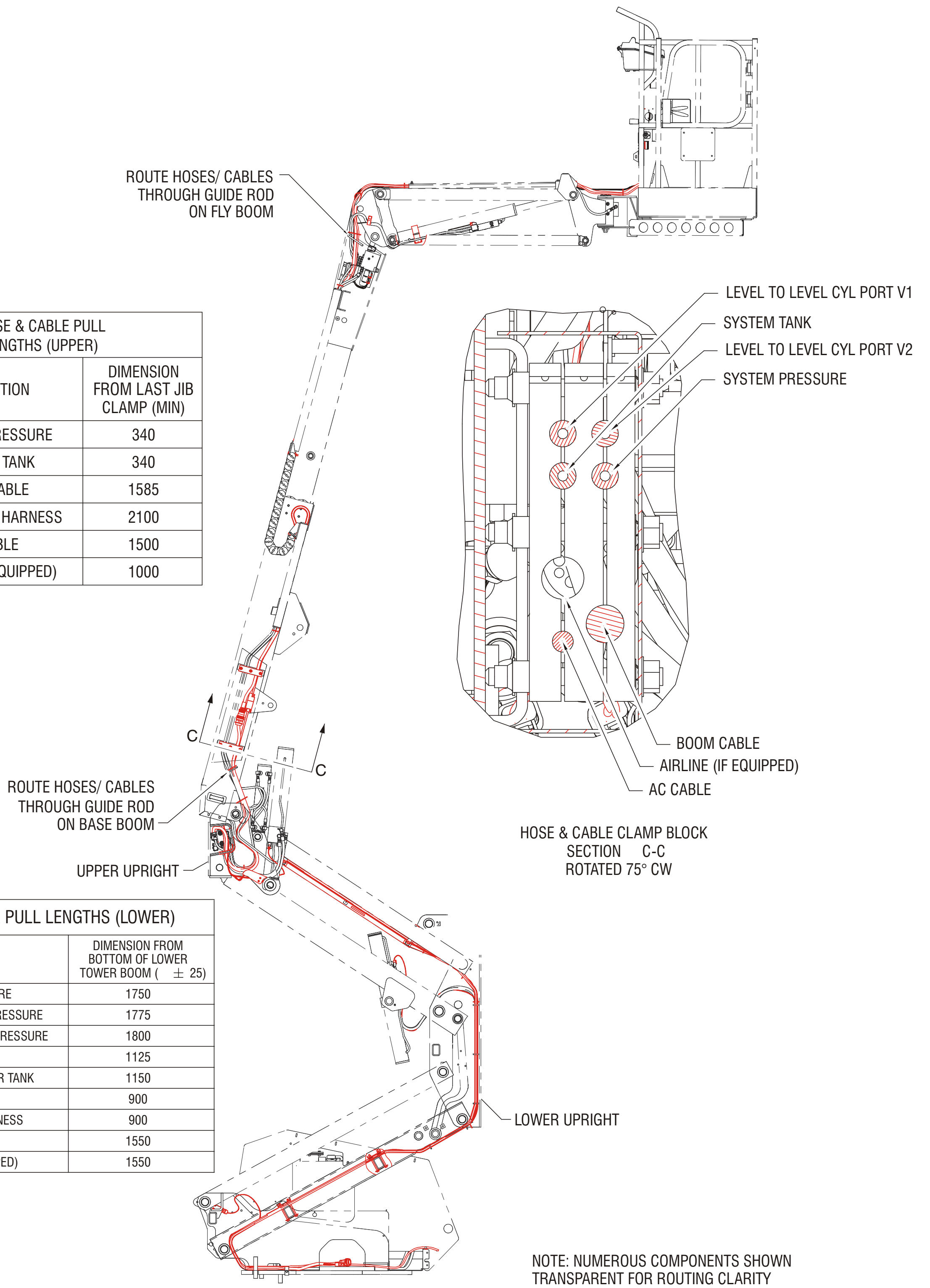


Figure 3-39. Swing Bearing Removal

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

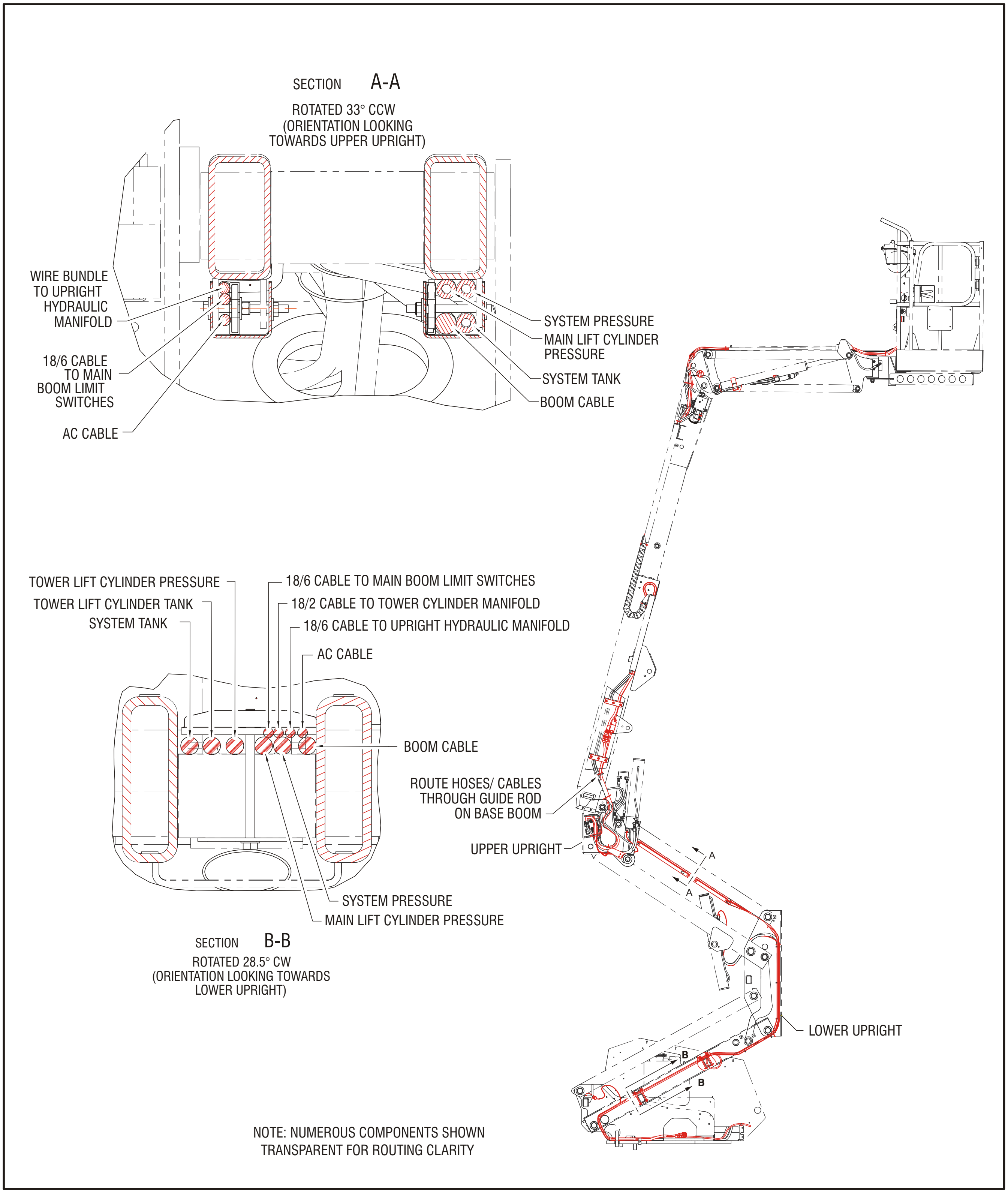


Figure 3-41. Cable Installation and Identification - Sheet 2 of 8

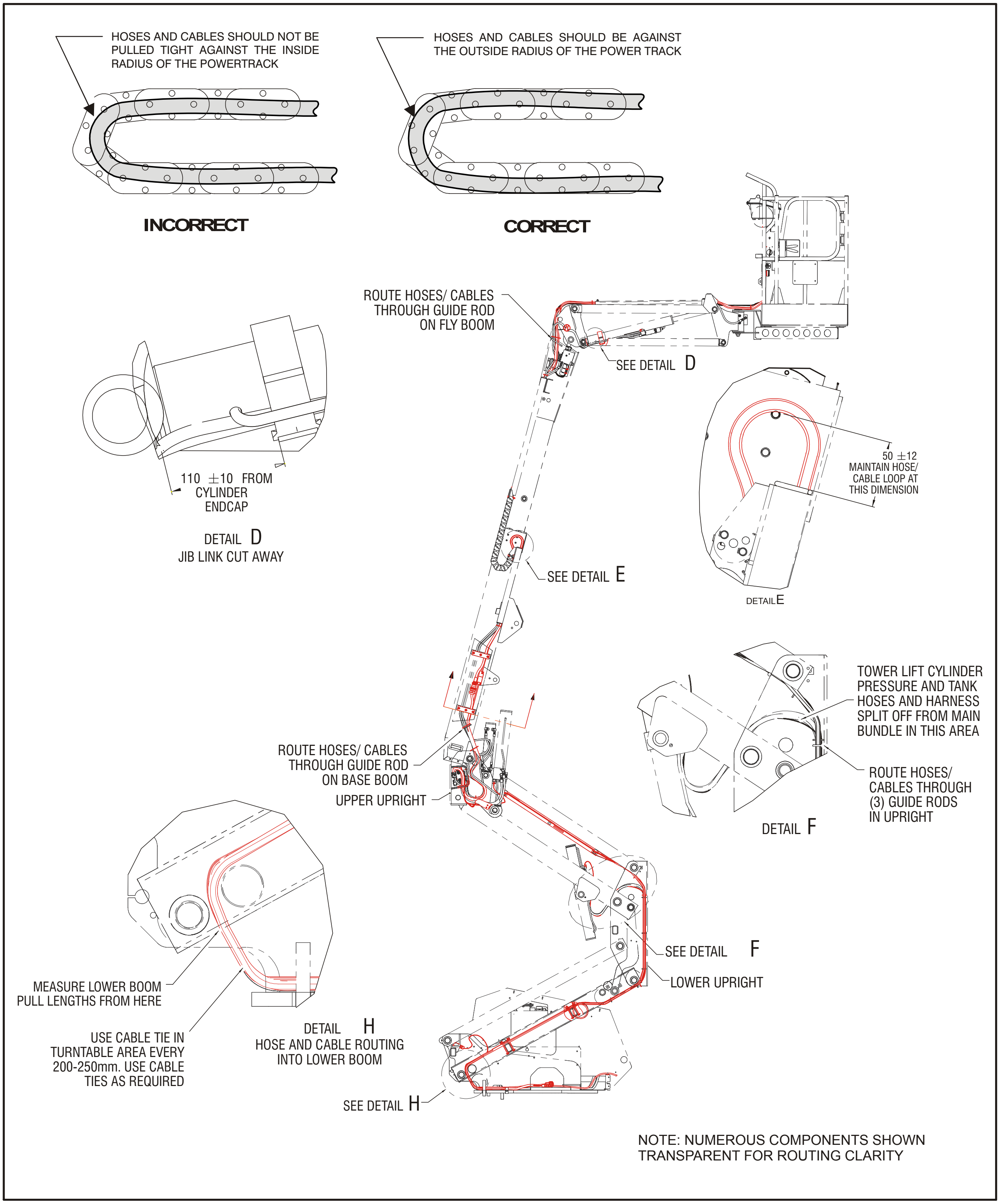
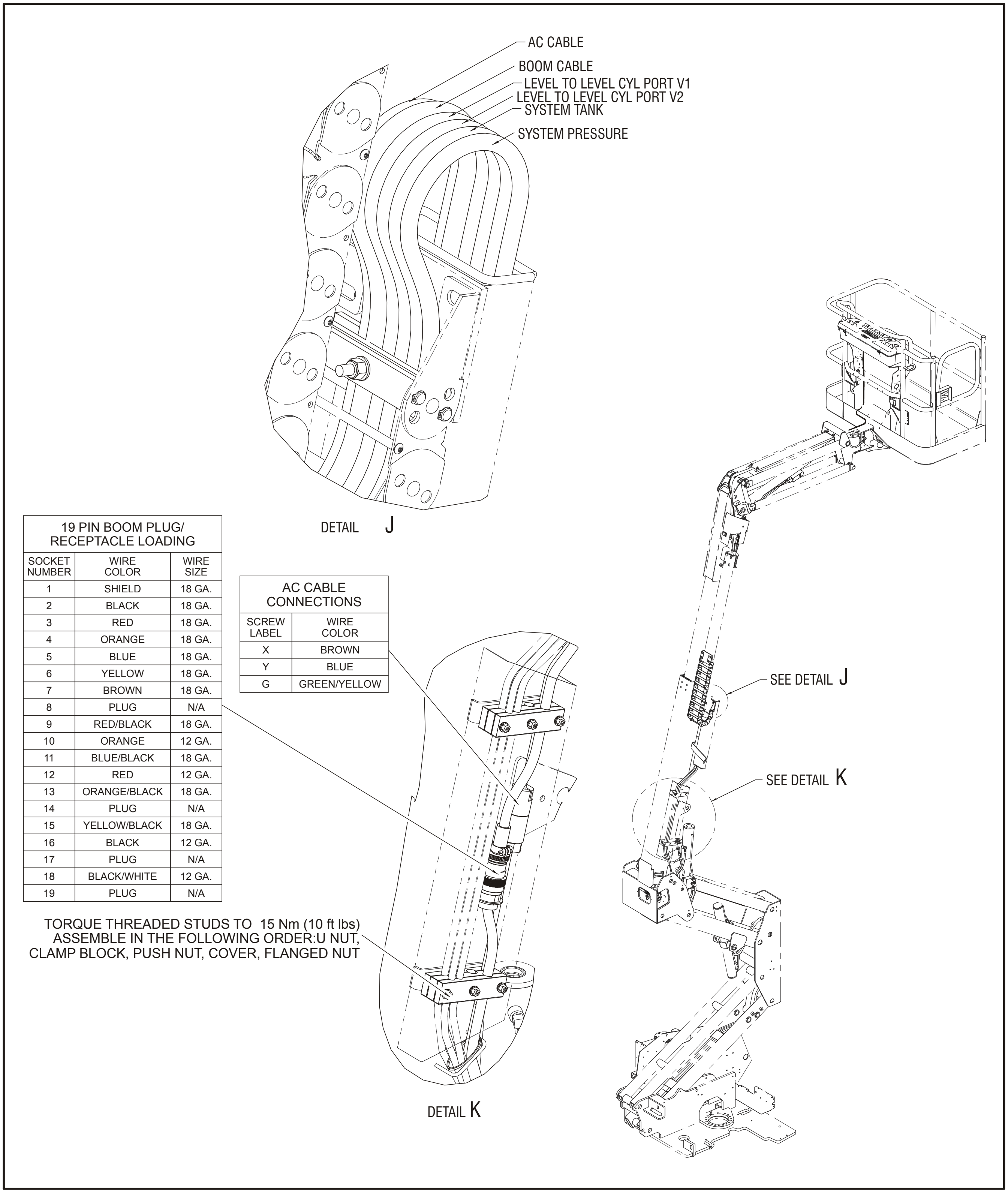


Figure 3-42. Cable Installation and Identification - Sheet 3 of 8



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

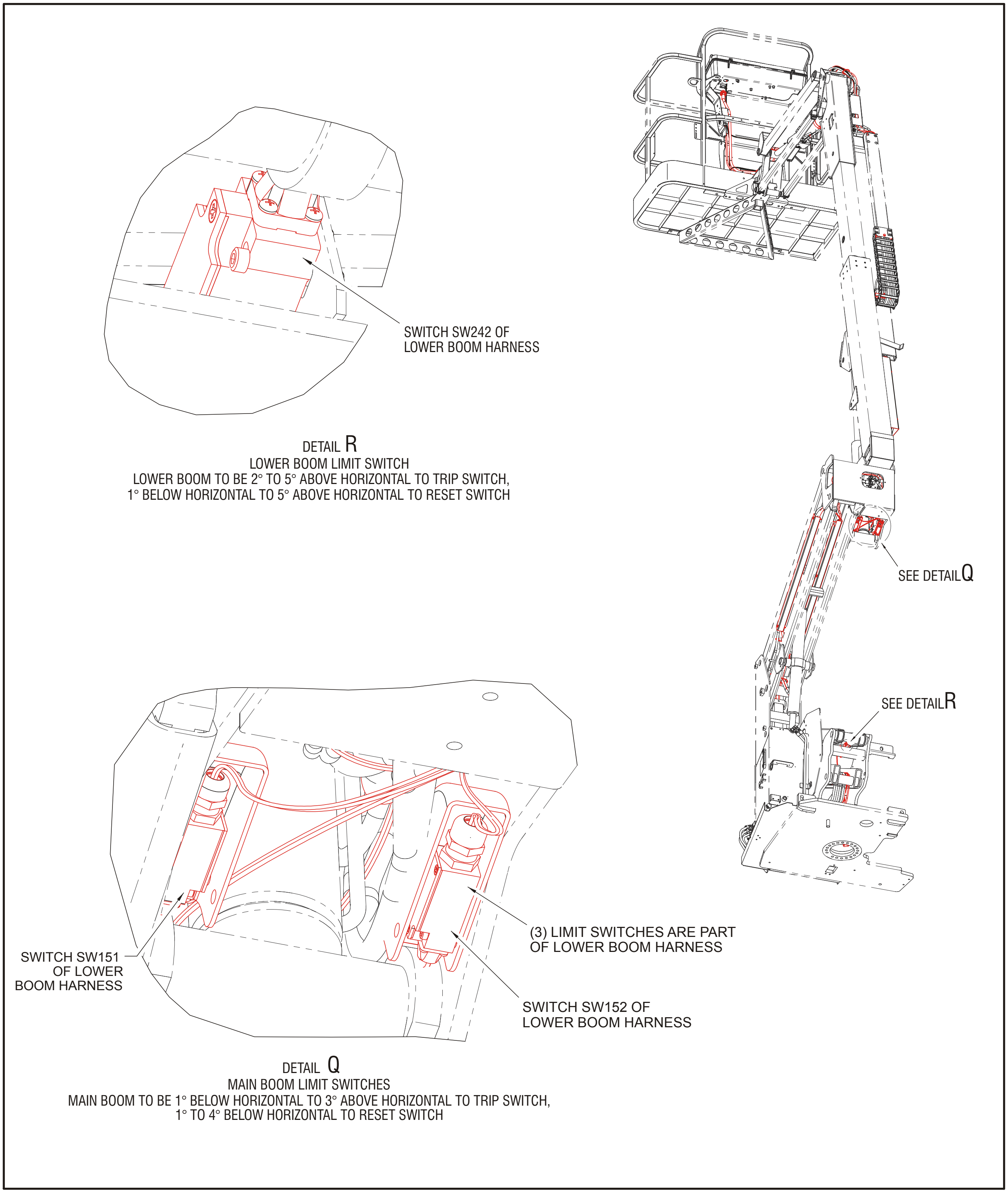


Figure 3-44. Cable Installation and Identification - Sheet 5 of 8

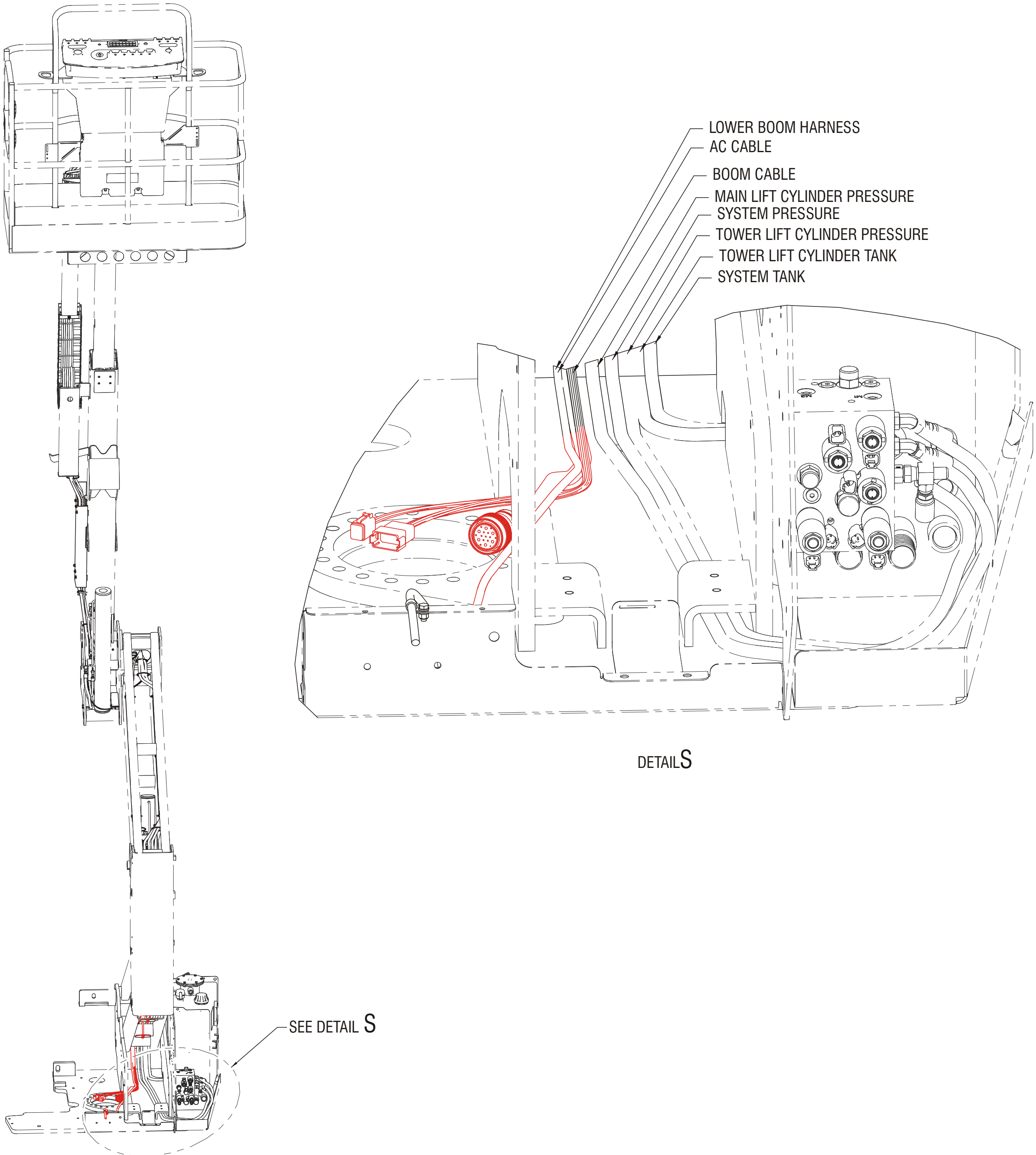


Figure 3-45. Cable Installation and Identification - Sheet 6 of 8

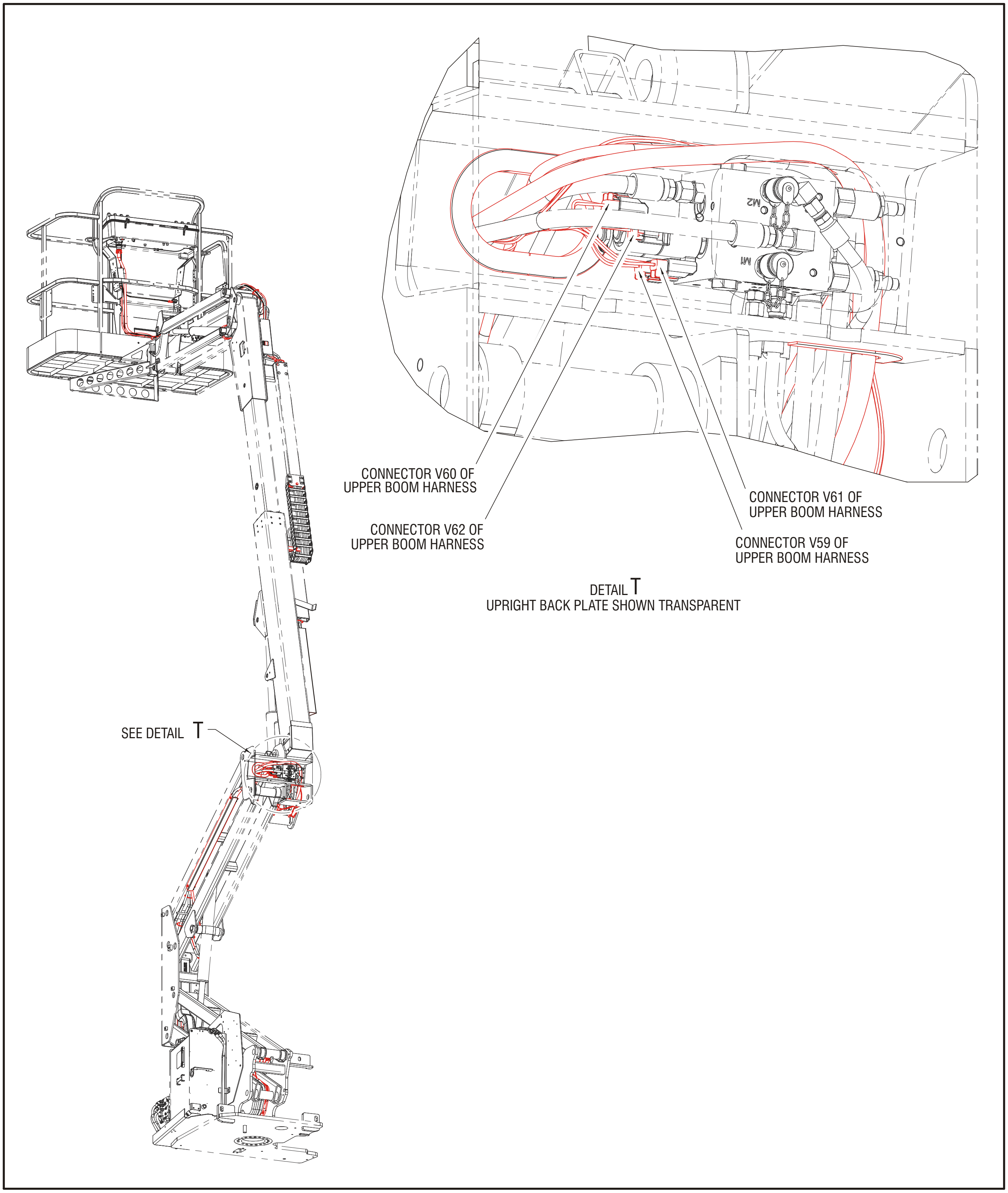


Figure 3-46. Cable Installation and Identification - Sheet 7 of 8

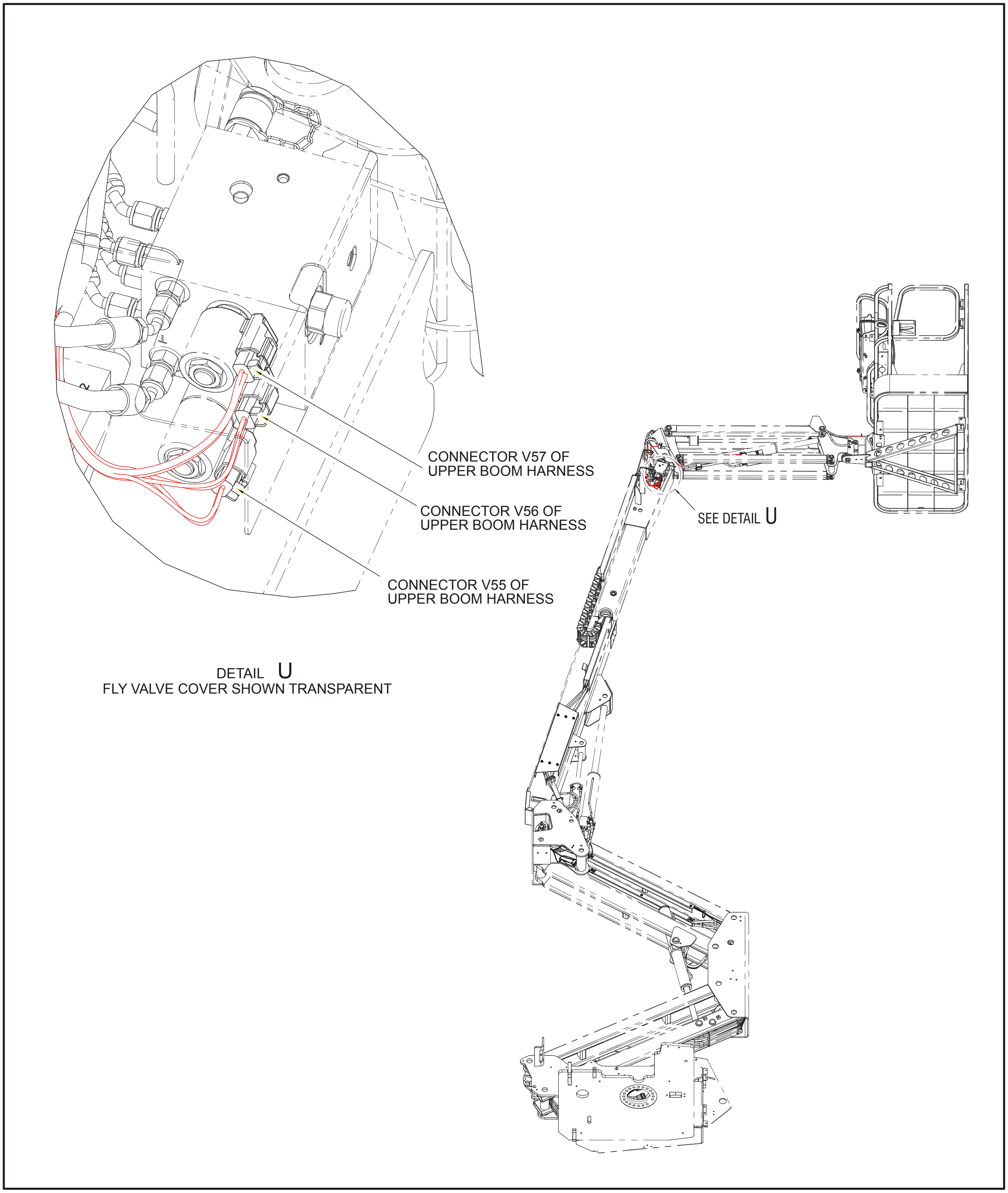


Figure 3-47. Cable Installation and Identification - Sheet 8 of 8

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

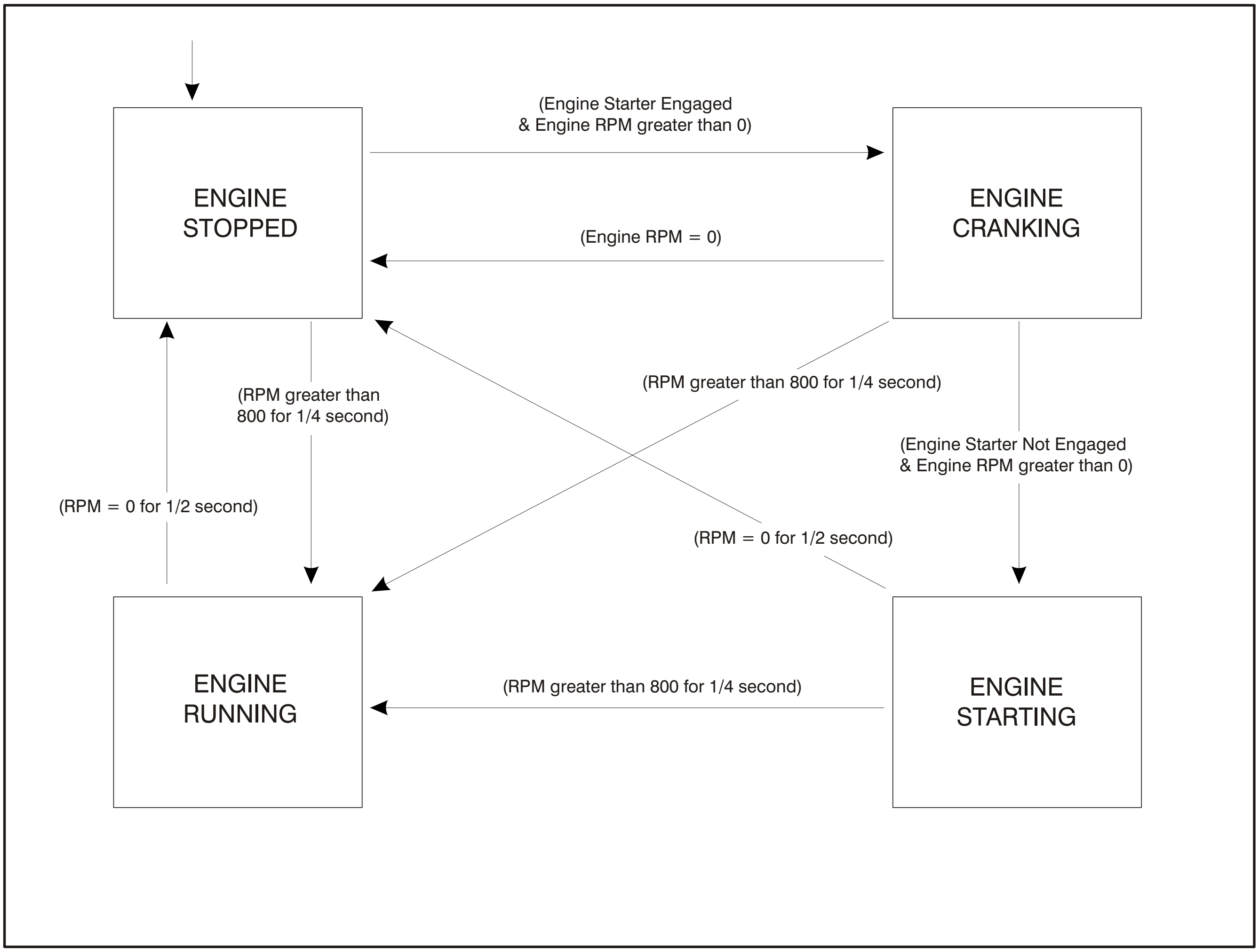


Figure 3-48. Engine Operating State Diagram

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.*

Table 3-5. Engine RPM Levels

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

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

Engine Stop RPM

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

Idle RPM

Idle RPM occurs when all of the following conditions exist;

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

Mid Engine RPM

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

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

Multi-Function RPM

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

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

High Engine RPM

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

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

Generator RPM

Generator RPM occurs when all of the following conditions exist;

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

3.15 ENGINE CONTROLS

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

Ambient Air Temperature Sensor

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

Fuel Level Sensor

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

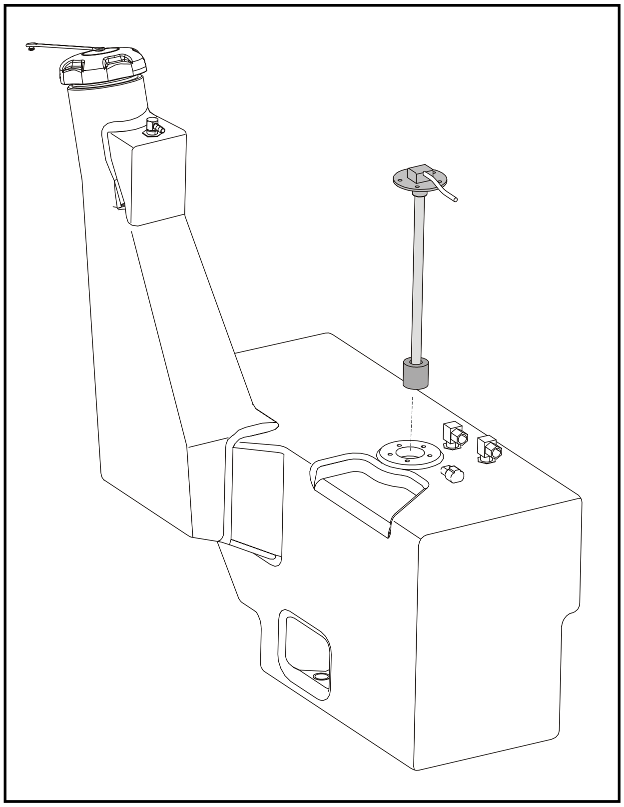


Figure 3-49. Fuel Level Sensor

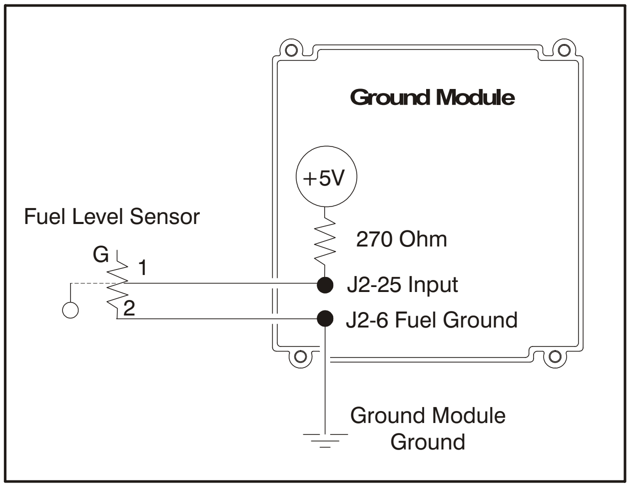


Figure 3-50. Fuel Level Sensor Schematic

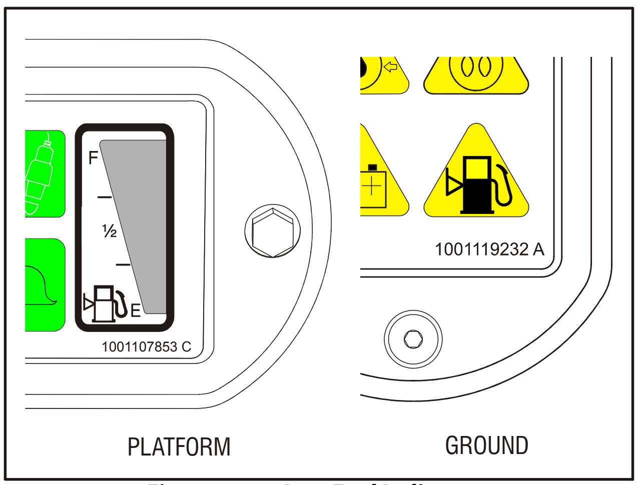
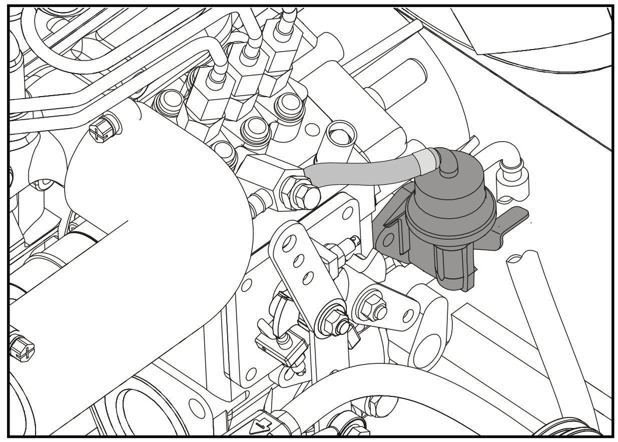


Figure 3-51. Low Fuel Indicators

3.16 ENGINE STARTUP PROCEDURE (KUBOTA)

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

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



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

3.17 KUBOTA ENGINE

Engine Oil Pressure Switch

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

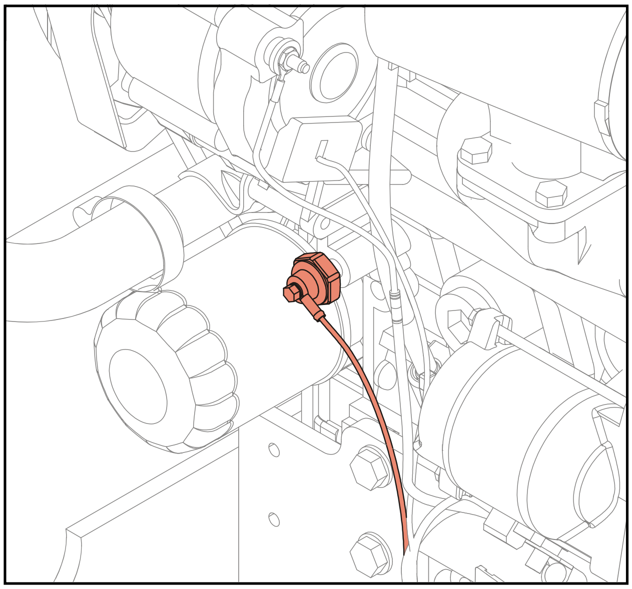


Figure 3-52. Engine Oil Pressure Switch

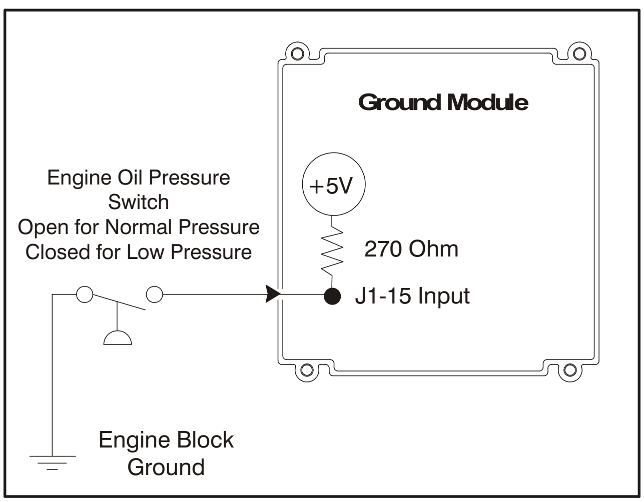


Figure 3-53. Engine Oil Pressure Switch Schematic

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.

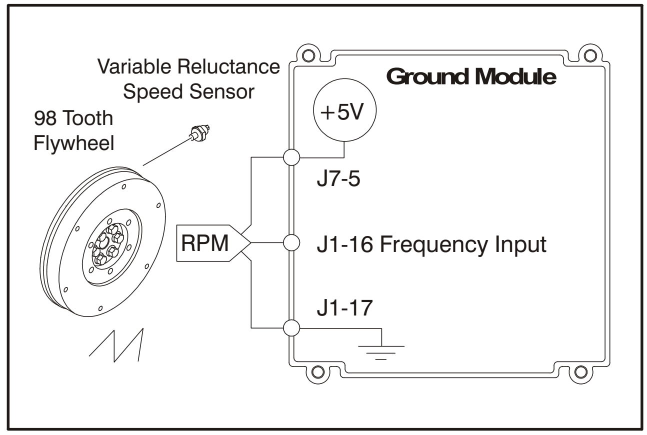


Figure 3-54. Engine Speed Sensor Schematic

Coolant Sensor

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

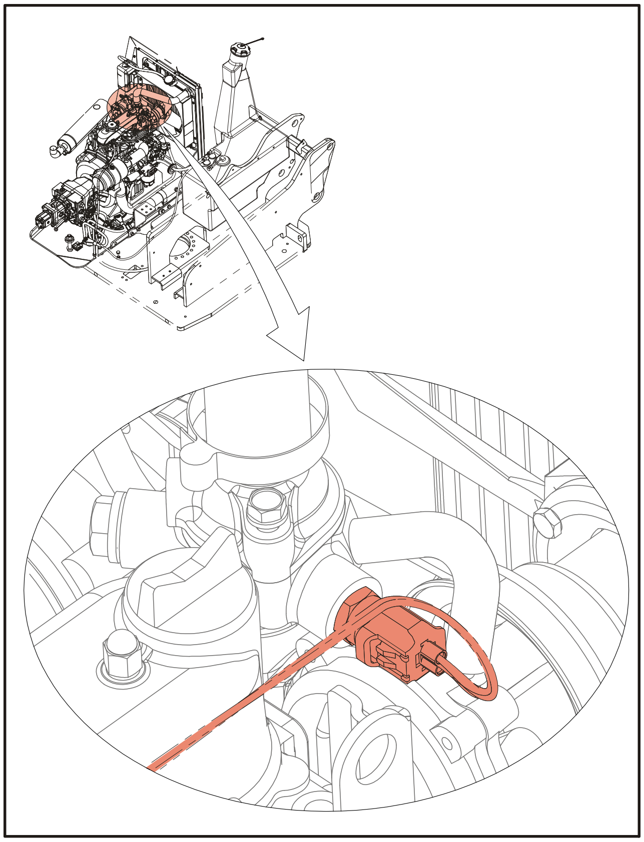


Figure 3-55. Engine Coolant Sensor

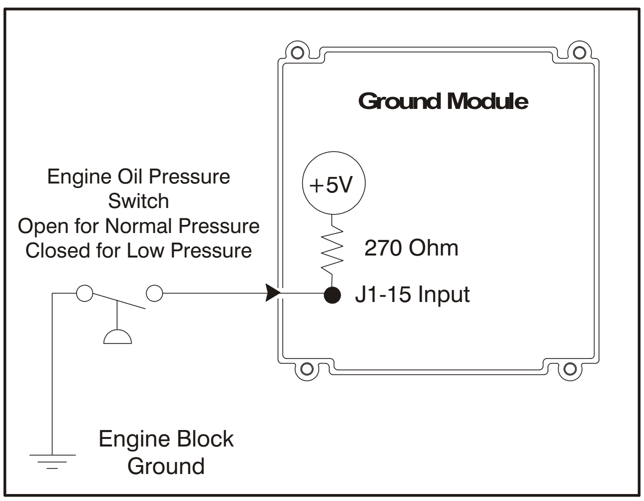


Figure 3-56. Engine Coolant Sensor Schematic

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.

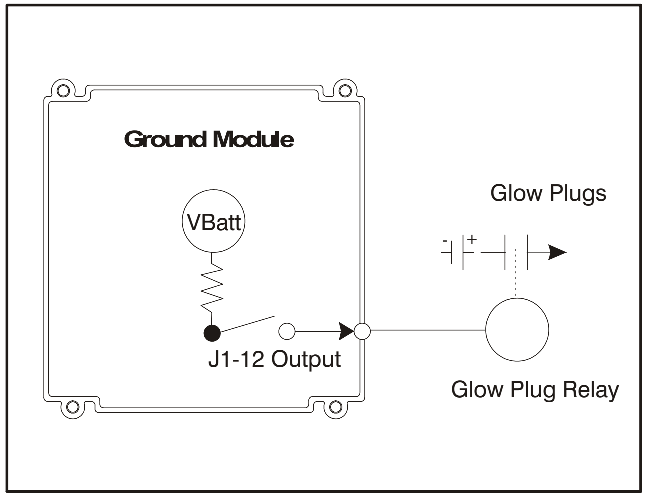


Figure 3-57. Engine Glow Plug Schematic

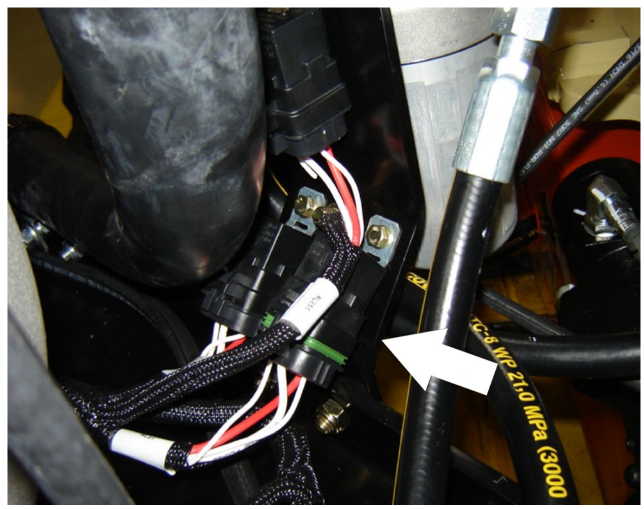


Figure 3-58. Glow Plug Relay

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 3-6, Glow Plug Conditions.

Table 3-6. Glow Plug Conditions

Engine Coolant Temperature	Battery Voltage	Ambient Temperature	Glow Plug Time On
Greater than or equal to 122° F (50° C)	--	--	Off
--	Less than 11V	--	Off
Less than 122° F (50° C)	Greater than 11V	Greater than 59°F(15°C)	Off
Less than 122° F (50° C)	Greater than 11V	Temp Between 23°F and 59°F (-5°C and 15°C)	On for 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 3-7, Engine Actuator Conditions.

Table 3-7. Engine Actuator Conditions

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

ENGINE THROTTLE ACTUATOR

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

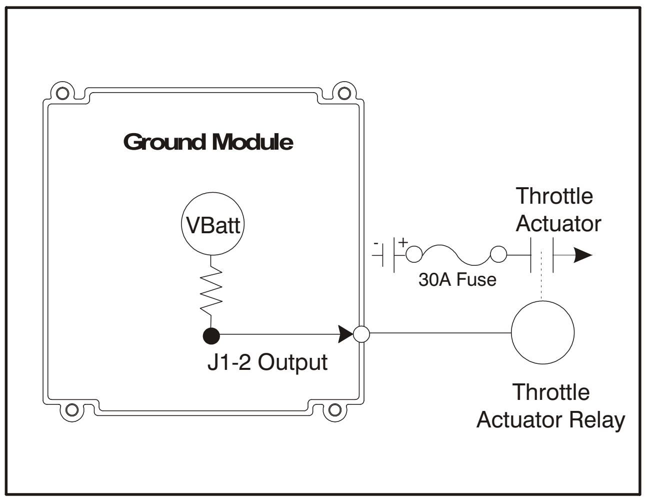


Figure 3-59. Engine Throttle Actuator Schematic

PROPORTIONAL FUEL RACK ACTUATOR

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

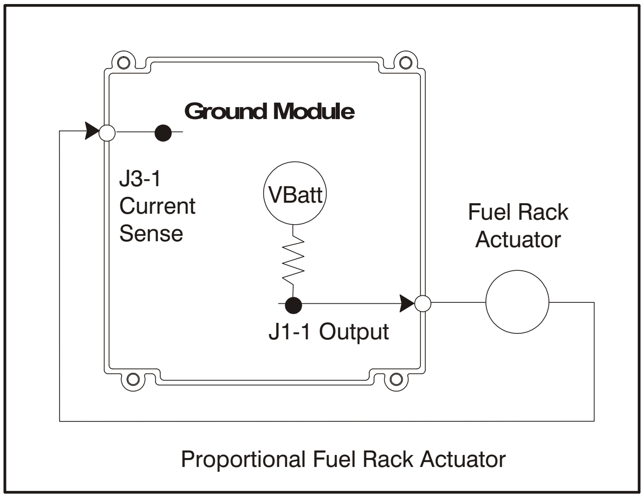


Figure 3-60. Proportional Fuel Rack Actuator Schematic

Engine Start

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

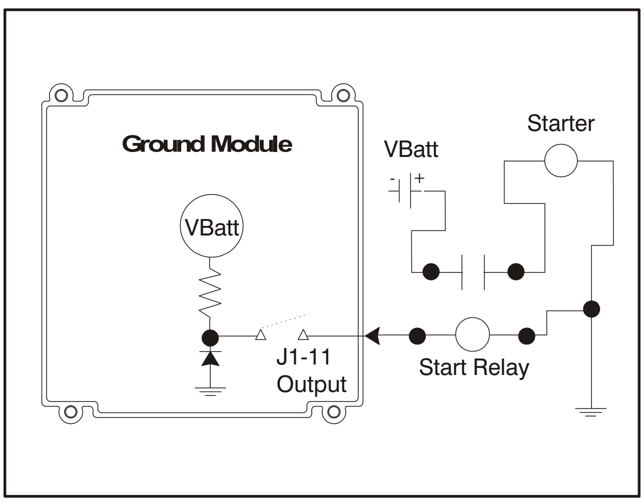


Figure 3-61. Engine Starter Schematic

Alternator Excitation

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

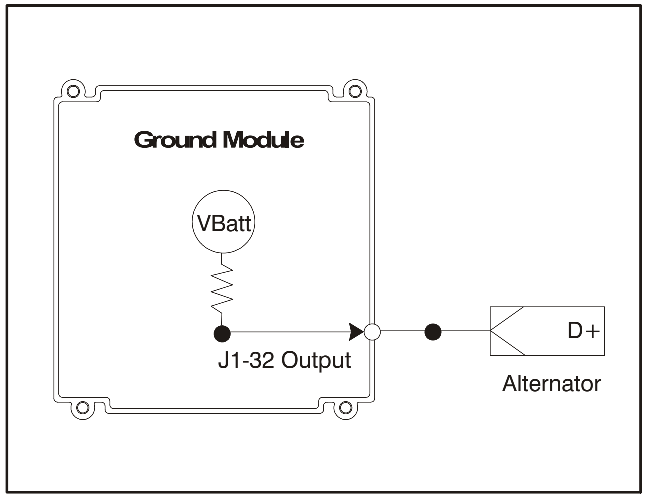


Figure 3-62. Alternator Schematic

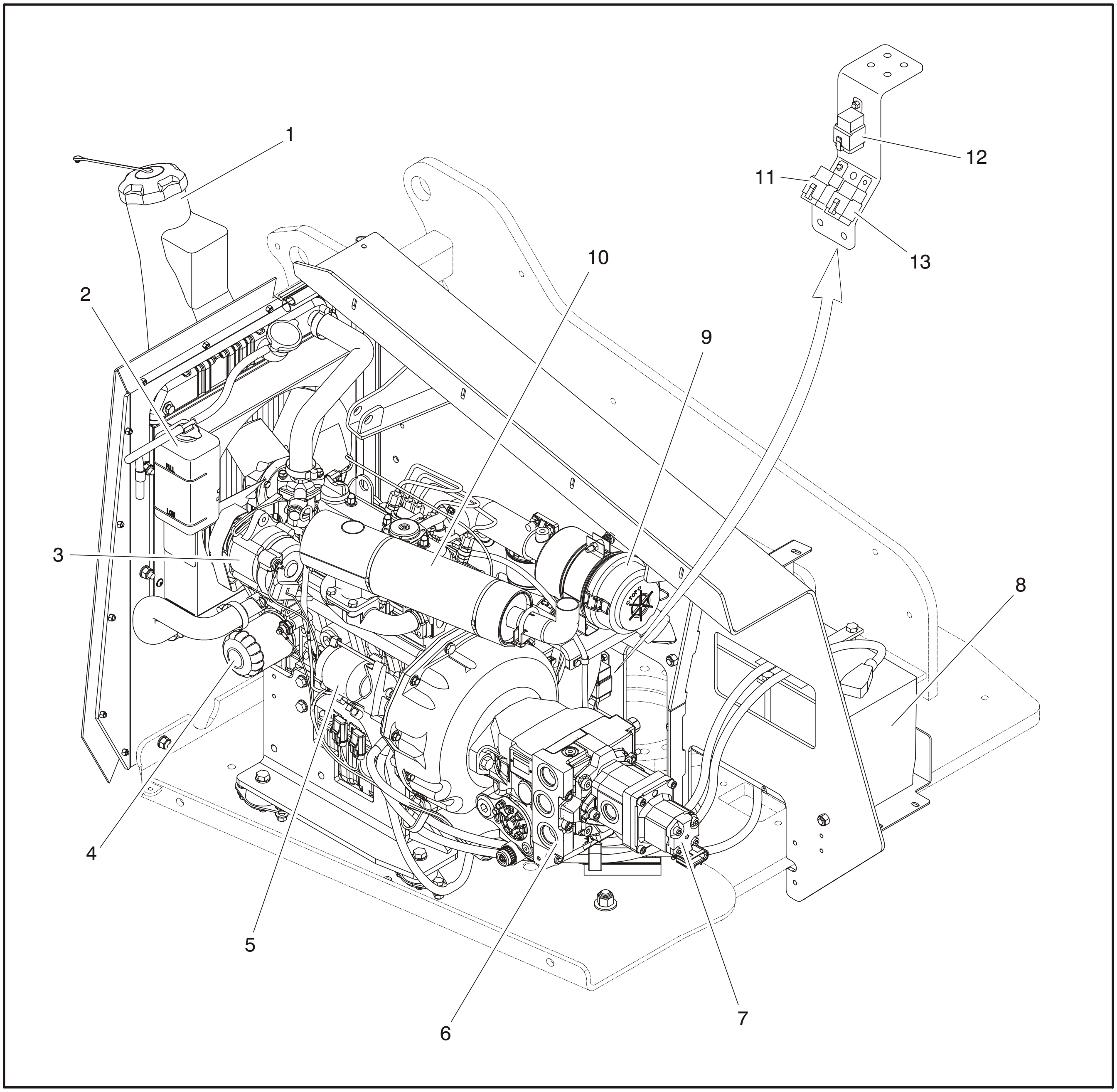
Fuel Pump

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

Shutdown

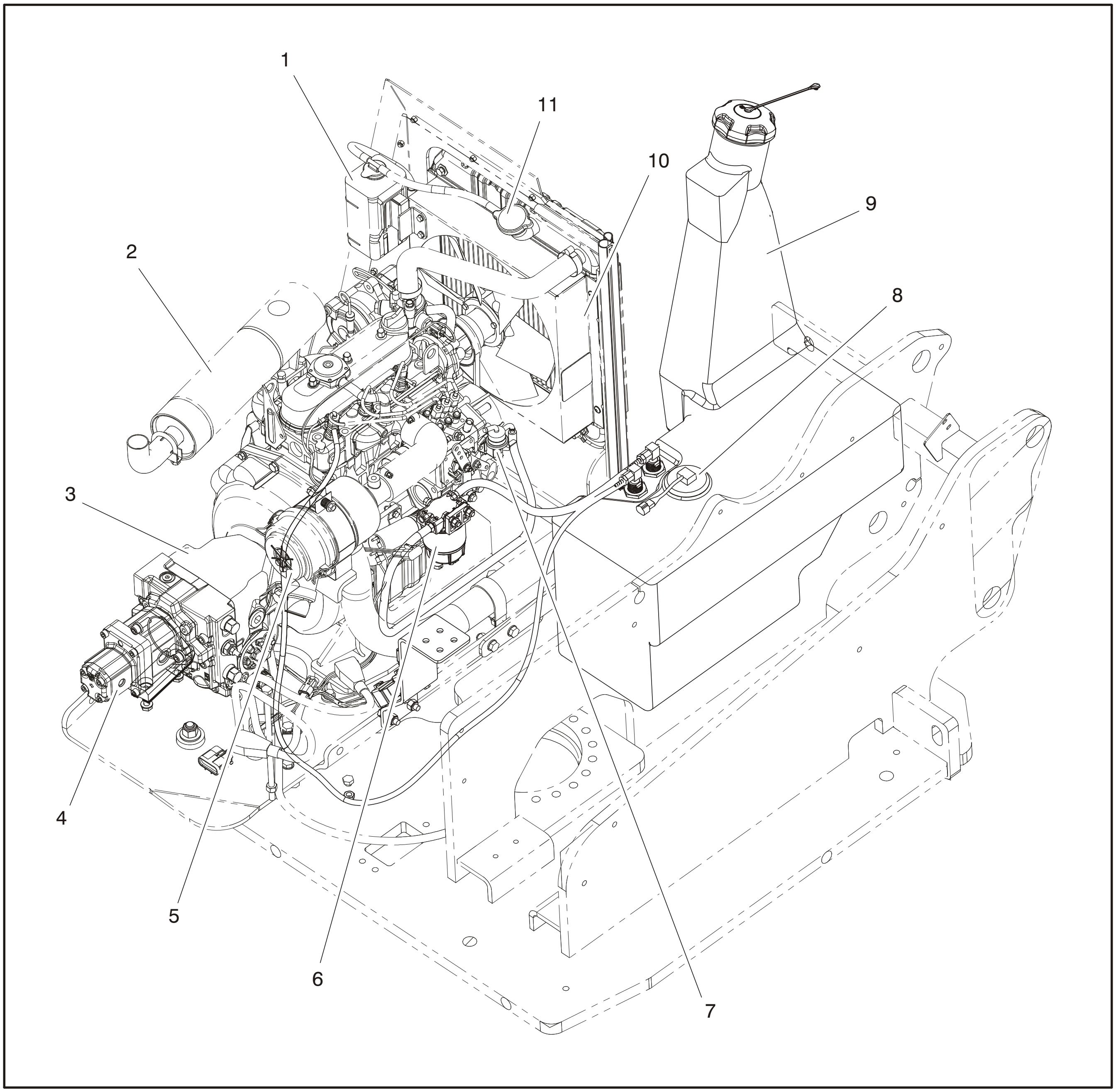
If the JLG Control System determines that the engine should be shut down and not allowed to run, the Ground Module takes the following steps to shut down the engine.

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



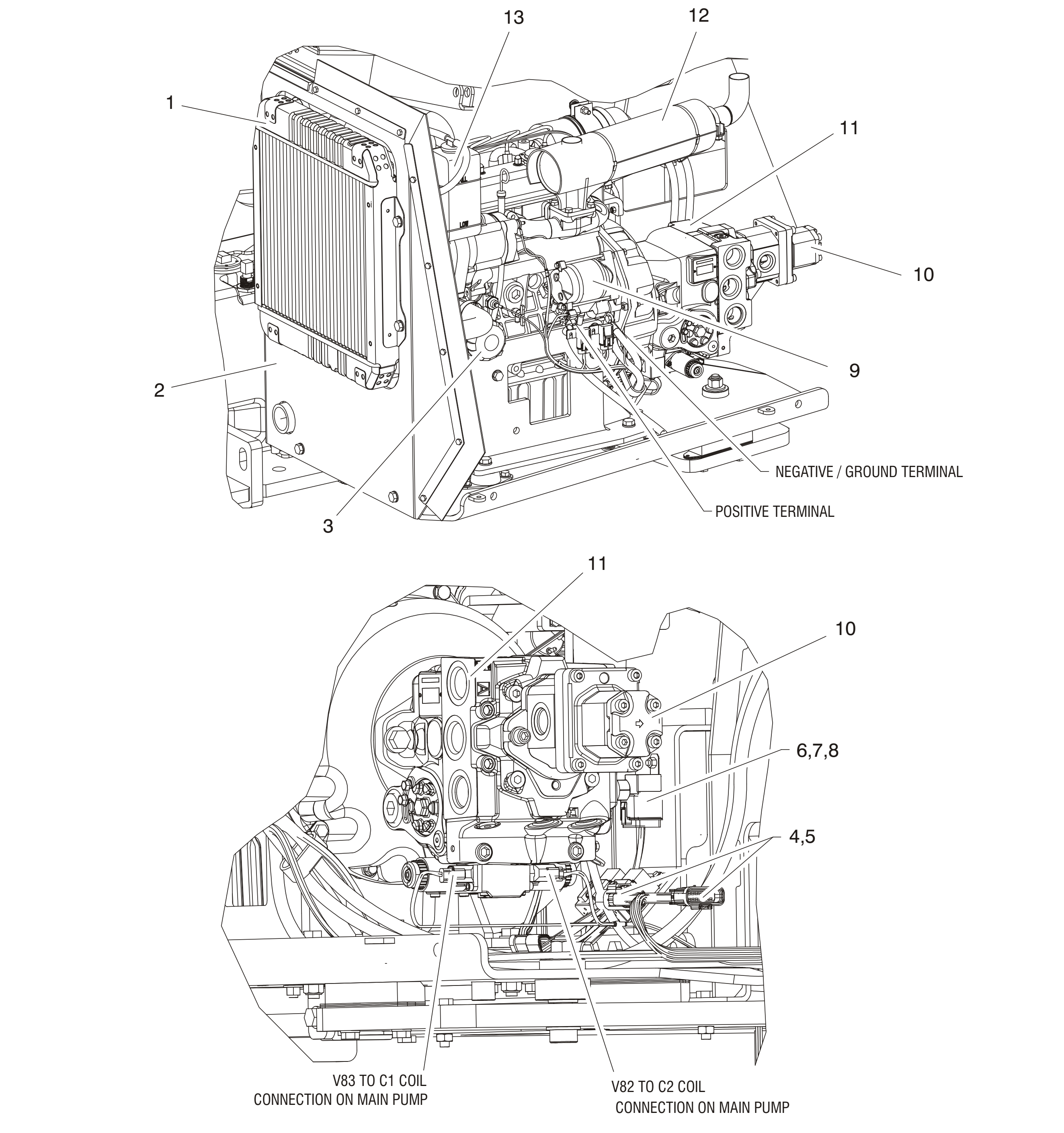
1. Fuel Tank	5. Starter	8. Battery	11. Starter Relay
2. Coolant Recovery Tank	6. Main Pump	9. Air Filter	12. Full Speed Relay
3. Alternator	7. Gear Pump	10. Muffler	13. Glow Plug Relay
4. Oil Filter			

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



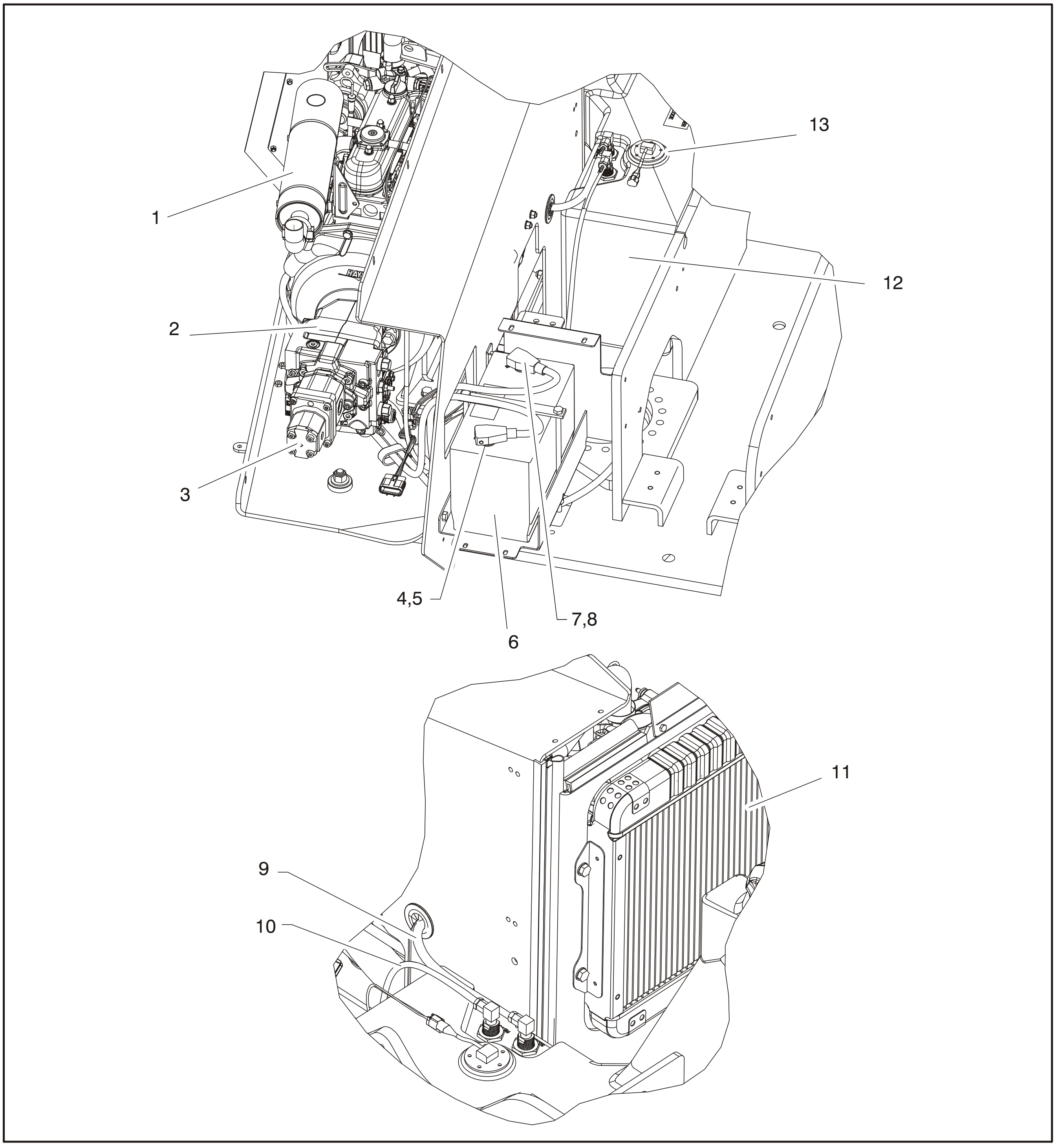
1. Coolant Recovery Tank
2. Muffler
3. Main Pump
4. Gear Pump
5. Air Filter
6. Fuel Filter/ Water Separator
7. Fuel Pump
8. Fuel Level Sending Unit
9. Fuel Tank
10. Radiator
11. Pressure Cap

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



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

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



1. Muffler
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

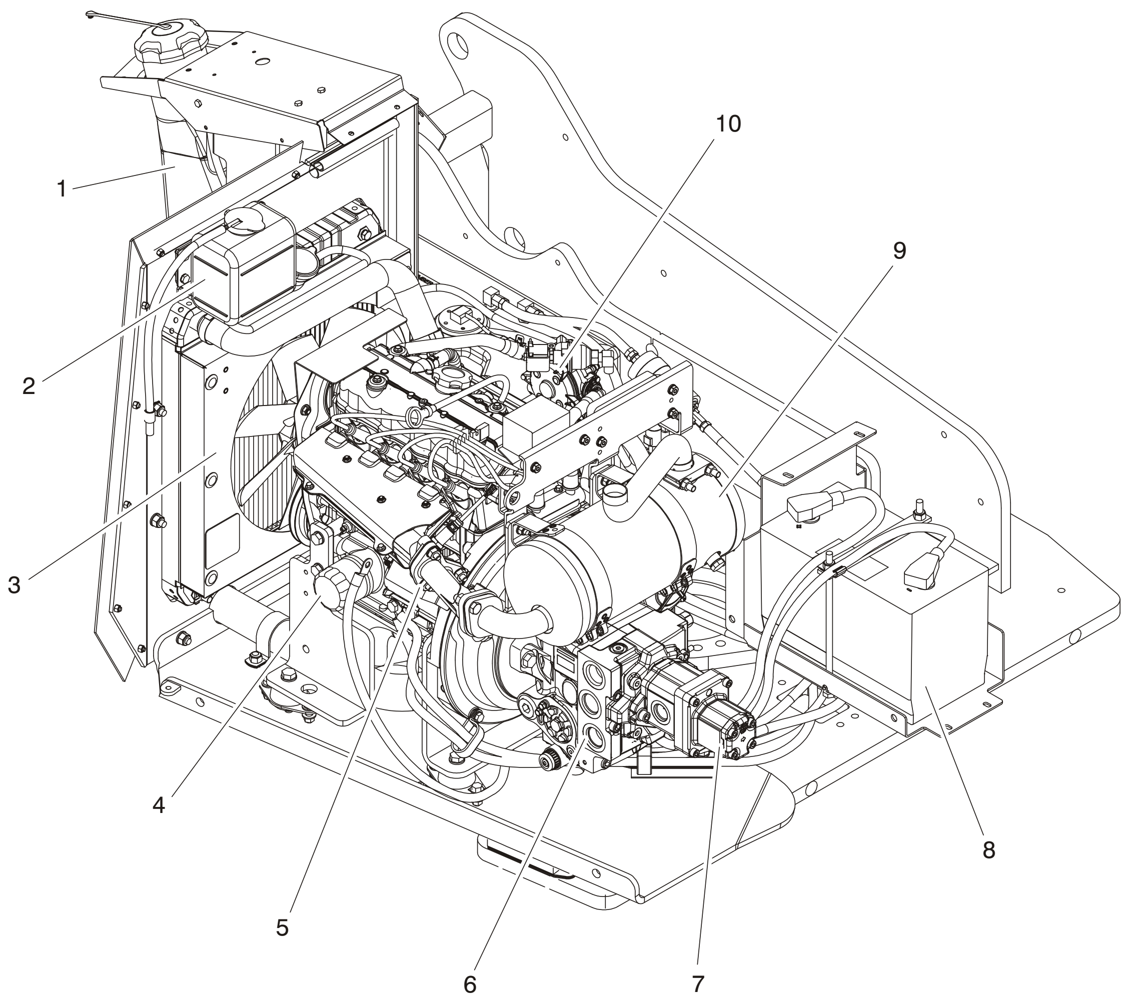
The Ground Module calculates the engine RPM based on information sent to it by the engine ECU.

Coolant Temperature

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

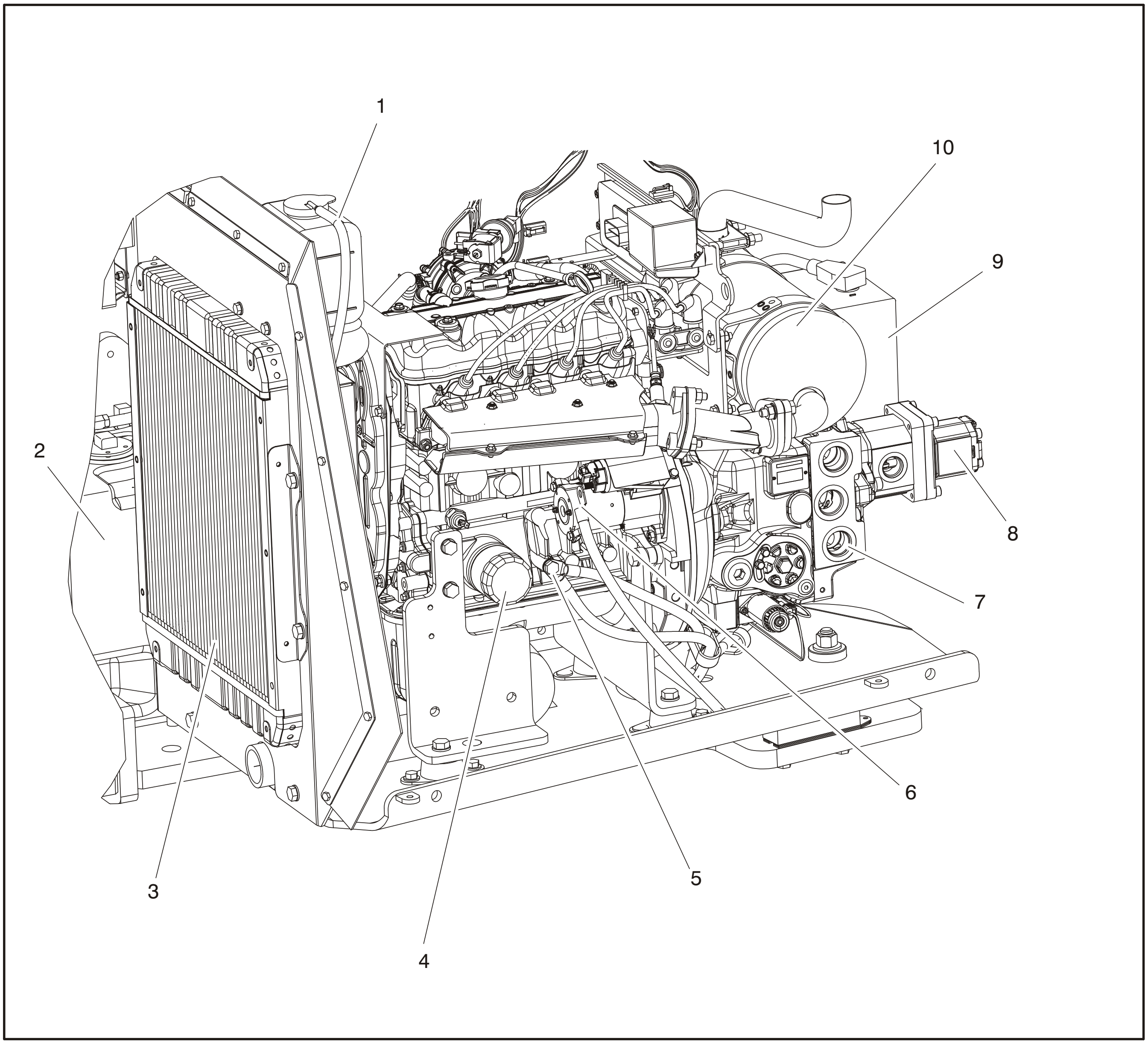
Fuel Select

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.



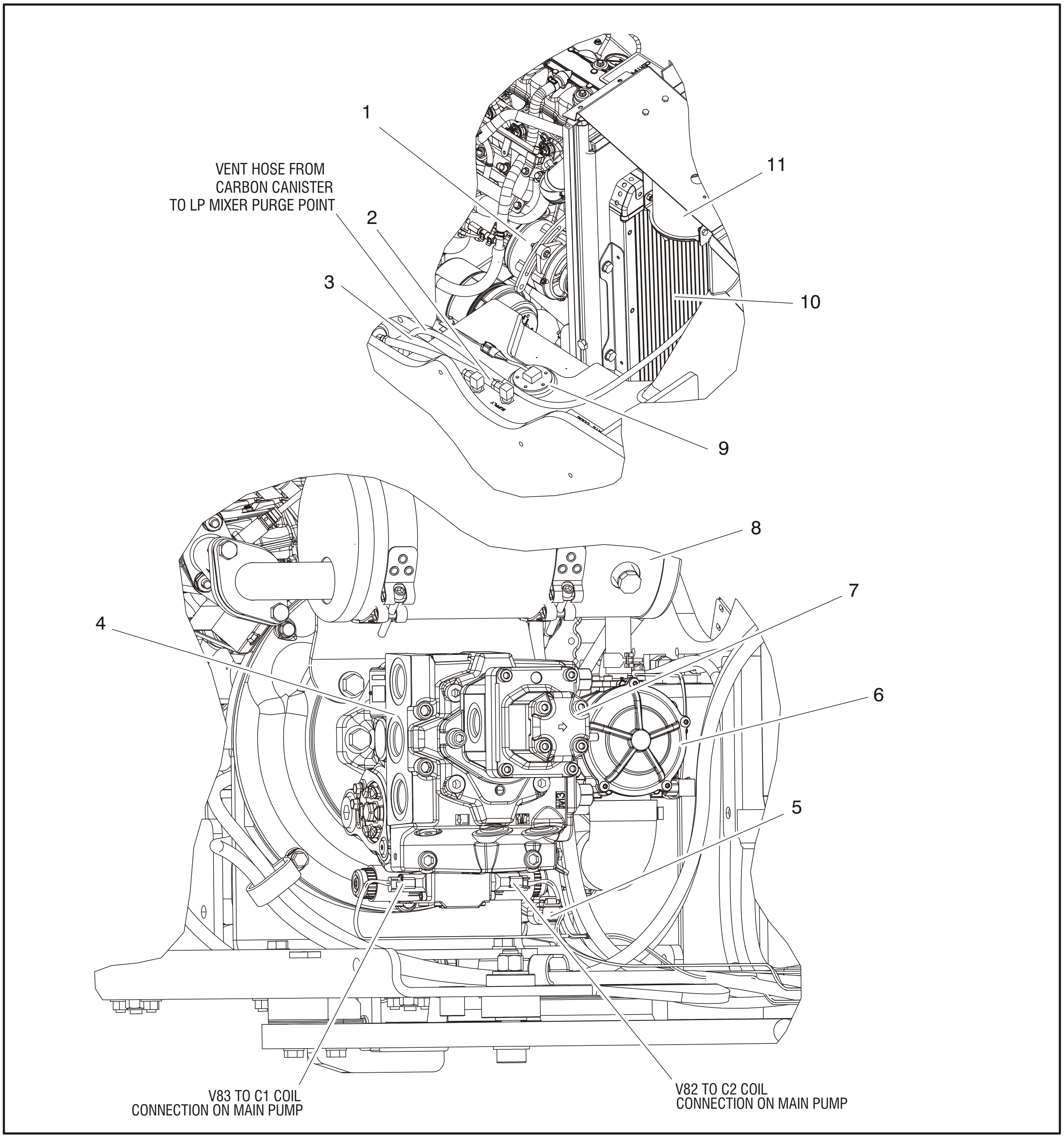
1. Fuel Tank	5. Starter	8. Battery
2. Coolant Recovery Tank	6. Main Pump	9. Muffler
3. Radiator	7. Gear Pump	10. Fuel Mixer
4. Oil Filter		

Figure 3-67. GM Engine - 1 of 6



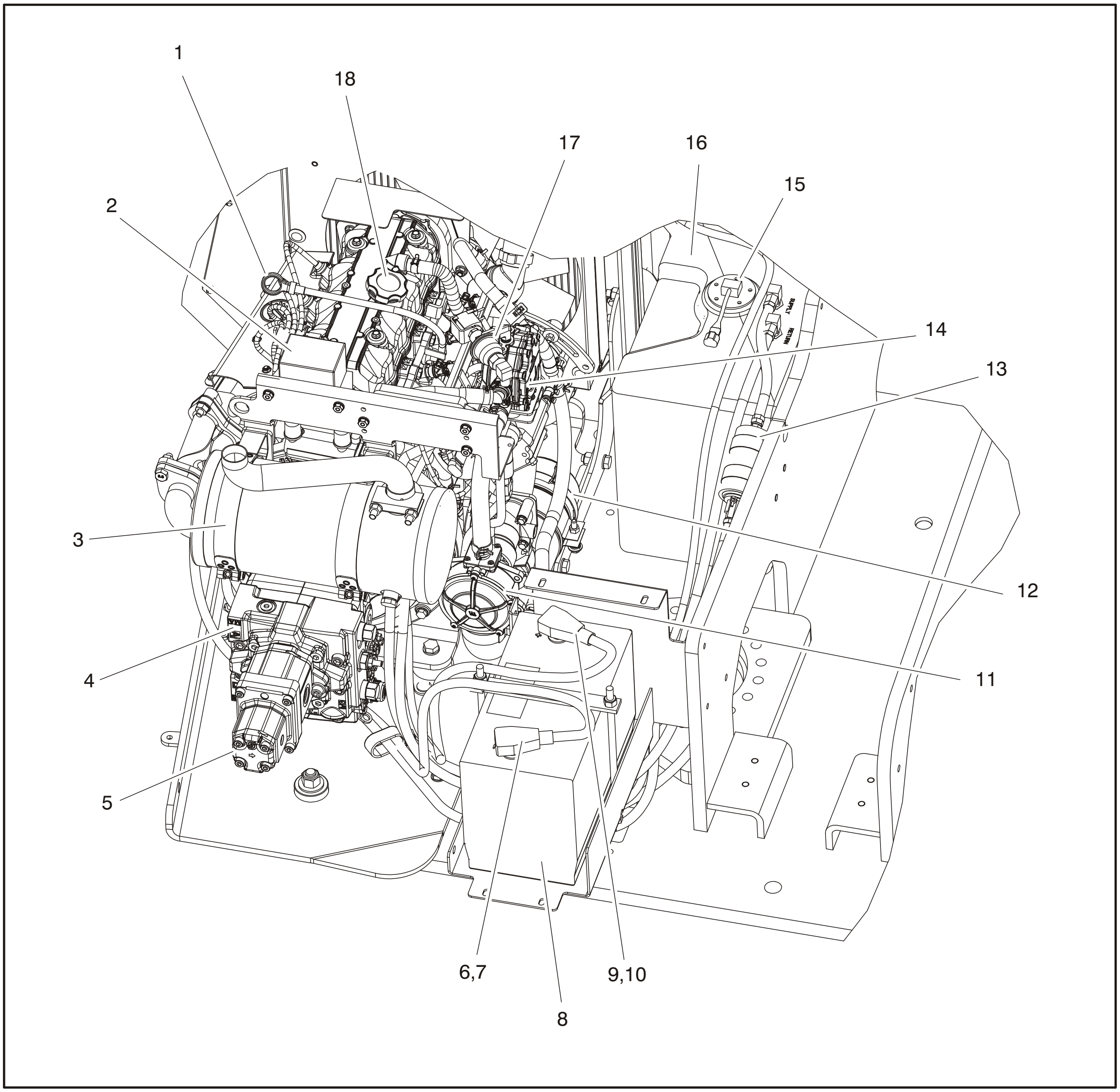
1. Coolant Recovery Tank
2. Fuel Tank
3. Radiator
4. Oil Filter
5. Negative/Ground Terminal
6. Positive Terminal
7. Main Pump
8. Gear Pump
9. Battery
10. Muffler

Figure 3-68. GM Engine - 2 of 6



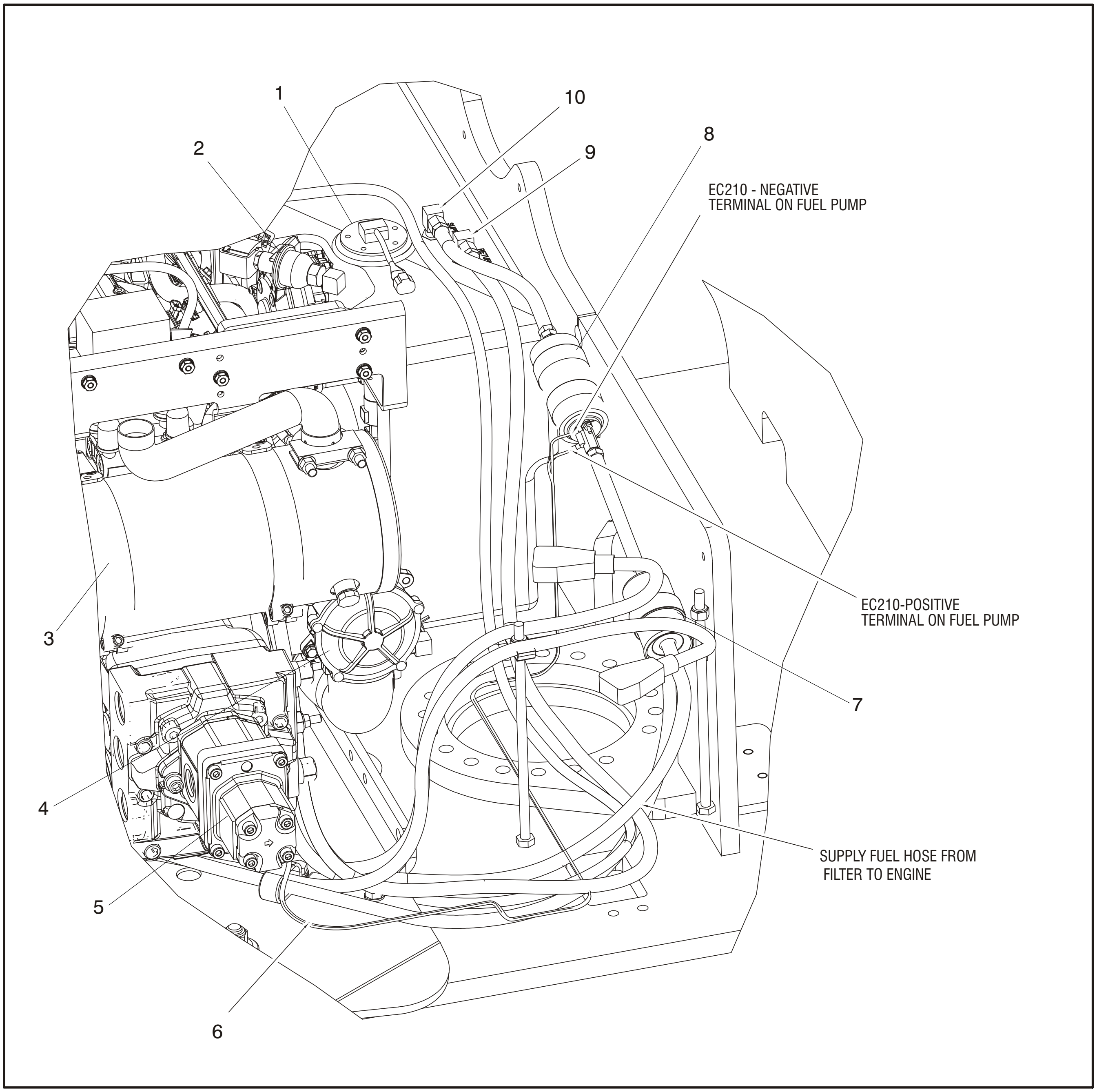
1. Alternator	4. Main Pump	7. Gear Pump	10. Radiator
2. Supply Fuel Hose	5. Fuel Pump Harness	8. Muffler	11. Carbon Cannister
3. Return Fuel Hose	6. Air/Fuel Mixer	9. Fuel Level Sensor	

Figure 3-69. GM Engine - 3 of 6



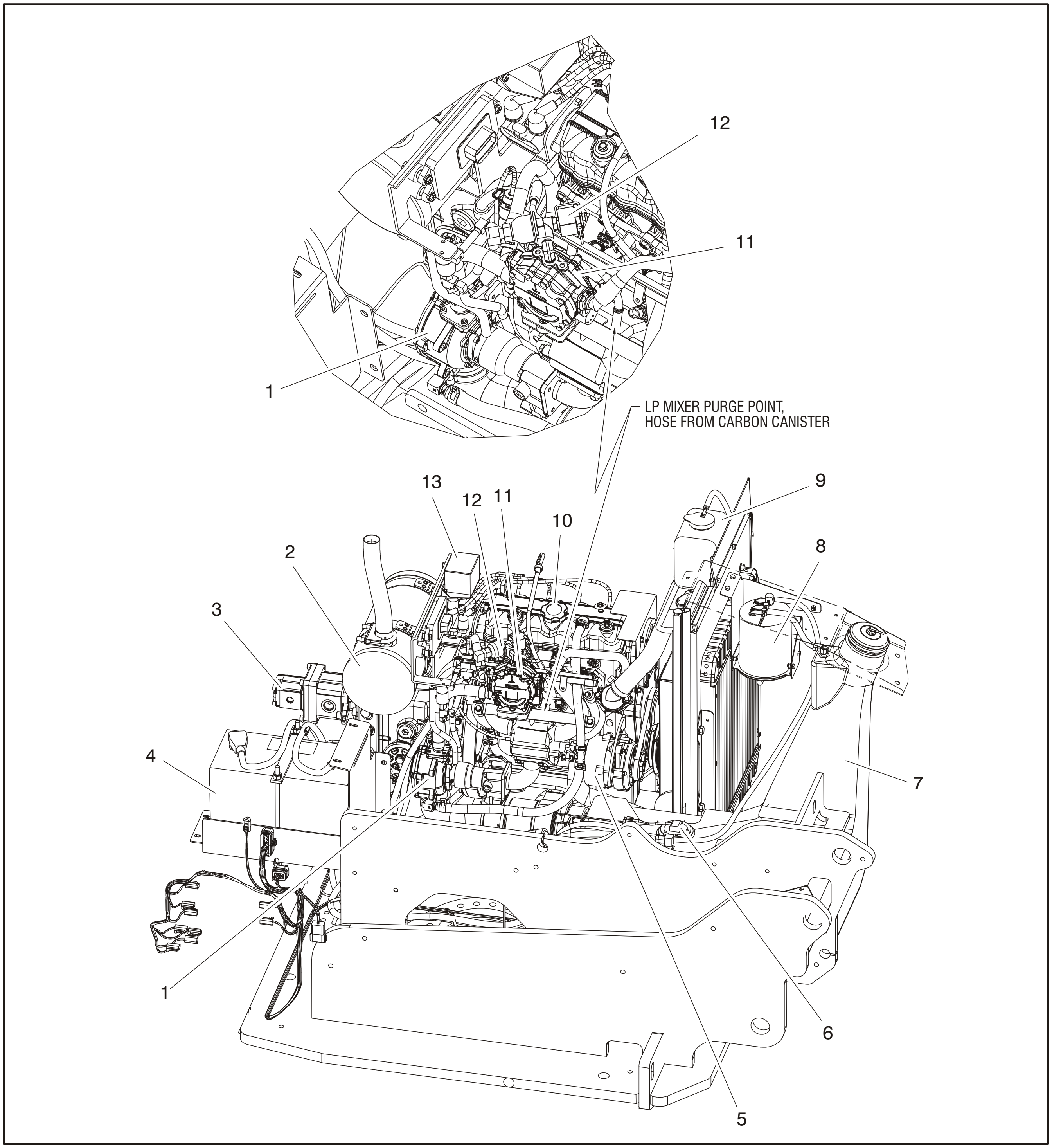
1. Dipstick	6. Negative Battery Cable	11. Air/Fuel Mixer	16. Fuel Tank
2. Relays	7. Negative Battery Post	12. Air Filter	17. Fuel Lock-off Valve
3. Muffler	8. Battery	13. Fuel Pump	18. Engine Oil Fill Cap
4. Main Pump	9. Positive Battery Cable	14. Fuel Mixer	
5. Gear Pump	10. Positive Battery Post	15.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

Figure 3-70. GM Engine - 4 of 6



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

Figure 3-71. GM Engine - 5 of 6



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

Figure 3-72. GM Engine - 6 of 6

Table 3-8. GM Engine Diagnostics Codes

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

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
105	3	113	IAT voltage high
105	4	112	IAT voltage low
105	15	111	IAT higher than expected stage 1
106	4	107	MAP voltage low
106	16	108	MAP pressure high
108	0	2229	BP pressure high
108	1	129	BP pressure low
110	0	1522	CHT higher than expected stage 2
110	0	217	ECT higher than expected stage 2
110	3	118	ECT voltage high
110	4	117	ECT voltage low
110	15	116	ECT higher than expected stage 1
110	16	1521	CHT higher than expected stage 1
168	15	563	Vbat voltage high
168	17	562	Vbat voltage low
173	0	2428	VEGT temperature high
174	3	183	FT high voltage
174	4	182	FT low voltage
441	0	1417	EMWT1 higher than expected stage 2
441	3	1411	EMWT1 voltage high
441	4	1413	EMWT1 voltage low
441	15	1415	EMWT1 higher than expected stage 1
442	0	1418	EMWT2 higher than expected stage 2
442	3	1412	EMWT2 voltage high
442	4	1414	EMWT2 voltage low
442	15	1416	EMWT2 higher than expected stage 1
443	0	1425	ERWT1 higher than expected stage 2
443	3	1419	ERWT1 voltage high
443	4	1421	ERWT1 voltage low
443	15	1423	ERWT1 higher than expected stage 1
444	0	1426	ERWT2 higher than expected stage 2
444	3	1420	ERWT2 voltage high
444	4	1422	ERWT2 voltage low
444	15	1424	ERWT2 higher than expected stage 1
515	0	1112	RPM above spark rev limit level
515	15	219	RPM higher than max allowed govern speed
515	16	1111	RPM above fuel rev limit 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 3-8. GM Engine Diagnostics Codes

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

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
723	2	341	CAM input signal noise
723	4	342	Loss of CAM input signal
724	10	134	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 3-8. GM Engine Diagnostics Codes

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

Table 3-8. GM Engine Diagnostics Codes

SPN Code	FMI Code	DTC	Description
3221	3	8904	UEGO cal resistor voltage high
3221	4	8905	UEGO cal resistor voltage low
3221	31	8901	UEGO microprocessor internal fault
3222	0	8916	UEGO sense cell impedance high
3222	3	8902	UEGO heater supply high voltage
3222	4	8903	UEGO heater supply low voltage
3222	10	8914	UEGO sense cell slow to warm up
3225	0	8917	UEGO pump cell impedance high
3225	1	8918	UEGO pump cell impedance low
3225	3	8912	UEGO pump voltage at high drive limit
3225	4	8913	UEGO pump voltage at low drive limit
3225	10	8915	UEGO pump cell slow to warm up
520200	0	171	Adaptive-learn gasoline bank1 high
520200	1	172	Adaptive-learn gasoline bank1 low
520201	0	174	Adaptive-learn gasoline bank2 high
520201	1	175	Adaptive-learn gasoline bank2 low
520202	0	1161	Adaptive-learn LPG high
520202	1	1162	Adaptive-learn LPG low
520203	0	1163	Adaptive-learn NG high
520203	1	1164	Adaptive-learn NG low
520204	0	1155	Closed-loop gasoline bank1 high
520204	1	1156	Closed-loop gasoline bank1 low
520205	0	1157	Closed-loop gasoline bank2 high
520205	1	1158	Closed-loop gasoline bank2 low
520206	0	1151	Closed-loop LPG high
520206	1	1152	Closed-loop LPG low
520207	0	1153	Closed-loop NG high
520207	1	1154	Closed-loop NG low
520208	10	154	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 3-8. GM Engine Diagnostics Codes

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

3.19 FUEL RESERVE / CUT-OUT SYSTEM

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

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

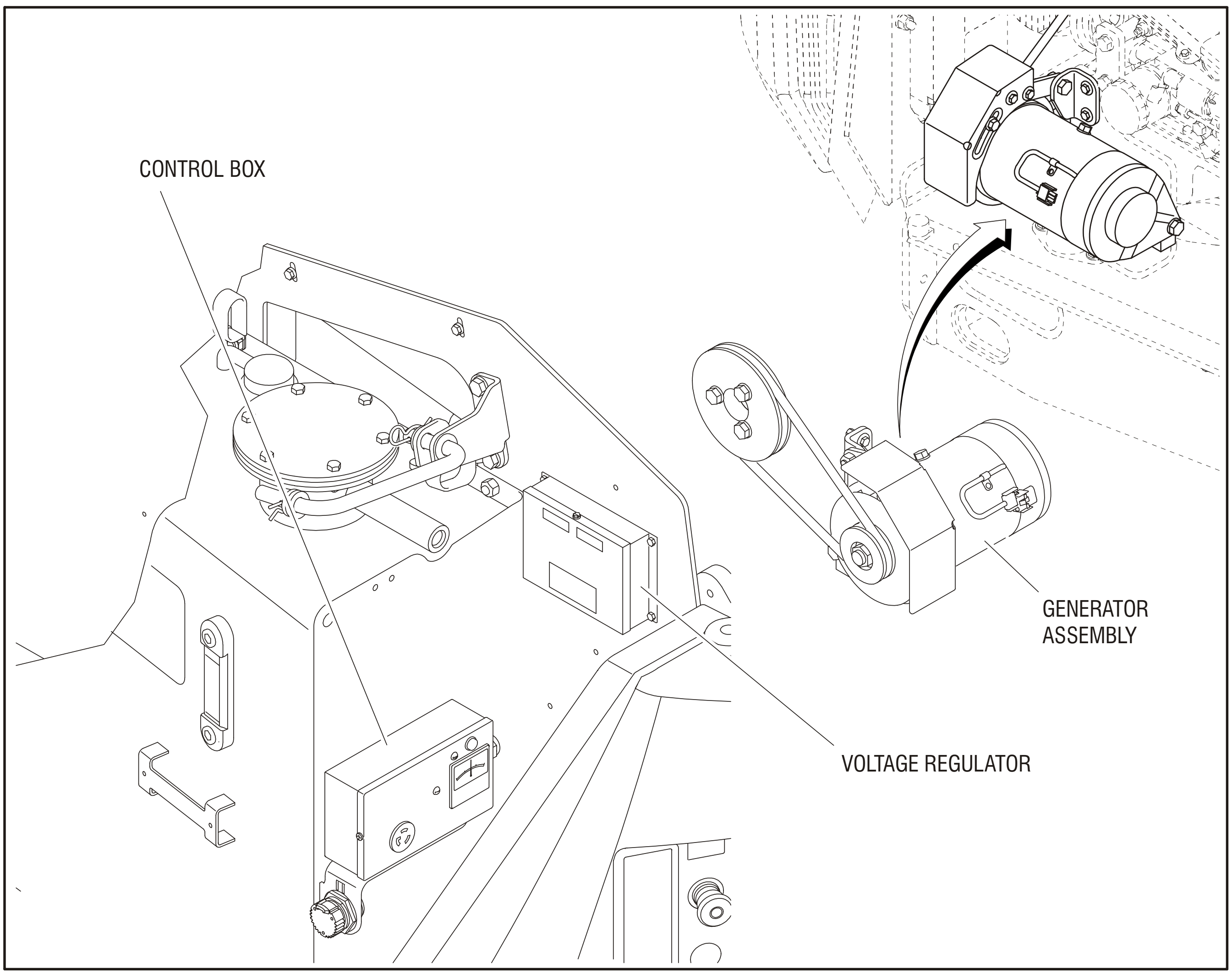


Figure 3-73. Generator

3.22 COUNTERWEIGHT

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

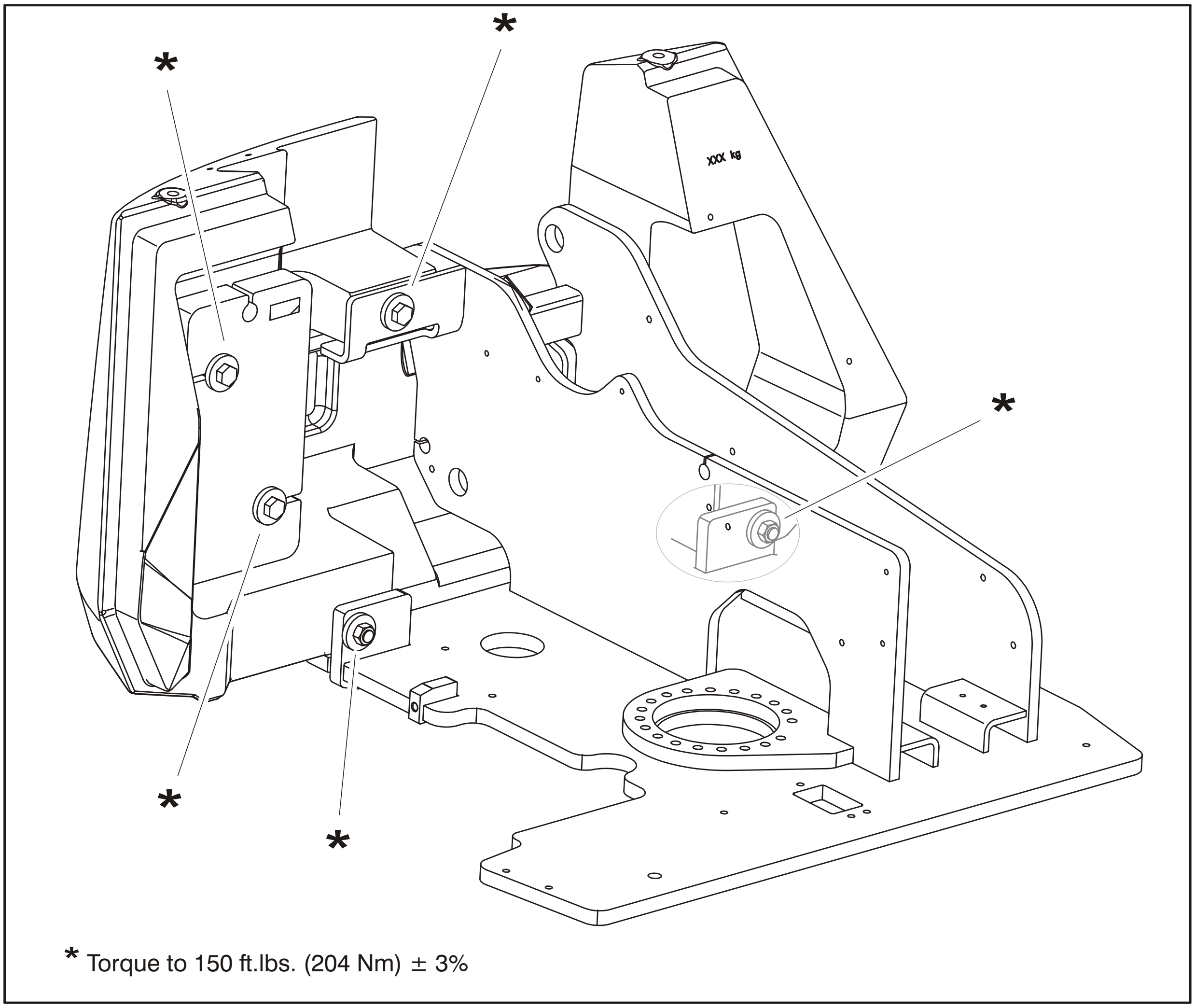


Figure 3-74. Counterweight Bolt Torque

NOTES:

SECTION 4. BOOM & PLATFORM

4.1 PLATFORM CONTROL ENABLE SYSTEM

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

4.2 TRANSPORT POSITION SENSING SYSTEM

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

This system is used to control the following systems:

- Above Elevation - Drive Speed Cutback System

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

4.3 PLATFORM

Platform/Support Removal

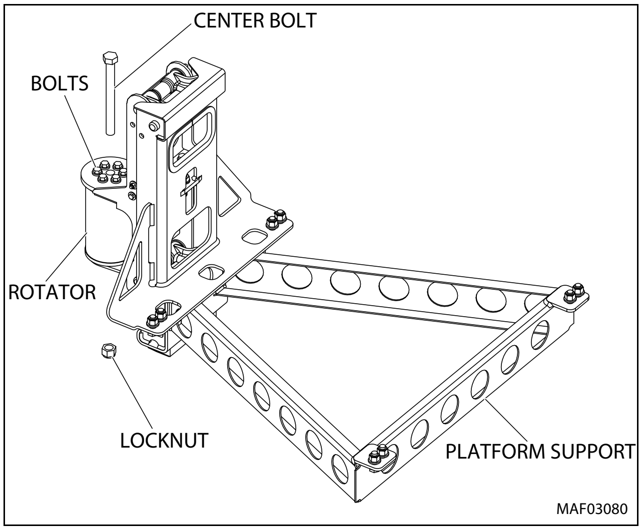
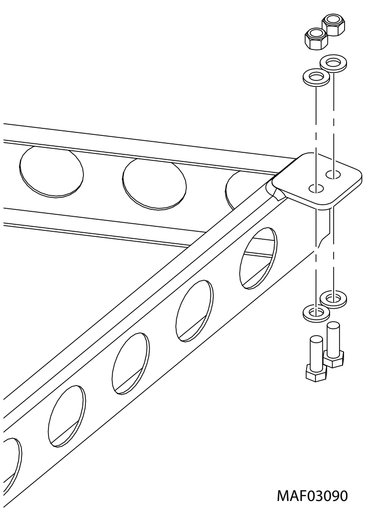


Figure 4-1. Location of Components Platform Support

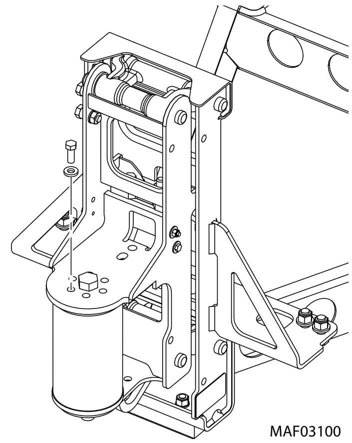
1. Disconnect electrical cable from control console.
2. Tag and disconnect the hydraulic lines from the rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove the bolts securing the platform to the platform support, then remove the platform.



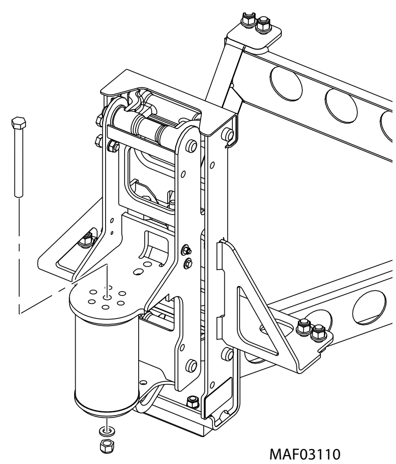
4. Using a suitable device, support the platform support.

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

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



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



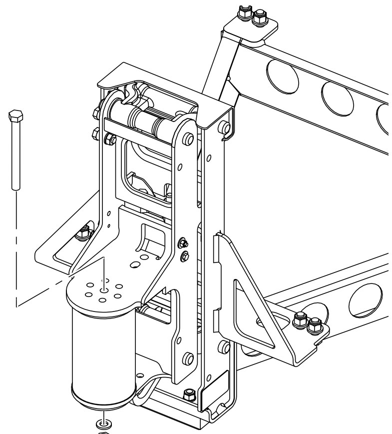
7. Remove the platform support from rotator.

Support Installation

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

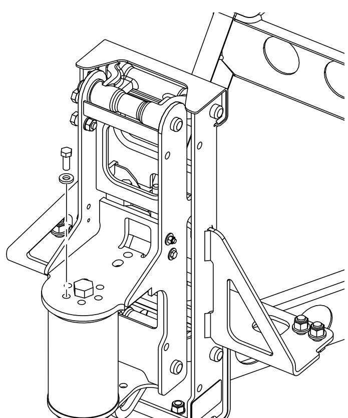
NOTE: *The platform support weighs approximately 42 lbs. (19 kg).*

2. Install the rotator center bolt and locknut.



MAF03110

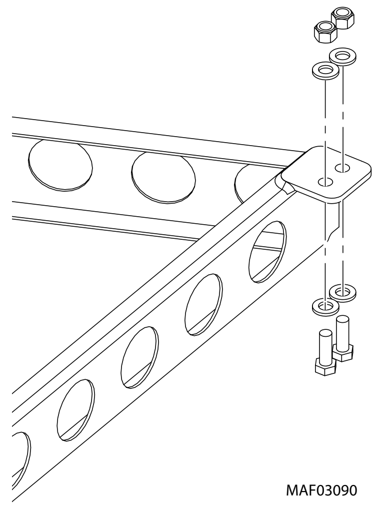
3. Apply JLG Threadlocker P/N 0100011 to the eight bolts securing the support to the rotator and install the bolts.



MAF03100

4. Torque the nut on the rotator center bolt and the retaining bolts. See Figure 4-2.

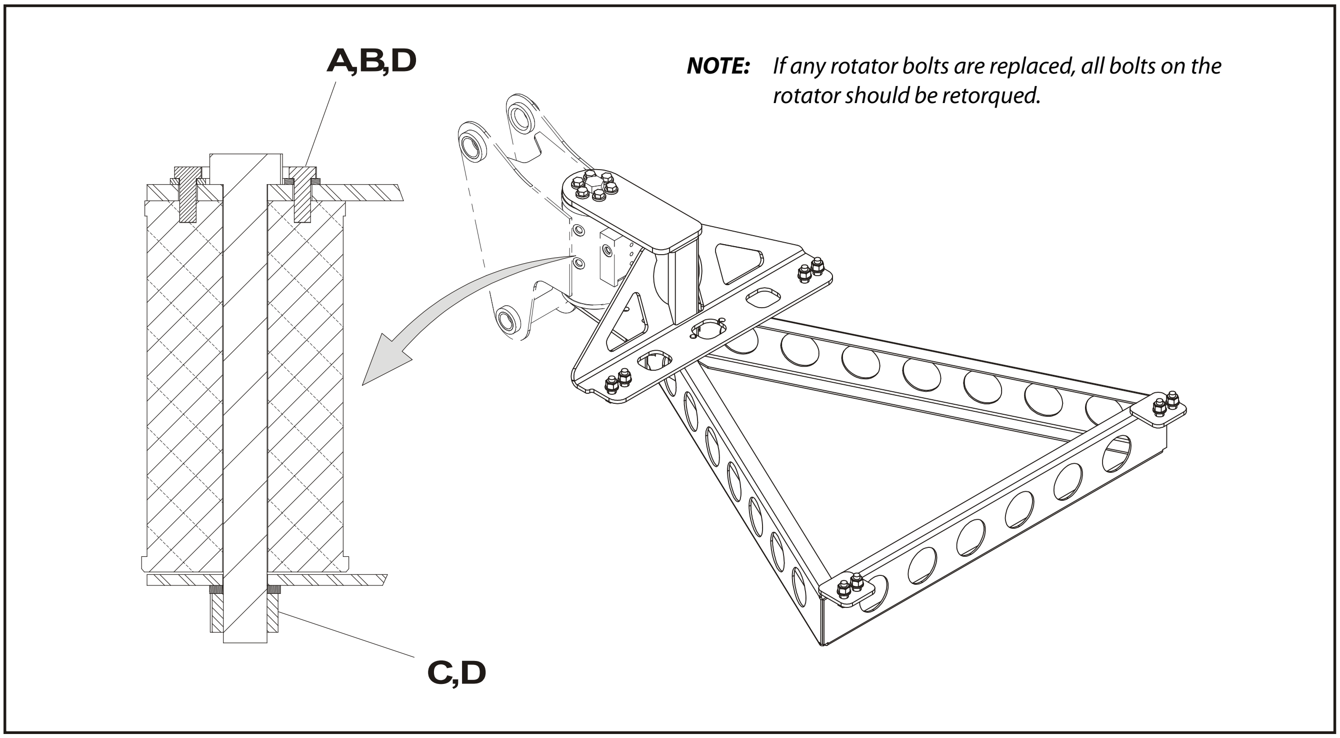
5. Position the platform on the platform support and install the bolts securing the platform to the platform support. See Figure 4-2.



MAF03090

6. Remove tag and reconnect the hydraulic lines to the rotator.

7. Connect the electrical harness to the platform control console.



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

Figure 4-2. Platform Support Torque Values

4.4 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness connectors located in turntable.

NOTICE

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

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

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

4. Using suitable lifting device, adequately support Powertrack weight along entire length.
5. Remove hardware #1 securing the powertrack on the tube carrier.
6. Remove bolt #2 securing the powertrack on the base boom section. Remove the powertrack assembly.

Installation

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

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

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

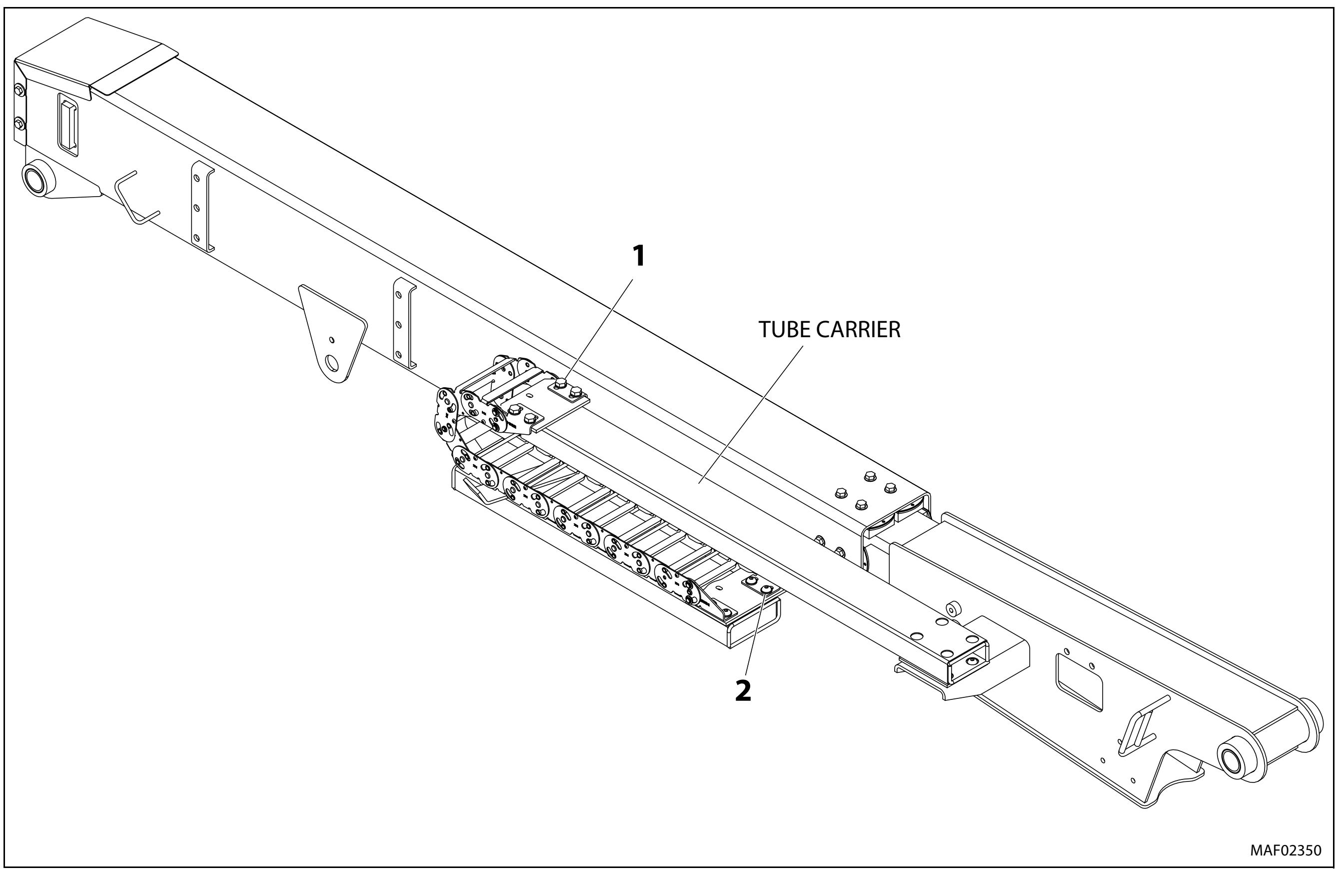


Figure 4-3. Location of Components - Powertrack

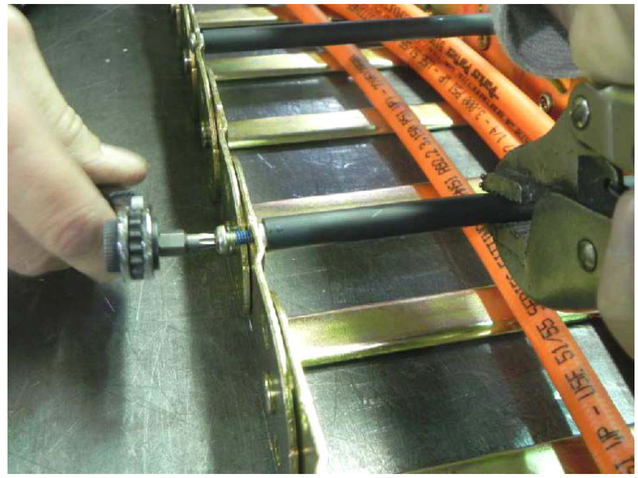
4.5 POWERTRACK MAINTENANCE

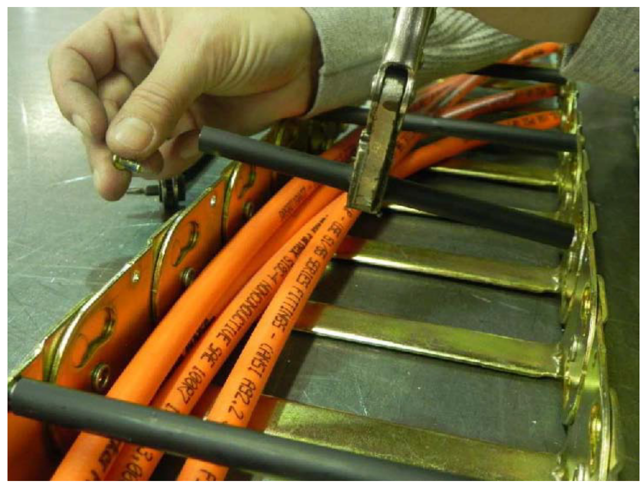
Remove Link

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

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

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

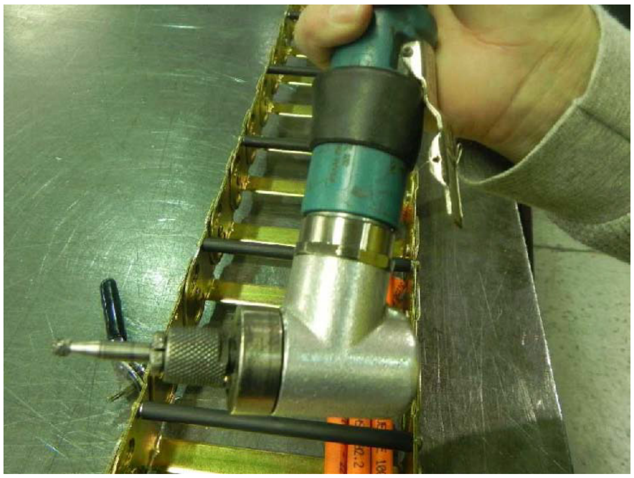




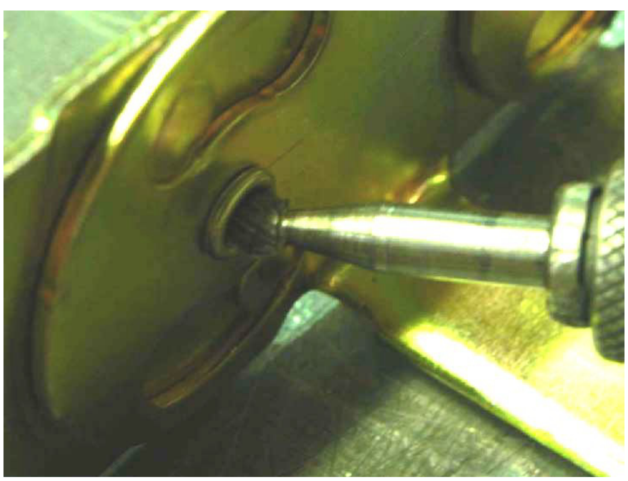
NOTICE

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

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

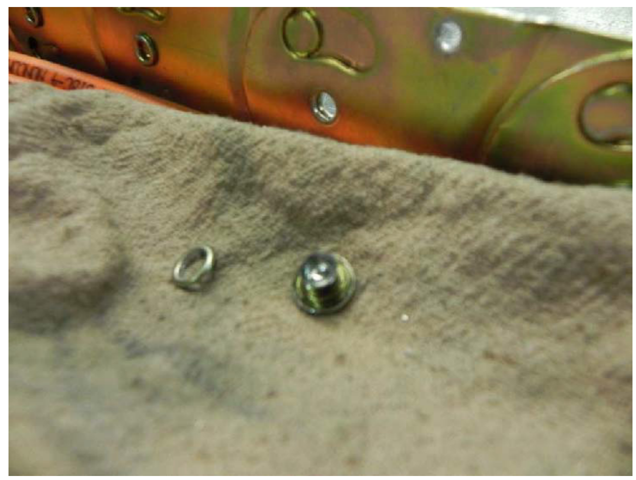


4. Insert tool into rolled over end of rivet. Grind out middle of rivet until rolled over part of rivet falls off. Repeat for all rivets to be removed.

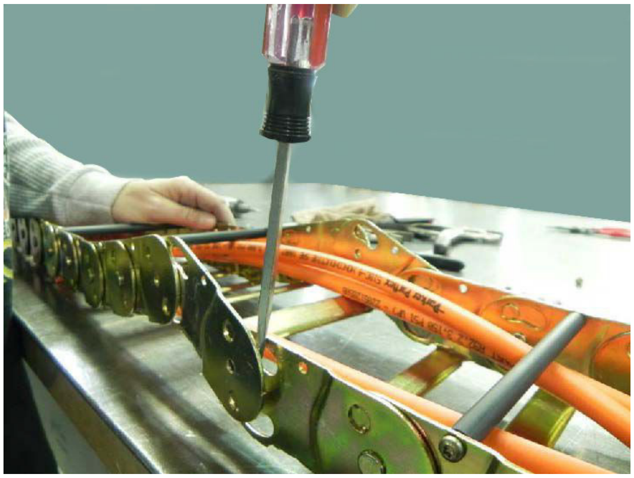


5. After grinding it may be necessary to use a center punch with a hammer to remove rivet.

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



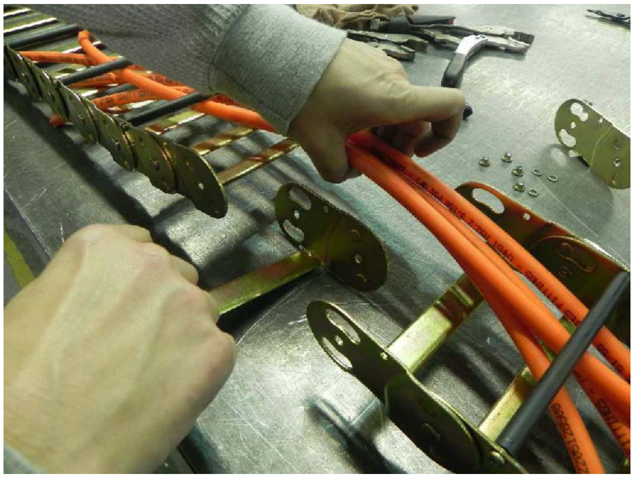
6. Insert flat head screwdriver between links. Twist and pull links apart.



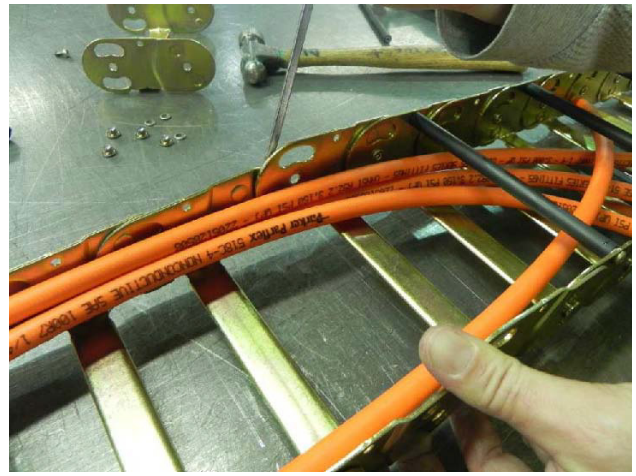
7. Remove link from other section of powertrack using screwdriver.

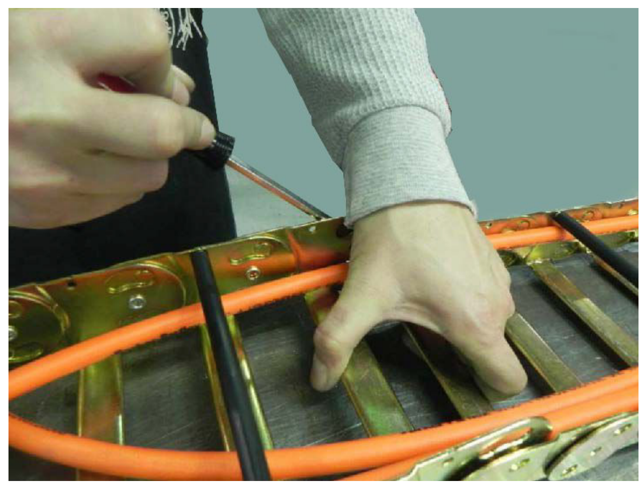
Install New Link

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

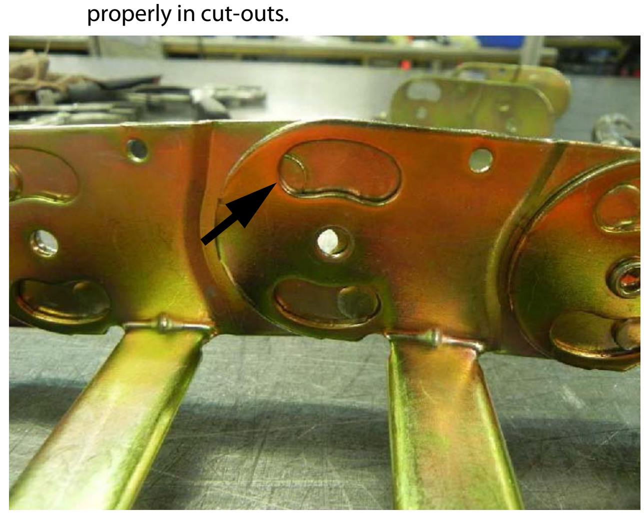


2. Spread half-shear (female) end of new link and slide cut-out end of track section into it. Use a screwdriver if necessary.

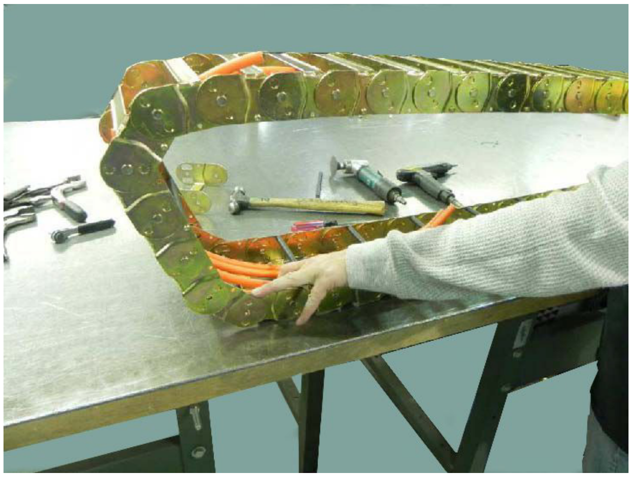




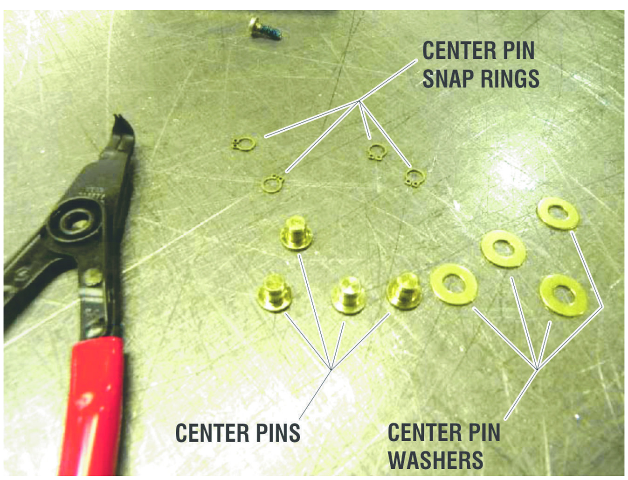
3. After new link is installed round half-shears do not fit properly in cut-outs.



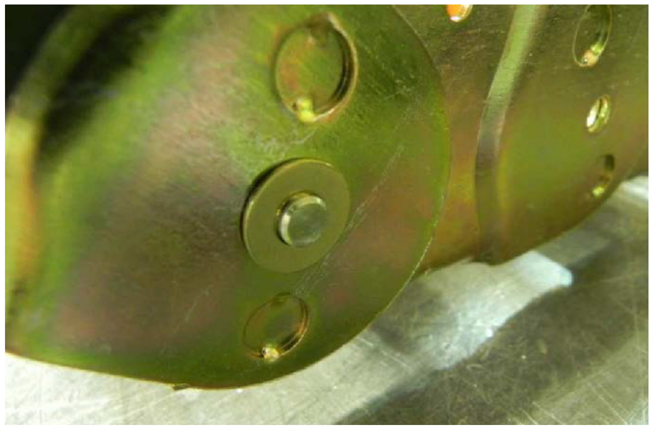
4. Pull moving end over track so new connection is positioned in curve of powertrack. Round half-shears will rotate into cut-outs.



5. Parts shown below connect new link to powertrack.



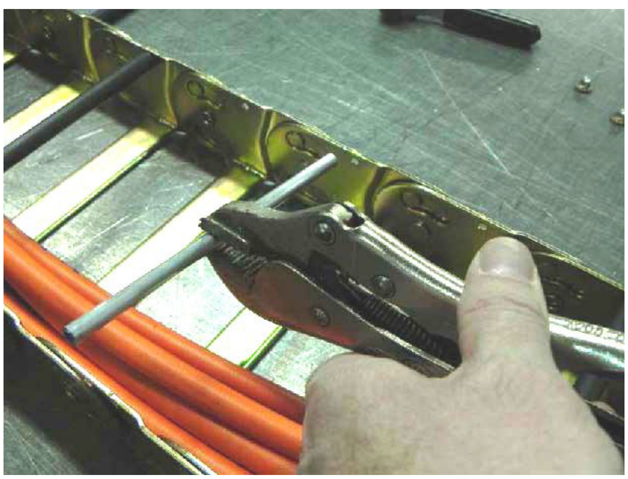
6. Push pin through center hole then slide washer on pin.

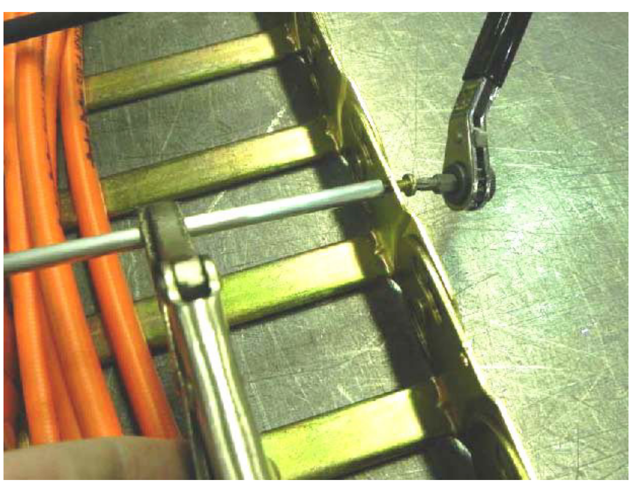


7. Install snap ring in groove on pin. Repeat pin installation steps for all center holes with rivets removed.

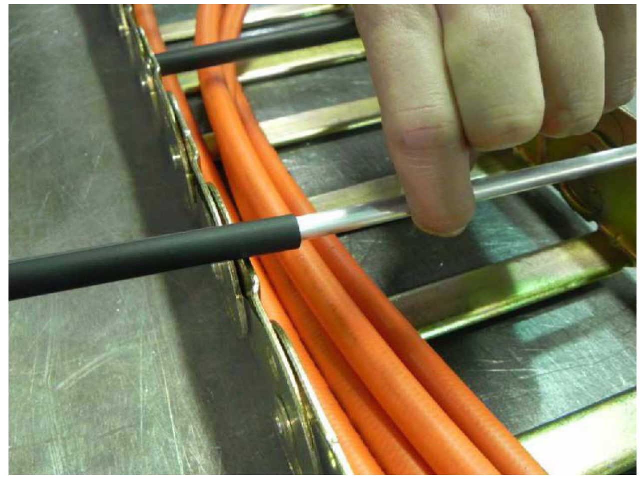
NOTE: *Make sure snap rings are seated in pin groove and closed properly.*

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

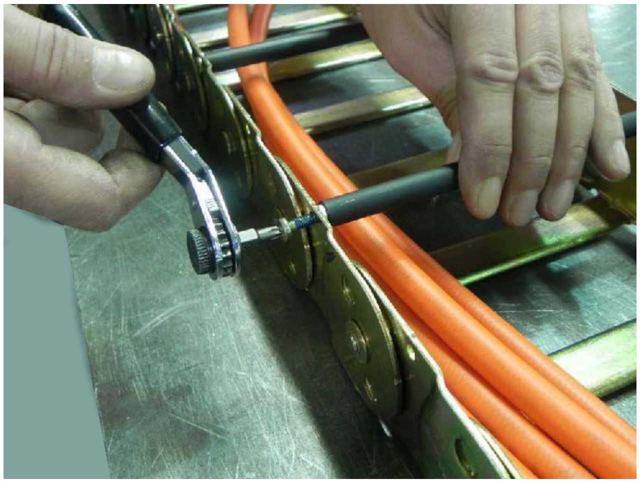




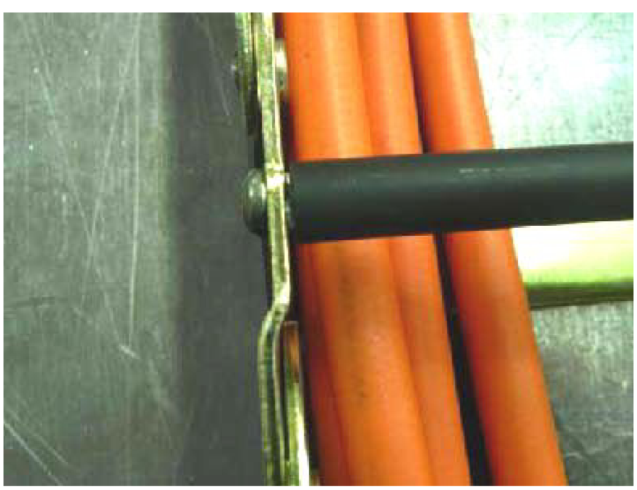
2. Pull up on other end of round bar and slide new poly roller on bar.



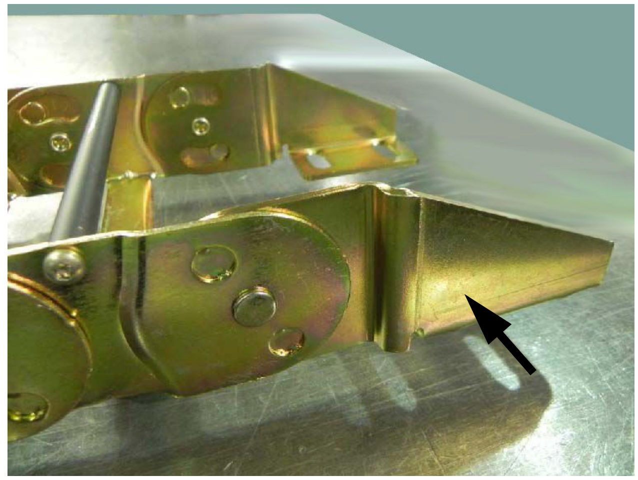
3. Install new 8-32 x 0.500 self threading screw on other side. Torque to 18-20 in. lbs. (2-2.25 Nm).



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



Replace Fixed End Brackets



NOTICE

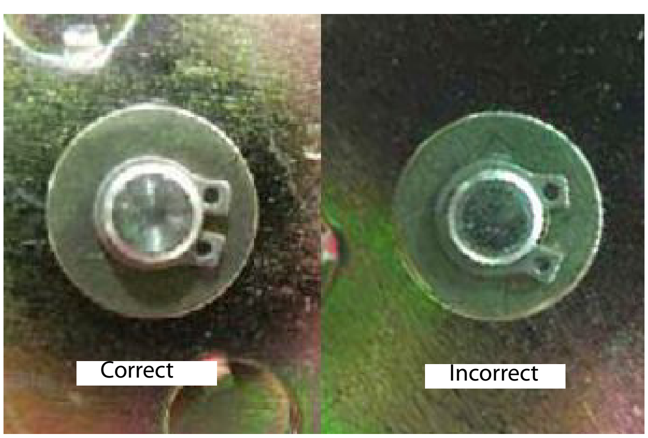
REPOSITION CABLES/HOSES AND KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

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

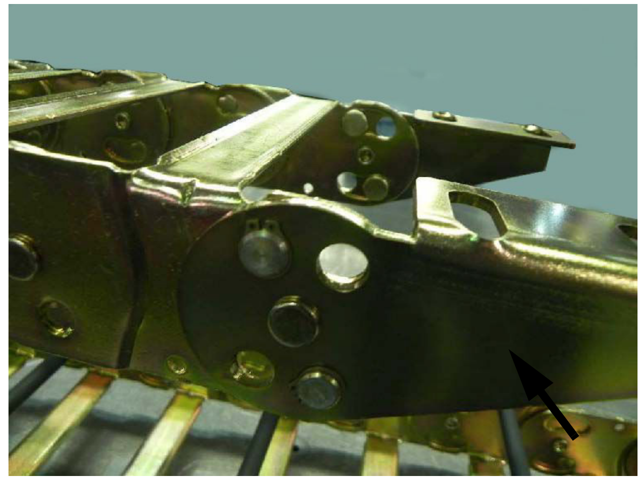
2. Parts used: Bracket Center Pin and Center Pin Snap Ring.

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

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



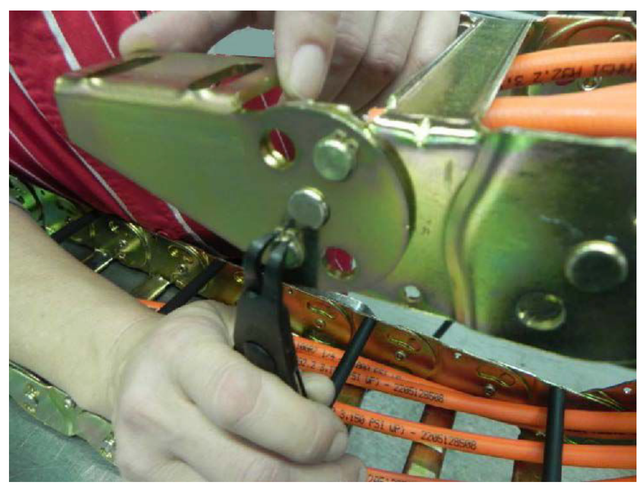
Replace Moving End Brackets



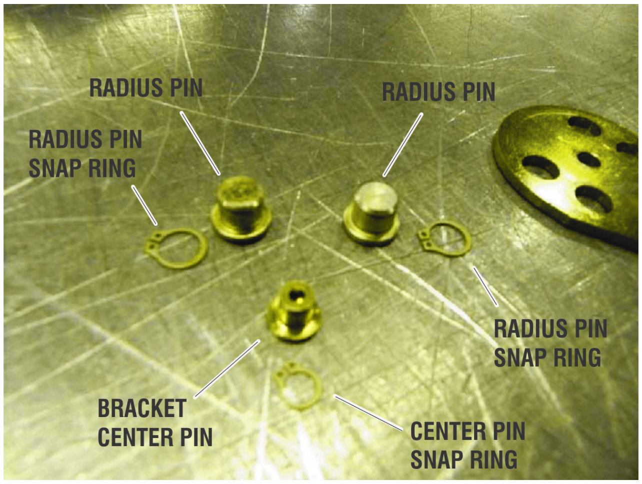
NOTICE

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

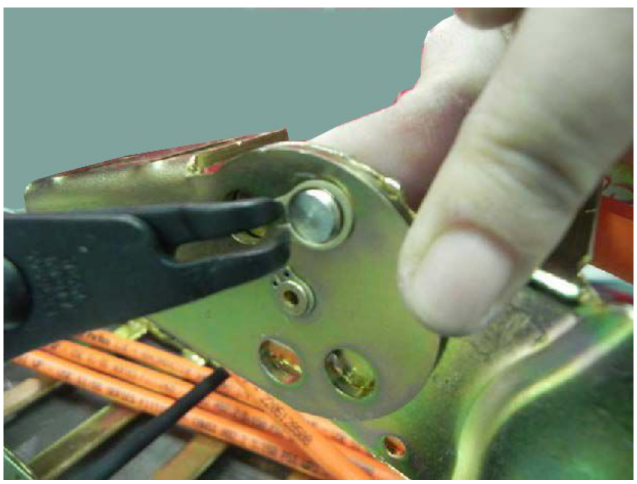
1. Remove existing pins and center rivet. Remove rivet as shown in link removal instructions on page 4-7. Repeat on other bracket if replacing it.



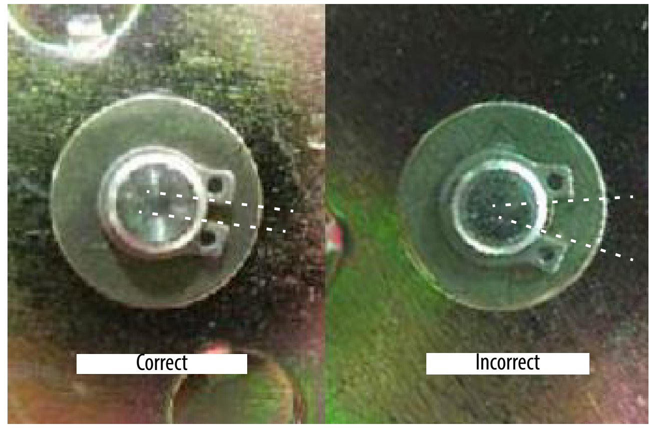
2. Install center pin with snap ring in new bracket.



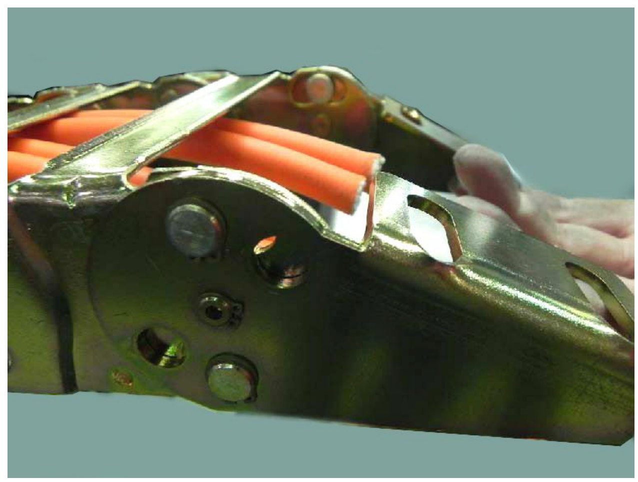
3. Install radius pins and snap rings in original locations. Repeat with other moving end if replacing it.



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



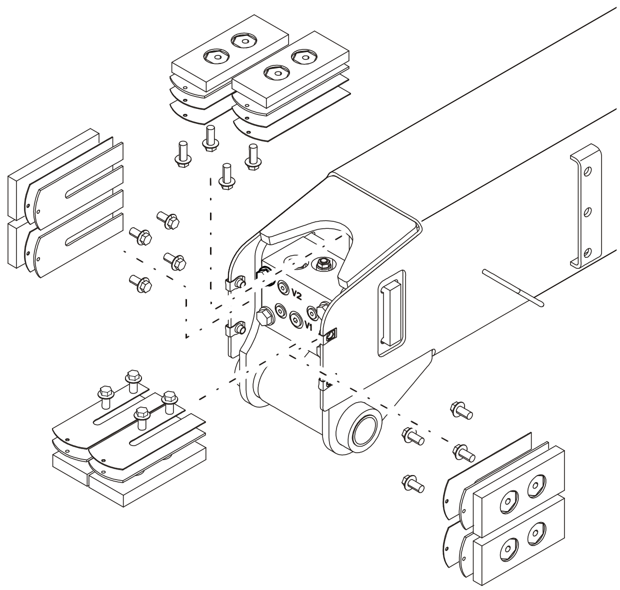
4. Make sure both brackets rotate correctly.



4.6 BOOM MAINTENANCE

Disassembly of the Main Boom

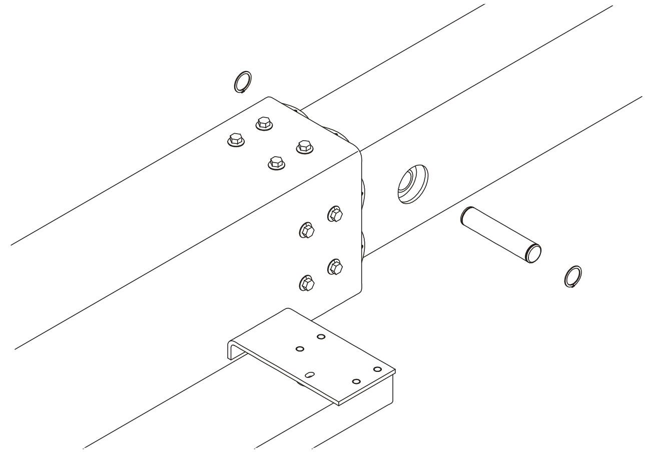
1. Loosen the wear pad retaining bolts at the rear of fly boom section and remove the shims and wear pads noting the location and amount of shims to aid in reassembly.



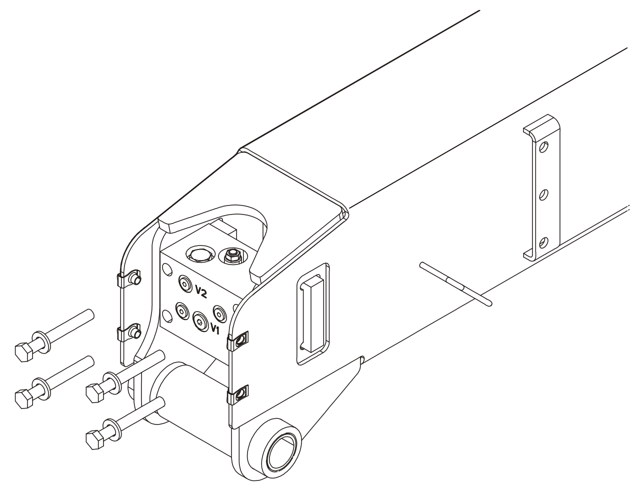
2. Using a portable power source, attach hose to telescope cylinder port block. Using all applicable safety precautions, activate hydraulic system and extend cylinder to gain access to cylinder rod retaining pin. Shut down the portable power source.
3. Carefully disconnect hydraulic hose from retract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

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

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

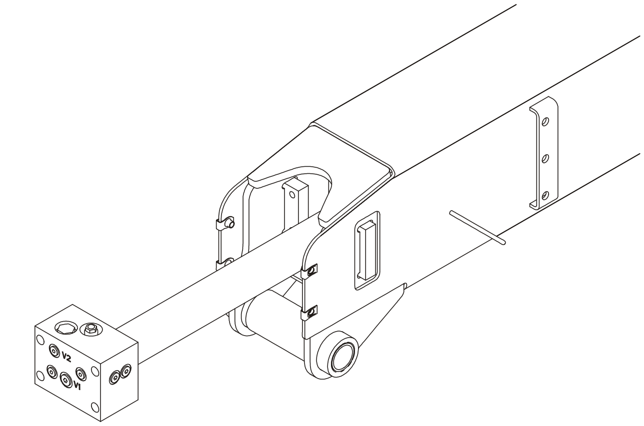


5. Remove the bolts and washers securing telescope cylinder to the rear of the base boom section.

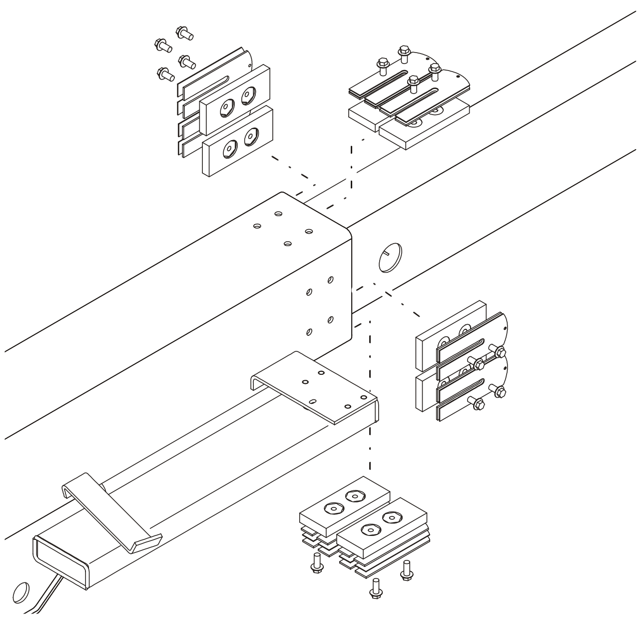


NOTE: *The telescope cylinder weighs approximately 53 lbs. (24 kg).*

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



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



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

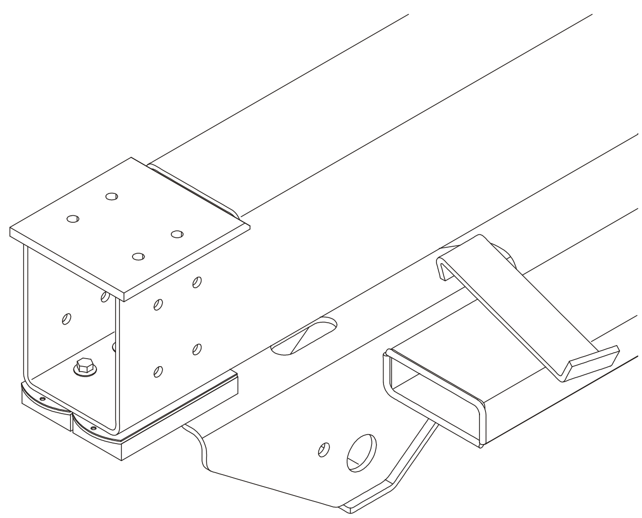
8. Using a suitable lifting device, remove fly boom from boom section.

Inspection

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

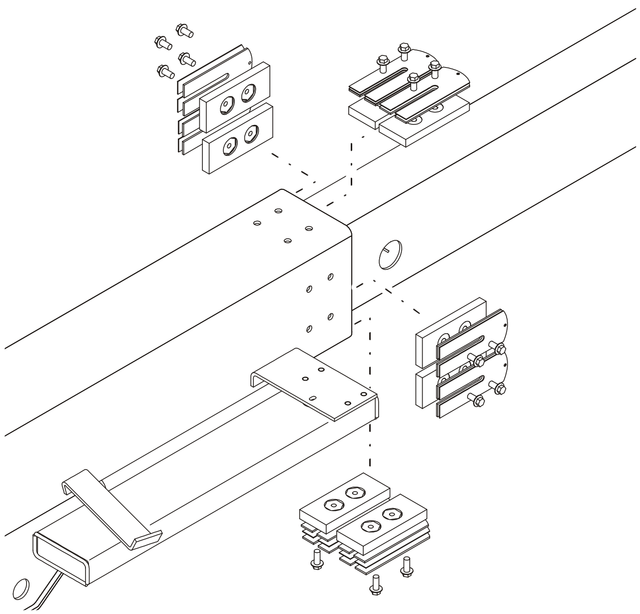
Assembly of the Main Boom

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

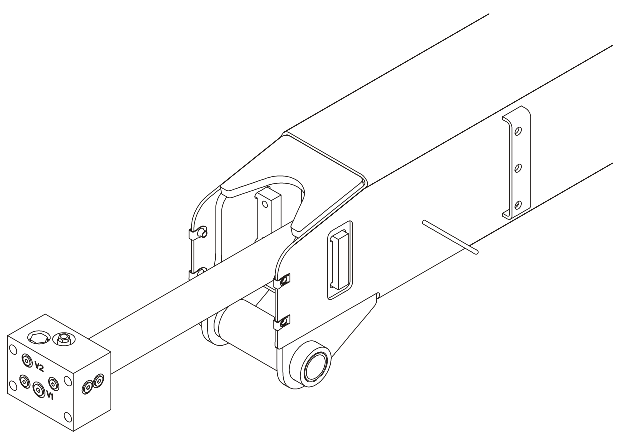


2. Using an adequate lifting device, slide the fly boom section into the base boom section. Install the remaining shims on the rear of the fly section as noted during disassembly and torque the retaining bolts to 40 ft.lbs. (55 Nm). Pull the fly section out of the base section enough to install the pin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

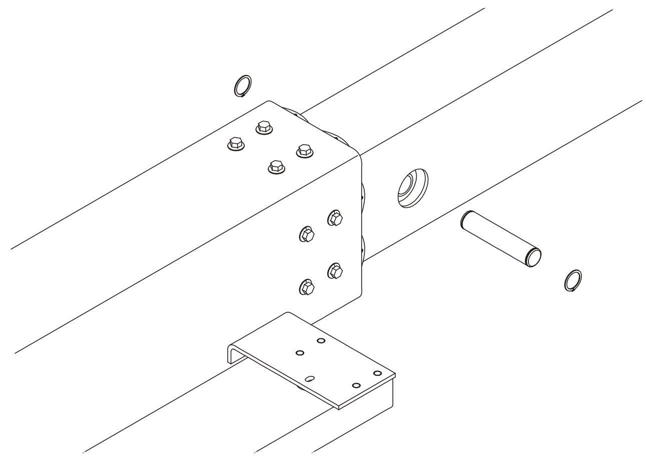
3. Using JLG P/N 0100011 thread locking compound or equivalent, install the front wear pads and shims as noted during disassembly on the base boom section. Torque the retaining bolts to 40 ft.lbs. (55 Nm).



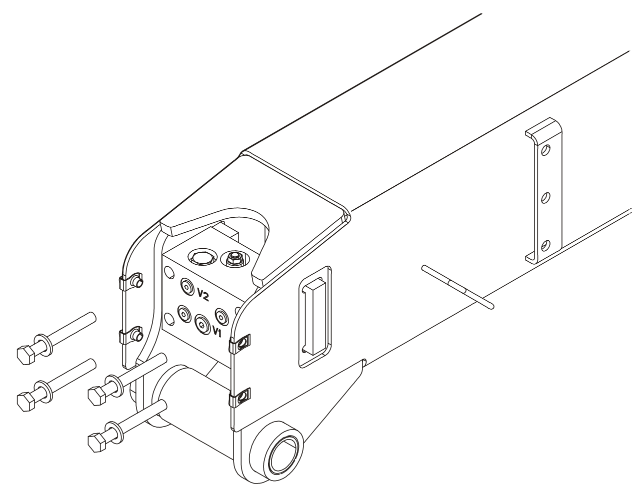
4. Using an adequate lifting device, install the telescope cylinder into the boom assembly. It will aid assembly if the cylinder is extended to enable connection to the fly boom section.

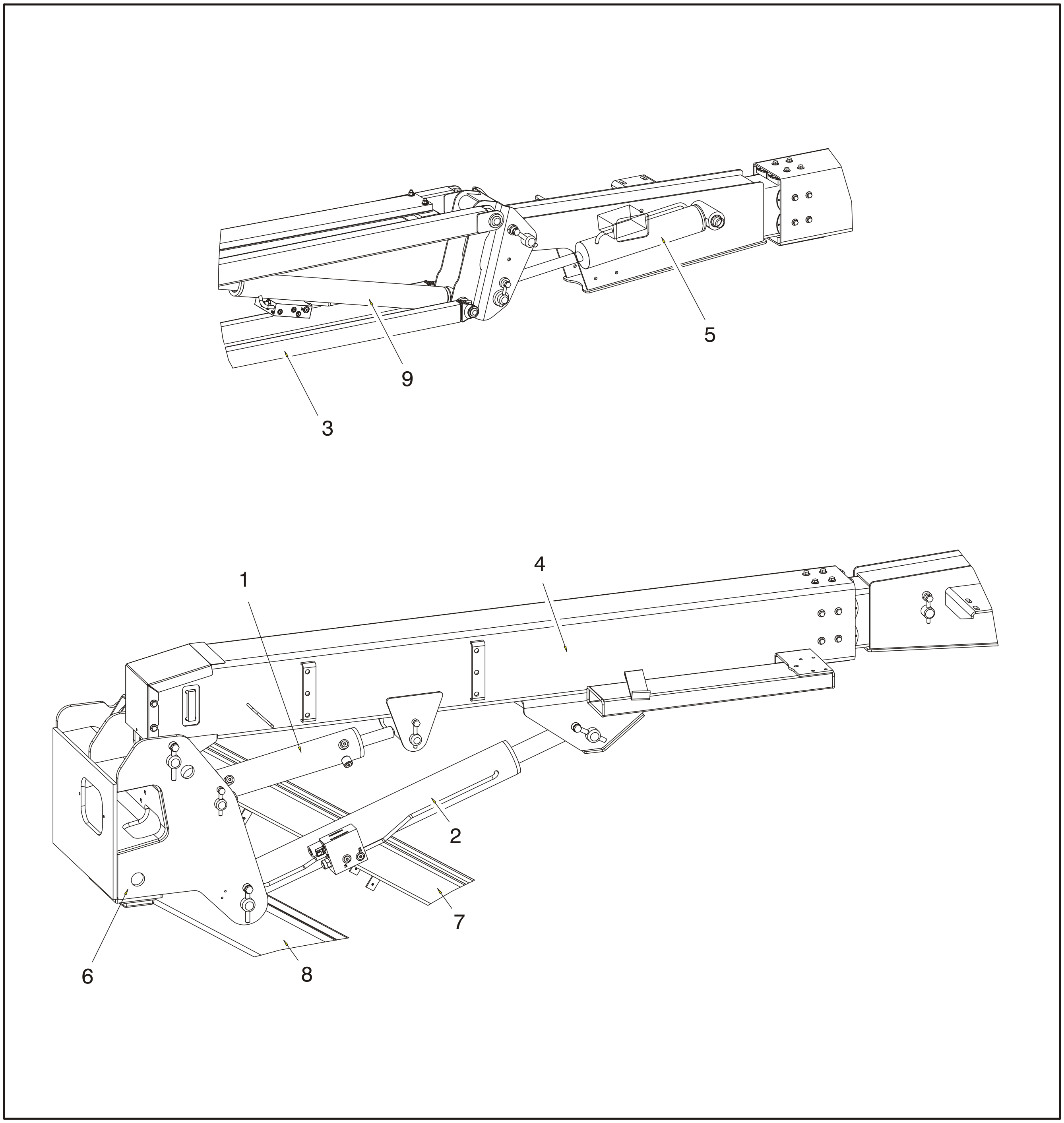


5. Align the telescope cylinder rod end with the corresponding hole in the fly boom section. If necessary, attach a portable power supply to the cylinder to extend or retract the cylinder for alignment. Install the retaining pin and secure it in place with the retaining ring.



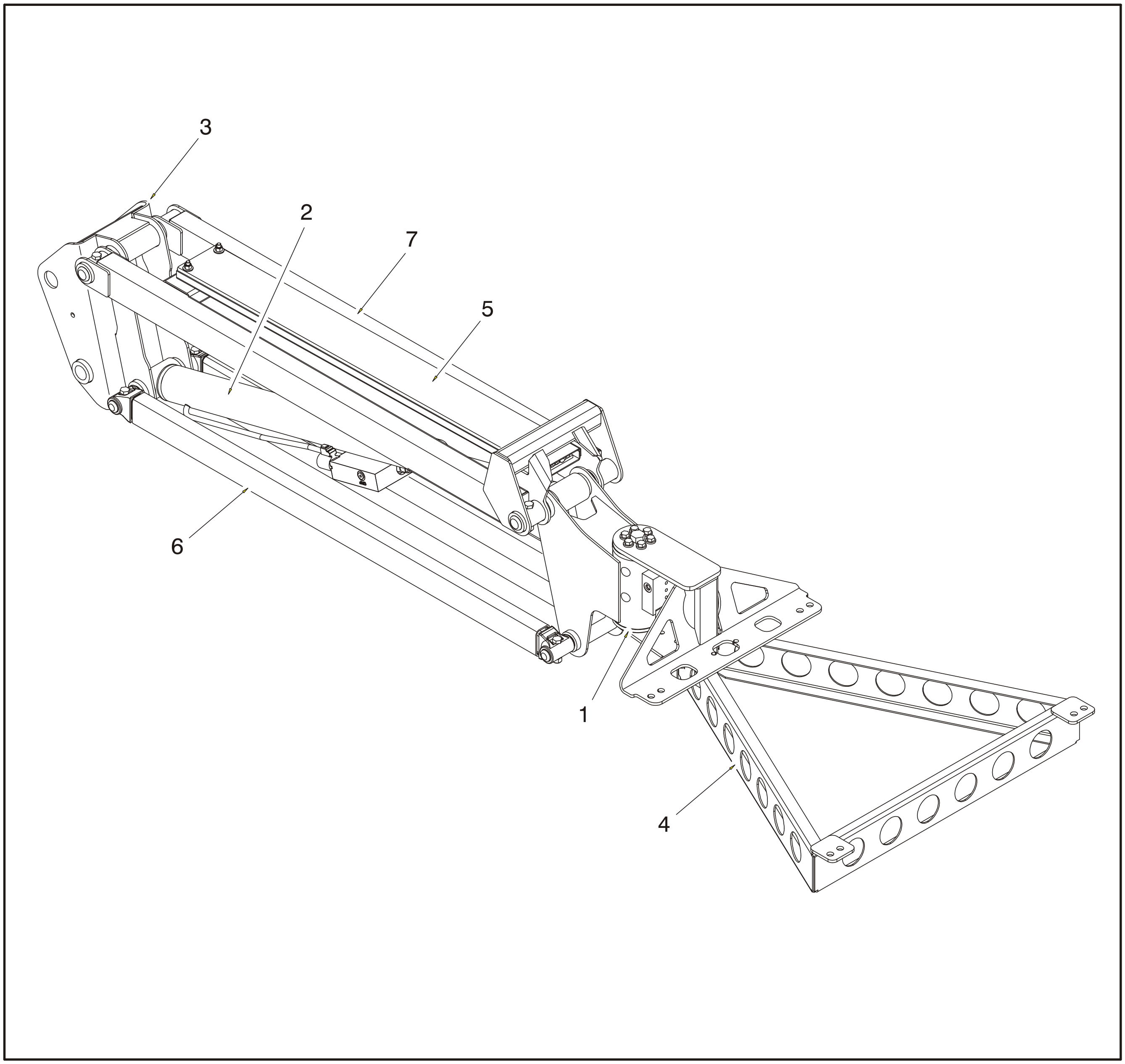
6. Using JLG P/N 0100011 thread locking compound or equivalent, secure the rear of the telescope cylinder to the base boom section with the attaching bolts and washers. Torque the bolts 95 ft.lbs. (129 Nm).





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

Figure 4-4. Main Boom Assembly



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

Figure 4-5. Jib/ Platform Support

4.7 BOOM CLEANLINESS GUIDELINES

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

1. JLG recommends the use of the JLG Hostile Environment Package if available to keep the internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.

2. JLG recommends that you follow all guidelines for servicing your equipment in accordance with the instructions outlined in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to the proper operation of the machine. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.

3. Debris and foreign matter inside of the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JLG Service & Maintenance Manuals.

4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow the debris toward the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.

5. If pressurized air cannot dislodge the debris, then water with mild solvents applied via a pressure washer can be used. Again the method is to wash the debris toward the nearest exiting point from the boom. Make sure that all debris is removed, that no "puddling" of water has occurred, and that the boom internal components are dry prior to operating the machine. Make sure you comply with all federal and local laws for disposing of the wash water and debris.

6. If neither pressurized air nor washing of the boom dislodges and removes the debris, then disassemble the boom in accordance to the instructions outlined in the JLG Service & Maintenance Manual to remove the debris.

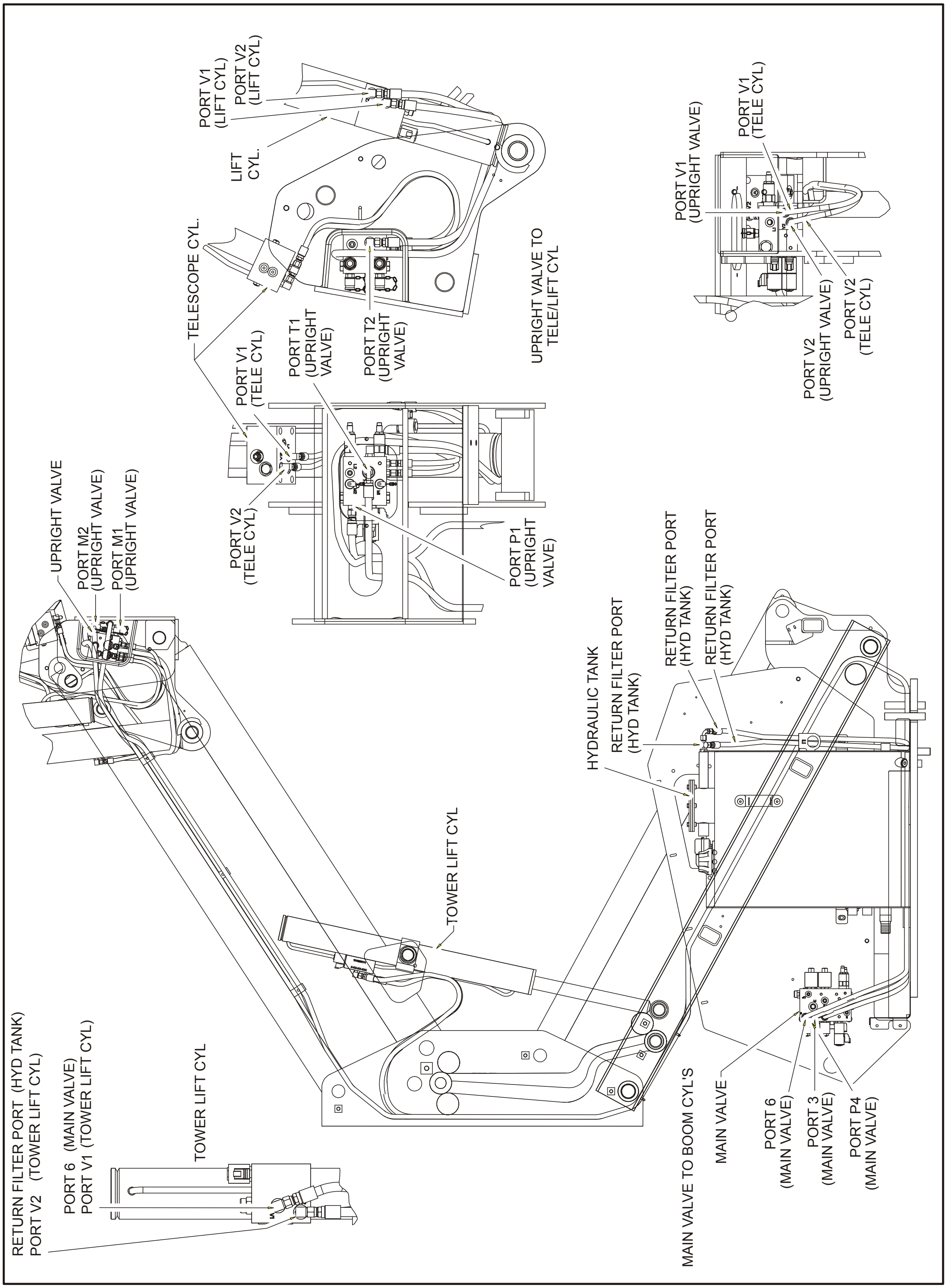


Figure 4-6. Boom Hydraulic Lines - Sheet 1 of 2

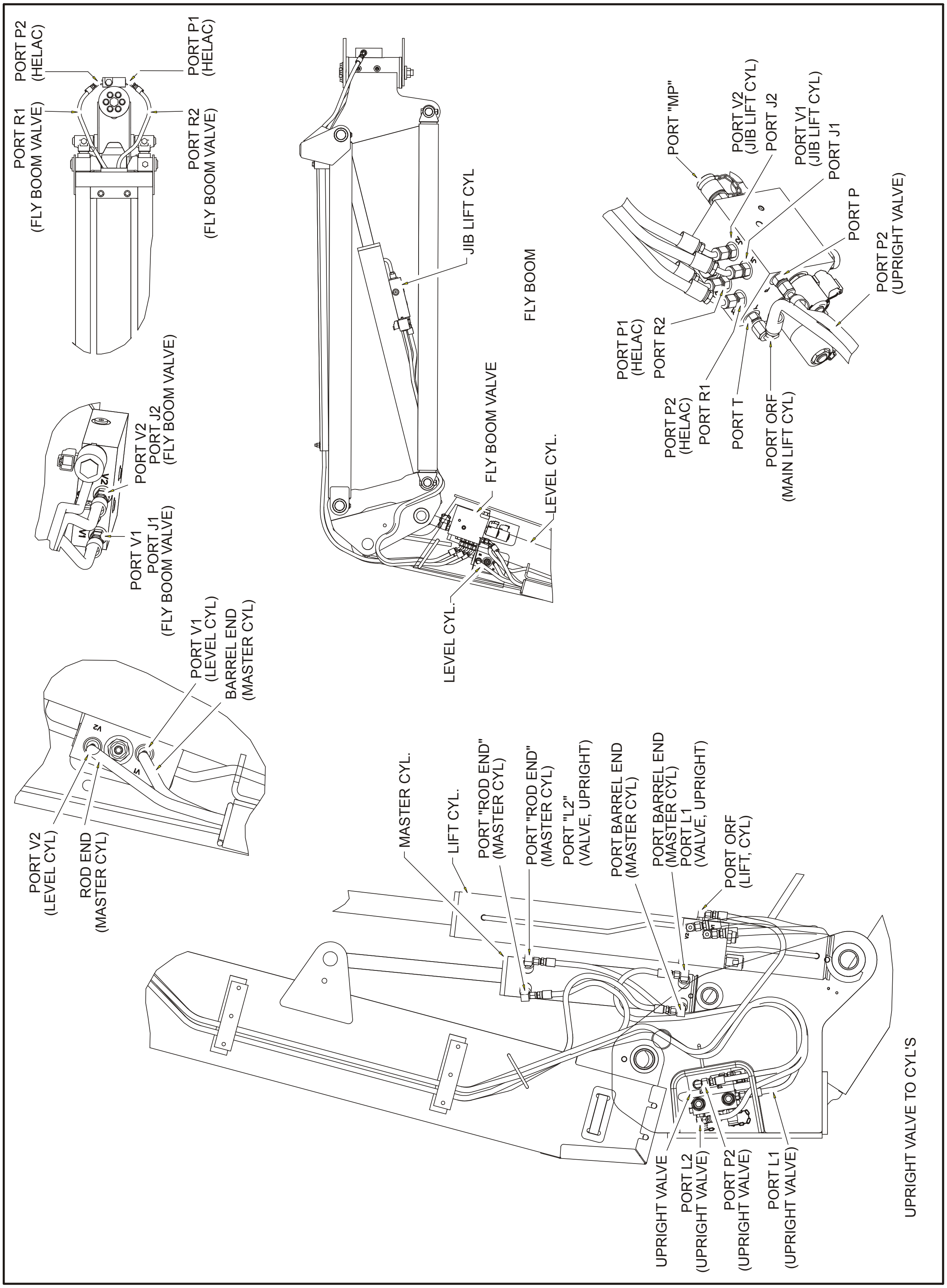


Figure 4-7. Boom Hydraulic Lines - Sheet 2 of 2

4.8 ROTARY ACTUATOR

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

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

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

Theory of Operation

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

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

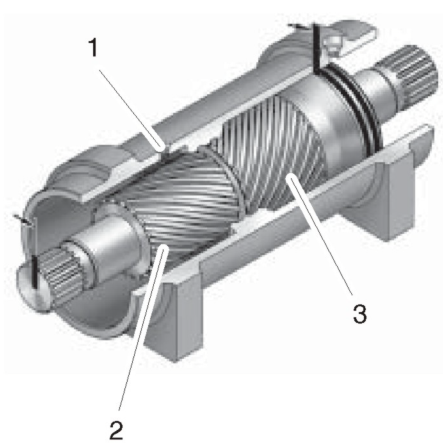
As hydraulic pressure is applied, the piston is displaced axially within the housing - similar to the operation of a hydraulic cylinder - while, simultaneously, the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the housing, preventing piston movement and locking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

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

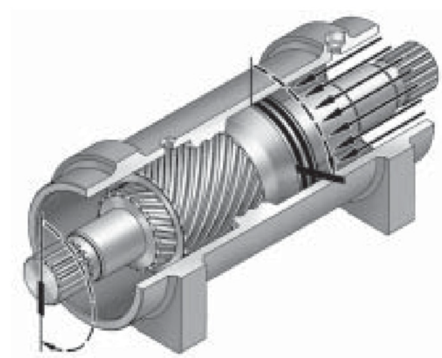
Many actuators are equipped with counterbalance valves, which performs four major functions.

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

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



Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary. For clarity, the shaft flange, bearings, and end cap are not shown.



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

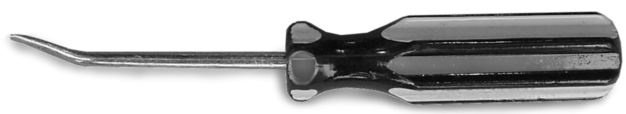
Figure 4-8. Actuator Theory of Operation

Tools Required

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

1. PIPE VISE
2. HEXWRENCH
   Removal and replacement of port plugs and set screws.
3. ASSORTED SCREWS
4. SAFETY GLASSES
5. END CAP REMOVAL TOOLS
   (provided with seal kit)
6. DRILL
7. FLASHLIGHT
   Helps in locating and examining timing marks, component failure and overall condition.
8. RUBBER MALLET
   Removal and installation of shaft and piston sleeve assembly.
9. PLASTIC MANDREL
10. PRY BAR
    Removal of end cap and manual rotation of shaft.
11. FELT MARKER
    Highlights timing marks and outlines troubled areas. Permanent ink is recommended.
12. T-HANDLE SCREW EXTRACTOR
13. HEX WRENCH SET
    Removal and replacement of port plugs and set screws (106,110).
14. SEAL TOOLS
    Removal and installation of seals and wear guides. Directions on making a seal tool are provided at bottom
15. PUNCH
16. DOWEL PINS
    Removal and installation of end cap.

MAKING A SEAL TOOL



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

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

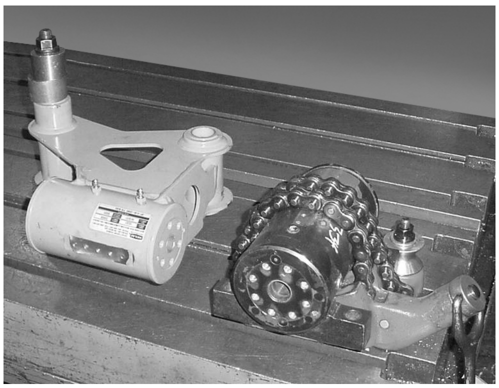
CAUTION

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

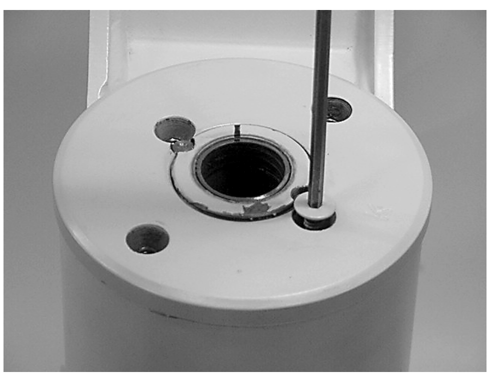
Disassembly

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

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

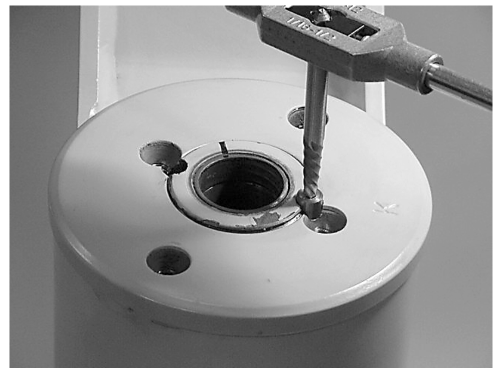


1. Remove port plugs (106.1) (106.2) and drain oil. Inspect oil for signs of contamination, i.e. water, metal shavings.



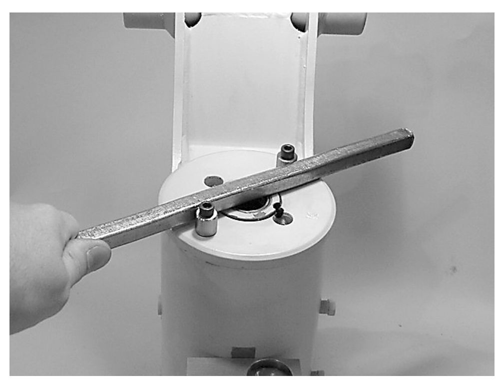
2. Remove the cap screws (113) that cover the end cap lock pins (109).
3. Using a 1/8" (3 mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/16" (5 mm).
4. Remove the lock pins using a screw extracting tool such as an "Easy Out" (a size #2 is shown).

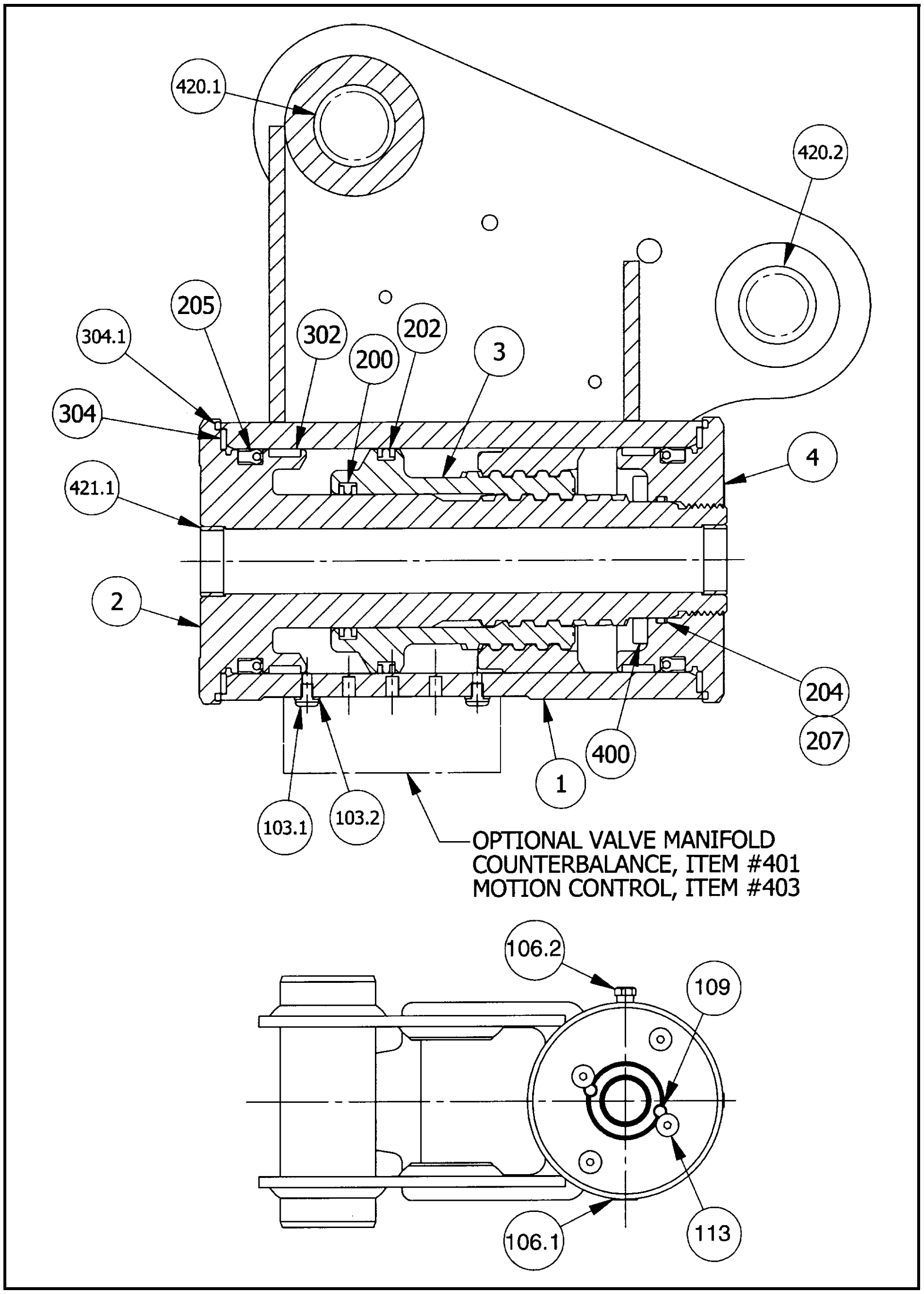
   If the pin cannot be removed with the screw extractor, use a 5/16" bit to drill out the entire pin. Do not drill deeper than 1/2" (12.7 mm).



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

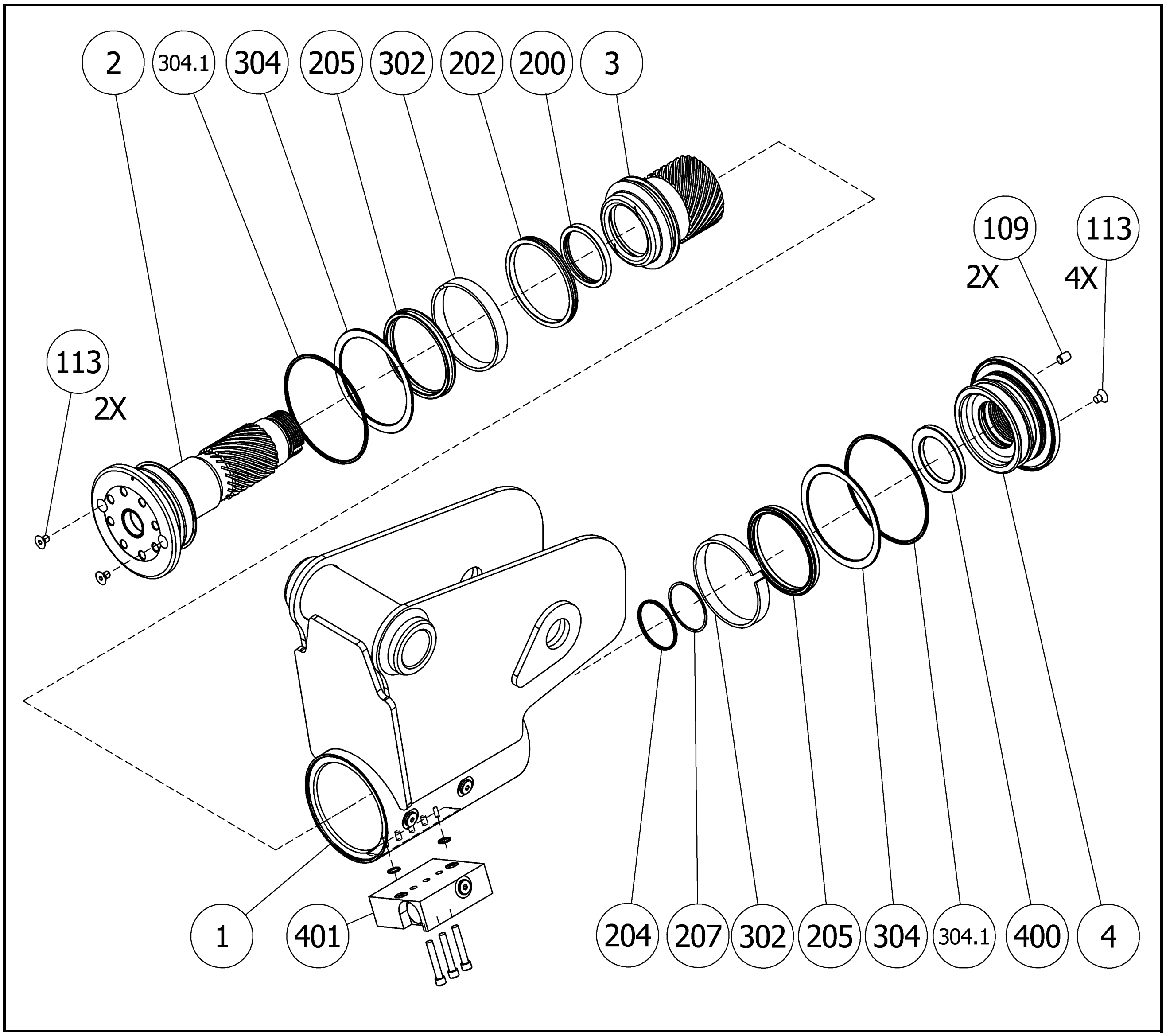
6. Using a metal bar or similar tool, unthread the end cap (4) by turning it counterclockwise.





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

Figure 4-9. Rotary Actuator - Assembly Drawing



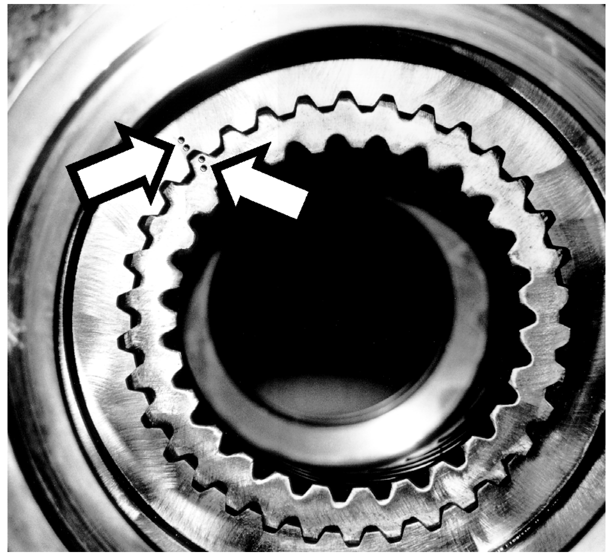
PARTS	HARDWARE	SEALS	BEARINGS	ACCESSORIES
1. Housing	103.1. Screw	200. T-Seal	302. Wear Guide	400. Stop Tube
2. Shaft	103.2. Washer	202. T-Seal	304. Thrust Washer	401 Counterbalance Valve
3. Piston Sleeve	106.1. Port Plug	204. O-ring		
4. End Cap	106.2. Port Plug	205. Cup Seal		
	109. Lock Pin	207. Backup Ring		
	113. Capscrew	304.1. Exclusion Seal		

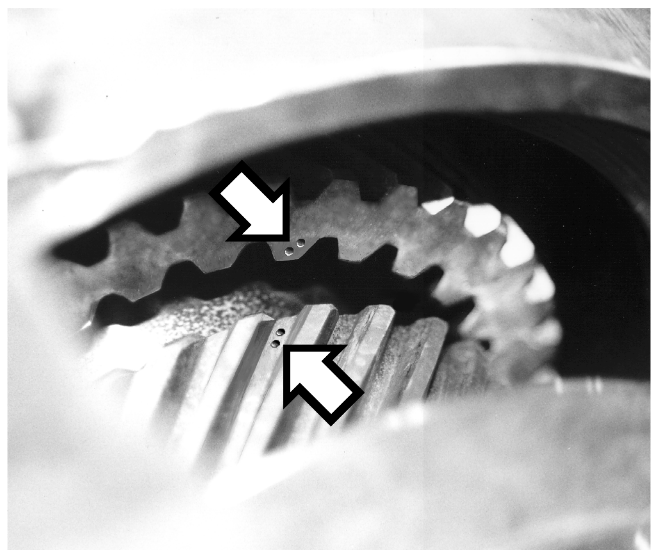
Figure 4-10. Rotary Actuator - Exploded View

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

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

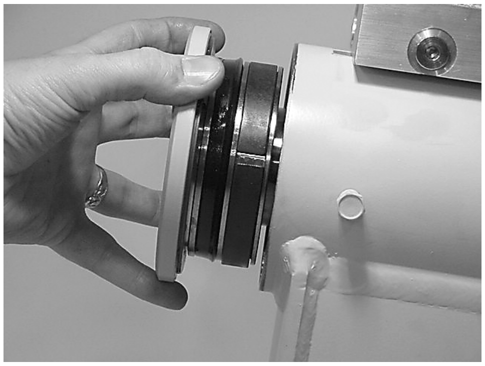
9. Every actuator has two sets of small punched timing marks that indicate timing between the gear sets. The location and appearance of the marks can vary slightly between models. One set indicates the timing between the piston sleeve (3) and the housing (1) (upper photo), the second set between the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



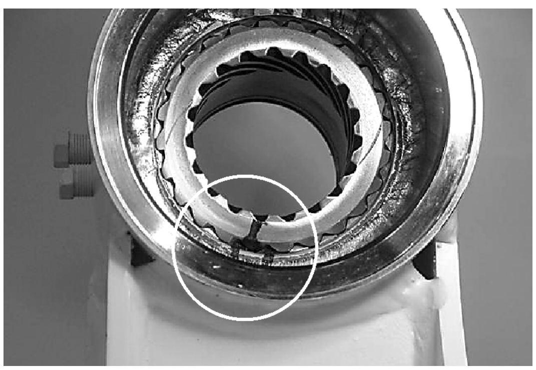


10. Prior to removing the shaft (2), use a felt marker to clearly indicate the timing between shaft and piston sleeve (3). This will greatly simplify timing when the actuator is reassembled.

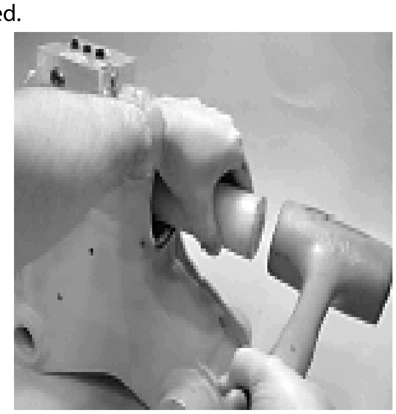
11. Remove the shaft (2) by rotating counterclockwise. As the shaft is rotated, it will disengage from the piston sleeve (3) and can be removed. It may be necessary to strike the threaded end of the shaft with a rubber mallet.



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



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



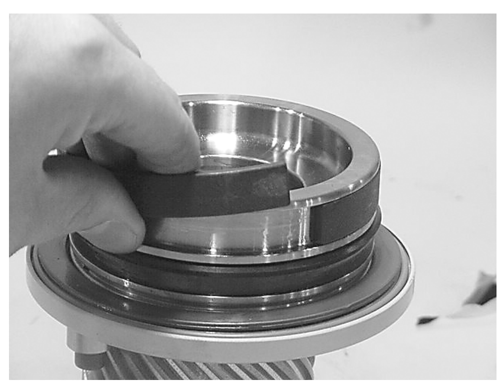
14. At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.

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

NOTICE

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

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



17. Remove the main pressure seal (205).

18. Remove the thrust washer (304) from the end cap (4) and shaft (2).

19. Remove the O-ring (304.1) from its groove in the end cap (4) and shaft (2).

20. Remove the outside diameter piston seal (202) from the piston.

21. Remove the inside diameter piston seal (200).

Inspection

NOTICE

PRIOR TO ASSEMBLY OF ACTUATOR, THESE STEPS MUST BE CLOSELY FOLLOWED TO ENSURE PROPER OPERATION OF THE ACTUATOR.

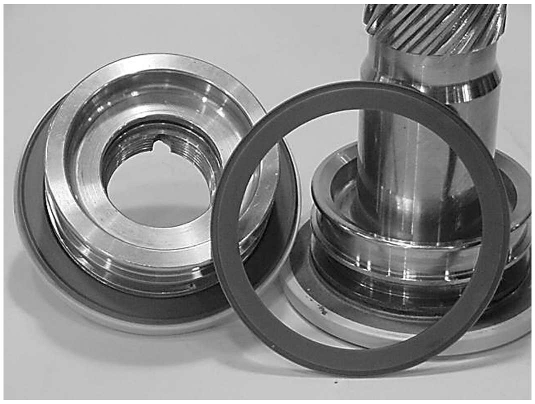
1. Clean all parts in a solvent tank and dry with compressed air prior to inspecting.
2. Carefully inspect all critical areas for any surface finish abnormalities: Seal grooves, bearing grooves, thrust surfaces, shaft surface, housing bore and gear teeth.

NOTICE

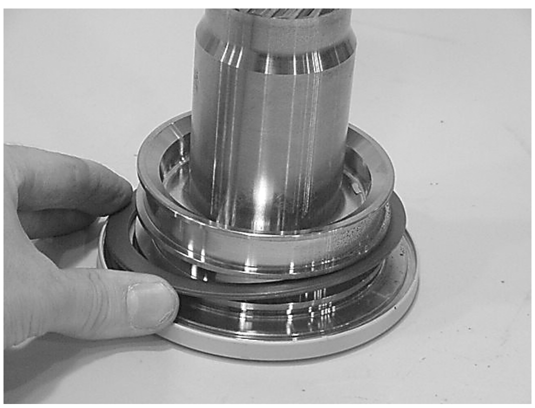
SMALL OR MINOR SURFACE SCRATCHES CAN BE CAREFULLY POLISHED.

Assembly

1. Gather all the components and tools into one location prior to re-assembly. Use the cut away drawing to reference the seal orientations.

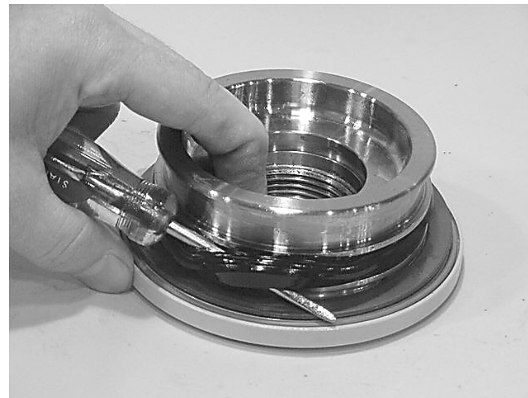


2. Coat the thrust washers (304) with a generous amount of Lithium grease. Install the thrust washer (304) onto shaft (2) and end cap (4).



3. Install the exclusion seal (304.1) into the appropriate grooves on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).

4. Using a seal tool install the main pressure seal (205) onto shaft (2) and end cap (4). Use the seal tool in a circular motion.



5. Install the wear guide (302) on the end cap (4) and shaft (2).

6. Install the O-ring (204) and back-up ring (207) into the inner seal groove on the end cap (4).

7. Install the inner T-seal (200) into the appropriate groove in the piston (3). Use a circular motion to ensure the seal is correctly seated in the groove.

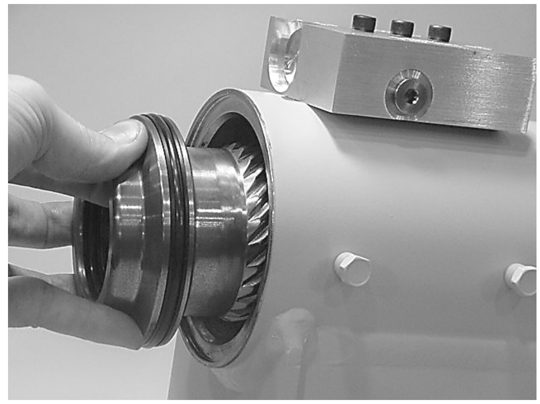
Install the outer T-seal (202) by stretching it around the groove in a circular motion.

Each T-seal has 2 back-up rings (see Assembly Drawing for orientation). Beginning with the inner seal (200) insert one end of backup ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly.

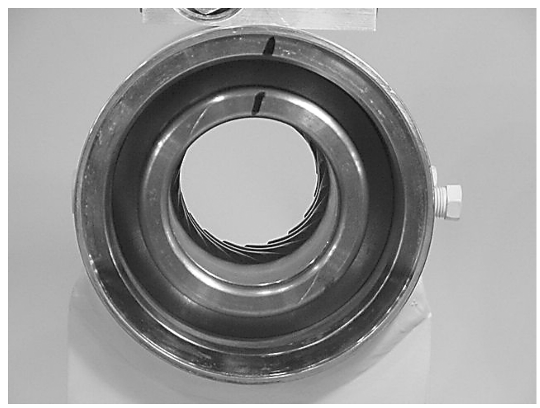
Insert the other back up ring in upper groove.

Repeat both of these steps for the outer seal (202).

8. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) contacts the inside housing bore.

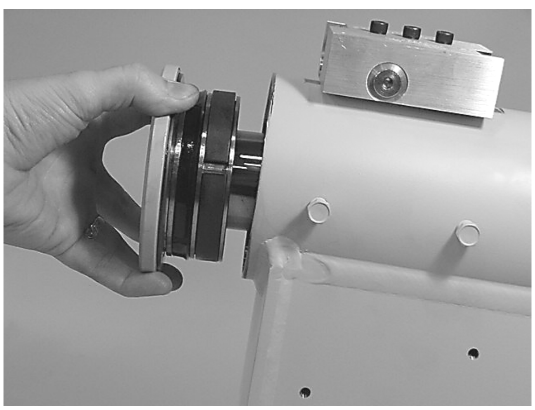


9. Looking into the housing bore from the shaft flange end, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly align as shown. Using a rubber mallet, tap the piston into the housing until the gear teeth contact.

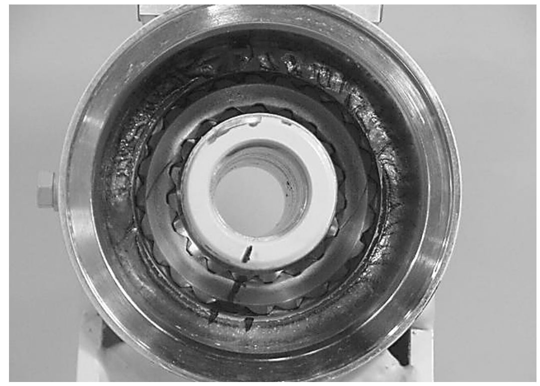


10. Looking into the bore from the opposite end of the housing (1) be sure the timing marks align correctly. Rotate the piston as necessary until aligned, then gently tap the piston (3) into the housing until the gear teeth mesh together. Tap the piston into the housing until it completely bottoms out against the ring gear.

11. Insert the shaft (2) into the piston (3). Be careful not to damage the piston seals. Do not engage the piston gear teeth yet.



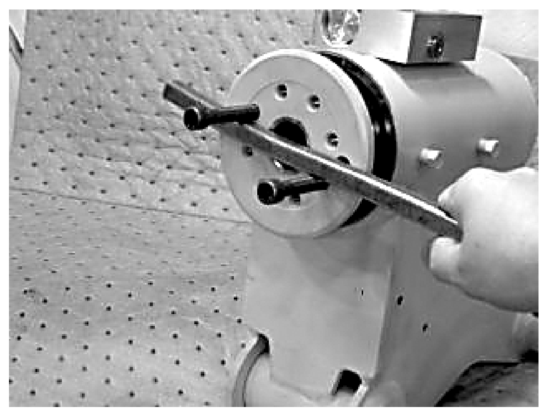
12. Looking at the actuator from the end opposite the shaft flange, use the existing timing marks to align the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). When the marks align, gently tap the flange end of the shaft with a rubber mallet until the gear teeth engage.



13. Install two bolts in the threaded holes in the flange. Using a metal bar, rotate the shaft in a clockwise direction until the wear guides are seated inside the housing bore.

NOTICE

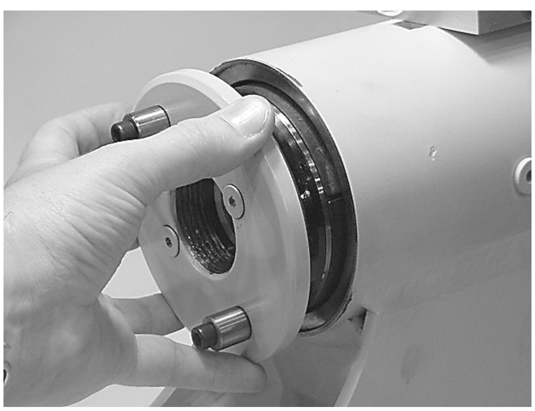
AS THE SHAFT IS ROTATED, BE CAREFUL NOT TO DISENGAGE THE PISTON AND HOUSING GEARING.



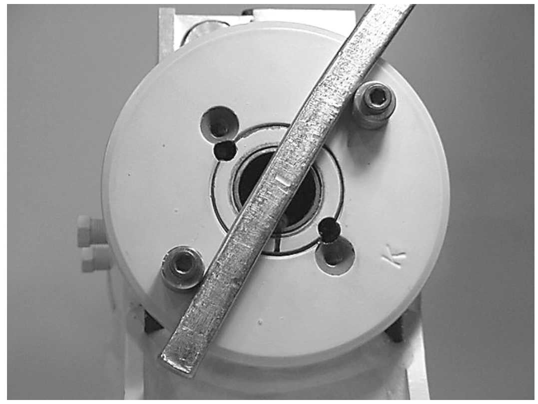
14. Install the stop tube (400) onto the shaft end if necessary. Stop tubes are an available option to limit the rotation of an actuator.

15. Coat the threads on the end of the shaft with anti-seize grease to prevent galling.

16. Thread the end cap (4) onto the shaft (2). Make sure the wear guide remains in place on the end cap as it is threaded into the housing (1).

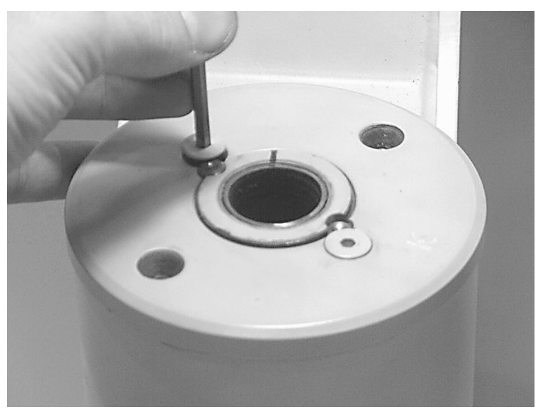


17. Tighten the end cap (4) using a metal bar. In most cases the original holes for the lock pins will align.



18. Insert the lock pins (109) provided with the Helac seal kit into the holes with the dimple side up. Then, using a punch, tap the lock pins to the bottom of the hole.

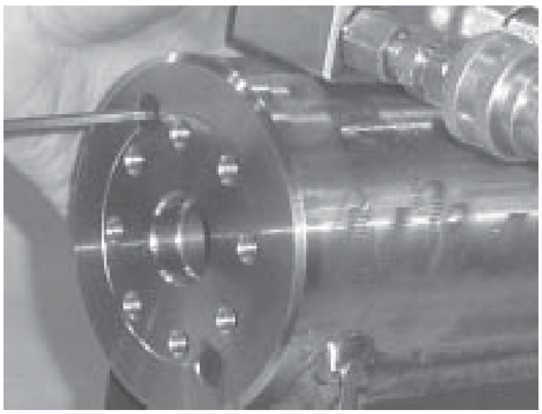
19. Insert the set screws (113) over the lock pins. Tighten to 25 in-lbs. (2.8 Nm).



Greasing Thrust Washers

1. After the actuator is assembled but before it is put into service, the thrust washer area must be packed with Lithium grease.

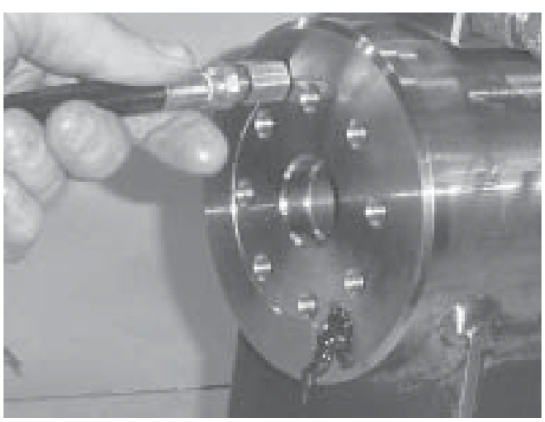
   There are two grease ports located on both the shaft flange and the end cap. They are plugged with cap screws (113) or set screws. Remove the grease port screws from the shaft flange and end cap. (See exploded view)



NOTICE

IF A HYDRAULIC TEST BENCH IS NOT AVAILABLE, THE ACTUATOR CAN BE ROTATED BY HAND, OPEN THE PRESSURE PORTS AND USE A PRY BAR WITH CAP SCREWS INSERTED INTO THE SHAFT FLANGE TO TURN THE SHAFT IN THE DESIRED DIRECTION.

Insert the tip of a grease gun into one port and apply grease to the shaft flange. Continue applying until grease flows from the opposite port. Cycle the actuator five times and apply grease again. Repeat this process on the end cap. Insert the cap screws into the grease ports and tighten to 25 in-lbs. (2.8 Nm).



Installing Counterbalance Valve

Refer to Figure 4-11., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old Loctite.
2. Make sure the new valve has the O-rings in the counterbores of the valve to seal it to the actuator housing.
3. The bolts that come with the valve are grade 8 bolts. New bolts should be installed with a new valve. Loctite #242 should be applied to the shank of the three bolts at the time of installation.
4. Torque the 1/4-inch bolts 110 to 120 inch pounds (12.4 to 13.5 Nm). Do not torque over 125 inch pounds (14.1 Nm). Torque the 5/16-inch bolts 140 inch pounds (15.8 Nm). Do not torque over 145 inch pounds (16.3 Nm).

Testing the Actuator

If the equipment is available, the actuator should be tested on a hydraulic test bench. The breakaway pressure — the pressure at which the shaft begins to rotate — should be approximately 400 psi (28 bar). Cycle the actuator at least 25 times at 3000 psi (210 bar) pressure. After the 25 rotations, increase the pressure to 4500 psi (315 bar) to check for leaks and cracks. Perform the test again at the end of the rotation in the opposite direction.

TESTING THE ACTUATOR FOR INTERNAL LEAKAGE

If the actuator is equipped with a counterbalance valve, plug the valve ports. Connect the hydraulic lines to the housing ports. Bleed all air from the actuator (see Installation and Bleeding) Rotate the shaft to the end of rotation at 3000 psi (210 bar) and maintain pressure. Remove the hydraulic line from the non-pressurized side.

Continuous oil flow from the open housing port indicates internal leakage across the piston. Replace the line and rotate the shaft to the end of rotation in the opposite direction. Repeat the test procedure outlined above for the other port. If there is an internal leak, disassemble, inspect and repair.

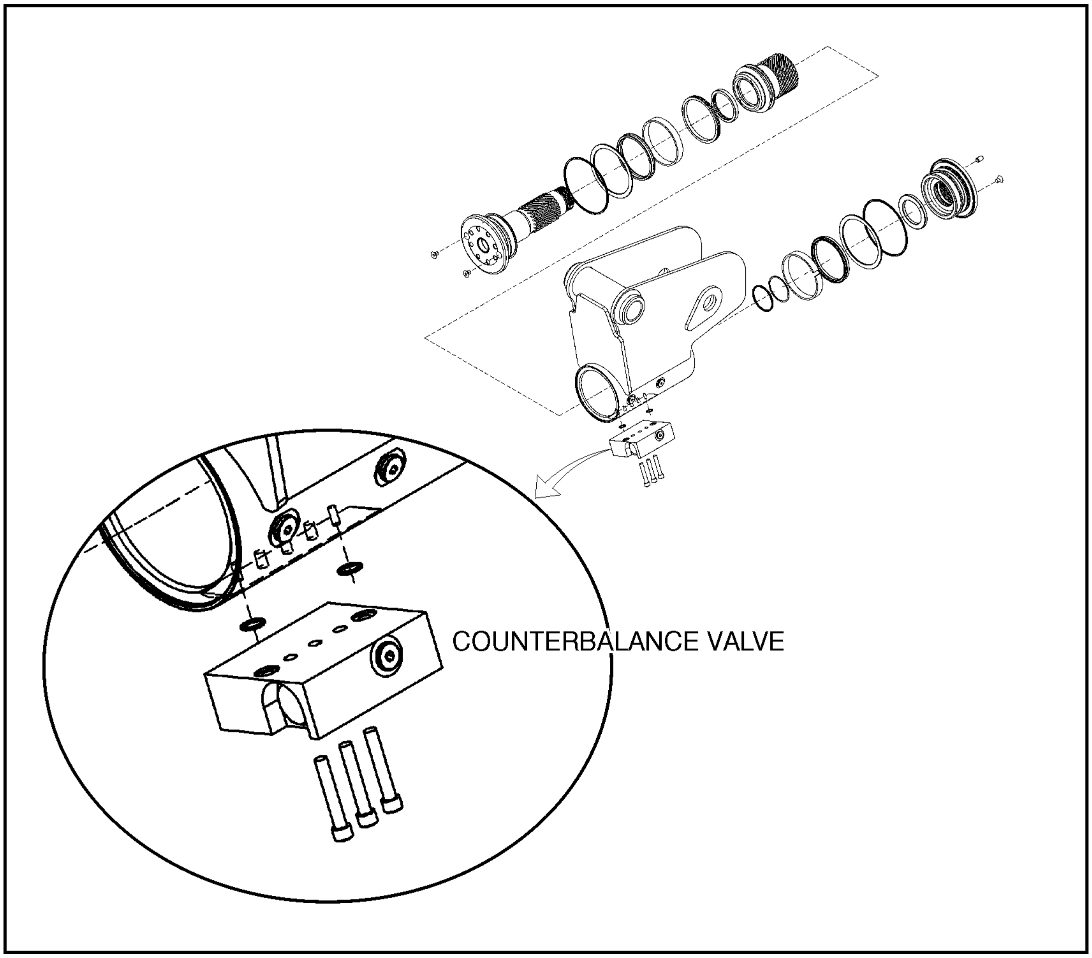


Figure 4-11. Rotator Counterbalance Valve

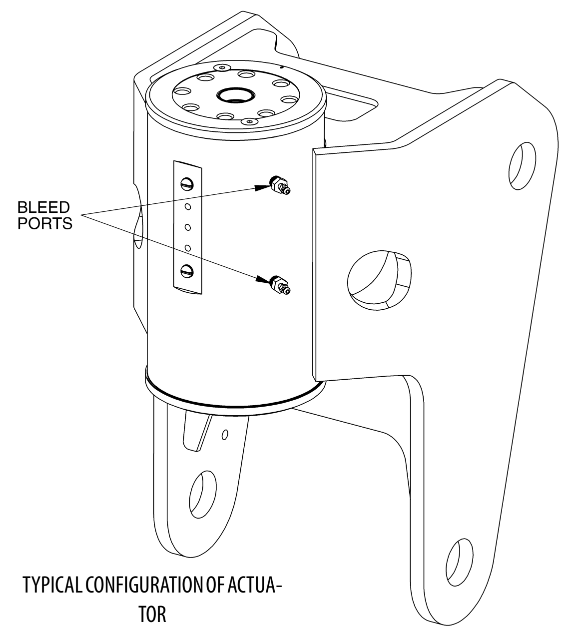
Installation and Bleeding

After installation of the actuator on the equipment, it is important that all safety devices such as tie rods or safety cables are properly reattached.

To purge air from the hydraulic lines, connect them together to create a closed loop and pump hydraulic fluid through them. Review the hydraulic schematic to determine which hydraulic lines to connect. The linear feet and inside diameter of the hydraulic supply lines together with pump capacity will determine the amount of pumping time required to fully purge the hydraulic system.

Bleeding may be necessary if excessive backlash is exhibited after the actuator is connected to the hydraulic system. The following steps are recommended when a minimum of two gallons (8 liters) is purged.

1. Connect a 3/16" inside diameter x 5/16" outside diameter x 5 foot clear, vinyl drain tube to each of the two bleed nipples. Secure them with hose clamps. Place the vinyl tubes in a clean 5-gallon container to collect the purged oil. The oil can be returned to the reservoir after this procedure is completed.



TYPICAL CONFIGURATION OF ACTUATOR

2. With an operator in the platform, open both bleed nipples 1/4 turn. Hydraulically rotate the platform to the end of rotation (either clockwise or counterclockwise), and maintain hydraulic pressure. Oil with small air bubbles will be seen flowing through the tubes. Allow a 1/2 gallon of fluid to be purged from the actuator.

3. Keep the fittings open and rotate the platform in the opposite direction to the end position. Maintain hydraulic pressure until an additional 1/4 gallon of fluid is pumped into the container.

4. Repeat steps 2 & 3. After the last 1/2 gallon is purged, close both bleed nipples before rotating away from the end position.

Troubleshooting

Table 4-1. Troubleshooting

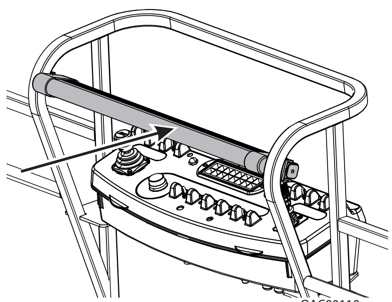
Problem	Cause	Solution
1. Shaft rotates slowly or not at all	a. Insufficient torque output	a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.
	b. Low rate of fluid flow	b. Inspect ports for obstructions and hydraulic lines for restrictions and leaks.
	c. Control or counterbalance valve has internal leak	c. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	d. Piston and/or shaft seal leak	d. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	e. Corrosion build-up on the thrust surfaces	e. Re-build the actuator. Remove all rust then polish. Replacement parts may be needed.
	f. Swollen seals and composite bearings caused by incompatible hydraulic fluid	f. Re-build the actuator. Use fluid that is compatible with seals and bearings.
2. Operation is erratic or not responsive	a. Air in actuator	a. Purge air from actuator. See bleeding procedures.
3. Shaft will not fully rotate	a. Twisted or chipped gear teeth	a. Check for gear binding. Actuator may not be able to be rebuilt and may need to be replaced. Damage could be a result of overload or shock.
	b. Port fittings are obstructing the piston	b. Check thread length of port fittings. Fittings should during stroke not reach inside the housing bore.
4. Selected position cannot be maintained	a. Control or counterbalance valve has internal leak	a. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	b. Piston and/or shaft seal leak	b. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	c. Air in actuator	c. Purge air from actuator. See bleeding procedures

4.9 SKYGUARD®

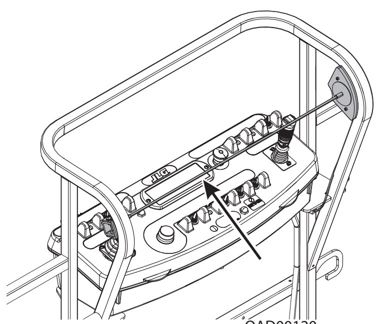
Operation

SkyGuard provides enhanced control panel protection. When the SkyGuard sensor is activated, functions in use at the time of actuation will reverse or cutout. The SkyGuard Function Table provides more details on these functions.

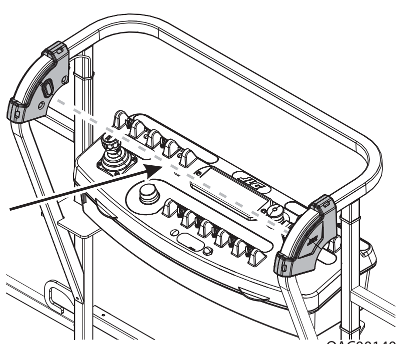
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



SkyGuard



SkyGuard SkyLine™



SkyGuard SkyEye™

⚠ WARNING

THE MACHINE OPERATOR IS REQUIRED TO PERFORM A DAILY FUNCTION TEST TO ENSURE PROPER OPERATION OF THE SKYGUARD SYSTEM.

Function Test

SKYGUARD ONLY

Perform this function test if **SkyGuard only** is selected in machine setup (refer to Table 6-7).

From the Platform Control Console in an area free from obstructions:

1. Operate the telescope out function, then activate SkyGuard sensor.
2. Once sensor has been activated, ensure telescope out function stops then telescope in function operates for a short duration. Additionally, verify Soft Touch/SkyGuard indicator light flashes and horn sounds. If machine is equipped with SkyGuard beacon, ensure it flashes when sensor activates.
3. With SkyGuard sensor still engaged, press and hold yellow Soft Touch/SkyGuard override button. Operate a function to verify operation can be resumed.
4. Disengage SkyGuard sensor, release controls, and recycle footswitch. Ensure normal operation available.

In Ground Mode:

1. Operation is allowed regardless of SkyGuard activation.

SOFT TOUCH ONLY

If **Soft Touch only** is selected in machine setup (refer to Table 6-7), machine will treat the Soft Touch/SkyGuard override switch as if it is a Soft Touch switch.

SKYGUARD NOT SELECTED IN MACHINE SETUP

If the SkyGuard system is installed on the machine, but no option is selected in the machine setup (refer to Table 6-7), SkyGuard sensor status will be ignored. No function cutout or reversal will be implemented.

Diagnostics & Troubleshooting

If SkyGuard does not function when the sensor is engaged, first verify the configuration under the MACHINE SETUP: SKYGUARD OPTION menu using the handheld Analyzer. Ensure the selected configuration matches the actual system installed on the machine. If not, select the correct configuration, then verify operation.

Additionally, use the handheld analyzer to navigate to the DIAGNOSTICS: FEATURES → SKYGUARD INPUTS menu to determine additional SkyGuard fault information.

Engage the SkyGuard sensor and observe the Analyzer to determine if the switch/relay closes.

If the status of the switch/relay remains OPEN while the SkyGuard sensor is actively engaged, it is possible the sensor has failed and should be replaced immediately.

If the status of the switch/relay remains CLOSED while the SkyGuard sensor is actively engaged, a power or ground wire may not be making good contact or may be loose or broken. Additionally, there is a low probability that both relays may have failed.

If the switch/relay status is in disagreement, then one may have failed or is not installed correctly. In this case, the machine will be inoperable.

FAULT CODES

Refer to Table 6-14 for more fault code information

- **0039 -** SkyGuard switch activation fault
- **2563 -** switch disagreement fault

Table 4-2. SkyGuard Function Table

Drive Forward	Drive Reverse	Steer	Swing	Tower Lift Up	Tower Lift Down	Boom Lift Up	Boom Lift Down	Boom Tele Out	Boom Tele In	Jib Lift	Basket Level	Basket Rotate
R*/C**	R	C	R	R	C	R	R	R	C	C	C	C
R = Indicates Reversal is Activated												
C = Indicates Cutout is Activated												
* DOS (Drive Orientation System) Enabled												
** DOS Not Enabled, machine is driving straight without steering, and any other hydraulic function is active												

SECTION 5. BASIC HYDRAULIC INFORMATION & SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

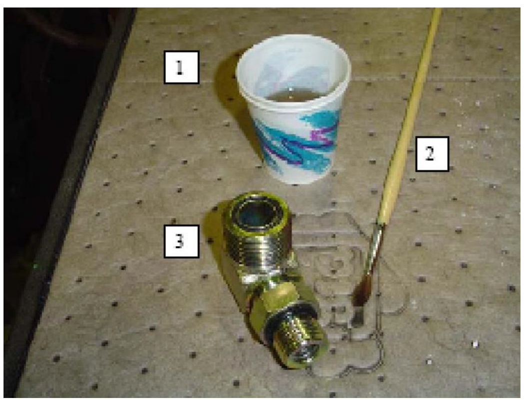
When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

NOTE: *All O-ring fittings must be pre-lubricated with hydraulic oil prior to assembly.*

Cup and Brush

The following is needed to correctly oil the o-ring in this manner:

- A small container for hydraulic oil
- Small paint brush



1. Hold the fitting in one hand while using the brush with the other hand to dip into the container. Remove excess hydraulic oil from the brush so an even film of oil is applied on the o-ring.

2. Holding the fitting over the hydraulic oil container, brush an even film of oil around the entire o-ring in the fitting, making sure the entire o-ring is completely saturated.

3. Turn the o-ring on the other side of the fitting and repeat the previous step, ensuring the entire o-ring is coated with hydraulic oil.

Dip Method

NOTE: *This method works best with Face Seal o-rings, but will work for all o-ring fitting types.*

The following is needed to correctly oil the o-ring in this manner:

- A small leak proof container
- Sponge cut to fit inside the container
- A small amount of hydraulic oil to saturate the sponge.

1. Place the sponge inside the container and add hydraulic oil to the sponge until it is fully saturated.
2. Dip the fitting into the sponge using firm pressure. Upon lifting the fitting, a small droplet will form and drip from the bottom of the fitting. This should signify an even coating of oil on the fitting.

3. O-ring Boss type fittings will require more pressure in able to immerse more of the fitting into the saturated sponge. This will also cause more oil to be dispersed from the sponge.

Spray Method

This method requires a pump or trigger spray bottle.

1. Fill the spray bottle with hydraulic oil.
2. Hold the fitting over a suitable catch can.
3. Spray the entire o-ring surface with a medium coat of oil.

Brush-on Method

This method requires a sealed bottle brush.

1. Fill the bottle with hydraulic oil.
2. Using slight pressure to the body of the spray bottle, invert the bottle so the brush end is in the downward position.
3. Brush hydraulic oil on the entire o-ring, applying an even coat of oil.

5.2 HYDRAULIC CYLINDERS

Holding (counterbalance) valves are used in the Lift, Level, Jib, Telescope, and Axle Lockout circuits to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its' related holding valve.

NOTE: *The steer cylinder weighs approximately 37.2 lbs (16.9 kg).*

NOTE: *The tower lift cylinder weighs approximately 76 lbs (34.5 kg).*

NOTE: *The upper lift cylinder weighs approximately 97 lbs (44 kg).*

NOTE: *The master cylinder weighs approximately 35.3 lbs (16 kg).*

NOTE: *The level cylinder weighs approximately 37.4 lbs (17 kg).*

NOTE: *The jib lift cylinder weighs approximately 55 lbs (25 kg).*

NOTE: *The telescope cylinder weighs approximately 52.7 lbs (23.9 kg).*

NOTE: *The axle oscillation lockout cylinder weighs approximately 26.2 lbs(11.9 kg).*

Disassembly and Assembly Instructions

1. Make sure the work area is large enough for the entire cylinder and clean and free of dirt. Ensure the cylinder can be secured firmly in place during disassembly.
2. Prepare all the necessary tools and replacement parts. Refer to Table 5-2, Required Tools.

General Information

1. Clean any burrs or contamination from the surface of the cylinder before disassembly.
2. Handle every part with care. Each part is precision made and hitting parts together or letting them fall could damage the machined surfaces.
3. Do not twist or strike parts to get them apart. This will damage the part and/or threads, resulting in leakage and poor function.
4. Do not let the cylinder in a disassembled condition for a long period of time. It only takes a short period of time for the parts to rust.

Standard of Maintenance

Parts and seals should be replaced according to the conditions as follows.

1. Bushings - 1/4 of the bushing is worn off.
2. Seal and Slide Ring - Replace during disassembly.
3. Pin Bushing - When it is worn down.
4. Rod - Bent or warped more than 0.5mm/1m.

Inspection After Assembly

Table 5-1. Inspection After Assembly

Operation Inspection Without Load	There is no problem when fully extended 5 times without load						
Dimension	Check the retracted length and stroke						
Inspection of the Surface	When each of the cylinders are pressurized with test pressure on the piston end, it should not be loose and have no change in pressure or external leakage						
Inspection of external leakage	Check the oil leakage at the rod area. Refer to Figure 5-1., Acceptable Oil Leakage on Cylinder Rod.						
Inspection of internal leakage	Leakage Unit: ml/ 10 minutes						
	Bore (mm)	Leakage (ml)	Bore (mm)	Leakage (ml)	Bore (mm)	Leakage (ml)	Remark
	32	0.4	100	4	160	10	
	40	0.6	125	5.6	180	12.6	
	50	1	140	6	200	15.6	
	63	1.6			220	20	
	80	2.3			250	22	

Check the oil leakage status on the rod surface with a flow of 20cc - 40cc. Oil leakage in an amount as shown in example A is unacceptable. Examples B-G are acceptable.

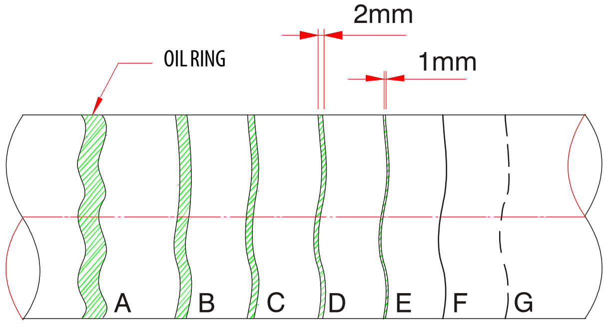


Figure 5-1. Acceptable Oil Leakage on Cylinder Rod

Table 5-2. Required Tools

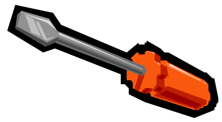
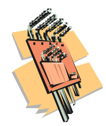
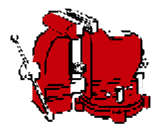
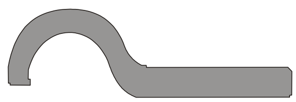
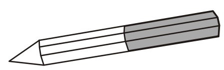
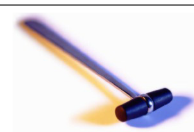
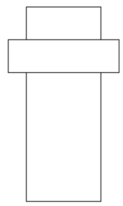
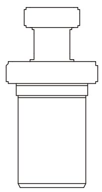
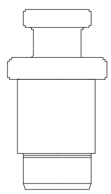
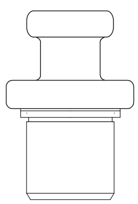
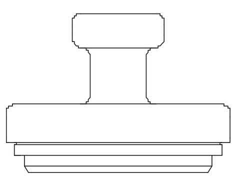
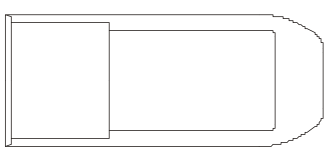
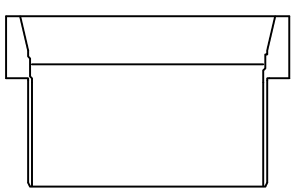
Item No.	Description	Quantity
1	Flat-head Screwdriver 	1
2	Allen Wrench Set 	1 Set
3	Vise 	1
4	Spanner Wrench 	1 Set
5	Punch 	1
6	Torque Wrench 	1 Set
7	Plastic Hammer 	1
8	Crescent Wrench 	1
9	Hera (Seal Disassembly)  	

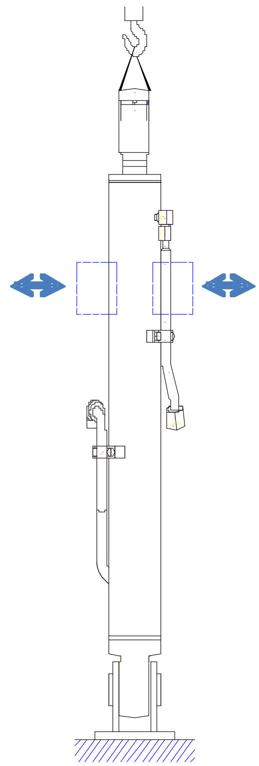
Table 5-3. Special Tools

Name of Tool	Description
Bushing for Disassembly	
Bushing for Press	
MRP Bearing Disassembly	
MRP Bearing Press	
Dust Wiper Press/ Dust Wiper Insert	
Gland Seal Protection (Gland Guide Jig)	
Piston Seal Protection (Piston Guide Jig)	

Disassembly Procedure

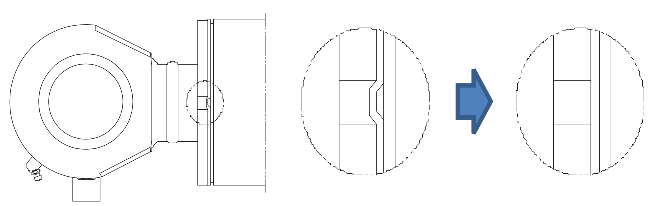
1. Remove the oil from the cylinder.

2. Fix the cylinder in a vertical or horizontal position. Vertical position is convenient for disassembly and assembly. Fix the base by inserting the pin not to be rotated. Remove any hoses, valves, or fittings that may be in the way.



3. Unscrew the cylinder Head

   Glands that are threaded into the barrel are locked in place with caulking. Using a spanner wrench, unscrew the gland from the barrel. (It is easier to do this with rod pulled out 5cm from the gland). If there is no caulking, continue with the disassembly process.

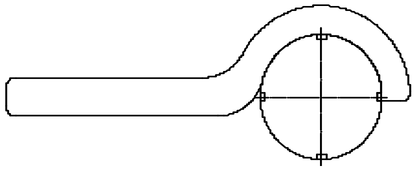


4. Remove the Rod assembly

   a. Check if the cap or plug has been removed from the cylinder ports.

   b. Place a suitable container under the cylinder to catch any oil coming out of the cylinder.

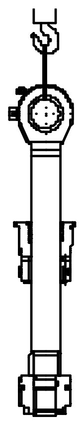
c. After the Rod assembly is pulled from the barrel, unscrew the head using a spanner wrench.



d. After disassembling the rod assembly, place it on a support.

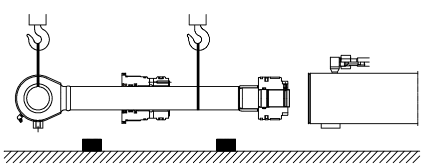
CAUTION

IF THE CYLINDER IS AT A VERTICAL POSITION FOR DISASSEMBLY, GIVE ATTENTION TO THE FOLLOWING; WHEN THE HEAD IS UNSCREWED AND THE ROD ASSEMBLY IS PULLED FROM THE BARREL, THERE IS A SPACE BETWEEN THE HEAD AND PISTON. IT IS POSSIBLE FOR THE HEAD TO SUDDENLY SLIDE DOWN, POSSIBLY CAUSING INJURY. TO PREVENT THIS, THE HEAD SHOULD BE PUSHED AGAINST THE PISTON BEFORE PROCEEDING.

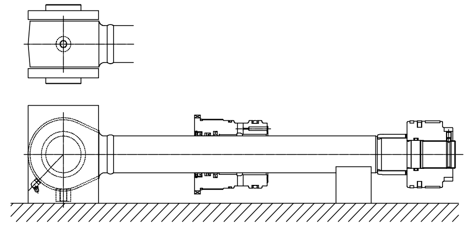


CAUTION

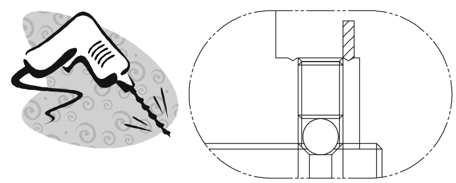
IF A CYLINDER IS AT A HORIZONTAL POSITION FOR DISASSEMBLY, GIVE ATTENTION TO THE FOLLOWING; IT IS POSSIBLE FOR THE ROD TO FALL AND BE DAMAGED WHEN REMOVED FROM THE BARREL IF NOT PROPERLY SUPPORTED. PLACE SUPPORT UNDER THE BARREL AS SHOWN BELOW.



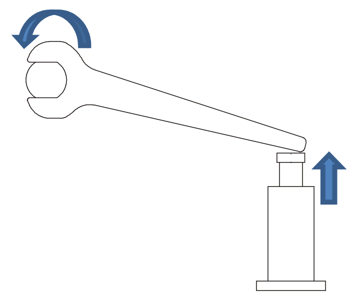
5. Place the Rod assembly on blocking as shown below. Use the pin hole to keep it from rotating.



6. Unscrew the Piston Nut.
   a. Unscrew the set screw. Caulking is used to lock the setscrew so grind the caulking area and then unscrew the set screw.

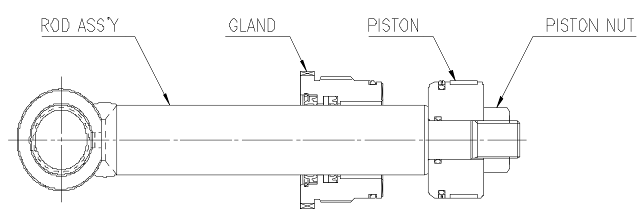


   b. Remove the steel ball
   c. Unscrew the piston nut. The piston nut is secured with a torque specified in Table 5-4, Piston Nut Torque. 1.5 x this torque is needed to remove the nut. If the stronger torque is needed, use a power wrench operated by a hydraulic unit

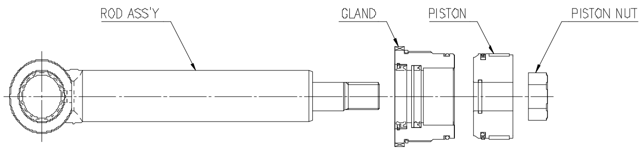


NOTE: *If it is not a set screw type, continue with the disassembly of the piston nut.*

7. Remove the PISTON NUT, PISTON and GLAND in sequence.



8. Piston nut, piston, gland disassembly.

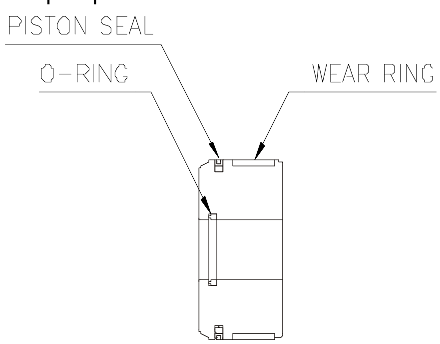


a. Unscrew the Piston Nut.

b. Take the piston apart by sliding off the rod in the direction of the rod threads.

c. Take the gland apart by sliding off the rod in the direction of the rod threads.

9. Take apart piston seals.



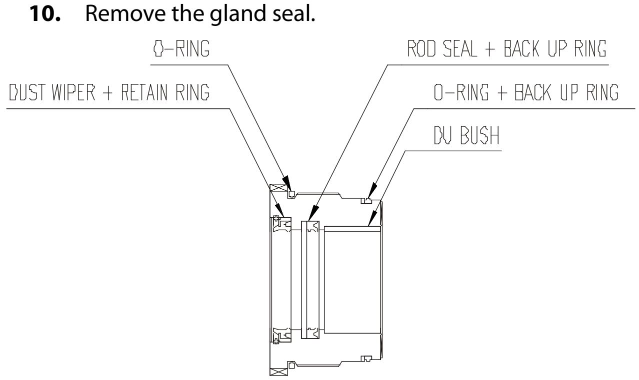
a. The wear ring is easily taken apart by hand.

b. The piston seal is a two piece seal; the ring at the outer side is easily removed. Remove the ring inside of the piston seal.

c. Remove the o-ring.

NOTE: *All seals must be discarded after removal. They can not be reused.*

10. Remove the gland seal.

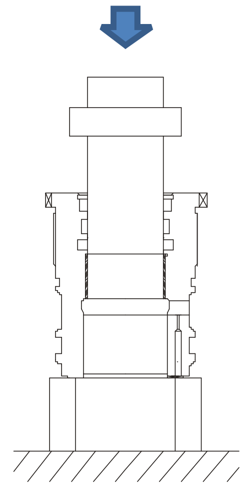


a. Remove the rod seal and backup ring.

b. Remove the retaining ring with a flat-head screwdriver prior to removing the dust wiper and remove the dust wiper.

c. Remove the o-ring and backup ring.

d. The du bushing is pressed in and must be removed by using a tool as shown below.



NOTICE

DISCARD ALL SEALS AFTER REMOVAL AND REPLACE THEM WITH NEW ONES FOR ASSEMBLY.

11. MRP BEARING DISASSEMBLY

To remove the MRP bearing, break it into pieces.

12. WASHING AND STORAGE

All removed parts should be washed with cleaning solution and then coated with light oil to prevent rust. If the cylinder is not to be reassembled right away, store the parts and put a covering over them.

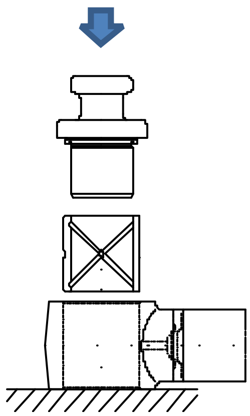
Assembly

⚠ CAUTION

TAKE CARE NOT TO LET ANY PAINT CHIPS OR DIRT FALL INSIDE THE CYLINDER. THIS COULD CAUSE LEAKAGE.

1. Pin bushing assembly

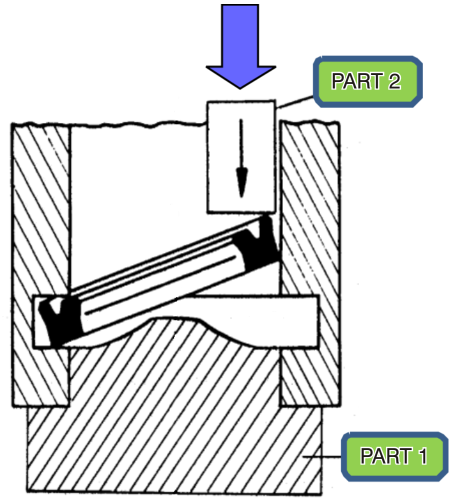
Coat the opening with oil to aid in assembly and press the bushing into the rod as shown below.

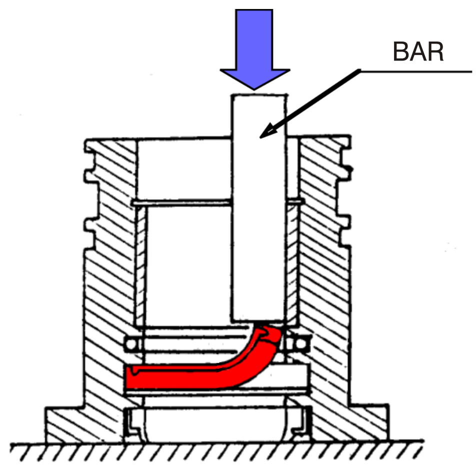


2. Gland seal assemblies

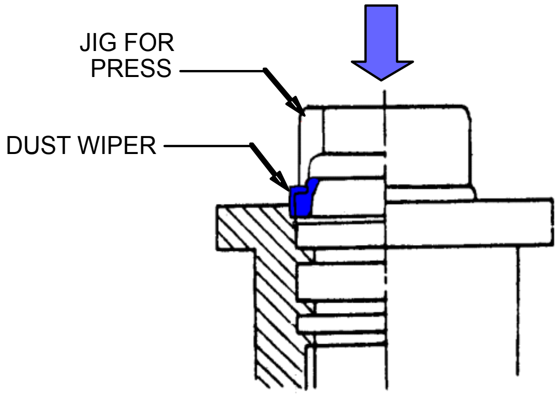
a. Coat the opening with oil to aid in assembly and press the bushing into place with the proper tool.

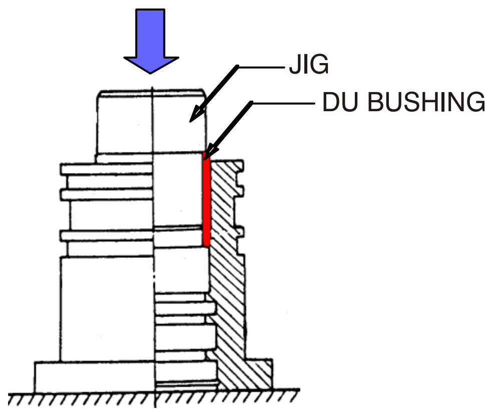
b. Rod seal assembly (Keep the right direction and do not make damage to seal)





c. Install du bushing assembly and dust wiper assembly as shown below.





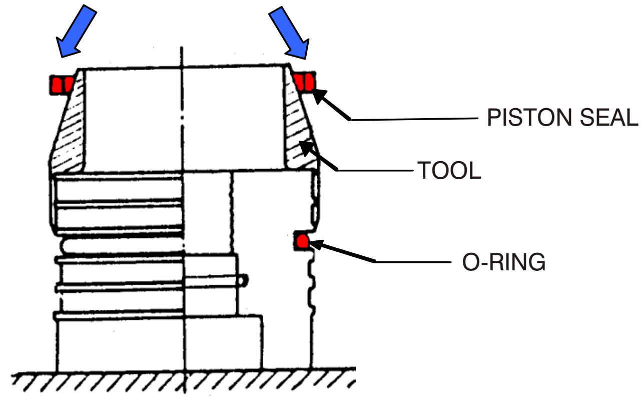
d. Assemble back up ring, o-ring (Check the sequence of back up ring, o-ring.)

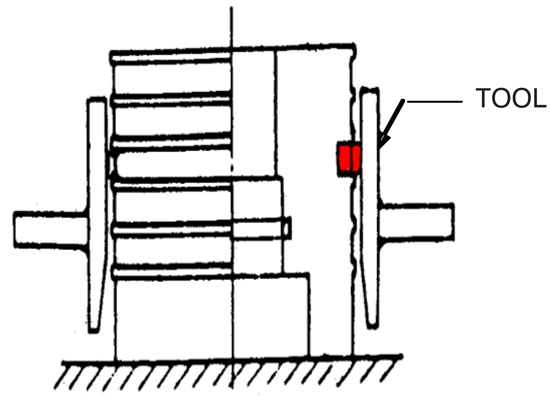
3. Piston Seal Assembly

a. Assembly the seal assembly.

b. Install the o-ring into the groove.

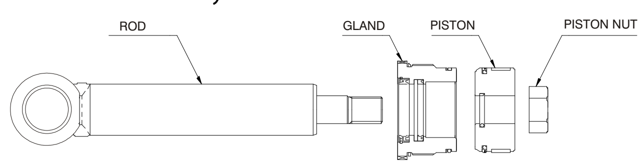
c. Using a proper tool, press the piston seal onto the piston. When installing the piston seal, it is stretched while passing over the head.





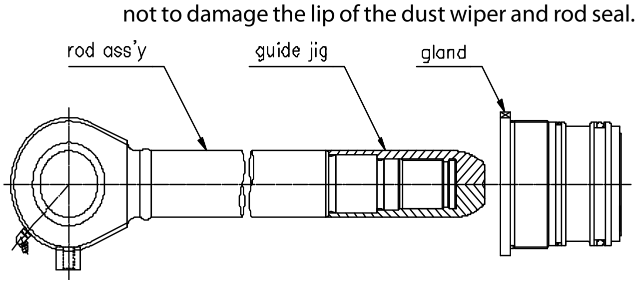
d. Install the wear ring assembly by spreading it apart.

4. Rod assembly



a. Secure the rod assembly.

b. Install the Head onto the rod assembly. Take care as not to damage the lip of the dust wiper and rod seal.



c. Assemble Piston.

d. Torque the Piston nut as specified in Table 5-4, Piston Nut Torque. Lack of the torque can result in internal leakage, the piston coming unscrewed, and thread damage. If overtorqued, the piston surface which meets the rod will be damaged.

Table 5-4. Piston Nut Torque

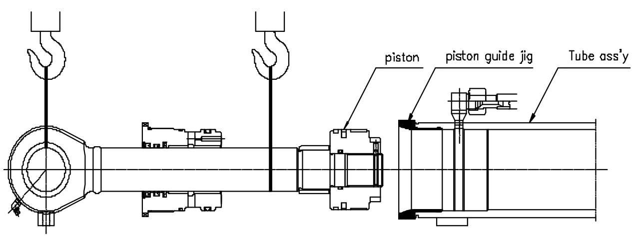
CYLINDER	PISTON
STEERING	NA
TOWER LIFT	267 ft.lbs.
UPPER LIFT	528 ft.lbs.
MASTER	267 ft.lbs.
LEVEL	267 ft.lbs.
JIB	267 ft.lbs.
TELESCOPE	267 ft.lbs.
RAM LOCK	NA

5. Assemble the rod assembly.

a. Secure the barrel at a vertical or horizontal position.

b. Insert the assembly into the barrel.

c. When piston is inserted to the barrel take care as to not damage the seal rings.

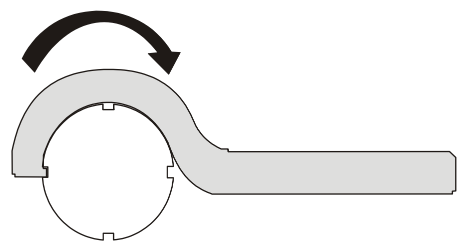


6. Gland assembly.

Install the gland using a spanner wrench as shown below

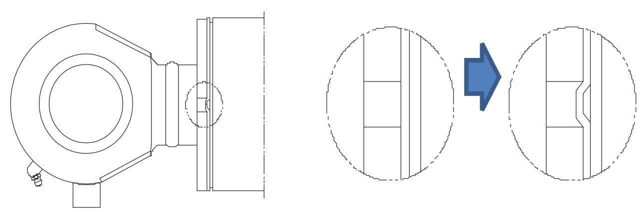
Table 5-5. Gland Torque

CYLINDER	GLAND
STEERING	397 ft.lbs.
TOWER LIFT	463 ft.lbs.
UPPER LIFT	550 ft.lbs.
MASTER	463 ft.lbs.
LEVEL	463 ft.lbs.
JIB	405 ft.lbs.
TELESCOPE	318 ft.lbs.
RAM LOCK	NA



7. Caulking.

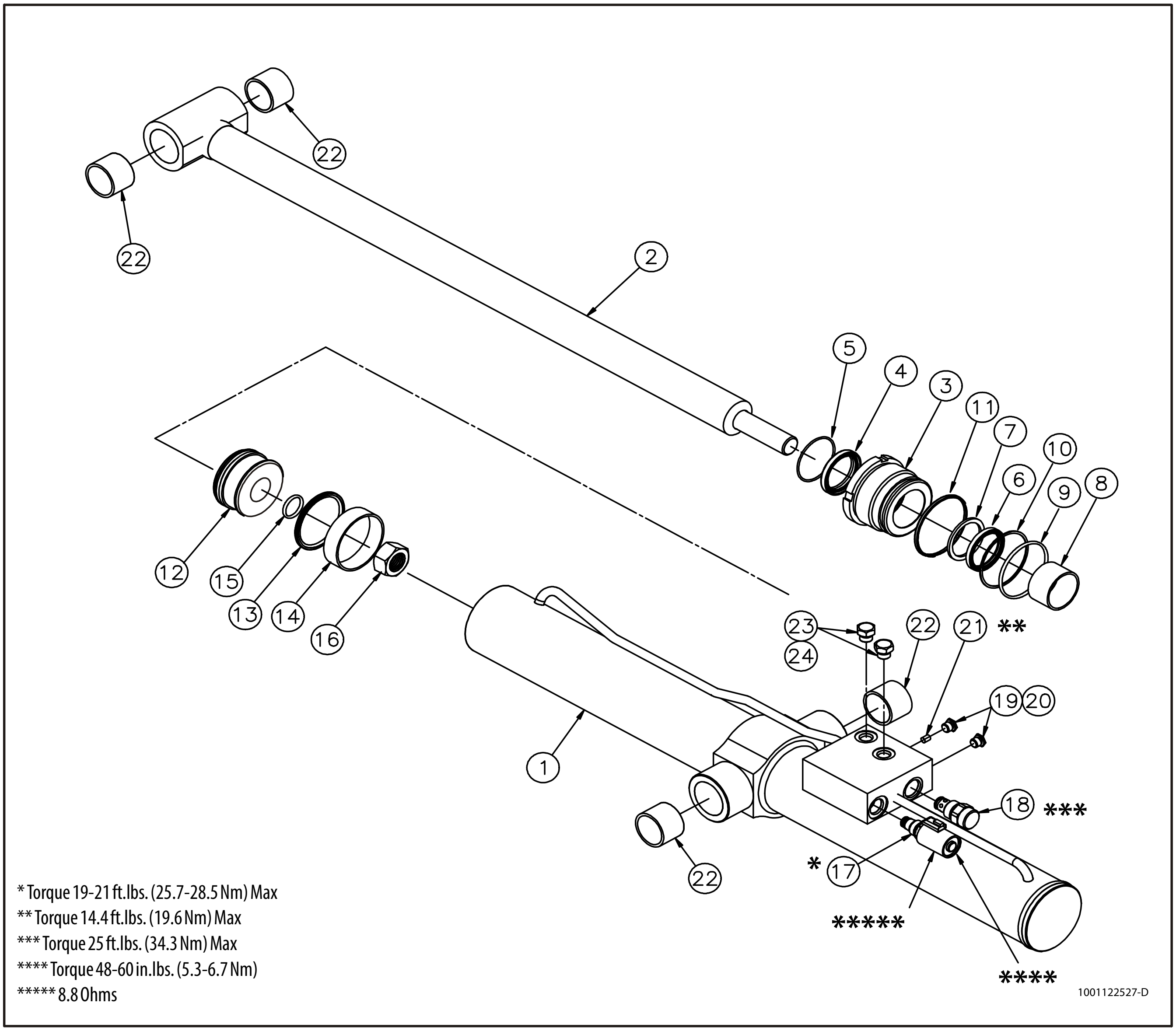
Caulk at the machined area of the cylinder barrel end so that it locks the cylinder head in place and it does not unscrew from the barrel. If there is no caulking hole, caulking is not necessary.



8. Test operation.

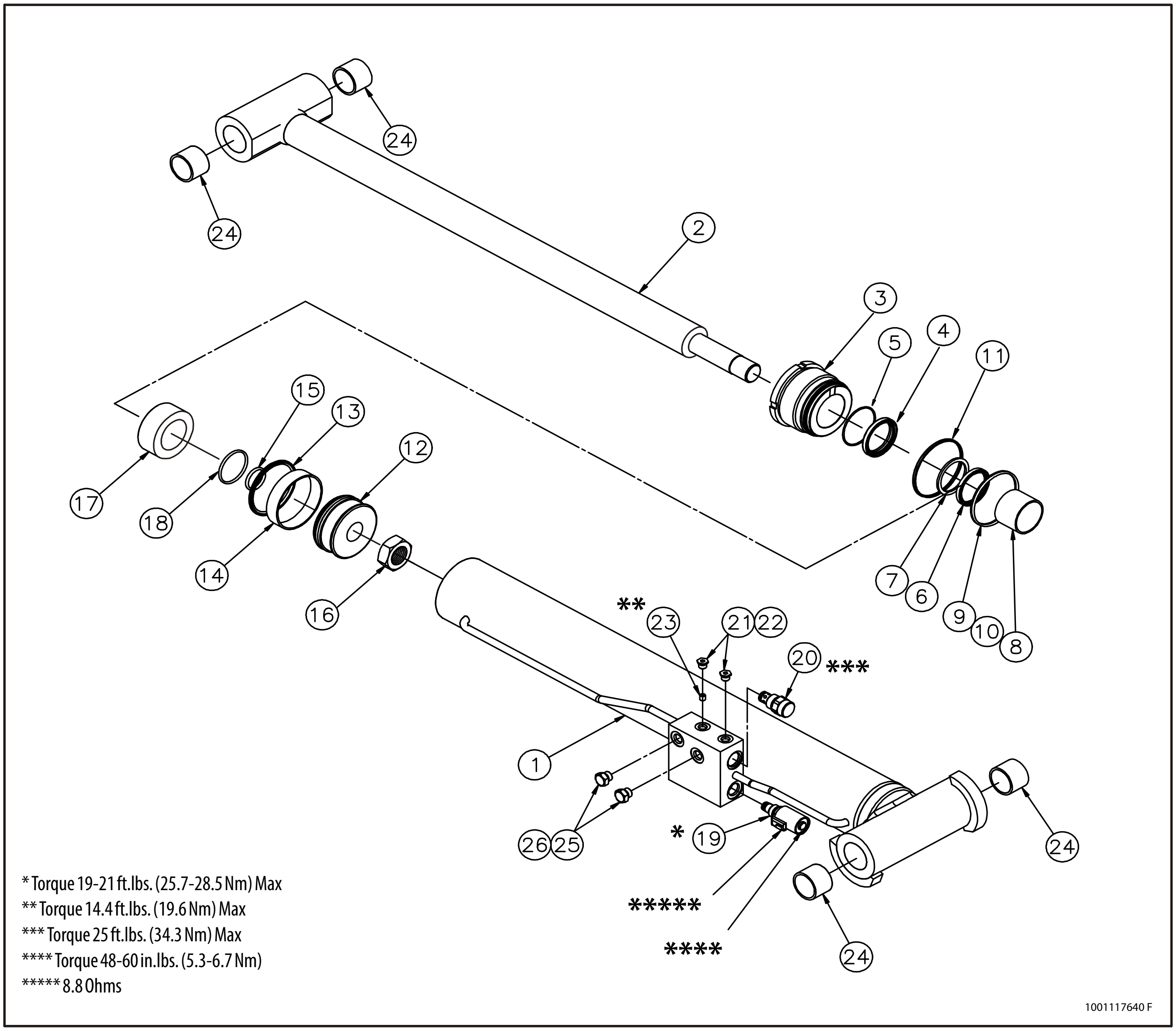
a. Install the cylinder on a machine. Fill the cylinder with oil and then have the cylinder slowly operated a minimum of 8 cycles. If it is operated too fast in the beginning, cavitation will result. It is important to make sure all air is cycled from the cylinder.

b. Grease the end of the pin.



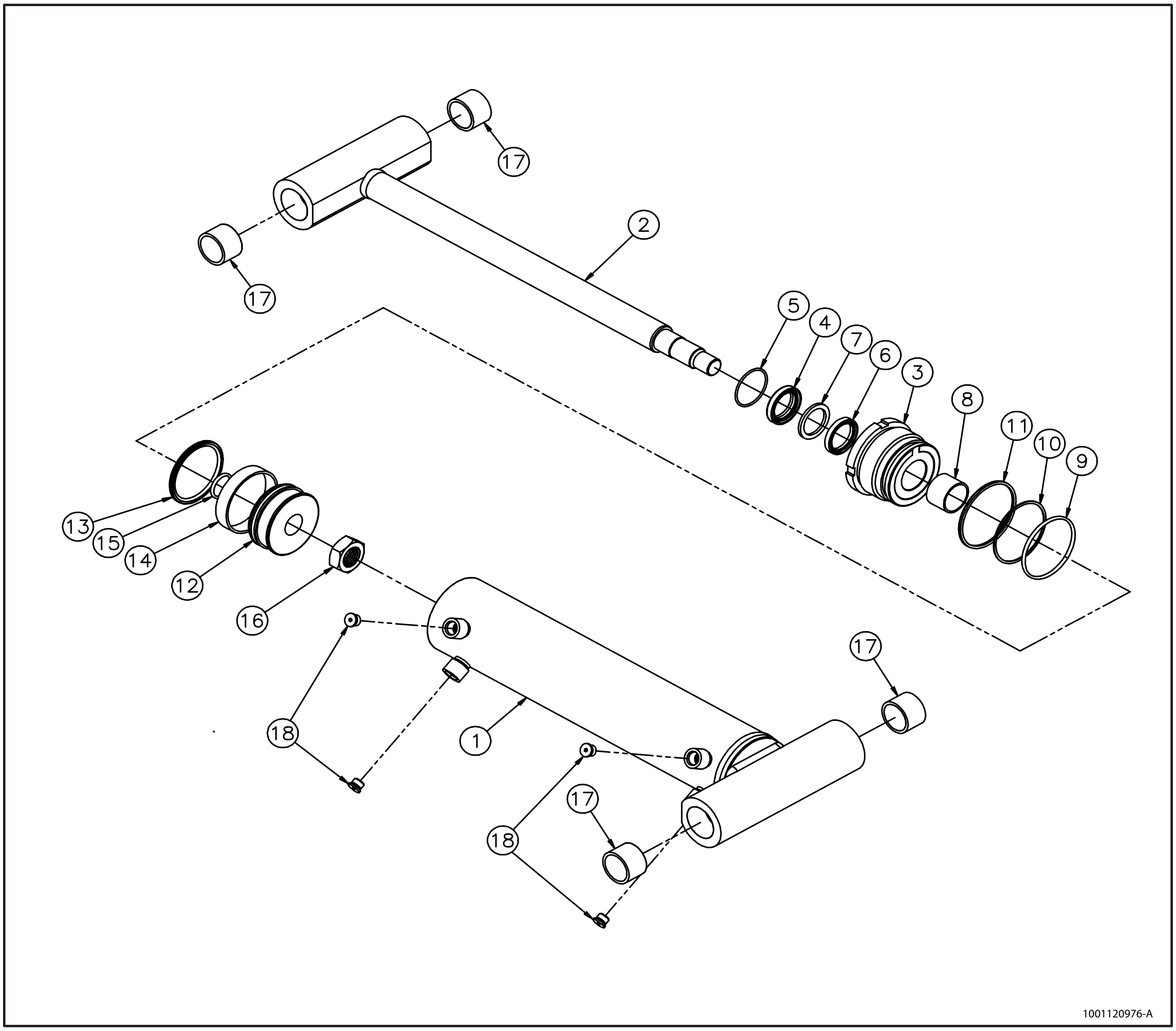
1.	Tube	6.	Rod Seal	11.	O-ring	16.	Nut	21.	Orifice
2.	Rod	7.	Backup Ring	12.	Piston	17.	Poppet Valve	22.	MPR Bearing
3.	Gland	8.	Dry Bearing	13.	Piston Seal	18.	Check Valve	23.	Plug
4.	Dust Wiper	9.	O-ring	14.	Wear Ring	19.	Plug	24.	O-ring
5.	Retaining Ring	10.	Backup Ring	15.	O-ring	20.	O-ring		

Figure 5-2. Tower Lift Cylinder



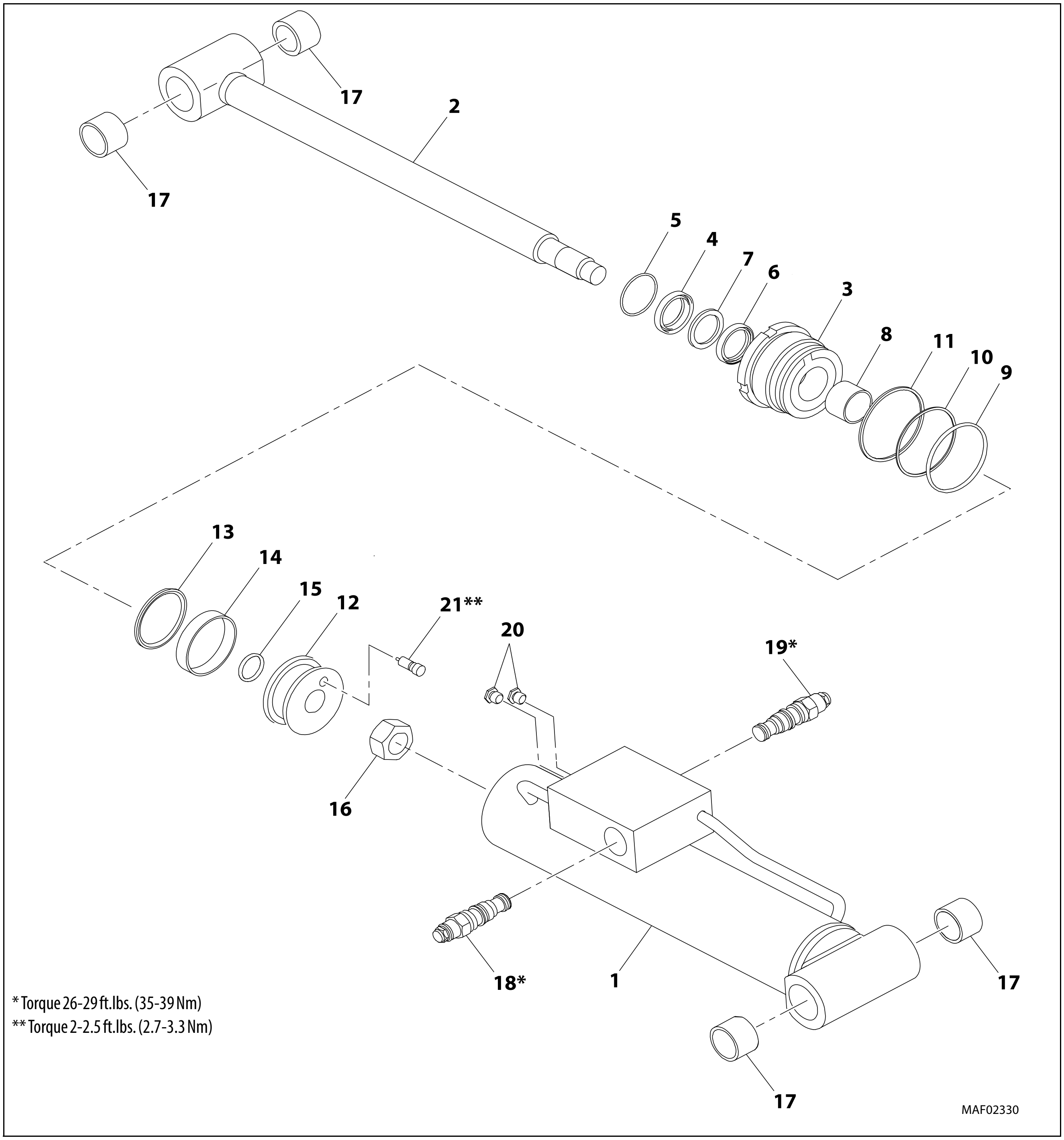
1. Tube	7. Backup Ring	12. Piston	17. Spacer	22. O-ring
2. Rod	8. Dry Bearing	13. Piston Seal	18. O-ring	23. Orifice
3. Gland	9. O-ring	14. Wear Ring	19. Poppet Valve	24. MPR Bearing
4. Dust Wiper	10. Backup Ring	15. O-ring	20. Check Valve	25. Plug
5. Retaining Ring	11. O-ring	16. Nut	21. Plug	26. O-ring
6. Rod Seal				

Figure 5-3. Upper Lift Cylinder



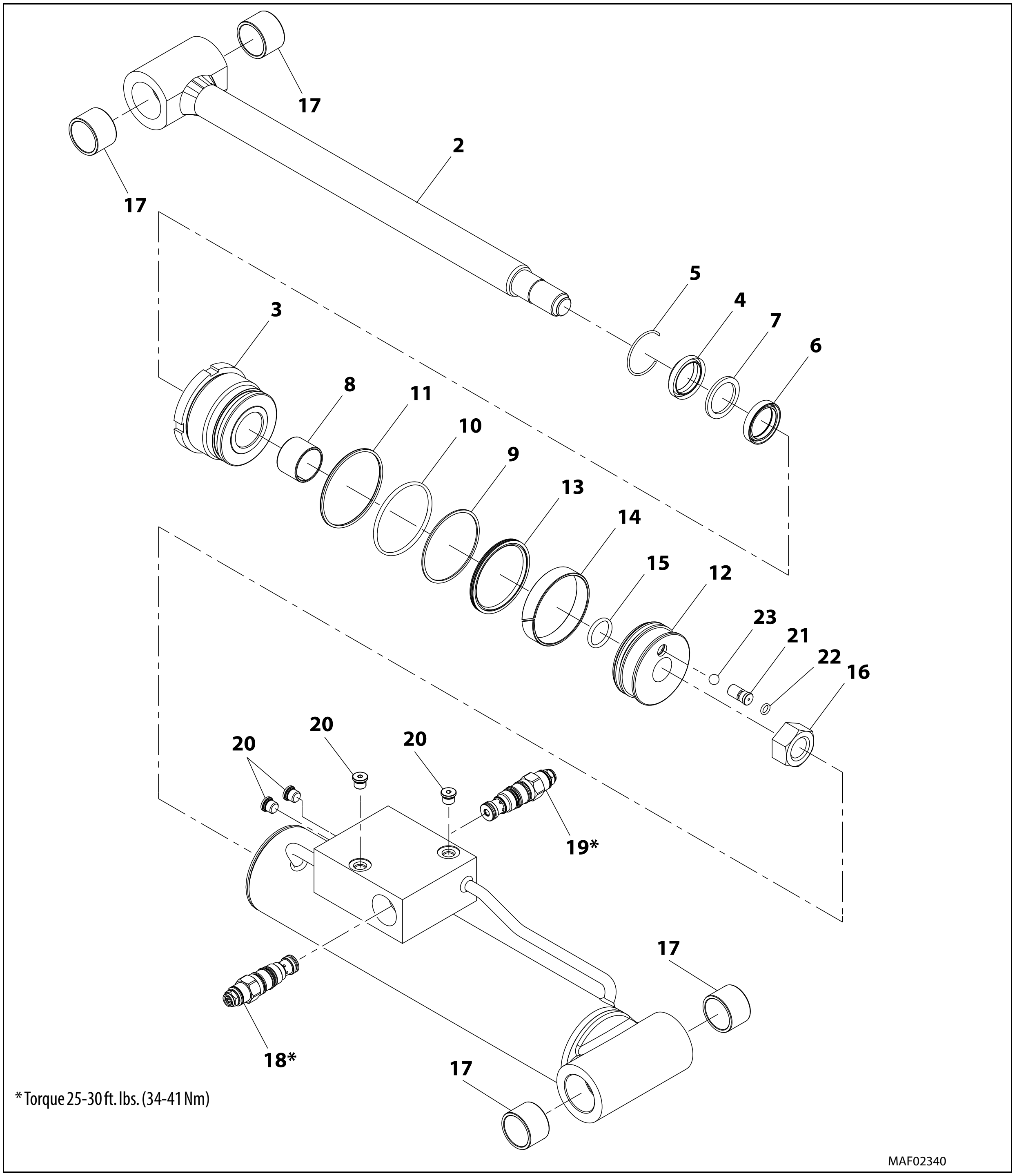
1. Tube
2. Rod
3. Gland
4. Dust Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Dry Bearing
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. Wear Ring
15. O-ring
16. Nut
17. MRP Bearing
18. Plug

Figure 5-4. Master Cylinder



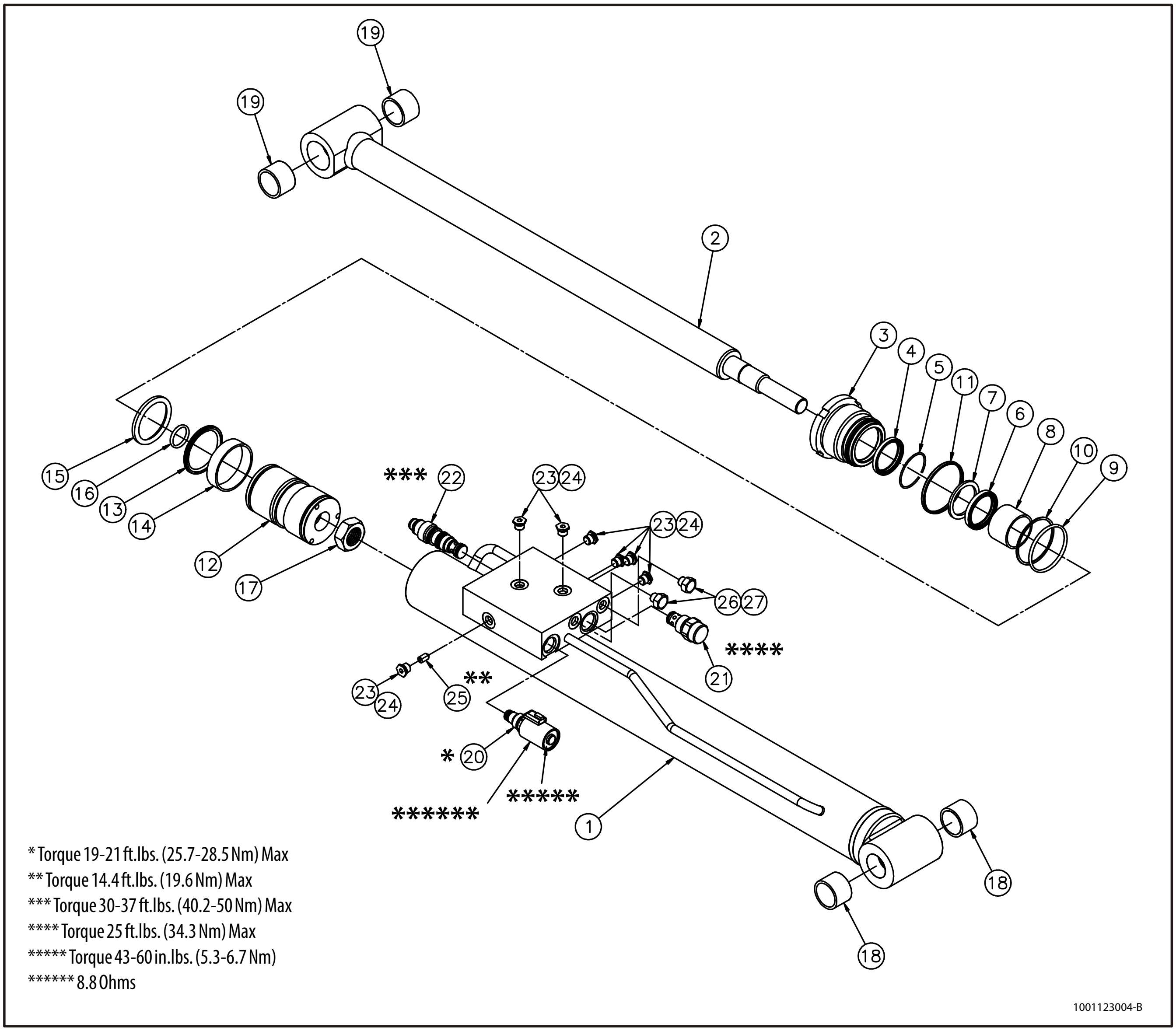
1. Barrel
2. Rod
3. Cylinder Head
4. Wiper Seal
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Bearing
9. O-Ring
10. Backup Ring
11. O-Ring
12. Piston
13. Piston Seal
14. Wear Ring
15. O-Ring
16. Nut
17. Bushing
18. Cartridge Valve
19. Cartridge Valve
20. Plug
21. Phase Valve

Figure 5-5. Level Cylinder (Prior to SN 0300238046)



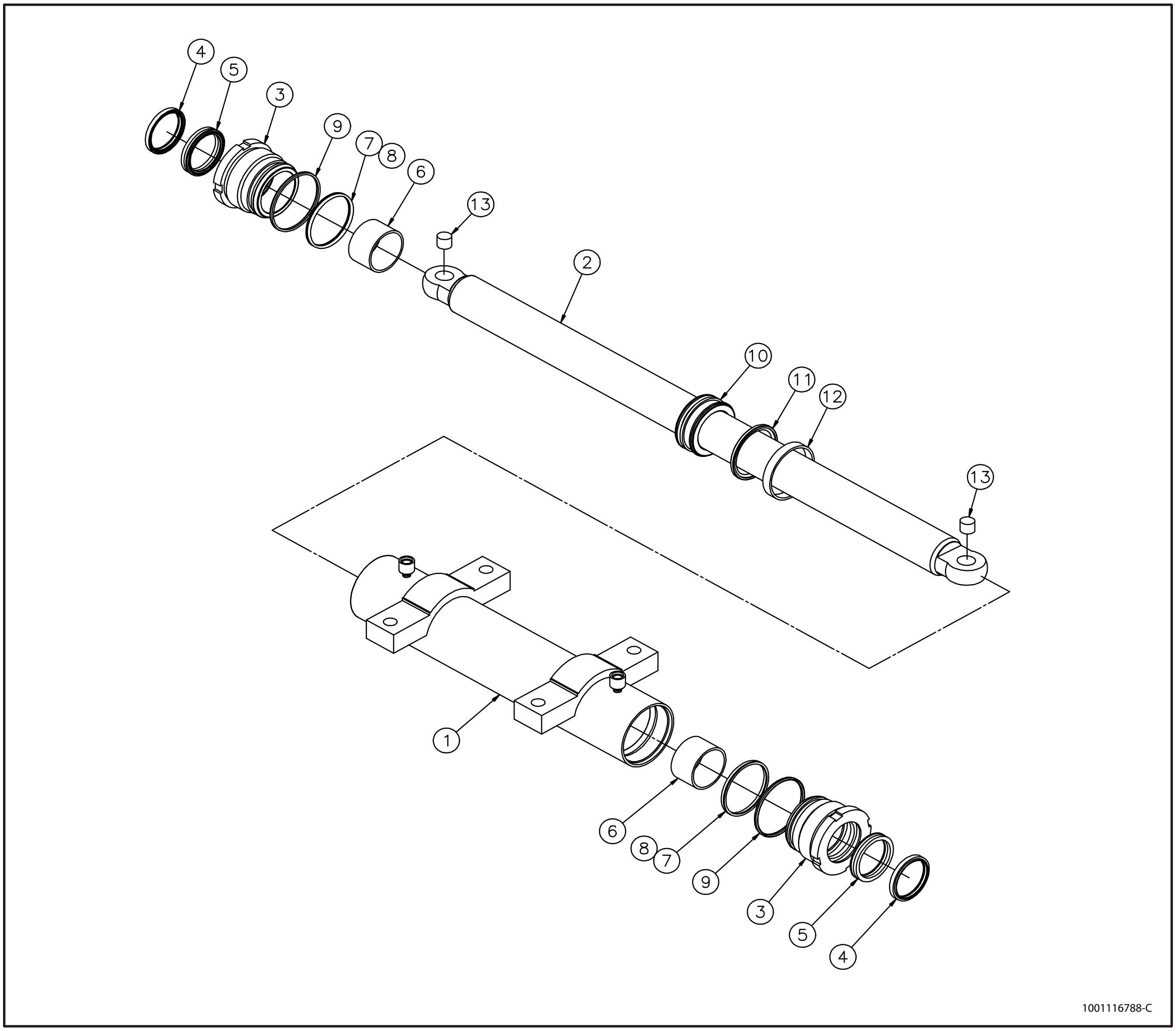
1. Barrel	6. Rod Seal	11. O-Ring	16. Nut	20. Plug
2. Rod	7. Backup Ring	12. Piston	17. Bushing	21. Valve Seat
3. Cylinder Head	8. Bearing	13. Piston Seal	18. Cartridge Valve	22. O-Ring
4. Wiper Seal	9. O-Ring	14. Wear Ring	19. Cartridge Valve	23. Steel Ball
5. Retaining Ring	10. Backup Ring	15. Wear Ring		

Figure 5-6. Level Cylinder (SN 0300238046 to Present)



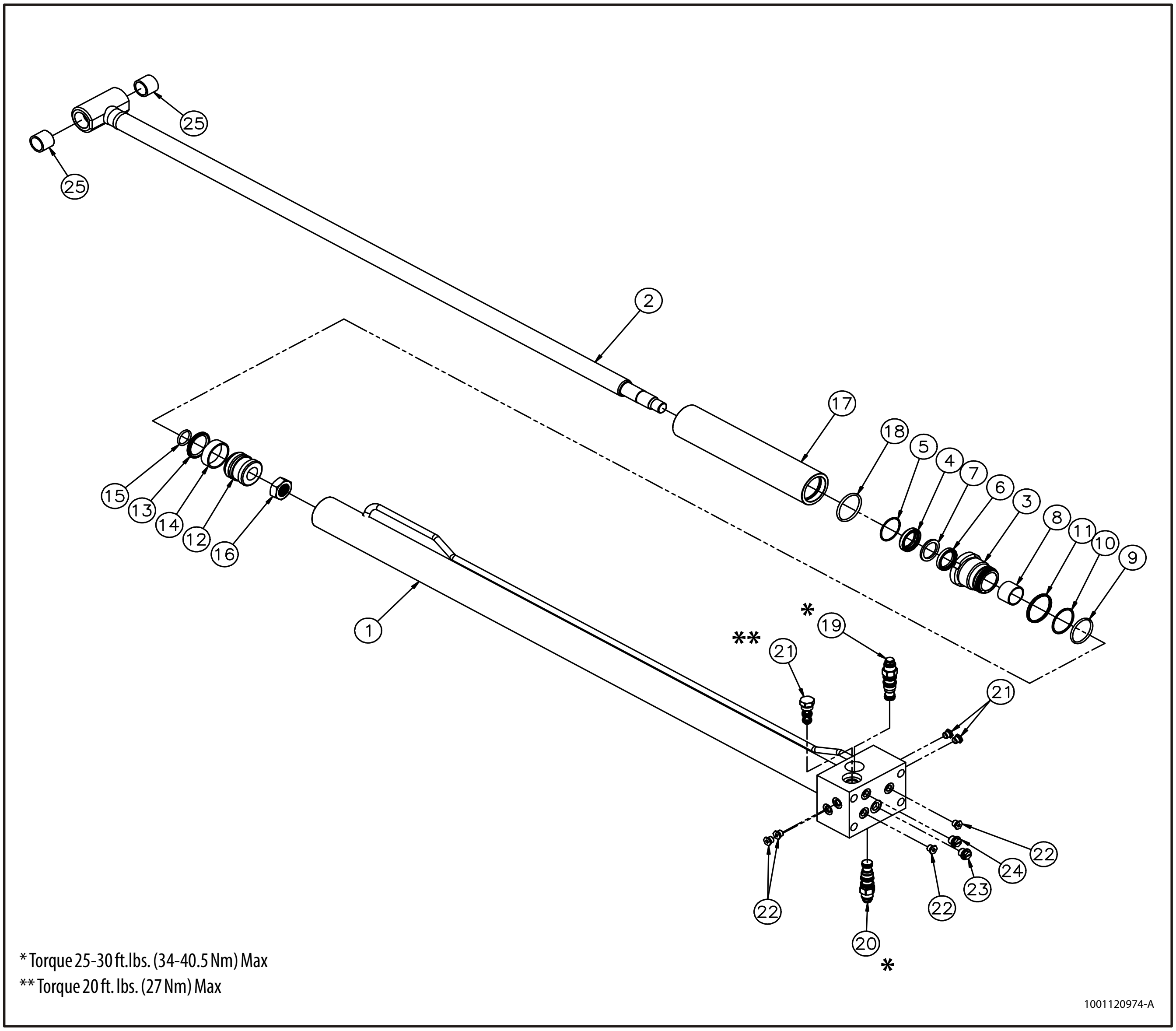
1. Tube
2. Rod
3. Gland
4. Dust Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Dry Bearing
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. Wear Ring
15. O-ring
16. Piston Ring
17. Hex Nut
18. MRP Bearing
19. MRP Bearing
20. Poppet Valve
21. Check Valve
22. Counterbalance Valve
23. Plug
24. O-ring
25. Orifice
26. Plug
27. O-ring

Figure 5-7. Jib Cylinder



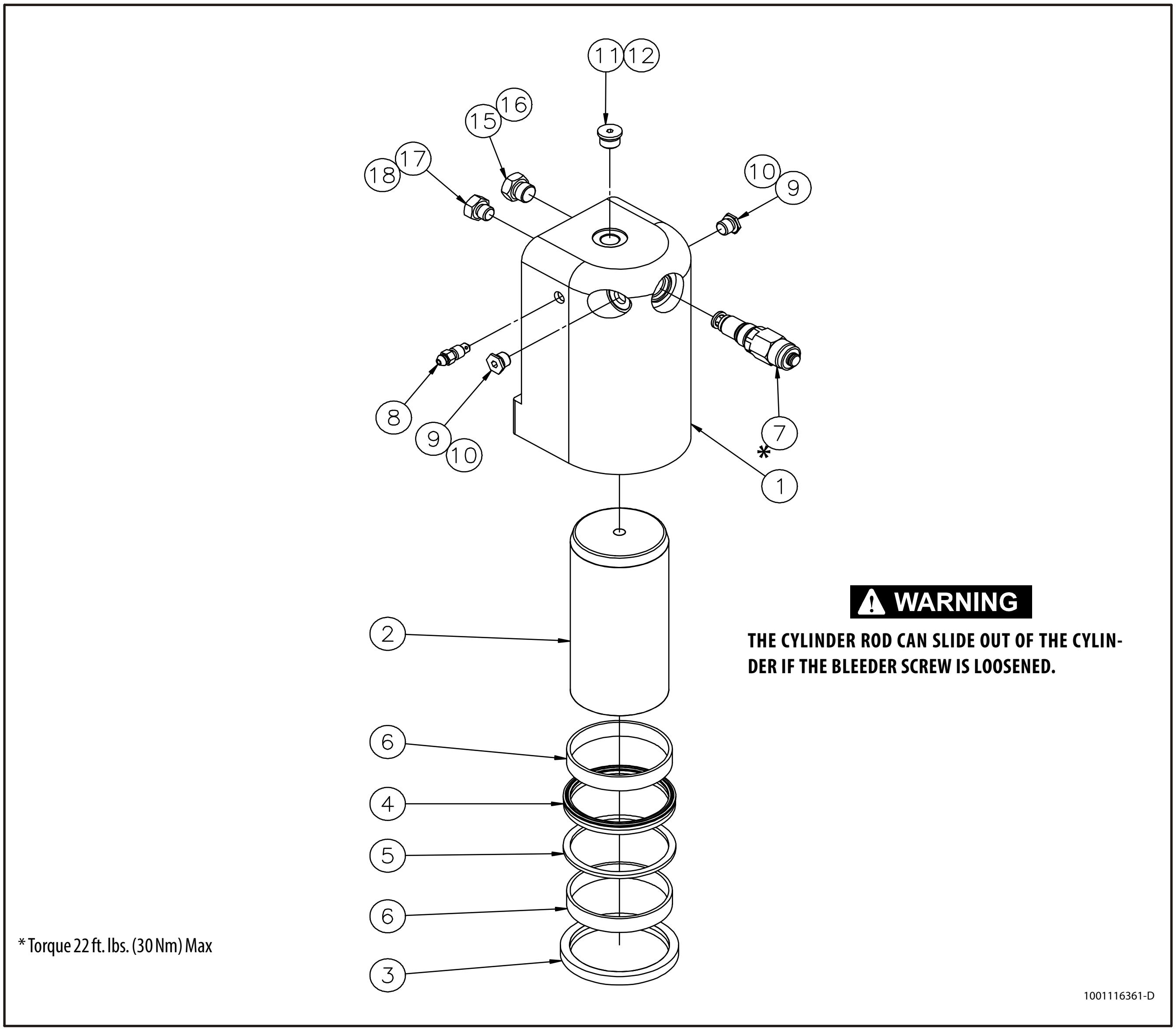
1.	Tube	6.	Rod Seal	11.	Wear Ring
2.	Rod	7.	Dry Bearing	12.	Piston Seal
3.	Piston	8.	O-ring	13.	MRP Bearing
4.	Gland	9.	Backup Ring		
5.	Dust Wiper	10.	O-ring		

Figure 5-8. Steer Cylinder



1. Tube Assembly	6. Rod Seal	11. O-ring	16. Hex Nut	21. Load Shuttle Valve
2. Rod	7. Backup Ring	12. Piston	17. Spacer	22. Plug
3. Gland	8. Dry Bearing	13. Piston Seal	18. O-ring	23. Plug
4. Dust Wiper	9. O-ring	14. Wear Ring	19. Counterbalance Valve	24. Plug
5. Retaining Ring	10. Backup Ring	15. O-ring	20. Counterbalance Valve	25. MRP Bearing

Figure 5-9. Telescope Cylinder



1. Body	6. Wear Ring	11. Plug	16. O-ring
2. Rod	7. Counterbalance Valve	12. O-ring	17. Plug
3. Dust Wiper	8. Bleeder	13. Not Used	18. O-ring
4. Rod Seal	9. Plug	14. Not Used	
5. Backup Ring	10. O-ring	15. Plug	

Figure 5-10. Axle Lockout Cylinder

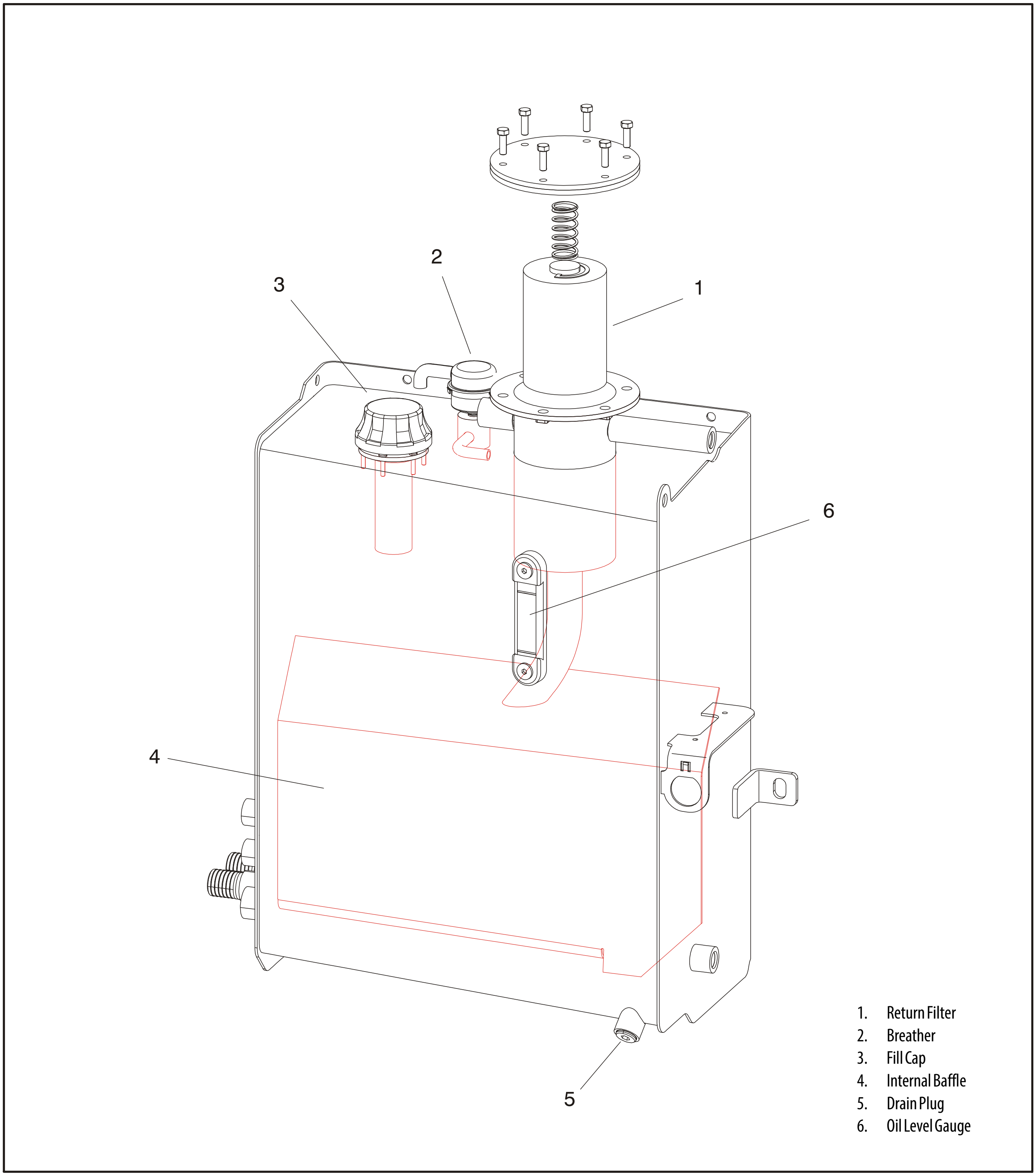


Figure 5-11. Hydraulic Tank

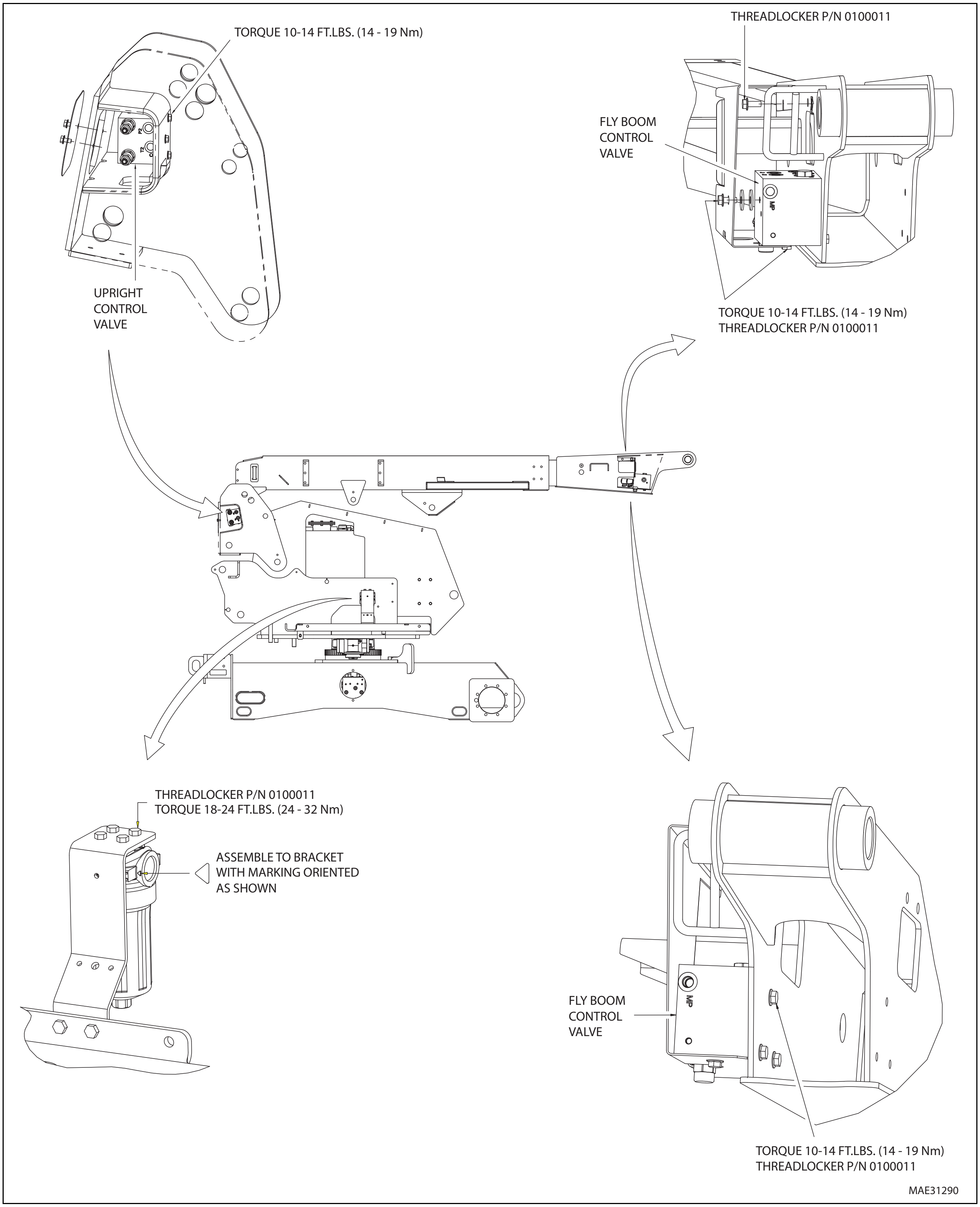


Figure 5-11. Valve Installation - Sheet 1 of 2

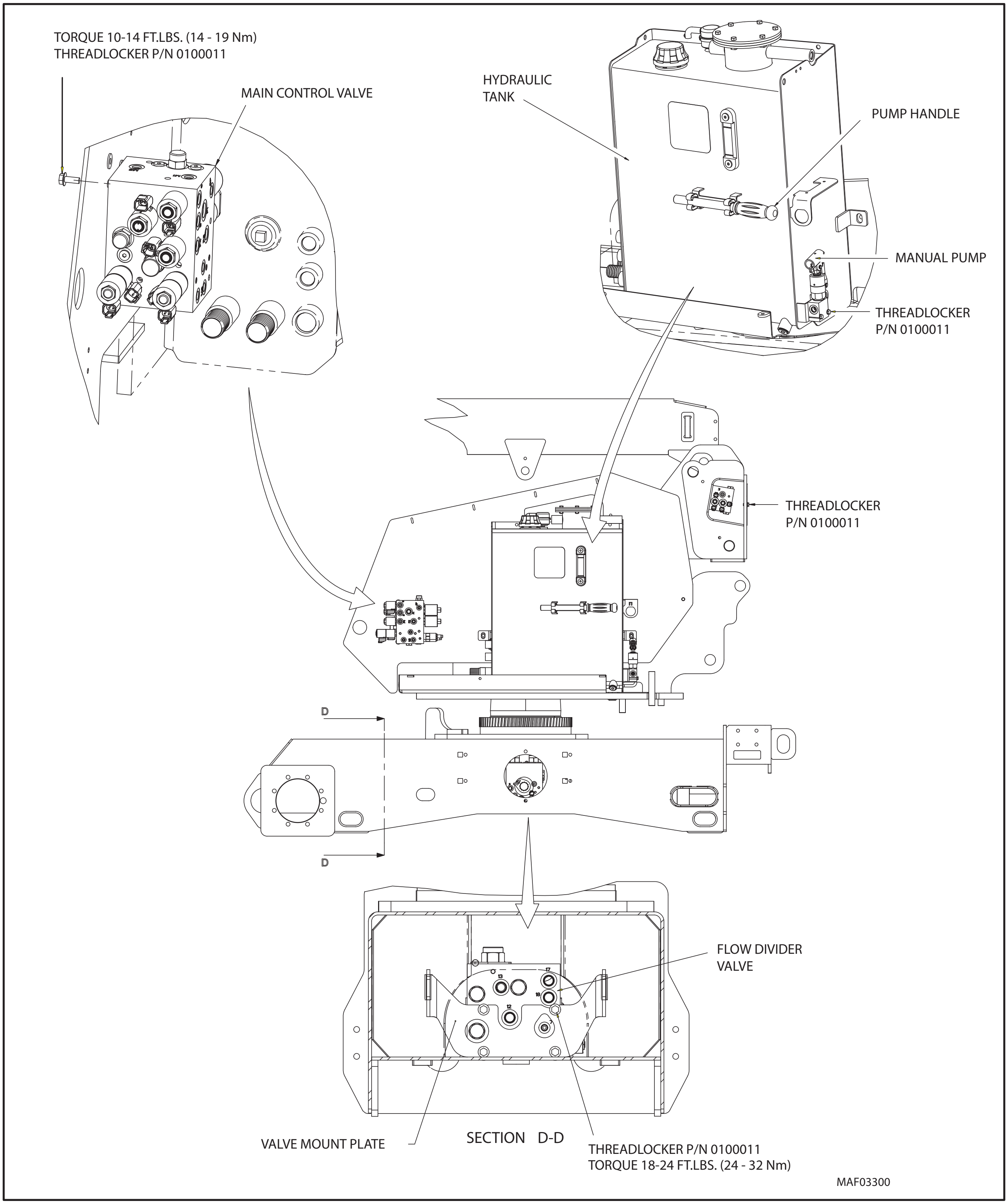


Figure 5-12. Valve Installation - Sheet 2 of 2

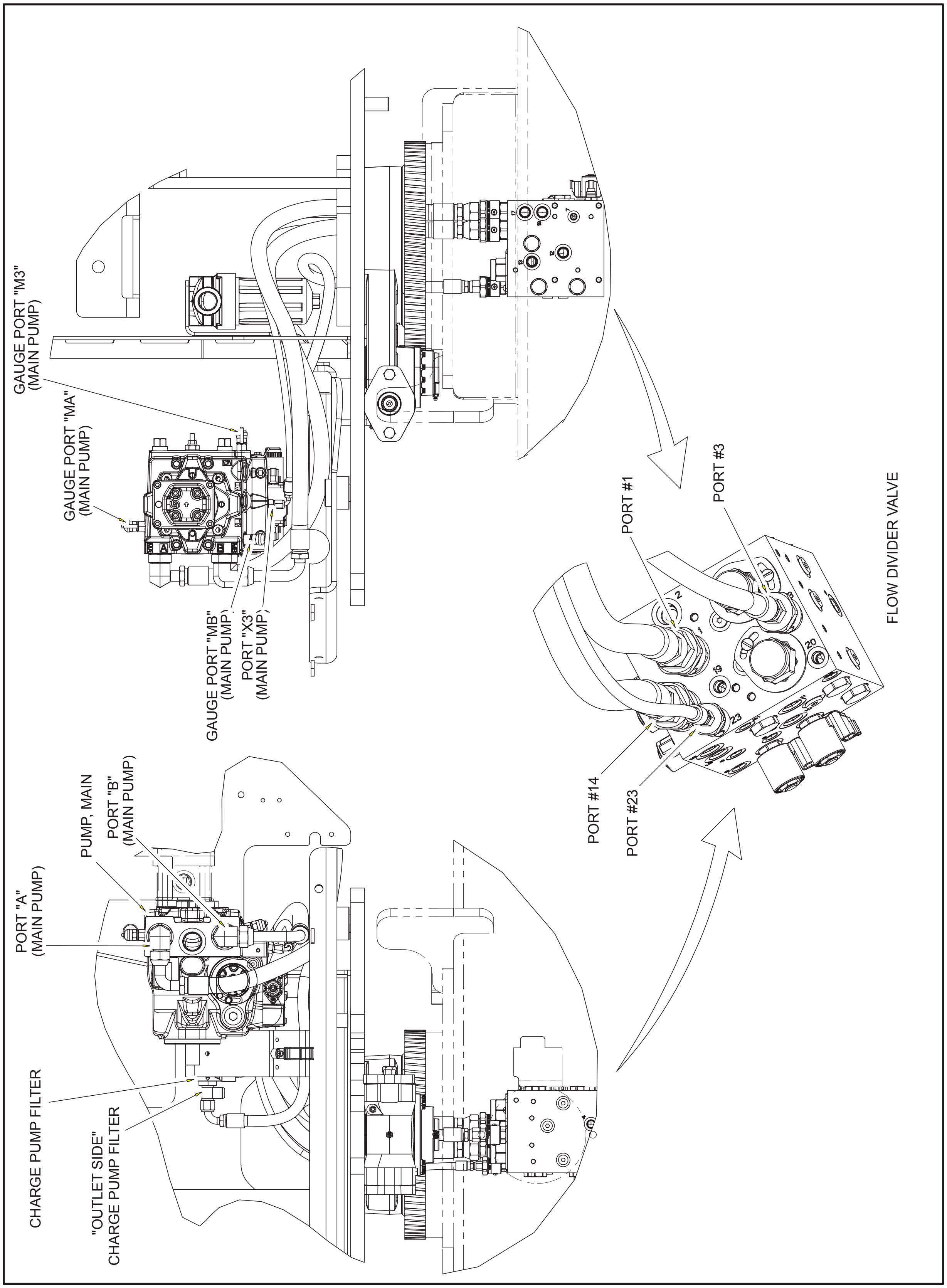


Figure 5-13. Main Pump\Charge Filter Hydraulic Lines

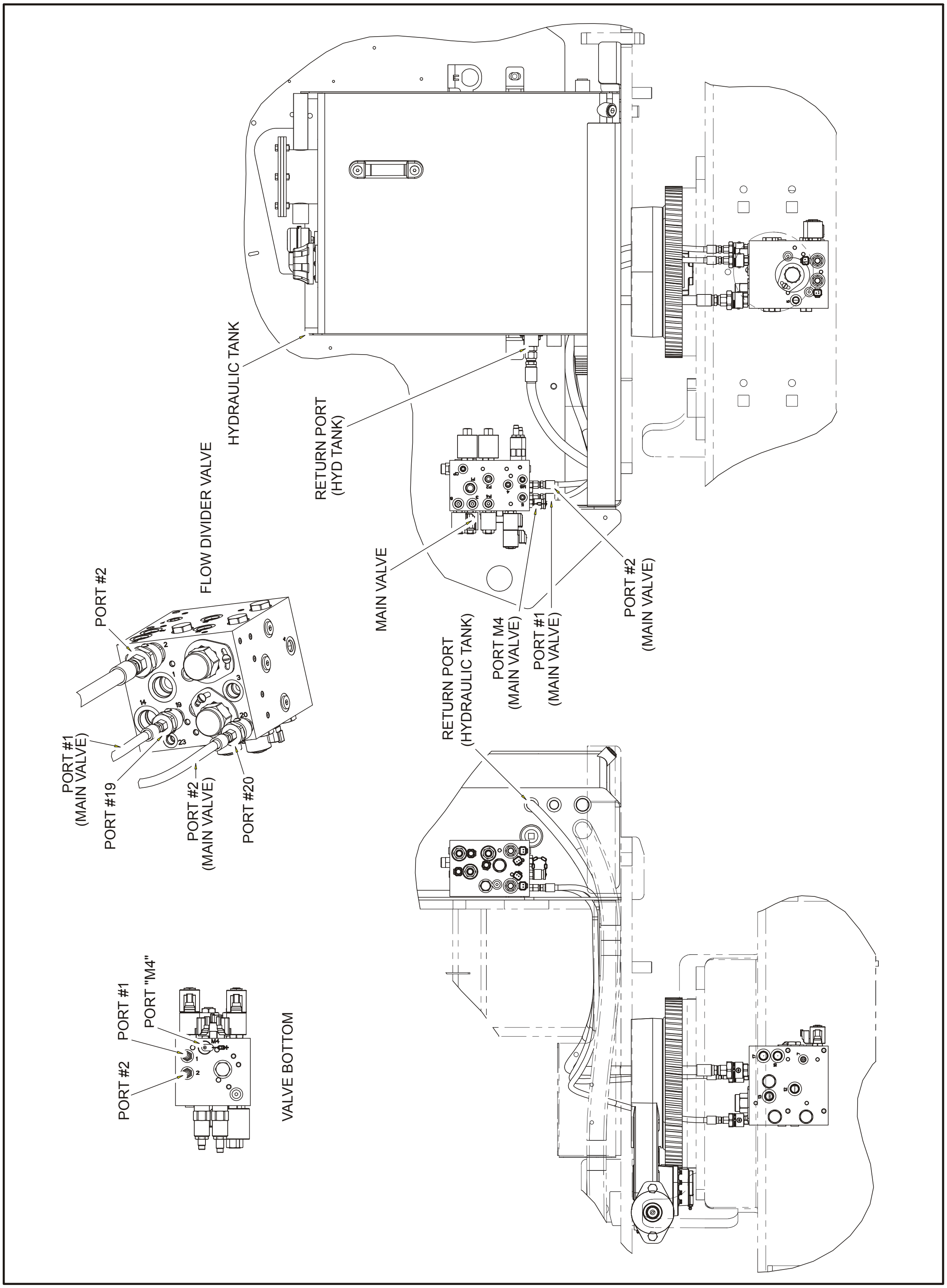


Figure 5-14. Main Pump\Main Valve Hydraulic Lines

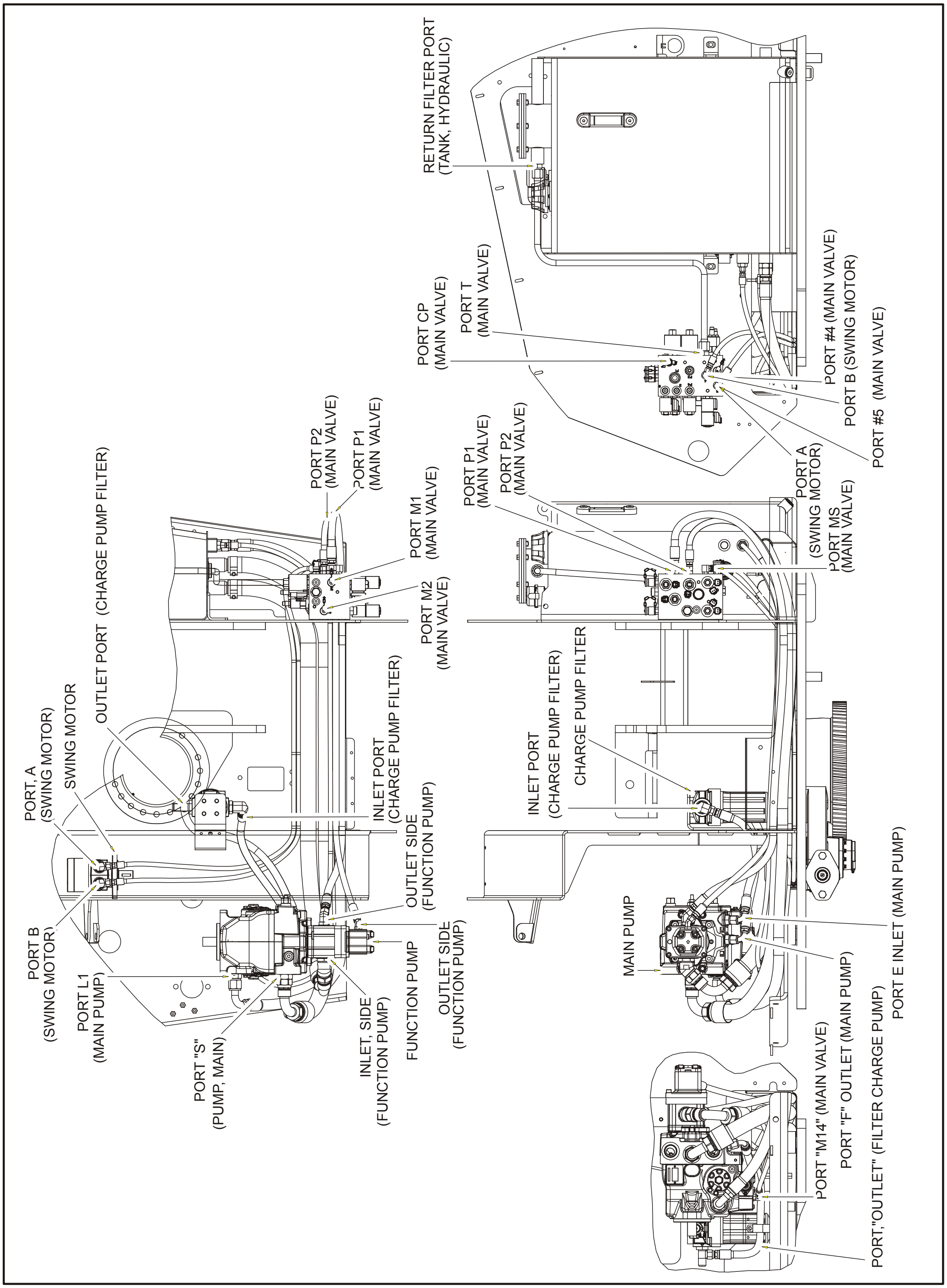
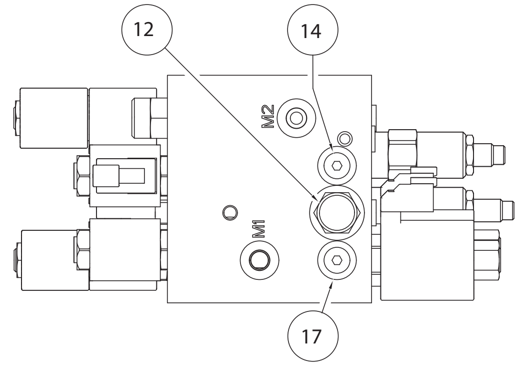
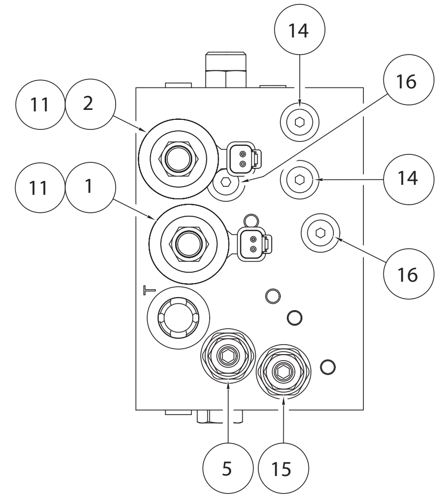
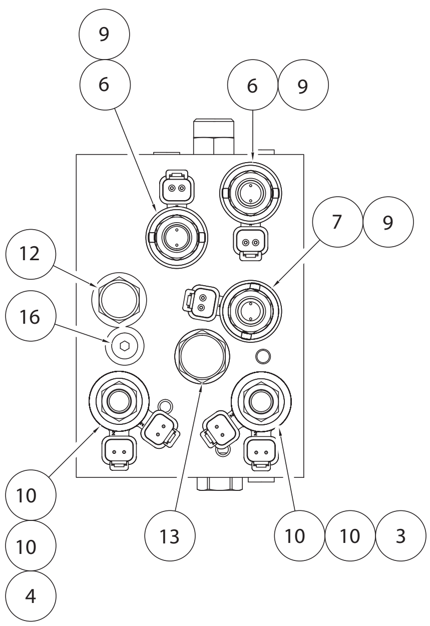


Figure 5-15. Drive Pump to Main Valve/Tank Hydraulic Lines







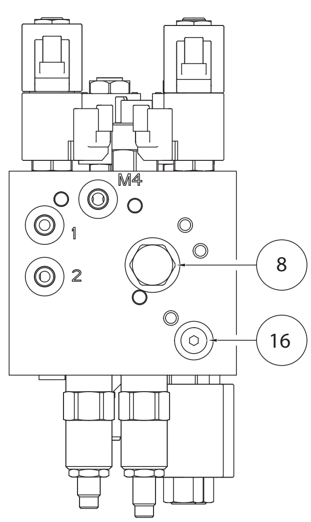


Table 5-6. Main Control Valve Specifications

#	Item	Torque		Ohms
		ft.lbs.	Nm	
1	Solenoid /w Integral Relief Valve	24-26	32.7-35.4	--
2	Solenoid /w Integral Relief Valve	24-26	32.7-35.4	--
3	Solenoid Valve	16-20	24.4-27.1	--
4	Solenoid Valve	16-20	24.4-27.1	--
5	Relief Valve	19-21	25.8-28.6	--
6	Flow Control Valve	19-21	25.8-28.6	--
7	Flow Control Valve	19-21	25.8-28.6	--
8	Load Shuttle Valve	19-21	25.8-28.6	--
9	Coil	5-7	6.8-9.5	5.4
10	Coil	5-7	6.8-9.5	9.8
11	Coil	5-7	6.8-9.5	7.2
12	Pressure Compensated Flow Regulator Valve	19-21	25.8-28.6	--
13	Pressure Compensator	24-26	32.7-35.4	--
14	Check Valve	12-14	16.3-19	--
15	Relief Valve	19-21	25.8-28.6	--
16	Plug	12-14	16.3-19	--
17	Plug	8	11	

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Figure 5-16. Main Control Valve Torque Specifications

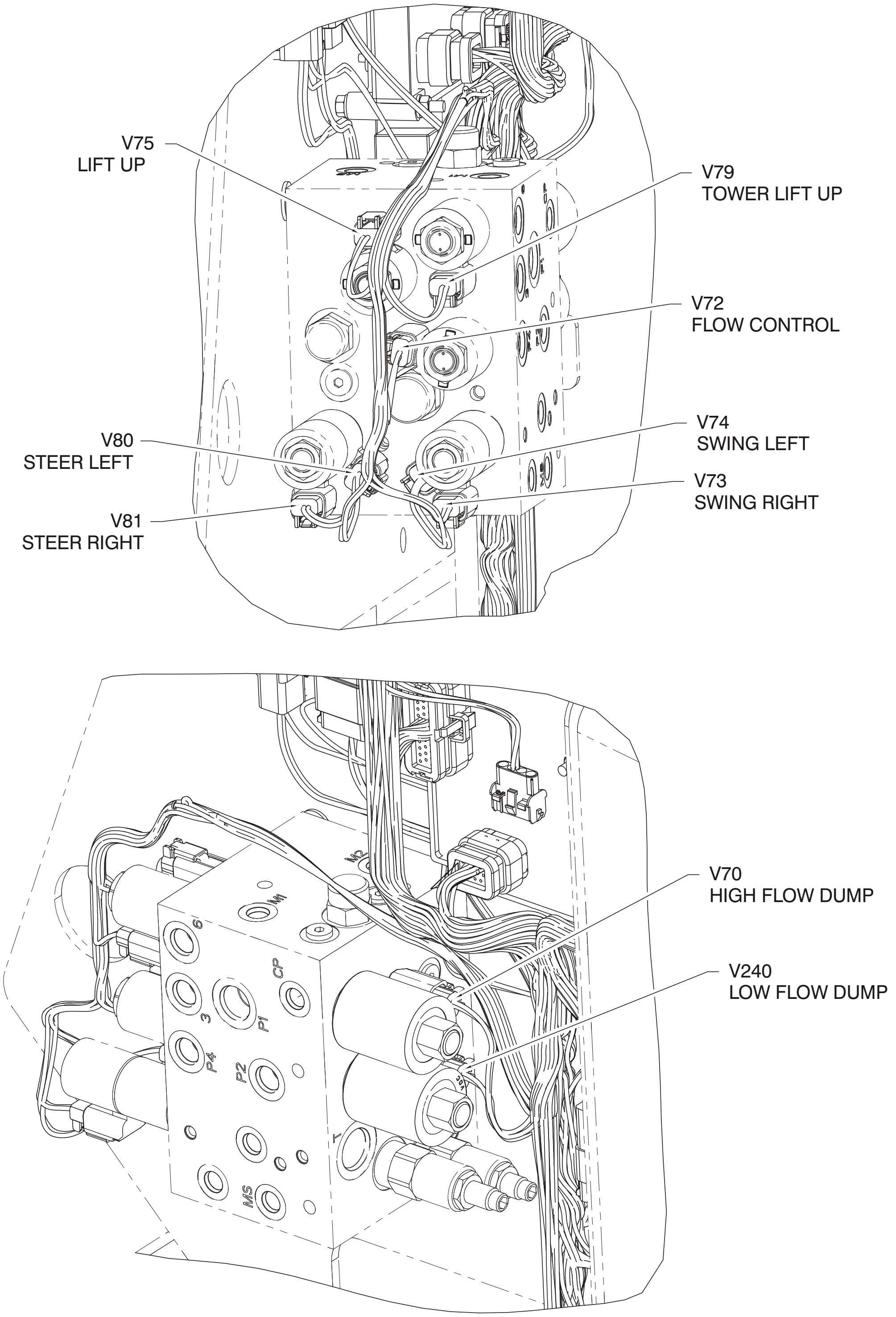
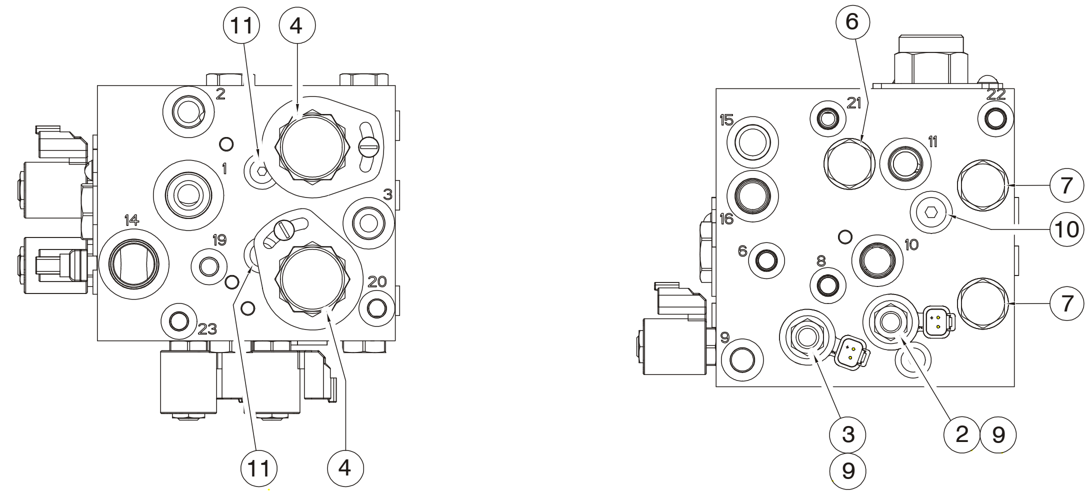
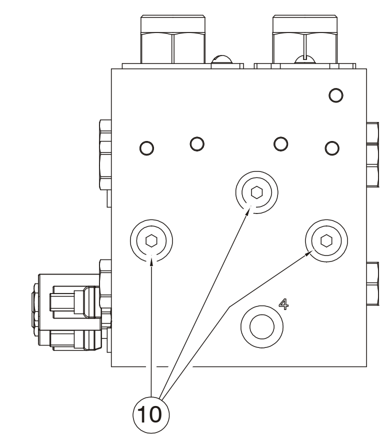


Figure 5-17. Main Control Valve Identification





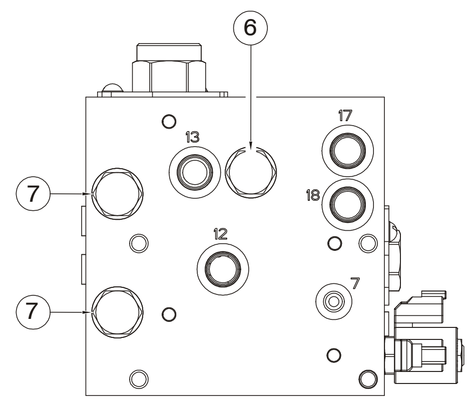


Table 5-6. Flow Divider Specifications

#	Item	Torque		Ohms
		ft.lbs.	Nm	
1	Solenoid Valve	4-5	5.4-6.8	--
2	Solenoid Valve	4-5	5.4-6.8	--
3	Solenoid Valve	4-5	5.4-6.8	--
4	Pilot/Directional Valve	46-54	62.6-73.4	--
5	Flow Divider Valve	73-77	99-104	--
6	Flow Divider Valve	48-52	65-70	--
7	Check Valve	24-26	32.5-35.25	--
8	Coil	4-5	5.4-6.8	8.8
9	Coil	4-5	5.4-6.8	8.8
10	Plug	24-26	32.5-35.25	--
11	Plug	12-14	16.3-19	--

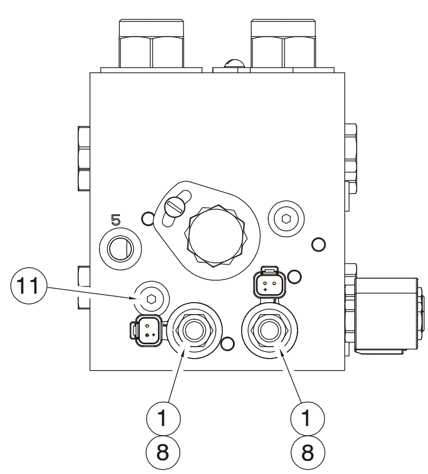


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Figure 5-18. Flow Divider Valve Torque Specifications

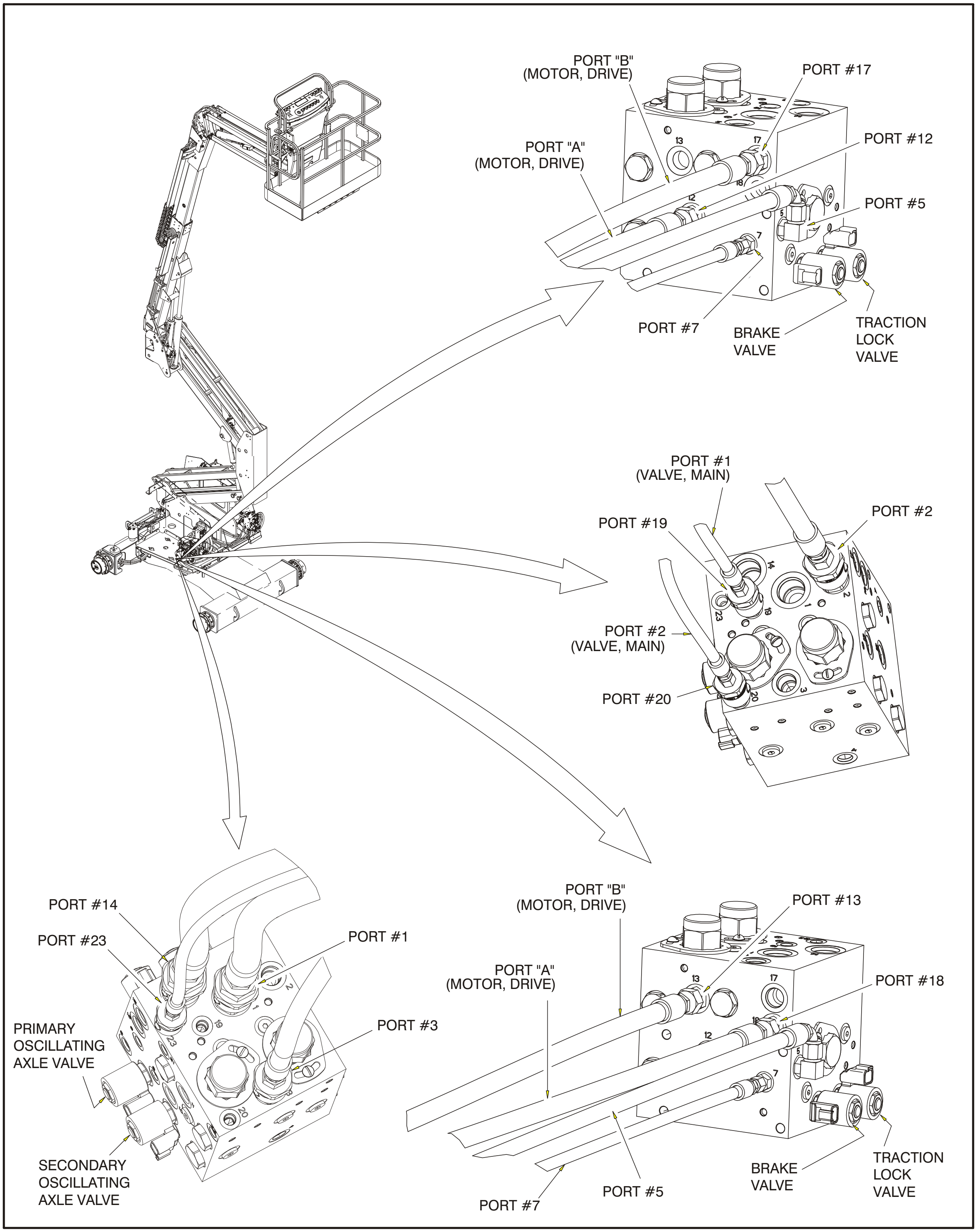


Figure 5-19. Flow Divider Valve Identification - Sheet 1 of 3

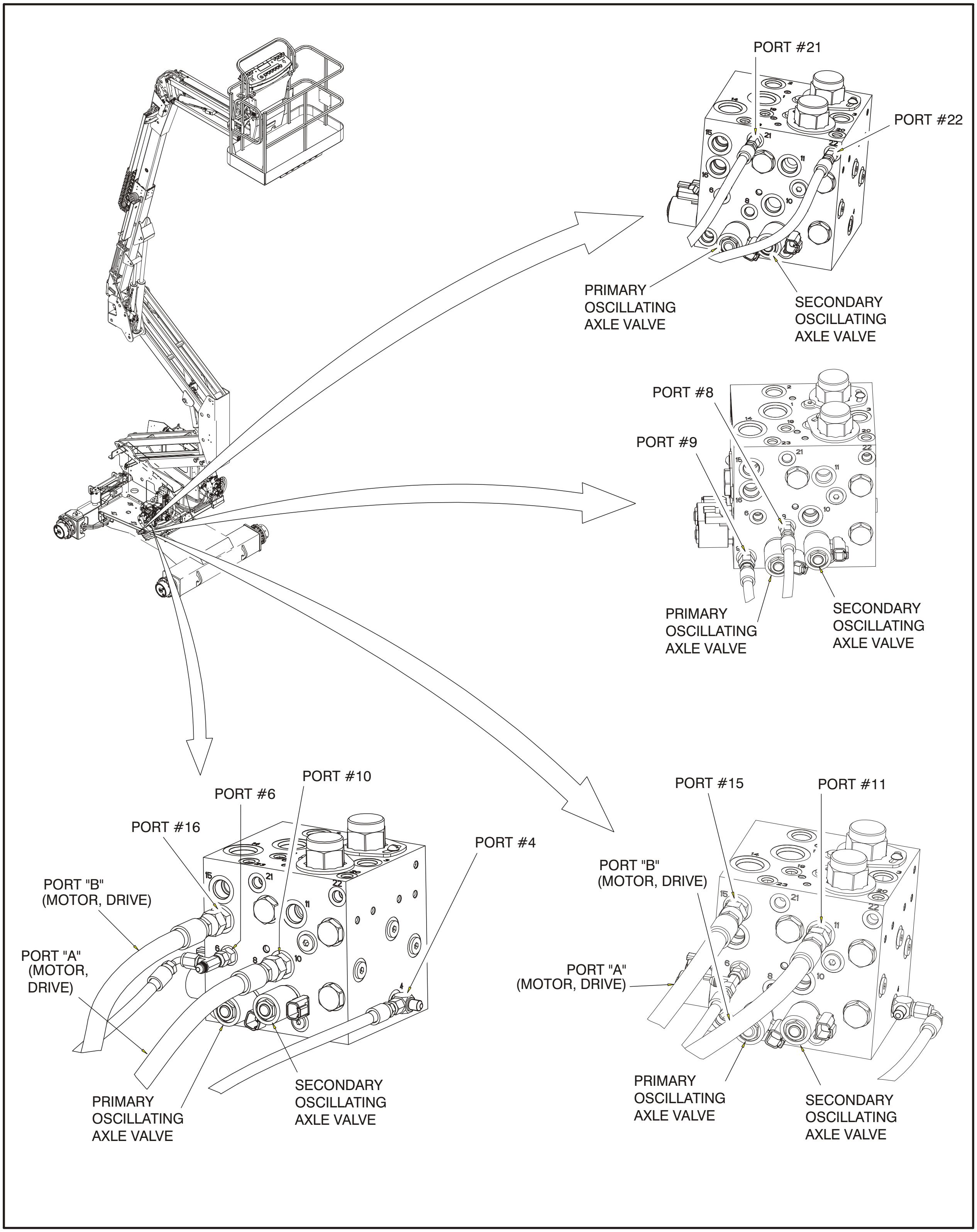


Figure 5-20. Flow Divider Valve Identification - Sheet 2 of 3

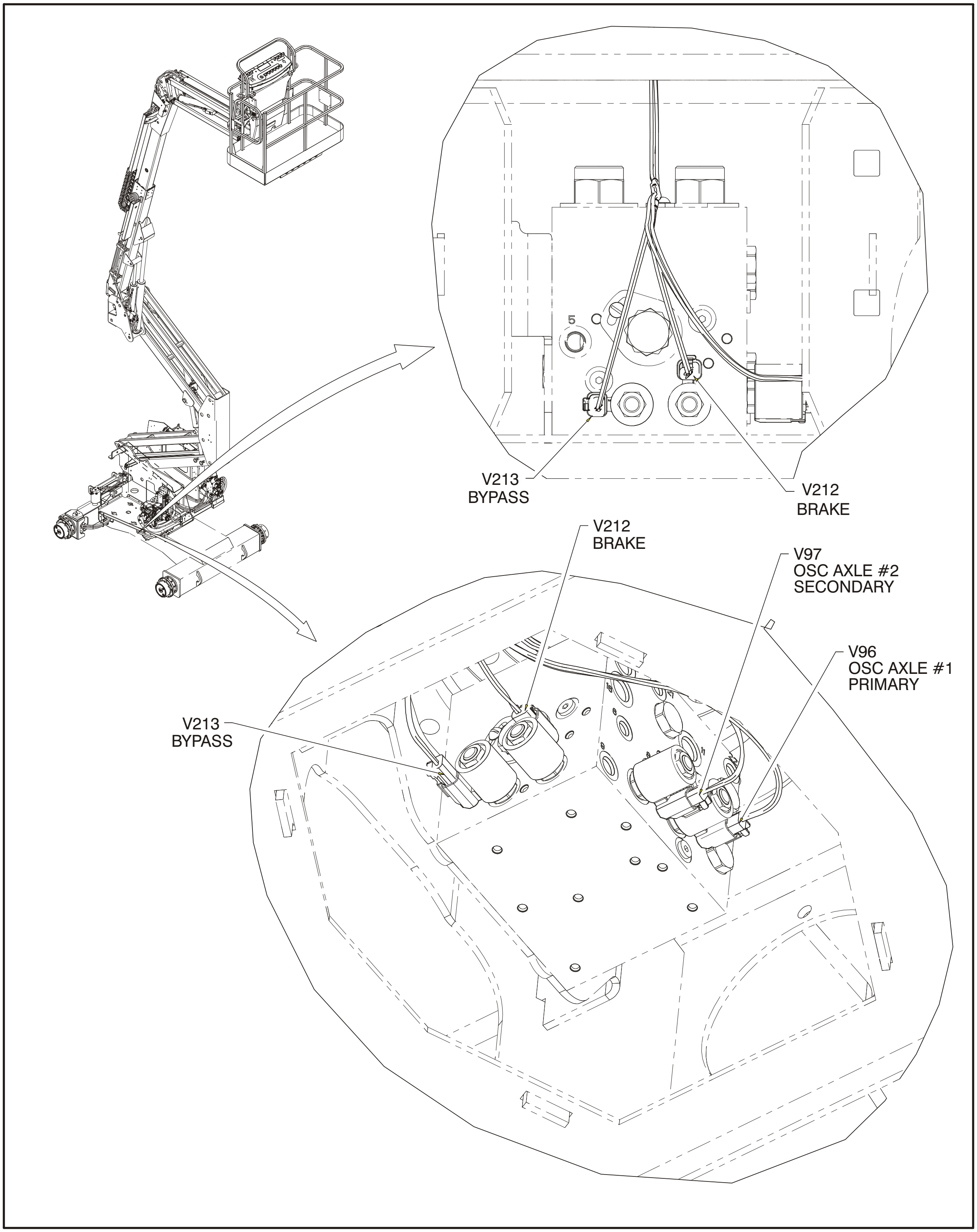
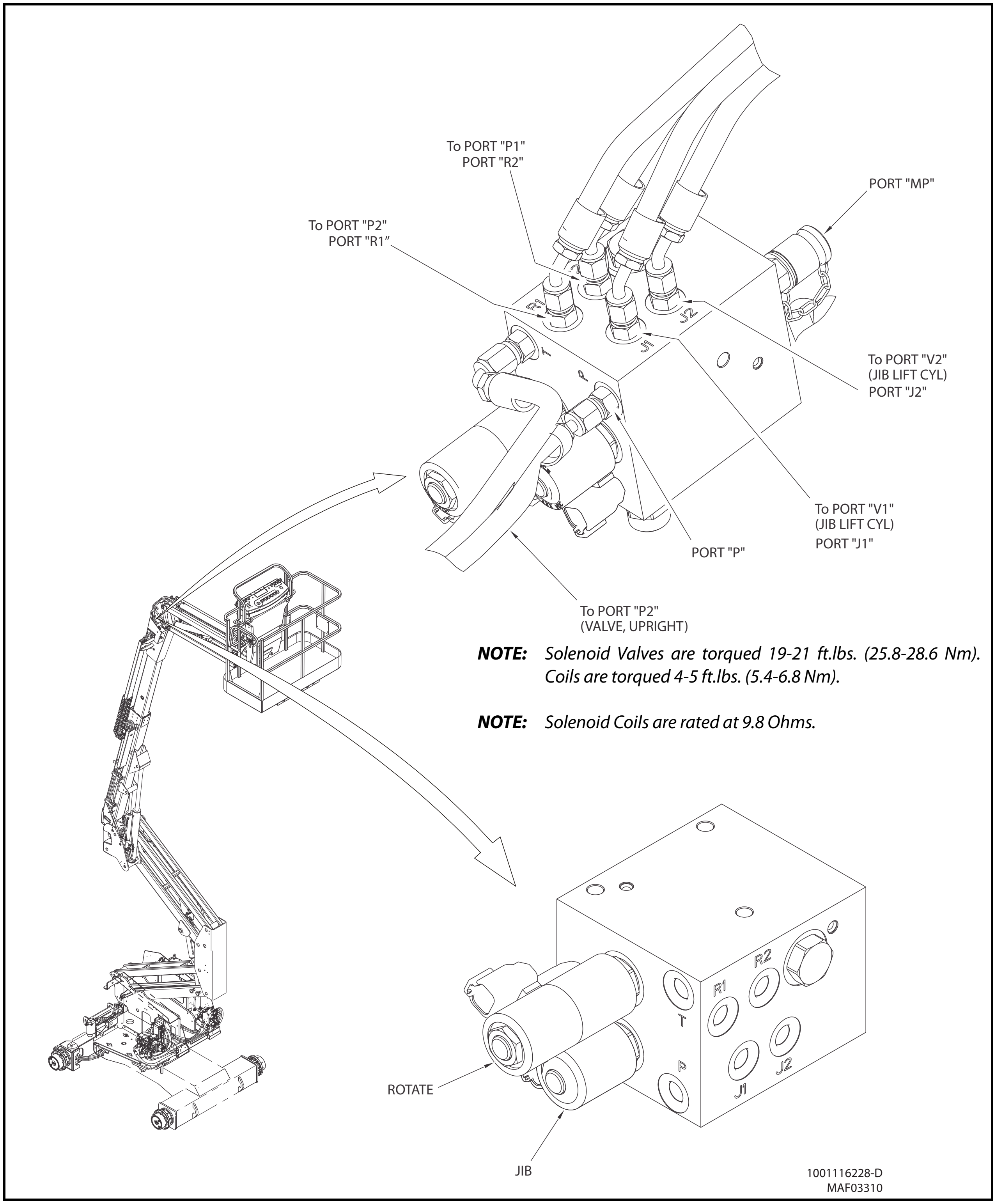


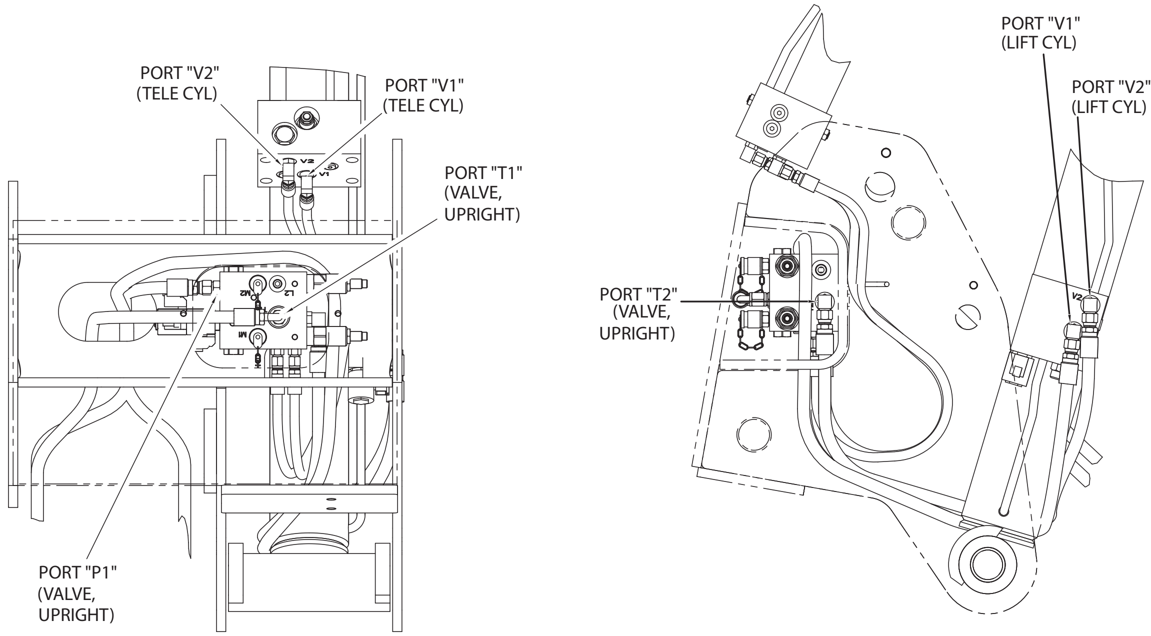
Figure 5-21. Flow Divider Valve Identification - Sheet 3 of 3

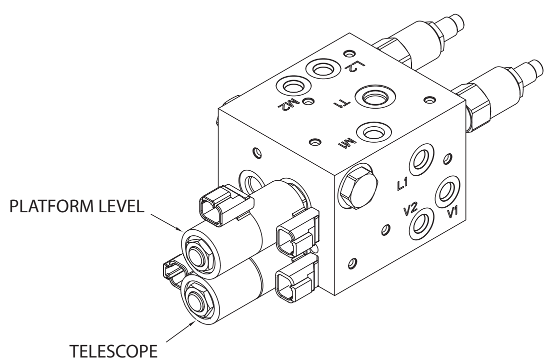


NOTE: *Solenoid Valves are torqued 19-21 ft.lbs. (25.8-28.6 Nm). Coils are torqued 4-5 ft.lbs. (5.4-6.8 Nm).*

NOTE: *Solenoid Coils are rated at 9.8 Ohms.*

Figure 5-22. Fly Boom Control Valve Identification





NOTE: *Solenoid Valves are torqued 19-21 ft.lbs. (25.8-28.6 Nm). Coils are torqued 4-5 ft.lbs. (5.4-6.8 Nm).*

NOTE: *Solenoid Coils are rated at 9.8 Ohms.*

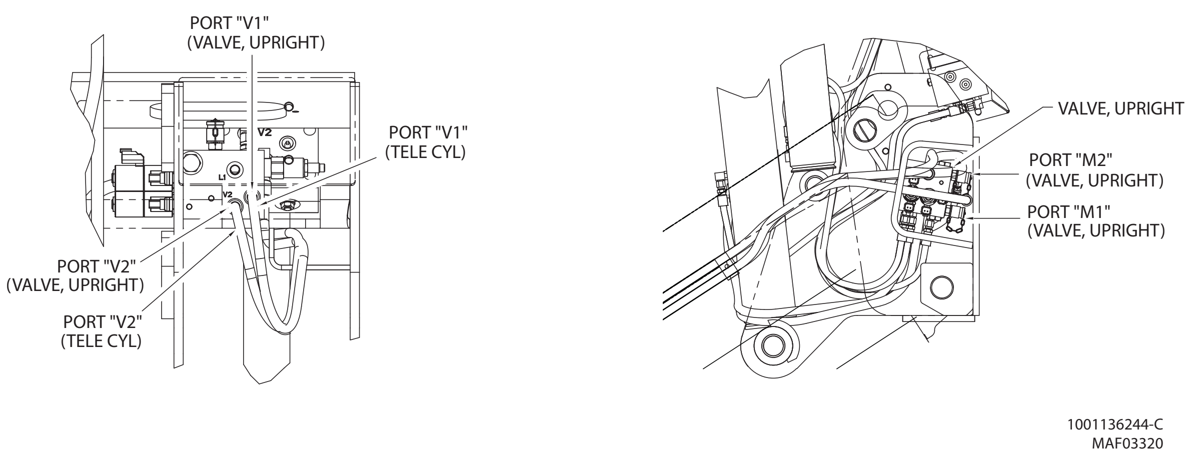


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Figure 5-23. Upright Control Valve Identification

5.3 DRIVE PUMP

Description

Sauer-Danfoss H1 tandem closed circuit piston pumps convert input torque to hydraulic power.The tandem design powers two independent drive trains for dual-path propel applications.The two-piece input shaft transmits rotational force to the cylinder block. A splined coupling connects the front and rear shafts. Bearings at the front, rear, and center of the pump support the shaft. Splines connect each shaft to a cylinder block. A lip-seal at the front end of the pump prevents leakage where the shaft exits the pump housing.The spinning cylinder block contains nine reciprocating pistons. Each piston has a brass slipper connected at one end by a ball joint. The block spring, ball guide, and slipper retainer hold the slippers to the swash plate. The reciprocating movement of the pistons occurs as the slippers slide against the inclined swashplates during rotation.Via the valve plates, one half of each cylinder block is connected to port A or C and the other half to port B or D. Front and rear sections have independent porting in the center section. As each piston cycles in and out of its bore, fluid is drawn from one port and displaced to the other thereby imparting hydraulic power into the system. A small amount of fluid is allowed to flow from the cylinder block/valve plate and slipper/swashplate interfaces for lubrication and cooling.Case drain ports return this fluid to the reservoir. An external charge pump (not shown) provides clean, cool fluid to makeup this lubricating flow and to maintain minimum loop pressure.

The angle of each swashplate controls the volume and direction of fluid displaced into the system.The servo pistons control the angle of the swashplates. Each pump control, by varying the pressure at the servo pistons, controls each piston's position. An electric signal to the control coils transmits the command from the operator to the pump. Mechanical feedback of the swashplate position to the control through the feedback pins allows for very precise displacement control and increases overall system stability. Non-feedback control options do not use the mechanical feedback link.

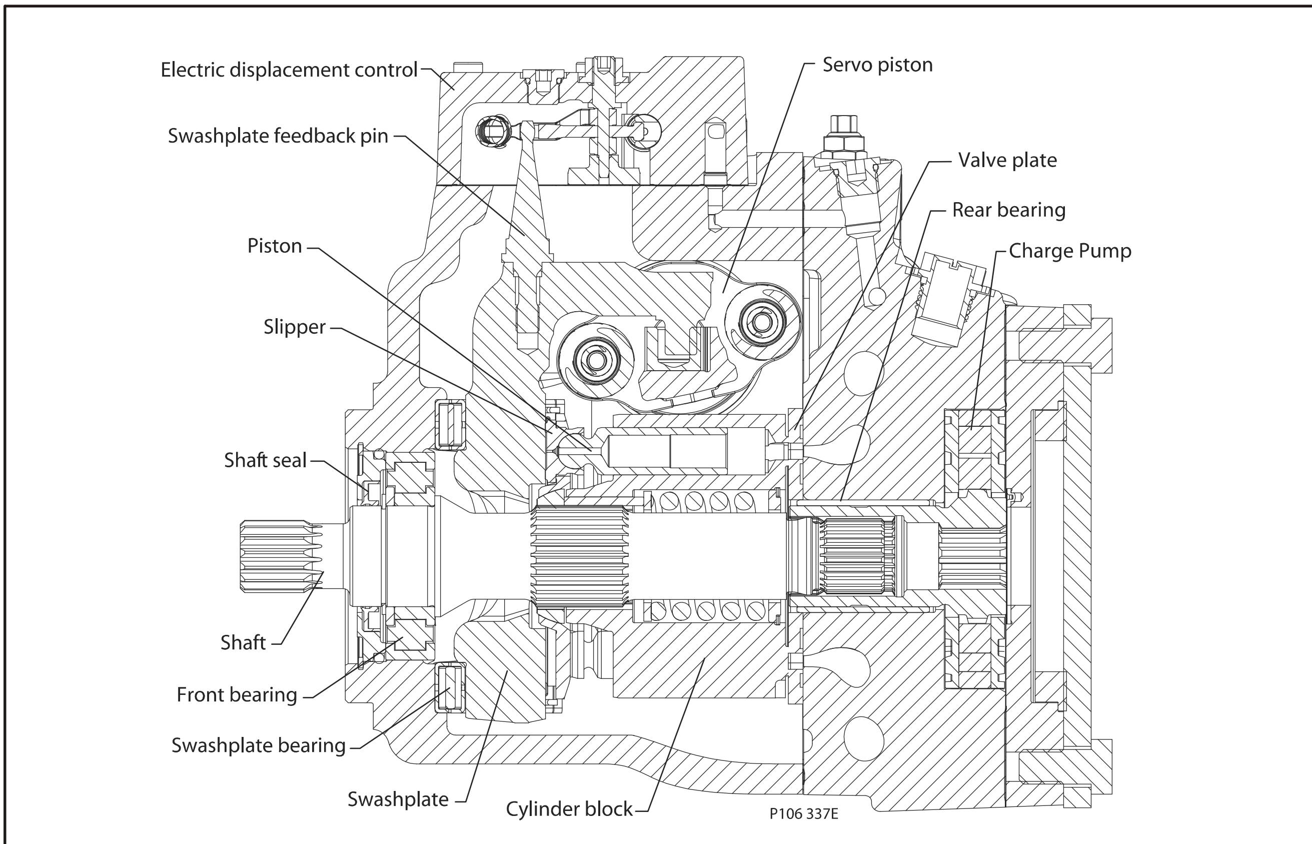


Figure 5-24. Drive Pump - Cross Sectional View

The System Circuit

THE BASIC CLOSED CIRCUIT

Hydraulic lines connect the main ports of the pump to the main ports of the motor. Fluid flows in either direction from the pump to the motor and back. Either of the hydraulic lines can be under high pressure. In pumping mode the position of the pump swashplate determines which line is high pressure as well as the direction of fluid flow.

CASE DRAIN AND HEAT EXCHANGER

The pump and motor require case drain lines to remove hot fluid from the system.The pump and motor drain from the top-most port to ensure the cases remain full of fluid.The motor case drain can connect to the lower drain port on the pump housing or it can tee into the case drain line upstream of the heat exchanger. A heat exchanger with bypass valve cools the case drain fluid before it returns to the reservoir.

High Pressure Relief Valve (HPRV) and Charge Check

All H1 pumps have a combination high pressure relief and charge check valve. The high-pressure relief function is a dissipative (heat generating) pressure control valve for the purpose of limiting excessive system pressures. The charge check function replenishes the low-pressure side of the working loop with charge oil. Each side of the transmission loop has a dedicated non-adjustable, factory-set HPRV valve. When system pressure exceeds the factory setting, oil is passed from the high pressure system loop into the charge gallery, and into the low pressure system loop via the charge check.

The pump may have different pressure settings at each system port. When an HPRV valve is used in conjunction with a pressure limiter, the HPRV valve is always factory set above the setting of the pressure limiter. The system pressure shown in the order code for pumps with only HPRV is the HPRV setting.The system pressure shown in the order code for pumps with pressure limiter and HPRV, is the pressure limiter setting.

NOTE: *HPRVs are set at low flow condition. Any application or operating condition which leads to elevated HPRV flow will cause a pressure rise with flow above the valve setting.*

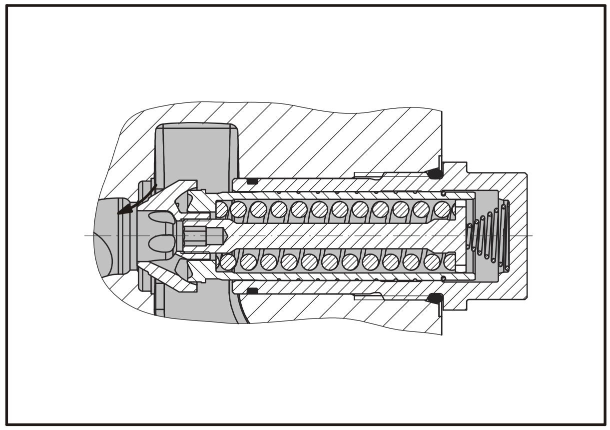


Figure 5-25. High Pressure Relief and Charge Check Valve with Bypass Valve in charging mode

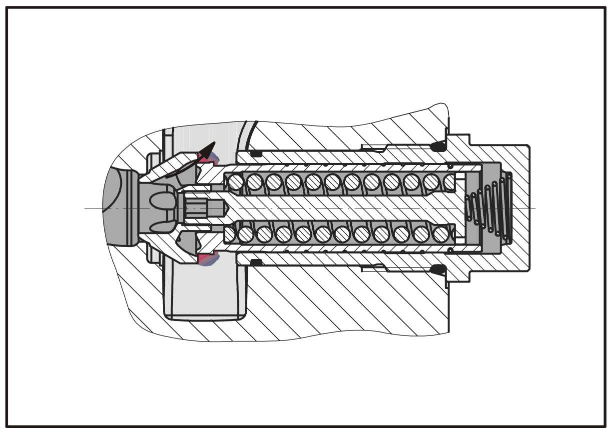


Figure 5-26. High Pressure Relief and Charge Check Valve with Bypass Valve in relief mode

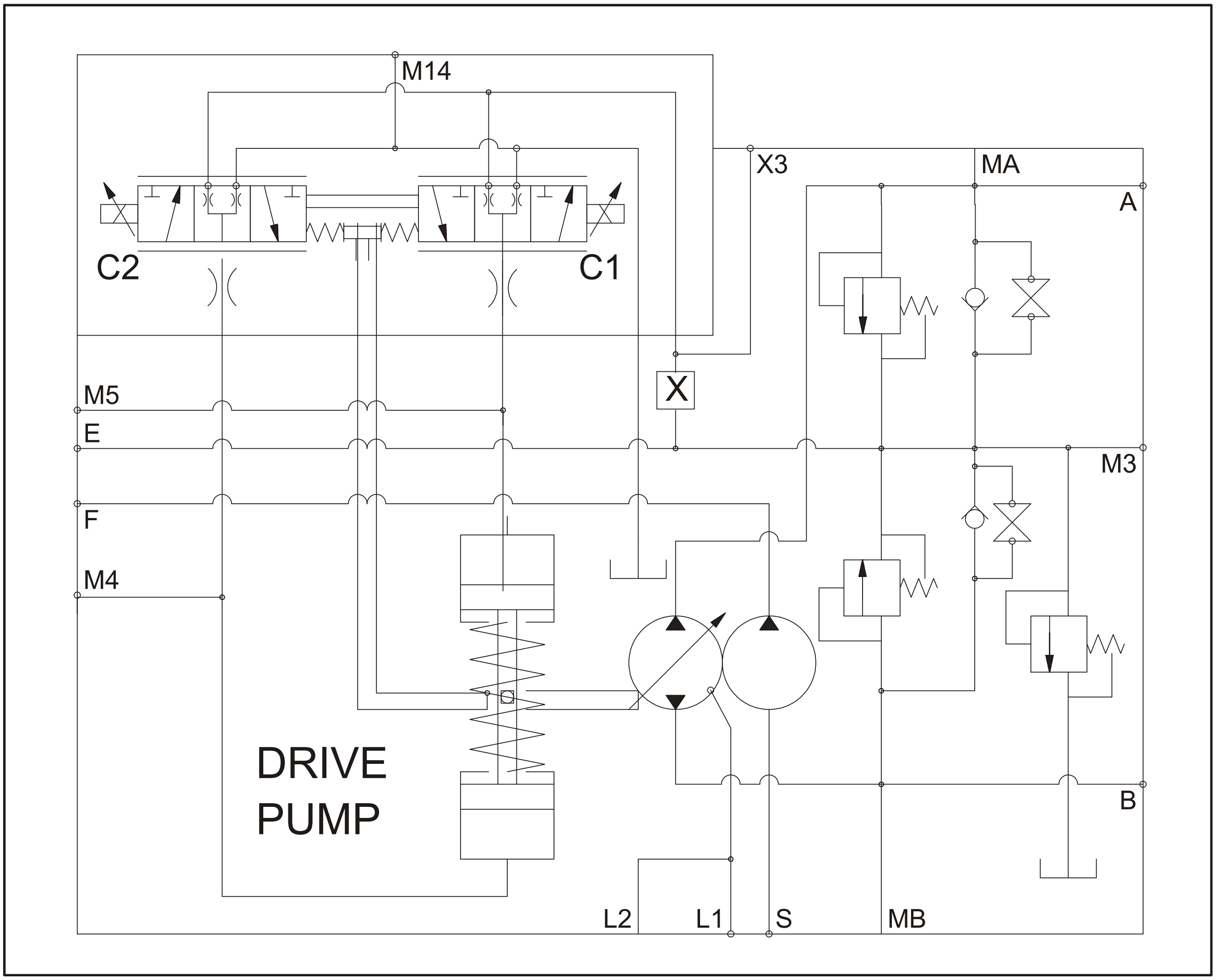


Figure 5-27. Drive Pump Hydraulic Schematic

Charge Pressure Relief Valve

The charge pressure relief valve maintains charge pressure at a designated level above case pressure.The charge pressure relief valve is a direct acting poppet valve that opens and discharges fluid to the pump case when pressure exceeds a designated level. This level is nominally set with the pump running at 1800 min^{-1} (rpm). For external charge flow, the CPRV is set with a flow of 30 l/min [8 US gal/min]. In forward or reverse, charge pressure will be slightly lower than in neutral position. The model code of the pump specifies the charge relief setting.

Typically charge pressure increases from 1.2-1.5 bar per 10 l/min [17.4-21.8 psi per 2.64 US gal/min].

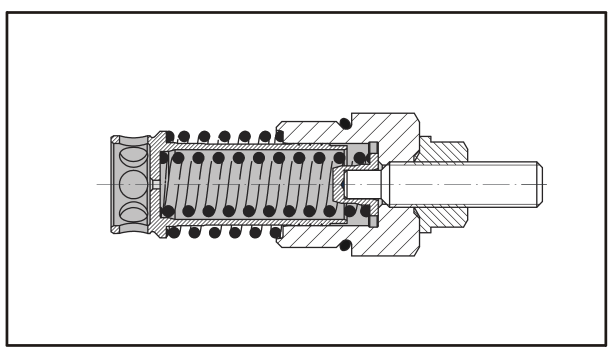


Figure 5-28. Charge pressure relief valve

Electrical Displacement Control (EDC)

EDC PRINCIPLE

The Electrical Displacement Control (EDC) consists of proportional solenoids on each side of a three-position, four-way porting spool. The proportional solenoid applies a force to the spool, which ports hydraulic fluid to either side of the servo piston. Differential pressure across the servo piston rotates the swashplate, changing the pump's displacement from full displacement in one direction to full displacement in the opposite direction.

EDC OPERATION

H1 EDC's are current driven controls requiring a Pulse Width Modulated (PWM) signal. Pulse width modulation allows more precise control of current to the solenoids. The PWM signal causes the solenoid pin to push against the porting spool, which pressurizes one end of the servo piston, while draining the other. Pressure differential across the servo piston moves the swashplate. A swashplate feedback link, opposing control links, and a linear spring provide swashplate position force feedback to the solenoid. The control system reaches equilibrium when the position of the swashplate spring feedback force exactly balances the input command solenoid force from the operator. As hydraulic pressures in the operating loop change with load, the control assembly and servo/swashplate system work constantly to maintain the commanded position of the swashplate.

The EDC incorporates a positive neutral dead-band as a result of the control spool porting, spring preload from the servo piston assembly, and the linear control spring. Once the neutral threshold current is reached, the swashplate position becomes directly proportional to the control current.To minimize the effect of the control neutral deadband, we recommended the transmission controller or operator input device incorporate a jump up current.

NOTE: *The neutral position of the control spool does provide a positive preload pressure to each end of the servo piston assembly.*

When the control input signal is either lost or removed, or if there is a loss of charge pressure, the spring-loaded servo piston automatically returns the pump to neutral position.

The EDC is a displacement (flow) control. Pump swashplate position is proportional to the input command and therefore vehicle or load speed (excluding influence of efficiency), is dependent only on the prime mover speed or motor displacement.

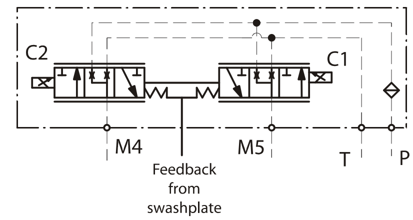


Figure 5-29. EDC-Schematic Diagram

WARNING may result in injury

CAUTION may result in damage to product or property

Non-reusable part, use a new part

Option – either part may exist

Measurement required

External hex head

Internal hex head

Lubricate with hydraulic fluid

Inspect for wear or damage

Note correct orientation

Torque specification

Cover splines with installation sleeve

Pressure measurement/gauge location or specification

NOTE: *These symbols are used throughout the Drive Pump illustrations.*

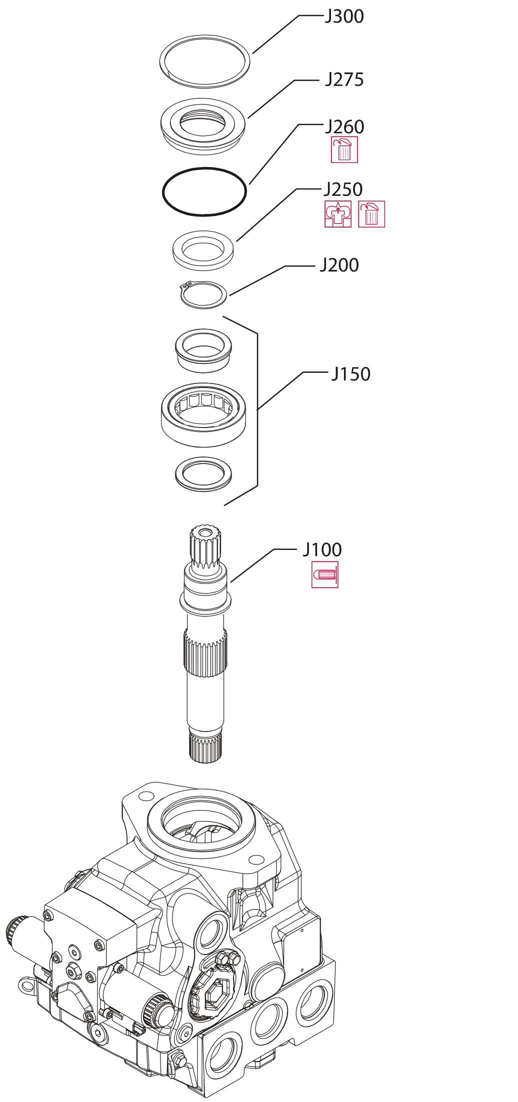
Figure 5-30. Symbol Chart

Disassembly

SHAFT SEAL REMOVAL

1. Orient pump with the shaft pointing up.

2. Remove the spiral ring (J300) from the front housing to release the shaft seal carrier (J275).



3. Pry on the lip of the seal carrier to remove it from the pump.

4. Remove and discard the O-ring (J260) and seal (J250) from the seal carrier.

INPUT SHAFT

1. Pull the shaft with bearing out of the pump. If necessary, tap lightly on the shaft to dislodge it from the internal pump components.

CAUTION

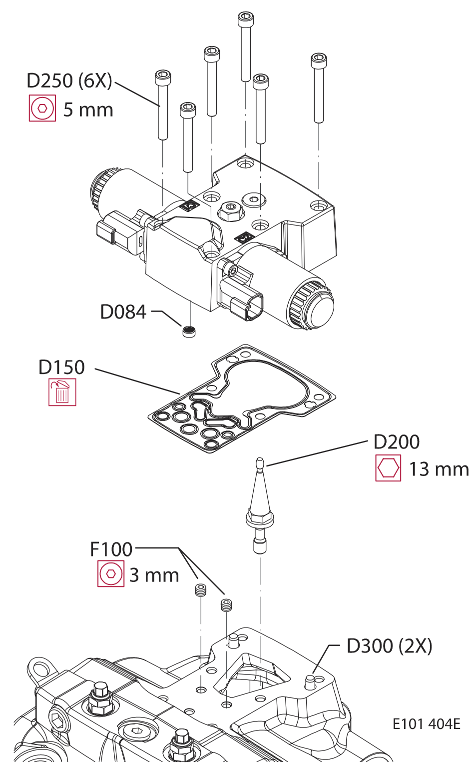
DO NOT DAMAGE THE HOUSING BORE, SHAFT OR BEARING WHEN REMOVING THE SHAFT AND SHAFT SEAL.

2. Remove the snap ring (J200) using snap ring pliers.

3. Use an adequate press to remove the bearing from the shaft.

EDC CONTROL REMOVAL

1. Remove control screws (D250) using a 5 mm internal hex wrench. Remove the control from the pump.



2. Remove and discard the gasket (D150).

3. Using a 13 mm deep well socket wrench, remove feedback pin (D200) from top of swash plate.

4. If necessary, remove the screen (D084).

CAUTION

SCREEN (D084) MAY BE LOOSE AND FALL OUT OF CONTROL. TAKE CAUTION NOT TO LOSE IT.

5. If necessary, remove orifices (F100) using a 3 mm internal hex wrench.

NOTICE

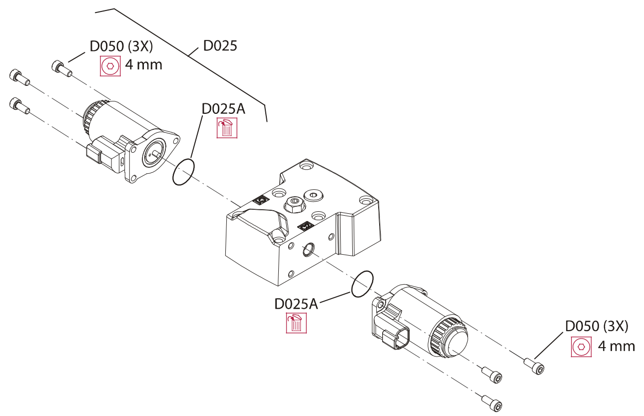
DOWEL PINS (D300) ARE A PRESS FIT AND WILL REMAIN IN HOUSING.

EDC CONTROL DISASSEMBLY

NOTICE

IT IS NOT NECESSARY TO REMOVE SOLENOIDS (D025) UNLESS YOU ARE REPLACING THEM.

1. Use a 4 mm internal hex wrench to remove cap screws (D050).



NOTICE

IF YOU SUSPECT A COIL MALFUNCTION, REMOVE THE COIL. REMOVE THE PLASTIC NUT WITH A 26 MM 12 POINT SOCKET. INSTALL A NEW COIL. TORQUE NUT TO 5 NM [3.7 FT.LBS.].

2. Remove solenoids (D025). Remove and discard O-rings (D025A).

NOTICE

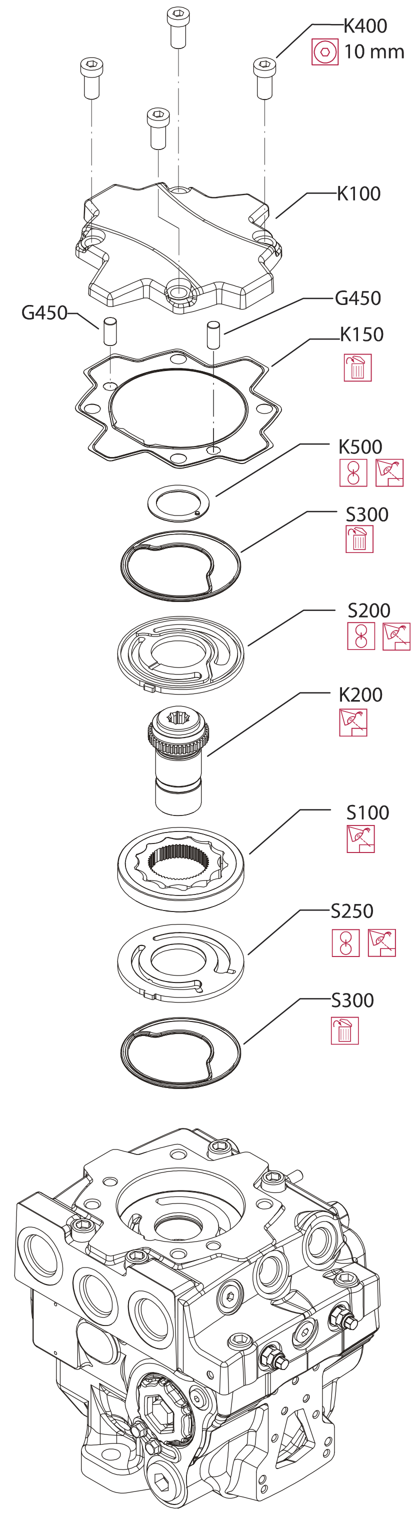
DO NOT DISASSEMBLE INTERNAL PARTS OF CONTROL. INTERNAL PARTS ARE NOT AVAILABLE SEPARATELY. CONTROL IS SOLD AS A COMPLETE UNIT ONLY.

AUXILIARY PAD OR END COVER REMOVAL

NOTICE

REMOVE AUXILIARY PUMP, IF PRESENT.

1. Position pump so end cover (K100) or auxiliary pad is on top.



2. Remove end cover/auxiliary pad screws (K400) using an 8 mm internal hex wrench.

NOTICE

ALIGNMENT PINS (G450) ARE IN END COVER. THEY MAY DISLODGE DURING DISASSEMBLY.

3. Remove and discard gasket (K150).
4. Remove thrust washer (K500). Note thrust washer orientation.
5. Remove pressure balance plate (S200) and seal (S300). Note plate orientation. Discard seal (S300).
6. Remove coupling (K200).

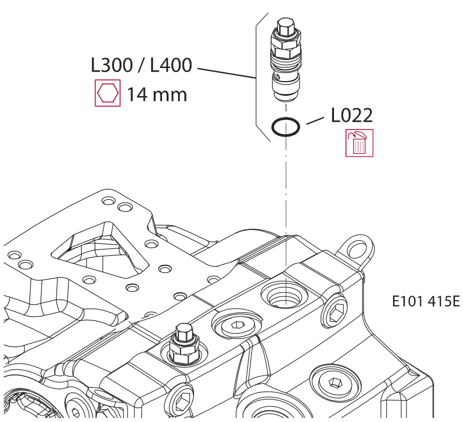
CHARGE PUMP REMOVAL

1. Remove charge pump outer ring (S150),and gear-set(S100).
2. Remove valve plate (S250) with seal (S300). Discard seal (S300).

NOTE: *If charge pump requires replacement, replace as a kit. Kit includes (S300), (S250), (S100), and(S200).*

PRESSURE LIMITER REMOVAL

1. Using a 14 mm wrench, remove pressure limiter cartridges (L300) and (L400).



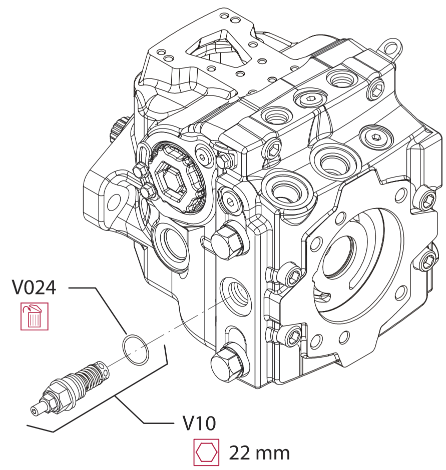
NOTE: *Pressure limiter (L300 / L400) is available as complete unit only. Seal (L022) is available separately.*

2. Remove and discard O-ring (L022).

NOTE: *Right and left pressure settings are different. Tag each valve for later re-assembly*

CHARGE PRESSURE RELIEF VALVE REMOVAL

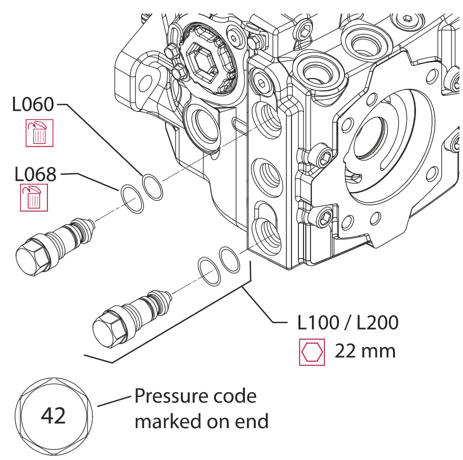
Using a 22 mm wrench, remove the charge pressure relief valve (VI0). Discard O-ring (V024).



NOTE: *Charge pressure relief valve (VI0) is available as complete unit only. Seal (V024) is available separately.*

HIGH PRESSURE RELIEF VALVE REMOVAL

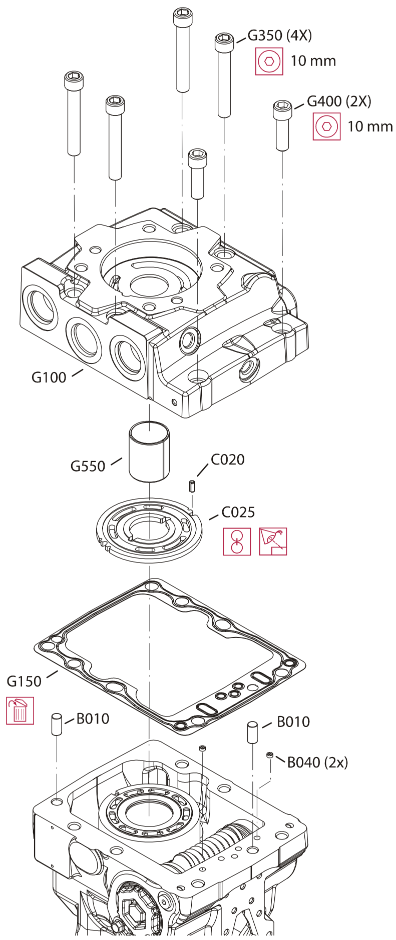
Using a 22 mm wrench, remove the HPRV valves (LI00 / L200). Discard O-rings (L060) and seals (L068).



NOTE: *HPRV valves may not have the same pressure setting. Tag each valve for reassembly.*

ENDCAP REMOVAL

1. Remove two endcap screws (G400) using a 10 mm internal hex wrench.



2. Remove four endcap screws (G350) using a 10 mm internal hex wrench.

3. Carefully remove the endcap (G100) and valveplate (C025). Valveplate may be stuck to endcap. Alignment pin (C020) may remain in endcap.

NOTICE

NOTE VALVE PLATE ORIENTATION FOR PROPER REASSEMBLY.

4. Place the endcap and valve plate in a clean area, protecting them from contamination.

5. Remove and discard gasket (G150).

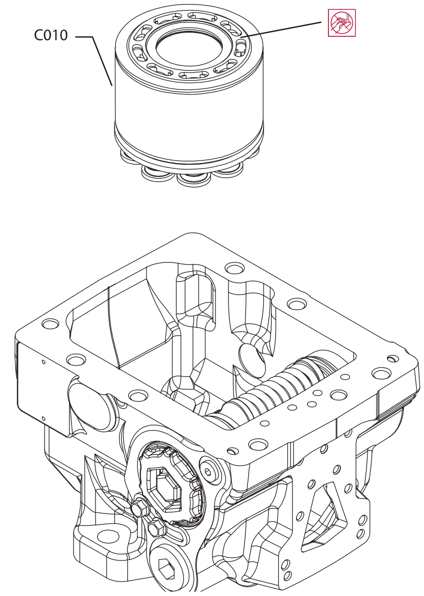
6. If necessary, remove bushing (G550) using a suitable puller.

7. Remove locating pins (B010).

NOTE: *If necessary, use a hook to remove screens (B040) and discard.*

CYLINDER BLOCK KIT REMOVAL

1. Remove cylinder block assembly (C010).



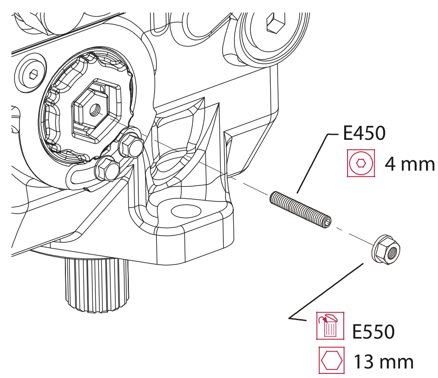
2. Set cylinder block and components on a clean dry surface.

CAUTION

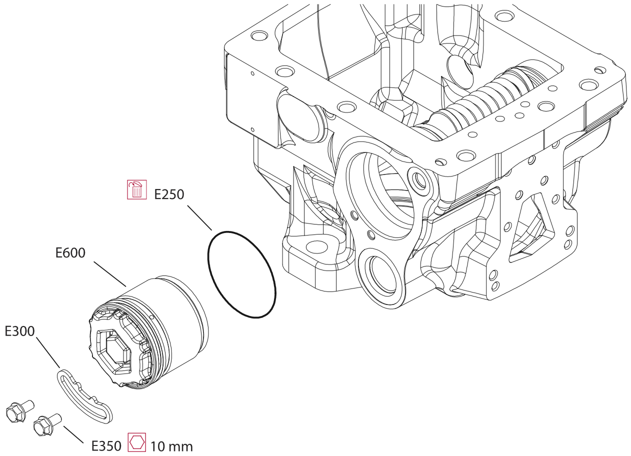
DO NOT SCRATCH THE RUNNING SURFACES OF THE CYLINDER BLOCK OR SLIPPERS. SCRATCHES IN THESE SURFACES CAN LEAD TO POOR PERFORMANCE OR PUMP FAILURE.

SERVO SLEEVE REMOVAL

1. If equipped, remove and discard locking nut (E550) and remove displacement limiter screw (E450).



2. Remove the locking screws (E350) with a 10 mm hex wrench. Remove the locking plates (E300).



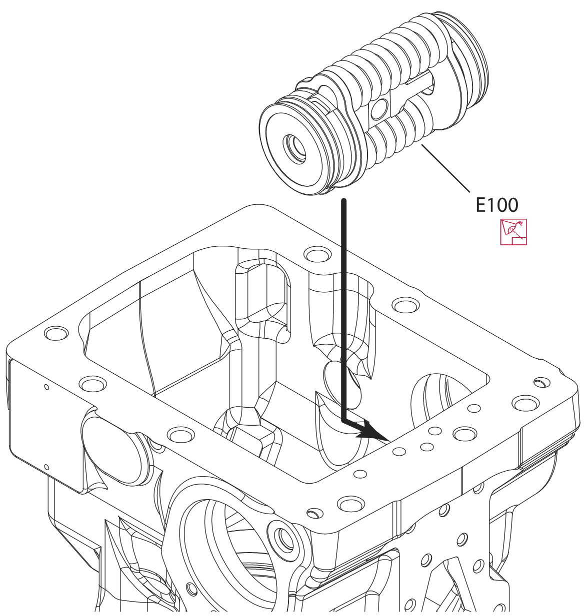
3. Using a 3/4 in.deep socket, unthread the servo sleeves (E600) from each side of the pump. Servo piston will be loose after servo cylinders are removed. Discard O-rings (E250).

CAUTION

DO NOT ALLOW LOOSE SERVO PISTON TO DAMAGE INTERNAL MACHINED SURFACES OF PUMP.

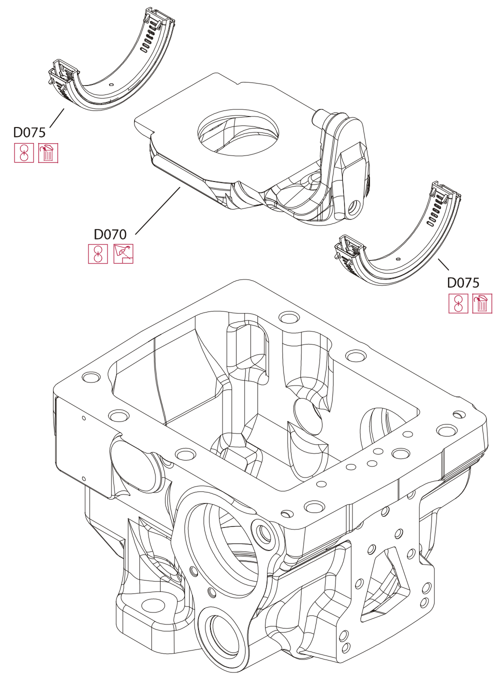
SERVO PISTON REMOVAL

Tilt swashplate up to disengage servo arm from piston. Remove the servo piston assembly (E100).



SWASHPLATE AND SWASHPLATE BEARING REMOVAL

1. Lift the swashplate (D070) out by grasping the swashplate pin. Swashplate bearings (D075) will remain on the swash plate.



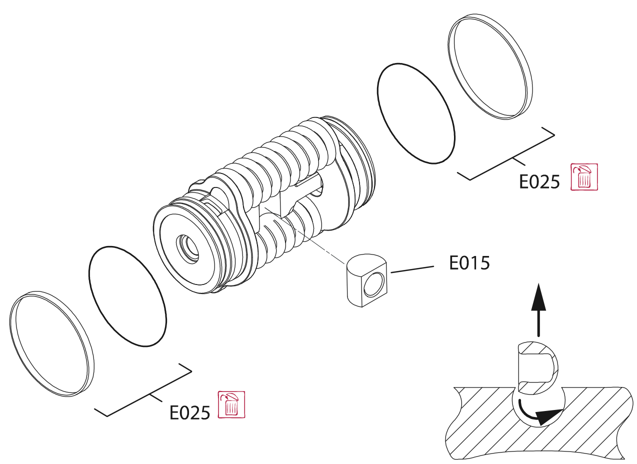
2. Remove bearings (D075) by sliding them from the swashplate and discard them.

NOTICE

DO NOT REUSE SWASHPLATE BEARINGS.

SERVO PISTON DISASSEMBLY

1. Remove and discard seals (E025).



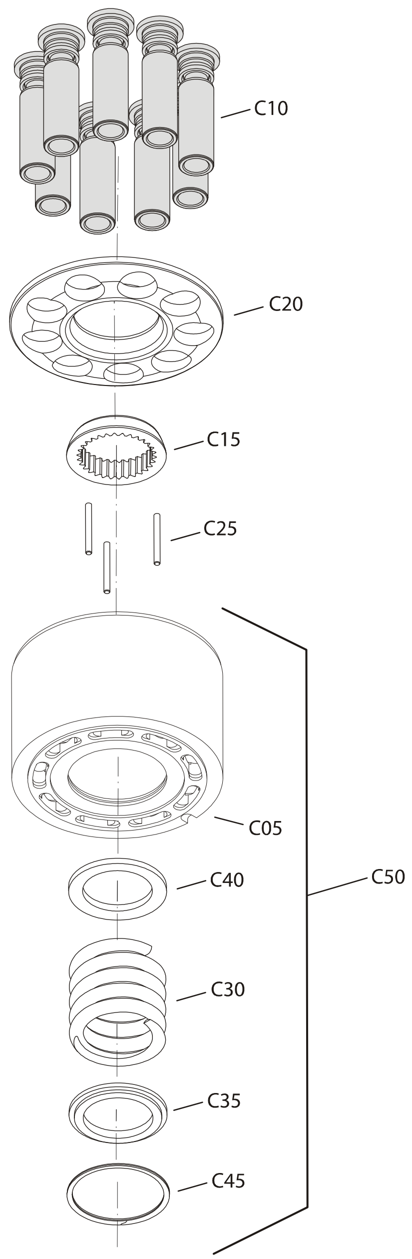
2. Remove slider block (EO 15).

NOTE: *Servo (E100) is available as an assembly only. Seals (E025) and slider block (E015) are available as repair items.*

CYLINDER KIT

1. Pull to remove the slipper retainer (C20) with the pistons (C10) from the cylinder kit.

NOTE: *The pistons are not selectively fitted, however units with high hourly usage may develop wear patterns. Number the pistons and bores for reassembly if they are to be reused.*



2. Remove the ball guide (C15).
3. Remove the three pins (C25).

BLOCK SPRING REMOVAL

NOTE: *Most repairs do not require block spring removal. Perform the following only if you suspect problems with the block spring.*

1. Turn the block over. Using a press, apply pressure on the block spring washer (C35) to compress the block spring (C30). Compress the spring enough to safely remove the spiral retaining ring (C45).While maintaining pressure, unwind the spiral retaining ring. Carefully release the pressure and remove the outer block spring washer, block spring, and inner block spring washer (C40) from the cylinder block.

WARNING

RISK OF PERSONAL INJURY: COMPRESSING THE BLOCK SPRING REQUIRES ABOUT 350 TO 400 N [80 TO 90 LBF]. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT.

ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO REMOVE THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING RING IS REMOVED.

Inspection

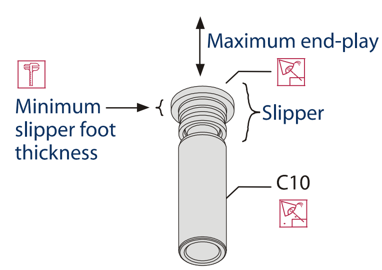
OVERVIEW

After disassembly, wash all parts (including the end-cap and housing) thoroughly with clean solvent and allow to air dry. Blow out oil passages in the housing and endcap with compressed air. Conduct inspection in a clean area and keep all parts free from contamination. Clean and dry parts again after any rework or resurfacing.

PISTONS AND SLIPPERS

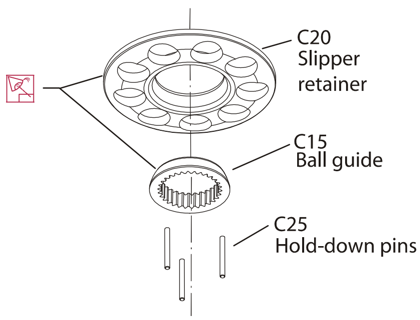
Inspect the pistons for damage and discoloration. Discolored pistons may indicate excessive heat; do not reuse.

Inspect the running surface of the slippers. Replace any piston assemblies with scored or excessively rounded slipper edges. Replace any piston assemblies with excessively worn slippers. Check the slipper axial end-play. Replace any piston assemblies with excessive end-play.



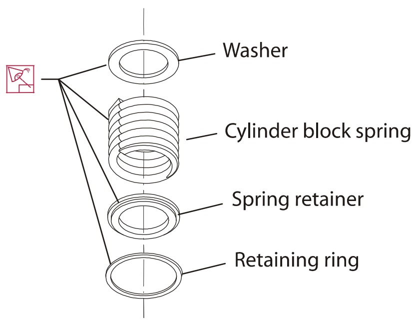
BALL GUIDE, SLIPPER RETAINER, AND HOLD-DOWN PINS

Ensure ball guide is free of nicks and scratches, and not scored. Examine for discoloration that may indicate excessive heat or lack of lubrication.The slipper retainer should be flat, and slippers should fit in the retainer with minimal side play. Place the hold-down pins on a flat surface and roll them to make sure they are straight. Discard and replace any damaged parts.



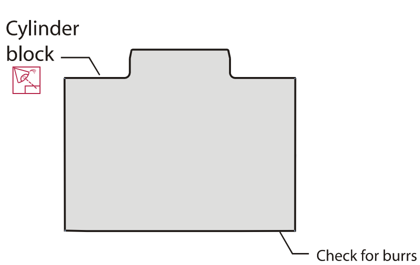
BLOCK SPRING, AND WASHERS

If cylinder kit was fully disassembled, visual inspection of the cylinder block, spring, and washers should indicate minimal wear. Replace if cracks or other damage are present.



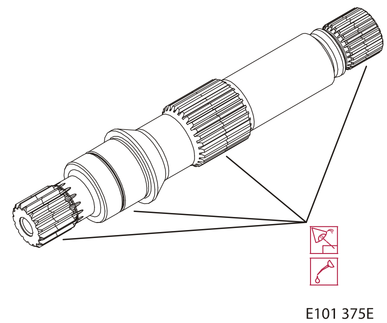
CYLINDER BLOCK

Examine the running face of the cylinder block. The surface should be smooth and free of nicks and burrs. Ensure that no scratches or grooves exist; these may drastically reduce output flow.



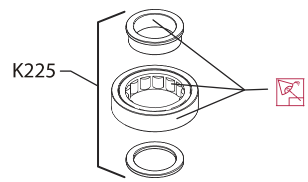
SHAFT

Check to see that the shaft and its splines are straight and free of damage or heavy wear. Inspect the shaft surface where it meets the shaft seal. Replace the shaft if a groove exists at the sealing land surface where it meets the shaft seal. Clean the sealing area with a nonabrasive material if necessary. Lubricate the shaft with a light coat of hydraulic fluid before reassembly.



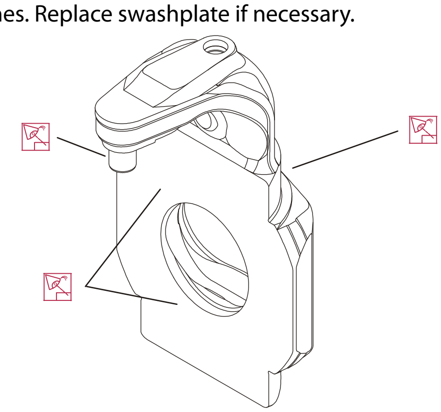
SHAFT BEARING

Clean bearing with a solvent and lubricate with hydraulic fluid. Inspect for wear, or pitting. Rotate the bearing in your hand. Replace if it does not rotate smoothly.



SWASHPLATE

Carefully inspect each machined surface of the swashplate for wear. Ensure all swashplate surfaces are smooth. Inspect the swashplate's slipper running surface for flatness and brass transfer. Excessive brass transfer from slippers may indicate you should replace the slippers. Check the journals for scratches. Replace swashplate if necessary.



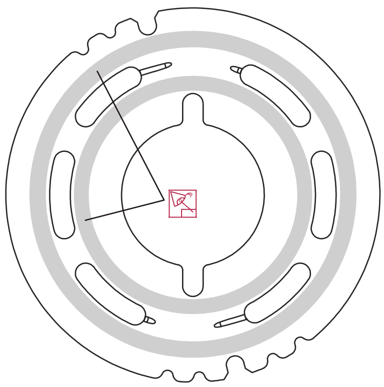
VALVE PLATE

Inspect the valve plate for scratches and grooves. Check the plate for pitting along the running face. If pitting from cavitation exists, replace the valve plate. Check for excess wear on the brass running face. If you observe any discoloration or burn marks, replace the valve plate.

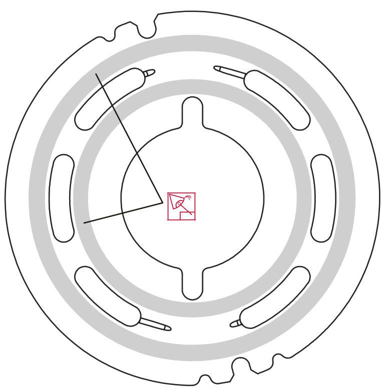
Run a fingernail or pencil tip across the diameter of the sealing land surface (see illustration).You should feel no deep or outstanding grooves.These may decrease pump flow. Lap or replace if grooves or nicks are present. Inspect the mating surfaces of the endcap and valve plate for any possible contamination; even a few thousandths of an inch may affect pump operation.

Ensure plate appears flat and smooth on both the running face and the bottom surface. Perform a magnetic particle inspection to detect cracks. Replace if any cracks exist.

Counterclockwise valveplate

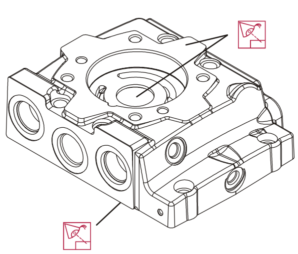


Clockwise valveplate



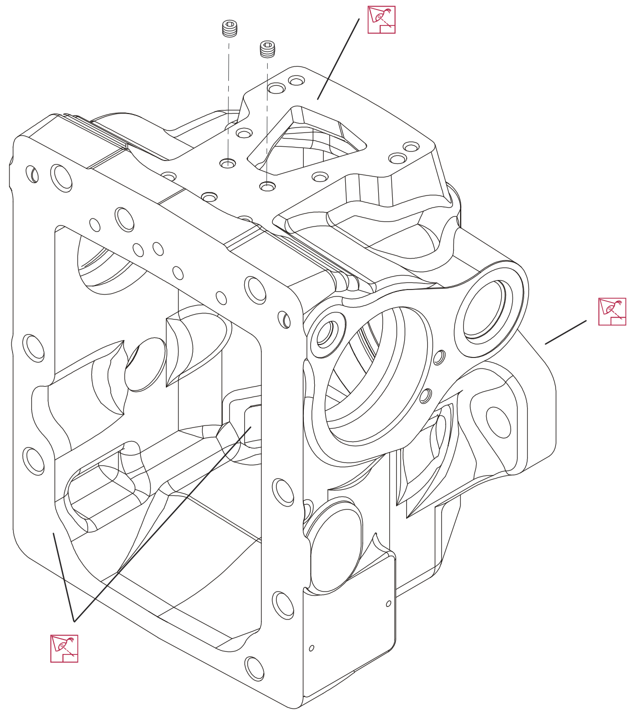
ENDCAP

Inspect the endcap. Inspect all machined surfaces for scratches or pits. Carefully check the bearing surface for wear. Inspect valve seats carefully for wear or cracks. Replace if damaged.



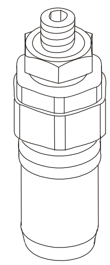
HOUSING

Inspect the housing to ensure that it is clean and free of foreign material. Inspect the swashplate bearing surfaces, and endcap and control mating surfaces.



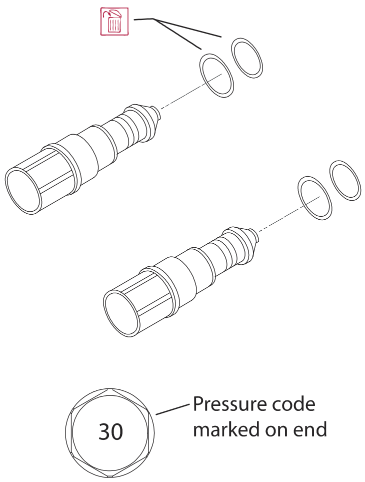
PRESSURE LIMITER

Pressure limiter valves are available as complete units only. If you suspect valve malfunction, replace the valve(s) and test pump operation. Replace O-rings before reassembly.



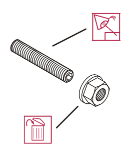
HPRV VALVE

HPRV valves are available as complete units only. If you suspect valve malfunction, replace the valve(s) and test pump operation. Replace O-rings before reassembly.



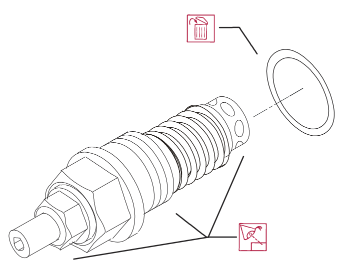
OPTIONAL DISPLACEMENT LIMITER

Inspect the displacement limiter screw threads. Ensure that the screw is not bent. Replace the seal/nut.



CHARGE PRESSURE RELIEF VALVE

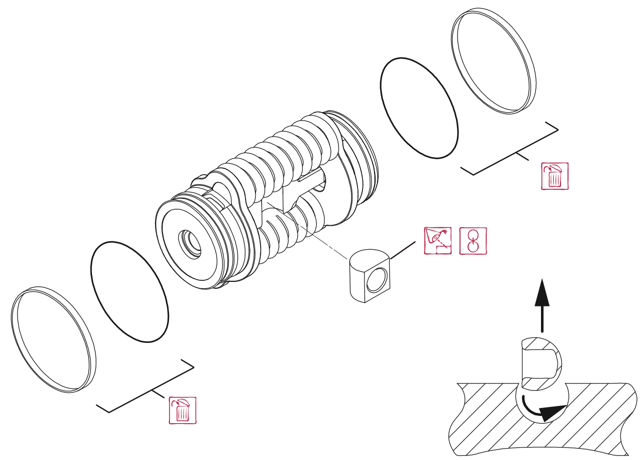
Charge pressure relief valve is available as a complete unit only. If you suspect valve malfunction, replace the valve and test pump operation. Replace O-rings before assembly.



SERVO PISTON ASSEMBLY

NOTE: *Do not disassemble servo piston assembly. Replacement servo piston assembly is available as a complete unit only.*

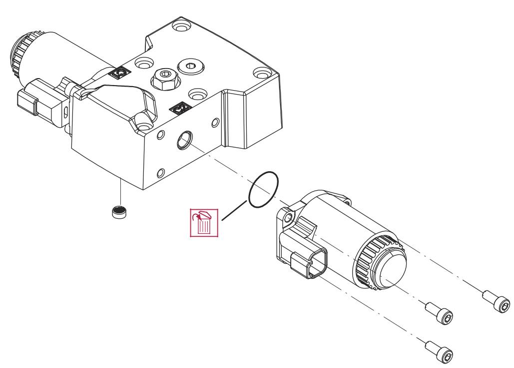
Inspect slider block for wear or damage. Replace if necessary. Inspect springs for warping or cracking. Replace entire assembly if springs are damaged. Inspect servo piston for wear, cracks, or damage. Replace entire assembly if servo piston is damaged.



CONTROL

NOTE: *If you suspect a coil malfunction, remove the coil by removing the plastic nut with a 26 mm 12 point socket. Install a new coil. Torque nut to 5 Nm [3.7 ft.lbs.].*

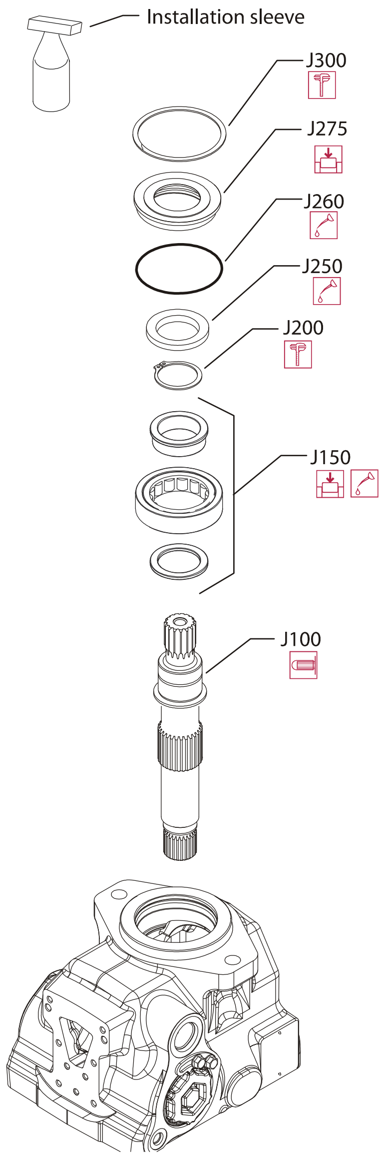
Inspect sealing surfaces of control. If you find nicks or scratches that may allow fluid leakage, replace control. Inspect feedback spring and linkage. Control is available as a complete unit only. If you suspect control operation problems, replace control with a new unit and test pump. If necessary, you may remove and clean the control orifices. Use a 3 mm internal hex. wrench Torque to 2.5 Nm [1.8 Ib.ft.]. Remove and replace the screen if contaminated. Screen is not serviceable.



Assembly

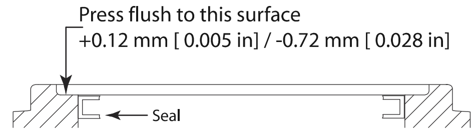
SHAFT AND SEAL INSTALLATION

1. Orient pump with the mounting flange pointing up.
2. Using an adequate press, press the bearing (J150) onto the shaft (J100) and install the retaining ring (J200). Ensure the retaining ring diameter is less than 38.84 mm [1.53 in] once installed on the shaft.



3. Lubricate and install a new O-ring (J260) onto seal carrier (J275). Press a new seal (J250) into the seal carrier so the solid side of the seal is against the shoulder of the seal carrier.

NOTE: *Seal does not need to be flush with surface of seal carrier. Top of seal may be 0.12 mm [0.005 in] above surface or 0.72 mm [0.028 in] below surface of seal carrier.*



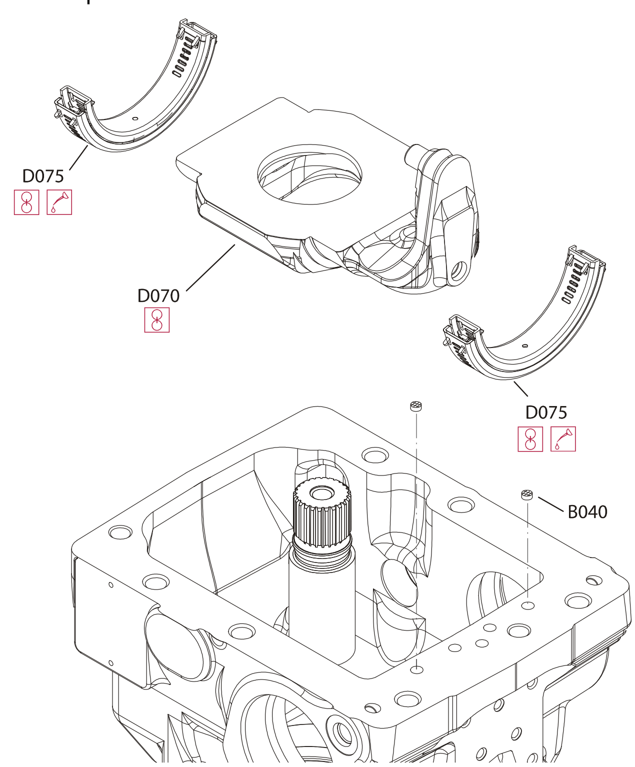
4. Install the shaft assembly into the front housing. Cover the shaft with an installation sleeve to protect it during installation of the seal carrier.
5. Hand press the seal carrier (J275) into the housing. Ensure the seal carrier clears the spiral ring groove in the housing. Remove protective cover from shaft end.
6. Install the spiral ring (J300) into the housing. The inside diameter of the ring must be at least 68 mm [2.677 in] after installation.

SWASHPLATE BEARINGS AND SWASHPLATE INSTALLATION

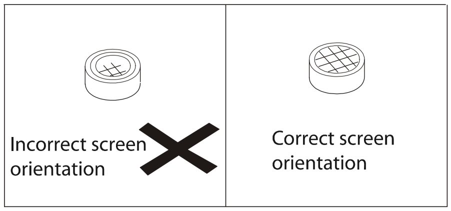
1. Position housing with front flange pointing down.

NOTE: *Always replace swashplate bearings (D075).*

2. Coat swashplate bearings (D075) with hydraulic fluid and install them onto the swashplate (D070). The inner race of the swashplate bearing clips onto the swashplate.

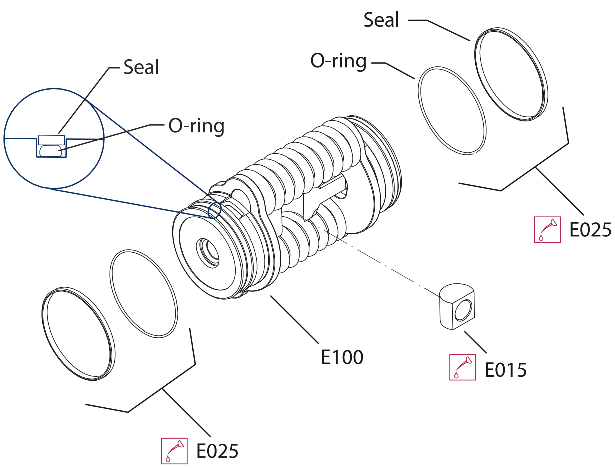


3. Install the swashplate and bearings into the housing. Ensure swashplate is in neutral position.
4. If removed, install new filter screens (B040) into housing. Install screens in same orientation as when removed.

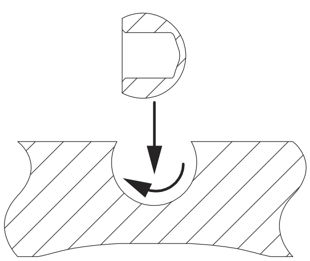


SERVO PISTON REASSEMBLY

1. Lubricate and install new piston seals and O-rings (E025). Stretch O-rings onto servo piston, then install piston seals outboard of the O-rings. Allow seals to relax before installing servo piston. Use the servo cylinder to resize the seals before installing servo piston.

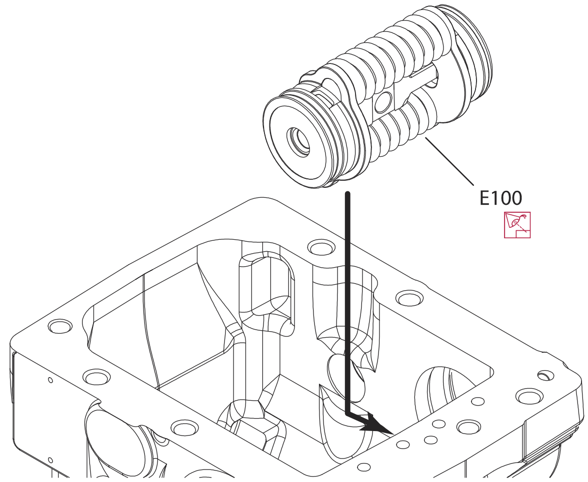


2. Lubricate and install slider block (EOT 5).



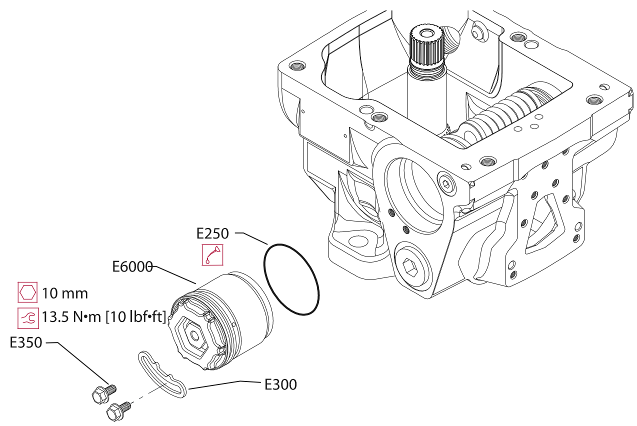
SERVO PISTON INSTALLATION

Install servo piston assembly (E100). Ensure swashplate pin fits properly in servo slider block (EOT5).



SERVO CYLINDER INSTALLATION

1. Lubricate new O-rings (E250) and install on each servo cylinder.



2. While holding the servo piston in place, thread servo cylinders into housing using a 3/4 in socket. Thread cylinders equal distance in each side of pump until each cylinder contacts servo cylinder. Do not compress servo piston spring.

⚠ CAUTION

DO NOT ALLOW LOOSE SERVO PISTON TO DAMAGE INTERNAL MACHINED SURFACES OF PUMP.

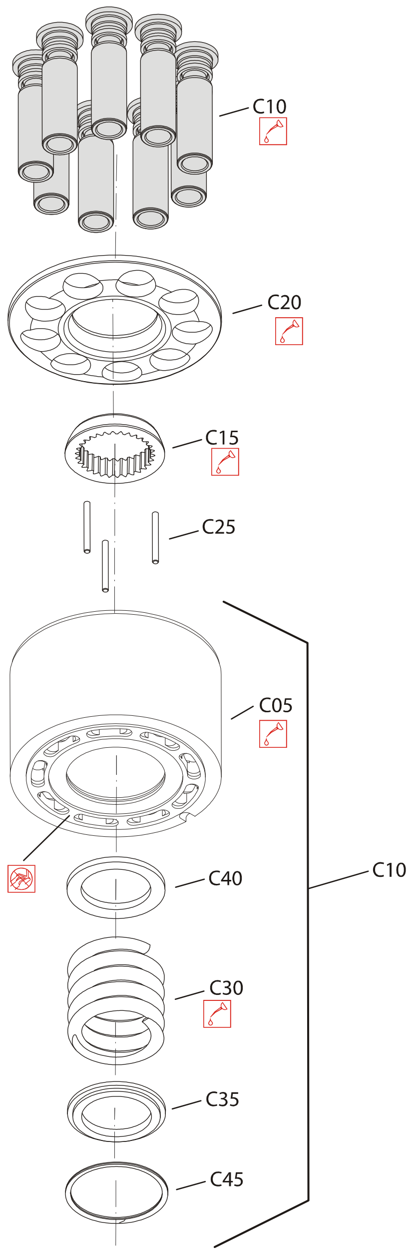
DO NOT DAMAGE SEALS WHEN INSTALLING SERVO CYLINDERS.

3. Install locking plates (E300). Using a 10 mm wrench, install locking plate screws (E350). Torque screws to 13.2-16.1 Nm [9.7-11.9 lb.ft.].

NOTE: *After pump assembly is complete, mount pump on test stand. Perform mechanical neutral adjustment and control neutral adjustment. Refer to HI Closed Circuit Axial Piston Pumps 078/147/165 Service Manual 520L0848 for adjustment procedures.*

CYLINDER KIT REASSEMBLY

1. Coat all parts with hydraulic fluid prior to reassembly.



2. Install the inner block spring washer (C40), block spring (C30), and outer washer (C35) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (C45) into the groove in the cylinder block.

⚠ WARNING

RISK OF PERSONAL INJURY: COMPRESSING THE BLOCK SPRING REQUIRES ABOUT 350 TO 400 N [80 TO 90 LB.F.]. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO INSTALL THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING RING IS INSTALLED.

3. Turn the block over and install the hold-down pins (C25) and ball guide (C15) into the cylinder block.

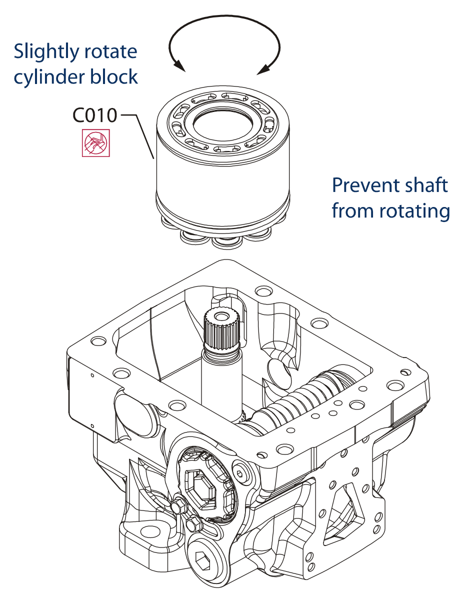
4. Insert the pistons (C10) into the slipper retainer (C20). Install the piston/retainer assembly into the cylinder block. Ensure the concave surface of the retainer seats on the ball guide. If you are reusing the pistons, install them to the original block bores. Lubricate the pistons, slippers, retainer, and ball guide before assembly. Set the cylinder kit aside on a clean surface until needed.

NOTE: *Be sure to install the slipper retainer (C20) so it mates correctly with the ball guide (C15) (concave side of the slipper retainer against the convex side of the ball guide).*

CYLINDER KIT INSTALLATION

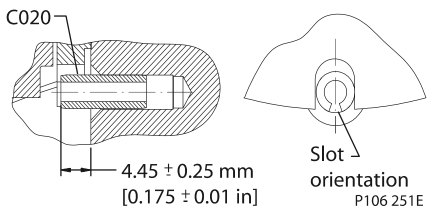
1. Position pump with shaft pointing down.

2. Insert the cylinder block kit onto the shaft. While holding the shaft, slightly rotate the cylinder block kit to help start the shaft splines over the ball guide and align it with the block splines.

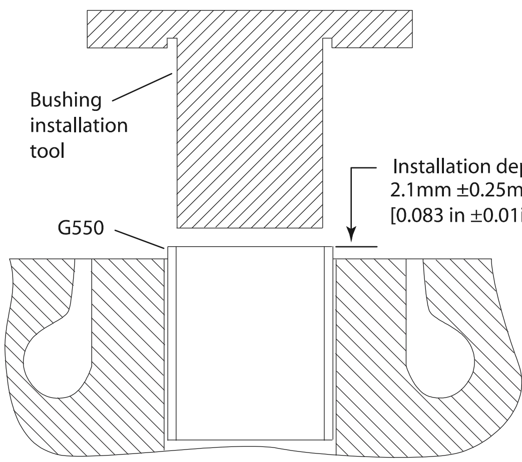


TIMING PIN AND ENDCAP BUSHING INSTALLATION

1. Install timing pin (C020) in endcap as shown. Orient slot away from valve plate. Install the alignment pins (B010) in housing. Measure pin insertion depth to verify proper pin insertion.



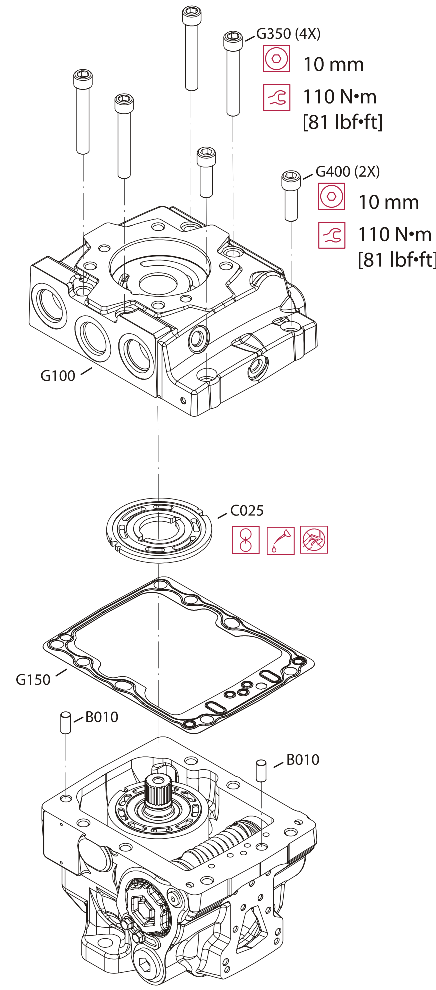
2. Orient endcap bushing slots towards top or bottom of endcap. Lubricate and press the bushings (G550) into the end cap to depth shown below.



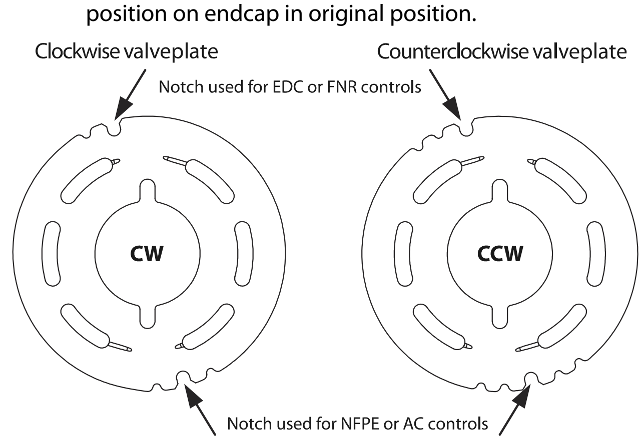
NOTE: *Ensure that bushing is properly installed. Improper installation resulting in improper depth or misalignment will result in premature bushing and charge pump failure.*

VALVE PLATE AND ENDCAP INSTALLATION

1. Install the alignment pins (B010) in housing.



2. Clean the valve plate (C025) and endcap(G100).
3. Apply a liberal amount of assembly grease to the backside of the valve plate surface to hold it in place and position on endcap in original position.

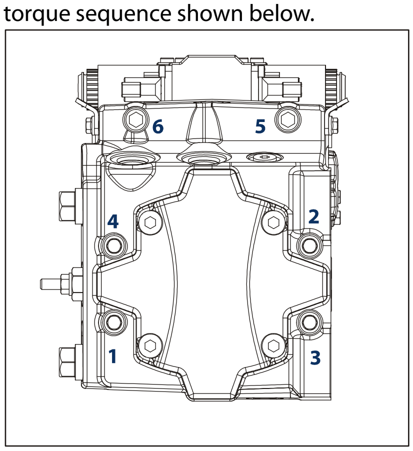


NOTE: *For proper pump operation, it is extremely important to ensure that there is no contamination between the end cap and valve plate.*

4. Install new gasket (G150).

NOTE: *Do not bend or warp the gasket in an attempt to straighten it.This may damage the embossing which is not visible under the rubber coating.*

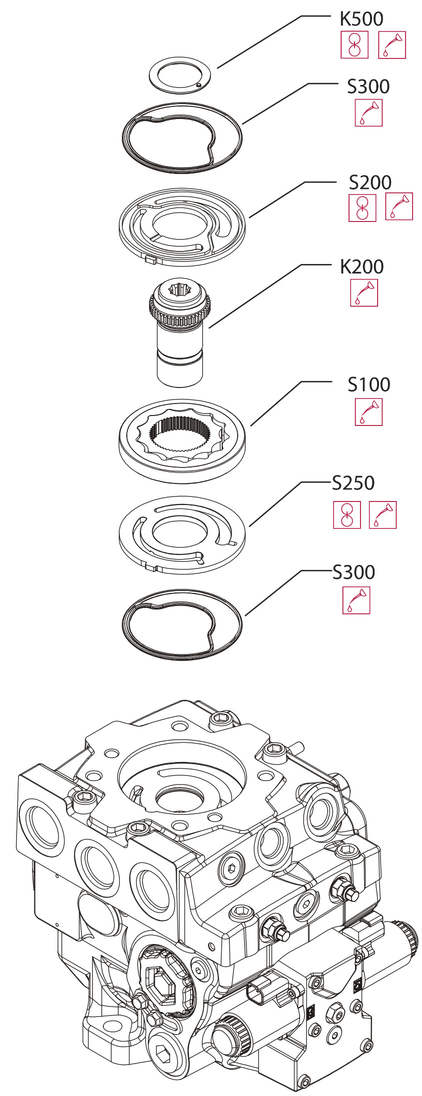
5. Using a 10 mm internal hex wrench install endcap with cap screws (G350) and (G400).
6. Torque cap screws (G350) and (G400) to 110 Nm[81 lb.ft.].
7. Use torque sequence shown below.



CHARGE PUMP INSTALLATION

NOTE: *Charge pump components are available as a complete kit only. Kit includes (S300), (S250), (SI 00), (SI 50), and (S200).*

1. Install new seal (S300) to valve plate (S250). Lubricate valve plate (S250) and install in same orientation as when it was removed.

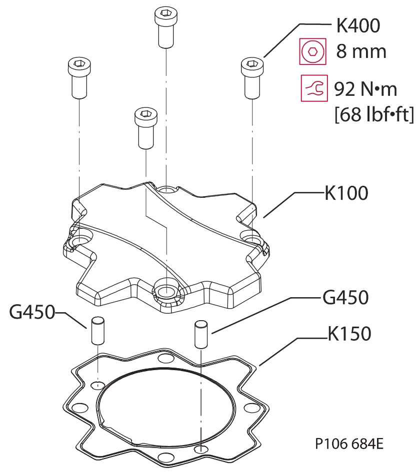


2. Lubricate and install outer ring (S150) and charge pump gear set (S100). Lubricate and install coupling (K200).
3. Lubricate and install pressure-balance plate (S200) in same orientation as when it was removed. Install new outer seal (S300).
4. Lubricate and install thrust washer (K500) in same orientation as when it was removed.

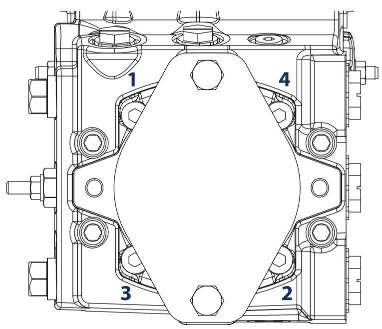
NOTE: *Bump on thrust washer fits into hole in cover.*

END COVER INSTALLATION

1. Install alignment pins (G450). Install gasket (K150).

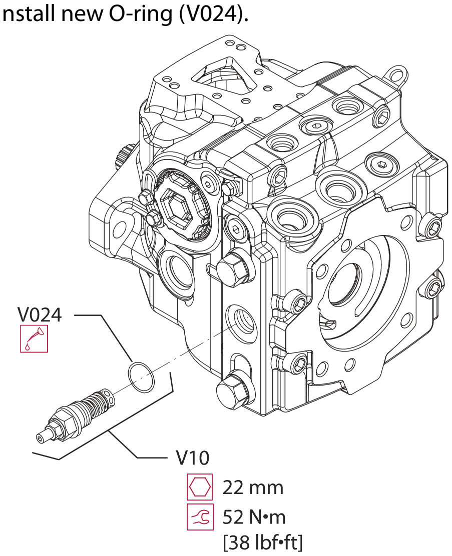


2. Install end cover with capscrews (K400) using an 10 mm internal hex wrench. Torque to 92 Nm [68 lb.ft.]. Follow torque sequence below.



CHARGE PRESSURE RELIEF VALVE INSTALLATION

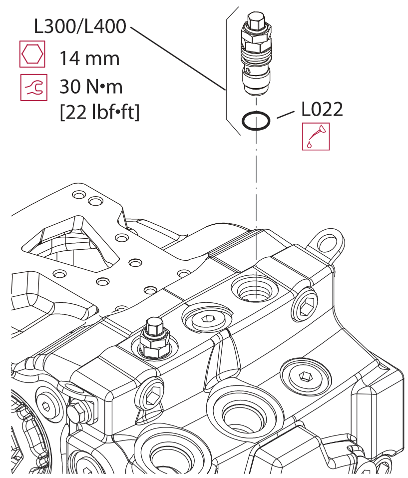
1. Install new O-ring (V024).



2. Using a 22 mm wrench, install the charge pressure relief valve (VI0).
3. Torque to 52 Nm [38 lb.ft.].

PRESSURE LIMITER INSTALLATION

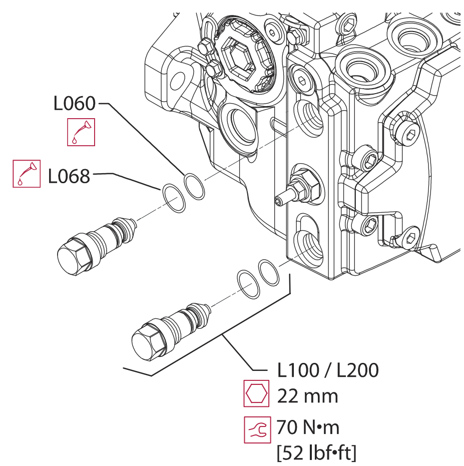
1. Lubricate and install O-rings (L022).



2. Using a 14 mm wrench, install pressure limiter cartridges (L300) and (L400).
3. Torque to 30 Nm [22 lb.ft.].

HPRV VALVE INSTALLATION

1. Replace and lubricate O-rings (L060) and backup rings (L068) before reassembly.



2. Using a 22 mm wrench, install HPRV valves (L100) and (L200).
3. Torque to 70 Nm [52 lb.ft.].

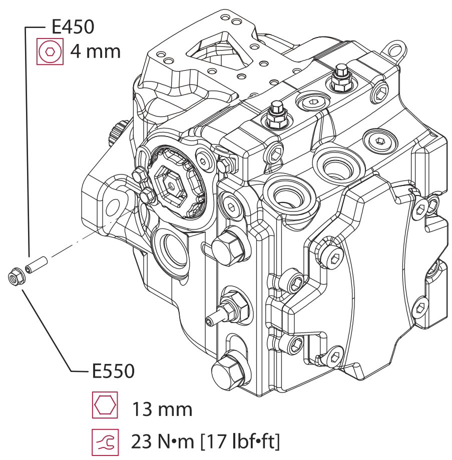
OPTIONAL DISPLACEMENT LIMITER INSTALLATION

NOTE: *Set the approximate displacement limiter depth. See the table below for displacement change per turn. Run screw in until it contacts the servo piston, then back out the appropriate number of turns.*

Table 5-6. Displacement Limiter Adjustment Data

Locknut wrench size and torque	Adjusting screw size	Approximate displacement change per revolution of adjusting screw
13 mm 23 Nm [17 ft.lbs.]	4 mm internal hex	5.1 cm^3 [0.31 in^3]

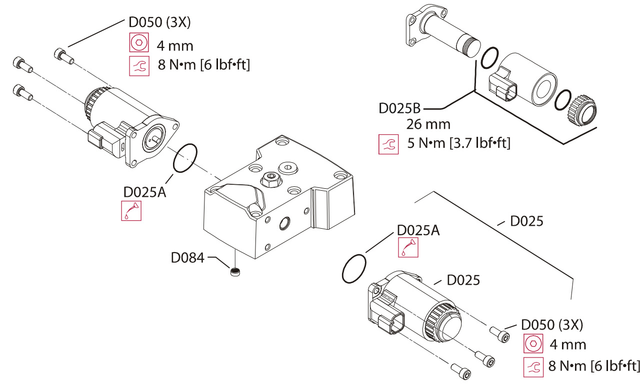
1. Thread displacement limiter adjusting screw (E450) into servo sleeve.



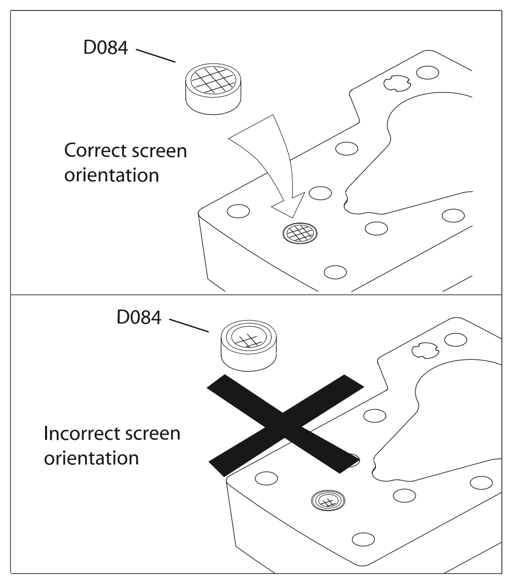
2. Thread a new locking nut onto adjustment screw.Torque to 23 Nm [17 ft.lbs.] using a 13mm hex wrench.

EDC CONTROL ASSEMBLY

1. Install new O-rings (D025A) into solenoids (D025), and attach solenoids with capscrews (D050) using 4 mm internal hex wrench. Torque to 8 Nm [6 ft.lbs.].



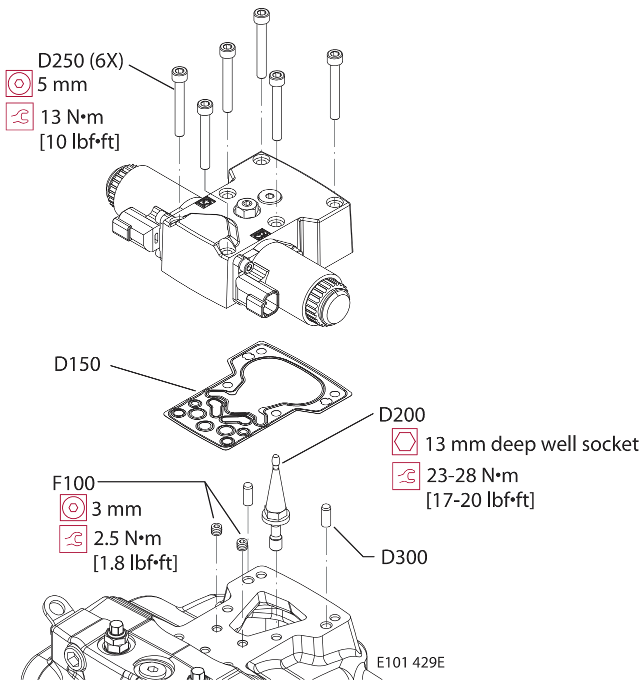
2. Replace screen (D084) if removed. Drawing shows proper screen orientation.



NOTE: *If you suspect coil malfunction, remove the coil (D025B) by removing the plastic nut with a 26 mm 12 point socket. Install a new coil and torque the nut to 5 Nm [3.7 ft.lbs.].*

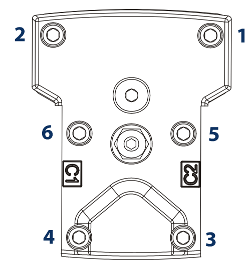
EDC CONTROL INSTALLATION

1. Use a 13 mm deep well socket to install feedback pin in swashplate. Torque to 23-28 Nm [17-20 ft.lbs.]. Do not overtorque.



NOTE: *If orifices (F100) were removed, reinstall using a 3 mm internal hex wrench.Torque to 2.5 Nm [1.8 ft.lbs.].*

2. Install dowel pins (D300).
3. Install new gasket (D150).
4. Position control on pump housing. Remove plug on top of control to visually ensure that feedback pin on swashplate is engaged properly in control arms.
5. Using a 5 mm internal hex wrench, fasten control to pump with hex screws (D250). Torque screws to 13 Nm [10 ft.lbs.]. Follow torque sequence shown.



Port Locations and Gauge Installation

PORT LOCATIONS AND GAUGE INSTALLATION

The following table and drawing show the port locations and gauge sizes needed. When testing system pressures, calibrate pressure gauges frequently to ensure accuracy. Use snubbers to protect gauges.

Table 5-7. Port information

Port identifier	Port size	Wrench size	Pressure obtained	Gauge size, bar [psi]
L1,L2	1 1/16-12 UNF28	9/16 internal hex	Case drain	10bar[100psi]
MA, MB	9/16-18 UNF	1/4 internal hex	System pressure	600 bar [10,000 psi]
M3	9/16-18 UNF 2B	1/4 internal hex	Charge pressure	50 bar [1000 psi]
M4,M5	7/16-20 UNF 2B	3/16 internal hex	Servo pressure	50 bar [1000 psi]

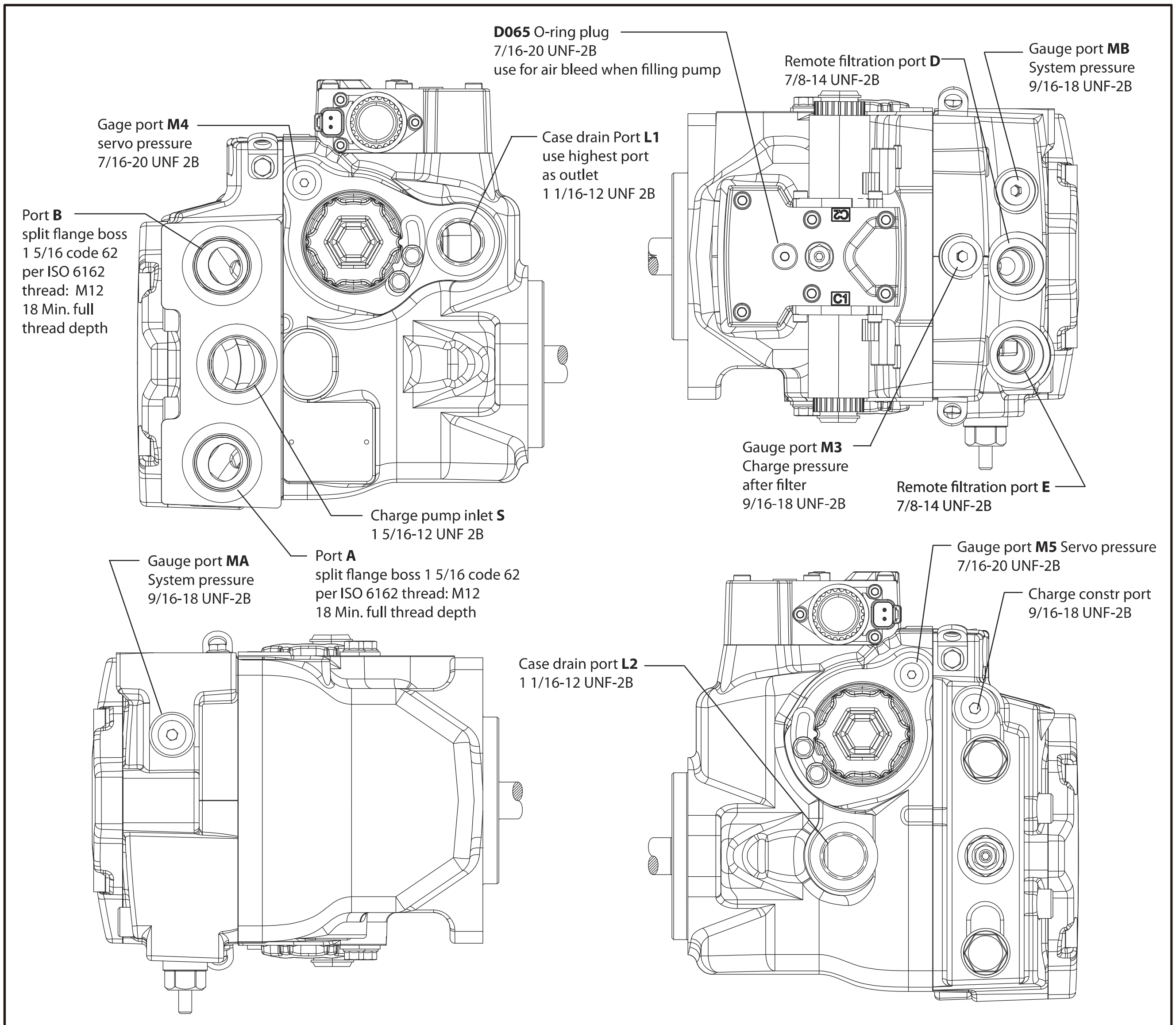


Figure 5-31. Port Locations

Fastener Size and Torque Chart

Table 5-8. Fastener Size and Torque Chart

Item	Fastener	Wrench size	Torque
D015	Neutral adjust screw	4 mm internal hex	NA
D050	Coil mounting bolt	4 mm internal hex	8 Nm [9 ft.lbs.]
D060	Neutral adjust locking nut	13 mm	10 Nm [7 ft.lbs.]
D250	Electric control mounting bolt	5 mm internal hex	13 Nm [10 ft.lbs.]
E350	Servo cylinder locking bolt	Servo cylinder locking bolt	14.5 Nm [11 ft.lbs.]
K350Apad	Shipping cover mounting bolt	17mm	48 Nm [35 ft.lbs.]
K350 Bpad	Shipping cover mounting bolt	18mm	77 Nm [58 ft.lbs.]
K400	Rear cover/aux pad mounting bolt	8 mm internal hex	92 Nm [68 ft.lbs.]
L010	Pressure limiter adjust screw	8 mm	NA
L300/L400	Pressure limiter cartridge	14mm	30 Nm [22 ft.lbs.]
L024	Pressure limiter locking nut	14mm	20 Nm [15 ft.lbs.]
L100/L200	High pressure relief valve	22 mm	70 Nm [52 ft.lbs.]
V10	Charge pressure cartridge	22 mm	52 Nm [38 ft.lbs.]
V020	Charge pressure adjusting screw	4 mm internal hex	NA
V022	Charge pressure locking nut	13mm	12 Nm[9 ft.lbs.]

Plug Size and Torque Chart

Table 5-9. Plug Size and Torque Chart

Item	O-ring plug	Wrench size	Torque
B015	7/16-20	3/16 in internal hex	19 Nm [14 ft.lbs.]
B020	1-1/16- 12	9/16 in internal hex	49 Nm [36 ft.lbs.]
D065	7/16-20	3/16 in internal hex	19 Nm [14 ft.lbs.]
G250	9/16-18	7 mm internal hex	22-26 Nm [16-20 ft.lbs.]
G300/G302	9/16-18 UNF	1/4 in internal hex	42 Nm [30 ft.lbs.]

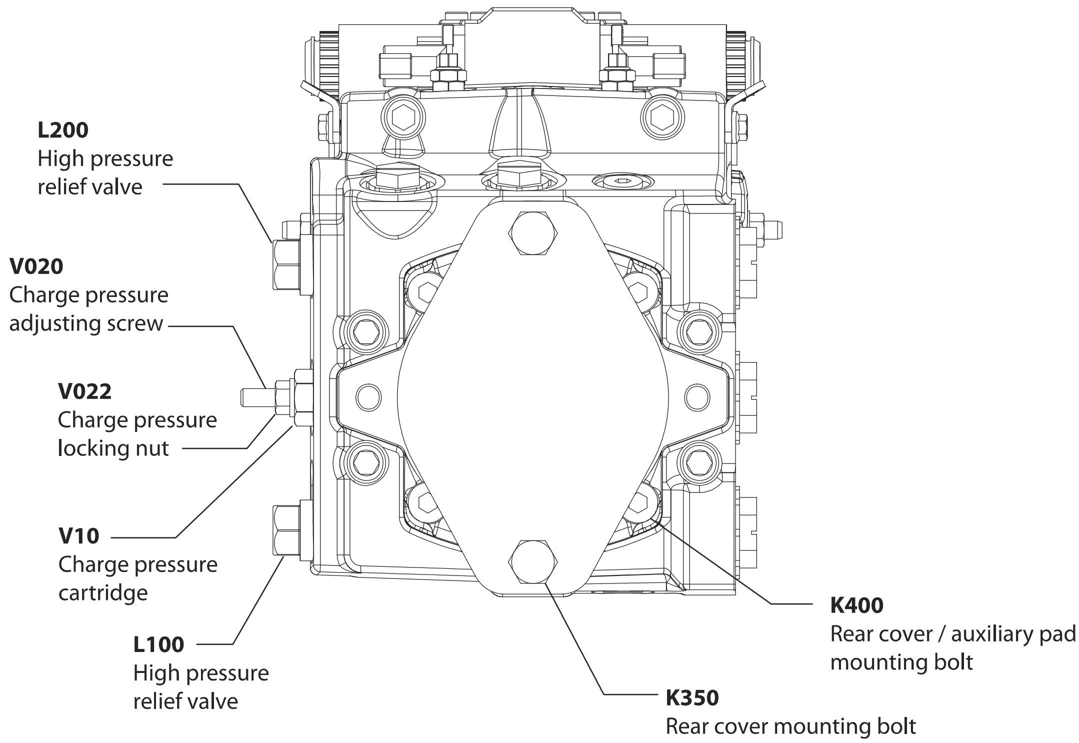


Figure 5-32. Fasteners and Plugs - Sheet 1 of 2

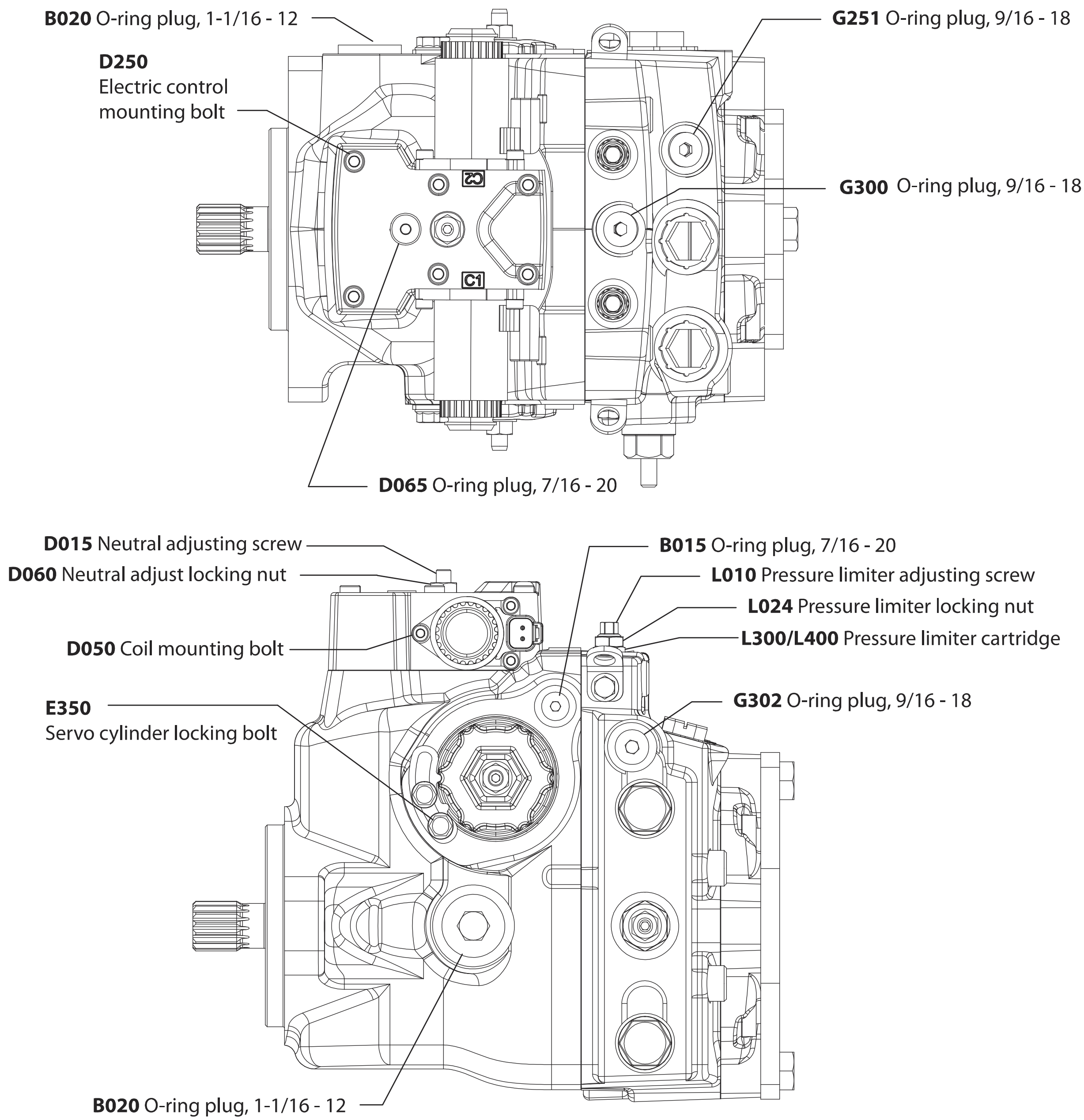


Figure 5-33. Fasteners and Plugs - Sheet 2 of 2

Initial Startup Procedures

GENERAL

Follow this procedure when starting-up a new pump installation or when restarting an installation in which the pump has been removed and re-installed on a machine. Ensure pump has been thoroughly tested on a test stand before installing on a machine.

⚠ WARNING

UNINTENDED MOVEMENT OF THE MACHINE OR MECHANISM MAY CAUSE INJURY TO THE TECHNICIAN OR BYSTANDERS. TO PROTECT AGAINST UNINTENDED MOVEMENT, SECURE THE MACHINE OR DISABLE/ DISCONNECT THE MECHANISM WHILE SERVICING.

PRE-FILL PROCEDURE

The case of the pump MUST be pre-filled before starting the engine. Failure to do so can cause premature failure of the pump.

1. Fill the hydraulic reservoir.
2. Locate the L2 case port on the pump. It is located on the back side facing the turntable side plate. Using a 9/16" allen wrench, remove the O-ring plug.
3. When hydraulic oil starts to flow out of this port for approximately 30 to 40 seconds, install the O-ring plug.

START-UP PROCEDURE

Prior to installing the pump, inspect for damage that may have occurred during shipping.

1. Ensure that the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.
2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and there are no air leaks.
3. Install the pump. Install a 50 bar [1000 psi] gauge in the charge pressure gauge port M3.
4. Fill the housing by adding filtered oil in the upper case drain port. If the control is installed on top, open the construction plug in the top of the control to assist in air bleed.
5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron filler filter. Fill inlet line from reservoir to pump. Ensure construction plug in control is closed after filling.
6. Disconnect the pump from all control input signals.
7. Close construction plug removed in step 4.

⚠ CAUTION

AFTER START-UP THE FLUID LEVEL IN THE RESERVOIR MAY DROP DUE TO SYSTEM COMPONENTS FILLING. DAMAGE TO HYDRAULIC COMPONENTS MAY OCCUR IF THE FLUID SUPPLY RUNS OUT. ENSURE RESERVOIR REMAINS FULL OF FLUID DURING START-UP.

AIR ENTRAPMENT IN OIL UNDER HIGH PRESSURE MAY DAMAGE HYDRAULIC COMPONENTS. CHECK CAREFULLY FOR INLET LINE LEAKS.

DO NOT RUN AT MAXIMUM PRESSURE UNTIL SYSTEM IS FREE OF AIR AND FLUID HAS BEEN THOROUGHLY

8. Use a common method to disable the engine to prevent it from starting. Crank the starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.
9. When the gauge begins to register charge pressure, enable, and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.
10. When adequate charge pressure is established (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.
11. Shut off engine. Connect pump control signal. Start engine, checking to be certain pump remains in neutral. Run engine at normal operating speed and carefully check for forward and reverse control operation.
12. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of loop.

NOTE: *Normal charge pressure fluctuation may occur during forward and reverse operation.*

13. Check that the reservoir is full. Remove charge pressure gauge.The pump is now ready for operation.

Troubleshooting

This section provides general steps to follow if you observe undesirable system conditions. Follow the steps listed until you solve the problem. Some of the items are system specific. We reference the section in this manual if more information is available. Always observe the safety precautions listed in the Introduction section and precautions related to your specific equipment.

PRECAUTIONS

CAUTION

HIGH INLET VACUUM CAUSES CAVITATION WHICH CAN DAMAGE INTERNAL PUMP COMPONENTS.

WARNING

ESCAPING HYDRAULIC FLUID UNDER PRESSURE CAN HAVE SUFFICIENT FORCE TO PENETRATE YOUR SKIN CAUSING SERIOUS INJURY AND/OR INFECTION. RELIEVE PRESSURE IN THE SYSTEM BEFORE REMOVING HOSES, FITTINGS, GAUGES, OR COMPONENTS. SEEK IMMEDIATE MEDICAL ATTENTION IF YOU ARE CUT

WARNING

UNINTENDED MOVEMENT OF THE MACHINE OR MECHANISM MAY CAUSE INJURY TO THE TECHNICIAN OR BYSTANDERS. TO PROTECT AGAINST UNINTENDED MOVEMENT, SECURE THE MACHINE OR DISABLE/ DISCONNECT THE MECHANISM WHILE SERVICING.

CAUTION

CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS AND VOID THE MANUFACTURER'S WARRANTY. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND REINSTALLING SYSTEM COMPONENTS AND LINES.

WARNING

HYDRAULIC FLUID CONTAINS HAZARDOUS MATERIAL. AVOID CONTACT WITH HYDRAULIC FLUID. ALWAYS DISPOSE OF USED HYDRAULIC FLUID ACCORDING TO STATE, AND FEDERAL ENVIRONMENTAL REGULATIONS.

Table 5-10. Electrical Troubleshooting

Item	Description	Action
Control operates pump in one direction only.	Control coil failure	Measure resistance at coil pins. Resistance should be 14.20 Ohm (24V) or 3.66 Ohm (12V) at 20×C [70×F]. Replace coil.
No pump function	No power to controller	Restore power to controller.
Erratic pump function	Electrical connection to pump is bad	Disconnect connection, check wires, reconnect wires.
Filter bypass indicator switch	Filter switch may be bad	Check/replace filter switch. Add gauge to filter bypass port to verify proper fluid flow and verify switch operation by measuring resistance, open resistance=>510 Ohm, closed resistance<=122Ohm

Table 5-11. System Operating Hot

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid does not meet cooling demands of system	Fill reservoir to proper level.
Heat exchanger	Heat exchanger is not sufficiently cooling the system	Check air flow and input air temperature for heat exchanger. Clean, repair or replace heat exchanger.
Charge pressure	Low charge pressure overworks system	Measure charge pressure. Inspect and adjust or replace charge relief valve. Inspect charge pump. Repair or replace charge pump.
Charge pump inlet vacuum	High inlet vacuum overworks system. A dirty filter increases the inlet vacuum. Inadequate line size will restrict flow	Check charge inlet vacuum. If high, inspect inlet filter and replace as necessary. Check for adequate line size, length or other restrictions.
System relief pressure settings	If the system relief valves are worn, contaminated, or valve settings are too low, the relief valves get overworked	Verify settings of pressure limiters and high pressure relief valves and adjust or replace as necessary.
System pressure	Frequent or long term operation over system relief setting creates heat in system	Measure system pressure. If pressure is too high, reduce loads.

Table 5-12. System Noise Or Vibration

Item	Description	Action
Reservoir oil level	Low oil level leads to cavitation	Fill reservoir.
Aeration of the oil/pump inlet vacuum	Air in system decreases efficiency of units and controls. Air in system is indicated by excessive noise in pump, foaming in oil, and hot oil.	Find location where air is entering into the system and repair. Check that inlet line is not restricted and is proper size.
Cold oil	If oil is cold, it may be too viscous for proper function and pump cavitates	Allow the oil to warm up to its normal operating temperature with engine at idle speed
Pump inlet vacuum	High inlet vacuum causes noise/cavitation	Check that inlet line is not restricted and is proper size. Check filter and bypass switch.
Shaft couplings	A loose shaft coupling causes excessive noise	Replace loose shaft coupling.
Shaft alignment	Misaligned pump and prime mover shafts create noise	Align shafts.
Charge/system relief valves	Unusual noise may indicate sticking valves. Possible contamination	Clean/replace valves and test pump.

Table 5-13. Neutral Difficult or Impossible to Find

Item	Description	Action
Input to pump control	Input to control module is operating improperly	Disconnect input and check to see if pump comes back to neutral. If Yes, input fault, replace/repair external controller. If No, go to next step.
Pump control neutral	Neutral set improperly	Shunt servo gauge ports M4 and M5 together with external hose and see if pump comes back to neutral. If Yes: control neutral improperly set (see page 35). If no: balance swashplate (see Mechanical neutral adjustment, page 37). If you still cannot set neutral, replace control.

Table 5-14. Sluggish System Response

Item	Description	Action
Oil level in reservoir	Low oil level causes sluggish response	Fill reservoir.
High pressure relief valves/ pressure limiter settings	Incorrect pressure settings affects system reaction time	Adjust or replace high pressure relief valves.
Low prime mover speed	Low engine speed reduces system performance	Adjust engine speed.
Charge pressure	Incorrect pressure affects system performance	Measure and adjust charge pressure relief or replace charge pump.
Air in system	Air in system produces sluggish system response	Fill tank to proper level. Cycle system slowly for several minutes to remove air from system.
Contaminated control orifices	Control orifices are plugged	Clean control orifices.
Contaminated control screens	Control screens are plugged	Clean or replace control screens.
Pump inlet vacuum	Inlet vacuum is too high resulting in reduced system pressure	Measure charge inlet vacuum. Inspect line for proper sizing. Replace filter. Confirm proper bypass operation.

Pump Adjustment

Read through the entire topic before beginning a service activity. Refer to Figure 5-31., Port Locations, for location of gauge ports and suggested gauge size.

CAUTION

CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS AND VOID YOUR WARRANTY. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND REINSTALLING SYSTEM LINES

1. With the prime mover off, thoroughly clean the outside of the pump.
2. If removing the pump, tag each hydraulic line. When you disconnect hydraulic lines, cap them and plug each open port to prevent contamination.
3. Ensure the surrounding area is clean and free of contaminants like dirt and grime.
4. Inspect the system for contamination.
5. Check the hydraulic fluid for signs of contamination: oil discoloration, foam in the oil, sludge, or metal particles.
6. If there are signs of contamination in the hydraulic fluid, replace all filters and drain the hydraulic system. Flush the lines and refill the reservoir with the correct filtered hydraulic fluid.
7. Before re-installing the pump, test for leaks.

CHARGE PRESSURE RELIEF VALVE ADJUSTMENT

NOTE: *Ensure charge pressure is properly set before checking pressure limiter.*

1. Install a 50 bar [1000 psi] pressure gauge in charge pressure gauge port M3. Install a 10 bar [100 psi] gauge at case pressure port L1, L2, or L3. Operate the system with the pump in neutral (zero displacement) when measuring charge pressure.
2. The table shows the acceptable pump charge pressure range for some nominal charge relief valve settings (refer to model code located on serial number plate). These pressures assume 1800 min-1 (rpm) pump speed and a reservoir temperature of 50°C [120°F],and are referenced to case pressure.

NOTE: *Listed pressures assume a pump speed of 1800 rpm and charge flow of 26.5 l/min [7 US gal/min]. At higher pump speeds or higher charge flows the charge pressure will rise over the rated setting.*

3. Rotate the adjusting screw clockwise to increase the setting; counter clockwise to decrease it. Subtract the case pressure reading to compute the actual charge pressure.

NOTE: *Pressure change per turn is dependant on charge flow entering pump.*

4. While holding the adjusting screw, torque locknut to 17 Nm [13 lb.ft.].
5. When you achieve the desired charge pressure setting, remove the gauges and plug the ports.

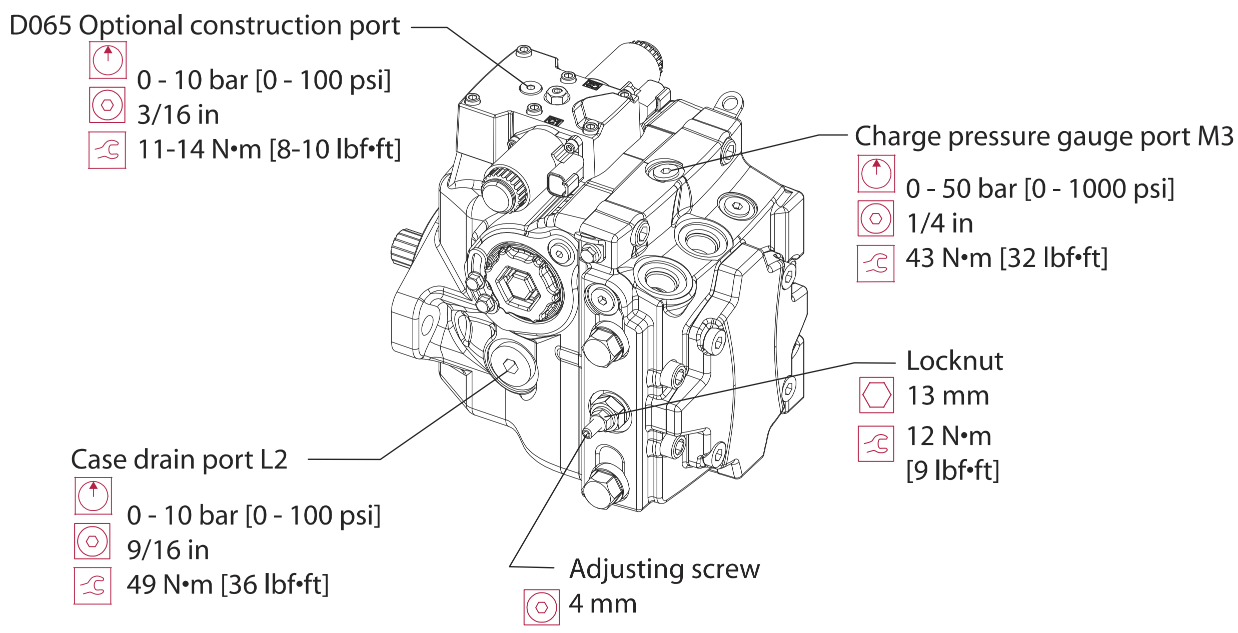


Figure 5-34. Charge Pressure Adjustment

PRESSURE LIMITER ADJUSTMENT

Lock motor output shaft to adjust the pressure limiter setting. Lock the vehicle's brakes or rigidly fix the work function so it cannot rotate.

NOTE: *Ensure charge pressure is properly set before checking pressure limiter.*

NOTE: *If you change pressure limiter settings, you must also change the HPRV valve to maintain proper PL function. Refer to the table for corresponding settings.*

1. Install 600 bar [10,000 psi] pressure gauges in the high pressure gauge ports (MA and MB). Install a 50 bar [1000 psi] pressure gauge in the charge pressure gauge port (M3).

NOTE: *The model code on the serial plate gives the factory setting of the PL (Pressure Limiter).The PL setting is referenced to charge pressure. Subtract charge pressure from system pressure gauge readings to compute the effective PL setting.*

2. Start the prime mover and operate at normal speed.
3. Use a 17mm wrench to loosen the locking nut (L024).
4. Activate the control input until pressure in the high side of the system loop stops rising. This pressure is the PL setting.
5. Return the pump to neutral and adjust the PL setting using an internal hex wrench. Wrench size is in the diagram on the previous page. Turn the adjusting screw clockwise to increase the PL setting, counter clockwise to decrease it.The adjustment is very sensitive. Change per turn is approximately 150 bar [2176 psi].

NOTE: *Change per turn is 150 bar/rev [2176 psi/rev].*

6. Repeat steps four and five until you reach the desired PL setting. After adjustment, torque the locknut (L024) to 12 Nm [9 ft.lbs.]. Do not over torque.

7. Shut down the prime mover. Remove gauges and replace plugs.

Table 5-15. Pressure Limiter Settings

Pressure limiter setting	HPRV setting
150	200
180	230
200	250
230	280
250	300
280	330
300	350
330	380

Table 5-15. Pressure Limiter Settings

Pressure limiter setting	HPRV setting
350	400
380	420
400	450
410	
420	
430	480
440	
450	
460	510
470	
480	

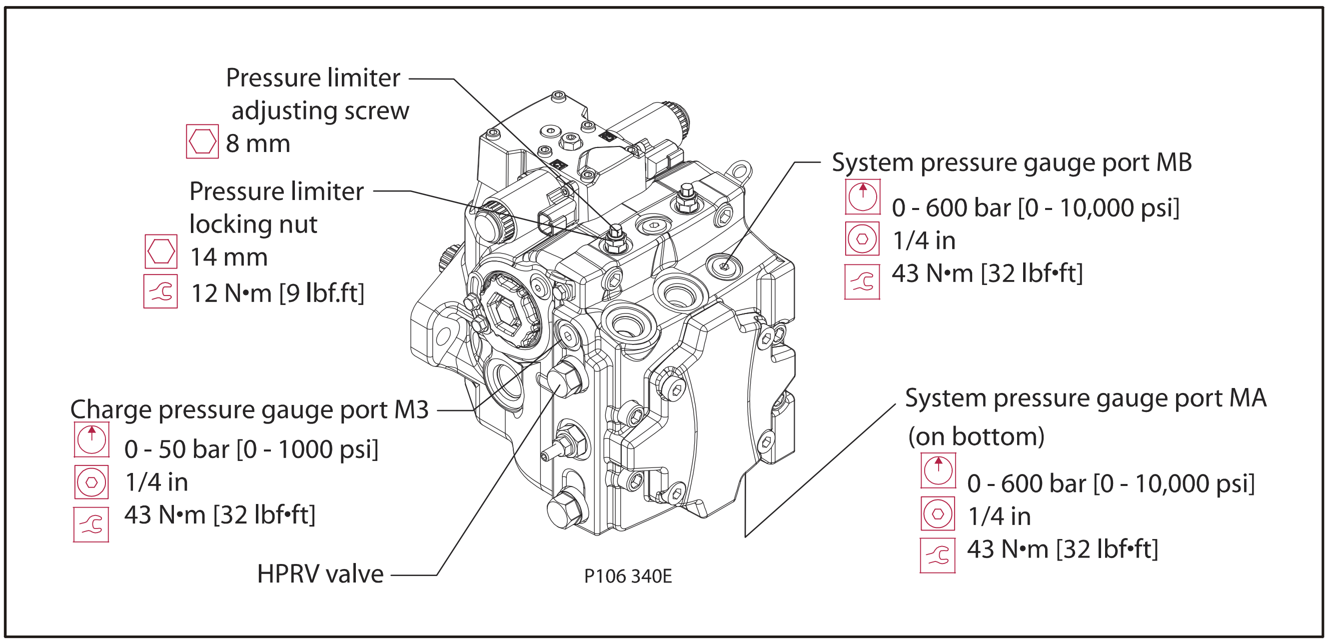


Figure 5-35. Pressure Limiter Adjustment

Displacement Limiter Adjustment

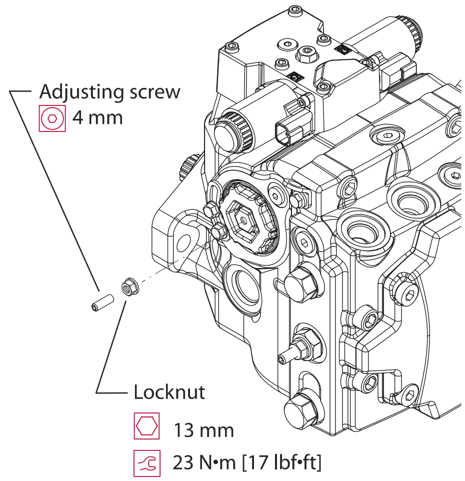
If your pump has displacement limiters, you will find them on either servo cover. You can limit forward and reverse displacement independently.

NOTE: *Displacement limiters are not pre-set by the factory. We install them as far as possible without contacting the servo piston. Limiting displacement requires clockwise adjustment of the limiting screw.*

CAUTION

BEFORE ADJUSTING THE DISPLACEMENT LIMITER, MARK THE POSITION OF THE SERVO CYLINDER. BE SURE THE SERVO CYLINDER DOES NOT TURN WHEN SETTING THE DISPLACEMENT LIMITER LOCKNUT.

1. Loosen the locking nut.



2. Rotate the adjusting screw to achieve the desired maximum displacement. Set the adjusting screw against the servo piston by feel before counting turns. Refer to the table below for change per turn. Clockwise rotation decreases displacement, counter clockwise rotation increases it. Adjustment is possible from zero to maximum.

3. After establishing the desired maximum displacement setting, hold the adjusting screw while torquing the locknut to the value in the table below.

4. Test operation of the vehicle/ machine to verify proper maximum speed of vehicle/work function.

Table 5-16. Displacement Limiter Adjustment Data

Displacement	Locknut wrench size and torque	Adjusting Screw Size	approximate displacement change per revolution of adjusting screw
45	13 mm 23Nm[17lb.ft.]	4 mm internal hex	5.1 cm3 [0.31 in3]
53	13 mm 23Nm [17 lb.ft.]	4 mm internal hex	6.0 cm3 [0.37 in3]

Control Neutral Adjustment

NOTICE

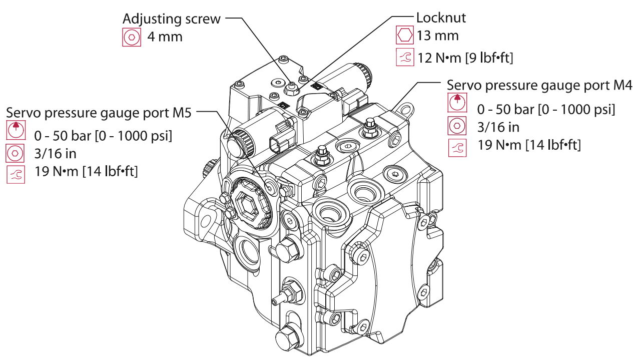
ADJUSTMENT OF THE EDC IS VERY SENSITIVE. BE SURE TO HOLD THE HEX WRENCH STEADY WHILE LOOSENING THE LOCKNUT. TOTAL ADJUSTMENT IS LESS THAN 120 DEGREES.

All functions of the Electric Displacement Control (EDC) are preset at the factory. Adjust the pump to neutral with the pump running on a test stand or on the vehicle/machine with the prime mover operating. If adjustment fails to give satisfactory results, you may need to replace the control or coils. Refer to Control Solenoids in this section.

WARNING

UNINTENDED MOVEMENT OF THE MACHINE OR MECHANISM MAY CAUSE INJURY TO THE TECHNICIAN OR BYSTANDERS. TO PROTECT AGAINST UNINTENDED MOVEMENT, SECURE THE MACHINE OR DISABLE/ DISCONNECT THE MECHANISM WHILE SERVICING.

1. Install a 50 bar [1000 psi] gauge in each of the two servo gauge ports (M4and M5). Disconnect the external control input (electrical connections) from the control. Start the prime mover and operate at normal speed.



2. Use a 4mm internal hex wrench to hold the neutral adjusting screw (D015) stationary while loosening the locknut (D060) with a 13mm wrench.

3. Observe pressure gauges. If necessary, turn adjusting screw (D015) to reduce any pressure differential.

4. Rotate the neutral adjusting screw (D015) clockwise until the pressure increases on the gauge. Note the angular position of the wrench. Then rotate the neutral adjusting screw counter clockwise until the pressure increases by an equal amount on the other gauge. Again note the angular position of the wrench.

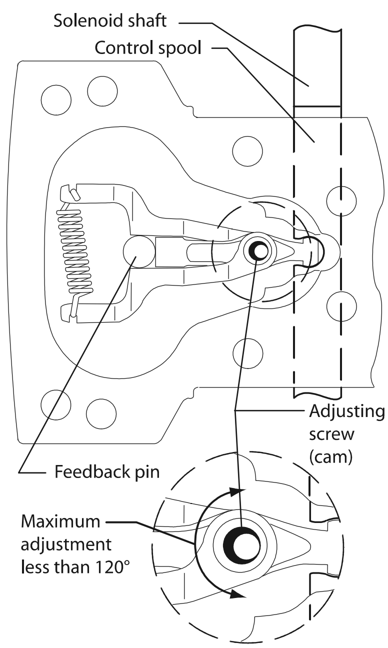


Figure 5-36. Neutral Adjustment (EDC) - Bottom View

5. Rotate the neutral adjusting screw clockwise half the distance between the wrench positions noted above. The gauges should read the same pressure, indicating that the control is in its neutral position.

6. Hold the neutral adjusting screw stationary and tighten the lock nut (D060).Torque to 10 Nm [7 lb.ft.]. Do not over torque the nut.

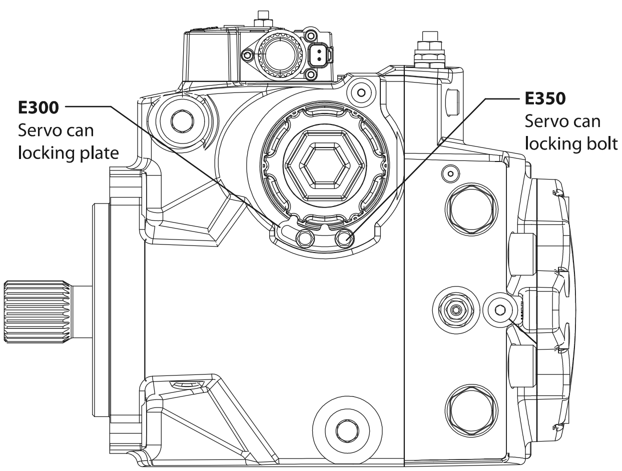
7. When the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control input.

NOTE: *A small pressure differential of 1.5 bar [22 psi] or less is acceptable. Zero differential is usually not possible.*

Mechanical Neutral Adjustment

SERVO ADJUSTMENT

1. Run prime mover at 1800 min rpm.
2. If using a PWM signal, ensure the signal is off. Check the servo pressure gauges. Ensure the differential between M4 and M5 is less than 1.5 bar [22 psi].
3. Using a 3/4 in hex deep socket, unthread both servo cylinders 2-3 turns.This step ensures the servo cylinders have no contact with the servo piston.



4. Stroke the pump by turning the control eccentric screw (or supplying current to solenoid C1) until the servo pressure at port M4 is 1 to 2 bar [14- 29 psi] greater than at port M5 and the system pressure gauges indicate displacement. Pressure should be greater at port MA for clockwise rotation, or MB for counter clockwise rotation. This also indicates the servo piston is in contact with the servo cylinder on side M5.
5. Slowly thread the servo cylinder on the M5 side in until the system pressure differential starts to decrease. Maintain servo pressure differential between 1-2 bar [14-29 psi] during this step. Continue turning the servo cylinder in until the system pressure differential (between ports MA/MB) is less than 1.5 bar [22 psi]. This procedure sets the servo and swashplate to mechanical neutral on the M5 side.
6. To complete setting neutral, repeat steps 1-5 but stroke the pump in the opposite direction by turning the eccentric screw in the opposite direction, or by supplying current to solenoid C2. Reverse gauge locations (M4 for M5, MB for MA) from those stated above since the pump is now stroking the other direction.
7. Remove all gauges and replace gauge port plugs. You can find wrench sizes and plug torques in the Plug size and torque chart.

SERVO ADJUSTMENT SIDE M4

1. Run prime mover at 1800 rpm.
2. If using a PWM signal to set mechanical neutral, start with the electronic control testing tool off (no current to either solenoid). Check to be sure the servo pressure differential is less than 1.5 bar [22 psi]. Reference Control Neutral Adjustment.
3. Turn neutral adjust excenter screw (or supply current to solenoid C2) until the servo pressure at port M5 is 1 - 2 bar [14- 29 psi] greater than at port M4.
4. The system pressure differential must be greater than zero and the pressure at port A (B for clockwise rotation) must be greater than the pressure at port B (A for clockwise rotation). This step ensures the servo is in contact with the servo cylinder on side M4.
5. Slowly turn in the servo cylinder on the M4 side until the system pressure differential starts to decrease. The servo pressure differential must be maintained between 1-2 bar [14-29 psi] during this step. Continue turning in the servo cylinder until the system pressure differential is less than 1.5 bar [22 psi]. This procedure sets the servo and swashplate to mechanical neutral.

VERIFY NEUTRAL SETTING

1. If using a PWM signal to set mechanical neutral, check that servo pressure differential is less than 1.5 bar [22 psi]. Refer to Control Neutral Adjustment.
2. To verify mechanical neutral, provide current to solenoid C1,or turn neutral adjust excenter screw, until the servo pressure differential is 3 bar [43 psi]. The system pressure differential must be below 1.5 bar [22 psi]. Repeat test on solenoid C2 side.
3. The current required to set the servo pressure differential to 3 bar [43 psi] should be the same for each solenoid. Refer to TS-392.
4. If using neutral adjust excenter screw to set mechanical neutral, reset control neutral.

Removing the Pump

Before working on the pump, thoroughly clean the outside. If the pump has an auxiliary pump attached, remove both pumps as a single unit. Tag and cap all hydraulic lines as they are disconnected, and plug all open ports to ensure that dirt and contamination do not get into the system.

CAUTION

CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS AND VOID THE MANUFACTURER'S WARRANTY. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND INSTALLING SYSTEM LINES.

DISASSEMBLY, INSPECTION, ASSEMBLY

1. With the prime mover off, thoroughly clean all dirt and grime from the outside of the pump.
2. Tag, disconnect, and cap each hydraulic line connected to the pump. As hydraulic lines are disconnected, plug each open port, to ensure that dirt and contamination do not get into the pump.
3. Remove the pump and its auxiliary pump (if applicable) as a single unit.

NOTE: *Be careful, do not damage solenoids and electrical connections when using straps or chains to support the pump.*

4. Ensure the work surface and surrounding area are clean and free of contaminants such as dirt and grime.
5. Inspect the system for contamination.
6. Look at the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or metal particles.
7. Before replacing the pump, replace all filters and drain the hydraulic system. Flush the system lines and fill the reservoir with the correct, filtered hydraulic fluid.
8. Fill the pump with clean, filtered hydraulic fluid.
9. Attach the pump to the prime mover. Torque mounting screws according to the manufacturers recommendation.
10. Replace all hydraulic lines. Ensure the charge inlet line is filled with fluid.

Electric Control Module

NOTE: *Remove plug on top of control to ensure the swashplate feedback pin is properly positioned in the center of the control module when installing control.*

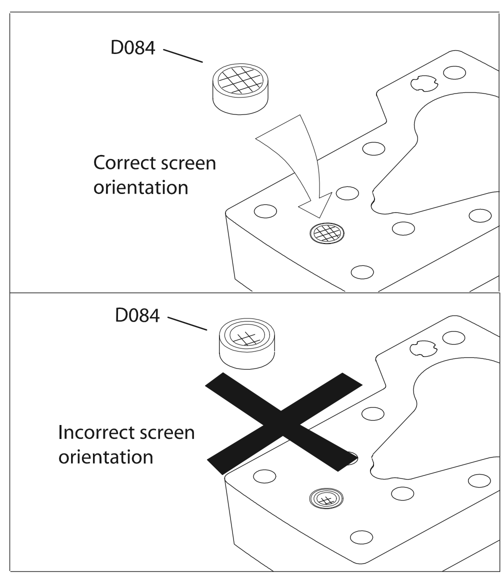
REMOVAL, INSPECTION, REASSEMBLY

Refer to Figure 5-37., Control Module Removal/Installation.

1. Using a 5 mm internal hex wrench, remove the six cap screws (D250).
2. Remove the control module and gasket (D150). Discard the gasket.
3. If necessary, remove orifices (F100) using a 3 mm internal hex wrench. Tag and number them for reinstallation.
4. Inspect the machined surfaces on the control and top of the pump. If you find any nicks or scratches, replace the component.

NOTE: *Ensure you install dowel pins (D300) in housing before installing control.*

5. Install a new gasket (D150).
6. If you removed screen (D084), install a new one. Install with the mesh facing outward (see drawing).



7. If previously removed, install orifices (F100) using a 3 mm internal hex wrench. Torque to 2.5 Nm [1.8 lb.ft.].
8. Install the control module and six cap screws (D250).
9. Using a 5 mm internal hex wrench, torque the cap screws (D250) to 13.5 Nm [10 lb.ft.].

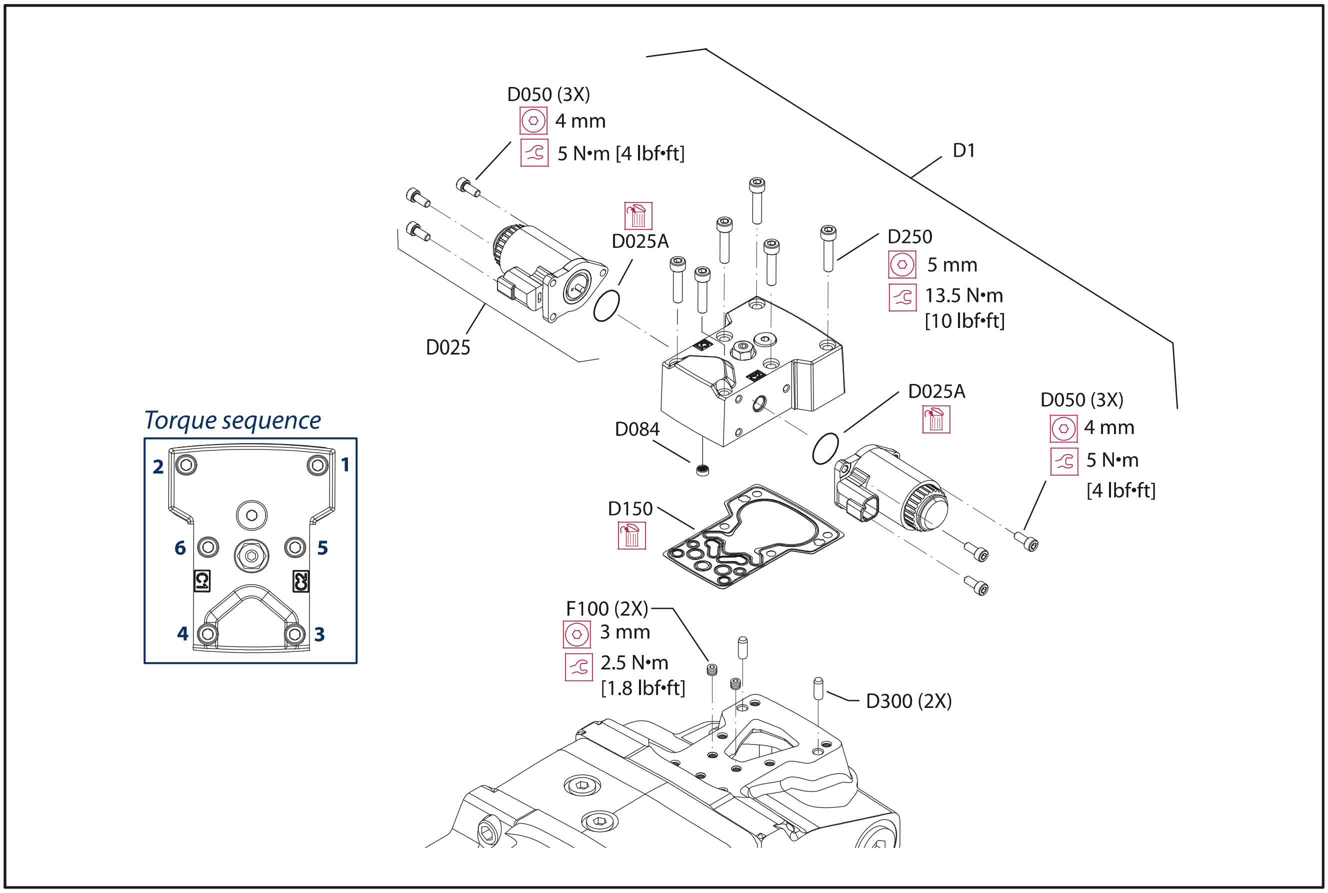


Figure 5-37. Control Module Removal/Installation

Control Solenoids

REMOVAL, INSPECTION, REASSEMBLY

1. Disconnect electrical connection and remove the three cap screws (D050) using a 4 mm internal hex wrench.
2. Remove the solenoid (D025) and O-ring (D025A). Discard the O-ring.
3. If necessary, remove the coil using a 12 point 26 mm socket.
4. Inspect the machined surface on the control. If you find any nicks or scratches, replace the component.
5. Lubricate new O-ring (D025A) using petroleum jelly and install.
6. Install solenoid with three cap screws (D050) using a 4 mm internal hex wrench. Torque screws to 5 Nm [4 lb.ft.].
7. Install coil using a 12 point 26 mm socket. Torque coil nut to 5 Nm [3.7 ft.lbs.].
8. Reconnect electrical connections and test the pump for proper operation.

Shaft Seal, Roller Bearing and Shaft Replacement

CAUTION

DO NOT DAMAGE THE HOUSING BORE, SHAFT OR BEARING WHEN REMOVING THE SHAFT AND SHAFT SEAL.

The shaft assembly is serviceable without disassembling the pump. Orient the pump on the work surface so the shaft is pointing to the side.

REMOVAL, INSPECTION, ASSEMBLY

1. Unwind the spiral ring (J300) from the housing to release the shaft/seal/bearing subassembly.
2. Pry on the lip of the seal carrier (J275) to dislodge it from the pump. Remove the seal carrier. Remove and discard O-ring (J260). Press the seal (J250) out of the carrier and discard.

3. Pull the shaft (J100) with bearing (J150) out of the pump. If necessary, tap lightly on the shaft to dislodge it from the cylinder block. C

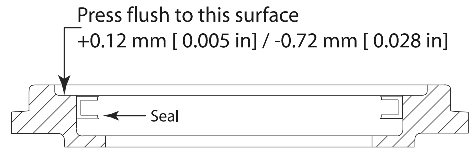
4. Remove the retaining ring (J200) using retaining ring pliers. Press the bearing off the shaft.

5. Inspect the shaft journals for wear, scratching, and pits. Check the splines for fretting; replace if damaged. Rotate the bearing, if it does not rotate smoothly, replace it.

6. Press the bearing (J150) onto the shaft (J100) and replace the retaining ring (J200). Ensure the retaining ring diameter is less than 38.84 mm [1.53 in] when installed on the shaft.

7. Install the shaft/bearing assembly into the pump.

8. Lubricate and install a new O-ring (J260) onto seal carrier (J275). Press a new seal (J250) into the seal carrier. Press the seal until it is flush within +0.12mm [0.005 in] or -0.72 mm [0.0028 in] of the inside lip of the carrier as shown below.



9. Cover the shaft with a protective sleeve while installing the seal carrier. Hand press the seal carrier into the housing. Ensure the seal carrier clears the spiral ring groove in the housing. Remove the protective sleeve.

10. Wind the spiral ring into the housing. Ensure the inside diameter of the spiral ring is greater than 68 mm [2.677 in] after installation.

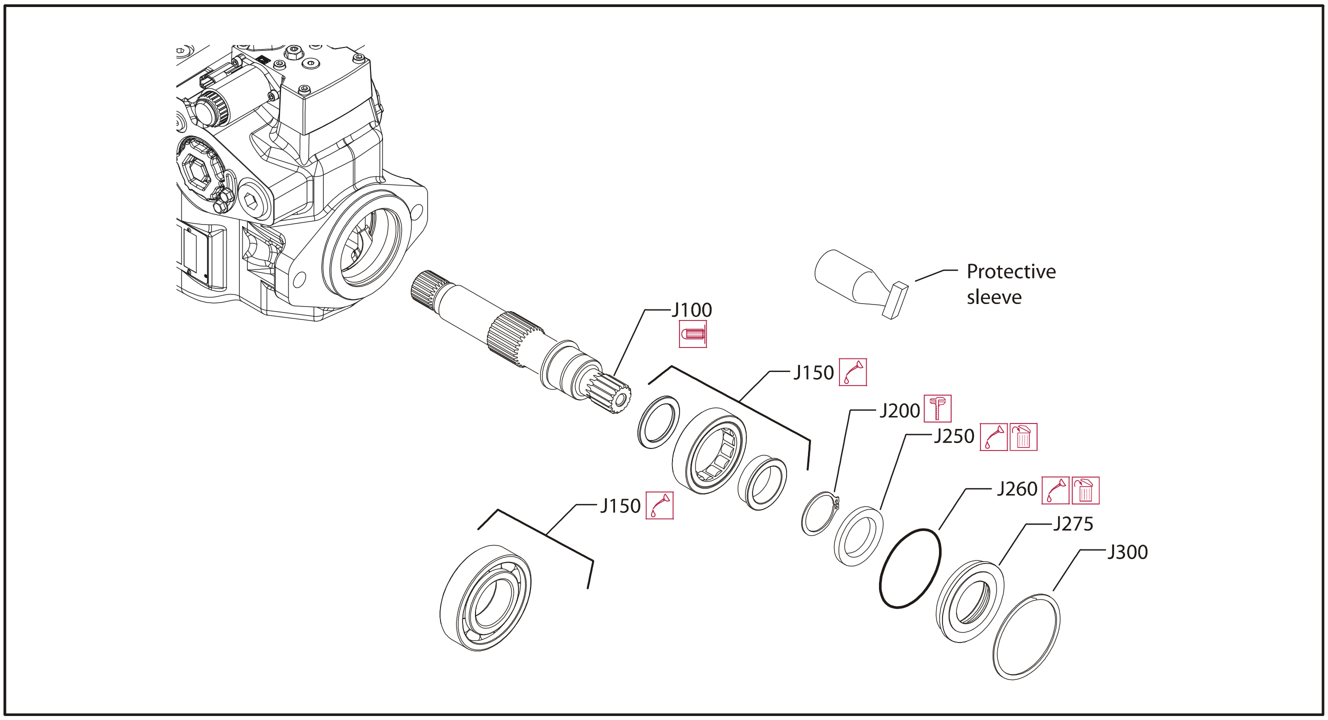
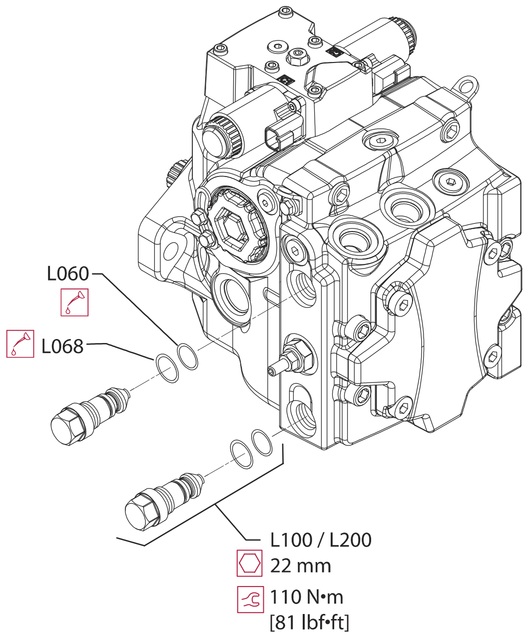


Figure 5-38. Shaft assembly

Charge Check / HPRV

REMOVAL, INSPECTION, ASSEMBLY

1. Using a hex wrench shown in the table below, remove the HPRVs (L1 50). Remove and discard the O-rings (L060) and backup rings (L068).



2. Inspect the sealing surfaces in the pump for nicks or scratches. Check the valves for damage. Replace any damaged components.

3. Lubricate and install new backup rings (L068) and O-rings (L060).

4. Install HPRVs. Torque to the value in the table below.

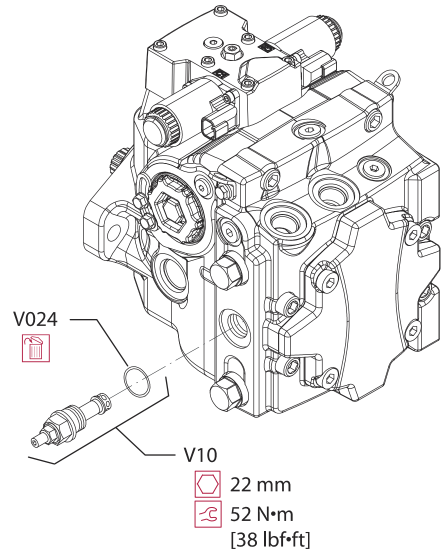
5. Operate the vehicle/machine through full range of controls to ensure proper operation. Check for leaks.

Charge Pressure Relief Valve

Replace the charge pressure relief valve (V010) as a complete unit. Do not attempt to repair the internal components of the valve. Torque to 52 Nm [38 lb.ft.]. See Charge Pressure Relief Valve Adjustment for adjustment instructions.

REMOVAL, INSPECTION, ASSEMBLY

1. Using a 22 mm wrench, remove the charge pressure relief valve (V010). Discard seal (V024).



2. Inspect the sealing surfaces of the pump for nicks or scratches.

3. Lubricate and install new seal (V024).

4. Install the charge pressure relief valve. Torque to 52 Nm [38 lb.ft.].

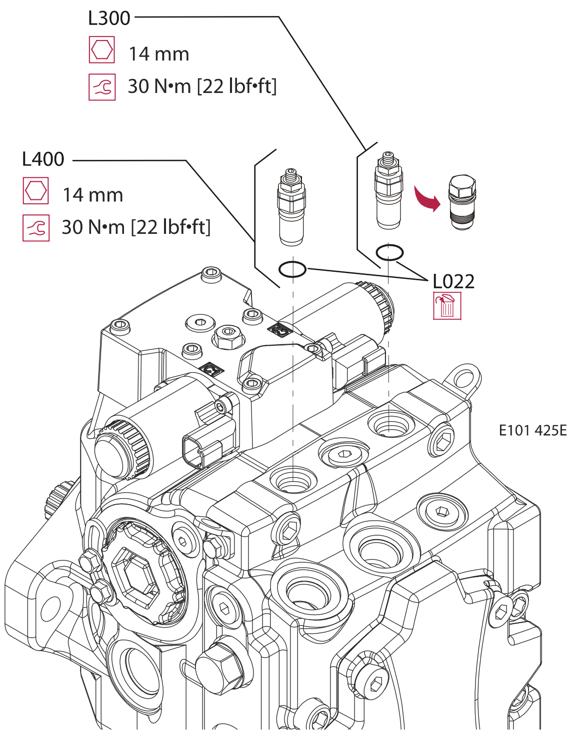
5. Operate vehicle/machine through full range of controls to ensure proper operation.

Pressure Limiter Valve Replacement

Replace the pressure limiter valve as a complete unit. Do not attempt to repair individual components. See Pressure limiter adjustment for adjustment instructions.

REMOVAL, INSPECTION, ASSEMBLY

1. Using a 14 mm wrench, remove the pressure limiter valve (L100). Discard O-ring.



2. Inspect the sealing surfaces of the pump for nicks or scratches.

3. Install new O-ring. Lubricate O-ring with petroleum jelly.

4. Replace pressure limiter valve. Torque to 30 Nm [22 lb.ft.].

5. Operate pump at full range of controls to ensure proper machine operation. Pressure limiter is available as complete unit only. O-ring is available separately.

5.4 GEAR PUMP

Disassembly

Prior to proceeding with disassembly, it may be necessary to prepare some subassemblies separately.

The details for preparing each subassembly are given in the following section.

Also, some general recommendations are given below.

CLEANLINESS

Cleanliness is a primary factor for reliable pump performance. Wash the outside of the pump thoroughly before disassembly and all pieces prior to assembly. Cleaning parts with clean shop solvent and air drying is usually adequate.

LUBRICATION OF MOVING PARTS

During assembly, it is imperative to provide lubrication with clean hydraulic oil to all the running parts of the pump.

It is also necessary to coat the seals with grease. The absence of lubrication during assembly can cause the unit to seize after a few minutes of running.

CARE OF SURFACE TREATMENT

Be careful when handling all the internal surfaces, especially bearings, gears, and body faces. Do not touch or score them with metal tools or cutting edges.

MARKING THE PARTS

Mark the parts before completely disassembling a pump. The marks allow components to be reassembled in the same relative position. This action should be applied to the body, bearings, and gears. Scribing, bluing, or using a felt tip pen to mark the outside of the body on the inlet side is suggested to indicate the relative position of the front flange and the rear cover to the body. Mark the bearing blocks also on the inlet side and the gears position relative to each other. DO NOT scribe internal surfaces.

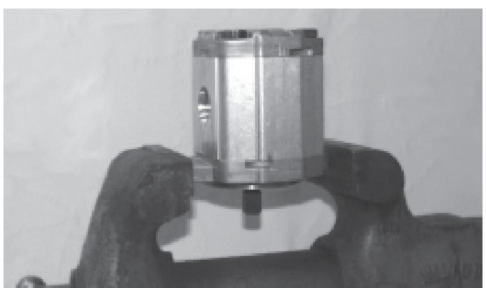
PROCEDURE

1. Clamp the unit.

   Clamp the unit in a vice from the flange side.

   Make sure the vice jaws are clean and have smooth surfaces to prevent damage to the pump.

   Clamping the pump on the body is not recommended because serious damage to the surfaces, on which the ports are located, may occur.



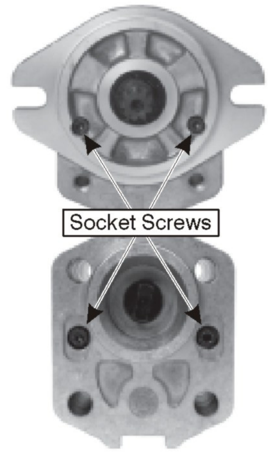
2. Remove capscrews.

   Use a 17 mm socket wrench and loosen the four capscrews on the cover. Next completely unscrew the capscrews and remove them.

   Inspect the threads of the capscrews for damage.

3. Remove socket head capscrews.

   Using a 4 mm internal hex wrench, loosen and remove the two small socket screws placed in the center of the cover. Repeat the same operation for the corresponding screws on the rear flange.



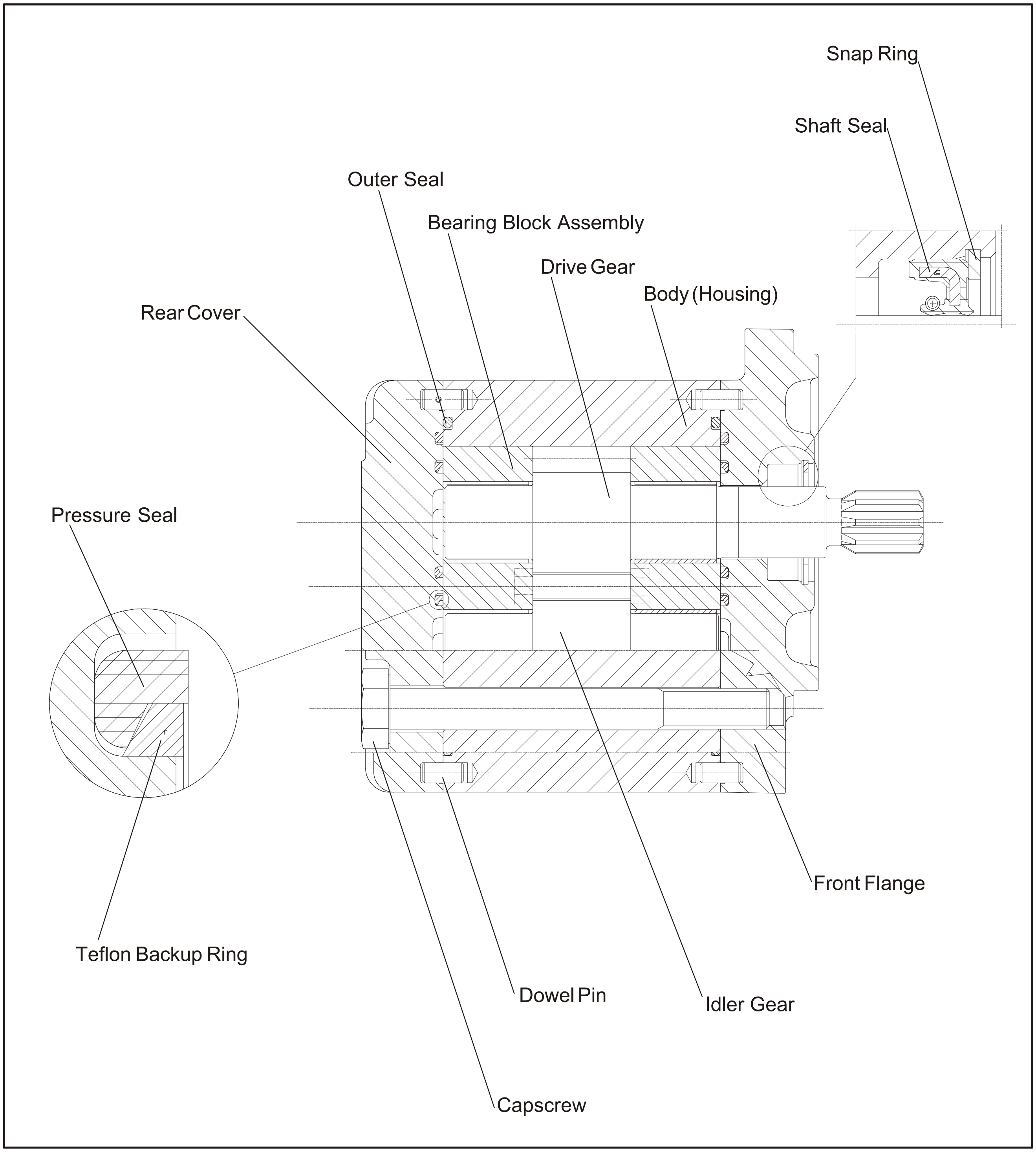


Figure 5-39. Gear Pump Cutaway

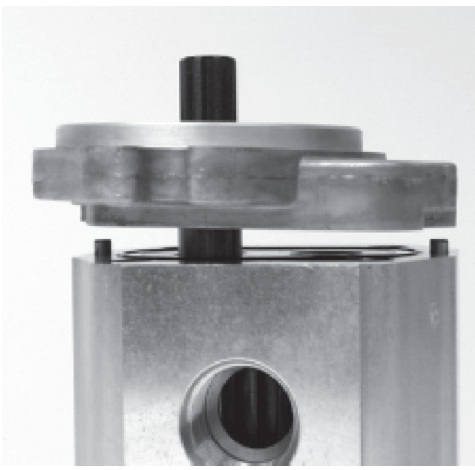
4. Remove front flange.

Place the pump on the table and slowly remove the front flange.

Be careful not to damage the shaft seal when removing the flange. Avoid contact of the shaft seal lips with key-way edges (in tapered and parallel shafts) or splined shaft teeth.

Inspect the front flange and seal area.

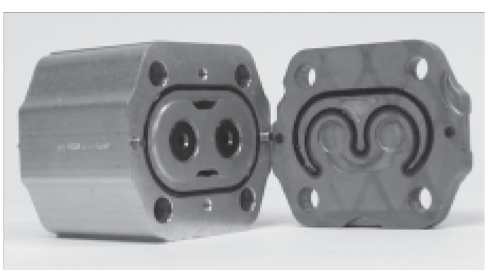
Clean with shop solvent, dry, and set aside.



5. Remove rear cover.

Clean with shop solvent, dry, and set aside.

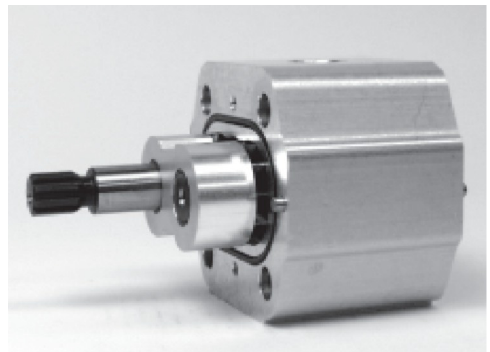
Visually inspect rear cover and seal area.



6. Remove bearing blocks and gears.

Place the pump on its side and carefully remove the bearing block and gear set. To accomplish this, hold the pump body and push with your fingers on the rear bear-ing block.

Mark the relative positions of the gear mesh (drive gear tooth to idler gear tooth) and the bearing blocks to the body so they can be reassembled in the same position.



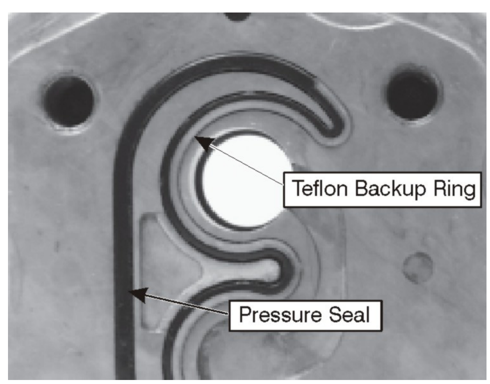
7. Remove pressure seals.

Check the seal quality. Replacement is recommended whenever there are burrs, evidence of extrusion, or marks caused by overheating. If the seals need to be replaced, carefully remove them from the flange cover, beginning with the backup ring and then the pressure seal.

NOTICE

IMPORTANT: DO NOT USE TOOLS WITH SHARP EDGES TO REMOVE THE SEALS, AS DAMAGE TO THE COVER CAN RESULT.

After removal, dispose of damaged seals.



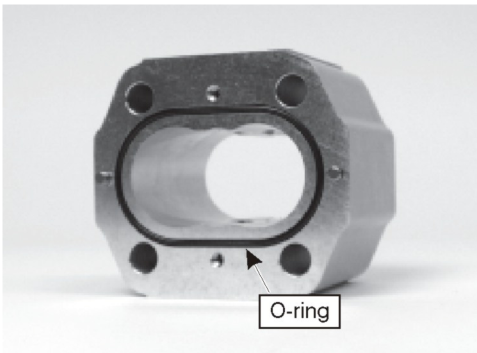
8. Remove Outer O-Ring Seal

Check the quality of this seal. If necessary, replace it. Follow the same removal recommendations given in step 7.}

After removal, discard the damaged seal.

NOTICE

DO NOT USE TOOLS WITH SHARP EDGES TO REMOVE THE SEALS, AS DAMAGE TO THE COVER CAN RESULT.



9. Remove the snap ring.

Place the flange on the work surface. Using internal snap ring pliers, remove the snap ring.

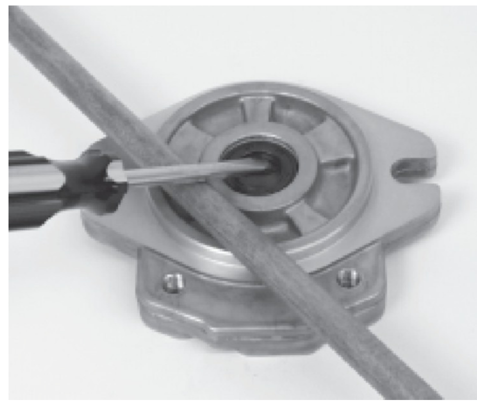
10. Remove the shaft seal.

Check the shaft seal quality and remove if necessary.

To remove, pry the bottom of the shaft seal and force it out while rotating the flange to lift it out evenly.

Do not use the flange pilot to gain leverage, damage may result. Use a plastic rod or wooden dowel as a fulcrum.

After removal, dispose of damaged seal.



ASSEMBLY

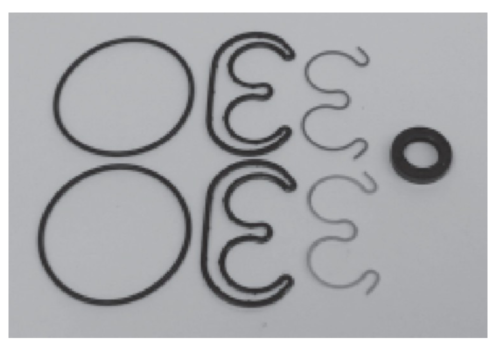
1. Prepare the seals.

Have the entire seal kit available.

Lightly coat all seals with seal grease. The grease is needed to adhere the seals to their grooves.

NOTICE

DO NOT INSTALL DRY SEALS.



2. Install shaft seal into front flange.

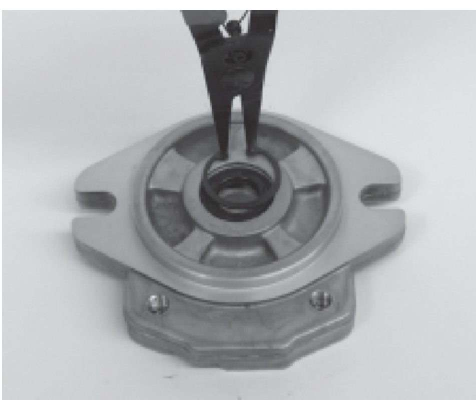
Prepare the flange and shaft seal by lightly.

lubricating with grease.

Seat the seal in the flange by hand. Then, using the shaft seal installation tool (shown on page 52), press the seal until the tool stops on the flange. This will insure the seal is inserted to the proper depth.

3. Install snap ring.

Install the snap ring using internal snap ring pliers. Ensure the snap ring fits securely in its groove. This is necessary to retain the shaft seal.

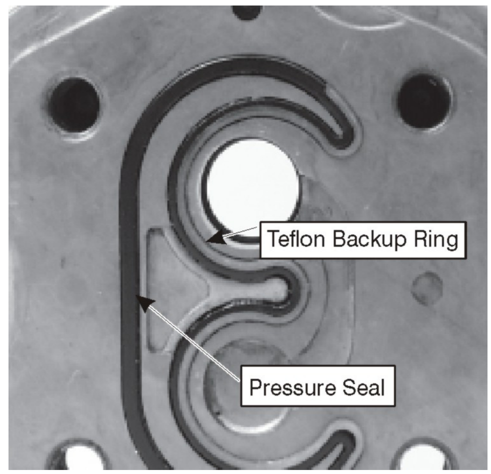


4. Install pressure seals.

Prepare the pressure seals by lightly lubricating them with grease.

Install pressure seals into the grooves on the front flange and rear cover. Then install the teflon backup ring.

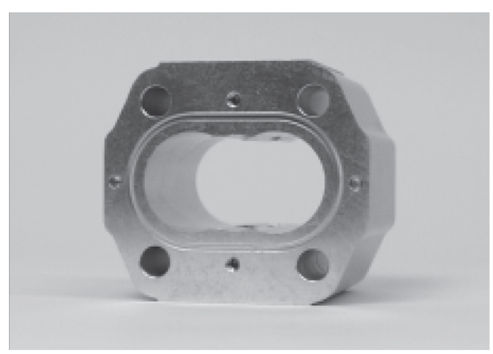
Ensure that the seals are located in the grooves, as shown.



5. Prepare the body.

Clean the body.

Inspect the internal and mating surfaces. Ensure the surfaces are free of burrs and scratches. Check both the bearing block mating surface and the cut-in path. The cut-in path should be no deeper than 0.1 mm (0.004 in).



6. Install outer seal.

Prepare the outer seal by lightly lubricating with grease.

Install outer seals in the grooves on both sides of the body.

7. Prepare the gears.

CAUTION

THE GEAR SURFACES ARE SUPERFINISHED. RESIDUE ON HANDS AND FINGERS MAY BE CORROSIVE TO THIS SURFACE. DO NOT TOUCH.

Carefully clean the two gears. If the gears are new, wash them with shop solvent to remove any anticorrosive grease on the surfaces.

Inspect the journals and the flat faces on the top and bottom of the gears. Ensure these surfaces are free from burrs or scratches. If scratches or burrs are found, clean them with a flat stone and/or very fine emery paper. Rewash the gears after this operation.

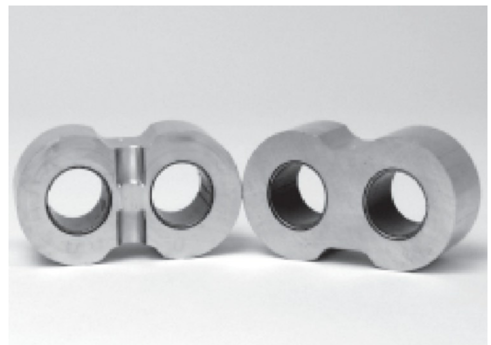
8. Prepare the bearing blocks.

Clean the two bearing blocks.

Inspect the flat surfaces of the bearing blocks for burrs or scratches on the edges. If necessary, remove burrs with very fine emery paper. Then rewash the bearings.

Inspect the DU™ bushings for wear. There should be no bronze showing.

Using clean hydraulic oil, lubricate the internal and external surfaces of the bearing blocks.



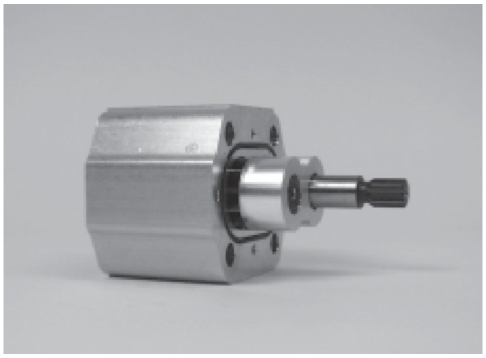
9. Assemble the bearing blocks and gears.

Lubricate the journals and the gear faces.

Assemble the bearing blocks and gears. Ensure that the recessed bearing faces are installed adjacent to the gear faces. Align all assembly marks made during disassembly. Ensure the front and rear bearing blocks occupy the same location with respect to the housing as before disassembly. Ensure that the relative position of the gear mesh is maintained as before disassembly. Misalignment of the gear teeth may increase operating noise.

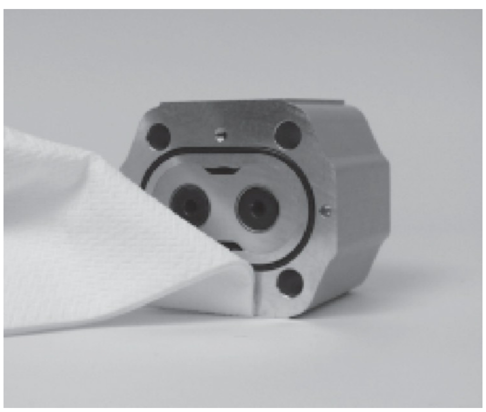
10. Install the gear block assembly.

Install the bearing block and gear assembly into the body cavity. Align the assembly marks to ensure that the gear block assembly is installed with the same orientation as before disassembly.



11. Clean the mating surfaces.

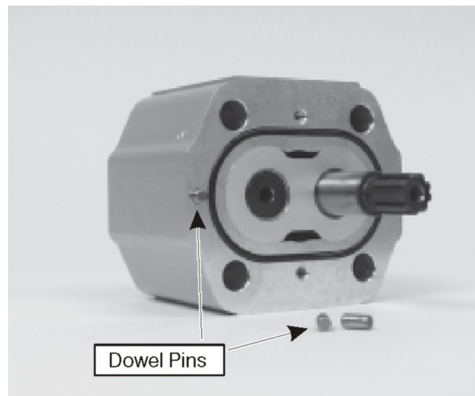
Remove any excess lubrication and grease from the mating surfaces of the pump body. Ensure that these surfaces are dry and free of contamination before moving on to the next step.

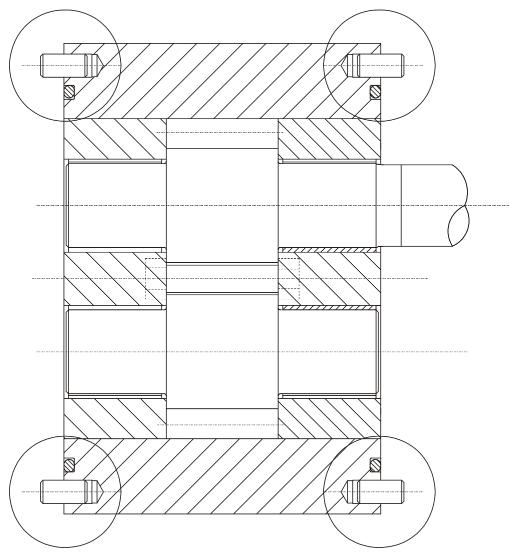


12. Install the dowel pins.

Install four 5 mm dowel pins into the proper cavities on both sides of the body (refer to the illustration below). Swab the pins with assembly grease or petroleum jelly to retain them during assembly.

Do not install dowel pins to the rear cover or flange, as one of them may drop inside the pump during assembly.

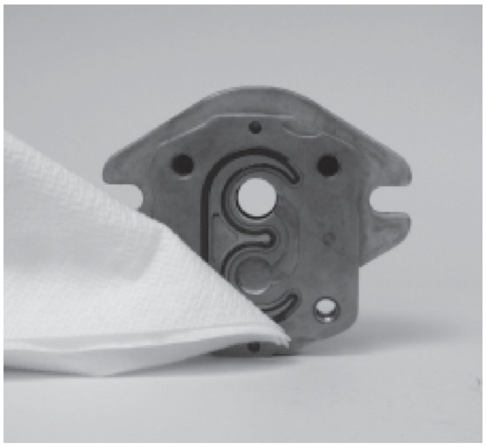




13. Clean the mating surfaces.

Remove any excess lubrication and grease from the mating surfaces of the front flange and rear cover. Ensure that these surfaces are dry and free of contamination before moving on to the next step.

Ensure the pressure seals are seated properly after this operation.

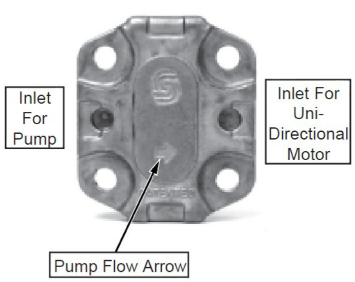


14. Install Rear Cover.

Mount the cover on the body. Ensure the arrow on the back is oriented properly. The arrow should be:

- In the same direction as the flow if the unit is a pump.
- Against the direction of the flow if the unit is a unidirectional motor.
- If the unit is a bidirectional motor the arrow does not appear on the cover.

Ensure that all the pressure seals stay in place during this operation.



15. Prepare pump for front flange assembly.

Place the pump with the rear cover downwards.

Ensure that the assembly marks on the bearing block / body are properly aligned.

16. Install the front flange.

Install a protective sleeve over the shaft. The sleeve is used to protect the shaft seal from damage by the shaft splines / keyway during front flange assembly.

Install the flange onto the body, then remove the protective sleeve.

Ensure that the seals remain seated in their grooves during this operation.

17. Torque sequence.

Install capscrews. While observing the torque sequence shown, pre tighten the capscrews. Then, using a torque wrench, tighten them to the proper torque.

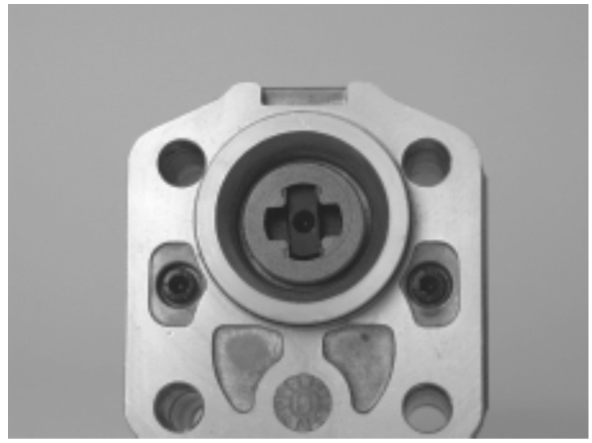
Torque 44-54 Nm (32-40 ft.lbs.).

18. Install socket head capscrews.

Using a 4 mm internal hex wrench, install the socket head capscrews to the front flange and rear cover.

Torque 2.5-3.4 Nm (22-30 ft.lbs.).

If used, install new o-ring to flange pilot.



Troubleshooting

Table 5-17. Troubleshooting

Low or No Flow From Gear Pump		
Item	Description	Action
1. Check oil level in reservoir.	Insufficient oil to supply gear pump.	Fill reservoir to proper level.
2. Check input spline condition.	Input shaft broken or stripped.	Repair or replace gear pump.
3. Check pressure at pump inlet. Recommended inlet pressure: 0.8 to 3.0 bar absolute. 0.6 Minimum at cold start.	Clogged suction filter or inlet screen.	Replace filter or clean suction screen.
4. Check condition of gear faces and bearing blocks.	Scored bearing block and gear faces will reduce pump efficiency.	Repair or replace gear pump.
5. Check bushings.	Overpressure of gear pump will cause idler gear bushing to fail.	Repair or replace gear pump.
Excessive Noise		
Item	Description	Action
1. Check oil level in reservoir.	Excessive air will cause cavitation sound.	Fill reservoir to proper level.
2. Check inlet line for leaks.	Excessive air will cause cavitation sound.	Repair inlet line.
3. Check pressure at pump inlet. Recommended inlet pressure: 0.8 to 3.0 bar absolute. 0.6 Minimum at cold start.	Lower than normal inlet pressure causes excessive pump noise.	Return inlet pressure to recommended levels.
External Leakage		
Item	Description	Action
1. Check for pinched o-rings or backup ring seal.	Pinched seal will allow leakage.	Replace pinched seal.
2. Check pressure seals.	Damage to pressure seals is typically caused by reduced "stack-up" in the pump assembly. This may be due to under-torqued assembly fasteners, or more commonly is attributed to excessive wear on the bearing blocks. Reduced "stack-up" will affect seal efficiency possibly to the point of seal extrusion.	Inspect condition of bearing blocks. If they are found to be worn, repair or replace the pump. If bearing blocks are not worn, replace pressure seals and re-torque pump assembly fasteners.

5.5 PRESSURE SETTING PROCEDURE

1. P1 Main relief valve

   This is a solenoid valve and relief valve all in one. The relief portion is pre-set and non adjustable. The cartridge is located on the “T” port face of the valve block. This cartridge is the solenoid valve located at the top on that face. To check, install a pressure gauge at port “M1”. Activate lower lift up. At the end of stroke, the pressure read should be 2500 psi, +/- 150 psi. If the boom cannot be raised to full extension, remove the hose from port “#6”. Plug and cap. This is non adjustable, so if the setting is not correct the valve cartridge will need replaced.

2. P2 Main relief valve

   This is a solenoid valve and relief valve all in one. The relief portion is pre-set and non adjustable. The cartridge is located on the tank port face of the valve block. This cartridge is the solenoid valve located just above the “T” port. To check, install a pressure gauge at port “M2”. Activate telescope in, or remove the hose from port “P4”. Plug and cap. The pressure read should be 3000 psi, +/- 150. This is non adjustable, so if the setting is not correct the valve cartridge will need replaced.

3. Swing relief valve

   The swing relief valve is adjustable and is located on the “T” port face of the valve block. The relief valve is located right next to the “T” port. To check, install a pressure gauge at port “MS”. Activate swing until the turn-table is bottomed out at the stop. You can also remove the hose from port “5”, plug and cap. Activate swing right. You should read 1000 psi +/-100. To increase, turn clockwise. To decrease, turn counter-clockwise.

4. Steer relief valve

   The steer relief valve is adjustable and is located on the “T” port face of the valve block. The steer relief valve is located right next to the swing relief valve. To check, install a pressure gauge at port “M2”. Activate steer right. You should read 2500 psi +/-100. To increase, turn clockwise. To decrease, turn counter-clockwise.

5. Platform level up relief valve

   This relief valve is adjustable and is located on the valve manifold inside the tower upright boom. Install a pressure gauge at port “M1” of this valve. Remove the hose from port L1 located on the bottom of the valve. Plug and cap. The relief valve is located above port “T2”. Activate level up. The pressure read should be 2800 psi +/-100. To increase, turn clockwise. To decrease, turn counter-clockwise. Re-hose port L1.

6. Platform level down relief valve

   This relief valve is adjustable and is located on the valve manifold inside the tower upright boom. Install a pressure gauge at port “M2” of this valve. The relief valve is located above port “P2”. Activate level down. The pressure read should be 1400 psi +/-100. To increase, turn clockwise. To decrease, turn counter-clockwise.

5.6 OIL SAMPLING

See Figure 5-40., Oil Sampling Port.

This machine is equipped with an oil sampling valve to allow for verification of hydraulic oil condition.

Procedure

1. Function the machine for approximately 15 minutes operating all functions.
2. Switch the select switch to the ground controls and start the engine.
3. Locate the oil sampling valve on the front of the main control valve.
4. Unscrew the knurled end which is attached to the chain.
5. Place a drip pan under the spout and push in for approximately 10 seconds. This should flush out the valve.
6. Open and place the sample bottle under the spout.
7. Push in on the end of the valve and fill up the bottle.
8. Cap the bottle immediately.
9. Thread the knurled cap back onto the valve.
10. The sample is complete.

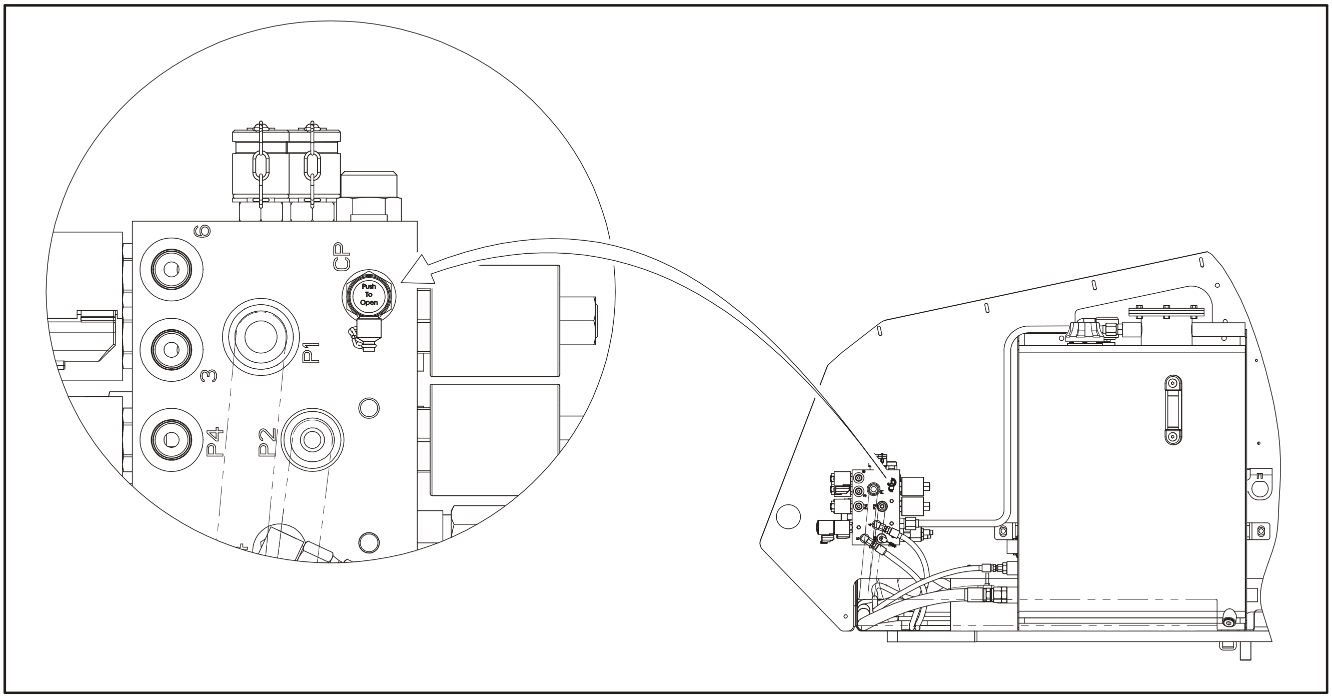


Figure 5-40. Oil Sampling Port

NOTES:

SECTION 6. JLG CONTROL SYSTEM

6.1 JLG CONTROL SYSTEM ANALYZER KIT INSTRUCTIONS

Introduction

NOTICE

WHEN INSTALLING A NEW POWER MODULE CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS.

NOTICE

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

The JLG designed Control System is a 12 volt based motor control unit installed on the boom lift.

The JLG Control System provides simplicity in viewing and adjusting the various personality settings for smooth control of: acceleration, deceleration, creep and max.-speed for all boom, drive, and steering functions.

The upper lift, swing, and drive are controlled by individual joysticks, with steering being controlled by a rocker switch built into the top the drive joystick. To activate Drive, Lift, and Swing simply pull up on the slide lock location on the joystick and move the handle into the direction desired.

The controller will control current output, as programmed for smooth operation and maximum cycle time. Speeds for all boom functions can also be adjusted via the Personalities menu on the Analyzer.

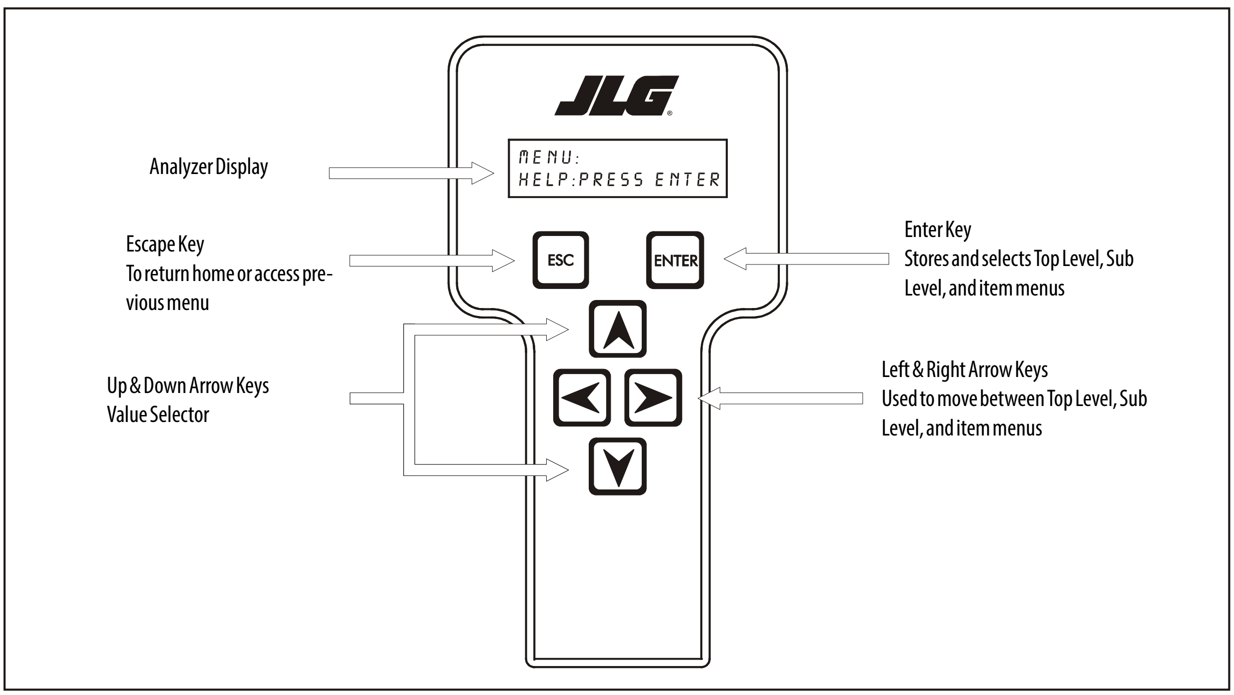


Figure 6-1. Hand Held Analyzer

The JLG Control System controller has a built in LED to indicate any faults. The system stores recent faults which may be accessed for troubleshooting. Optional equipment includes a beacon light, function cutout, and ground alarm. These options may be added later but some must be programmed into the controller when installed.

The Control System may be accessed by using a custom designed, hand held analyzer (Analyzer Kit, JLG P/N 2901443 or separately, Analyzer, JLG P/N 1600244 & Cable, JLG P/N 1600633) which will display two lines of information at a time, by scrolling through the program.

NOTE: *Each module has a label with the JLG part number and a serial number which contains a date code.*

6.2 ANALYZER MENU STRUCTURE

There are seven levels within the Analyzer menu structure and they are as follows;

1. **HELP: PRESS ENTER**
   This is the default menu that appears at power up of the Analyzer. This menu displays the current Help (fault) message. This is intended to quickly guide the technician in the event of a fault in the JLG Control System. This menu also displays functional interlocks. Pressing ENTER shows Logged Help which is a record of the last 25 Help (fault) messages. Editing of information in this menu is not possible.

2. **DIAGNOSTICS**
   This menu provides real-time status information about the control system as a diagnostic aid.

3. **SYSTEM TEST**
   This menu is used to activate and then interact with the Control System's self-test functionality. Starting the System Test will cause the functionality of each device to be tested. Outputs are energized to detect short or open circuit conditions and digital inputs are stimulated to simulate switching conditions. Editing of information in this menu is not possible.

4. **ACCESS LEVEL**
   This menu allows the technician to navigate between access levels; Operator Access or Service Access. To enter the Service access level, a five-digit code must be entered. Powering down returns the Analyzer to Operator Access.

5. **PERSONALITIES**
   This menu contains performance settings specific to the machine. These settings are necessary to maintain functions such as solenoid breakpoints and joystick engagement percentages and are organized in an outline format (see Figure 6-14., Analyzer Personalities Menu - Sheet 2 of 3 (Software Version P2.1)). These settings can be modified in the Service access level.

6. **MACHINE SETUP**
   This menu contains machine configuration information for the JLG Control System. Selections in this menu can change interlock functionality and cause some Personality and Machine Setup entries to be visible or hidden. These settings can be modified in the Service access level.

7. **CALIBRATIONS**
   This menu allows the operator to interact with the sensors on the machine. These settings can be modified in the Service access level.

6.3 USING THE HAND HELD ANALYZER

To Connect the JLG Control System Analyzer

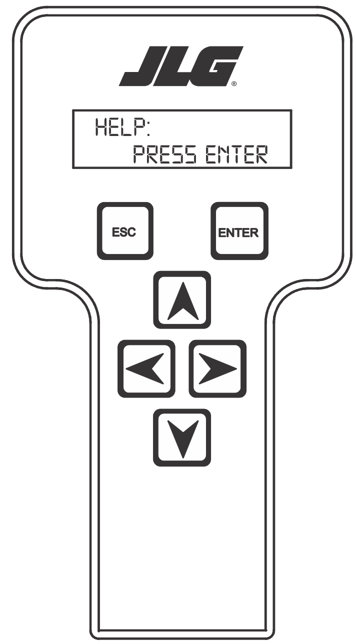
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

NOTE: *The cable has a four pin connector at each end of the cable; the cable cannot be connected backwards.*

2. Power up the Control System by turning the lower key to the platform or ground position and pulling both emergency stop buttons on.

Using the Analyzer

With the machine power on and the analyzer connected properly, the analyzer will display the following:



HELP:
PRESS ENTER

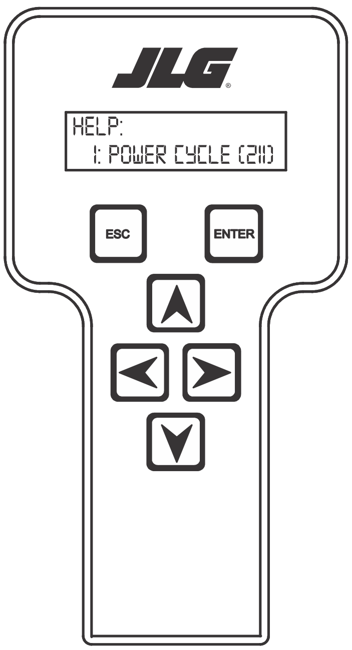
At this point, using the **RIGHT** and **LEFT** arrow keys, you can move between the top level menu items. To select a displayed menu item, press **ENTER**. To cancel a selected menu item, press ESC.; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

HELP
DIAGNOSTICS
SYSTEM TEST
OPERATOR ACCESS
PERSONALITIES
MACHINE SETUP
CALIBRATIONS (Service Access only)

If you press **ENTER**, at the **HELP: PRESS ENTER** display, and a fault is present, the analyzer display will scroll the fault across the screen. If there was no fault detected, the display will read: **HELP: EVERYTHING OK.** If powered up at the ground station, the display will read: **GROUND OK.**

If **ENTER** is pressed again, the display moves to the following display:



LOG (211)
1: POWER CYCLE

At this point, the analyzer will display the last fault the system has seen, if any are present. You may scroll through the fault logs to view what the last 25 faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESC.** two times. **POWER CYCLE (211)** indicates a power up.

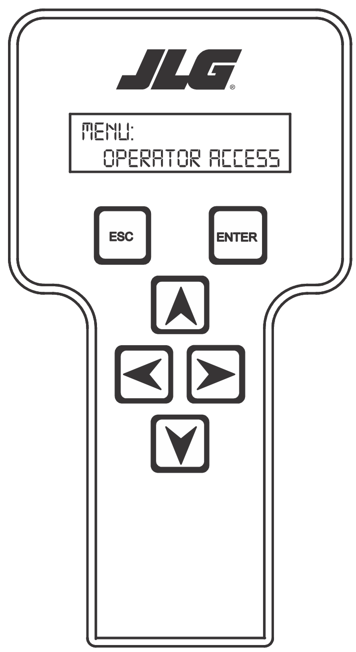
When a top level menu is selected, a new set of menu items may be offered: for example:

SYSTEM
DATALOG
VERSIONS
ENGINE
OPER CONTROLS

Pressing **ENTER** with any of the above displayed menus, will display additional sub-menus within the selected menu. In some cases, such as **DRIVE**, the next level is the parameter or information to be changed. Refer to the flow chart for what menus are available within the top level menus. You may only view the personality settings for selected menus while in Operator Access level. Remember, you may always cancel a selected menu item by pressing the **ESC.** key.

Changing the Access Level of the Hand Held Analyzer

When the analyzer is first connected, you will be in Operator Access level which enables you to only view most settings which cannot be changed until you enter a password to advance to a lower level. This ensures that a setting cannot be accidentally altered. To change the access level, the correct password must be entered. To enter the password, scroll to the **OPERATOR ACCESS** level menu. For example:



ACCESS LEVEL:
CODE 00000

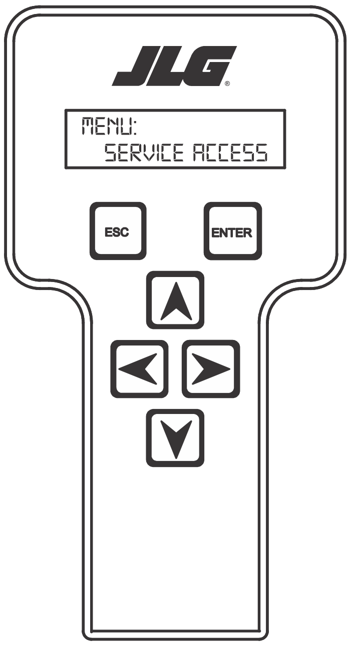
Press **ENTER** to select the **ACCESS LEVEL** menu.

Using the **UP** or **DOWN** arrow keys, enter the first digit of the password, 3.

Then using the **RIGHT** arrow key, position the cursor to the right one space to enter the second digit of the password.

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 33271.

Once the correct password is displayed, press **ENTER**. The access level should display the following, if the password was entered correctly:

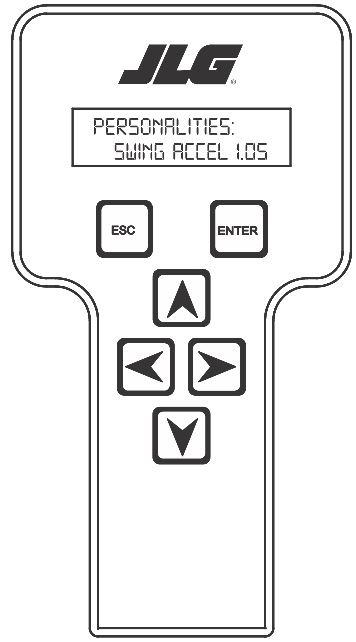


MENU:
SERVICE ACCESS

Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings.

Adjusting Parameters Using the Hand Held Analyzer

Once you have gained Service Access, and a personality item is selected, press the UP or DOWN arrow keys to adjust its value, for example:

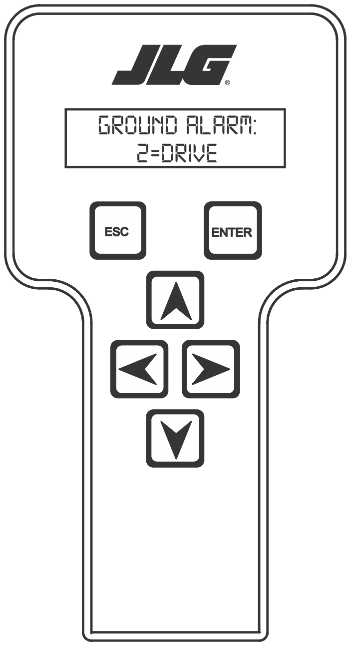


SWING:
ACCEL 1.0s

There will be a minimum and maximum for the value to ensure efficient operation. The Value will not increase if the **UP** arrow is pressed when at the maximum value nor will the value decrease if the **DOWN** arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at Service Access.

Machine Setup

When a machine digit item is selected, press the UP or DOWN arrow keys to adjust its value, for example:



GROUND ALARM:
2 = DRIVE

The effect of the machine digit value is displayed along with its value. The above display would be selected if the machine was equipped with a ground alarm and you wanted it to sound when driving. There are certain settings allowed to install optional features or select the machine model.

When selection the machine model to match the size of the machine, the personality settings will all default to the factory recommended setting.

NOTE: *Refer to Table 6-6, Machine Model Adjustment for the recommended factory settings.*

NOTE: *Password 33271 will give you Service Access, which will permit you to change all machine personality settings.*

There are two settings that JLG strongly recommends that you do not change. These settings are so noted below:

DRIVE MT ELEV MAX (Driving with engine at Max Torque and machine at maximum elevation)
DRIVE ME ELEV MAX (Driving with engine at Mid Engine and machine at maximum elevation)

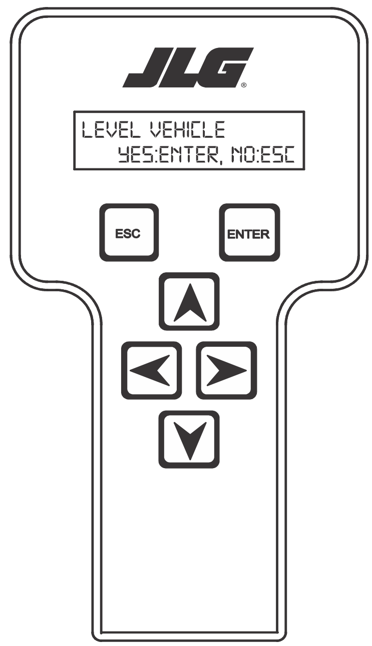
⚠ WARNING

CHANGING THESE SETTINGS COULD ADVERSELY AFFECT THE STABILITY OF YOUR MACHINE.

Level Vehicle Description

⚠ WARNING

DO NOT LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.



LEVEL VEHICLE
YES:ENTER, NO:ESC

Not available in Operator Access ENTER confirms that vehicle is currently level, and zeroes the tilt sensor measurements.

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
ACCEL	ACCELERATE
ACT	ACTIVE
A/D	ANALOG DIGITAL CONVERTER COUNT
AMB.	AMBIENT
ANG	ANGLE
AUX	AUXILIARY
BCS	BOOM CONTROL SYSTEM
BM	BOOM LENGTH ANGLE MODULE
BLAM	BOOM LENGTH ANGLE MODULE
BR	BROKEN
BSK	BASKET
CAL	CALIBRATION
CL	CLOSED
CM	CHASSIS MODULE
CNTL	CONTROL
CNTRL	CONTROL
C/O	CUT OUT
CONT(S)	CONTRACTOR(S)
COOR	COORDINATED
CRK PT	CRACK POINT
CRP	CREEP
CUT	CUTOUT
CYL	CYLINDER
DECEL	DECELERATE
D	DOWN
DN	DOWN
DWN	DOWN
DEG.	DEGREE
DOS	DRIVE ORIENTATION SYSTEM
DRV	DRIVE
E	ERROR
E&T	ELEVATED & TILTED
ELEV	ELEVATION
ENG	ENGINE
EXT	EXTEND
F	FRONT
FL	FLOW
FNT	FRONT
FOR	FORWARD
FWD	FORWARD
FSW	FOOT SWITCH
FUNC	FUNCTION
G	GROUND

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
GND	GROUND
GRN	GREEN
GM	GROUND MODULE
H	HOURS
HW	HARDWARE
HWFS	HARDWARE FAILSAFE
I	IN or CURRENT
JOY	JOYSTICK
L	LEFT
LB	POUND
LEN	LENGTH
LIM	LIMIT
LT	LEFT
LVL	LEVEL
M	MINUTES
MIN	MINIMUM
MAX	MAXIMUM
M	MAIN
MN	MAIN
mA	MA FOR MILLIAMPERES
mA/s	MILLIAMPERES PER SECOND
NO	NORMALLY OPEN or NO
NC	NORMALLY CLOSED
O	OUT
O/C	OPEN CIRCUIT
OP	OPEN
O/R	OVERRIDE or OUTRIGGER
O//R	OVERRIDE
OSC	OSCILLATING
OVRD	OVERRIDE
P	PLATFORM
P	PRESSURE
PCV	PROPORTIONAL CONTROL VALVE
PLAT	PLATFORM
PLT	PLATFORM
PM	PLATFORM MODULE
POT	POTENTIOMETER
PRES	PRESSURE
PRS	PRESSURE
PT	POINT
R	REAR or RIGHT
REV	REVERSE or REVISION
RET	RETRACT

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
ROT.	ROTATE
RT	RIGHT
S/C	SHORT CIRCUIT
SEL	SELECTOR
SN	SERIAL NUMBER
SPD	SPEED
STOW	STOWED
STOWD	STOWED
SW	SWITCH or SOFTWARE
TELE	TELESCOPE
TEMP	TEMPERATURE
TORQ.	TORQUE
TRN	TRANSPORT
T/T	TURNTABLE
T	TOWER
TURNTBL	TURNTABLE
TWR	TOWER
U	UPPER or UP
V	VOLT
VER	VERSION
VLV	VALVE
WIT	WITNESS
YEL	YELLOW

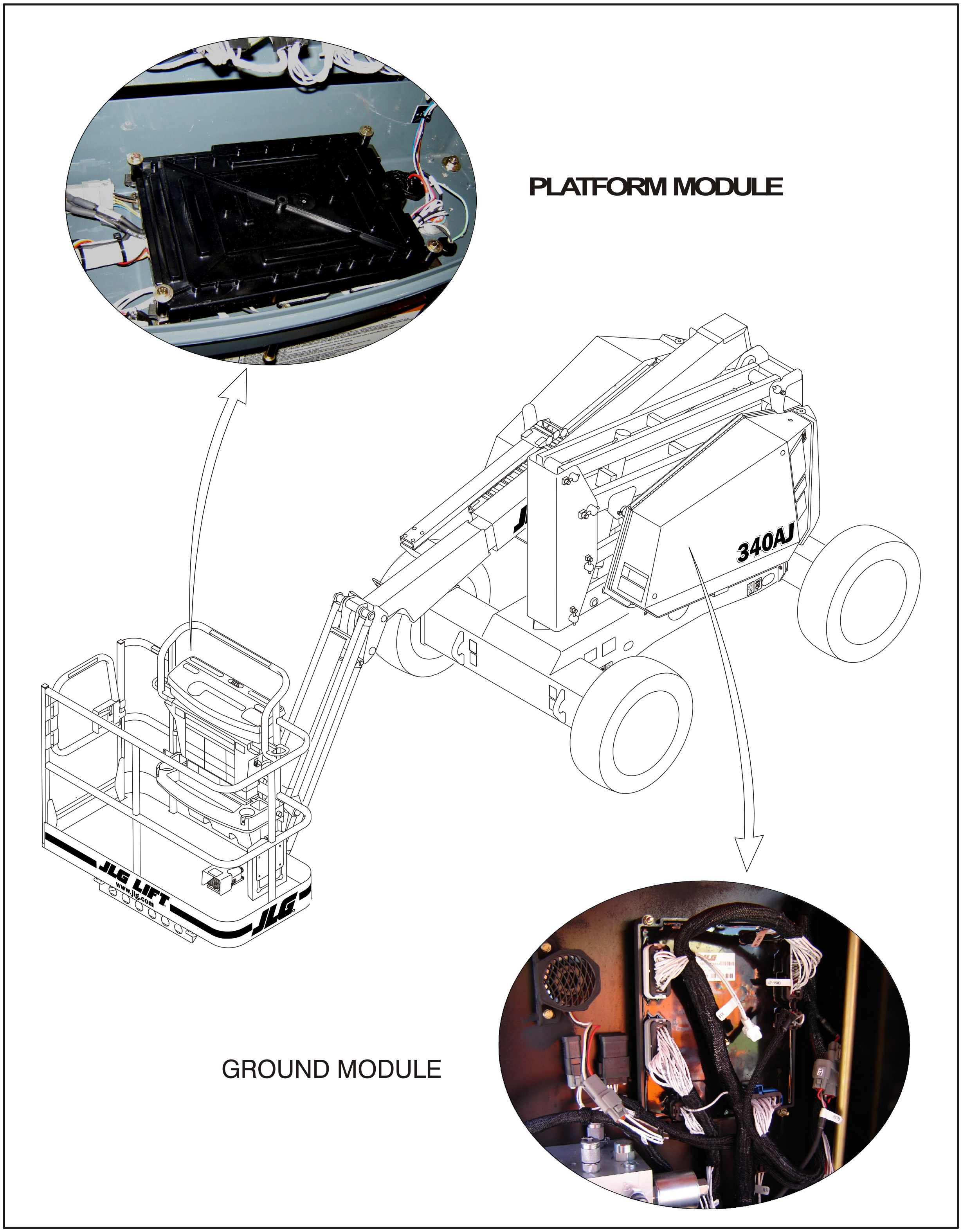


Figure 6-2. Control Module Location

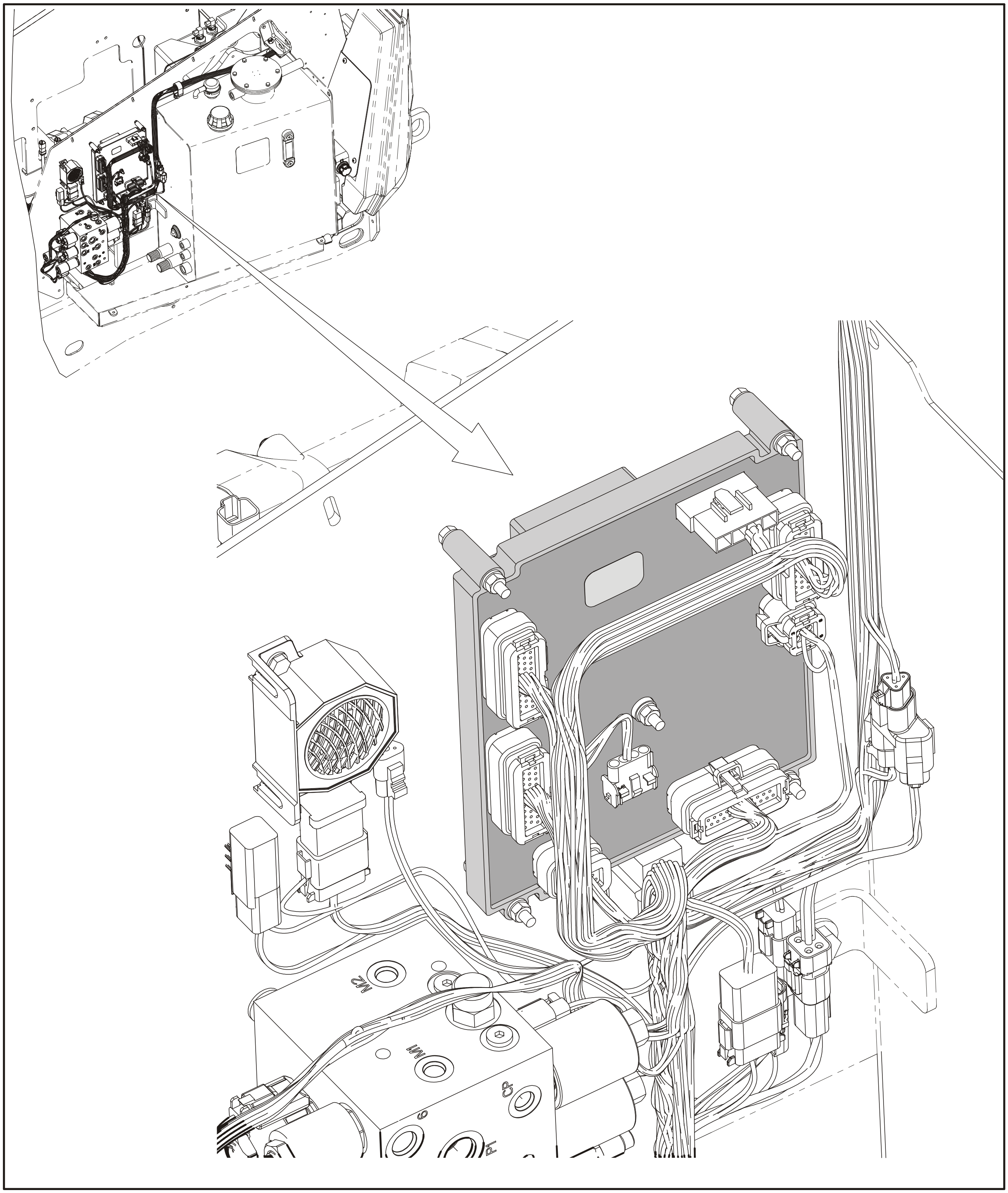


Figure 6-3. Ground Module - Sheet 1 of 4

Connector	Pin	Function	Type	
J1 (Natural)	1	PROPORTIONAL FUEL RACK ACTUATOR	DIGITAL	OUTPUT
	2	ENGINE THROTTLE ARM ACTUATOR	DIGITAL	OUTPUT
	3	DRIVE FORWARD VALVE	DIGITAL	OUTPUT
	4	UNUSED (GROUND)	GROUND	INPUT
	5	UNUSED (GROUND)	GROUND	INPUT
	6	DRIVE REVERSE VALVE	DIGITAL	OUTPUT
	7	OSCILLATING AXLE POWER	DIGITAL	OUTPUT
	8	UNUSED (GROUND)	GROUND	INPUT
	9	MSSO SWTICH GROUND	GROUND	INPUT
	10	UNUSED (ECU POWER)	DIGITAL	OUTPUT
	11	START RELAY	DIGITAL	OUTPUT
	12	ENGINE GLOW PLUG RELAY	DIGITAL	OUTPUT
	13	APU ENABLE RELAY	DIGITAL	OUTPUT
	14	ENGINE COOLANT TEMPERATURE SENSOR	ANALOG	INPUT
	15	ENGINE OIL PRESSURE SENSOR	ANALOG	INPUT
	16	ENGINE SPEED SINGAL	FREQUENCY	INPUT
	17	ENGINE SPEED GROUND	GROUND	INPUT
	18	ENGINE GROUND	GROUND	INPUT
	19	2WD VALVE GROUND	GROUND	INPUT
	20	TRACTION LOCK / 2WD VALVE	DIGITAL	OUTPUT
	21	UNUSED (TOWER ELEVATION SWITCH #2)	DIGITAL	INPUT
	22	GENERATOR ENABLE RELAY	DIGITAL	OUTPUT
	23	BRAKE VALVE	DIGITAL	OUTPUT
	24	UNUSED	N/C	N/C
	25	UNUSED (RESERVED FOR RS-485 HIGH)	SERIAL	I/O
	26	UNUSED (RESERVED FOR RS-485 LOW)	SERIAL	I/O
	27	BRAKE VALVE GROUND	GROUND	INPUT
	28	ANALYZER POWER	VOLTAGE	OUTPUT
	29	ANALYZER RS-232 RX	SERIAL	INPUT
	30	ANALYZER RS-232 TX	SERIAL	OUTPUT
	31	ANALYZER GROUND	GROUND	INPUT
	32	ALTERNATOR EXCITATION	DIGITAL	OUTPUT
	33	UNUSED (GROUND)	GROUND	INPUT
	34	UNUSED (TELESCOPE RETRACT SWTICH #2)	DIGITAL	INPUT
	35	UNUSED (CAPACITY LENGTH SWTICH #2)	DIGITAL	INPUT

Connector	Pin	Function	Type	
J2 (Gray)	1	STEER DUMP VALVE	DIGITAL	OUTPUT
	2	GROUND ALARM	DIGITAL	OUTPUT
	3	UNUSED (TOWER TELESCOPE IN VALVE)	DIGITAL	OUTPUT
	4	TELESCOPE IN VALVE	DIGITAL	OUTPUT
	5	PLATFORM LEVEL UP VALVE	DIGITAL	OUTPUT
	6	FUEL SENSOR GROUND	GROUND	INPUT
	7	PLATFORM LEVEL DOWN VALVE	DIGITAL	OUTPUT
	8	FRONT RIGHT STEER VALVE	DIGITAL	OUTPUT
	9	TOWER LIFT DOWN / TELESCOPE IN VALVE	DIGITAL	OUTPUT
	10	PLATFORM ROTATE LEFT VALVE	DIGITAL	OUTPUT
	11	LIFT UP VALVE	DIGITAL	OUTPUT
	12	JIB LIFT UP VALVE	DIGITAL	OUTPUT
	13	MAIN DUMP VALVE	DIGITAL	OUTPUT
	14	PLATFORM LEVEL / PLATFORM ROTATE / TELESCOPE VALVES GROUND	GROUND	INPUT
	15	UNUSED (TOWER TELESCOPE OUT VALVE)	DIGITAL	OUTPUT
	16	TELESCOPE OUT / TELESCOPE OUT DUMP VALVE	DIGITAL	OUTPUT
	17	TELESCOPE OUT DUMP VALVE GROUND	GROUND	INPUT
	18	STEER DUMP VALVE GROUND	GROUND	INPUT
	19	FRONT LEFT STEER VALVE	DIGITAL	OUTPUT
	20	TOWER LIFT UP / TELESCOPE OUT VALVE	DIGITAL	OUTPUT
	21	PLATFORM ROTATE RIGHT VALVE	DIGITAL	OUTPUT
	22	LIFT DOWN VALVE	DIGITAL	OUTPUT
	23	JIB LIFT DOWN VALVE	DIGITAL	OUTPUT
	24	UNUSED (CONFIGURATION #2)	DIGITAL	INPUT
	25	FUEL SENSOR SINGAL	ANALOG	INPUT
	26	HEAD / TAIL LIGHT ENABLE RELAY	DIGITAL	OUTPUT
	27	GROUND ALARM / HORN OUTPUT	DIGITAL	OUTPUT
	28	STEER VALVE GROUND	GROUND	INPUT
	29	GROUND ALARM GROUND	GROUND	INPUT
	30	MAIN DUMP VALVE GROUND	GROUND	INPUT
	31	FLOW CONTROL VALVE	DIGITAL	OUTPUT
	32	UNUSED (REAR STEER RIGHT VALVE)	DIGITAL	OUTPUT
	33	UNUSED (REAR STEER LEFT VALVE)	DIGITAL	OUTPUT
	34	SWING LEFT VALVE	DIGITAL	OUTPUT
	35	SWING RIGHT VALVE	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J3 (Black)	1	DRIVE CURRENT FEEDBACK	GROUND	INPUT
	2	THROTTLE ACTUATOR CURRENT FEEDBACK	GROUND	INPUT
	3	UNUSED (CABLE BRAKE SWITCH GROUND)	GROUND	INPUT
	4	SWING CURRENT FEEDBACK	GROUND	INPUT
	5	TOWER / TELESCOPE CURRENT FEEDBACK	GROUND	INPUT
	6	FLOW CONTROL VALVE CURRENT FEEDBACK	GROUND	INPUT
	7	GROUND ALARM POWER	VBAT	OUTPUT
	8	UNUSED (CABLE BRAKE SWITCH)	DIGITAL	INPUT
	9	CRIBBING ENABLE SWITCH	DIGITAL	INPUT
	10	UNUSED (INPUT)	DIGITAL	INPUT
	11	CONFIGURATION #1	DIGITAL	INPUT
	12	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	13	UNUSED (INPUT)	ANALOG	INPUT
	14	LIFT CURRENT FEEDBACK	GROUND	INPUT

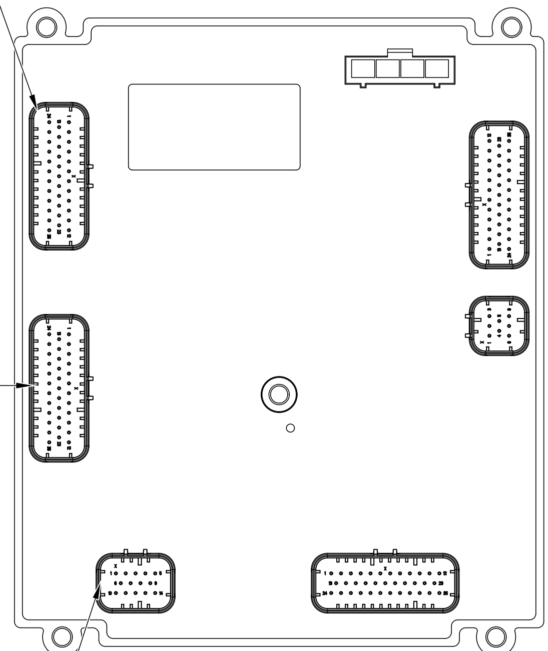


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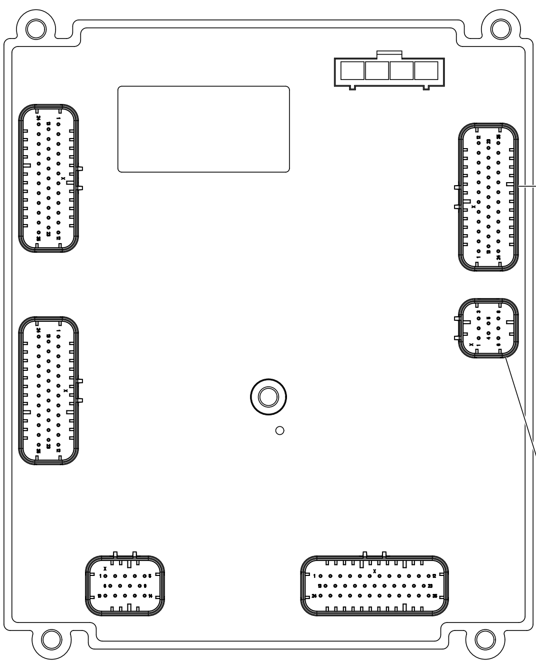
Figure 6-4. Ground Module - Sheet 2 of 4



Connector	Pin	Function	Type	
J7 (Black)	1	PLATFORM EMS	DIGITAL	INPUT
	2	PLATFORM MODE	DIGITAL	INPUT
	3	GROUND MODE	DIGITAL	INPUT
	4	BOOM ANGLE #1 SWITCH	ANALOG	INPUT
	5	SPEED SENSOR POWER	VOLTAGE	OUTPUT
	6	CAN1 TERMINATOR	TERM	I/O
	7	BOOM ANGLE #2 SWITCH	ANALOG	INPUT
	8	UNUSED (INPUT)	ANALOG	INPUT
	9	UNUSED (GROUND)	GROUND	INPUT
	10	UNUSED (TILT SENSOR GROUND)	GROUND	INPUT
	11	TOWER ELEVATION SWITCH	DIGITAL	INPUT
	12	OSCILLATING AXLE SWING SWITCH #1	DIGITAL	INPUT
	13	CAN1 HIGH	SERIAL	I/O
	14	GROUND MODE POWER TO PLATFORM	DIGITAL	INPUT
	15	FOOTSWITCH	DIGITAL	INPUT
	16	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	17	CAN1 TERMINATOR	TERM	I/O
	18	CAN1 SHIELD	GROUND	INPUT
	19	IGNITION RELAY GROUND	GROUND	INPUT
	20	OSCILLATING AXLE SWING SWITCH #2	ANALOG	INPUT
	21	TELESCOPE RETRACTED SWITCH #1	DIGITAL	INPUT
	22	TELESCOPE CUTBACK SWITCH	DIGITAL	INPUT
	23	UNUSED (CAPACITY LENGTH SWTICH #1)	DIGITAL	INPUT
	24	CAN1 LOW	SERIAL	I/O
	25	HOURMETER GROUND	GROUND	INPUT
	26	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	27	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	28	TELESCOPE RETRACTED SWITCH GROUND	GROUND	INPUT
	29	GROUND DISPLAY POWER	VBAT	OUTPUT
	30	GROUND ALARM POWER	VBAT	OUTPUT
	31	BOOM ELEVATION SWITCH POWER	VBAT	OUTPUT
	32	DOS SWITCH POWER	VBAT	OUTPUT
	33	TELESCOPE RETRACTED SWITCH POWER	VBAT	OUTPUT
	34	TELESCOPE CUTBACK SWITCH POWER	VBAT	OUTPUT
	35	DOS SWITCH	DIGITAL	INPUT

Connector	Pin	Function	Type	
J12 (Black)	1	UNUSED	FREQUENCY	INPUT
	2	UNUSED	FREQUENCY	INPUT
	3	CAN2 HIGH (TELEMATICS)	SERIAL	I/O
	4	CAN2 LOW (TELEMATICS)	SERIAL	I/O
	5	CAN2 SHIELD (TELEMATICS)	GROUND	INPUT
	6	CAN2 TERMINATOR	TERM	I/O
	7	CAN2 TERMINATOR	TERM	I/O
	8	UNUSED	DIGITAL	INPUT

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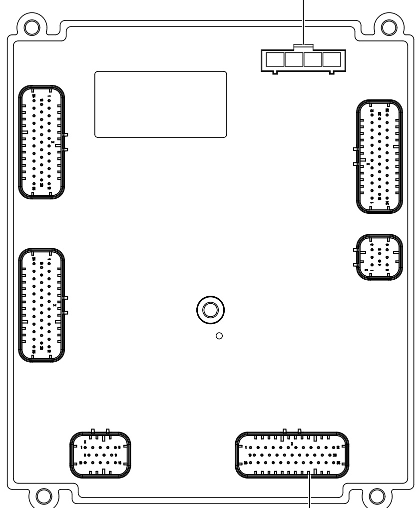
Figure 6-5. Ground Module - Sheet 3 of 4

Connector	Pin	Function	Type	
J12 (Black)	1	UNUSED	FREQUENCY	INPUT
	2	UNUSED	FREQUENCY	INPUT
	3	CAN2 HIGH (TELEMATICS)	SERIAL	I/O
	4	CAN2 LOW (TELEMATICS)	SERIAL	I/O
	5	CAN2 SHIELD (TELEMATICS)	GROUND	INPUT
	6	CAN2 TERMINATOR	TERM	I/O
	7	CAN2 TERMINATOR	TERM	I/O
	8	UNUSED	DIGITAL	INPUT



Connector	Pin	Function	Type	
J4 (Blue)	1	CRIBBING ENGAGED INDICATOR	DIGITAL	OUTPUT
	2	SYSTEM DISTRESS INDICATOR	DIGITAL	OUTPUT
	3	GLOWPLUG INDICATOR	DIGITAL	OUTPUT
	4	ENGINE START SWITCH	DIGITAL	INPUT
	5	PLATFORM LEVEL DOWN SWITCH	DIGITAL	INPUT
	6	PLATFORM ROTATE LEFT SWITCH	DIGITAL	INPUT
	7	MAIN TELESCOPE IN SWITCH	DIGITAL	INPUT
	8	JIB LIFT DOWN SWITCH	DIGITAL	INPUT
	9	UNUSED (JIB LEFT SWITCH)	DIGITAL	INPUT
	10	TOWER LIFT UP SWITCH	DIGITAL	INPUT
	11	UNUSED (TOWER TELESCOPE IN SWITCH)	DIGITAL	INPUT
	12	HOURMETER	DIGITAL	OUTPUT
	13	LOW FUEL INDICATOR	DIGITAL	OUTPUT
	14	PLATFORM OVERLOADED INDICATOR	DIGITAL	OUTPUT
	15	UNUSED (BOOM MALFUNCTION INDICATOR)	DIGITAL	OUTPUT
	16	AUXILIARY POWER / FUNCTION ENABLE SWITCH	DIGITAL	INPUT
	17	PLATFORM LEVEL UP SWITCH	DIGITAL	INPUT
	18	PLATFORM ROTATE RIGHT SWITCH	DIGITAL	INPUT
	19	JIB LIFT UP SWITCH	DIGITAL	INPUT
	20	UNUSED (JIB RIGHT SWITCH)	DIGITAL	INPUT
	21	TOWER LIFT DOWN SWITCH	DIGITAL	INPUT
	22	UNUSED (TOWER TELESCOPE OUT SWITCH)	DIGITAL	INPUT
	23	LIFT UP SWITCH	DIGITAL	INPUT
	24	UNUSED (BATTERY VOLTAGE)	VBAT	OUTPUT
	25	SWITCHES POWER	VBAT	OUTPUT
	26	BATTERY LOW / NOT CHARGING INDICATOR	DIGITAL	OUTPUT
	27	UNUSED (OUTPUT)	DIGITAL	OUTPUT
	28	ENGINE HIGH COOLANT TEMPERATURE INDICATOR	DIGITAL	OUTPUT
	29	ENGINE LOW OIL PRESSURE INDICATOR	DIGITAL	OUTPUT
	30	TELESCOPE OUT SWITCH	DIGITAL	INPUT
	31	INDICATORS GROUND	GROUND	INPUT
	32	UNUSED (GROUND)	GROUND	INPUT
	33	LIFT DOWN SWITCH	DIGITAL	INPUT
	34	SWING LEFT SWITCH	DIGITAL	INPUT
	35	SWING RIGHT SWITCH	DIGITAL	INPUT

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Figure 6-6. Ground Module - Sheet 4 of 4

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J8	1	MODULE GROUND	GROUND
	2	MODULE POWER	BATTERY VOLTAGE

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J5 NATURAL	1	LIFT / SWING JOYSTICK POWER	SUPPLY VOLTAGE
	2	LIFT CENTER TAP	INPUT
	3	LIFT SIGNAL	INPUT
	4	SWING SIGNAL	INPUT
	5	SWING CENTER TAP	INPUT
	6	UNUSED	INPUT
	7	LIFT / SWING JOYSTICK GROUND	GROUND
	8	UNUSED (GROUND)	GROUND

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J6 BLACK	1	DRIVE / STEER JOYSTICK POWER	SUPPLY VOLTAGE
	2	DRIVE CENTER TAP	INPUT
	3	DRIVE SIGNAL	INPUT
	4	STEER SIGNAL	INPUT
	5	STEER LEFT	INPUT
	6	STEER RIGHT	INPUT
	7	DRIVE / STEER JOYSTICK GROUND	GROUND
	8	UNUSED (GROUND)	GROUND

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J7 BLACK	1	GROUND MODE	GROUND MODE
	2	PLATFORM EMS	PLATFORM EMS
	3	PLATFORM EMS TO GROUND MODULE	PLATFORM MODE
	4	FOOTSWITCH POWER	BATTERY VOLTAGE
	5	GENERATOR SWITCH POWER	BATTERY VOLTAGE
	6	UNUSED (JIB BLOCK LIMIT SWITCH POWER)	BATTERY VOLTAGE
	7	SKYGUARD POWER	BATTERY VOLTAGE
	8	FOOTSWITCH DISENGAGE	DIGITAL INPUT
	9	GENERATOR SWITCH	DIGITAL INPUT
	10	UNUSED (+7 VOLTS)	+7 REFERENCE VOLTAGE
	11	UNUSED	ANALOG INPUT
	12	UNUSED	ANALOG INPUT
	13	UNUSED	ANALOG INPUT
	14	UNUSED (GROUND)	GROUND
	15	UNUSED (+7 VOLTS)	+7 REFERENCE VOLTAGE
	16	LSS GROUND	GROUND
	17	UNUSED (JIB BLOCK LIMIT SWITCH)	HS DIGITAL INPUT
	18	SKYGUARD INPUT #1 SWITCH	HS DIGITAL INPUT
	19	PLATFORM ALARM	LAMP OUTPUT
	20	PLATFORM ALARM GROUND	GROUND
	21	UNUSED (PLATFORM LEVEL UP VALVE)	ME DIGITAL OUTPUT
	22	UNUSED (PLATFORM LEVEL DOWN VALVE)	ME DIGITAL OUTPUT
	23	VALVES GROUND	GROUND
	24	SKYGUARD GROUND	GROUND
	25	JIB UP VALVE	ME DIGITAL OUTPUT
	26	JIB DOWN VALVE	ME DIGITAL OUTPUT
	27	UNUSED (JIB RIGHT VALVE)	ME DIGITAL OUTPUT
	28	UNUSED (JIB LEFT VALVE)	ME DIGITAL OUTPUT
	29	OPTION GROUND	GROUND
	30	CAN LOW	CAN LOW
	31	CAN HIGH	CAN HIGH
	32	CAN SHIELD	CAN SHIELD
	33	PLATFORM ROTATE LEFT VALVE	ME DIGITAL OUTPUT
	34	PLATFORM ROTATE RIGHT VALVE	ME DIGITAL OUTPUT
	35	UNUSED (GROUND)	GROUND

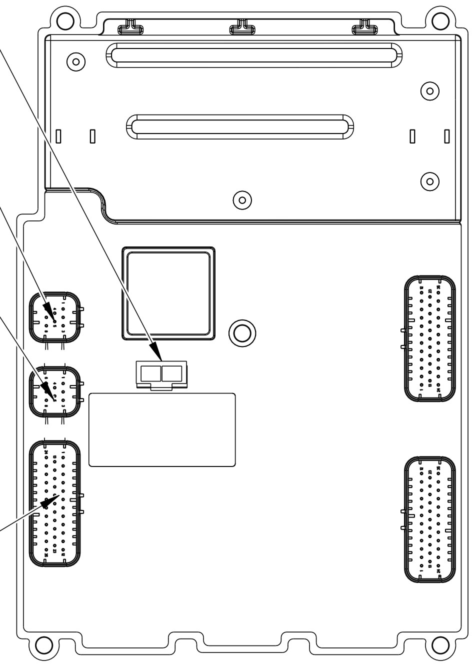

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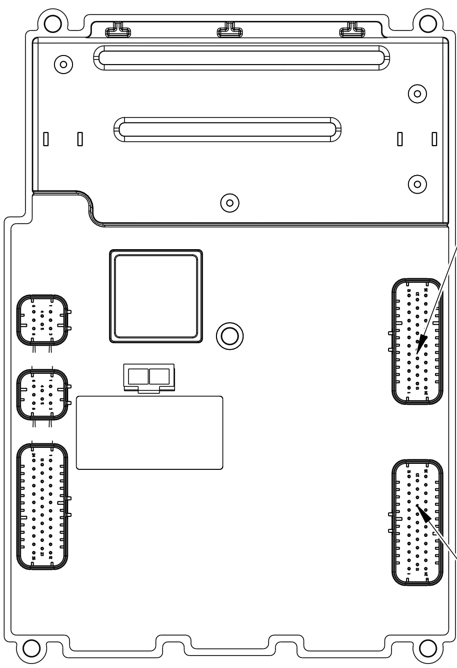
Figure 6-7. Platform Module - Sheet 1 of 2



CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J2 GRAY	1	UNUSED (JIB RIGHT SWITCH)	DIGITAL INPUT
	2	UNUSED (JIB LEFT SWITCH)	DIGITAL INPUT
	3	UNUSED (POWER)	HS DIGITAL INPUT
	4	DOS OVERRIDE SWITCH	HS DIGITAL INPUT
	5	UNUSED	LAMP OUTPUT
	6	CHASSIS TILTED INDICATOR	LAMP OUTPUT
	7	FUNCTION ENABLE INDICATOR	LAMP OUTPUT
	8	VEHICLE SYSTEM DISTRESS INDICATOR	LAMP OUTPUT
	9	CREEP SPEED INDICATOR	LAMP OUTPUT
	10	UNUSED (BROKEN CABLE INDICATOR)	LAMP OUTPUT
	11	PLATFORM OVERLOADED INDICATOR	LAMP OUTPUT
	12	500 / 600 LB CAPACITY INDICATOR	LAMP OUTPUT
	13	1000 LB CAPACITY INDICATOR	LAMP OUTPUT
	14	DOS INDICATOR	LAMP OUTPUT
	15	GENERATOR ON INDICATOR	LAMP OUTPUT
	16	SOFT TOUCH / SKYGUARD INDICATOR	LAMP OUTPUT
	17	GLOW PLUG ENGAGED INDICATOR	LAMP OUTPUT
	18	INDICATOR GROUND	GROUND
	19	UNUSED (LOW BATTERY INDICATOR)	LAMP OUTPUT
	20	UNUSED	LAMP OUTPUT
	21	LOW FUEL INDICATOR	LAMP OUTPUT
	22	1/4 FUEL LEVEL INDICATOR	LAMP OUTPUT
	23	3/4 FUEL LEVEL INDICATOR	LAMP OUTPUT
	24	1/2 FUEL LEVEL INDICATOR	LAMP OUTPUT
	25	INDICATOR GROUND	GROUND
	26	ANALYZER POWER	ANALYZER POWER
	27	ANALYZER GROUND	ANALYZER GROUND
	28	ANALYZER RX	ANALYZER RX
	29	ANALYZER TX	ANALYZER TX
	30	UNUSED (POWER)	BATTERY VOLTAGE
	31	SOFT TOUCH POWER	BATTERY VOLTAGE
	32	LSS POWER	BATTERY VOLTAGE
	33	OPTION POWER	BATTERY VOLTAGE
	34	UNUSED (POWER)	BATTERY VOLTAGE
	35	FULL FUEL LEVEL INDICATOR	LAMP OUTPUT

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J1 NATURAL	1	TOWER LIFT UP SWITCH	DIGITAL INPUT
	2	TOWER LIFT DOWN SWITCH	DIGITAL INPUT
	3	UNUSED (TOWER TELESCOPE IN SWITCH)	DIGITAL INPUT
	4	UNUSED (TOWER TELESCOPE OUT SWITCH)	DIGITAL INPUT
	5	MAIN TELESCOPE IN SWITCH	DIGITAL INPUT
	6	MAIN TELESCOPE OUT SWITCH	DIGITAL INPUT
	7	PLATFORM ROTATE RIGHT SWITCH	DIGITAL INPUT
	8	PLATFORM ROTATE LEFT SWITCH	DIGITAL INPUT
	9	PLATFORM LEVEL UP SWITCH	DIGITAL INPUT
	10	PLATFORM LEVEL DOWN SWITCH	DIGITAL INPUT
	11	JIB LIFT UP SWITCH	DIGITAL INPUT
	12	JIB LIFT DOWN SWITCH	DIGITAL INPUT
	13	SPEED PUMP POTENTIOMETER GROUND	GROUND
	14	ENGINE START SWITCH	DIGITAL INPUT
	15	AUXILIARY POWER SWITCH	DIGITAL INPUT
	16	UNUSED (CRAB STEER SELECT SWITCH)	DIGITAL INPUT
	17	UNUSED (COORDINATED STEER SELECT SWITCH)	DIGITAL INPUT
	18	SWITCH POWER	BATTERY VOLTAGE
	19	UNUSED	DIGITAL INPUT
	20	SOFT TOUCH SWITCH	DIGITAL INPUT
	21	UNUSED (CAPACITY SELECT SWITCH)	DIGITAL INPUT
	22	UNUSED	DIGITAL INPUT
	23	SKYGUARD INPUT #2 SWITCH	DIGITAL INPUT
	24	UNUSED	DIGITAL INPUT
	25	UNUSED	DIGITAL INPUT
	26	UNUSED	DIGITAL INPUT
	27	MAX SPEED SWITCH	DIGITAL INPUT
	28	MAX TORQUE SWITCH	DIGITAL INPUT
	29	SOFT TOUCH / SKYGUARD OVERRIDE BUTTON	DIGITAL INPUT
	30	HEAD / TAIL LIGHT SWITCH	DIGITAL INPUT
	31	HORN BUTTON	DIGITAL INPUT
	32	CREEP SWITCH	DIGITAL INPUT
	33	FUEL SELECT SWITCH	DIGITAL INPUT
	34	SPEED PUMP POTENTIOMETER POWER	+7 REFERENCE VOLTAGE
	35	SPEED PUMP POTENTIOMETER SIGNAL	DIGITAL INPUT

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Figure 6-8. Platform Module - Sheet 2 of 2

6.4 OPERATOR CONTROLS AND SWITCHES

Ground Control Switches

The Ground Control Station has switches that allow the operator to start the engine and activate boom functions.

Table 6-2. Ground Control Switch Inputs

Switch	Function	Ground Module Input
Engine Start and Aux/Function Enable	Engine Start	J4-4
	Aux/Function Enable	J4-16
Swing	Left	J4-34
	Right	J4-35
Tower Lift	Up	J4-10
	Down	J4-21
Lift	Up	J4-23
	Down	J4-33
Telescope	In	J4-7
	Out	J4-30
Jib Lift	Up	J4-19
	Down	J4-8
Platform Level	Up	J4-17
	Down	J4-5
Platform Rotate	Left	J4-6
	Right	J4-18

Platform Control Switches

The Platform Control Station has switches which allow the operator to operate boom, engine, and drive functions.

PROPORTIONAL JOYSTICKS

Table 6-3. Platform Control Joystick Inputs

Control	Function	Platform Module Input
Lift/Swing Joystick	Lift	J5-3
	Swing	J5-4
Drive/Steer Joystick	Drive	J6-3
	Steer Left	J6-5
	Steer Right	J6-6

TOGGLE SWITCHES

Table 6-4. Platform Control Switch Inputs

Switch	Function	Platform Module Input
Tower Lift	Up	J1-1
	Down	J1-2
Telescope	In	J1-5
	Out	J1-6
Jib Lift	Up	J1-11
	Down	J1-12
Platform Level	Up	J1-9
	Down	J1-10
Platform Rotate	Left	J1-8
	Right	J1-7
Engine Start and Aux Descent Enable	Engine Start	J1-14
	Aux Descent Enable	J1-15
Drive Speed	Max Speed	J1-27
	Max Torque	J1-28
Drive Orientation Override	Drive Orientation Override	J2-4
Horn	Horn	J1-31

6.5 CONTROL SYSTEM STARTUP CHECKS

The following actions and checks are performed during system startup:

- Inhibit all hydraulic functions
- Energize all Ground and Platform Station indicators and energize the Platform Alarm.
- Perform assessments as shown in Table 6-5, System Startup Checks.

Table 6-5. System Startup Checks

Item Checked	Function	Condition/Action
NOTE: In this table, abbreviations STB=Short To Battery, STG=Short to Ground, and OC=Open Circuit.		
System Communications		
CAN Bus 1	Ground Module and Platform module to perform successful CAN Bus communication	Successful communication
	Verify healthy CAN Bus and presence of Platform Module	Successful communication
	If applicable, confirm presence of LSS system	Successful communication
CAN Bus 2	If applicable, confirm presence of ECU	Successful communication
Ground Station		
Digital and Functional Switch Inputs	Engine Start	Open; de-energized
	Function Enable	Open; de-energized
	Swing Left	Open; de-energized
	Swing Right	Open; de-energized
	Tower Lift Up	Open; de-energized
	Tower Lift Down	Open; de-energized
	Lift Up	Open; de-energized
	Lift Down	Open; de-energized
	Telescope In	Open; de-energized
	Telescope Out	Open; de-energized
	Jib Up	Open; de-energized
	Jib Down	Open; de-energized
	Level Up	Open; de-energized
	Level Down	Open; de-energized
	Rotate Left	Open; de-energized
	Rotate Right	Open; de-energized

Table 6-5. System Startup Checks

Item Checked	Function	Condition/Action
Valve and Actuator Outputs	Engine Proportional Throttle Actuator	No STB/OC No STG; energize and verify current path
	Engine High Speed Throttle Actuator	No STB/OC for relay No STG; energize to verify
	Drive Forward Valve	No STB/OC No STG; energize and verify current path
	Drive Reverse Valve	No STB/OC No STG; energize and verify current path
	Swing Left Valve	No STB/OC No STG; energize and verify current path
	Swing Right Valve	No STB/OC No STG; energize and verify current path
	Tower Lift Up Valve	No STB/OC No STG; energize and verify current path
	Tower Lift Down Valve	No STB/OC Do not check STG
	Lift Up Valve	No STB/OC No STG; energize and verify current path
	Lift Down Valve	No STB/OC Do not check STG
	Flow Control Valve	No STB/OC No STG; energize and verify current path
	Telescope In Valve	No STB/OC No STG; energize Tele In and Out simultaneously
	Telescope Out Valve	No STB/OC No STG; energize Tele In and Out simultaneously
	Level Up Valve	No STB/OC No STG; energize Level Up and Down simultaneously
	Level Down Valve	No STB/OC No STG; energize Level Up and Down simultaneously
Platform Station		
Digital and Functional Switch Inputs (Platform Module communicates and Ground Module verifies)	Engine Start	Open; de-energized
	Emergency Descent	Open; de-energized
	Drive Speed Select	Open or Closed, but not both Max Speed and Max Torque
	Horn	Open; de-energized
	Tower Lift Up	Open; de-energized
	Tower Lift Down	Open; de-energized
	Telescope In	Open; de-energized
	Telescope Out	Open; de-energized
	Jib Up	Open; de-energized
	Jib Down	Open; de-energized
	Level Up	Open; de-energized
	Level Down	Open; de-energized
	Rotate Left	Open; de-energized
	Rotate Right	Open; de-energized

Table 6-5. System Startup Checks

Item Checked	Function	Condition/Action
Valve and Actuator Inputs	Jib Up Valve	No STB/OC No STG; energize Jib Up
	Jib Down Valve	No STB/OC Do not check STG
	Rotate Left Valve	No STB/OC No STG; energize Rotate Left and Right simultaneously
	Rotate Right Valve	No STB/OC No STG; energize Rotate Left and Right simultaneously

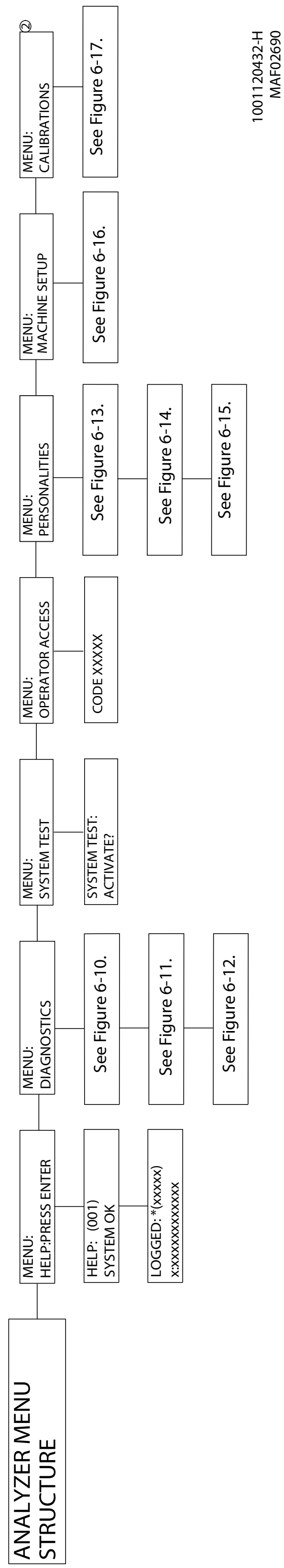

Figure 6-9. Analyzer Top Level Menu (Software Version P2.1)

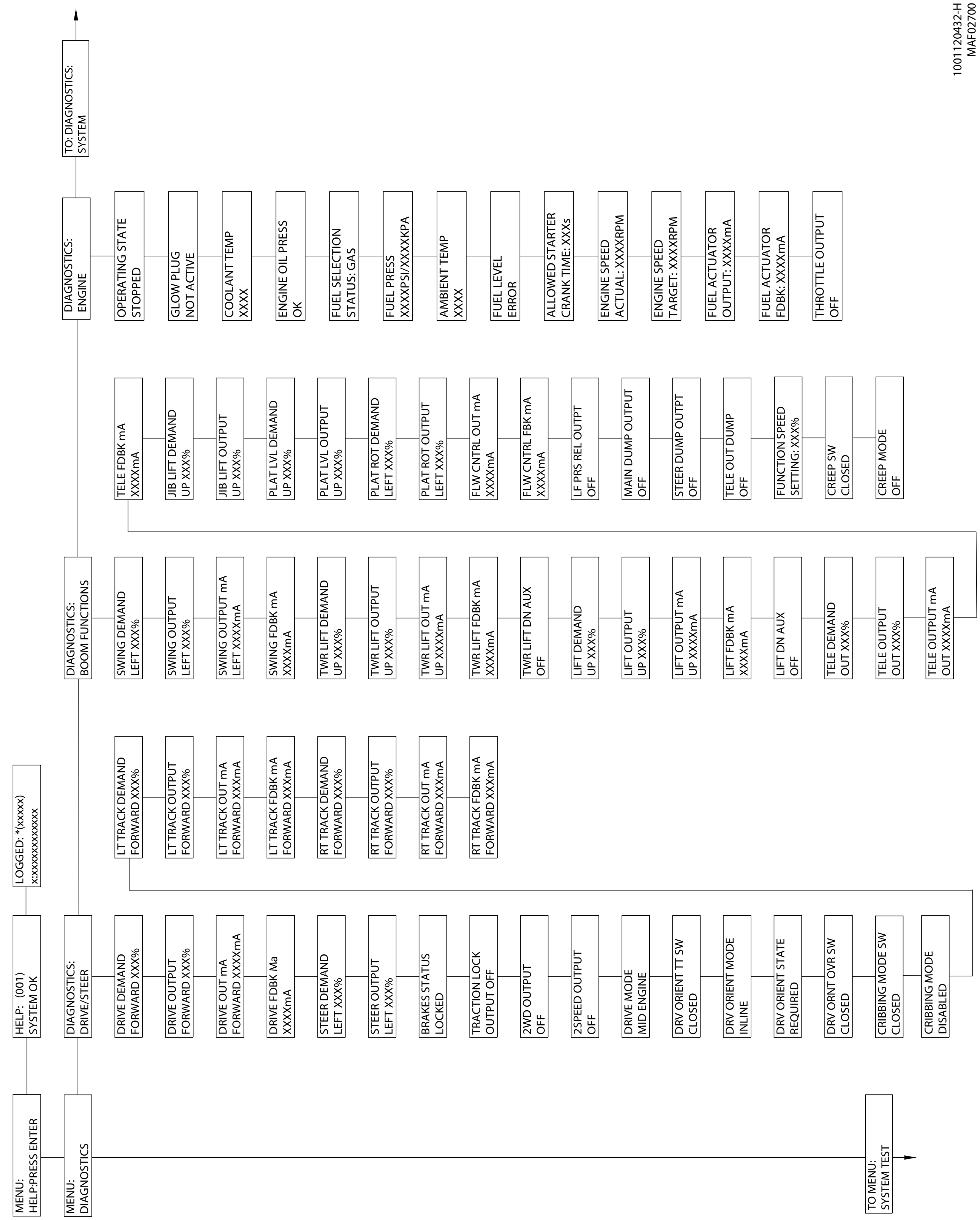

Figure 6-10. Analyzer Diagnostics Menu - Sheet 1 of 3 (Software Version P2.1)

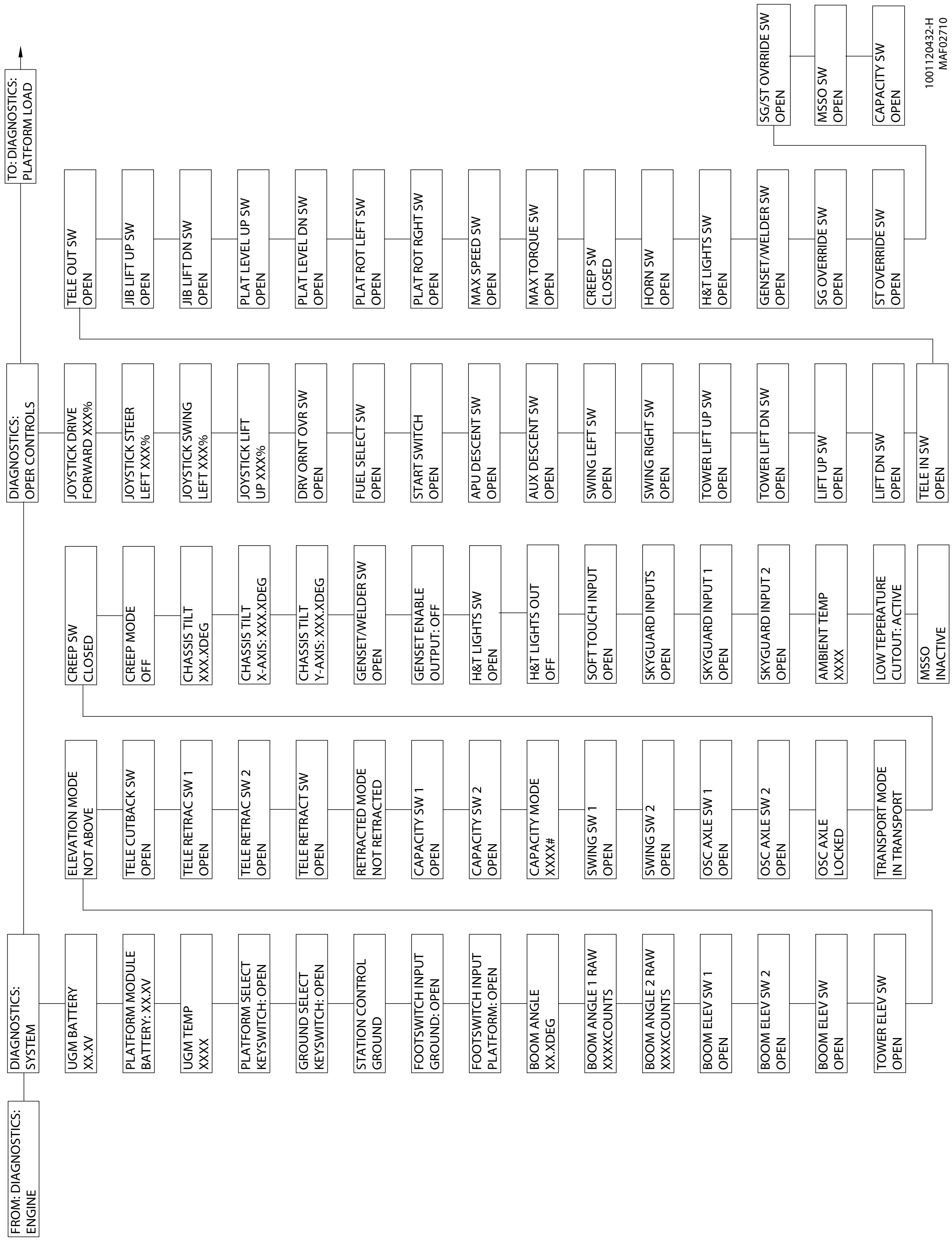

Figure 6-11. Analyzer Diagnostics Menu - Sheet 2 of 3 (Software Version P2.1)

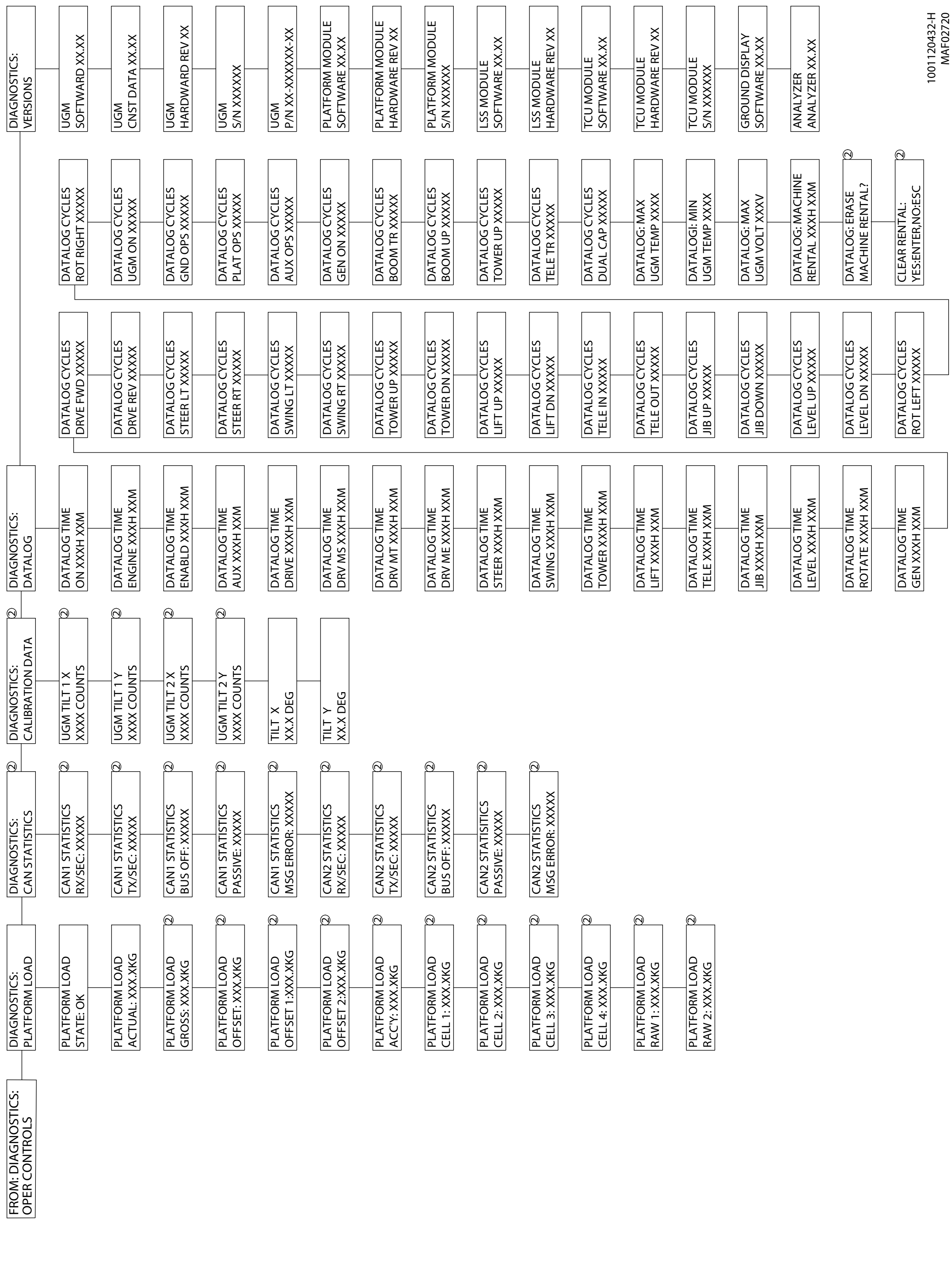

Figure 6-12. Analyzer Diagnostics Menu - Sheet 3 of 3 (Software Version P2.1)

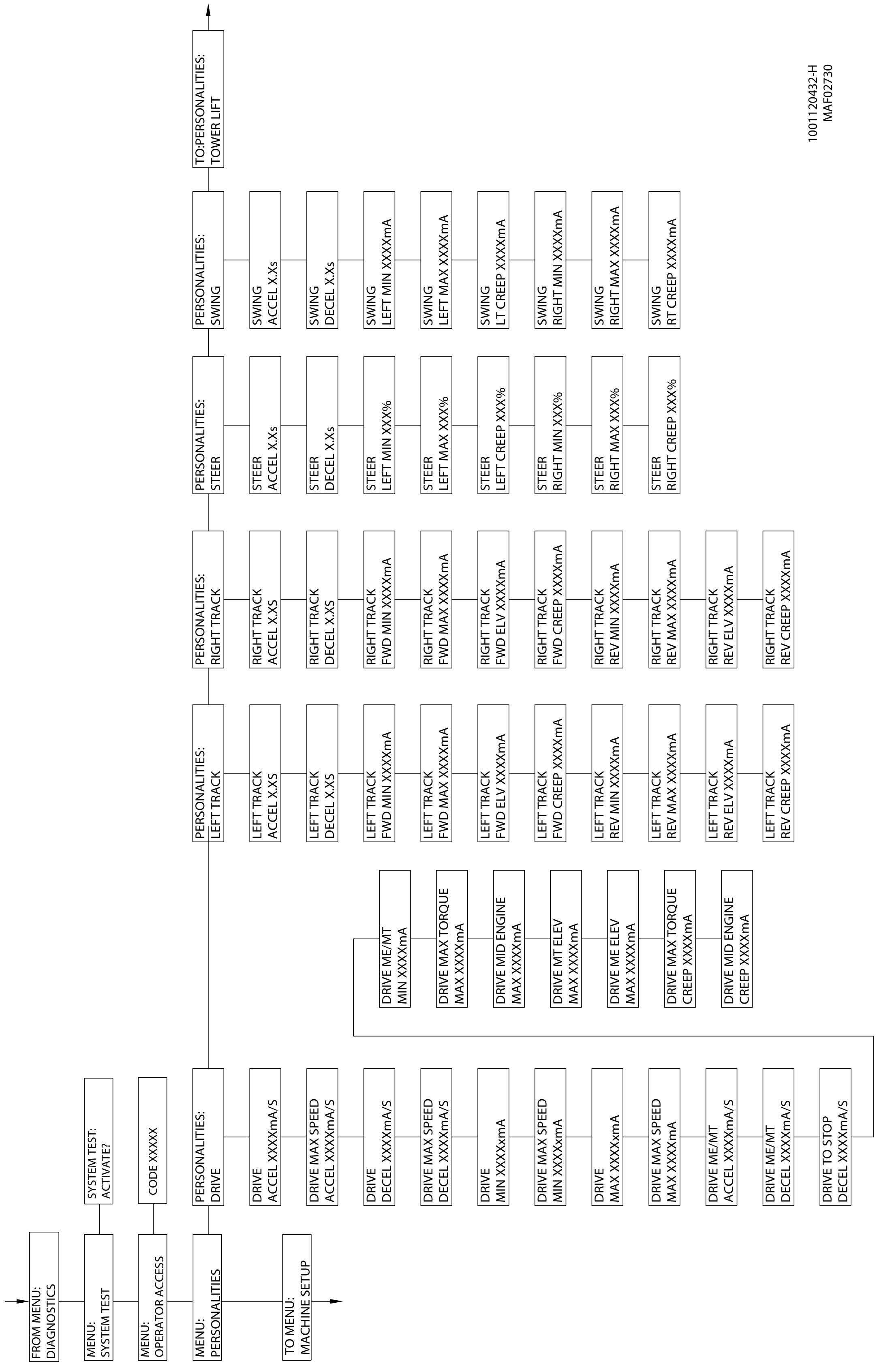

Figure 6-13. Analyzer Personalities Menu - Sheet 1 of 3 (Software Version P2.1)

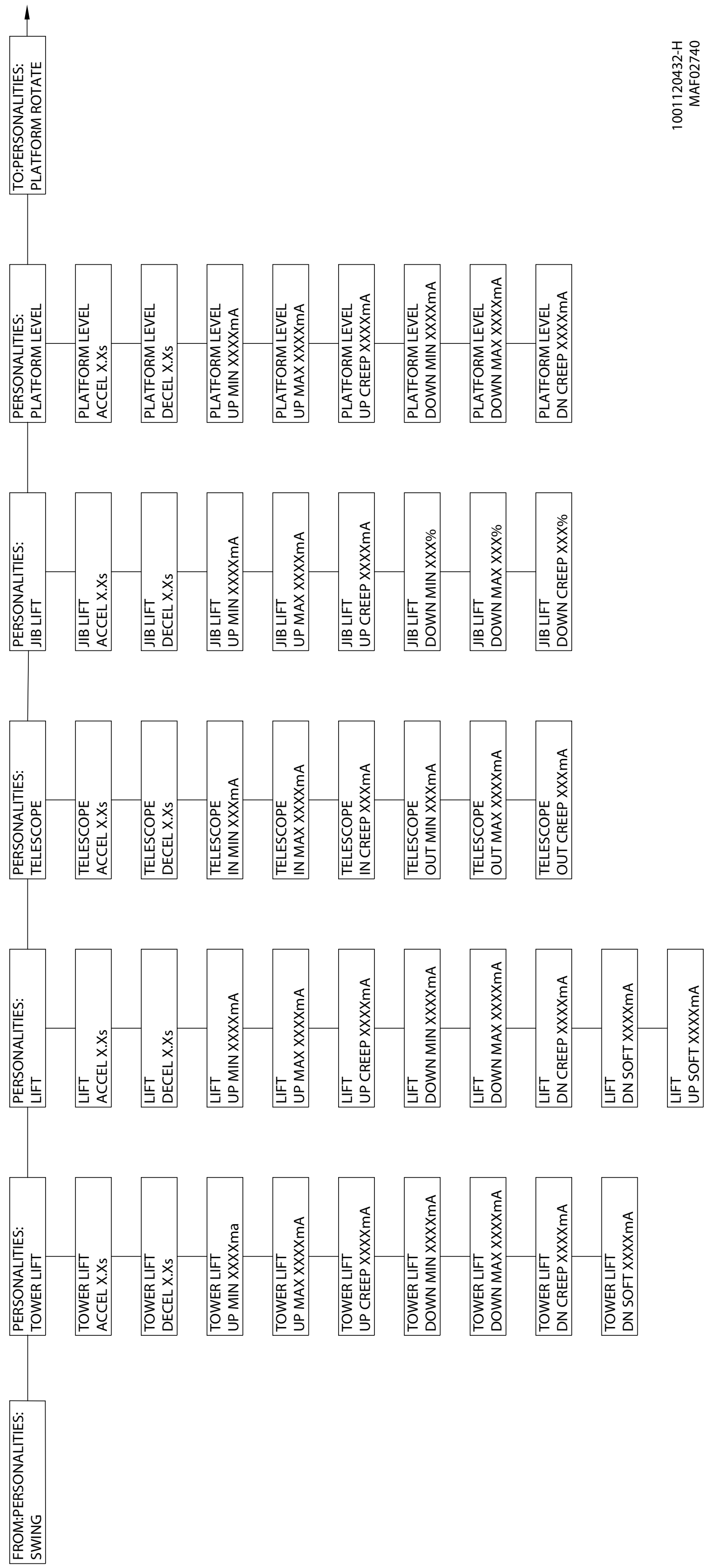

Figure 6-14. Analyzer Personalities Menu - Sheet 2 of 3 (Software Version P2.1)

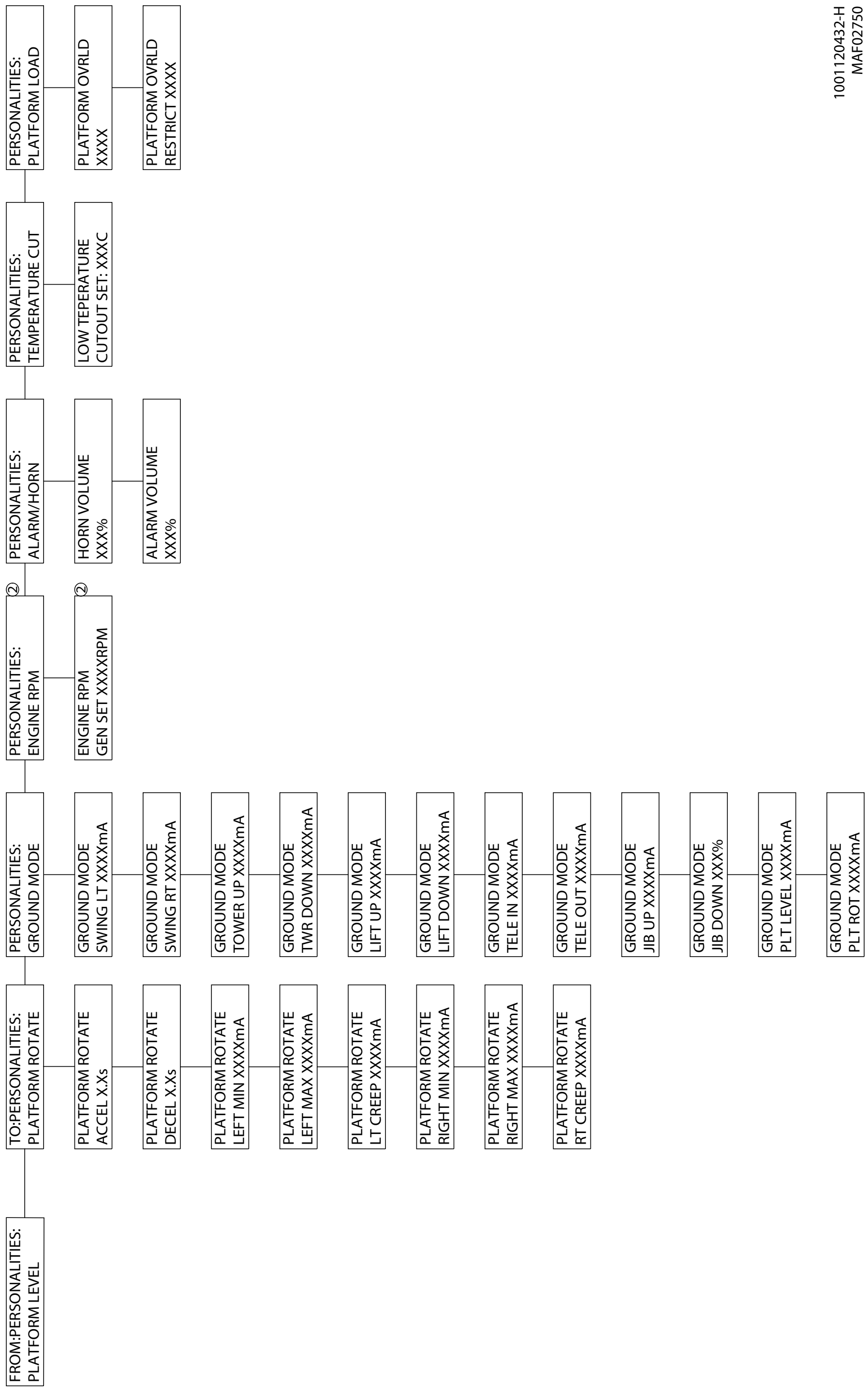

Figure 6-15. Analyzer Personalities Menu - Sheet 3 of 3 (Software Version P2.1)

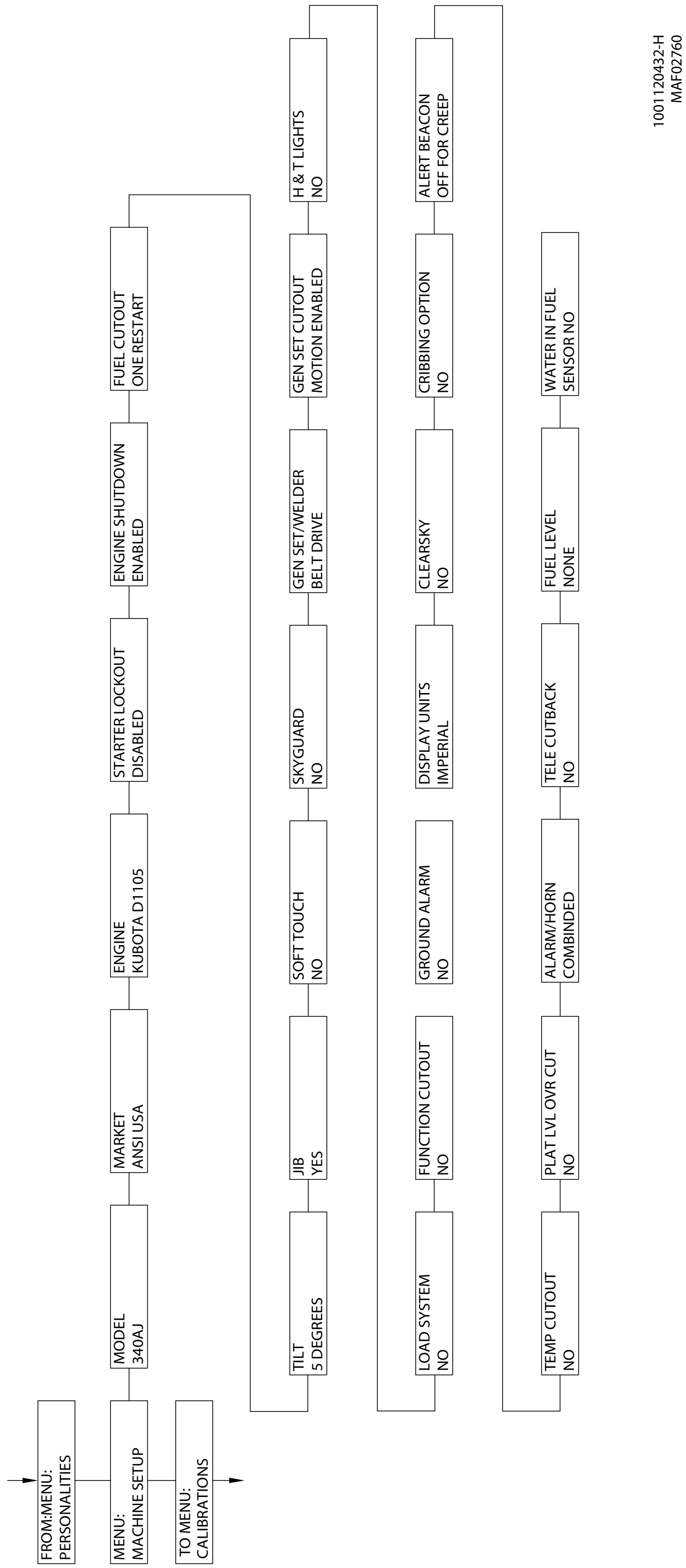

Figure 6-16. Analyzer Machine Setup Menu (Software Version P2.1)

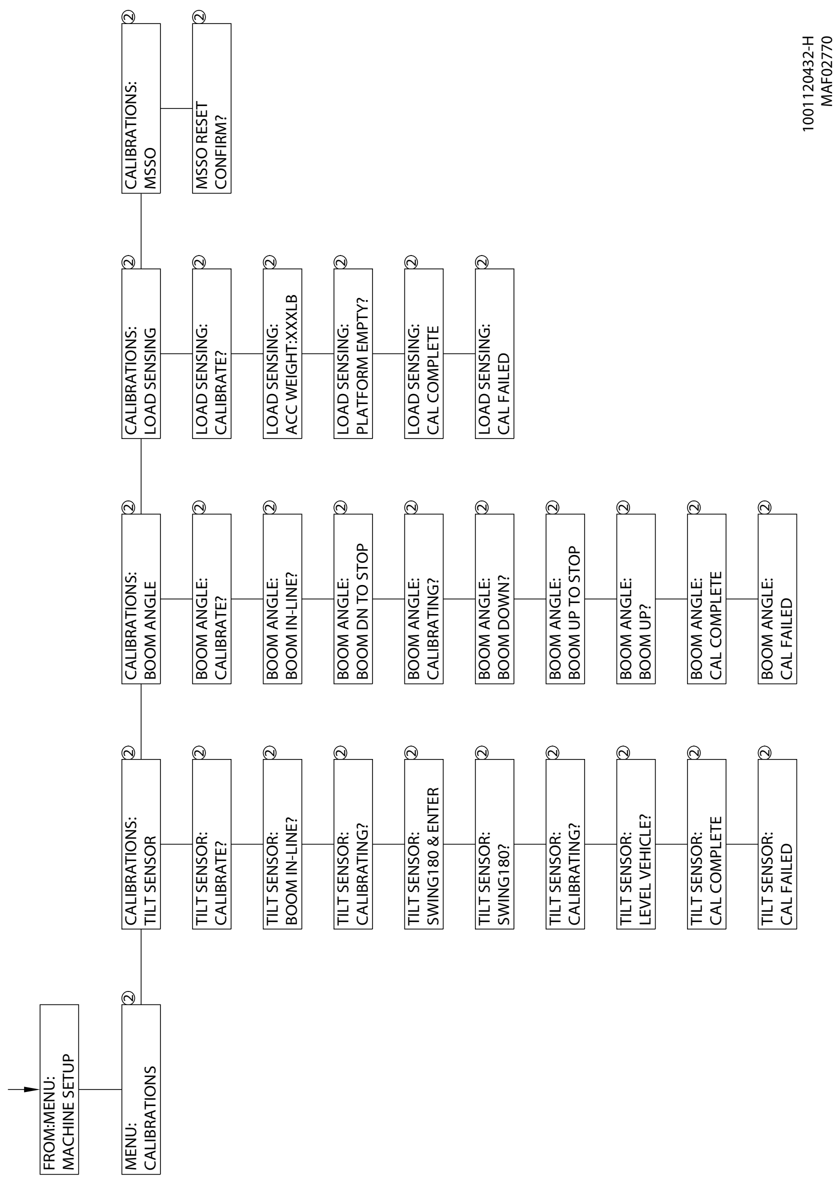

Figure 6-17. Analyzer Calibrations Menu (Software Version P2.1)

Table 6-6. Machine Model Adjustment

Adjustment		Adjustment Ranges	Default Setting	Model Time Ranges (In Seconds)
DRIVE	Max Speed Accel	25 - 2000mA/sec	275mA/sec	
	Max Speed Decel	25 - 2000mA/sec	175mA/sec	
	Max Speed Min	250 - 1800mA	635mA	
	Max Speed Max	250 - 1800mA	1500mA	42-47
	Mid-Engine/Max Torque Accel	25 - 2000mA/sec	300mA/sec	
	Mid-Engine/Max Torque Decel	25 - 2000mA/sec	100mA/sec	
	Drive to Stop Decel	25-2000mA/sec	1075mA/sec	
	Drive Mid-Engine/Max Torque Min	250 - 1800mA	640mA	
	Max Torque Max	250 - 1800mA	1100mA	
	Mid-Engine Max	250 - 1800mA	1135mA	
	Max Torque Elevated	250 - 850mA	790mA	57-85
	Mid-Engine Elevated	250 - 975mA	900mA	57-85
	Max Torque Creep	250 - 750mA	725mA	
	Mid-Engine Creep	250 - 900mA	850mA	
STEER	Accel	0.0 - 5.0sec	0.3sec	
	Decel	0.0 - 5.0sec	0.1sec	
	Min Right	10-100%	35%	
	Max Right	10-100%	80%	
	Creep Right	10-100%	50%	
	Min Left	10-100%	35%	
	Max Left	10-100%	80%	
	Creep Left	10-100%	50%	
SWING	Accel	0.0 - 5.0sec	2.2sec	
	Decel	0.0 - 5.0sec	1.2sec	
	Min Left	250 - 1400mA	400mA	
	Max Left	250 - 1400mA	880mA	58-72
	Creep Left	250 - 1400mA	600mA	
	Min Right	250 - 1400mA	400mA	
	Max Right	250 - 1400mA	880mA	58-72
	Creep Right	250 - 1400mA	600mA	
TOWER LIFT	Accel	0.0 - 5.0sec	3.0sec	
	Decel	0.0 - 5.0sec	1.0sec	
	Min Up	250 - 1400mA	400mA	
	Max Up	250 - 1400mA	1250mA	15-21
	Creep Up	250 - 1400mA	600mA	
	Min Down	250 - 1400mA	400mA	
	Max Down	250 - 1400mA	750mA	14-20
	Creep Down	250 - 1400mA	450mA	
	Soft Down	250 - 1400mA	450mA	

Table 6-6. Machine Model Adjustment

Adjustment		Adjustment Ranges	Default Setting	Model Time Ranges (In Seconds)
LIFT	Accel	0.0 - 5.0sec	2.0sec	
	Decel	0.0 - 5.0sec	1.0sec	
	Min up	250 - 1400mA	400mA	
	Max Up	250 - 1400mA	1250mA	19-25
	Creep Up	250 - 1400mA	525mA	
	Min Down	250 - 1400mA	400mA	
	Max Down	250 - 1400mA	850mA	13-19
	Creep Down	250 - 1400mA	500mA	
	Soft Down	250 - 1400mA	500mA	
TELESCOPE	Accel	0.0 - 5.0sec	1.2sec	
	Decel	0.0 - 5.0sec	0.5sec	
	Min In	250 - 1400mA	400mA	
	Max In	250 - 1400mA	1250mA	15-21
	Creep In	250 - 1400mA	675mA	
	Min Out	250 - 1400mA	400mA	
	Max Out	250 - 1400mA	1250mA	12-18
	Creep Out	250 - 1400mA	675mA	
JIB LIFT	Accel	0.0 - 5.0sec	1.2sec	
	Decel	0.0 - 5.0sec	0.5sec	
	Min Up	250 - 1400mA	400mA	
	Max Up	250 - 1400mA	1075mA	25-32
	Creep Up	250 - 1400mA	575mA	
	Min Down	10 - 70%	32%	
	Max Down	10 - 70%	53%	17-23
	Creep Down	10 - 70%	48%	
PLATFORM LEVEL	Accel	0.0 - 5.0sec	0.0sec	
	Decel	0.0 - 5.0sec	0.0sec	
	Min Up	250 - 1400mA	400mA	
	Max Up	250 - 1400mA	1250mA	
	Creep Up	250 - 1400mA	550mA	
	Min Down	250 - 1400mA	400mA	
	Max Down	250 - 1400mA	1250mA	
	Creep Down	250 - 1400mA	550mA	
PLATFORM ROTATE	Accel	0.0 - 5.0sec	0.0sec	
	Decel	0.0 - 5.0sec	0.0sec	
	Min Left	250 - 1400mA	400mA	
	Max Left	250 - 1400mA	1250mA	23-34
	Creep Left	250 - 1400mA	1250mA	
	Min Right	250 - 1400mA	400mA	
	Max Right	250 - 1400mA	1250mA	23-34
	Creep Right	250 - 1400mA	1250mA	

Table 6-6. Machine Model Adjustment

Adjustment		Adjustment Ranges	Default Setting	Model Time Ranges (In Seconds)
GROUND MODE	Swing	250 - 1400mA	875mA	
	Tower Up	250 - 1400mA	1245mA	
	Tower Down	250 - 1400mA	745mA	
	Lift Up	250 - 1400mA	1245mA	
	Lift Down	250 - 1400mA	845mA	
	Telescope	250 - 1400mA	1245mA	
	Jib Up	250 - 1400mA	1070mA	
	Jib Down	10 - 70%	52%	
	Platform Level	250 - 1400mA	1245mA	
	Platform Rotate	250 - 1400mA	1245mA	

NOTE: *Personality settings can be adjusted anywhere within the adjustment range in order to achieve optimum machine performance.*

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Table 6-7. Machine Configuration Programing Information (Software Version P2.1)

Configuration Label/Digit	Number	Description	Default Number
The machine configuration must be completed before any personality settings can be changed. Changing the personality settings first and then changing the model number of the machine configuration will cause the personality settings to return to default.			
MODEL NUMBER: 1	0	Visible only on a Non-Configured UGM	
	1	**340AJ**	**1**
	2	18RS	
	3	24RS	
MARKET: 2*	**1**	**ANSI USA**	**1**
	2	ANSI EXPORT	
	3	CSA	
	4	CE	
	5	AUSTRALIA	
	6	JAPAN	
	7	GB	
* Certain model selections will limit market options.			
ENGINE: 3*	**1**	**KUBOTA D1105**	**1**
	2	GM DUAL FUEL: GM/PSI 0.97L Dual Fuel (Tier 3)	
	3	KUBOTA DUAL FUEL	
	4	Deutz EMR2 (Tier 4i)	
	5	Deutz EMR4(Tier 4f)	
*Only visible under certain model selections. * Certain model selections will limit engine options. * Certain market selections will limit engine options.			
FLYWHEEL TEETH: 4*	**1**	**98 TEETH: 98 flywheel teeth.**	**1**
* This menu item is not visible			
GLOW PLUG:	1	NO GLOW PLUGS: No glow plugs installed.	
5*	**2**	**IN-CYLINDER: Glow plugs installed in each cylinder.**	**2**
* This menu item is not visible			

Table 6-7. Machine Configuration Programing Information (Software Version P2.1)

Configuration Label/Digit	Number	Description	Default Number
STARTER LOCKOUT: 6*	**1** 2	**DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.** ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	**1**
* Only visible for Engine Selection = Kubota D1105, Deutz EMR2 or Deutz EMR4.			
ENGINE SHUTDOWN: 7	1 **2**	DISABLED: No engine shutdown. **ENABLED: Shutdown engine for high coolant temperature fault or low oil pressure fault.**	**2**
FUEL CUTOUT: 8*	1 2 3 **4**	ONE RESTART: One restart with limited run time when near Empty. ENGINE STOP: No starting permitted when near Empty. NONE **RESTART: Restarts allowed with limited run time when near Empty.**	**4**
* Only visible for Engine Selection = Kubota D1105, Deutz EMR2 or Deutz EMR4. * Only visible if Fuel Level Menu selection is not NONE.			

Table 6-7. Machine Configuration Programing Information (Software Version P2.1)

Configuration Label/Digit	Number	Description	Default Number
TILT: 9*	1	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep.	
	2	4.5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4.5 degrees and above elevation; also reduces drive speed to creep.	
	3	4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep.	
	4	3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep.	
	5	5 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows tower lift up, drive, telescope out and lift up.	
	6	4.5 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4.5 degrees and above elevation; also disallows tower lift up, drive, telescope out and lift up.	
	7	4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, drive, telescope out and lift up.	
	8	3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, drive, telescope out and lift up.	
	9	**5 DEG + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.**	**9**
	10	4.5 DEG + DRV CT: Reduces the maximum speed of all boom functions to creep when tilted more than 4.5 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
	11	4 DEG + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
	12	3 DEG + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
* Certain market selections will limit tilt options and alter default setting. * Drive Reversal feature of X DEG + DRV CUT does not apply to crawlers. Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.			
JIB: 10*	1	NO: No jib installed.	
	2	**YES: Jib installed which has up and down movements only.**	**2**
* Certain model selections will limit visibility.			
SOFT TOUCH: 11	**1**	**NO: No Soft Touch System installed.**	**1**
	2	YES: Soft Touch System installed.	

Table 6-7. Machine Configuration Programing Information (Software Version P2.1)

Configuration Label/Digit	Number	Description	Default Number
SKYGUARD: 12	1	NO: No SkyGuard system installed.	
	2	**YES: SkyGuard system installed.**	**2**
GEN SET/WELDER: 13	**1**	**NO: No generator installed.**	**1**
	2	BELT DRIVE: Belt driven setup.	
GEN SET CUTOUT: 14*	**1**	**MOTION ENABLED: Motion enabled when generator is ON.**	**1**
	2	MOTION CUTOUT: Motion cutout in platform mode only.	
* Only visible if Gen Set / Welder Menu selection is not NO.			
H & T LIGHTS: 15*	**1**	**NO: No head and tail lights installed.**	**1**
	2	YES: Head and tail lights installed.	
* Only visible under certain model selections.			
LOAD SYSTEM: 16*	**1**	**NO: No load Sensor installed.**	**1**
	2	WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 Sec ON, 2 Sec OFF).	
	3	CUTOUT PLATFORM: All functions cutout, flash overload lit, disables telescope out & lift up, platform alarm beeps (5 Sec ON, 2 Sec OFF).	
	4	CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 Sec ON, 2 Sec OFF).	
	5	SPECIAL 1: Functions in creep, overload lamp lit, disables telescope out & lift up, platform alarm beeps (5 Sec ON, 2 Sec OFF).	
* Only visible under certain model selections. * Certain market selections will limit load system options or alter default settings.			
FUNCTION CUTOUT: 17*	**1**	**NO: No drive cutout.**	**1**
	2	BOOM CUTOUT: Boom function cutout while driving above elevation.	
	3	DRIVE CUTOUT: Drive & steer cutout above elevation.	
	4	DRIVE CUT E&T: Drive & steer cutout above elevation and tilted.	
* Only visible under certain market selections. * Certain market selections will limit function cutout options or alter default setting.			
GROUND ALARM: 18	1	NO: No ground alarm installed.	
	2	DRIVE: Travel alarm sounds when the drive function is active.	
	3	DESCENT: Descent alarm sounds when lift down is active.	
	4	**MOTION: Motion alarm sounds when any function is active.**	**4**

Table 6-7. Machine Configuration Programing Information (Software Version P2.1)

Configuration Label/Digit	Number	Description	Default Number
DRIVE TYPE: 19*	**1** 2	**4WD: Four wheel drive.** 2WD: Two wheel drive.	**1**
* Only visible under certain model selections.			
DISPLAY UNITS: 20*	1 **2**	METRIC: Celsius, Kilograms, Kilo Pascal. **IMPERIAL: Fahrenheit, Pounds, Pounds/in2**	**2**
* Certain market selections will alter default setting.			
CLEARSKY: 21	**1** 2	**NO: ClearSky (telematics) options is disabled.** YES: ClearSky (telematics) option is enabled.	**1**
* Only visible under certain model selections.			
CRIBBING OPTION: 22	**1** 2	**NO: Cribbing Option is disabled.** YES: Cribbing Option is enabled.	**1**
* Only visible under certain model selections. * Only visible under certain market selections.			
ALERT BEACON: 23	**1** 2	**OFF FOR CREEP** IN CREEP 20FPM	**1**
TEMP CUTOUT: 24*	**1** 2	**NO: No Low Temp Cutout System installed** YES: Low Temp Cutout System installed	**1**
* Only visible under certain market selections.			
PLAT LVL OVR CUTOUT: 25	**1** 2	**NO: Platform Level functions above elevation.** YES: Platform Level does not functions above elevation.	**1**
ALARM/HORN: 26	1 **2**	SEPARATE: Ambient alarm installed. **COMBINED: Single Horn/Alarm installed.**	**2**

Table 6-7. Machine Configuration Programing Information (Software Version P2.1)

Configuration Label/Digit	Number	Description	Default Number
TELE CUTBACK: 27*	**1**	**NO: No Telescope cutback option is disabled.**	**1**
	2	YES: Telescope cutback option is enabled.	
* Only visible under certain model selections.			
FUEL LEVEL: 28*	1	NONE: Fuel Level Switch/Sensor is not installed.	
	2	SWITCH: Fuel Level Switch is installed.	
	3	**SENSOR: Fuel level Sensor is installed.**	**3**
* Only visible under certain model selections.			
WATER IN FUEL SENSOR: 29*	**1**	**NO: Water in Fuel Sensor is not installed.**	**1**
	2	YES: Water in Fuel Sensor is installed.	
* Only visible under certain market selections. * Only visible for Engine Selection = Deutz EMR4.			

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Table 6-8. Machine Configuration Programming Settings (Software Version P2.1)

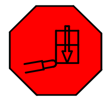
340AJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Model Number	**1**	**1**	**1**	**1**	**1**	**1**
Market	**1**	**2**	**3**	**4**	**5**	**6**
Engine	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	X	X	2
	X	X	X	X	X	X
	X	X	X	X	X	X
	X	X	X	X	X	X
Flywheel Teeth	**1**	**1**	**1**	**1**	**1**	**1**
Glow Plug	**2**	**2**	**2**	**2**	**2**	**2**
Starter Lockout	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Engine Shutdown	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Fuel Cutout	1	1	1	1	1	1
	2	2	2	2	2	2
	X	X	X	X	X	X
	4	**4**	**4**	**4**	**4**	**4**
Tilt	1	1	1	X	X	1
	X	X	X	X	X	X
	3	3	3	X	X	3
	4	4	4	4	4	4
	5	5	5	X	X	5
	X	X	X	X	X	X
	7	7	7	X	X	7
	8	8	8	8	8	8
	9	**9**	**9**	X	X	**9**
	X	X	X	X	X	X
	11	11	11	X	X	11
	12	12	12	**12**	**12**	12
Jib	X	X	X	X	X	X
	2	**2**	**2**	**2**	**2**	**2**
Soft Touch	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
SkyGuard	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Gen Set / Welder	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Gen Set Cutout	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Head & Taillights	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Load System	**1**	**1**	**1**	1	1	1
	X	***2***	X	X	X	***2***
	X	3	X	X	**3**	**3**
	X	4	X	**4**	X	4
	X	X	X	X	X	X
Function Cutout	**1**	**1**	**1**	X	**1**	**1**
	X	2	2	**2**	2	2
	3	3	3	X	3	3
	X	X	X	X	X	X
Ground Alarm	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	**4**	**4**	**4**	**4**	**4**
Drive Type	X	X	X	X	X	X
	X	X	X	X	X	X
Display Units	1	1	**1**	**1**	**1**	**1**
	2	**2**	2	2	2	2
Clearsky	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Cribbing Option	**1**	X	X	X	X	X
	2	X	X	X	X	X
Alert Beacon	**1**	**1**	**1**	**1**	1	**1**
	2	2	2	2	**2**	2
Temp Cutout	**1**	**1**	**1**	**1**	**1**	**1**
	X	2	X	2	X	X
Plant LVL OVR Cut	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Alarm / Horn	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Tele Cutback	X	X	X	X	X	X
	X	X	X	X	X	X
Fuel Level	X	X	X	X	X	X
	X	X	X	X	X	X
	3	**3**	**3**	**3**	**3**	**3**
Water in Fuel Sensor	X	X	X	X	X	X
	X	X	X	X	X	X

BOLD TEXT indicates the default setting. Plain text indicates another available selection. ***ITALIC TEXT*** indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

6.6 LSS SYSTEM

The JLG-designed Load Sensing System (LSS) measures platform load via a sensor mounted in the platform support structure. If the actual platform load exceeds the selected Rated Load, the following will occur:

1. The Overload Visual Warning Indicator will flash at the selected control position (platform or ground).



2. The Platform and Ground Alarms will sound 5 seconds On, and 2 seconds Off.
3. All normal movement will be prevented from the platform control position (optional - ground control functions may be prevented).
4. Further movement is permitted by:
   a. Removing the excess platform load until actual platform load is less than Rated Load.
   b. Operation of the overriding emergency system (Auxiliary Power Unit).
   c. By an authorized person at the ground control position (optional - ground control functions may be prevented).

NOTICE

THE LOAD SENSING SYSTEM MUST BE CALIBRATED WHEN ONE OR MORE OF THE FOLLOWING CONDITIONS OCCUR:

a. LSS Sensor removal or replacement
b. Addition or removal of certain platform mounted accessories. (Refer to Calibration)
c. Platform is removed, replaced, repaired or shows evidence of impact.

NOTICE

THE LOAD SENSING SYSTEM REQUIRES PERIODIC FUNCTION VERIFICATION NOT TO EXCEED 6 MONTHS FROM PREVIOUS VERIFICATION. REFER TO TESTING & EVALUATION.

All calibration procedures are menu driven through the use of a JLG Analyzer.

Diagnostic Menu

The Diagnostic Menu is another troubleshooting tool for the Load Sensing System. Sensor and status information is presented in real-time for the technician. Several sub-menus exist to organize the data.

To access the Diagnostic Menu, use the LEFT and RIGHT Arrow keys to select DIAGNOSTICS from the Top Level Menu. Press the ENTER key to view the menu.

Press the LEFT and RIGHT Arrow keys to view the displays and select the various sub-menus. To access a sub-menu, press the ENTER key. Once in a sub-menu, press the LEFT and RIGHT Arrow keys to view the various displays (just like a Top Level menu). To exit a sub-menu, press the ESC key.

Table 6-9, Diagnostic Menu Descriptions details the structure of the Diagnostic Menu, and describes the meaning of each piece of information presented.

Table 6-9. Diagnostic Menu Descriptions

Diagnostics Menu (Displayed on Analyzer 1^{st} Line)	Parameter (Displayed on Analyzer 2^{nd} Line)	Parameter Value (Displayed on Analyzer 2^{nd} Line)	Description
PLATFORM LOAD	STATE:	OK / OVERLOAD	LSS Status.
PLATFORM LOAD	ACTUAL:	XXX.X KG	Calibrated weight of the platform. ??? if Platform Load is Unhealthy**.
PLATFORM LOAD (service*)	GROSS:	XXX.X KG	Gross weight of the platform. ??? if both Cells are Unhealthy**.
PLATFORM LOAD (service*)	OFFSET 1:	XXX.X KG	Stored offset weight of Cell 1. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	OFFSET 2:	XXX.X KG	Stored offset weight of Cell 1. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	ACCESSORY	XXX.X KG	Stored accessory weight. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	UNRESTRICT	XXX.X KG	UGM will set Unrestricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RESTRICT	XXX.X KG	UGM will set Restricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RAW 1:	XXX.X KG	Gross value from Cell 1. ??? if Unhealthy**.
PLATFORM LOAD (service*)	RAW 2:	XXX.X KG	Gross value from Cell 2. ??? if Unhealthy**.
* Indicates only visible in service view mode ** Typically indicates a DTC is active			

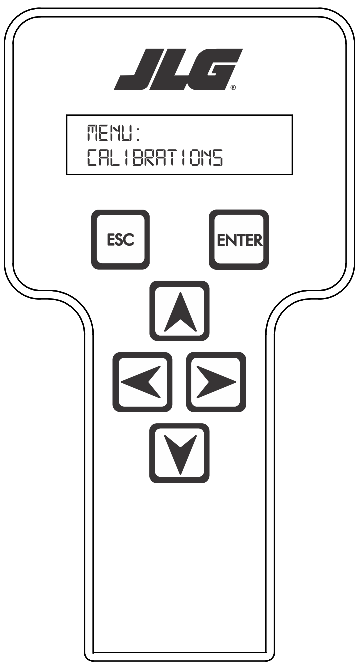
Calibration Procedure

1. Remove everything from the platform, except permanently fixed JLG Accessories, to allow the Load Sensing System to record its' weight during calibration. This includes all tools, debris, and customer-installed devices.

2. Plug the JLG Analyzer into the Machine at the Ground Station and enter Service Access Password 33271.

3. The platform should be approximately level for calibration. Level the platform from ground control (if necessary) to within +/- 5°.

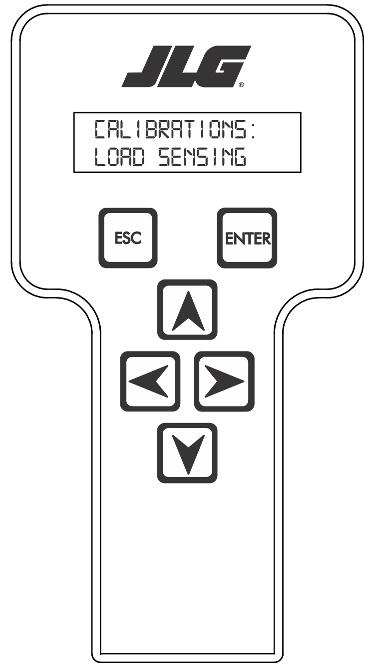
4. To access the Calibration Menu, use the LEFT and RIGHT Arrow keys to select CALIBRATION from the Top Level Menu. The screen will read:



NOTE: *The Calibration Menu is not available in OPERATOR ACCESS.*

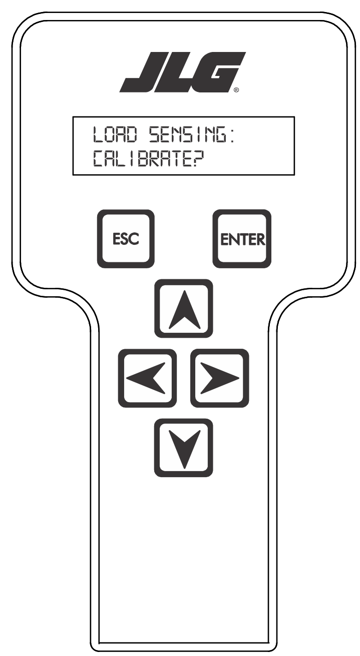
5. Press the ENTER key 

to view the menu. Upon entry to the Calibration Menu, the JLG Control System will link to the Analyzer and the screen will read:



6. Press Enter 

. The Screen will read:



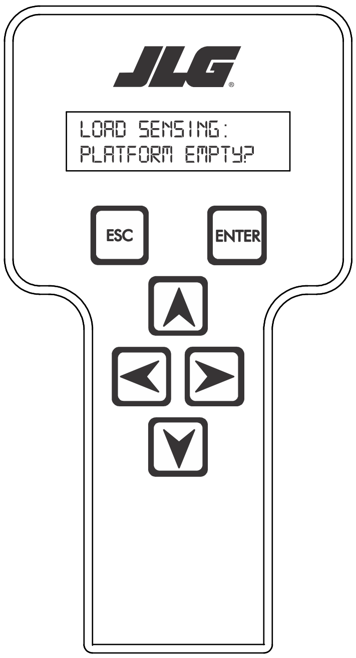
NOTE: *Calibration will auto fail if LSS DTC's are active (443, 444, 4479, 4480, 663, 821, 822, 823, 824, 8218, 8222 -> 8238, 991, 992, 993, 994 or 99285).*

Pressing the ESC key 

after starting calibration and before calibration is complete will display the CAL FAILED message. This will not disturb the prior calibration information.

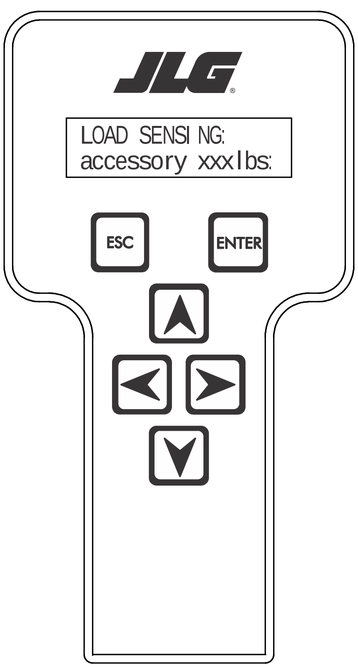
7. Press ENTER 

. The analyzer screen will read:



8. If the platform is empty, press ENTER 

. The screen will read:



NOTE: *Accessory weight will reset to 0 lbs. each time the machine is re-calibrated and will need to be re-entered.*

NOTE: *The Accessory weight will be temporarily stored in the Control System until calibration has been completed successfully.*

Refer to Table 6-10, Accessory Weights. Use the up and down analyzer keys to enter the accessory weight(s) (in lbs). When all the accessory weights are entered, press ENTER 

. The screen will read:

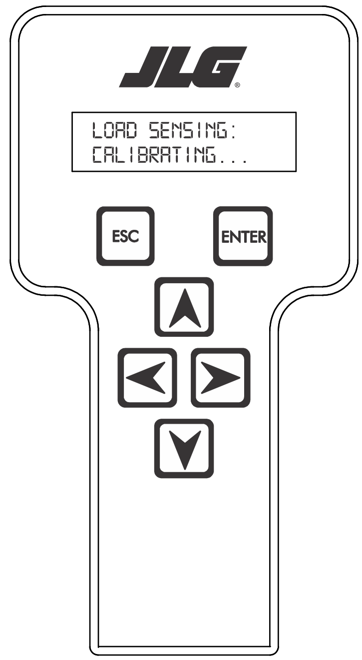


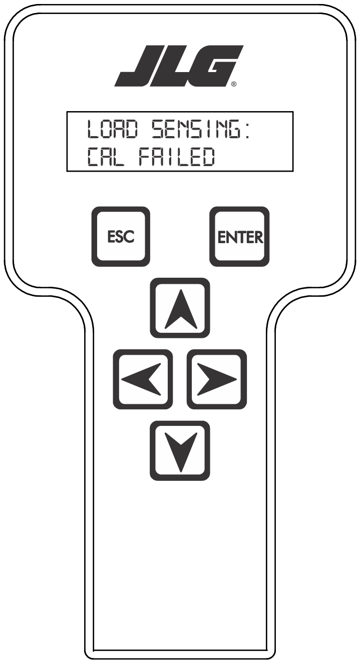
Table 6-10. Accessory Weights

Accessory	Weight
SkyWelder (stick welder)	70 lb (32 kg)
SkyWelder Prep	Prep only = 15 lb (7 kg) Full install = 70 lb (32 kg)
SkyCutter (plasma cutter)	70 lb (32 kg)
SkCutter / SkyWelder Combo	140 lb (64 kg)
Fire Extinguisher	45 lb (20 kg)
Overhead SoftTouch	80 lb (36 kg)
Work Surface	20 lb (9 kg)

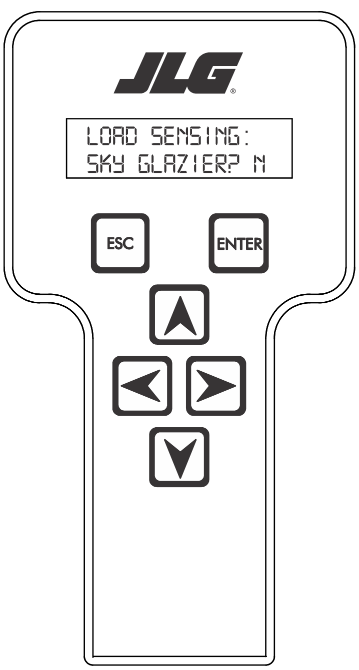
NOTE: *Not all Accessories are available on every JLG model. Some Accessory combinations are prohibited due to excessive weight and/or load restriction. If any installed JLG Accessories are labeled with weight decals but are not listed in the table above, include their weight when entering the ACC WEIGHT value.*

9. The control system will calculate the load cell readings and ensure it is greater than 130 lbs. (59 kg), but less than 575 lbs.(261 kg).

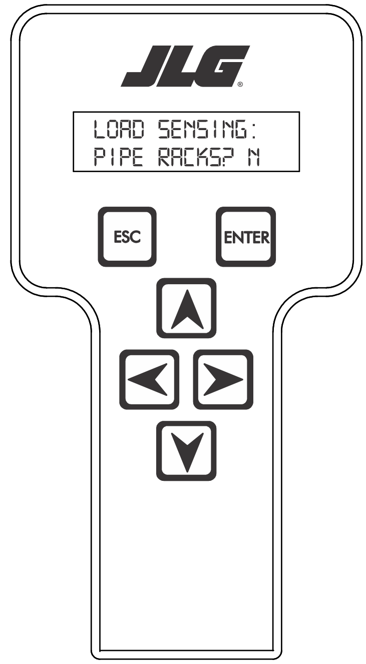
   If the platform weight is not within the allowed range, the calibration attempt will be unsuccessful and the Analyzer will show the following:



10. Press ENTER ENTER. The control system will ask for installed accessories. The screen will show the following:



11. Use the analyzer keys to select N for no or Y for yes. Press ENTER ENTER. The screen will read:



12. Use the analyzer keys to select N for no or Y for yes. Press ENTER. The control system will default to an estimate of unrestricted capacity, which can be adjusted if necessary. Refer to Table 6-11, SkyGlazier Capacity Reductions and Table 6-12, Pipe Rack Capacity Reductions.

The screen will read:

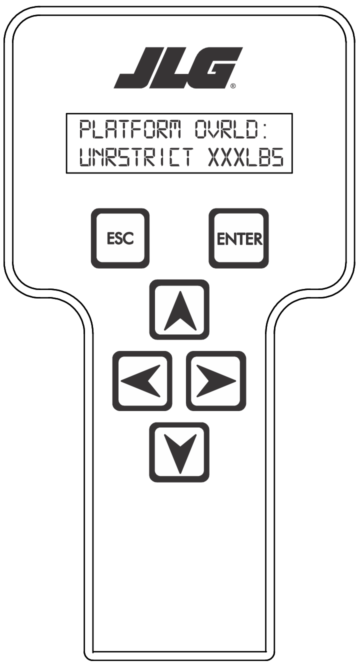


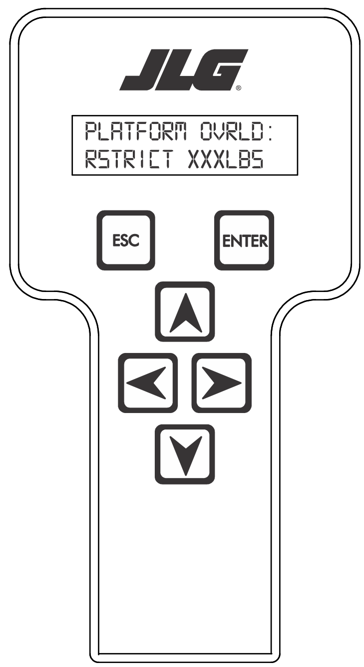
Table 6-11. SkyGlazier Capacity Reductions

Capacity	PLATFORM OVRLD	PLATFORM OVRLD RESTRICT
500 lb (227 kg)	400 lb (181 kg)	n/a
550 lb (250 kg)	400 lb (181 kg)	n/a
600 lb (272 kg)	400 lb (181 kg)	n/a
750 lb (340 kg)	n/a	590 lb (268 kg)
1000 lb (454 kg)	n/a	750 lb (340 kg)
Note: If both SkyGlazier and Pipe Racks are configured, capacity will be the lower of the two values.		

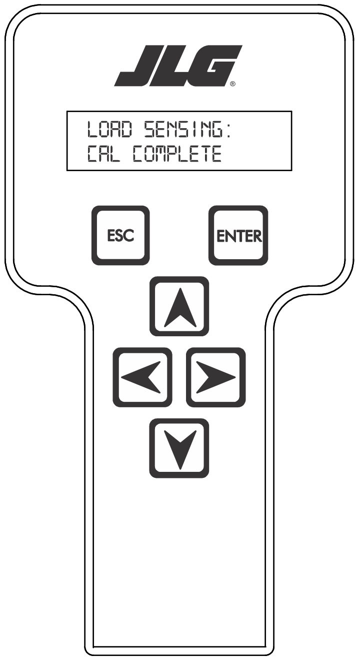
Table 6-12. Pipe Rack Capacity Reductions

Capacity	PLATFORM OVRLD	PLATFORM OVRLD RESTRICT
500 lb (227 kg)	400 lb (181 kg)	n/a
550 lb (250 kg)	450 lb (204 kg)	n/a
600 lb (272 kg)	500 lb (227 kg)	n/a
750 lb (340 kg)	n/a	650 lb (295 kg)
1000 lb (454 kg)	n/a	900 lb (408 kg)
Note: If both SkyGlazier and Pipe Racks are configured, capacity will be the lower of the two values.		

13. Press ENTER. The following screen will be displayed for restricted capacity, which can be adjusted if necessary. Refer to Table 6-11, SkyGlazier Capacity Reductions and Table 6-12, Pipe Rack Capacity Reductions.



14. Press ENTER . If calibration is successful, the screen will read:



Testing & Evaluation

Refer to Troubleshooting if the Load Sensing System fails to meet these guidelines.

1. Connect the JLG Analyzer.
2. Level the Platform. The platform should be approximately level for analysis, or the guidelines below will not be applicable. Level the platform from Ground Control (if necessary) to within ±5 degrees.
3. Observe the Empty Platform Weight. Proceed to the DIAGNOSTICS, PLTLOAD sub-menu and observe the measured platform load. All tools, debris, and customer-installed devices shall be removed during evaluation. Ideally, the PLTLOAD should be zero but can vary ±15lbs (± 7kg). Further, the reading should be stable and should not vary by more than ±2lbs (±1kg) (unless there is heavy influence from wind or vibration).
4. Use the Technician's Weight to Evaluate. The technician should enter the platform and record the PLTLOAD reading while standing in the center of the platform.
5. Confirm Control System Warnings and Interlocks. Using the keyswitch, select Platform Mode and power-up. Start the vehicle's engine and ensure that all controls are functional and the Load Sensing System's Overload Visual and Audible Warnings are not active. Simulate an Overload by unplugging the Shear Beam Load Cell. The Overload Visual Warning should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, and 2 seconds Off. With the engine running, all control should be prevented. Cycle the Platform EMS to stop the engine and then power-up again. The Overload Visual and Audible Warning should continue. Confirm that controls are responsive when using the Auxiliary Power Unit for emergency movement. Reconnect the Load Cell. The Overload Visual and Audible Warnings should cease and normal control function should return. Switch the vehicle's keyswitch to Ground Mode and repeat the above procedure. The Overload Visual Warning at the Ground Controls should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, 2 seconds Off. However, the controls should remain functional when using the engine and the Auxiliary Power Unit (if the Control System's MACHINE SETUP, LOAD is set to "2=CUTOUT PLT". If set to "3=CUTOUT ALL", then Ground Controls will be prevented when using the engine as in the platform).
6. Confirm Control System Capacity Indication (optional for vehicles with Dual Capacity Ratings). For vehicles equipped with a Capacity Select switch on the Platform Console Box, it is necessary to examine an additional interface between the Load Sensing System and the Control System. Using the keyswitch, select Platform Mode and power-up. If necessary, put the boom in the transport position (completely stowed) and center the Jib Plus (if equipped). Place the Capacity Select switch in the unrestricted position and ensure that the proper indicator illuminates on the Platform Console Box. Plug the JLG Analyzer into the Analyzer connection and proceed to the DIAGNOSTICS, SYSTEM submenu. Ensure that the CAPACITY displays indicate OFF. Place the Capacity Select switch in the unrestricted position (if so equipped) and ensure that the proper indicator illuminates on the Platform Console Box (but does not flash). For vehicles with unrestricted capacity, ensure that the unrestricted CAPACITY display indicates ON but the restricted CAPACITY indicates OFF. For vehicles with restricted capacity, ensure that the unrestricted CAPACITY display indicates OFF but the restricted CAPACITY indicates ON.
7. Confirm Load Sensing System Performance with Calibrated Weights. Operate the vehicle from Ground Control and place the boom in the transport position (fully stowed) for safety. Plug the JLG Analyzer into the control system connection and proceed to the DIAGNOSTICS, PLTLOAD display. Place 500lbs (230kg) in the platform and ensure that PLTLOAD is with ±5% of the actual weight. For Dual Capacity vehicles, do the same for the alternate capacity (unrestricted or restricted).

Troubleshooting

The following tables are furnished to provide possible resolutions for common difficulties. Difficulties are classified as General, Calibration, Measurement Performance, and Host System Functionality.

Table 6-13. LSS Troubleshooting Chart

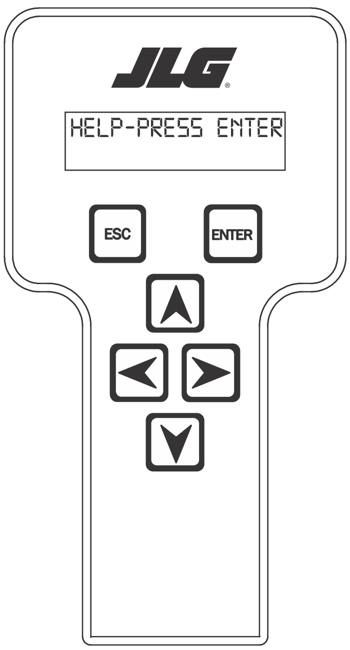
Difficulty	Possible Resolution
Empty Platform Weight (DIAGNOSTICS, PLATFORM LOAD) is not within ±15lbs (±7kg) of zero. or Platform Load readings (DIAGNOTICS, PLTLOAD) are unstable by more than ±2lbs (±1kg) (without the influence of vibration or wind). or There are large variations in Platform Load (DIAGNOSTICS, PLTLOAD) based on the location of the load. Tolerance to variations is 20lbs for an evaluation using the technician's weight, and ±5% of Rated Load when using calibrated weights.	The LSS System is unable to properly measure the platform weight. 1. The Load Cell is not properly plugged into the LSS Harness. It is possible poor electrical contact is made. 2. Wiring leading to the Load Cell is damaged. Carefully inspect sensor wiring where it passes through cable clamps for signs of damage. Inspect wiring where damage to the channel is apparent. 3. The Load Cell was not assembled properly during installation. Examine the sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL, LOAD displays and determine if the readings are reasonable. It is often helpful to apply slight downward pressure above the sensor and observe that its output increases (increasing force measurement; decreasing means the sensor is mounted upside-down). 4. The Load Cell is contaminated by debris or moisture. Examine the sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL, LOAD displays and determine if the readings are reasonable and stable (not changing by more than ±2lbs (±1kg) (without the influence of vibration or wind). Lack of measurement stability is a key indication of contamination. Unplug the connector and inspect for dirt or moisture. Look carefully into the female connector on the sensor's cordset for evidence of contamination. Debris should be brushed away with a soft bristle brush (do not introduce any cleaners as they will leave conductive residue). Moisture should be allowed to evaporate or accelerated with a heat-gun (use low heat and be carefully to not melt connector materials). Moisture intrusion into the molded portion of the connector (capillary action into the wire bundle) or the Shear Beam Load Cell itself will require replacement of the sensor. 5. The Load Cell has been mechanically damaged. If the Load Cell is physically deformed or has damage to the cover it should be replaced immediately. It is also possible to have invisible mechanical damage resulting from an extreme overload (>6000lbs [>2722kg]).
The Visual and Audible Overload Warnings fail to sound when platform is loaded beyond Rated Load, or when simulated by unplugging the Load Cell. Controls remain functional at Platform and Ground Control positions.	The Control System is failing to regard the overload signal from the LSS System, or the signal is shorted. 1. The Load Sensing System must be enabled within the Control System. Plug the JLG Analyzer into the Control System, enter the Access Level 1 password (33271), and examine the MACHINE SETUP, LOAD sub-menu. The selection "2=CUTOUT PLT" should be displayed (platform controls prevented during overload, ground controls remain operational). In country- or customer-specific circumstance, the selection "3=CUTOUT ALL" is used (platform and ground controls prevented during overload).
The Ground Audible Warning fails to sound, but the Platform Audible Warning sounds properly.	The Ground Alarm is missing or improperly installed. Verify that the device is mounted. Verify wiring from the Main Terminal Box and Ground Module.
Controls remain functional at the Ground Control position during an overload, or when simulated by unplugging the Load Cell. The Controls at the Platform Control position are prevented when using the engine, but not when using the Auxiliary Power Unit.	The JLG Control System is configured to prevent platform controls only in the event of overload. Alternately, the Host Control System can be configured to prevent ground and platform controls for country- or customer-specific circumstances. Using the JLG Analyzer, enter the Access Level 1 password (33271). Proceed to the MACHINE SETUP, LOAD sub-menu. Set this parameter to "2=CUTOUT PLT" to prevent platform controls in the event of overload. Set this parameter to "3=CUTOUT ALL" to prevent platform and ground controls in the event of overload.

6.7 RESETTING THE MSSO SYSTEM

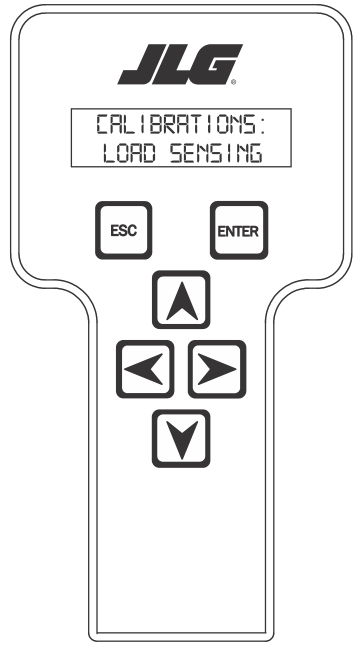
1. Use the following procedure to reset the MSSO system.
2. Position the Platform/Ground select switch to the desired position.
3. Plug the analyzer into the connector coming from the ground control module or from the platform console.

NOTE: *If performing the procedure from the platform console, the Emergency Stop switch on the ground console must also be pulled out.*

4. Pull out the Emergency Stop switch.
5. The analyzer screen should read:

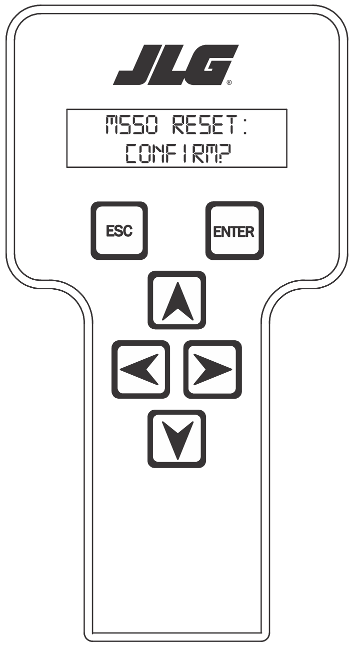


6. Use the arrow button to reach OPERATOR ACCESS. Press Enter .
7. Enter the Access Code, 33271.
8. Use the right Arrow key to reach MENU: CALIBRATIONS. Press Enter .
9. Use the arrow keys to reach the LOAD SENSING menu. The screen should read:



10. Press ENTER .
11. Use the Down  arrow to reach MSSO RESET.

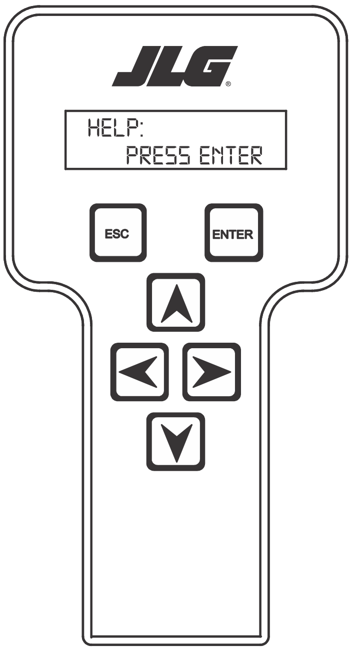
12. Press Enter . The screen will read:



13. Press Enter . The JLG Control System will reset an active 873 DTC and the MSSO System will be reset. Press Escape to return to the CALIBRATIONS menu.

6.8 SYSTEM FAULT MESSAGES

The Help Message display on the JLG Analyzer provides diagnostic feedback to explain vehicle operation and interlocks. After the Analyzer is connected to the Ground Module or Platform Module, the Control System shall receives an "Initialize Analyzer" command from the Analyzer and the Control System commands the Analyzer to display the top menu item:



If the operator presses ENTER when in Platform Mode and no active faults are present, the Control System commands the Analyzer to display:

EVERYTHING OK

If the operator presses ENTER when in Ground Mode, display will read GROUND MODE OK.

Pressing ENTER again will cause the Analyzer to display the current Help description followed by its' Diagnostic Trouble Code (DTC). Help Messages larger than the Analyzer's display are scrolled across the screen and repeated. Using the up arrow will increase the scroll speed. If the Fault is active, an asterisk will appear beside the DTC. If the operator enters Logged Help, the Control System will show the previous 25 logged DTCs along with the Fault description on the analyzer screen.

Table 6-14, System Fault Code Listing lists the fault codes applicable for this machine and the analyzer message that accompanies the fault code. Table 6-15, Fault Code Troubleshooting Information contains evaluation, response, display, and operational requirements for each Fault condition.

Table 6-14. System Fault Code Listing

DTC	Analyzer Text
001	EVERYTHING OK
0010	RUNNING AT CUTBACK - OUT OF TRANSPORT POSITION
0011	FSW OPEN
0012	RUNNING AT CREEP - CREEP SWITCH OPEN
0013	RUNNING AT CREEP - TILTED AND ABOVE ELEVATION
0014	CHASSIS TILT SENSOR OUT OF RANGE
0030	RUNNING AT CREEP - PLATFORM STOWED
0031	FUEL LEVEL LOW - ENGINE SHUTDOWN
211	POWER CYCLE
212	KEYSWITCH FAULTY
213	FSW FAULTY
224	FUNCTION PROBLEM - STEER LEFT PERMANENTLY SELECTED
225	FUNCTION PROBLEM - STEER RIGHT PERMANENTLY SELECTED
227	STEER SWITCHES FAULTY
2211	FSW INTERLOCK TRIPPED
2212	DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH
2213	STEER LOCKED - SELECTED BEFORE FOOTSWITCH
2216	D/S JOY. OUT OF RANGE HIGH
2217	D/S JOY. CENTER TAP BAD
2219	L/S JOY. OUT OF RANGE HIGH
2220	L/S JOY. CENTER TAP BAD
2221	LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH
2222	WAITING FOR FSW TO BE OPEN
2223	FUNCTION SWITCHES LOCKED - SELECTED BEFORE ENABLE
2224	FOOTSWITCH SELECTED BEFORE START
2247	FUNCTION PROBLEM - PLATFORM ROTATE LEFT PERMANENTLY SELECTED
2248	FUNCTION PROBLEM - PLATFORM ROTATE RIGHT PERMANENTLY SELECTED
2249	FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED
2250	FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED
2251	FUNCTION PROBLEM - TELESCOPE IN PERMANENTLY SELECTED
2252	FUNCTION PROBLEM - TELESCOPE OUT PERMANENTLY SELECTED
2257	FUNCTION PROBLEM - TOWER LIFT UP PERMANENTLY SELECTED
2258	FUNCTION PROBLEM - TOWER LIFT DOWN PERMANENTLY SELECTED
2262	FUNCTION PROBLEM - PLATFORM LEVEL UP PERMANENTLY SELECTED
2263	FUNCTION PROBLEM - PLATFORM LEVEL DOWN PERMANENTLY SELECTED
234	FUNCTION SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM
235	FUNCTION SWITCHES LOCKED - SELECTED BEFORE AUX POWER
236	FUNCTION SWITCHES LOCKED - SELECTED BEFORE START SWITCH
237	START SWITCH LOCKED - SELECTED BEFORE KEYSWITCH
2310	FUNCTION PROBLEM - GROUND ENABLE PERMANENTLY SELECTED
2370	FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED
2371	FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED
2372	FUNCTION PROBLEM - SWING LEFT PERMANENTLY SELECTED

Table 6-14. System Fault Code Listing

DTC	Analyzer Text
2373	FUNCTION PROBLEM - SWING RIGHT PERMANENTLY SELECTED
23104	BOOM TRANSPORT SWITCH DISAGREEMENT
23105	FUNCTION PROBLEM - TOWER LIFT UP PERMANENTLY SELECTED
23106	FUNCTION PROBLEM - TOWER LIFT DOWN PERMANENTLY SELECTED
23107	FUNCTION PROBLEM - LIFT UP PERMANENTLY SELECTED
23108	FUNCTION PROBLEM - LIFT DOWN PERMANENTLY SELECTED
23109	FUNCTION PROBLEM - TELESCOPE IN PERMANENTLY SELECTED
23110	FUNCTION PROBLEM - TELESCOPE OUT PERMANENTLY SELECTED
23111	FUNCTION PROBLEM - PLATFORM LEVEL UP PERMANENTLY SELECTED
23112	FUNCTION PROBLEM - PLATFORM LEVEL DOWN PERMANENTLY SELECTED
23113	FUNCTION PROBLEM - PLATFORM ROTATE LEFT PERMANENTLY SELECTED
23114	FUNCTION PROBLEM - PLATFORM ROTATE RIGHT PERMANENTLY SELECTED
259	MODEL CHANGED - HYDRAULICS SUSPENDED - CYCLE EMS
2513	GENERATOR MOTION CUTOUT ACTIVE
2514	BOOM PREVENTED - DRIVE SELECTED
2516	DRIVE PREVENTED - ABOVE ELEVATION
2517	DRIVE PREVENTED - TILTED & ABOVE ELEVATION
2518	DRIVE PREVENTED - BOOM SELECTED
2520	FUNCTIONS LOCKED OUT - CONSTANT DATA VERSION IMPROPER
331	BRAKE - SHORT TO BATTERY
332	BRAKE - OPEN CIRCUIT
334	LIFT UP VALVE - OPEN CIRCUIT
335	LIFT DOWN VALVE - SHORT TO BATTERY
336	LIFT DOWN VALVE - OPEN CIRCUIT
3311	GROUND ALARM - SHORT TO BATTERY
3352	LP LOCK - SHORT TO GROUND
3353	LP LOCK - OPEN CIRCUIT
3354	LP LOCK - SHORT TO BATTERY
3355	LP START ASSIST - SHORT TO GROUND
3356	LP START ASSIST - OPEN CIRCUIT
3357	LP START ASSIST - SHORT TO BATTERY
3358	MAIN DUMP VALVE - SHORT TO GROUND
3359	MAIN DUMP VALVE - OPEN CIRCUIT
3360	MAIN DUMP VALVE - SHORT TO BATTERY
3361	BRAKE - SHORT TO GROUND
3362	START SOLENOID - SHORT TO GROUND
3363	START SOLENOID - OPEN CIRCUIT
3364	START SOLENOID - SHORT TO BATTERY
3365	STEER DUMP VALVE - SHORT TO GROUND
3366	STEER DUMP VALVE - OPEN CIRCUIT
3367	STEER DUMP VALVE - SHORT TO BATTERY
3373	GEN SET/WELDER - SHORT TO GROUND
3374	GEN SET/WELDER - OPEN CIRCUIT

Table 6-14. System Fault Code Listing

DTC	Analyzer Text
3375	GEN SET/WELDER - SHORT TO BATTERY
3376	HEAD TAIL LIGHT - SHORT TO GROUND
3377	HEAD TAIL LIGHT - OPEN CIRCUIT
3378	HEAD TAIL LIGHT - SHORT TO BATTERY
3379	HOUR METER - SHORT TO GROUND
3382	PLATFORM LEVEL UP VALVE - SHORT TO GROUND
3383	PLATFORM LEVEL UP VALVE - OPEN CIRCUIT
3384	PLATFORM LEVEL UP VALVE - SHORT TO BATTERY
3388	PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND
3389	PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT
3390	PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY
3394	PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND
3395	PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT
3396	PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY
3397	PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND
3398	PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT
3399	PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY
33100	JIB LIFT UP VALVE - SHORT TO GROUND
33101	JIB LIFT UP VALVE - OPEN CIRCUIT
33102	JIB LIFT UP VALVE - SHORT TO BATTERY
33103	JIB LIFT DOWN VALVE - SHORT TO GROUND
33104	JIB LIFT DOWN VALVE - OPEN CIRCUIT
33105	JIB LIFT DOWN VALVE - SHORT TO BATTERY
33106	TOWER LIFT UP VALVE - SHORT TO GROUND
33107	TOWER LIFT UP VALVE - OPEN CIRCUIT
33109	TOWER LIFT DOWN VALVE - SHORT TO GROUND
33110	TOWER LIFT DOWN VALVE - OPEN CIRCUIT
33118	SWING RIGHT VALVE - SHORT TO GROUND
33119	SWING RIGHT VALVE - OPEN CIRCUIT
33120	TELESCOPE IN VALVE - SHORT TO BATTERY
33122	SWING LEFT VALVE - SHORT TO GROUND
33123	TELESCOPE OUT VALVE - SHORT TO BATTERY
33130	THROTTLE ACTUATOR - SHORT TO GROUND
33131	THROTTLE ACTUATOR - OPEN CIRCUIT
33132	THROTTLE ACTUATOR - SHORT TO BATTERY
33182	LIFT VALVES - SHORT TO BATTERY
33186	TELESCOPE OUT VALVE - OPEN CIRCUIT
33188	TELESCOPE OUT VALVE - SHORT TO GROUND
33189	TELESCOPE IN VALVE - OPEN CIRCUIT
33190	TELESCOPE IN VALVE - SHORT TO GROUND
33279	GLOWPLUG - OPEN CIRCUIT
33280	GLOWPLUG - SHORT TO BATTERY
33281	GLOWPLUG - SHORT TO GROUND

Table 6-14. System Fault Code Listing

DTC	Analyzer Text
33287	LIFT - CURRENT FEEDBACK READING TOO LOW
33295	SWING LEFT VALVE - OPEN CIRCUIT
33314	FLOW CONTROL VALVE - OPEN CIRCUIT
33315	FLOW CONTROL VALVE - SHORT TO BATTERY
33316	FLOW CONTROL VALVE - SHORT TO GROUND
33317	DRIVE FORWARD VALVE - OPEN CIRCUIT
33318	DRIVE FORWARD VALVE - SHORT TO BATTERY
33319	DRIVE FORWARD VALVE - SHORT TO GROUND
33320	DRIVE REVERSE VALVE - OPEN CIRCUIT
33322	DRIVE REVERSE VALVE - SHORT TO GROUND
33331	DRIVE - CURRENT FEEDBACK READING TOO LOW
33406	LIFT UP VALVE - SHORT TO GROUND
33410	DRIVE - CURRENT FEEDBACK READING LOST
33412	SWING VALVES - SHORT TO BATTERY
33413	TOWER LIFT - CURRENT FEEDBACK READING TOO LOW
33414	SWING - CURRENT FEEDBACK READING TOO LOW
33415	FLOW CONTROL VALVE - CURRENT FEEDBACK READING TOO LOW
33416	TOWER LIFT - CURRENT FEEDBACK READING LOST
33417	LIFT - CURRENT FEEDBACK READING LOST
33418	SWING - CURRENT FEEDBACK READING LOST
33419	FLOW CONTROL VALVE - CURRENT FEEDBACK READING LOST
33420	TRACTION LOCK VALVE - SHORT TO BATTERY
33421	TRACTION LOCK VALVE - OPEN CIRCUIT
33422	TRACTION LOCK VALVE - SHORT TO GROUND
33423	OSCILLATING AXLE VALVES - SHORT TO BATTERY
33424	OSCILLATING AXLE VALVES - SHORT TO GROUND
33425	TOWER LIFT VALVES - SHORT TO BATTERY
342	PLATFORM LEVEL UP VALVE - SHORT TO BATTERY
343	PLATFORM LEVEL UP VALVE - SHORT TO GROUND
345	PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT
346	PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY
347	PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND
349	PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT
3410	PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY
3411	PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND
3412	PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT
3413	PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY
3414	PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND
3415	JIB LIFT UP VALVE - OPEN CIRCUIT
3416	JIB LIFT UP VALVE - SHORT TO BATTERY
3417	JIB LIFT UP VALVE - SHORT TO GROUND
3418	JIB LIFT DOWN VALVE - OPEN CIRCUIT
3419	JIB LIFT DOWN VALVE - SHORT TO BATTERY

Table 6-14. System Fault Code Listing

DTC	Analyzer Text
3420	JIB LIFT DOWN VALVE - SHORT TO GROUND
431	FUEL SENSOR - SHORT TO BATTERY
432	FUEL SENSOR - SHORT TO GROUND
433	OIL PRESSURE - SHORT TO BATTERY
434	OIL PRESSURE - SHORT TO GROUND
435	COOLANT TEMPERATURE - SHORT TO GROUND
437	ENGINE TROUBLE CODE
438	HIGH ENGINE TEMP
4310	NO ALTERNATOR OUTPUT
4311	LOW OIL PRESSURE
4313	THROTTLE ACTUATOR FAILURE
4314	WRONG ENGINE SELECTED - ECM DETECTED
4322	LOSS OF ENGINE SPEED SENSOR
4323	SPEED SENSOR READING INVALID SPEED
4326	FUEL ACTUATOR - SHORT TO GROUND
4327	FUEL ACTUATOR - OPEN CIRCUIT
4328	FUEL ACTUATOR - SHORT TO BATTERY
4329	FUEL ACTUATOR - CURRENT FEEDBACK READING TOO LOW
4330	FUEL ACTUATOR - CURRENT FEEDBACK READING LOST
441	BATTERY VOLTAGE TOO LOW - SYSTEM SHUTDOWN
442	BATTERY VOLTAGE TOO HIGH - SYSTEM SHUTDOWN
443	LSS BATTERY VOLTAGE TOO HIGH
444	LSS BATTERY VOLTAGE TOO LOW
445	BATTERY VOLTAGE LOW
662	CANBUS FAILURE - PLATFORM MODULE
663	CANBUS FAILURE - LOAD SENSING SYSTEM MODULE
666	CANBUS FAILURE - ENGINE CONTROLLER
6613	CANBUS FAILURE - EXCESSIVE CANBUS ERRORS
6622	CANBUS FAILURE - TCU MODULE
6629	CANBUS FAILURE - TELEMATICS CANBUS LOADING TOO HIGH
681	REMOTE CONTRACT MANAGEMENT OVERRIDE - ALL FUNCTIONS IN CREEP
813	CHASSIS TILT SENSOR NOT CALIBRATED
814	CHASSIS TILT SENSOR OUT OF RANGE
815	CHASSIS TILT SENSOR DISAGREEMENT
821	LSS CELL #1 ERROR
822	LSS CELL #2 ERROR
823	LSS CELL #3 ERROR
824	LSS CELL #4 ERROR
825	LSS HAS NOT BEEN CALIBRATED
826	RUNNING AT CREEP - PLATFORM OVERLOADED
827	DRIVE & BOOM PREVENTED - PLATFORM OVERLOADED
828	LIFT UP & TELE OUT PREVENTED - PLATFORM OVERLOADED

Table 6-14. System Fault Code Listing

DTC	Analyzer Text
8211	LSS READING UNDER WEIGHT
8639	FRONT LEFT STEER VALVE - OPEN CIRCUIT
8640	FRONT LEFT STEER VALVE - SHORT TO BATTERY
8641	FRONT LEFT STEER VALVE - SHORT TO GROUND
8642	FRONT RIGHT STEER VALVE - OPEN CIRCUIT
8643	FRONT RIGHT STEER VALVE - SHORT TO BATTERY
8644	FRONT RIGHT STEER VALVE - SHORT TO GROUND
8669	OSCILLATING AXLE SWITCH DISAGREEMENT
991	LSS WATCHDOG RESET
992	LSS EEPROM ERROR
993	LSS INTERNAL ERROR - PIN EXCITATION
994	LSS INTERNAL ERROR - DRDY MISSING FROM A/D
998	EEPROM FAILURE - CHECK ALL SETTINGS
9910	FUNCTIONS LOCKED OUT - PLATFORM MODULE SOFTWARE VERSION IMPROPER
9911	FUNCTIONS LOCKED OUT - LSS MODULE SOFTWARE VERSION IMPROPER
9915	CHASSIS TILT SENSOR NOT GAIN CALIBRATED
9919	GROUND SENSOR REF VOLTAGE OUT OF RANGE
9920	PLATFORM SENSOR REF VOLTAGE OUT OF RANGE
9921	GROUND MODULE FAILURE - HIGH SIDE DRIVER CUTOUT FAULTY
9922	PLATFORM MODULE FAILURE - HWFS CODE 1
9923	GROUND MODULE FAILURE - HWFS CODE 1
9924	FUNCTIONS LOCKED OUT - MACHINE NOT CONFIGURED
9944	CURRENT FEEDBACK GAINS OUT OF RANGE
9945	CURRENT FEEDBACK CALIBRATION CHECKSUM INCORRECT
9949	MACHINE CONFIGURATION OUT OF RANGE - CHECK ALL SETTINGS
9977	LSS CORRUPT EEPROM
9979	FUNCTIONS LOCKED OUT - GROUND MODULE SOFTWARE VERSION IMPROPER
9986	GROUND MODULE VLOW FET FAILURE

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
EVERYTHING OK or GROUND MODE OK	001[1]	The platform station (EVERYTHING OK) or ground station (GROUND MODE OK) is selected and the system detects no problems exist.	No response required.	-
RUNNING AT CUTBACK – OUT OF TRANSPORT POSITION	0010[1]	Tower Elevation Switch shows tower is elevated out of transport position or Boom Elevation Switch #1 shows boom elevated out of transport position or Boom Elevation Switch #2 shows boom elevated out of transport position	Machine is considered Out Of Transport Position	Lower boom into transport position
FSW OPEN	0011[1]	Machine is in Platform Mode Drive/Steer or Boom function control is activated when Footswitch not engaged	Machine is not allowed to enter the Machine Enabled state	Release controls, Engage Footswitch and reactivate Drive/ Steer and/or Boom function control
RUNNING AT CREEP - CREEP SWITCH OPEN	0012[1]	Machine is in Platform Mode Platform creep switch is turned on	Creep Mode is active	Turn Platform creep switch off
RUNNING AT CREEP - TILTED AND ABOVE ELEVATION	0013[1]	Fault RUNNING AT CREEP - CREEP SWITCH OPEN (DTC 0012) is not active Machine is Out Of Transport Position Machine chassis is considered Tilted	Creep Mode is active	Lower Machine and place on firm, level surface
RUNNING AT CREEP – PLATFORM STOWED	0030[1]	Platform is in Stowed Position	Lift Down and Level Down function speed maximums are limited to Ground Creep	Raise Platform from Stowed Position
LOAD SENSOR READING UNDER WEIGHT	0015	LSS has been calibrated and the UGM has determined that the load sensing system reading is less than -50lbs for 2 seconds. If the load sensing system determines that the reading is greater than -50lbs for 5 seconds this fault will no longer be annunciated. No control system interlocks present when DTC is active.		Ensure platform is not resting on the ground or is not leveled at an extreme negative angle. Re-calibrate the load sensing system if the above items are not a factor.
FUEL LEVEL LOW – ENGINE SHUTDOWN	0031	Engine Shutdown has occurred due to Fuel Level being EMPTY	Machine prohibits engine cranking and throttle functions	Add fuel to fuel tank
APU ACTIVE	0035	Emergency Descent Mode is active	Operation specified in Emergency Descent Mode section	Stop using Emergency Descent Mode
KEYSWITCH FAULTY	212	Both Ground and Platform Keyswitches are energized at the same time	The Control System assumes a station selection of Ground	On Analyzer under DIAGNOSTICS-->SYSTEM-->PLATFORM SELECT (and GROUND SELECT), activate Platform and Ground keyswitches to determine fault location; then troubleshoot wiring and/or keyswitch.
FSW FAULTY	213	The ground footswitch input and platform footswitch input have been both engaged or disengaged for a time period greater than or equal to 1 second	Machine does not allow any functions	Use the Emergency Stop Switch to cycle power

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUNCTION PROBLEM - STEER LEFT PERMANENTLY SELECTED	224	The machine is in Platform mode and the Steer Left switch is energized at startup	Machine enters Creep Mode and Steer Left and Right are prohibited	Enable machine and on Analyzer under DIAGNOSTICS-->DRIVE/STEER-->STEER DEMAND, observe Steer Left and Right commands; open Platform box and troubleshoot wiring or replace joystick.
FUNCTION PROBLEM - STEER RIGHT PERMANENTLY SELECTED	225	The machine is in Platform mode and the Steer Right switch is energized at startup	Machine enters Creep Mode and Steer Left and Right are prohibited	Enable machine and on Analyzer under DIAGNOSTICS-->DRIVE/STEER-->STEER DEMAND, observe Steer Left and Right commands; open Platform box and troubleshoot wiring or replace joystick.
STEER SWITCHES FAULTY	227	Both steer switch inputs on the Drive/Steer joystick are energized at startup (Platform or Ground mode).	Drive and Steer are prohibited.	Enable machine and on Analyzer under DIAGNOSTICS-->DRIVE/STEER-->STEER DEMAND, observe Steer Left and Right commands; open Platform box and troubleshoot wiring or replace joystick.
FSW INTERLOCK TRIPPED	2211	Machine is in Platform Mode. The footswitch is depressed for a time period greater than or equal to 7 seconds without activation of any functions	The Machine Enabled function is disabled	Release the footswitch
DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	2212	The Control System detects one of the following conditions: The machine is in Platform Mode and the drive joystick is not in the neutral position immediately following Start Up. The machine is in Platform Mode and the footswitch is depressed or DTC 2213, 2221, or 2223 are active while the drive joystick is not in the neutral position.	If caused by the drive joystick not being in the neutral position immediately following the startup period then disable drive and steer If caused by engaging footswitch while the drive joystick is not in the neutral position, then do not allow the machine to enter the Machine Enabled state	If caused by the drive joystick not being in the neutral position immediately following Start Up, then return Drive joystick to its neutral position before depressing footswitch If caused by footswitch being depressed while the drive joystick is not in the neutral position then release the footswitch, return the Drive joystick to neutral and depress the footswitch again
STEER LOCKED - SELECTED BEFORE FOOTSWITCH	2213	The Ground Module detects that the machine is in Platform Mode and the footswitch is depressed or DTC 2212, 2221 or 2223 is active while the steer controls are not in the neutral position.	Do not allow the machine to enter the Machine Enabled state	Steer controls are returned to neutral and the footswitch is released

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
D/S JOY. OUT OF RANGE HIGH	2216	The Platform Module detects that the drive/steer joystick voltage is out of range	The Control System disables Drive; Brake release and Steer still permitted	The Platform Module detects the voltage is in range and no longer reports the fault. Move joystick through range of motion and check voltage (should be approximately 0.7-6.3V).
D/S JOY. CENTER TAP BAD	2217	The Platform Module detects that the drive/steer center tap voltage is out of range	The Control System disables Drive; Brake release and Steer still permitted	The Platform Module detects the voltage is in range and no longer reports the fault
L/S JOY. OUT OF RANGE HIGH	2219	The Platform Module detects that the Lift/Swing joystick reference voltage is high	Disable Lift and Swing in Platform Mode	The Platform Module no longer reports the fault
L/S JOY. CENTER TAP BAD	2220	The Platform Module detects that the Lift/Swing center tap voltage is out of range	Disable Lift and Swing in Platform Mode.	The Platform Module detects that the lift/swing center tap voltage is in range and no longer reports the fault
LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	2221	The Ground Module detects one of the following conditions: The machine is in Platform Mode and the Lift and/or Swing controls are not in the neutral position immediately following Start Up. The machine is in Platform Mode and the footswitch is depressed or DTC 2212, 2213 or 2223 are active while the Lift/Swing joystick is not in the neutral position.	If fault occurs at startup, disable Lift and Swing in Platform Mode If fault occurs by engaging the footswitch after the control, then machine is not permitted to enter the Machine Enabled state.	Return Lift/Swing controls to neutral while not in the Enabled state. Return Lift/Swing controls to neutral and release the footswitch
WAITING FOR FSW TO BE OPEN	2222	Machine is in Platform Mode Footswitch has been engaged since Start Up	Machine is not allowed to enter the Machine Enabled state	Release the Footswitch
FUNCTION SWITCHES LOCKED - SELECTED BEFORE ENABLE	2223	The machine is in Platform Mode and the footswitch is depressed or DTC 2212, 2213, or 2221 is active while any of the following boom control inputs are engaged: Tower Lift Telescope Platform Level Platform Rotate Jib Lift	Machine is not allowed to enter the Machine Enabled state	Release engaged control switch and then depress footswitch
FOOTSWITCH SELECTED BEFORE START	2224	Machine is in Platform mode The footswitch is already engaged when an engine start is attempted from the platform controls	Disable engine start	Release the footswitch before attempting to start the engine
FUNCTION PROBLEM - PLATFORM ROTATE LEFT PERMANENTLY SELECTED	2247	The machine is in Platform mode and the platform rotate switch is sending a continual left rotate signal.	Machine enters Creep Mode and Platform Rotate Left and Right prohibited.	Release the footswitch and return the platform rotate switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if faulty.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUNCTION PROBLEM - PLAT-FORM ROTATE RIGHT PERMA-NENTLY SELECTED	2248	The machine is in Platform mode and the platform rotate switch is sending a continual right rotate signal.	Machine enters Creep Mode and Platform Rotate Left and Right prohibited.	Release the footswitch and return the platform rotate switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if faulty.
FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED	2249	The machine is in Platform mode and the jib lift switch is sending a continual lift up signal.	Machine enters Creep Mode and Platform Jib Lift Up and Down prohibited.	Release the footswitch and return the platform jib lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if faulty.
FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED	2250	The machine is in Platform mode and the jib lift switch is sending a continual lift down signal.	Machine enters Creep Mode and Platform Jib Lift Up and Down prohibited.	Release the footswitch and return the platform jib lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if faulty.
FUNCTION PROBLEM - TELE-SCOPE IN PERMANENTLY SELECTED	2251	The machine is in Platform mode and the telescope switch is sending a continual telescope in signal.	Machine enters Creep Mode and Tele In and Out prohibited.	Release the footswitch and return the telescope switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CON-TROLS on Analyzer. Replace the switch if faulty.
FUNCTION PROBLEM - TELE-SCOPE OUT PERMANENTLY SELECTED	2252	The machine is in Platform mode and the telescope switch is sending a continual telescope out signal.	Machine enters Creep Mode and Tele In and Out prohibited.	Release the footswitch and return the telescope switch to neutral. Replace the switch if faulty.
FUNCTION PROBLEM - TOWER LIFT UP PERMANENTLY SELECTED	2257	The machine is in Platform mode and the tower lift switch is sending a continual tower lift up signal.	Machine enters Creep Mode and Tower Lift Up and Down prohibited.	Release the footswitch and return the telescope switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CON-TROLS on Analyzer. Replace the switch if faulty.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUNCTION PROBLEM - TOWER LIFT DOWN PERMANENTLY SELECTED	2258	The machine is in Platform mode and the tower lift switch is sending a continual tower lift down signal.	Machine enters Creep Mode and Tower Lift Up and Down prohibited.	Release the footswitch and return the telescope switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer.Replace the switch if faulty.
FUNCTION PROBLEM - PLATFORM LEVEL UP PERMANENTLY SELECTED	2262	The machine is in Platform mode and the platform level up switch is sending a continual level up signal.	Machine enters Creep Mode and Platform Level Up and Down prohibited.	Release the footswitch and return the platform level switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if faulty.
FUNCTION PROBLEM - PLATFORM LEVEL DOWN PERMANENTLY SELECTED	2263	The machine is in Platform mode and the platform level down switch is sending a continual level up signal.	Machine enters Creep Mode and Platform Level Up and Down prohibited.	Release the footswitch and return the platform level switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if faulty.
FUNCTION SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM	234	The Ground Module detects one of the following conditions: The machine is in Ground Mode and both direction inputs of the following boom controls are energized at the same time: Engine Start/Aux, Telescope, Platform Level, Platform Rotate, Jib Lift, Tower Lift, Lift, or Swing. The machine is in Platform Mode and both direction inputs of the following boom controls are energized at the same time: Engine Start/Aux, Telescope, Platform Level, Platform Rotate, Jib Lift, Tower Lift	The boom function that is triggering the fault is disabled. **NOTE: If Engine Start/Aux Power is at fault, Emergency Descent will still be permitted.**	Check the switch for the applicable function. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace if faulty.
FUNCTION SWITCHES LOCKED - SELECTED BEFORE AUX POWER	235	The Ground Module detects one of the following conditions: The machine is in Ground Mode, the engine is stopped, and the ground Auxiliary Descent switch is selected after a Ground control switch has been selected. The machine is in Platform Mode, the engine is stopped, and the platform Auxiliary Descent switch is selected after a Platform control switch has been selected.	Emergency Descent mode is disabled	Release all function switches. Activate the Auxiliary Descent switch *before* any other applicable control switches or start the engine

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUNCTION SWITCHES LOCKED - SELECTED BEFORE START SWITCH	236	The Ground Module detects one of the following conditions: The machine is in Ground Mode, the engine is stopped, and any boom control is selected before the ground engine start switch is selected. The machine is in Platform Mode, the engine is stopped, any drive/steer or boom control is already engaged and the foot-switch is not engaged before the platform engine start switch is selected	Engine start is disabled	Release all function switches. Start the engine *before* any other applicable function switches are selected.
START SWITCH LOCKED - SELECTED BEFORE KEY-SWITCH	237	The engine start switch for the selected station is engaged during the Ground Module startup sequence.	Engine start is disabled	Release the engine start switch. Position the Ground/ Platform Select switch to the opposite operating station to verify the engine can be started. View switch state on Analyzer under DIAGNOSTICS-->OPER CONTROLS-->START SWITCH.
FUNCTION PROBLEM - GROUND ENABLE PERMANENTLY SELECTED	2310	The machine is in Ground mode and the Enable switch is in the selected position.	Disable Start and Boom functions, including Emergency Descent.	Return the switch to the off position. View switch state on Analyzer under DIAGNOSTICS-->OPER CONTROLS-->AUX DESCENT SW. Replace the switch if defective.
FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED	2370	The machine is in Ground mode and the Jib Lift switch is selected and trying to activate the Jib Lift Up function at startup.	Jib Lift Up and Down prohibited.	With the machine controls not enabled, return the Jib Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED	2371	The machine is in Ground mode and the Jib Lift switch is selected and trying to activate the Jib Lift Down function at startup.	Jib Lift Up and Down prohibited.	With the machine controls not enabled, return the Jib Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - SWING LEFT PERMANENTLY SELECTED	2372	The machine is in Ground mode and the Swing switch is selected and trying to activate the Swing Left function at startup.	Swing Left and Right prohibited.	With the machine controls not enabled, return the Swing switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUNCTION PROBLEM - SWING RIGHT PERMANENTLY SELECTED	2373	The machine is in Ground mode and the Swing switch is selected and trying to activate the Swing Right function at startup.	Swing Left and Right prohibited.	With the machine controls not enabled, return the Swing switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
BOOM TRANSPORT SWITCH DISAGREEMENT	23104	The Ground Module detects that Boom Elevation switch #1 and switch #2 are not in agreement for more than 4 seconds while lifting.	The Ground Module assumes an "Above Elevation" condition and does not allow Axle Oscillation.	Verify that the two boom angle switches are adjusted to actuate simultaneously. Cycle Power.
FUNCTION PROBLEM – TOWER LIFT UP PERMANENTLY SELECTED	23105	The machine is in Ground mode and the Tower Lift switch is selected and trying to activate the Tower Lift Up function at startup.	Tower Lift Up and Down prohibited.	With the machine controls not enabled, return the Tower Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM – TOWER LIFT DOWN PERMANENTLY SELECTED	23106	The machine is in Ground mode and the Tower Lift switch is selected and trying to activate the Tower Lift Down function at startup.	Tower Lift Up and Down prohibited.	With the machine controls not enabled, return the Tower Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - LIFT UP PERMANENTLY SELECTED	23107	The machine is in Ground mode and the Lift switch is selected and trying to activate the Lift Up function at startup.	Lift Up and Down prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - LIFT DOWN PERMANENTLY SELECTED	23108	The machine is in Ground mode and the Lift switch is selected and trying to activate the Lift Down function at startup.	Lift Up and Down prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUNCTION PROBLEM - TELE-SCOPE IN PERMANENTLY SELECTED	23109	The machine is in Ground mode and the Telescope switch is selected and trying to activate the Telescope In function at startup.	Tele In and Out prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - TELE-SCOPE OUT PERMANENTLY SELECTED	23110	The machine is in Ground mode and the Telescope switch is selected and trying to activate the Telescope Out function at startup.	Tele In and Out prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - PLAT-FORM LEVEL UP PERMA-NENTLY SELECTED	23111	The machine is in Ground mode and the Platform Level switch is selected and trying to activate the Platform Level Up function at startup.	Platform Level Up and Down prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - PLAT-FORM LEVEL DOWN PERMA-NENTLY SELECTED	23112	The machine is in Ground mode and the Platform Level switch is selected and trying to activate the Platform Level Down function at startup.	Platform Level Up and Down prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - PLAT-FORM ROTATE LEFT PERMA-NENTLY SELECTED	23113	The machine is in Ground mode and the Platform Rotate switch is selected and trying to activate the Platform Rotate Left function at startup.	Platform Rotate Right and Left prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.
FUNCTION PROBLEM - PLAT-FORM ROTATE RIGHT PERMA-NENTLY SELECTED	23114	The machine is in Ground mode and the Platform Rotate switch is selected and trying to activate the Platform Rotate Right function at startup.	Platform Rotate Right and Left prohibited.	With the machine controls not enabled, return the Lift switch to neutral. Actuate switch while monitoring state changes under appropriate menu in DIAGNOSTICS-->OPER CONTROLS on Analyzer. Replace the switch if defective.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
ROD SIDE PRESSURE SENSOR – FAULTY	23217*	After the operator demand is complete (enable valve de-energized after a tower lift down or boom lift down) and footswitch still active, the flow control are directional valves are appropriately held for 3sec to check the tower lift enable valve. This diagnostic is run at the same time as DTC 33563 If Rod side pressure is greater than 1800psi or less than 1000psi, fault is detected Fault, once triggered, is maintained within a given key-cycle Machine will be trapped in transport		Check relief setting or pressure transducer
*This fault will not be active if Boom Sensors are not calibrated, a subsequent function is activated, any retrieval mode is active, any valves or sensors involved in the diagnostics are not healthy, ground mode is selected or dump valve is energized for less than 3sec after a function is complete				
MODEL CHANGED – HYDRAULICS SUSPENDED – CYCLE EMS	259	The MACHINE SETUP → MODEL is changed using the analyzer	All of the boom, drive, and steer functions are disabled; the engine will be shut down.	Cycle Power.
GENERATOR MOTION CUTOUT ACTIVE	2513	MACHINE SETUP → GEN SET = BELT DRIVE and GEN SET CUTOUT = MOTION CUTOUT The machine is being operated in Platform mode and the footswitch and Generator Enable switch are engaged while any of the configured boom, drive, or steer functions are attempting to be activated.	All of the boom, drive, and steer functions are disabled.	Motion is no longer attempted or generator is turned off.
BOOM PREVENTED – DRIVE SELECTED	2514	The machine is set up to cut out boom functions when the drive or steer is being operated. The machine is in the Out of Transport position and the operator is operating a Drive or Steer function and attempts to activate a boom function. Note: DTC 2514 supercedes DTC 2518 if drive/steer and boom functions are both active when the machine changes from Below Elevation to Above Elevation.	All boom functions are disabled.	Stop operating any Drive or Steer functions. Activate the Boom function.
DRIVE PREVENTED – ABOVE ELEVATION	2516	The machine is set up to cut out drive and steer when the boom is above elevation. The machine is in the Out of Transport position. The Control System senses the boom is above elevation and the operator is attempting to activate Drive or Steer	Disable Drive and Steer	Place the machine in the transport position before attempting to drive or steer.
DRIVE PREVENTED – TILTED & ABOVE ELEVATION	2517	The machine is set up to cut out drive and steer when the chassis is tilted and boom is above elevation. The machine is in the Out Of Transport position. The Control System senses the chassis is tilted and the operator is attempting to activate Drive or Steer	Disable Drive and Steer	Place the machine in the transport position before attempting to drive or steer.
DRIVE PREVENTED – BOOM SELECTED	2518	The machine is set up to cut out functions when the boom is being operated. The machine is in the Out Of Transport position. The operator is operating a boom function and tries to activate the Drive or Steer controls.	Disable Drive and Steer	Stop operating any boom functions. Activate the Drive or Steer function.
FUNCTIONS LOCKED OUT – CONSTANT DATA VERSION IMPROPER	2520	The Ground Module detects a mismatch between programmed sections of the processor memory.	Disable all machine and engine functions (i.e., command engine shutdown and do not permit start).	Reprogram the software so that the memory values match. Cycle Power.
RUNNING AT CREEP - PLATFORM LEVELED UNDER	2587	The control system has determined that the platform is leveled under and is being considered to be in a loading/unloading position. Boom, Tower, and Level Override functions will operate at creep speed.		

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
BRAKE – SHORT TO BATTERY	331	The Ground Module detects a short to battery at the brake output.	Disable Drive and Brake outputs.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
BRAKE – OPEN CIRCUIT	332	The Ground Module detects an open circuit at the brake output.	No response required.	Inspect wiring for physical damage. Check for a good connection at the solenoid and for wire continuity through this circuit. Cycle power to clear the fault.
LIFT UP VALVE – OPEN CIRCUIT	334	The Ground Module detects an open circuit at the lift up valve output.	The Ground Module suspends the Lift Up/Down command and reverts to Open Loop Current control for Lift; Lift speed is limited to Creep after both Lift Up/Down controls are returned to neutral and the machine controls are not Enabled.	Inspect wiring for physical damage. Check for a good connection at the solenoid and for continuity through the circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Cycle power to clear the fault.
LIFT DOWN VALVE – SHORT TO GROUND	335	The Ground Module detects a short to ground at the Lift Down valve output.	Ground Module Lift Up and Down outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
LIFT DOWN VALVE – OPEN CIRCUIT	336	The Ground Module detects an open circuit at the Lift Down valve output.	The Ground Module suspends Lift Up/Down commands and reverts to Open Loop Current control for Lift; Lift speed is limited to Creep after both Lift Up/Down controls have been returned to neutral and machine is not Enabled.	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
GROUND ALARM – SHORT TO BATTERY	3311	The Ground Module detects a short to battery at the Ground Alarm output.	No response required.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
MAIN DUMP VALVE – SHORT TO GROUND	3358	The Ground Module detects a short to ground at the Main Dump Valve output.	The Main Dump Valve output is disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
MAIN DUMP VALVE – OPEN CIRCUIT	3359	The Ground Module detects an open circuit at the Main Dump Valve output.	No response required.	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
MAIN DUMP VALVE – SHORT TO BATTERY	3360	The Ground Module detects a short to battery at the Main Dump Valve output.	Ground Module Main Dump, Swing Left/Right, Tower Lift Up, and Lift Up outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
BRAKE – SHORT TO GROUND	3361	The Ground Module detects a short to ground at the Brake output.	Ground Module Drive/Steer and Brake outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
START SOLENOID – SHORT TO GROUND	3362	The Ground Module detects a short to ground at the Engine Starter Solenoid.	Engine Start attempt is not permitted.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
START SOLENOID – OPEN CIRCUIT	3363	Ground Module detects an open circuit at this output; if machine is equipped with a Dual Fuel ECU, ground module will only evaluate for open circuit conditions until first Start is attempted for each power cycle due to possibility of ECU opening ground solenoid return path to disable Start and causing erroneous diagnostics.	No response required.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
START SOLENOID – SHORT TO BATTERY	3364	The Ground Module detects a short to battery at the Engine Starter Solenoid.	Ground Module Engine Start is disabled by de-energizing the Fuel Actuator (Kubota) or sending an Engine Shutdown command (Dual Fuel ECU)	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
STEER DUMP VALVE – SHORT TO GROUND	3365	The Ground Module detects a short to ground at the Steer Dump Valve output.	Ground Module Steer Dump output is disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
STEER DUMP VALVE – OPEN CIRCUIT	3366	The Ground Module detects an open circuit at the Steer Dump Valve output.	No response required.	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.

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Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
STEER DUMP VALVE – SHORT TO BATTERY	3367	The Ground Module detects a short to battery at the Steer Dump Valve output.	Ground Module Steer Dump, Steer, and Flow Control outputs are disabled; Steer, Tele In/Out, Jib Up (permitted if operating in Emergency Descent mode), Level Up/Down, and Rotate Left/Right functions are disallowed.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
GEN SET/WELDER – SHORT TO GROUND	3373	The Ground Module detects a short to ground at the Gen Set/Welder output.	Ground Module Generator relay output is disabled thereby disabling generator functionality.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
GEN SET/WELDER – OPEN CIRCUIT	3374	The Ground Module detects an open circuit at the Gen Set/Welder output.	No response required.	Check for a good connection at the relay and for continuity through this circuit. With the relay disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
GEN SET/WELDER – SHORT TO BATTERY	3375	The Ground Module detects a short to battery at the Gen Set/Welder output.	The Ground Module Generator relay output is disabled, but the Ground Module considers the Generator always enabled and restricts engine speed to Generator RPM. If MACHINE SETUP → GENSET CUTOUT = MOTION CUTOUT, disregard cutout and permit motion.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
HEAD TAIL LIGHT – SHORT TO GROUND	3376	The Ground Module detects a short to ground at the Head-Tail Light output.	Ground Module H&T Light relay output is disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
HEAD TAIL LIGHT – OPEN CIRCUIT	3377	The Ground Module detects an open circuit at the Head-Tail Light output.	No response required.	Check for a good connection at the relay and for continuity through this circuit. With the relay disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Fault cleared with power cycle.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
HEAD TAIL LIGHT – SHORT TO BATTERY	3378	The Ground Module detects a short to battery at the Head-Tail Light output.	Disable Ground Module H&T Light relay output is disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
HOUR METER – SHORT TO GROUND	3379	The Ground Module detects a short to ground at the Hourmeter output.	Ground Module Hourmeter output is disabled.	Inspect wiring for physical damage and check for wire continuity. Confirm high resistance reading across hourmeter. Cycle power to clear the fault.
HOUR METER – SHORT TO BATTERY	3381	The Ground Module detects a short to battery at the Hourmeter output.	Ground Module Hourmeter output is disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
PLATFORM LEVEL UP VALVE – SHORT TO GROUND	3382	The Ground Module detects a short to ground at the Platform Level Up Valve output.	Ground Module Platform Level Up is disabled; Level Down speed is limited to Creep.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
PLATFORM LEVEL UP VALVE – OPEN CIRCUIT	3383	The Ground Module detects an open circuit at the Platform Level Up Valve output.	Platform Level speed is limited to Creep.	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.
PLATFORM LEVEL UP VALVE – SHORT TO BATTERY	3384	The Ground Module detects a short to battery at the Platform Level Up Valve output.	Ground Module Platform Level Up, Level Down, and Flow Control Valve outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
PLATFORM LEVEL DOWN VALVE – SHORT TO GROUND	3388	The Ground Module detects a short to ground at the Platform Level Down Valve output.	Ground Module Platform Level Up and Down valve outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
PLATFORM LEVEL DOWN VALVE – OPEN CIRCUIT	3389	The Ground Module detects an open circuit at the Platform Level Down Valve output.	Platform Level speed is limited to Creep.	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.
PLATFORM LEVEL DOWN VALVE – SHORT TO BATTERY	3390	The Ground Module detects a short to battery at the Platform Level Down Valve output.	Ground Module Platform Level Up, Level Down, and Flow Control Valve outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
TOWER LIFT UP VALVE – SHORT TO GROUND	33106	The Ground Module detects a short to ground at the Tower Lift Up Valve output.	Ground Module Tower Lift Up output is disabled; Tower Lift Down speed is limited to Creep	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
TOWER LIFT UP VALVE – OPEN CIRCUIT	33107	The Ground Module detects an open circuit at the Tower Lift Up Valve output.	The Ground Module suspends Tower Lift Up/Down commands and reverts to Open Loop Current control for Tower Lift; Tower Lift speed is limited to Creep after both Tower Lift Up/Down controls have been returned to neutral and machine is not Enabled	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
TOWER LIFT DOWN VALVE – SHORT TO GROUND	33109	The Ground Module detects a short to ground at the Tower Lift Down Valve output.	Ground Module Tower Lift Up and Down outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
TOWER LIFT DOWN VALVE – OPEN CIRCUIT	33110	The Ground Module detects an open circuit at the Tower Lift Down Valve output.	The Ground Module suspends Tower Lift Up/Down commands and reverts to Open Loop Current control for Tower Lift; Tower Lift speed is limited to Creep after both Tower Lift Up/Down controls have been returned to neutral and machine is not Enabled	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
SWING RIGHT VALVE – SHORT TO GROUND	33118	The Ground Module detects a short to ground at the Swing Right Valve output.	Swing Left and Right outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
SWING RIGHT VALVE – OPEN CIRCUIT	33119	The Ground Module detects an open circuit at the Swing Right Valve output.	The Ground Module suspends Swing Left/Right commands and reverts to Open Loop Current control for Swing; Swing speed is limited to Creep after both Swing Left/Right controls are returned to neutral and machine is not Enabled	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
TELESCOPE IN VALVE – SHORT TO BATTERY	33120	The Ground Module detects a short to battery at the Telescope In Valve output.	Ground Module Telescope In, Telescope Out, and Flow Control Valve outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
SWING LEFT VALVE – SHORT TO GROUND	33122	The Ground Module detects a short to ground at the Swing Left Valve output.	Ground Module Swing Left and Right outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
TELESCOPE OUT VALVE – SHORT TO BATTERY	33123	The Ground Module detects a short to battery at the Telescope Out Valve output.	Ground Module Telescope In, Telescope Out, and Flow Control Valve outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
THROTTLE ACTUATOR – SHORT TO GROUND	33130	The Ground Module detects a short to ground at the Throttle Actuator output (Kubota).	The Ground Module Throttle Actuator output is disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
THROTTLE ACTUATOR – OPEN CIRCUIT	33131	The Ground Module detects an open circuit at the Throttle Actuator output (Kubota).	No response required	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
THROTTLE ACTUATOR – SHORT TO BATTERY	33132	The Ground Module detects a short to battery at the Throttle Actuator output (Kubota).	The Ground Module Throttle Actuator output is disabled; functions are set to Creep speed.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
LIFT VALVES – SHORT TO BATTERY	33182	The Ground Module detects a short to battery at either the Lift Up or Lift Down valve	The Ground Module Lift Up and Down outputs are disabled and ground current return path is open circuited.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.

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Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
TELESCOPE OUT VALVE – OPEN CIRCUIT	33186	The Ground Module detects an open circuit at the Telescope Out Valve output.	Tele speed is limited to Creep	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
TELESCOPE OUT VALVE – SHORT TO GROUND	33188	The Ground Module detects a short to ground at the Telescope Out Valve output.	Ground Module Telescope Out output is disabled; Tele In speed is limited to Creep.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
TELESCOPE IN VALVE – OPEN CIRCUIT	33189	The Ground Module detects an open circuit at the Telescope In Valve output.	Tele speed is limited to Creep	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
TELESCOPE IN VALVE – SHORT TO GROUND	33190	The Ground Module detects a short to ground at the Telescope In Valve output.	Ground Module Telescope In and Out outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
GLOWPLUG – OPEN CIRCUIT	33279	The Ground Module detects an open circuit at the Glow Plug output. (Kubota)	No response required	Check for a good connection at the relay and for continuity through this circuit. With the relay disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
GLOWPLUG – SHORT TO BATTERY	33280	The Ground Module detects a short to battery at the Glow Plug output. (Kubota)	Ground Module Glow Plug relay output is disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
GLOWPLUG – SHORT TO GROUND	33281	The Ground Module detects a short to ground at the Glow Plug output. (Kubota)	Ground Module Glow Plug relay output is disabled.	Inspect wiring for physical damage and check for wire continuity. Check for relay damage or shorting condition in connector. Cycle power to clear the fault.
LIFT – CURRENT FEEDBACK READING TOO LOW	33287	The Ground Module calls for current greater than 250mA, but the actual current is at least 125mA less than the called for current for more than 1 second	The Ground Module suspends Lift Up/Down commands and reverts to Open Loop Current control for Lift; Lift speed is limited to Creep after both Lift Up/Down controls have been returned to neutral and the machine is not Enabled	Part of the commanded current is being divided either prior to the solenoid connection or on the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
SWING LEFT VALVE – OPEN CIRCUIT	33295	The Ground Module detects an open circuit at the Swing Left Valve output.	The Ground Module suspends Swing Left/Right commands and reverts to Open Loop Current control for Swing; Swing speed is limited to Creep after both Swing Left/Right controls have been returned to neutral and the machine is not Enabled	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
FLOW CONTROL VALVE – OPEN CIRCUIT	33314	The Ground Module detects an open circuit at the Flow Control Valve output.	The Ground Module suspends output commands and reverts to Open Current loop control for Flow Control Valve; Tele In/Out, Jib Up, Rotate Right/Left, and Level Up/Down speed are limited to Creep after controls for those functions have all been simultaneously returned to neutral and the machine is not Enabled.	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
FLOW CONTROL VALVE – SHORT TO BATTERY	33315	The Ground Module detects a short to battery at the Flow Control Valve output.	Disable Ground Module Flow Control Valve output and open the ground current return path; disallow energization of valves for Tele In/Out, Jib Up (permitted if operating in Emergency Descent mode), Level Up/Down, or Rotate Right/Left.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FLOW CONTROL VALVE – SHORT TO GROUND	33316	The Ground Module detects a short to ground at the Flow Control Valve output.	Ground Module Flow Control Valve output is disabled; disallows energization of valves for Tele In/Out, Jib Up (permitted if operating in Emergency Descent mode), Level Up/ Down, or Rotate Right/Left.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
DRIVE FORWARD VALVE – OPEN CIRCUIT	33317	The Ground Module detects an open circuit at the Drive Forward Valve output.	The Ground Module suspends Drive Forward/Reverse commands and reverts to Open Current loop control for Drive; Drive speed is limited to Creep after both Drive Forward/Reverse controls have been returned to neutral and the machine is not Enabled.	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
DRIVE VALVES – SHORT TO BATTERY	33318	The Ground Module detects a short to battery at either the Drive Forward or Drive Reverse valve.	Ground Module Drive Forward and Reverse outputs are disabled and open the ground current return path.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
DRIVE FORWARD VALVE – SHORT TO GROUND	33319	The Ground Module detects a short to ground at the Drive Forward Valve output.	Ground Module Drive Forward and Reverse outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
DRIVE REVERSE VALVE – OPEN CIRCUIT	33320	The Ground Module detects an open circuit at the Drive Reverse Valve output.	The Ground Module suspends Drive Forward/Reverse commands and reverts to Open Current loop control for Drive; Drive speed is limited to Creep after both Drive Forward/Reverse controls have been returned to neutral and the machine is not Enabled.	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.
DRIVE REVERSE VALVE – SHORT TO GROUND	33322	The Ground Module detects a short to ground at the Drive Reverse Valve output.	Ground Module Drive Forward and Reverse outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
DRIVE – CURRENT FEEDBACK READING TOO LOW	33331	The Ground Module calls for current greater than 250mA, but the actual current is at least 125mA less than the called for current for more than 1 second	The Ground Module suspends Drive Forward/Reverse commands and reverts to Open Current loop control for Drive; Drive speed is limited to Creep after both Drive Forward/Reverse controls have been returned to neutral and the machine is not Enabled.	Part of the commanded current is being divided either prior to the solenoid connection or on the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
LIFT UP VALVE – SHORT TO GROUND	33406	The Ground Module detects a short to ground at the Lift Up Valve output.	Lift Up is disabled; Lift Down speed is limited to Creep	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
DRIVE – LOSS OF CURRENT FEEDBACK	33410	Measured feedback current is less than 225mA while Ground Module output is greater than 40% (Displayed on Analyzer DIAGNOSTICS menu).	The Ground Module suspends Drive Forward/Reverse commands and reverts to Open Current loop control for Drive; Drive speed is limited to Creep after both Drive Forward/Reverse controls have been returned to neutral and the machine is not Enabled.	Part or all of the commanded current is being diverted from the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
SWING VALVES – SHORT TO BATTERY	33412	The Ground Module detects a short to battery at either the Swing Right or Swing Left valve	Ground Module Swing Left and Right outputs are disabled and open the ground current return path is open circuited.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
TOWER LIFT – CURRENT FEEDBACK READING TOO LOW	33413	The Ground Module calls for current greater than 250mA, but the actual current is at least 125mA less than the called for current for more than 1 second	The Ground Module suspends Tower Lift commands and reverts to Open Current loop control for Tower Lift; Tower Lift speed is limited to Creep after both Tower Lift Up/Down controls have been returned to neutral and the machine is not Enabled.	Part of the commanded current is being divided either prior to the solenoid connection or on the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
SWING – CURRENT FEEDBACK READING TOO LOW	33414	The Ground Module calls for current greater than 250mA, but the actual current is at least 125mA less than the called for current for more than 1 second	The Ground Module suspends Swing Left/Right commands and reverts to Open Loop Current control for Swing; Swing speed is limited to Creep after both Swing Left/Right have been returned to neutral and the machine is not Enabled	Part of the commanded current is being divided either prior to the solenoid connection or on the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FLOW CONTROL VALVE – CURRENT FEEDBACK READING TOO LOW	33415	The Ground Module calls for current greater than 250mA, but the actual current is at least 125mA less than the called for current for more than 1 second	The Ground Module suspends and reverts to Open Current loop control for Flow Control Valve; Tele In/Out, Jib Up, Rotate Right/Left, and Level Up/Down speed is limited to Creep after controls for those functions have all been simultaneously returned to neutral and the machine is not Enabled	Part of the commanded current is being divided either prior to the solenoid connection or on the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
TOWER LIFT – CURRENT FEEDBACK READING LOST	33416	Measured feedback current is less than 225mA while Ground Module output is greater than 40% (Displayed on Analyzer DIAGNOSTICS menu).	The Ground Module suspends commands and reverts to Open Current loop control for Tower Lift; Tower Lift speed is limited to Creep after both Lift Up/ Down controls have been returned to neutral and the machine is not Enabled.	Part or all of the commanded current is being diverted from the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
LIFT – CURRENT FEEDBACK READING LOST	33417	Measured feedback current is less than 225mA while Ground Module output is greater than 40% (Displayed on Analyzer DIAGNOSTICS menu).	The Ground Module suspends Lift Up/Down commands and reverts to Open Loop Current control for Lift; Lift speed is limited to Creep after both Lift Up/ Down controls have been returned to neutral and the machine is not Enabled.	Part or all of the commanded current is being diverted from the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
SWING – CURRENT FEEDBACK READING LOST	33418	Measured feedback current is less than 225mA while Ground Module output is greater than 40% (Displayed on Analyzer DIAGNOSTICS menu).	The Ground Module suspends Swing Left/Right commands and reverts to Open Loop Current control for Swing; Swing speed is limited to Creep after both Swing Left/Right have been returned to neutral and the machine is not Enabled.	Part or all of the commanded current is being diverted from the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
FLOW CONTROL VALVE – CURRENT FEEDBACK READING LOST	33419	Measured feedback current is less than 225mA while Ground Module output is greater than 40% (Displayed on Analyzer DIAGNOSTICS menu).	The Ground Module suspends and reverts to Open Current loop control for Flow Control Valve; Tele In/Out, Jib Up, Rotate Right/Left, and Level Up/Down speed is limited to Creep after controls for those functions have all been simultaneously returned to neutral and the machine is not Enabled	Part or all of the commanded current is being diverted from the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
TRACTION LOCK VALVE – SHORT TO BATTERY	33420	The Ground Module detects a short to battery at the Traction Lock valve output.	If in Max Speed drive mode, the machine switches to Max Torque; Max Speed drive mode is disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
TRACTION LOCK VALVE – OPEN CIRCUIT	33421	The Ground Module detects an open circuit at the Traction Lock valve output.	If in Max Speed drive mode, the machine switches to Max Torque; Max Speed drive mode is disabled.	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage.Cycle power to clear the fault.
TRACTION LOCK VALVE – SHORT TO GROUND	33422	The Ground Module detects a short to ground at the Traction Lock valve output.	Traction Lock valve output is disabled. If in Max Speed drive mode, the machine switches to Max Torque; Max Speed drive mode is disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
OSCILLATING AXLE VALVES – SHORT TO BATTERY	33423	The Ground Module detects a short to battery condition on the J1-7 output.	The Ground Module assumes an Above Elevation State and de-energizes the J1-7 Oscillating Axle output.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
OSCILLATING AXLE VALVES – SHORT TO GROUND	33424	The Ground Module detects a short to ground condition on the J1-7 output.	The Ground Module to assumes an Above Elevation State and de-energizes J1-7 Oscillating Axle output.	Inspect wiring for physical damage and check for wire continuity. Check for shorting condition in connector. Cycle power to clear the fault.
TOWER LIFT VALVES – SHORT TO BATTERY	33425	The Ground Module detects a short to battery at either the Tower Lift Up or Tower Lift Down valve.	Ground Module Tower Lift Up and Down outputs are disabled and open the ground current return path.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
PLATFORM ROTATE LEFT VALVE – OPEN CIRCUIT	349	The Platform Module detects an open circuit at the Platform Rotate Left Valve output and reports it to the Ground Module.	Platform Rotate speed is limited to Creep	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.
PLATFORM ROTATE LEFT VALVE – SHORT TO BATTERY	3410	The Platform Module detects a short to battery at the Platform Rotate Left Valve output and reports it to the Ground Module.	Platform Module are disabled for Platform Rotate Right, Rotate Left, and Flow Control Valve outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
PLATFORM ROTATE LEFT VALVE – SHORT TO GROUND	3411	The Platform Module detects a short to ground at the Platform Rotate Left Valve output and reports it to the Ground Module.	Platform Rotate Right and Left outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
PLATFORM ROTATE RIGHT VALVE – OPEN CIRCUIT	3412	The Platform Module detects an open circuit at the Platform Rotate Right Valve output and reports it to the Ground Module.	Platform Rotate speed is limited to Creep	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
PLATFORM ROTATE RIGHT VALVE – SHORT TO BATTERY	3413	The Platform Module detects a short to battery at the Platform Rotate Right Valve output and reports it to the Ground Module.	Platform Rotate Right, Rotate Left, and Flow Control Valve outputs.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
PLATFORM ROTATE RIGHT VALVE – SHORT TO GROUND	3414	The Platform Module detects a short to ground at the Platform Rotate Right Valve output and reports it to the Ground Module.	Platform Rotate Right and Left outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
JIB LIFT UP VALVE – OPEN CIRCUIT	3415	The Platform Module detects an open circuit at the Jib Lift Up Valve output and reports it to the Ground Module.	Jib Lift speed is limited to Creep.	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.
JIB LIFT UP VALVE – SHORT TO BATTERY	3416	The Platform Module detects a short to battery at the Jib Lift Up Valve output and reports it to the Ground Module.	Jib Lift Up and Flow Control Valve outputs are disabled; Jib Lift Down speed is limited to Creep	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.
JIB LIFT UP VALVE – SHORT TO GROUND	3417	The Platform Module detects a short to ground at the Jib Lift Up Valve output and reports it to the Ground Module.	Jib Lift Up output is disabled; Jib Lift Down speed is limited to Creep	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
JIB LIFT DOWN VALVE – OPEN CIRCUIT	3418	The Platform Module detects an open circuit at the Jib Lift Down Valve output and reports it to the Ground Module.	Jib Lift speed is limited to Creep.	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.
JIB LIFT DOWN VALVE – SHORT TO BATTERY	3419	The Platform Module detects a short to battery at the Jib Lift Down Valve output and reports it to the Ground Module.	Jib Lift Up and Down outputs are disabled.	Check for a good connection at the solenoid and for continuity through this circuit. Inspect wiring for physical damage. Cycle power to clear the fault.
JIB LIFT DOWN VALVE – SHORT TO GROUND	3420	The Platform Module detects a short to ground at this output and reports it to the Ground Module.	Jib Lift Up and Down outputs are disabled.	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUEL SENSOR SHORT TO BATTERY	431	Ground Module fuel sensor input (J2-25) detects a voltage higher than 2.50 volts	The Control System shuts down all fuel level indicators in Platform and Ground stations.	Disconnect fuel sender and verify resistance readings can range from approximately 30ohms (full) to 240ohms (empty). If not, replace sender. With fuel sender connected, backprobe J2-25 and verify voltage range from approximately 0.5V to 2.3V. Troubleshoot wiring or connections.
FUEL SENSOR SHORT TO GROUND	432	Ground Module fuel sensor input (J2-25) detects a voltage less than or equal to 0.3 volts	The Control System shuts down all fuel level indicators in Platform and Ground stations.	Disconnect fuel sender and verify resistance readings can range from approximately 30ohms (full) to 240ohms (empty). If not okay, replace sender. With fuel sender connected, backprobe J2-25 and verify voltage range from approximately 0.5V to 2.3V. Troubleshoot wiring or connections.
OIL PRESSURE SHORT TO BATTERY	433	MACHINE SETUP → ENGINE = KUBOTA D1105 Oil Pressure reads a high value at Startup even though the engine has not been started (occurs for STB or OC – wire off pressure switch)	If MACHINE SETUP → ENGINE SHUTDOWN = ENABLED then engine start is not permitted; Low Oil Pressure indicator will be activated	Verify wire is connected to oil pressure switch. With engine off, switch should show low impedance to ground or replace switch. Observe state change on Analyzer under DIAGNOSTICS-->ENGINE-->ENGINE OIL PRESS
COOLANT TEMPERATURE SHORT TO GROUND	435	MACHINE SETUP → ENGINE = KUBOTA D1105 Ground Module coolant temperature input (J1-14) detects a voltage less than or equal to 0.05 volts	If MACHINE SETUP → ENGINE SHUTDOWN = ENABLED then engine will be shutdown High Engine Temperature indicator will be activated	Disconnect temperature sender and verify resistance reading > 0.15ohms (up to 50kohms is acceptable); then troubleshoot wiring. With system on, backprobe J1-14 and verify voltage > 1.5V.
ENGINE TROUBLE CODE	437	The engine controller reports a J1939 fault	Engine will operate at 1800RPM until power cycle.	Cycle power to clear the fault.
HIGH ENGINE TEMP	438	For a machine configured with a Kubota D1105 engine, the engine has been running more than 10 seconds and the engine coolant temperature is greater than 110ºC: For a machine with electronic engine controls, the ECM transmits an engine coolant high temperature critical fault (SPN:FMI 110:0)	If MACHINE SETUP → ENGINE SHUTDOWN = ENABLED then the engine will be shut down and the High Engine Temperature indicator will be lit	Reduce hydraulic loading of machine and inspect radiator for blockage of air flow.
NO ALTERNATOR OUTPUT	4310	The engine has been running more than 10 seconds and Ground Module system voltage is less than 11.5 volts for 10 seconds	The No Charge indicator will be lit	Ground Module system voltage greater than 11.7 volts

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
LOW OIL PRESSURE	4311	For a machine configured with a Kubota D1105 engine, the engine has been running more than 10 seconds and the engine oil pressure is LOW (debounce 3s). For a machine with electronic engine controls, the ECM transmits an engine oil low pressure critical fault (SPN:FMI 100:1).	If MACHINE SETUP → ENGINE SHUTDOWN = ENABLED then the engine will be shut down and the Low Oil Pressure indicator will be lit	Check engine oil level. Cycle power to clear the fault.
THROTTLE ACTUATOR FAILURE	4313	For a machine configured with a Kubota D1105 engine: THROTTLE ACTUATOR – OPEN CIRCUIT (33131) is <u>not</u> active THROTTLE ACTUATOR – SHORT TO GROUND (33130) is <u>not</u> active LOSS OF ENGINE SPEED SENSOR (4322) is not active desired engine speed is greater than 1800 but actual RPM is less than 1400 (debounce time = 3s) when no fault exists with Proportional Fuel Rack actuator	Disable Ground Module Throttle Actuator output and call for full opening (current = 1500mA) to Proportional Fuel Rack Actuator.	Cycle power to clear the fault.
WRONG ENGINE SELECTED – ECM DETECTED	4314	Machine is configured with a non-electronic controlled Kubota D1105 engine and the Ground Module detects an electronic engine controller on the CAN bus	No function inhibits required	Cycle power to clear the fault.
LOSS OF ENGINE SPEED SENSOR	4322	Machine is configured with a Kubota D1105 engine and the engine is running: LOW OIL PRESSURE fault (4311) is not active OIL PRESSURE SHORT TO BATTERY fault (433) is not active No engine shutdown command exists Engine RPM is read as 0 for 1500ms and Engine oil pressure is not LOW	Ground Module to limit all function speeds to creep, but run at High Engine speed until the oil pressure drops to a low value. Ground Module to disable Generator relay output until generator operator switch cycled.	Check proper seating/clearance of engine speed sensor installation. Verify continuity of wiring before replacing sensor. Fault cleared when Engine RPM greater than 0
SPEED SENSOR READING INVALID SPEED	4323	Machine is configured with a Kubota D1105 engine and the engine RPM reading is greater than 4000	The Ground Module commands High Engine speed and places all functions in Creep.	Verify integrity of wiring, particularly the ground, before replacing sensor. Fault cleared when engine RPM reading < 4000
FUEL ACTUATOR – SHORT TO GROUND	4326	The Ground Module detects a short to ground at the fuel actuator output. (Kubota)	The Ground Module disables the Fuel Actuator output	Inspect wiring for physical damage and check for wire continuity. Check for coil damage or shorting condition in connector. Cycle power to clear the fault.
FUEL ACTUATOR – OPEN CIRCUIT	4327	The Ground Module detects an open circuit at the fuel actuator output. (Kubota)	The Ground Module controls revert to Open Loop and restrict machine speeds to Creep.	Check for a good connection at the solenoid and for continuity through this circuit. With the solenoid disconnected, an open circuit voltage of nearly 8.0V exists on the Ground Module output pin for diagnostic purposes. Inspect wiring for physical damage. Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FUEL ACTUATOR – SHORT TO BATTERY	4328	The Ground Module detects a short to battery at the fuel actuator output. (Kubota)	Disable Ground Module Fuel Actuator output and open the ground current return path.	Inspect wiring for physical damage and check for wire continuity. Cycle power to clear the fault.
FUEL ACTUATOR - CURRENT FEEDBACK READING TOO LOW	4329	The Ground Module calls for current greater than 250mA, but the actual current is at least 125mA less than the called for current for more than 1 second	The Ground Module controls revert to Open Loop control and restricts all machine speeds to Creep.	Part of the commanded current is being divided either prior to the solenoid connection or on the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
FUEL ACTUATOR – CURRENT FEEDBACK READING LOST	4330	Measured feedback current is less than 225mA while Ground Module output is greater than 40% for a period of 100ms (Displayed on Analyzer DIAGNOSTICS menu).	The Ground Module controls revert to Open Loop and restricts all machine speeds to Creep.	Part or all of the commanded current is being diverted from the ground return path. Inspect wiring for physical damage and check for wire continuity and a low resistance return path. Cycle power to clear the fault.
BATTERY VOLTAGE TOO LOW – SYSTEM SHUTDOWN	441	The Ground Module detects that its supply voltage is less than 9 volts	Disable all Ground Module valve outputs except those used during Emergency Descent (Tower Lift Down, Lift Down, Jib Up/Down). If MACHINE SETUP → H&T LIGHTS = YES or → ENGINE = KUBOTA D1105 turn off lights and disable glow plugs.	Perform battery maintenance. Fault cleared when voltage is greater than 9.25 volts
BATTERY VOLTAGE TOO HIGH – SYSTEM SHUTDOWN	442	The Ground Module detects that its supply voltage is greater than 16.0 volts.	Disable all Ground Module and Platform outputs until voltage is less than 15.75 volts	Likely cause is poor alternator regulation; check alternator. Cycle power to clear the fault.
LSS BATTERY VOLTAGE TOO HIGH	443	MACHINE SETUP → LOAD SYSTEM NOT EQUAL The machine is configured with and Load Sensing System and the Ground Module detects that the LSS reports supply voltage greater than 16.0 volts.	Ground Module to set Platform Load State = Overloaded	LSS reports voltage less than 16.0V
LSS BATTERY VOLTAGE TOO LOW	444	The machine is configured with and Load Sensing System and the Ground Module detects that the LSS reports supply voltage less than 9.0 volts.	Ground Module to set Platform Load State = Overloaded	LSS reports voltage greater than 9.0V
BATTERY VOLTAGE LOW	445	The Ground Module detects that its supply voltage < 11 volts for 5 seconds while none of the following conditions exist: Engine is not cranking Emergency Descent Mode is not active Glow Plugs are not energized	No functions are inhibited	Voltage is greater than 11.25 volts

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
LSS BATTERY VOLTAGE - INITIALIZATION ERROR	4479	The shear beam is reporting a Sensor Supply Voltage Initialization Error The machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS BATTERY VOLTAGE - NOT CALIBRATED	4480	The shear beam is reporting a Sensor Supply Voltage calibration error. The machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
CANBUS FAILURE – PLATFORM MODULE	662	Ground Module does not receive any CAN messages from the Platform Module in 250ms	All functions will be decelerated to zero and generator will be disabled. If machine equipped with Dual Fuel engine, state of Fuel Selection switch shall be retained until CAN Bus 1 is restored. Reactivation of Footswitch is required to resume operation.	With power off, disconnect the boom cable at the bottom of the Platform box. With a multimeter, verify that the resistance between the CAN1H and CAN1L pins of the boom cable is approximately 120ohms. Verify the same at the connector entering the bottom of the box. If Okay, connect cable at platform and disconnect cable at connection near turntable. Check in the same manner then continue splitting and measuring in the manner over remainder of machine CAN Bus. When a bad reading occurs, check wire continuity on the individual wire. Fault is cleared when CAN messages are received from the Platform Module
CANBUS FAILURE – LOAD SENSING SYSTEM MODULE	663	The control system has lost communication with the load sensing system load pin. The machine will assume the platform is overloaded.	Ground Module to assume Platform Load State = Overloaded	Check wiring to load sensor.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
CANBUS FAILURE – ENGINE CONTROLLER	666	An engine with a CAN engine controller is configured in MACHINE SETUP No CAN messages are received from the engine controller for more than 250ms	Ground Module shall decel all functions, set Target engine RPM = Mid-Engine if Engine State ENGINE STOPPED, and assume Engine Controller reporting mid-Engine; otherwise Engine State = ENGINE STOPPED. If MACHINE SETUP → GENERATOR = YES, Generator Relay output to be turned off until re-enabled by operator. Reactivation of Footswitch is required to resume operation.	With power off, disconnect the CAN2 cable going to the engine at the tee near the UGM. With a multimeter, verify that the resistance between the CAN2H and CAN2L pins is approximately 120ohms both in the path to engine and path to UGM. If a bad reading occurs, check wire continuity on individual wires. CAN messages are received from the engine controller. Ground Module shall require re-activation of Footswitch to enable functions.
CANBUS FAILURE – EXCESSIVE CANBUS ERRORS	6613	More than 22 error frames per second for 4 seconds or more than 500 Buss Off conditions since last power cycle.	No functions are inhibited.	Cycle power to clear the fault.
CANBUS FAILURE – TCU MODULE	6622	MACHINE SETUP → CLEARSKY = YES No CAN2 messages are received from the TCU module for more than 30 seconds	No functions are inhibited.	CAN messages are received from the TCU module.
REMOTE CONTRACT MANAGEMENT OVERRIDE – ALL FUNCTIONS IN CREEP	681	MACHINE SETUP → CLEARSKY = YES Value set by ClearSky TCU	Puts the machine into Creep and locks into Transport	Cleared by ClearSky TCU
CHASSIS TILT SENSOR NOT CALIBRATED	813	The tilt sensor has not been calibrated	The Ground Module reports a faulted chassis tilt angle of 90 degrees	Calibrate the Tilt sensor to clear the fault
CHASSIS TILT SENSOR OUT OF RANGE	814	Fault CHASSIS TILT SENSOR NOT CALIBRATED (813) is not present and Tilt sensor measurement greater than 19º for 4 seconds. Note: Not to be reported during Tilt Sensor calibration.	No additional action required beyond Tilted requirements specified above. Ground Module reports 90° angle.	Tilt sensor reads less than 19º.
CHASSIS TILT SENSOR DISAGREEMENT	815	The Ground Module detects one of the following conditions: If a Drive, Steer, or Boom function is active or if the engine is cranking or if the primary raw Tilt Sensor readings greater than ±10 º then: if the two ground board tilt sensors disagree by more than or equal to 3 degrees for either the X axis or the Y axis for longer than 5 seconds then the fault will be logged. If no Drive, Steer, or Boom functions are active and the engine is not cranking or the primary raw Tilt Sensor readings are less than ±10 º then: if the two ground board tilt sensors disagree by more than or equal to 1 degree for either the X axis or the Y axis for longer than 3 seconds then the fault will be logged. Note: This fault is not reported if DTC 814 is active.	The Ground Module reports a faulted chassis tilt angle of 90 degrees	Cycle power to clear the fault.
LSS CELL #1 ERROR	821	MACHINE SETUP → LOAD SYSTEM is not set = NO The Ground Module detects that LSS is reporting error with Cell #1	Ground Module to assume Platform Load State = Overloaded	CAN messages are received from the LSS module.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
LSS READING UNDER WEIGHT	8211	LSS has been calibrated and the UGM has determined that the load sensing system reading is underweight while a period of time while operating drive or boom lift up at speeds greater than creep OR the UGM has determined that the load sensing system reading is less than -1.5 x Gross Platform Weight. The machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Ensure platform is not resting on the ground or is not leveled at an extreme negative angle. Re-calibrate the load sensing system if the above items are not a factor.
LSS CELL #2 ERROR	822	MACHINE SETUP → LOAD SYSTEM is not set = NO The Ground Module detects that LSS is reporting error with Cell #2	Ground Module to assume Platform Load State = Overloaded	CAN messages are received from the LSS module.
LSS STRAIN GAUGE 1 - STAGNANT	8222	The control system has determined that the strain gauge 1 reading in the load sensor is stagnant (not changing). If the platform is not considered to be overloaded boom functions will be restricted to creep.. If DTC 8223 is active in combination with DTC 8222 the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 2 - STAGNANT	8223	The control system has determined that the strain gauge 2 reading in the load sensor is stagnant (not changing). If the platform is not considered to be overloaded boom functions will be restricted to creep. If DTC 8222 is active in combination with DTC 8223 the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 1 - OUT OF RANGE LOW	8224	The shear beam is reporting an out of range low issue with the strain gauge 1 reading. If the platform is not overloaded the machine will be placed in to creep. If DTC 8225 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 2 - OUT OF RANGE LOW	8225	The shear beam is reporting an out of range low issue with the strain gauge 2 reading. If the platform is not overloaded the machine will be placed in to creep. If DTC 8224 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
LSS STRAIN GAUGE 1 - OUT OF RANGE HIGH	8226	The shear beam is reporting an out of range high issue with the strain gauge 1 reading. If the platform is not overloaded the machine will be placed in to creep. If DTC 8227 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 2 - OUT OF RANGE HIGH	8227	The shear beam is reporting an out of range high issue with the strain gauge 2 reading. If the platform is not overloaded the machine will be placed in to creep. If DTC 8226 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 1 - INITIALIZATION ERROR	8228	The shear beam is reporting an initialization issue with the strain gauge 1 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8229 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 2 - INITIALIZATION ERROR	8229	The shear beam is reporting an initialization issue with the strain gauge 2 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8228 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 1 - NOT CALIBRATED	8230	The shear beam is reporting a calibration issue with the strain gauge 1 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8231 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS CELL #3 ERROR	823	MACHINE SETUP → LOAD SYSTEM is not set = NO The Ground Module detects that LSS is reporting error with Cell #3	Ground Module to assume Platform Load State = Overloaded	CAN messages are received from the LSS module.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
LSS STRAIN GAUGE 2 - NOT CALIBRATED	8231	The shear beam is reporting a calibration issue with the strain gauge 2 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8230 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 1 - SENSOR DEFECT	8232	The shear beam is reporting a sensor defect issue with the strain gauge 1 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8233 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 2 - SENSOR DEFECT	8233	The shear beam is reporting a sensor defect issue with the strain gauge 2 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8232 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 1 - NOT INSTALLED	8234	The shear beam is reporting a not installed issue with the strain gauge 1 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8235 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 2 - NOT INSTALLED	8235	The shear beam is reporting a not installed issue with the strain gauge 2 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8234 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS NOT DETECTING CHANGE	8236	The control system has determined that the load sensor reading has not deviated by more than 1lb for 5s while operating drive or boom functions at greater than creep speed. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
LSS STRAIN GAUGE 1 - A/D DEFECT	8237	The shear beam is reporting an internal issue with the strain gauge 1 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8238 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS STRAIN GAUGE 2 - A/D DEFECT	8238	The shear beam is reporting an internal issue with the strain gauge 2 sensor. If the platform is not overloaded the machine will be placed in to creep. If DTC 8237 is also active the machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
LSS CELL #4 ERROR	824	MACHINE SETUP → LOAD SYSTEM is not set = NO The Ground Module detects that LSS is reporting error with Cell #4.	Ground Module to assume Platform Load State = Overloaded	CAN messages are received from the LSS module.
LSS HAS NOT BEEN CALIBRATED	825	The load sensing system is configured but has not been calibrated. The machine will assume the platform is overloaded.	Ground Module to assume Platform Load State = Overloaded	Calibrate the load sensing system.
RUNNING AT CREEP – PLATFORM OVERLOADED	826	Machine Setup → LOAD SYSTEM = WARN ONLY The platform is Overloaded Ground mode is active with Emergency Descent mode not active or Platform mode is active	Refer to Table 6-16, Overload Variations for machine response.	Not all of the trigger conditions are met
DRIVE & BOOM PREVENTED – PLATFORM OVERLOADED	827	The Platform is Overloaded and Machine Setup → LOAD SYSTEM = CUTOUT PLATFORM, Platform Mode is active, and conditions of Table 6-16, Overload Variations apply. -or- The Platform is Overloaded and Machine Setup → LOAD SYSTEM = CUTOUT ALL and conditions of Table 6-16, Overload Variations apply.	Refer to Table 6-16, Overload Variations for machine response.	Not all of the trigger conditions are met
LIFT UP & TELE OUT PREVENTED – PLATFORM OVERLOADED	828	MACHINE SETUP → LOAD SYSTEM = SPECIAL 1 Platform Mode is active The platform is Overloaded	Refer to Table 6-16, Overload Variations for machine response.	Not all of the trigger conditions are met
LSS READING UNDER WEIGHT	8211	MACHINE SETUP → LOAD SYSTEM NO The load sensor has been calibrated and Gross Platform Weight < (0.5 * Empty Platform Weight).	Ground Module to set Platform Load State = Overloaded	Not all of the trigger conditions are met
FRONT LEFT STEER VALVE – OPEN CIRCUIT	8639	The Ground Module detects an open circuit at the Front Left Steer Valve output.	Steer Left and Right speed are limited to Creep	Cycle power to clear the fault.
FRONT LEFT STEER VALVE – SHORT TO BATTERY	8640	The Ground Module detects a short to battery at the Front Left Steer Valve output.	The Ground Module disables the Drive Forward/Reverse and Steer Left/Right outputs.	Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
FRONT LEFT STEER VALVE – SHORT TO GROUND	8641	The Ground Module detects a short to ground at the Front Left Steer Valve output.	The Ground Module disables the Steer Left and Right outputs.	Cycle power to clear the fault.
FRONT RIGHT STEER VALVE – OPEN CIRCUIT	8642	The Ground Module detects an open circuit at the Front Right Steer Valve output.	Steer Left and Right speed is limited to Creep	Cycle power to clear the fault.
FRONT RIGHT STEER VALVE – SHORT TO BATTERY	8643	The Ground Module detects a short to battery at the Front Right Steer Valve output.	The Ground Module disables the Drive Forward/Reverse and Steer Left/Right outputs	Cycle power to clear the fault.
FRONT RIGHT STEER VALVE – SHORT TO GROUND	8644	The Ground Module detects a short to ground at the Front Right Steer Valve output.	The Ground Module disables the Steer Left and Right outputs	Cycle power to clear the fault.
OSCILLATING AXLE SWITCH DISAGREEMENT	8669	The Ground Module detects that Oscillating Axle switch #1 and switch #2 are not in agreement. Note: This fault will not to be reported if DTC 23104 BOOM TRANSPORT SWITCH DISAGREEMENT is active.	The Ground Module assumes an Above Elevation State and de-energizes J1-7 Oscillating Axle output.	Cycle power to clear the fault.
FUNCTIONS LOCKED OUT	9911			
LSS WATCHDOG RESET	991	The Ground Module detects an LSS report of an anomaly that has caused a WatchDog Timer reset.	The Ground Module sets the Platform Load State to Overloaded	Cycle power to clear the fault.
LSS EEPROM ERROR	992	The Ground Module detects an LSS report of an anomaly that exists in the LSS EEPROM	The Ground Module sets the Platform Load State to Overloaded	Cycle power to clear the fault.
LSS INTERNAL ERROR – PIN EXCITATION	993	The Ground Module detects an LSS report of improper excitation voltage.	The Ground Module sets the Platform Load State to Overloaded	Cycle power to clear the fault.
LSS INTERNAL ERROR – DRDY MISSING FROM A/D	994	The Ground Module detects an LSS report of an anomaly that exists in the LSS A/D converter operations.	The Ground Module sets the Platform Load State to Overloaded	Cycle power to clear the fault.
EEPROM FAILURE - CHECK ALL SETTINGS	998	The Ground Module has detected an anomaly in the EEPROM	The Ground Module disables all functions and resets the section of EEPROM where the failure occurred back to the defaults.	Cycle power to clear the fault.
FUNCTIONS LOCKED OUT - PLATFORM MODULE SOFTWARE VERSION IMPROPER	9910	The Ground Module software major version number does not match the major version number of the platform software	The platform alarm sounds continuously and, Creep mode is active. If the Platform Mode is active all Drive, Steer, and Boom functions are disabled.	Platform Module needs reprogrammed with correct version of software.
FUNCTION LOCKED OUT - LSS MODULE SOFTWARE VERSION IMPROPER	9911	The Ground Module determines that the LSS software version is not compatible with existing code.	The Ground Module sets the Platform Load State to Overloaded	Cycle power to clear the fault.
CHASSIS TILT SENSOR NOT GAIN CALIBRATED	9915	The tilt sensor gain calibration values recorded to flash memory during manufacturing are not present	The Ground Module reports a faulted chassis tilt angle of 90 degrees	Valid values must be present to reset.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
GROUND SENSOR REF VOLTAGE OUT OF RANGE	9919	The Ground Module has detected reference voltage is out of range (Reference Voltage is between 2.3V and 2.7V).	If MACHINE SETUP → Kubota D1105 and ENGINE SHUTDOWN → ENABLED, then call for engine shutdown and disable engine start operations; otherwise, no interlocks required.	Cycle power to clear the fault.
PLATFORM SENSOR REF VOLTAGE OUT OF RANGE	9920	The Platform Module detects that its reference voltage is out of range and reports the fault to the Ground Module	If in Platform mode, Lift/Swing and Drive are placed in Creep. All other functions shall operate normally.	Cycle power to clear the fault.
GROUND MODULE FAILURE:HIGH SIDE DRIVER CUTOUT FAULTY	9921	The engine is not running The engine is not cranking The Ground Module footswitch input (J7-15) is LOW The machine is in Platform Mode The Main Dump output (J2-13) is detected as HIGH via the analog feedback 300ms after it is attempted to be activated during the one time startup test of the Ground Module hardware shutoff circuitry	All Drive/Steer and Boom functions except Tower Lift Down, Lift Down, and Jib Lift Down are disabled.	Cycle power to clear the fault.
PLATFORM MODULE FAILURE: HWFS CODE 1	9922	The Platform Module detects faulty hardware	No response required.	Cycle power to clear the fault; if faults remains, replace board.
GROUND MODULE FAILURE: HWFS CODE 1	9923	The Ground Module detects faulty hardware.	No response required.	Cycle power to clear the fault; if faults remains, replace board.
FUNCTIONS LOCKED OUT - MACHINE NOT CONFIGURED	9924	The machine is powered up and no model has been selected yet in the MACHINE SETUP menu	Display??? or NO MODEL at Analyzer MACHINE SETUP menu MACHINE SETUP->MODEL NUMBER No other faults will be reported. All machine functions are disabled and the engine is not permitted to start.	Cycle power to clear the fault.
LSS - FACTORY CALIBRATION ERROR	99285	The load sensor is reporting a factor calibration issue (internal error) The machine will assume the platform is overloaded. This fault, once annunciated is latched within a given key cycle.		Possible sensor hardware issue.
CURRENT FEEDBACK GAINS OUT OF RANGE	9944	One or more of the current feedback gains that are calculated and written to flash memory during manufacturing are detected as being out of range	A gain of 1 is used for the factory gain(s) that was out of range; all functions are placed in Creep mode.	Cycle power to clear the fault.
CURRENT FEEDBACK CALIBRATION CHECKSUM INCORRECT	9945	The current feedback gains checksum that is calculated and written to flash memory during manufacturing is detected as being incorrect	All machine and engine functions are disabled (i.e., command engine shutdown and do not permit start).	Cycle power to clear the fault.

Table 6-15. Fault Code Troubleshooting Information

Help Message	DTC	Condition Producing DTC	Control System Response or Machine Condition	Corrective Action/ Operational Requirement for Function Movement and/or to Clear Fault
MACHINE CONFIGURATION OUT OF RANGE – CHECK ALL SETTINGS	9949	The Ground Module has detected an anomaly in stored readings for the Machine Setup configuration.	The Ground Module prompts the operator to correct the issue via Analyzer and disable all functions until stored data in corrupted area is changed.	Cycle Power and change the Machine Setup data.
LSS CORRUPT EEPROM	9977	The Ground Module is advising that the LSS module has detected faulty stored parameters.	The Ground Module sets the Platform Load State to Overloaded	Cycle power to clear the fault.
FUNCTIONS LOCKED OUT - GROUND MODULE SOFTWARE VERSION IMPROPER	9979	Ground Module detects a disagreement with internal checks on the version of software.	All machine and engine functions are disabled (i.e., command engine shutdown and do not permit start)	Cycle power to clear the fault.
GROUND MODULE VLOW FET FAILURE	9986	Ground Module has determined a hardware fault exists and is unable to read high-sensing inputs.	All machine and engine functions are disabled (i.e., command engine shutdown and do not permit start)	Cycle power to clear the fault.

[1]Annotated DTCs do not flash a numeric code, sound an alarm, and are not stored in annotated DTCs in Logged Help queue (this applies to most DTCs < 0100).

Table 6-16. Overload Variations

BROADCAST ONLY[3]	WARN ONLY	CUTOUT ALL	SPECIAL 1 (Access Industries)	CUTOUT PLATFORM
Platform				
Activate visual overload light at Platform Station	Activate visual overload light at Platform Station	Activate System Distress and Overload lights at Platform station	Activate visual overload light at Platform Station	Activate System Distress and Overload lights at Platform station
Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF	Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF	Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF	Activate Platform and Ground Alarm – on continuously	Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF
Do not report Fault	Activate creep mode all functions, energize Creep light, and report Fault	Do not permit Machine Enable (no creep light) and report Fault	Activate creep mode all functions, energize Creep light, and report Fault	Do not permit Machine Enable (no creep light) and report Fault
			Disable Telescope Out and Lift Up	
Ground				
Activate visual overload light (Ground Station)	Activate visual overload light (Ground Station)	Activate visual overload light (Ground Station)	Activate visual overload light (Ground Station)	Activate visual Overload light at Ground Station
Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF	Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF	Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF	Activate Platform and Ground Alarm – on continuously	Activate Platform and Ground Alarm – 5 sec ON, 2 sec OFF
Do not report Fault	Report Fault	Report Fault	Do not report Fault	Do not report fault.
	Activate creep mode all functions	Do not permit Machine Enable (no creep light)	Overload shall have no effect on function speeds.	Overload shall have no effect on function speeds.
Auxiliary Power/Emergency Descent				
Platform operation and annunciation as Platform Mode above	Platform operation and annunciation as Platform Mode above	Platform operation and annunciation as Platform Mode above, except do not disable all functions	Platform operation and annunciation as Platform Mode above	Platform operation and annunciation as Platform Mode above, except do not report Fault or disable all functions
Ground operation and annunciation as Ground Mode above, except do not activate creep mode	Ground operation and annunciation as Ground Mode above, except do not activate creep mode	Ground operation and annunciation as Ground Mode above, except do not report Fault or disable all functions	Ground operation and annunciation as Ground Mode above	Ground operation and annunciation as Ground Mode above
Faults				
No applicable fault	When the platform is overloaded, report "RUNNING AT CREEP - PLATFORM OVERLOADED."	When the platform is overloaded, report "DRIVE & BOOM PREVENTED – PLATFORM OVERLOADED."	When the platform is overloaded, report "LIFT UP & TELE OUT PREVENTED – PLATFORM OVERLOADED."	When the platform is overloaded, report the "DRIVE & BOOM PREVENTED – PLATFORM OVERLOADED."

Clarifications:
1. The term Report Fault is defined as logging the DTC on the Analyzer fault stack and flashing the System Distress lamp.
2. When specified, Ground Alarm energization shall only occur if MACHINE SETUP → GROUND ALARM ≠ NO.
3. This selection is not Analyzer configurable in MACHINE SETUP → LOAD SYSTEM but is shown here for completeness of the response table.

NOTES:

SECTION 7. BASIC ELECTRICAL INFORMATION & SCHEMATICS

7.1 GENERAL

This section contains basic electrical information and schematics to be used for locating and correcting most of the operating problems which may develop. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

NOTE: *Some of the procedures/connectors shown in this section may not be applicable to all models.*

7.2 MULTIMETER BASICS

A wide variety of multimeters or Volt Ohm Meters (VOM) can be used for troubleshooting your equipment. This section shows diagrams of a common, digital VOM configured for several different circuit measurements. Instructions for your VOM may vary. Please consult the meter operator's manual for more information.

Grounding

"Grounding the meter" means to take the black lead (which is connected to the COM (common) or negative port) and touch it to a good path to the negative side of the Voltage source.

Backprobing

To "backprobe" means to take the measurement by accessing a connector's contact on the same side as the wires, the back of the connector. Readings can be done while maintaining circuit continuity this way. If the connector is the sealed type, great care must be taken to avoid damaging the seal around the wire. It is best to use probes or probe tips specifically designed for this technique, especially on sealed connectors. Whenever possible insert probes into the side of the connector such that the test also checks both terminals of the connection. It is possible to inspect a connection within a closed connector by backprobing both sides of a connector terminal and measuring resistance. Do this after giving each wire a gentle pull to ensure the wires are still attached to the contact and contacts are seated in the connector.

Min/Max

Use of the "Min/Max" recording feature of some meters can help when taking measurements of intermittent conditions while alone. For example, you can read the Voltage applied to a solenoid when it is only operational while a switch, far from the solenoid and meter, is held down.

Polarity

Getting a negative Voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to the device under test correctly. Also check that the lead on the "COM" port goes to the Ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

Scale

M = Mega = 1,000,000 * (Displayed Number)

k = kilo = 1,000 * (Displayed Number)

m = milli = (Displayed Number) / 1,000

μ = micro = (Displayed Number) / 1,000,000

Example: 1.2 kΩ = 1200 Ω
Example: 50 mA = 0.05 A

Voltage Measurement

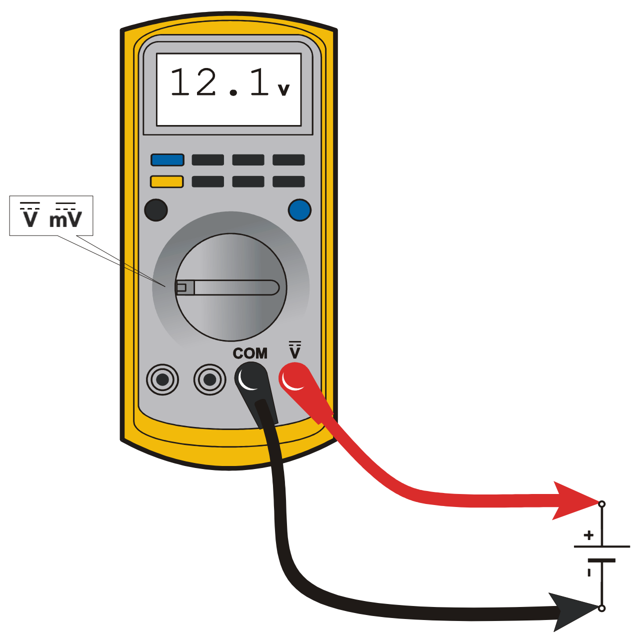


Figure 7-1. Voltage Measurement (DC)

- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual)
- Use firm contact with meter leads

Resistance Measurement

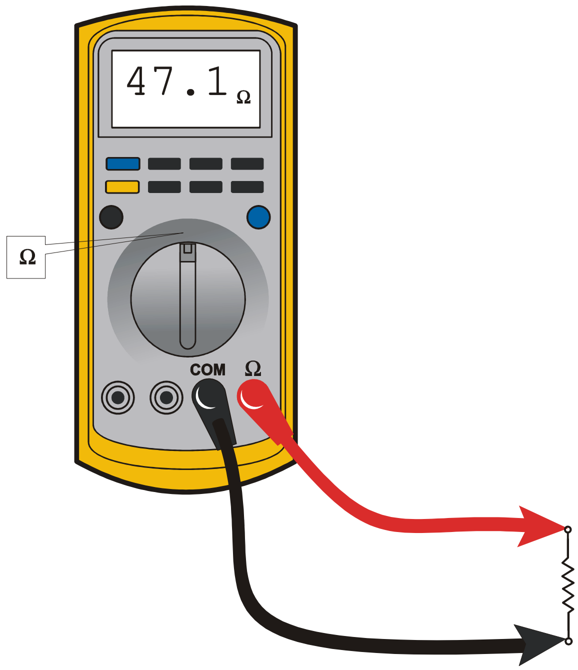


Figure 7-2. Resistance Measurement

- First test meter and leads by touching leads together. Resistance should read a short circuit (very low resistance)
- Circuit power must be turned OFF before testing resistance
- Disconnect component from circuit before testing
- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual)
- Use firm contact with meter leads

Continuity Measurement

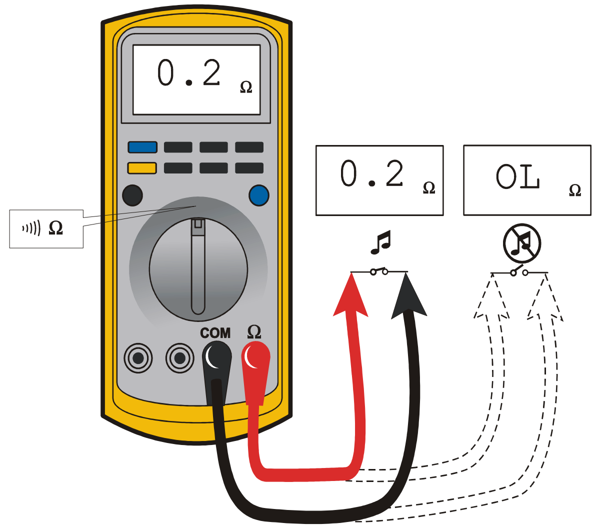


Figure 7-3. Continuity Measurement

- Some meters require a separate button press to enable audible continuity testing
- Circuit power must be turned OFF before testing continuity
- Disconnect component from circuit before testing
- Use firm contact with meter leads
- First test meter and leads by touching leads together. Meter should produce an audible alarm, indicating continuity

Current Measurement

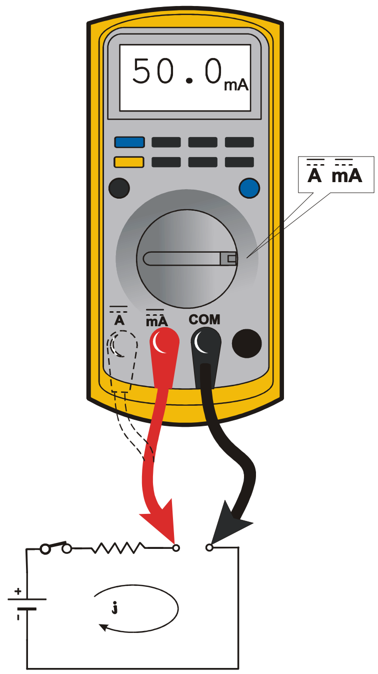


Figure 7-4. Current Measurement (DC)

- Set up the meter for the expected current range
- Be sure to connect the meter leads to the correct jacks for the current range you have selected
- If meter is not auto ranging, set it to the correct range (See multi meter's operation manual)
- Use firm contact with meter leads

7.3 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

NOTE: *This section is not applicable for battery terminals.*

NOTICE

JLG P/N 0100048 DIELECTRIC GREASE (NOVAGARD G661) IS THE ONLY MATERIAL APPROVED FOR USE AS A DIELECTRIC GREASE.

NOTE: *Do NOT apply dielectric grease to the following connections:*

- Main Boom Rotary sensor connections (on Celesco Sensor),
- LSS Modules connections,
- Deutz EMR 2 ECM connection.

Silicone Dielectric Compound must be used on all electrical connections except for those mentioned above for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors. This procedure applies to all plug connections not enclosed in a box. Silicone grease should not be applied to connectors with external seals.

1. To prevent oxidation, silicone grease must be packed completely around male and female pins on the inside of the connector prior to assembly. This is most easily achieved by using a syringe.

NOTE: *Over a period of time, oxidation increases electrical resistance at the connection, eventually causing circuit failure.*

2. To prevent shorting, silicone grease must be packed around each wire where they enter the outside of the connector housing. Also, silicone grease must be applied at the joint where the male and female connectors come together. Any other joints (around strain reliefs, etc.) where water could enter the connector should also be sealed.

NOTE: *This condition is especially common when machines are pressure washed since the washing solution is much more conductive than water.*

3. Anderson connectors for the battery boxes and battery chargers should have silicone grease applied to the contacts only.

NOTE: *Curing-type sealants might also be used to prevent shorting and would be less messy, but would make future pin removal more difficult.*

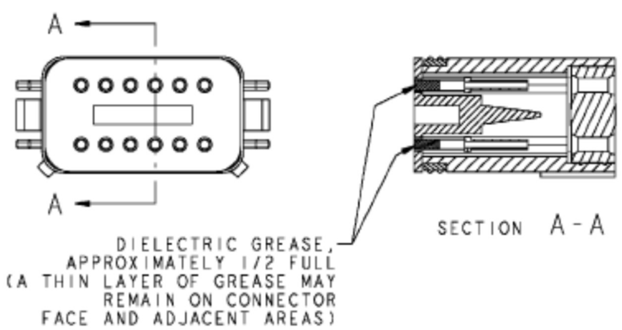
When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

Dielectric grease shall be applied to all electrical connectors at the time of connection (except those noted under Exclusions).

Installation of Dielectric Grease

Before following these instructions, refer to excluded connector types (See Exclusions below).

1. Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
2. Apply dielectric grease to the female contact (fill it approximately ½ full; see example below)
3. Leave a thin layer of dielectric grease on the face of the connector
4. Assemble the connector system immediately to prevent moisture ingress or dust contamination
5. Pierce one of the unused wire seals prior to assembly if the connector system tends to trap air (i.e. AMP Seal) and then install a seal plug.



Deutsch HD, DT, DTM, DRC Series

The Deutsch connector system is commonly used for harsh environment interconnect. Follow the installation instructions.

AMP Seal

The AMP Seal connector system is used on the Control ADE Platform and Ground Modules.

Apply dielectric grease to the male connector. If trapped air prevents the connector from latching, pierce one of the unused wire seals. After assembly, install a seal plug (JLG #4460905) in that location to prevent moisture ingress.

Note that seal plugs may be installed by the wire harness manufacturer if an unused wire seal becomes compromised (wire inserted in the wrong cavity during assembly and then corrected).

Figure 7-5. Application to Male Connector

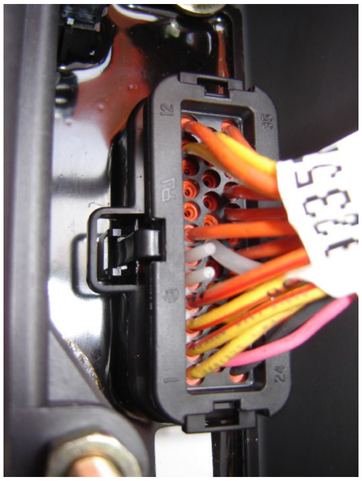
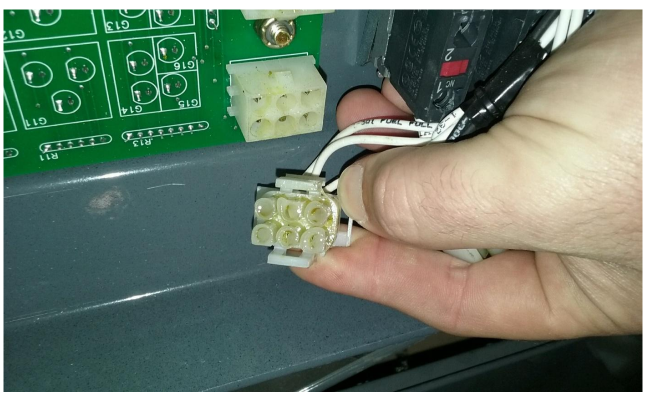


Figure 7-6. Use of Seal Plugs

AMP Mate-N-Lok

This connector system is widely used inside enclosures for general purpose interconnect. Follow the installation instructions..



DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.

Exclusions

A limited number of connectors do not benefit from dielectric grease, or may be permanently damaged by application. Dielectric grease may not be required in properly sealed enclosures.

BRAD HARRISON / PHOENIX CONTACT M12

The connector uses gold contact material to resist corrosion and an o-ring seal for moisture integrity. If dielectric grease is mistakenly applied to this connector system, the low-force contacts cannot displace the grease to achieve electrical contact. Once contaminated, there is no practical way to remove the dielectric grease (replacement of female contacts required). The JLG Load Sensing System and Rotary Angle Sensors are examples of components with the M12 connector system.

Figure 7-7. Brad-Harrison M12

Figure 7-8. Phoenix Contact M12

ENGINE CONTROL UNIT CONNECTORS

These connectors use back-seals for moisture integrity. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The EMR4 engine control module from Deutz employs this connector system (for example).

SEALED ENCLOSURES

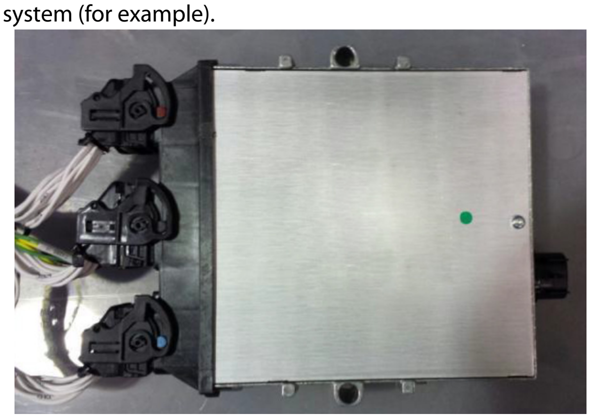
Application of dielectric grease is not required in properly sealed enclosures. To meet criteria, the enclosure must be rated to at least IP66 (dust tight; protected from powerful jets of water). The enclosure must be fitted with a high quality, continuous gasket and all wiring must pass through cable entrances.

MIL-C-5015 SPEC CONNECTORS

Crown Connector Inc's recommendation is to not use dielectric grease for this series connector. For similar model series connectors, the manufacturer should be contacted for confirmation before applying dielectric grease. A typical application for this connector is on David Clark Intercom connections in Aerial Work Platforms.

MOLEX CMC SERIES CONNECTORS

The CMC connector family is a sealed, high-density connection system using matte-seal technology for CP 0.635 and 1.50 mm terminals. To guarantee IP6K7 and IP6K9 sealing, a seal plug option is used. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The flexbox control modules from JDES employ this connector system (for example).



7.4 AMP CONNECTOR

Applying Silicone Dielectric Compound to AMP Connectors

Silicone Dielectric Compound must be used on the AMP connections for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors.

1. To prevent oxidation and low level conductivity, silicone dielectric grease must be packed completely around male and female pins on the inside of the connector after the mating of the housing to the header. This is easily achieved by using a syringe to fill the header with silicone dielectric compound, to a point just above the top of the male pins inside the header. When assembling the housing to the header, it is possible that the housing will become air locked, thus preventing the housing latch from engaging.
2. Pierce one of the unused wire seals to allow the trapped air inside the housing to escape.
3. Install a hole plug into this and/or any unused wire seal that has silicone dielectric compound escaping from it.

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-9.). Proceed as follows:

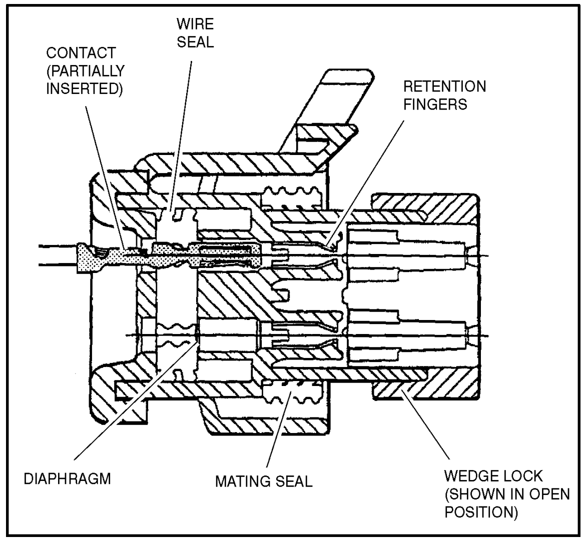


Figure 7-9. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-11.).
2. Pull back on the contact wire with a force of 1 or 2 lbs. to be sure the retention fingers are holding the contact (See Figure 7-11.).

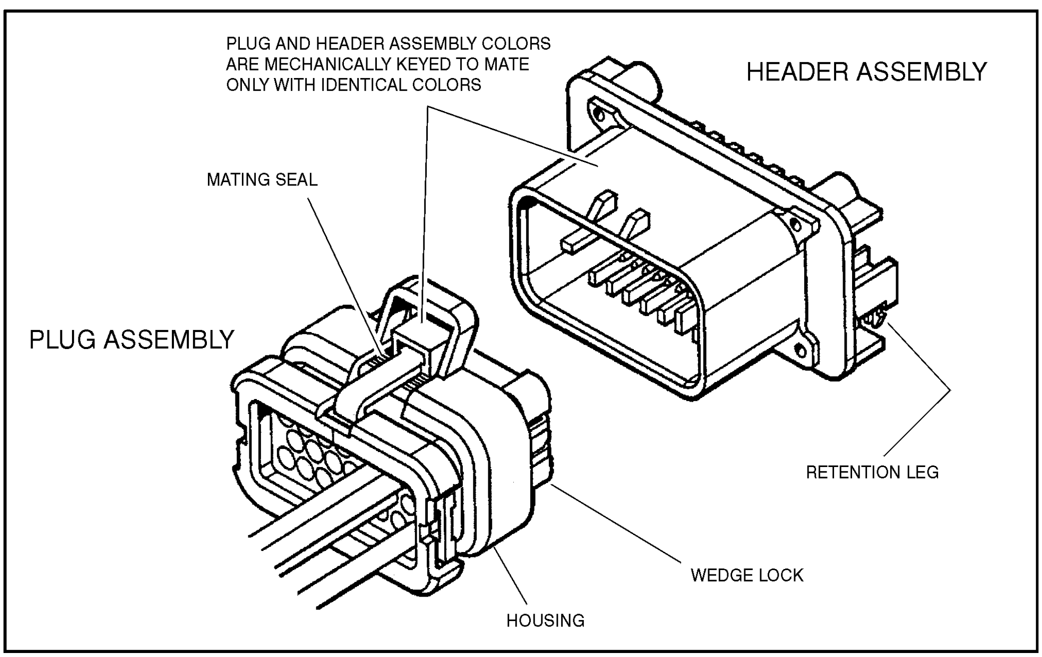


Figure 7-10. AMP Connector

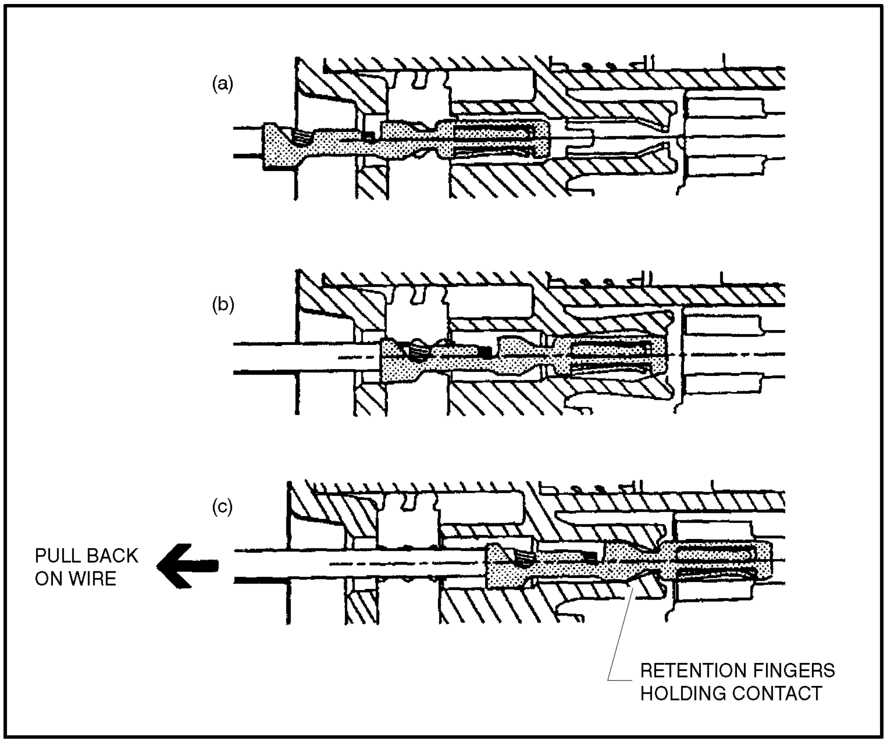


Figure 7-11. Connector Assembly Figure 2

3. After all required contacts have been inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward (See Figure 7-12.).

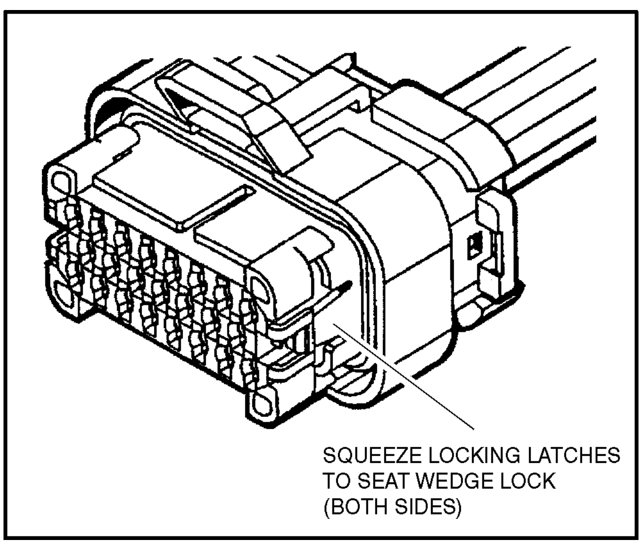


Figure 7-12. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-13.).

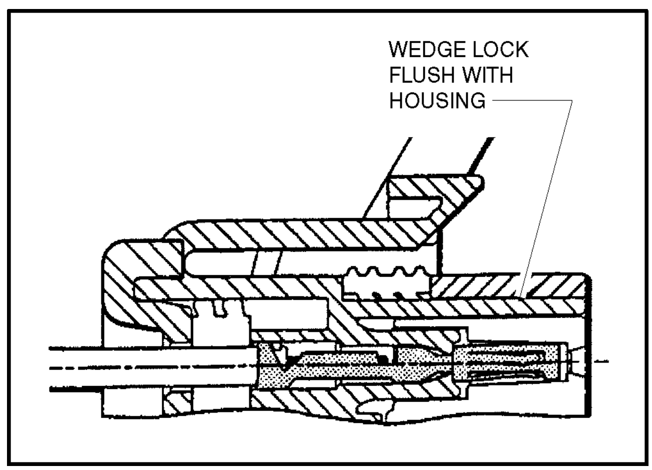


Figure 7-13. Connector Assembly Figure 4

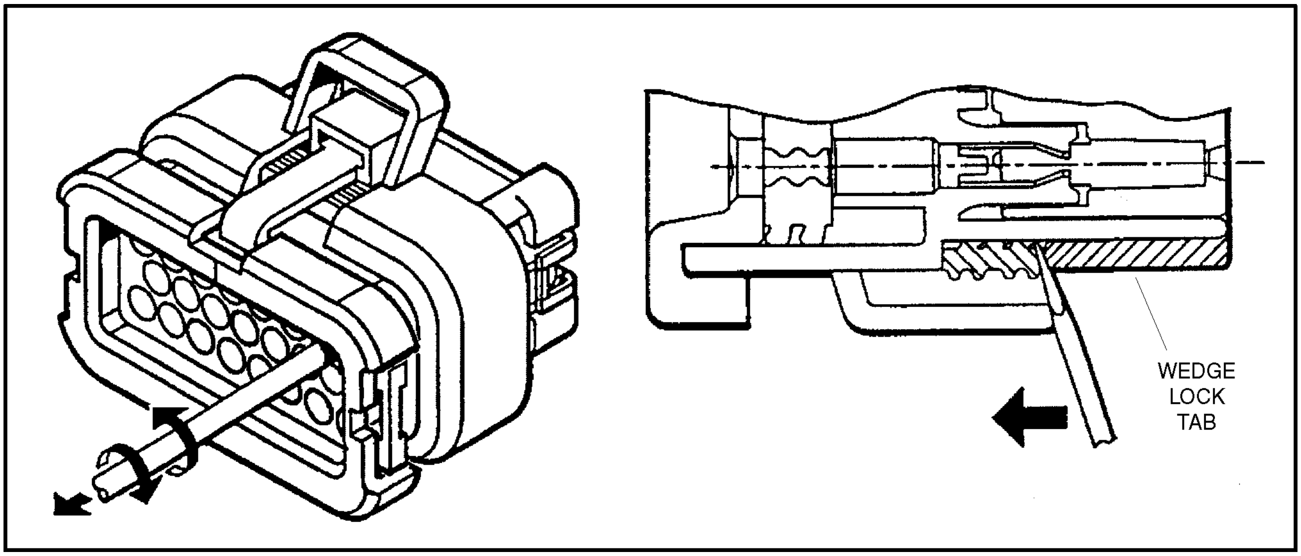


Figure 7-14. Connector Disassembly

Disassembly

5. Insert a 4.8 mm (3/16") wide screwdriver blade between the mating seal and one of the red wedge lock tabs.
6. Pry open the wedge lock to the open position.
7. While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the contact is removed.

NOTE: *The wedge lock should never be removed from the housing for insertion or removal of the contacts.*

Wedge Lock

The wedge lock has slotted openings in the forward, or mating end. These slots accommodate circuit testing in the field, by using a flat probe such as a pocket knife. DO NOT use a sharp point such as an ice pick.

Service - Voltage Reading

NOTICE

DO NOT PIERCE WIRE INSULATION TO TAKE VOLTAGE READINGS.

It has been common practice in electrical troubleshooting to probe wires by piercing the insulation with a sharp point. This practice should be discouraged when dealing with the AMPSEAL plug assembly, or any other sealed connector system. The resulting pinholes in the insulation will allow moisture to invade the system by traveling along the wire strands. This nullifies the effectiveness of the connector seals and could result in system failure.

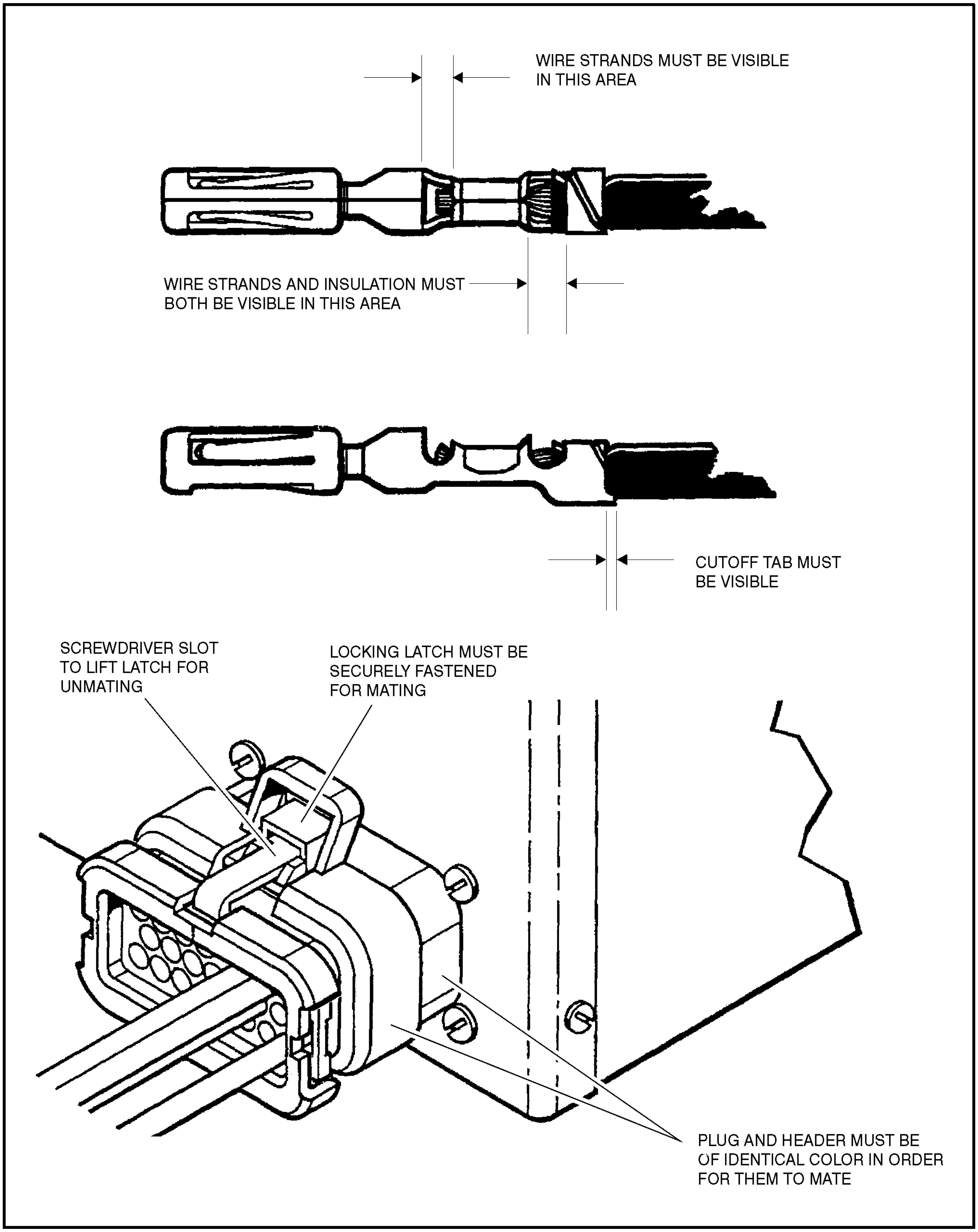


Figure 7-15. Connector Installation

7.5 DEUTSCH CONNECTORS

DT/DTP Series Assembly

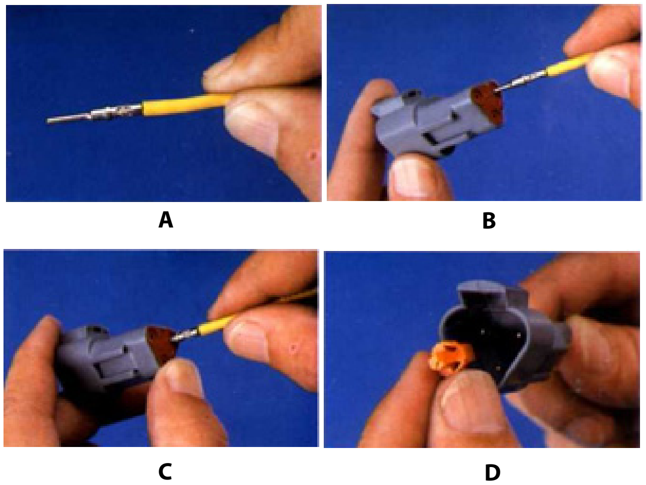


Figure 7-16. DT/DTP Contact Installation

1. Grasp crimped contact about 25mm behind the contact barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that it is properly locked in place.
4. Once all contacts are in place, insert wedgelock with arrow pointing toward exterior locking mechanism. The wedgelock will snap into place. Rectangular wedges are not oriented. Thy may go in either way.

NOTE: *The receptacle is shown - use the same procedure for plug.*

DT/DTP Series Disassembly

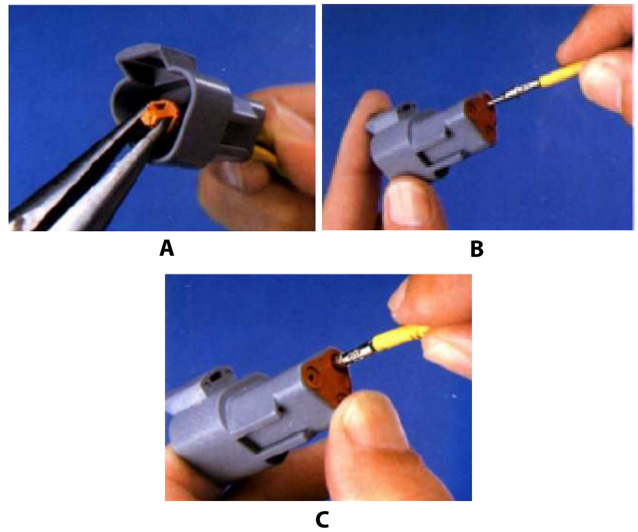


Figure 7-17. DT/DTP Contact Removal

5. Remove wedgelock using needlenose pliers or a hook shaped wire to pull wedge straight out.
6. To remove the contacts, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.
7. Hold the rear seal in place, as removing the contact may displace the seal.

HD30/HDP20 Series Assembly

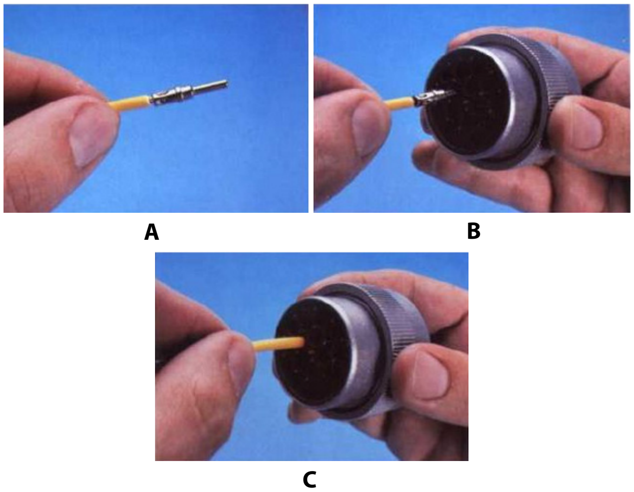


Figure 7-18. HD/HDP Contact Installation

8. Grasp contact about 25mm behind the contact crimp barrel.
9. Hold connector with rear grommet facing you.
10. Push contact straight into connector grommet until a positive stop is felt. A slight tug will confirm that it is properly locked in place.

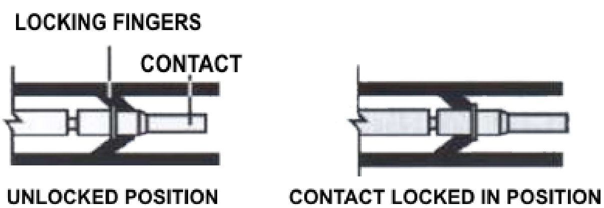


Figure 7-19. HD/HDP Locking Contacts Into Position

NOTE: *For unused wire cavities, insert sealing plugs for full environmental sealing*

HD30/HDP20 Series Disassembly

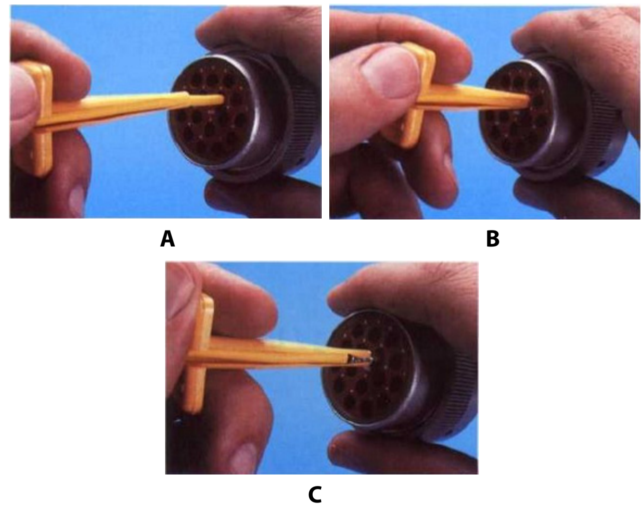


Figure 7-20. HD/HDP Contact Removal

11. With rear insert toward you, snap appropriate size extractor tool over the wire of contact to be removed.
12. Slide tool along into the insert cavity until it engages contact and resistance is felt.
13. Pull contact-wire assembly out of connector.

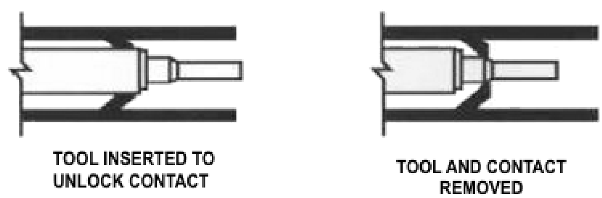


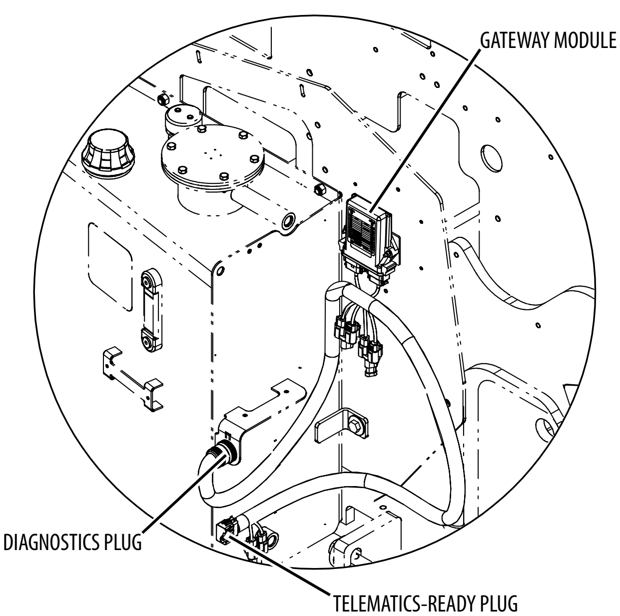
Figure 7-21. HD/HDP Unlocking Contacts

NOTE: *Do Not twist or insert tool at an angle.*

7.6 TELEMATICS GATEWAY

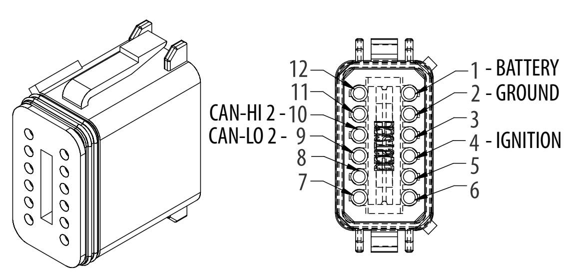
Personnel using machines equipped with an optional telematics gateway will be able to view the following data through their telematics device:

JLG LABEL	DESCRIPTION	UNIT
Engine Speed	Actual engine speed.	RPM
DEF Tank Level (If Equipped)	Indicates the level of DEF (diesel exhaust fluid) within the DEF tank if the machine is equipped with DEF tank. • 0% = Empty • 100% = Full	Percentage (%)
JLG Machine Faults: Active / Not-Active	• 00 - No Machine Faults • 01 - Active Machine Fault • 10 - Error • 11 - Not available	Bit
Total Idle Fuel Used	Total amount of fuel used during vehicle operation during idle conditions.	Liters
Total Idle Hours	Total time of engine operation during idle conditions.	Seconds
Total Engine Hours	Total time of engine operation.	Seconds
Total Fuel Used	Total amount of fuel used during vehicle operation.	Liters
Fuel Rate	Amount of fuel consumed by engine per unit of time.	Liters/Hour
Fuel Level	Ratio of fuel volume to the total volume of the fuel storage container. When a low fuel limit switch is present, the fuel level will indicate "full" until the switch opens, which will then indicate 10% fuel remaining. When Fuel Level 2 (SPN 38) is not used, Fuel Level 1 represents the total fuel in all fuel storage containers. When Fuel Level 2 is used, Fuel Level 1 represents the fuel level in the primary or left side fuel storage container.	Percentage (%)
DM1 Engine Faults	Shows actual engine fault codes.	N/A



Telematics-Ready (TCU) Plug

The telematics-ready (TCU) plug is a standard 12-pin Deutsch connector. Pin-out locations are shown below:



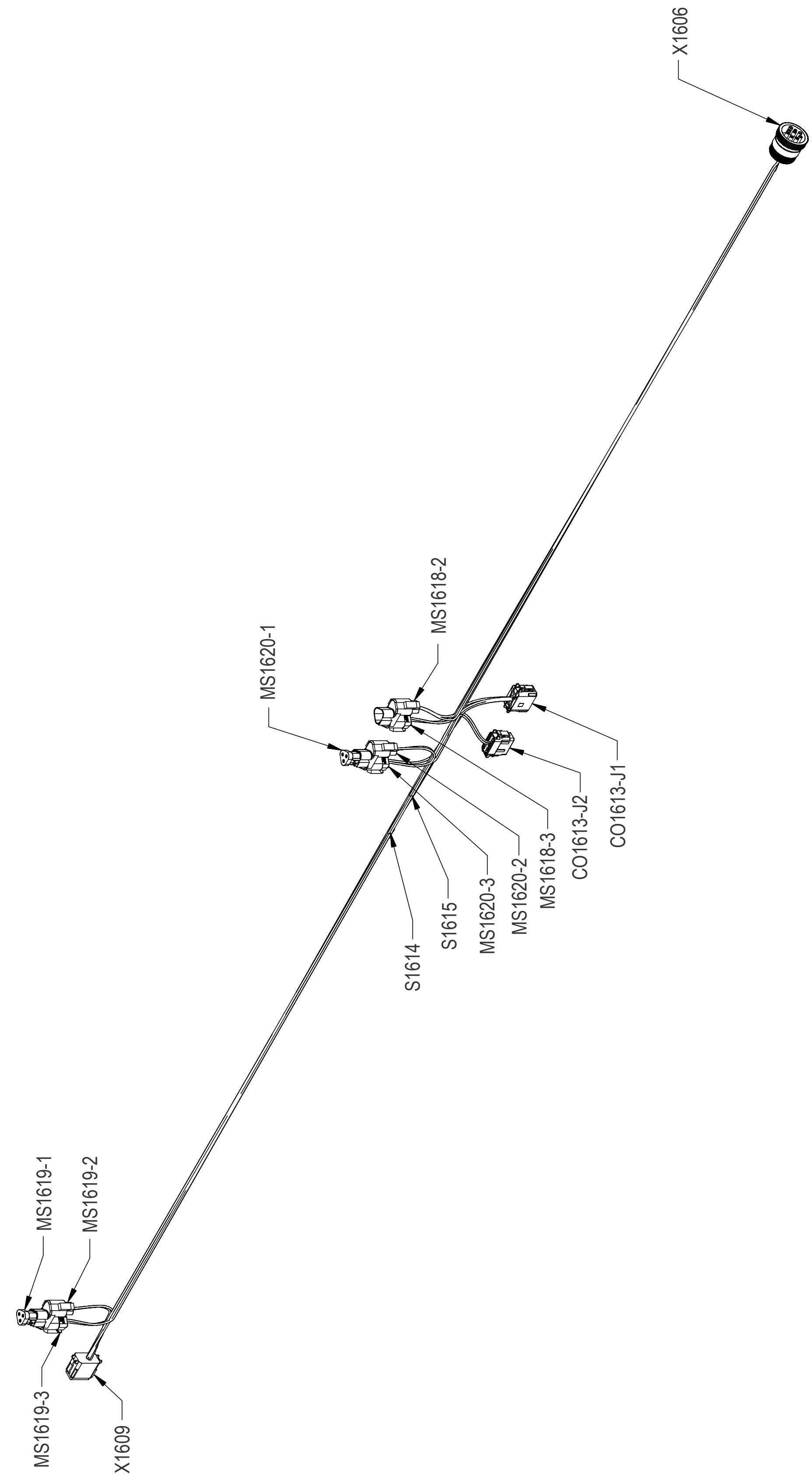


Figure 7-22. Telematics Gateway Harness - Sheet 1 of 3

X1609 (TCU)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	1-0 BAT	16 AWG	GXL	X1606 (B)
2	BLK	0-0 GND	16 AWG	GXL	S1615 (1)
4	ORN	2-0 IGN	16 AWG	GXL	S1614 (1)
9	GRN	CANL2	18 AWG	GXL	MS1619-2 (B)
10	YEL	CANH2	18 AWG	GXL	MS1619-2 (A)

MS1619-2 (CAN-T 2)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH2	18 AWG	GXL	X1609 (10)
B	GRN	CANL2	18 AWG	GXL	X1609 (9)

MS1619-3 (CAN-T 2)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH2	18 AWG	GXL	MS1620-2 (A)
B	GRN	CANL2	18 AWG	GXL	MS1620-2 (B)

CO1613-J1 (GATEWAY 1)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
9	GRN	CAN1	18 AWG	GXL	MS1618-2 (B)
10	YEL	CANH1	18 AWG	GXL	MS1618-2 (A)
11	BLK	0-2 GND	16 AWG	GXL	S1615 (2)
12	ORN	2-2 IGN	16 AWG	GXL	S1614 (2)

CO1613-J2 (GATEWAY 2)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
9	GRN	CANL2	18 AWG	GXL	MS1620-3 (B)
10	YEL	CANH2	18 AWG	GXL	MS1620-3 (A)

MS1620-2 (CAN-T 2)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH2	18 AWG	GXL	MS1619-3 (A)
B	GRN	CANL2	18 AWG	GXL	MS1619-3 (B)

MS1620-3 (CAN-T 2)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH2	18 AWG	GXL	CO1613-J2 (10)
B	GRN	CANL2	18 AWG	GXL	CO1613-J2 (9)

S1614					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	ORN	2-0 IGN	16 AWG	GXL	X1609 (4)
2	ORN	2-1 IGN	16 AWG	GXL	X1606 (H)
2	ORN	2-2 IGN	16 AWG	GXL	CO1613-J1 (12)

S1615					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	0-0 GND	16 AWG	GXL	X1609 (2)
2	BLK	0-1 GND	16 AWG	GXL	X1606 (A)
2	BLK	0-2 GND	16 AWG	GXL	CO1613-J1 (11)

MS1618-2 (CAN-T 1)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH1	18 AWG	GXL	CO1613-J1 (10)
B	GRN	CANL1	18 AWG	GXL	CO1613-J1 (9)

MS1618-3 (CAN-T 1)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CANH1	18 AWG	GXL	X1606 (C)
B	GRN	CANL1	18 AWG	GXL	X1606 (D)

X1606 (DIAG)					
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	BLK	0-1 GND	16 AWG	GXL	S1615 (2)
B	RED	1-0 BAT	16 AWG	GXL	X1609 (1)
C	YEL	CANH1	18 AWG	GXL	MS1618-3 (A)
D	GRN	CANL1	18 AWG	GXL	MS1618-3 (B)
H	ORN	2-1 IGN	16 AWG	GXL	S1614 (2)

Figure 7-23. Telematics Gateway Harness - Sheet 2 of 3

					FROM		TO	
WIRE NO.	COLOR	WIRE GAUGE	LENGTH (mm)	JACKET	REFERENCE	PIN	REFERENCE	PIN
CAN L2	GRN	18 AWG	1151	GXL	MS1619-3	B	MS1620-2	B
CAN L2	GRN	18 AWG	151	GXL	X1609	9	MS1619-2	B
CAN L1	GRN	18 AWG	157	GXL	MS1618-2	B	CO1613-J1	9
CAN L2	GRN	18 AWG	225	GXL	MS1620-3	B	CO1613-J2	9
CAN L1	GRN	18 AWG	1076	GXL	MS1618-3	B	X1606	D
CAN H2	YEL	18 AWG	155	GXL	X1609	10	MS1619-2	A
CAN H2	YEL	18 AWG	233	GXL	MS1620-3	A	CO1613-J2	10
CAN H1	YEL	18 AWG	157	GXL	MS1618-2	A	CO1613-J1	10
CAN H2	YEL	18 AWG	1150	GXL	MS1619-3	A	MS1620-2	A
CAN H1	YEL	18 AWG	1079	GXL	MS1618-3	A	X1606	C
0-0 GND	BLK	16 AWG	1006	GXL	X1609	2	S1615	1
0-1 GND	BLK	16 AWG	1145	GXL	X1606	A	S1615	2
0-2 GND	BLK	16 AWG	223	GXL	CO1613-J1	11	S1615	2
1-0 BAT	RED	16 AWG	2150	GXL	X1609	1	X1606	B
2-0 IGN	ORN	16 AWG	939	GXL	X1609	4	S1614	1
2-1 IGN	ORN	16 AWG	1212	GXL	S1614	2	X1606	H
2-2 IGN	ORN	16 AWG	287	GXL	CO1613-J1	12	S1614	2

Figure 7-24. Telematics Gateway Harness - Sheet 3 of 3

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7.7 ELECTRICAL SCHEMATICS

SHEET 2: PLATFORM BOX

SHEET 3: PLATFORM AND BOOM COMPONENTS

SHEET 4: CHASSIS, TURN-TABLE, AND UGM

SHEET 5: GROUND USER INTERFACE AND TELEMATICS INTERFACE

SHEET 6: ENGINE (KUBOTA) AND GENERATOR

SHEET 7: ENGINE (GM) VENDOR SCHEMATIC

SHEET 8: MIDENGINE HARNESS SCHEMATIC

SHEET 9: CHASSIS LIGHT, PLATFORM LIGHTS SCHEMATIC

SHEET 10: ALERT BEACON OPTION
HARNESS,GEN 2 PLAT INTERFACE

SHEET 11: PLATFORM BOX
CONSOLE BOX HARNESS WITH SKYGUARD
CONN AND 1 CELL LSS

1001119638-Q
MAF03010

Figure 7-25. Electrical Schematic - Sheet 1 of 20

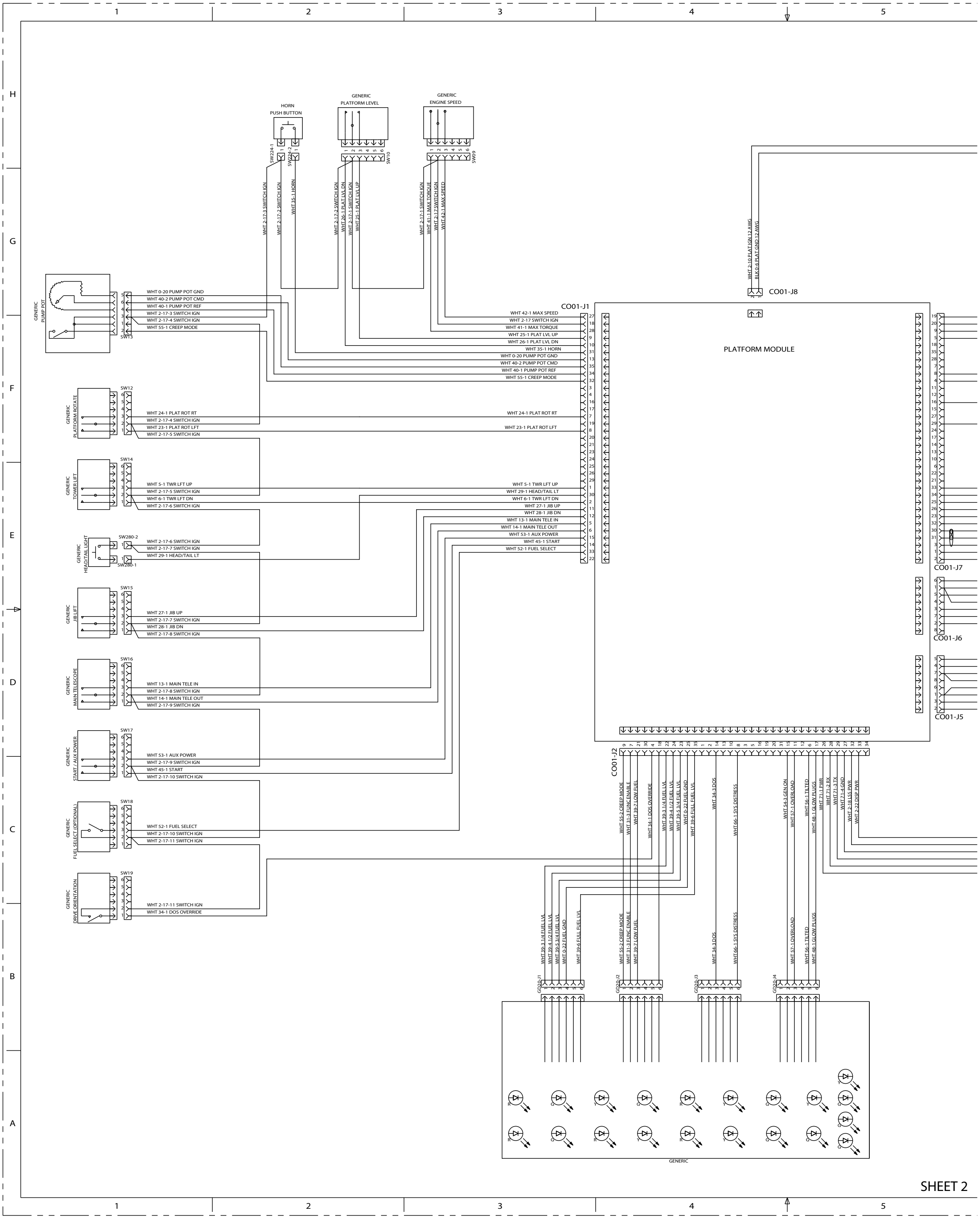

Figure 7-26. Electrical Schematic - Sheet 2 of 20

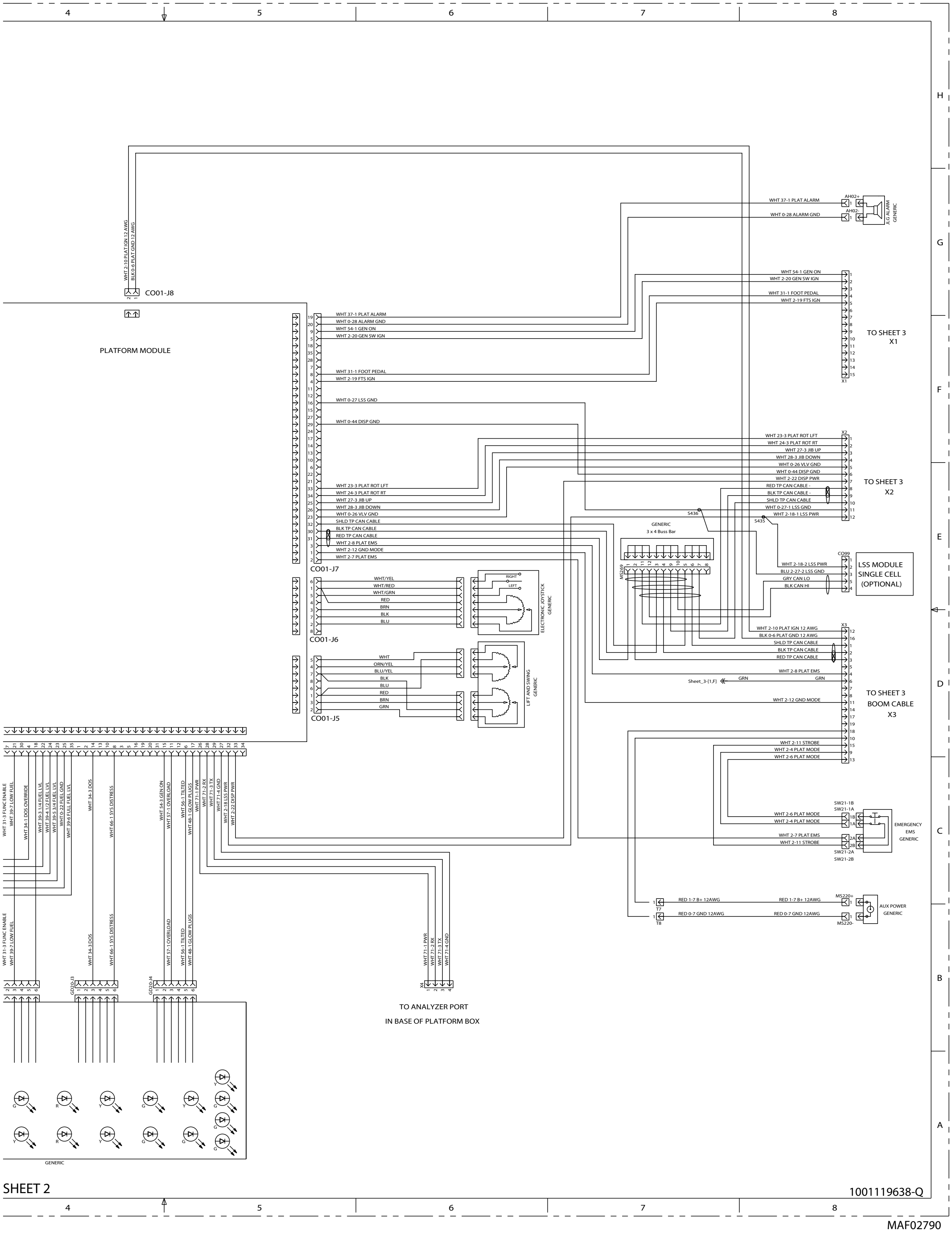

Figure 7-27. Electrical Schematic - Sheet 3 of 20

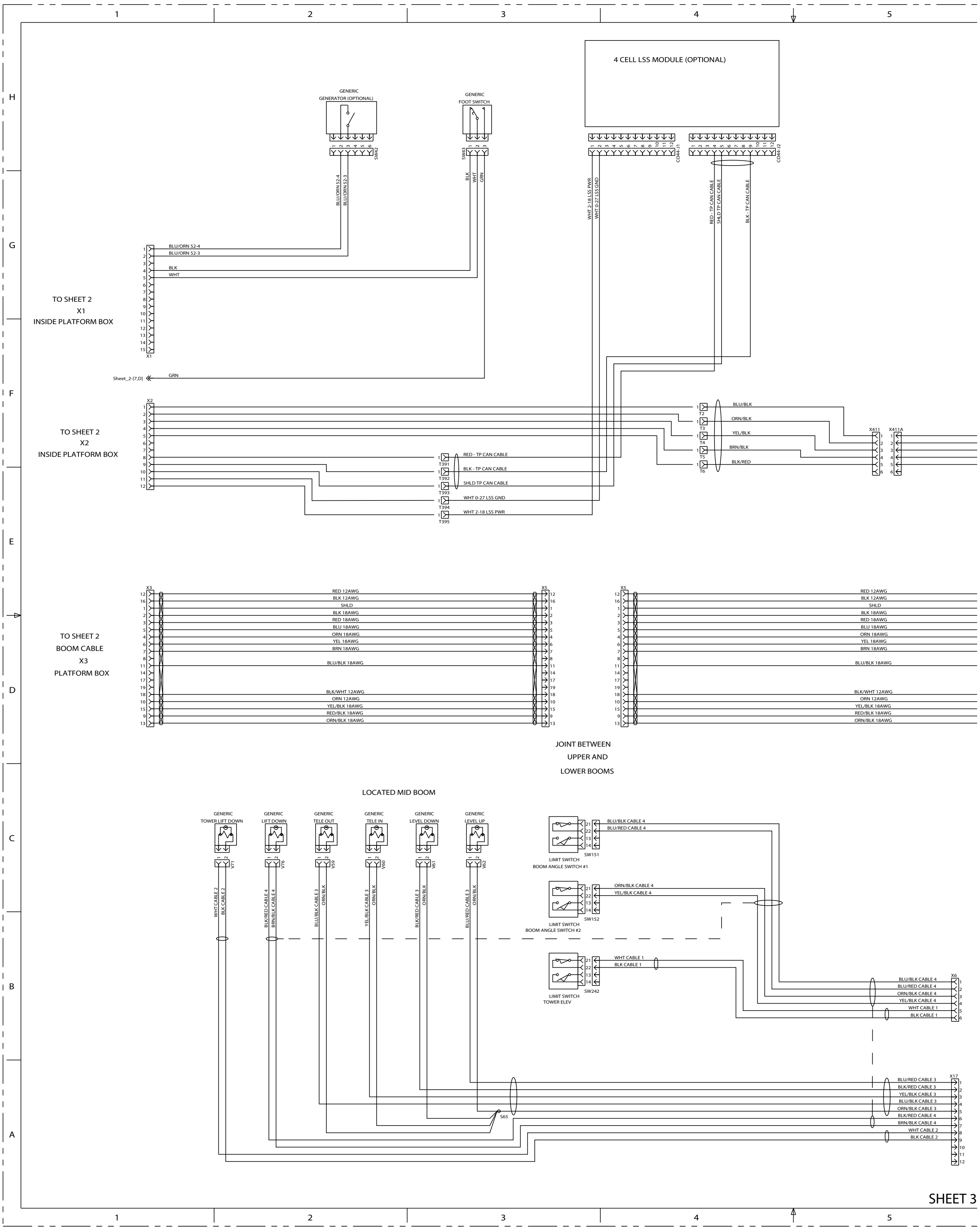

Figure 7-28. Electrical Schematic - Sheet 4 of 20

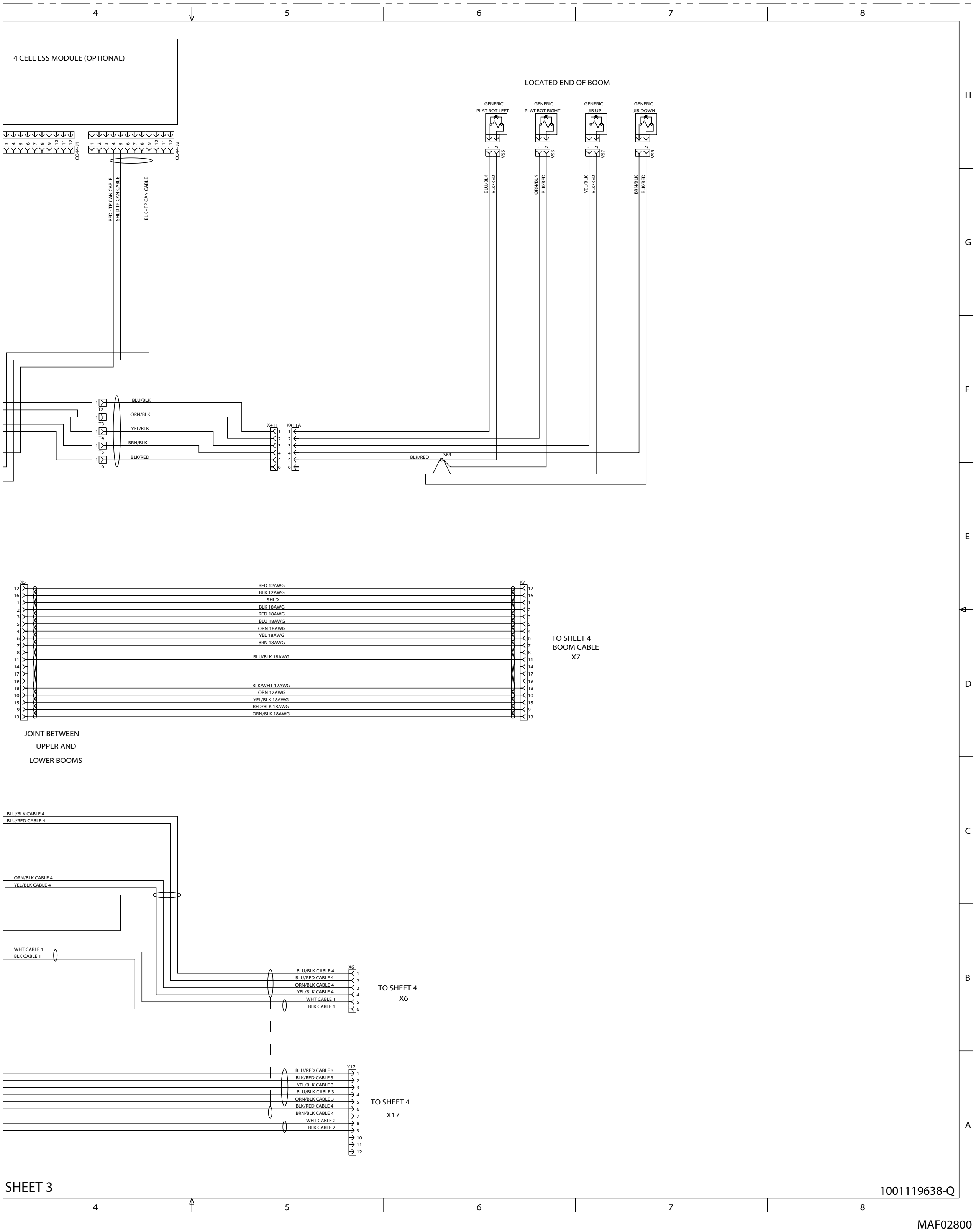

Figure 7-29. Electrical Schematic - Sheet 5 of 20

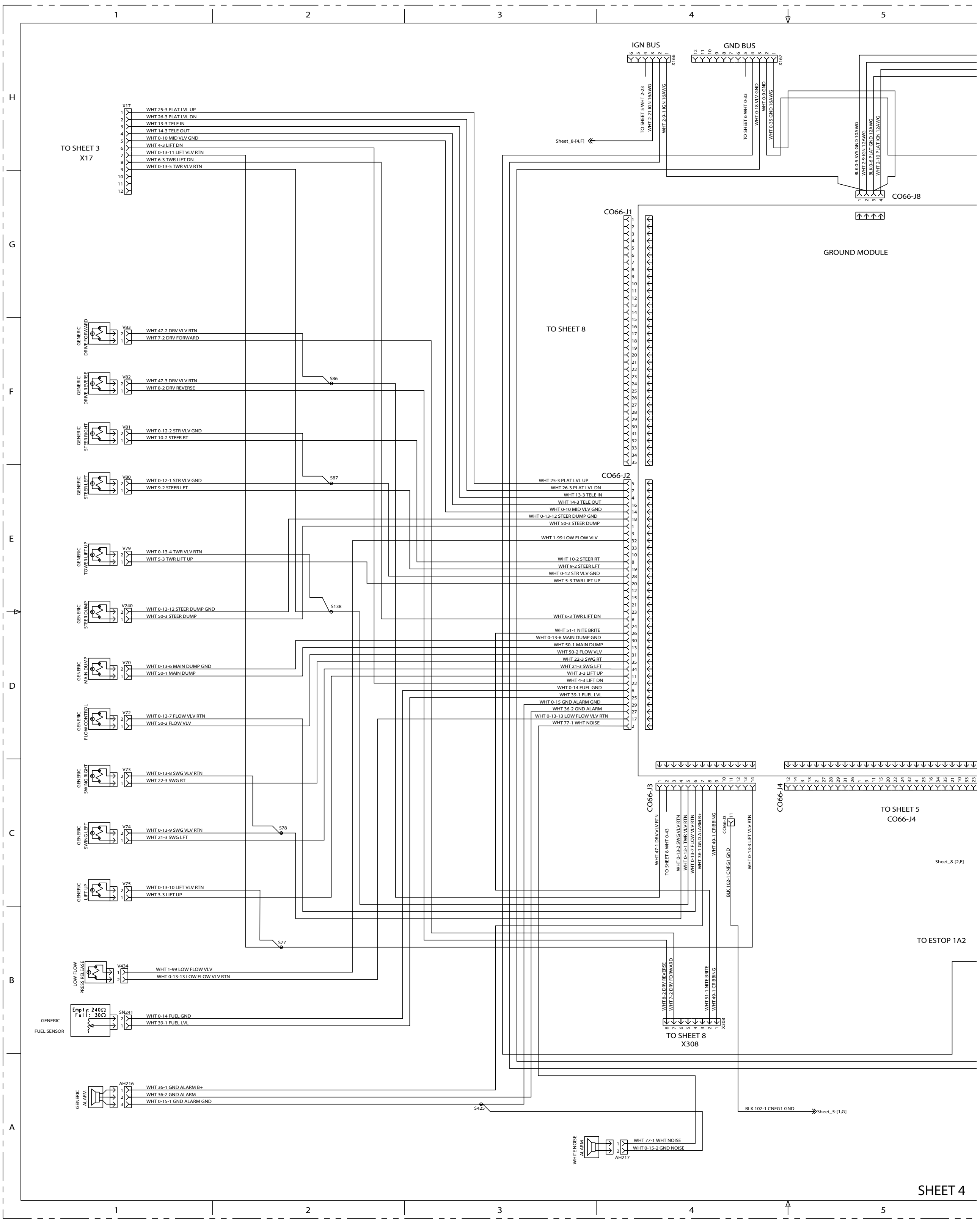

Figure 7-30. Electrical Schematic - Sheet 6 of 20

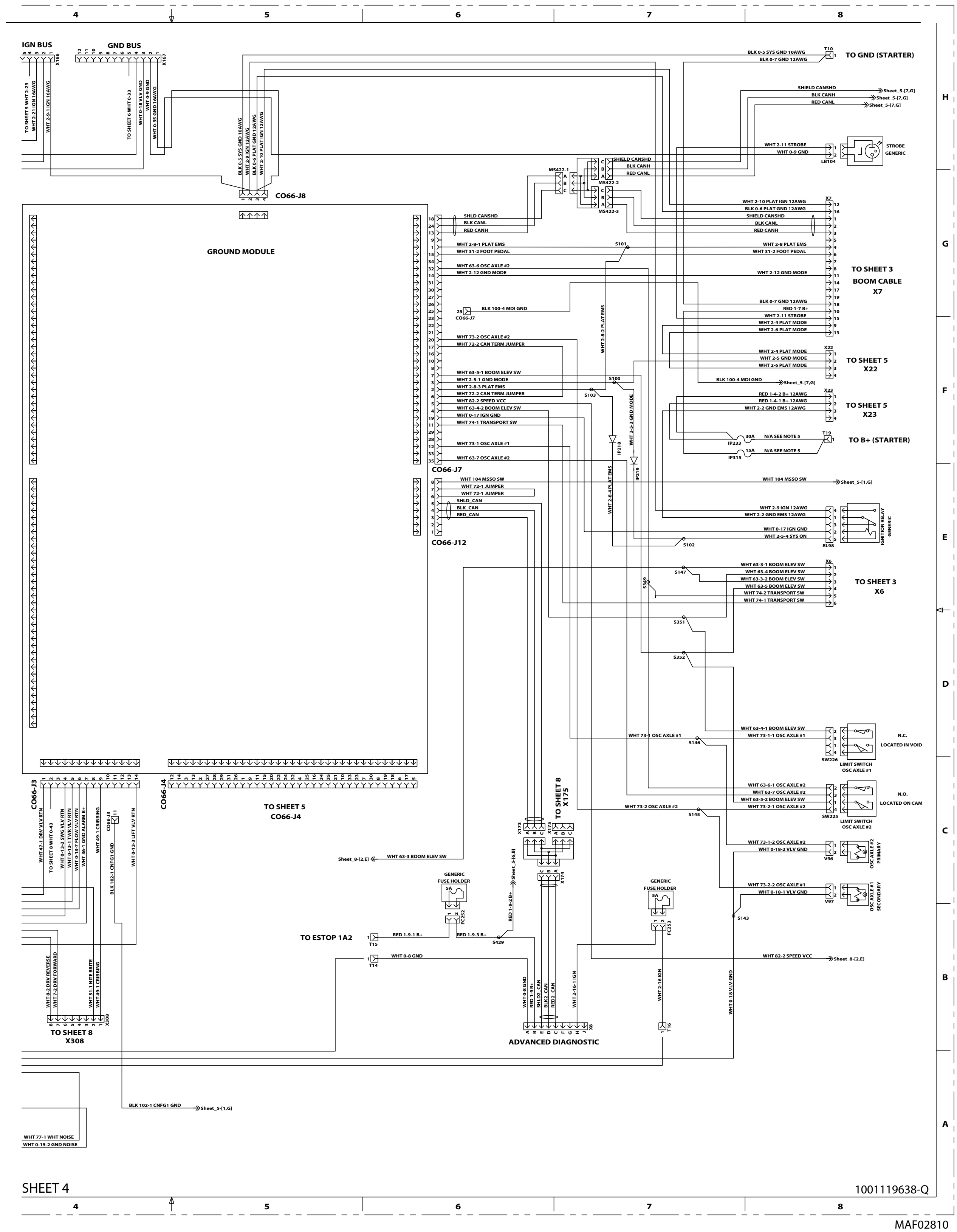

Figure 7-31. Electrical Schematic - Sheet 7 of 20

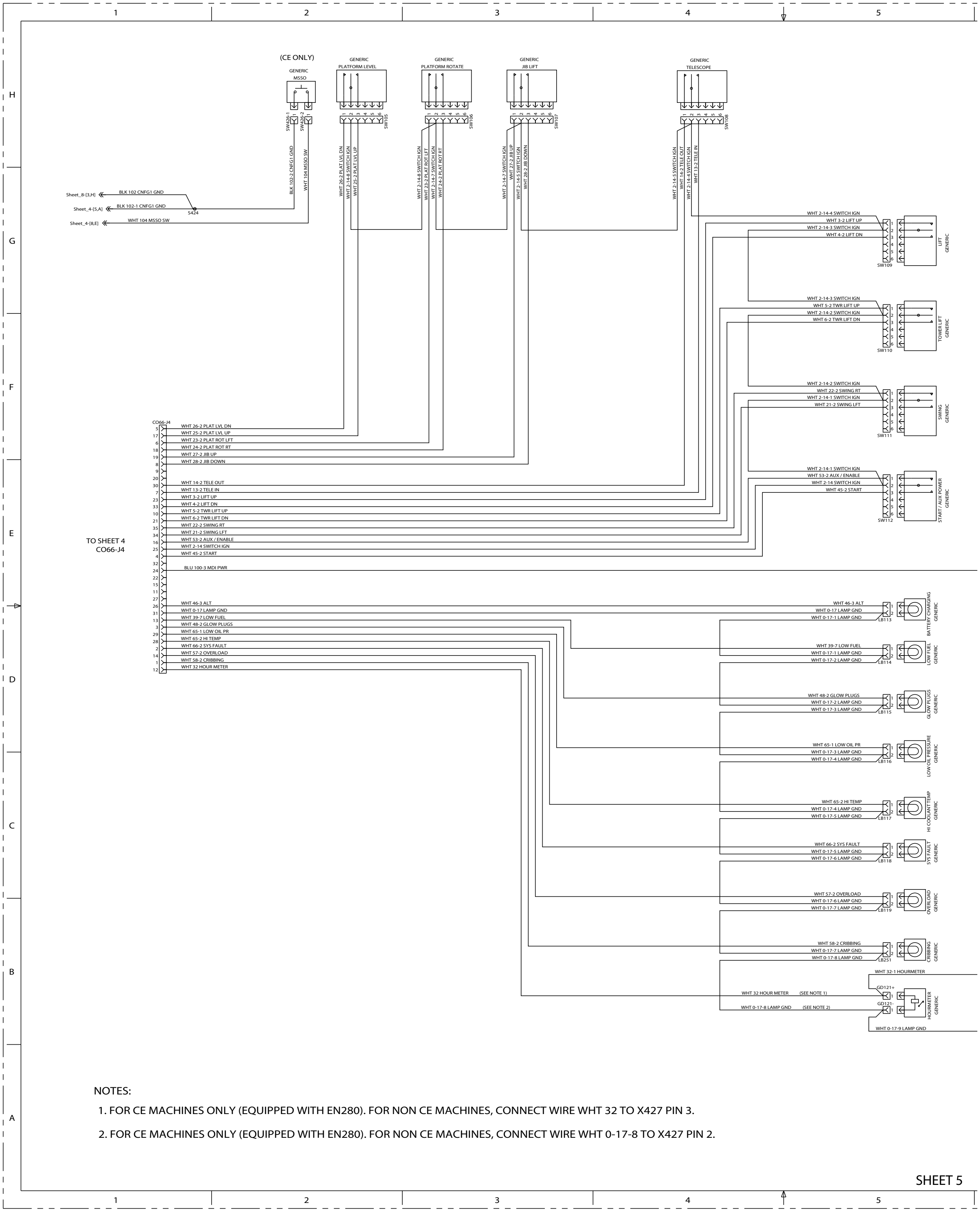

Figure 7-32. Electrical Schematic - Sheet 8 of 20

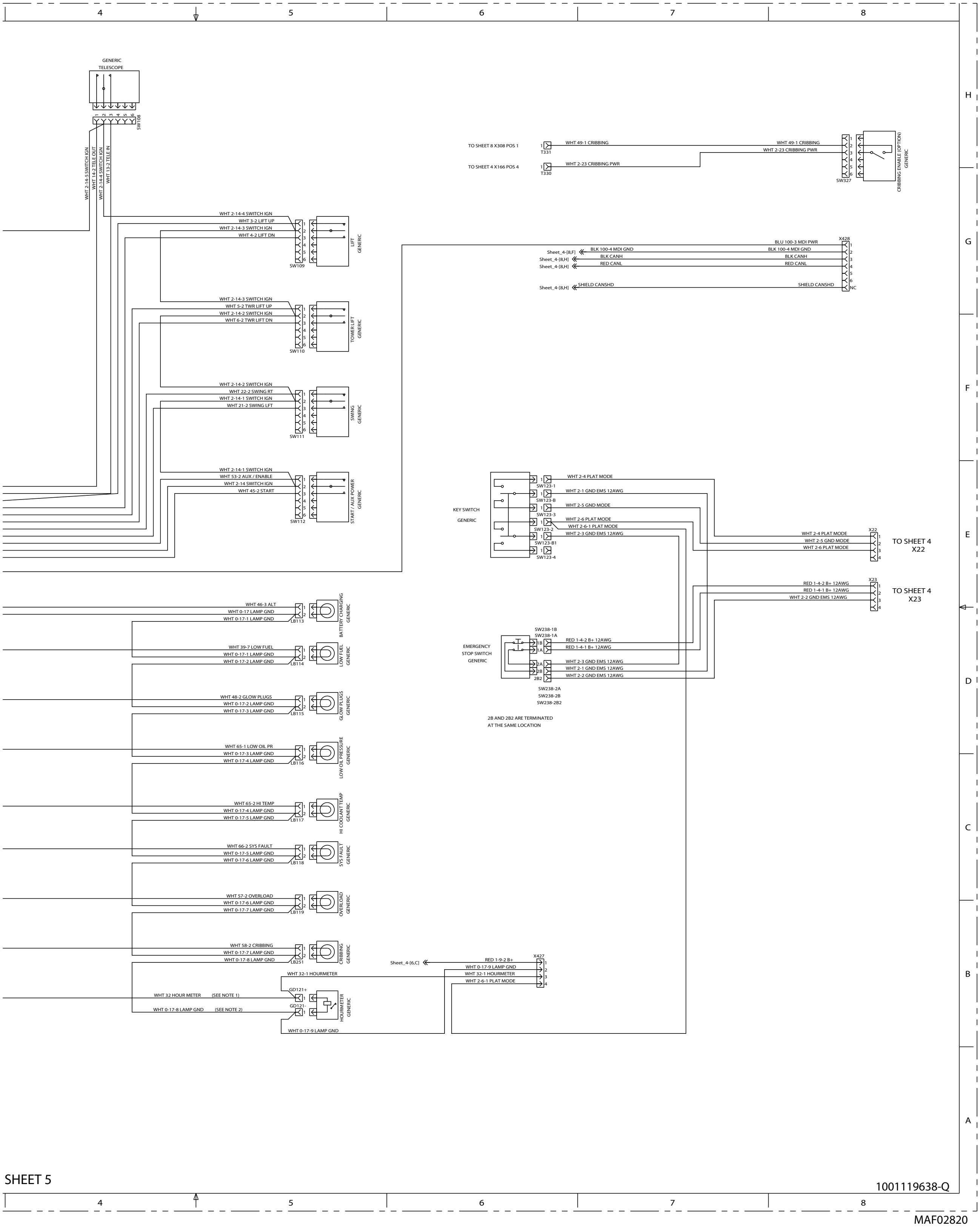

Figure 7-33. Electrical Schematic - Sheet 9 of 20

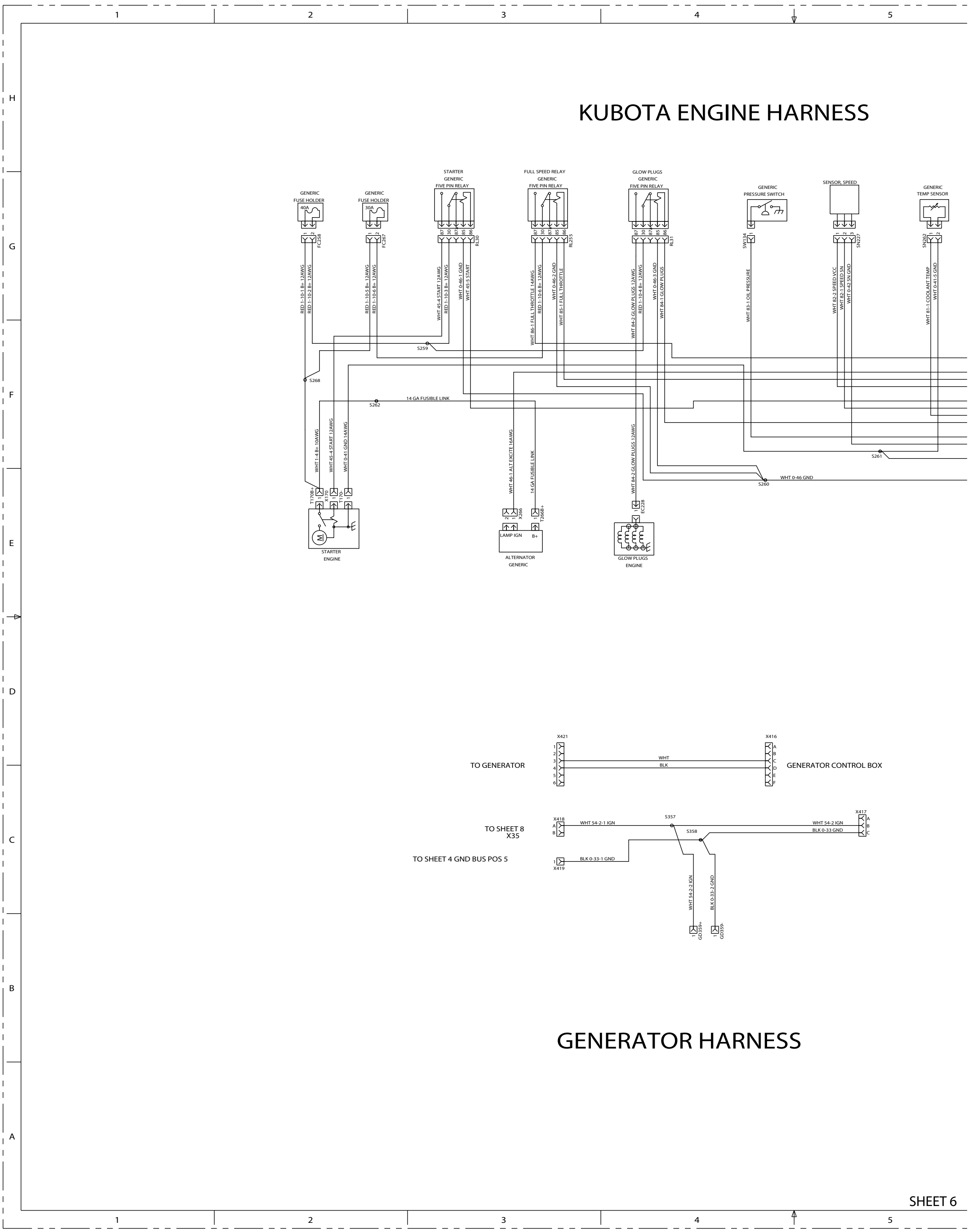

Figure 7-34. Electrical Schematic - Sheet 10 of 20

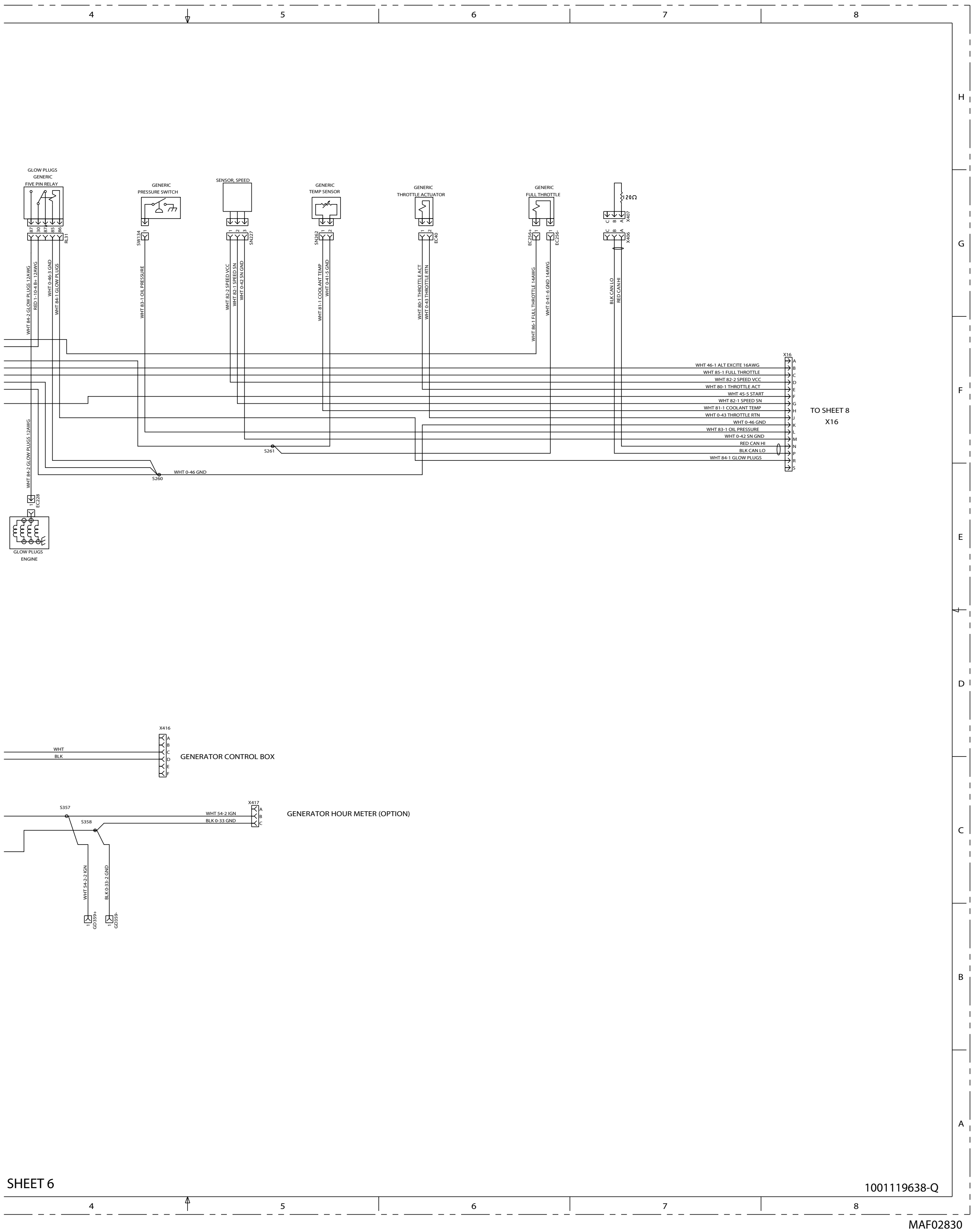

Figure 7-35. Electrical Schematic - Sheet 11 of 20

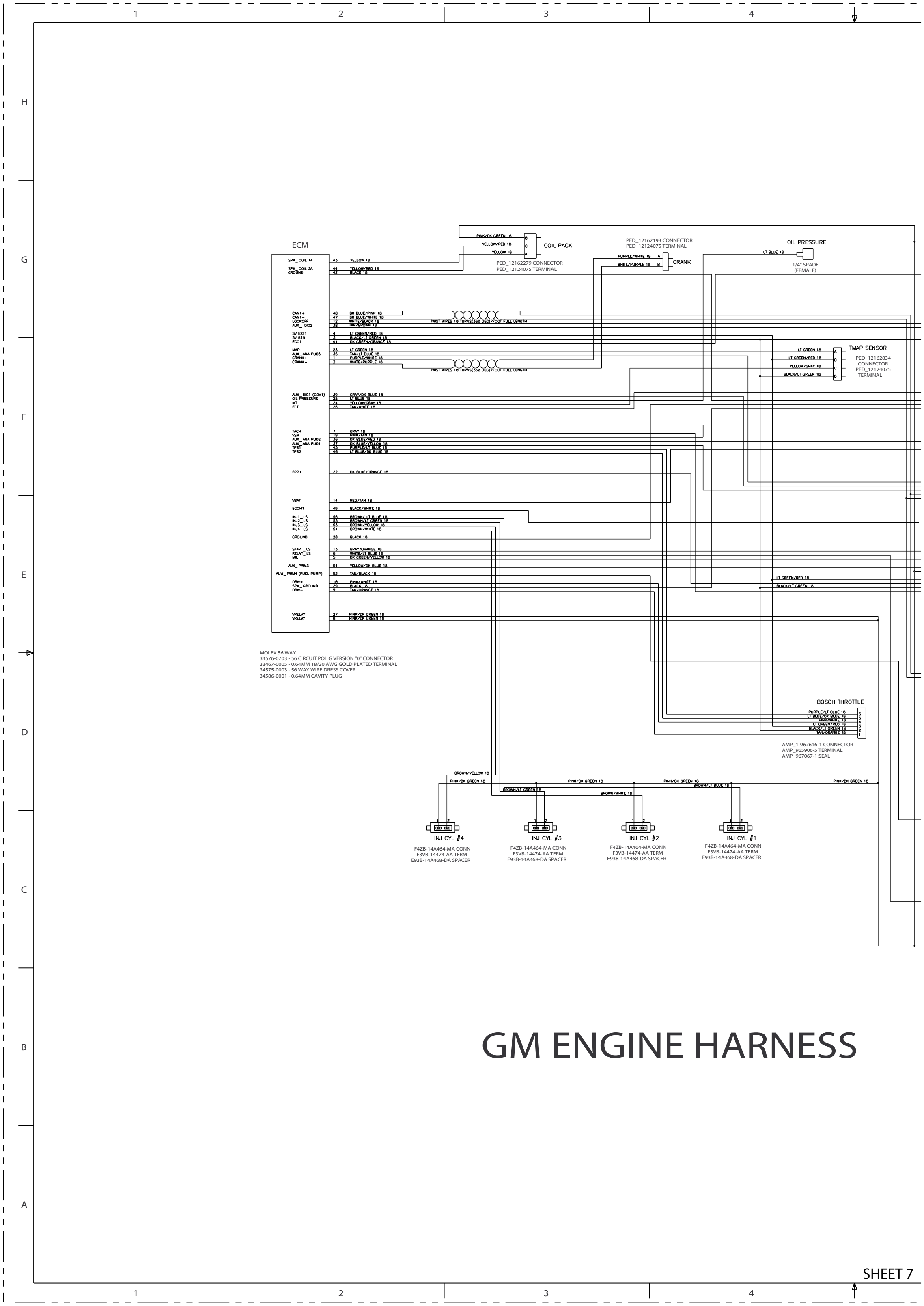

Figure 7-36. Electrical Schematic - Sheet 12 of 20

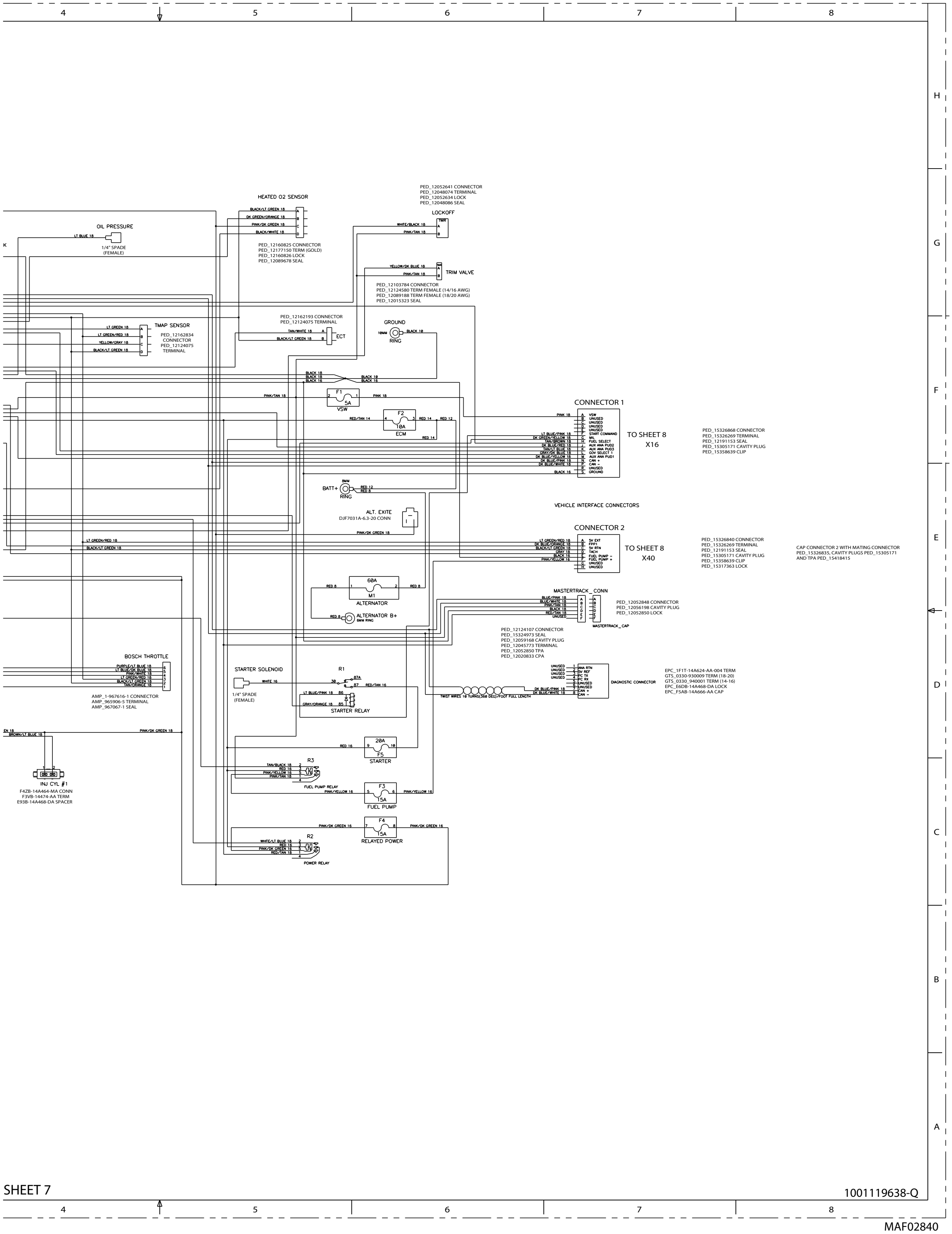

Figure 7-37. Electrical Schematic - Sheet 13 of 20

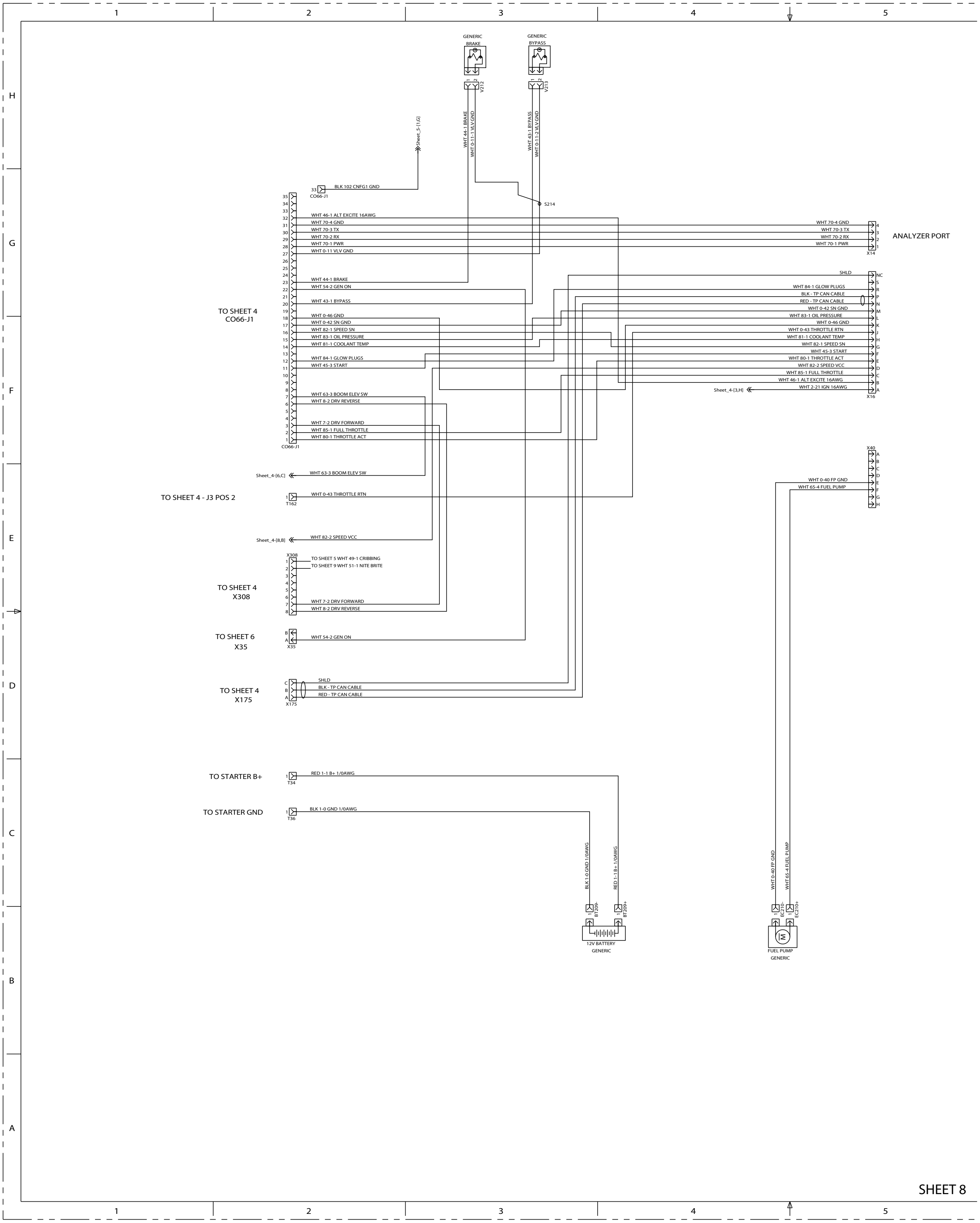

Figure 7-38. Electrical Schematic - Sheet 14 of 20

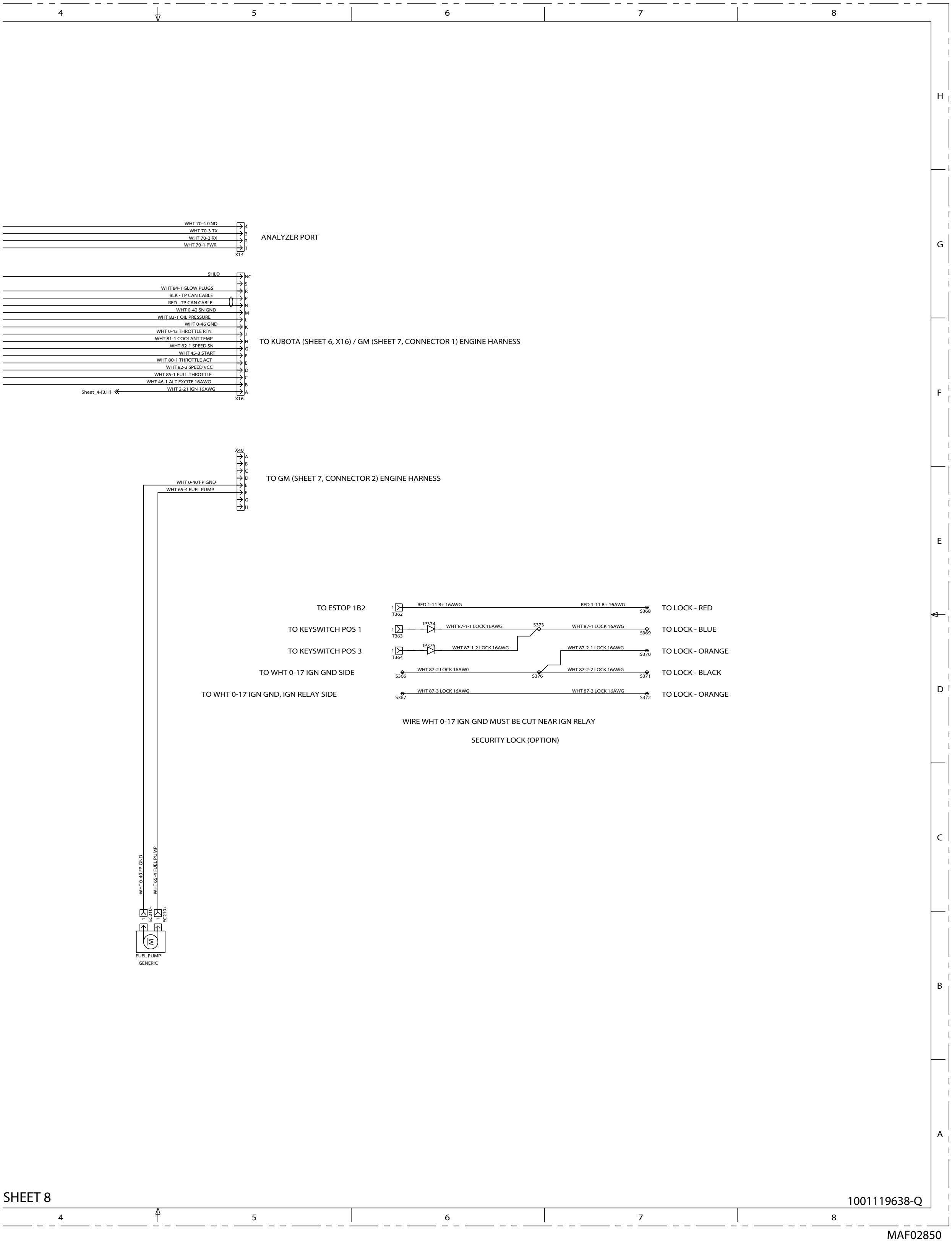

Figure 7-39. Electrical Schematic - Sheet 15 of 20

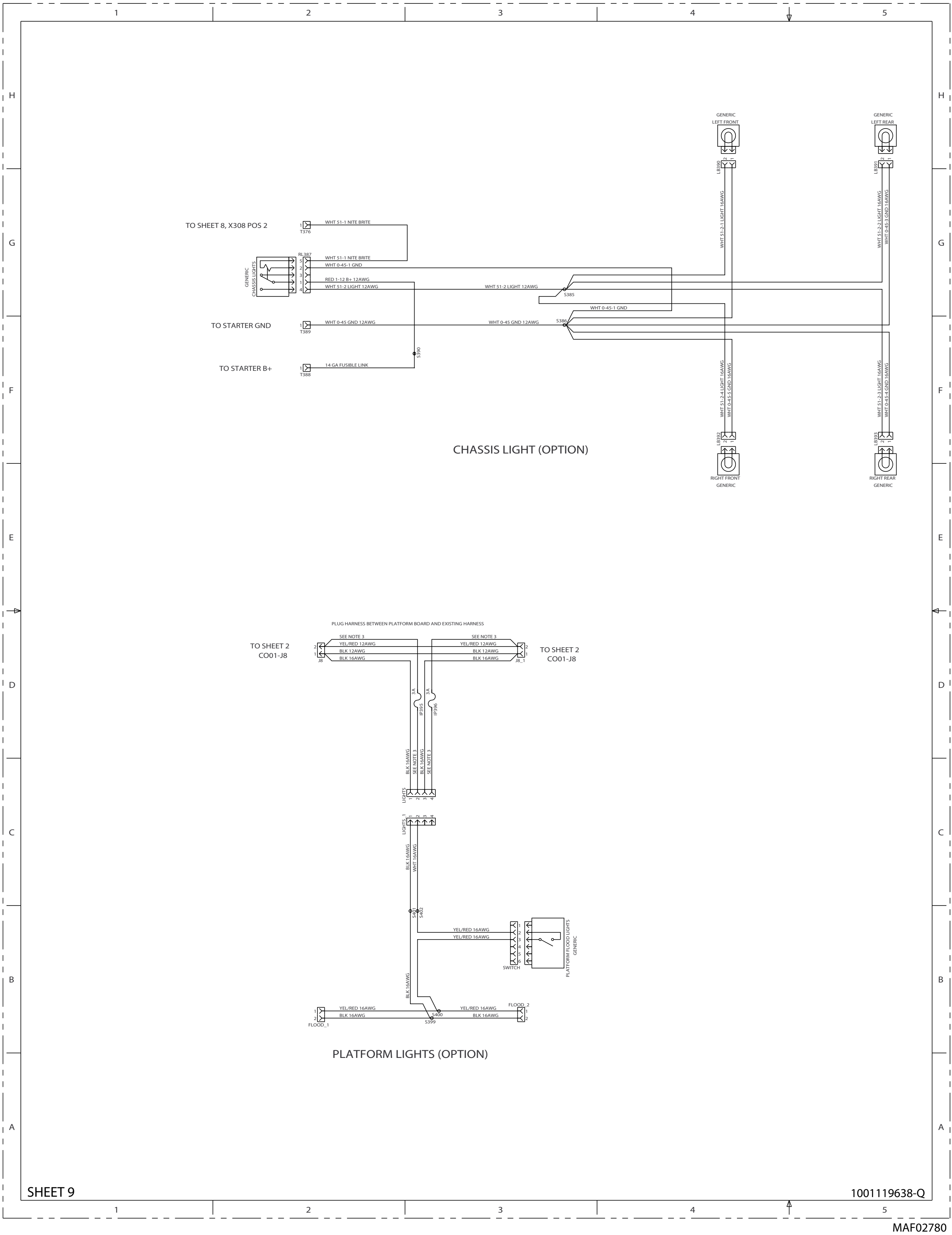

Figure 7-40. Electrical Schematic - Sheet 16 of 20

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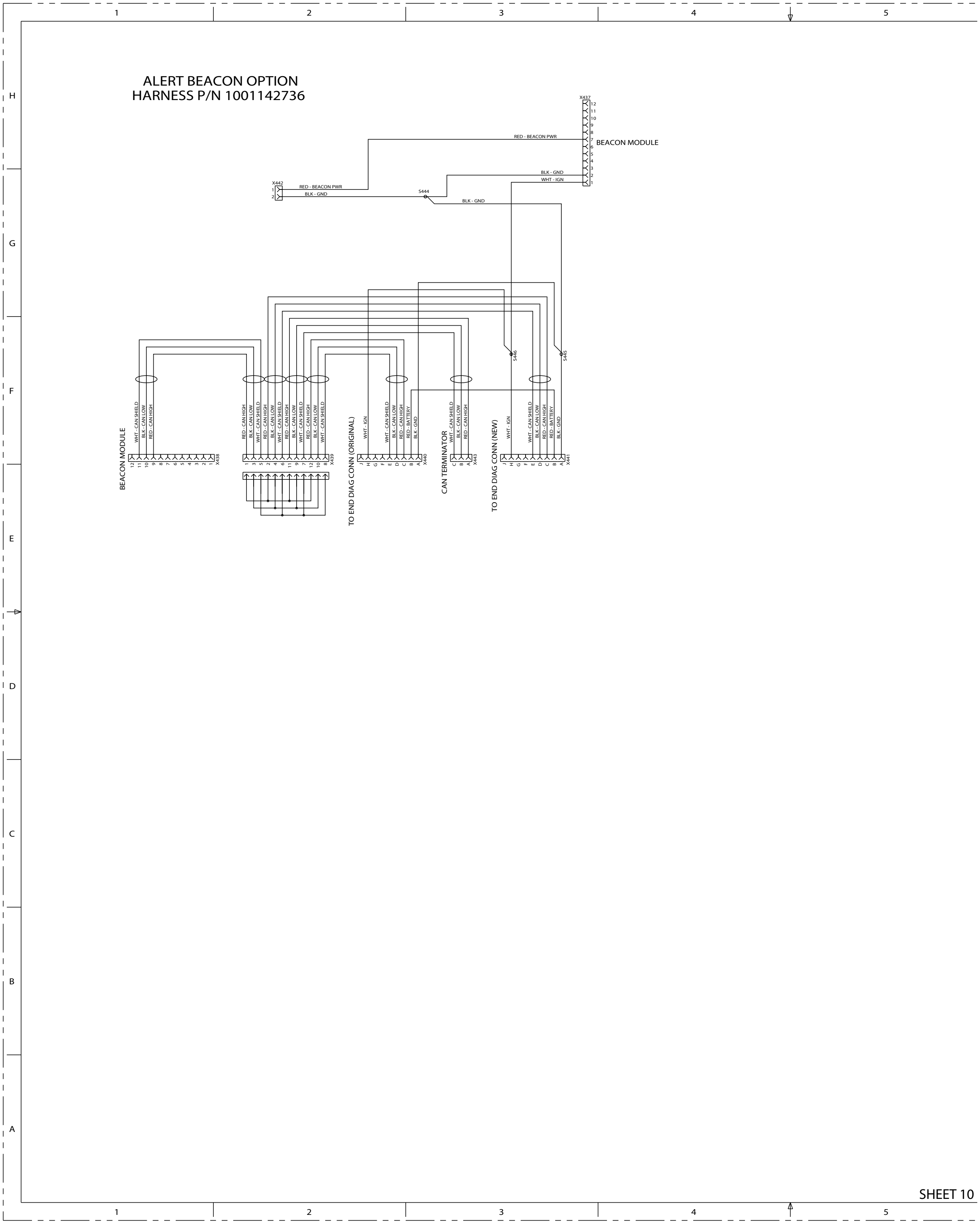


Figure 7-41. Electrical Schematic - Sheet 17 of 20

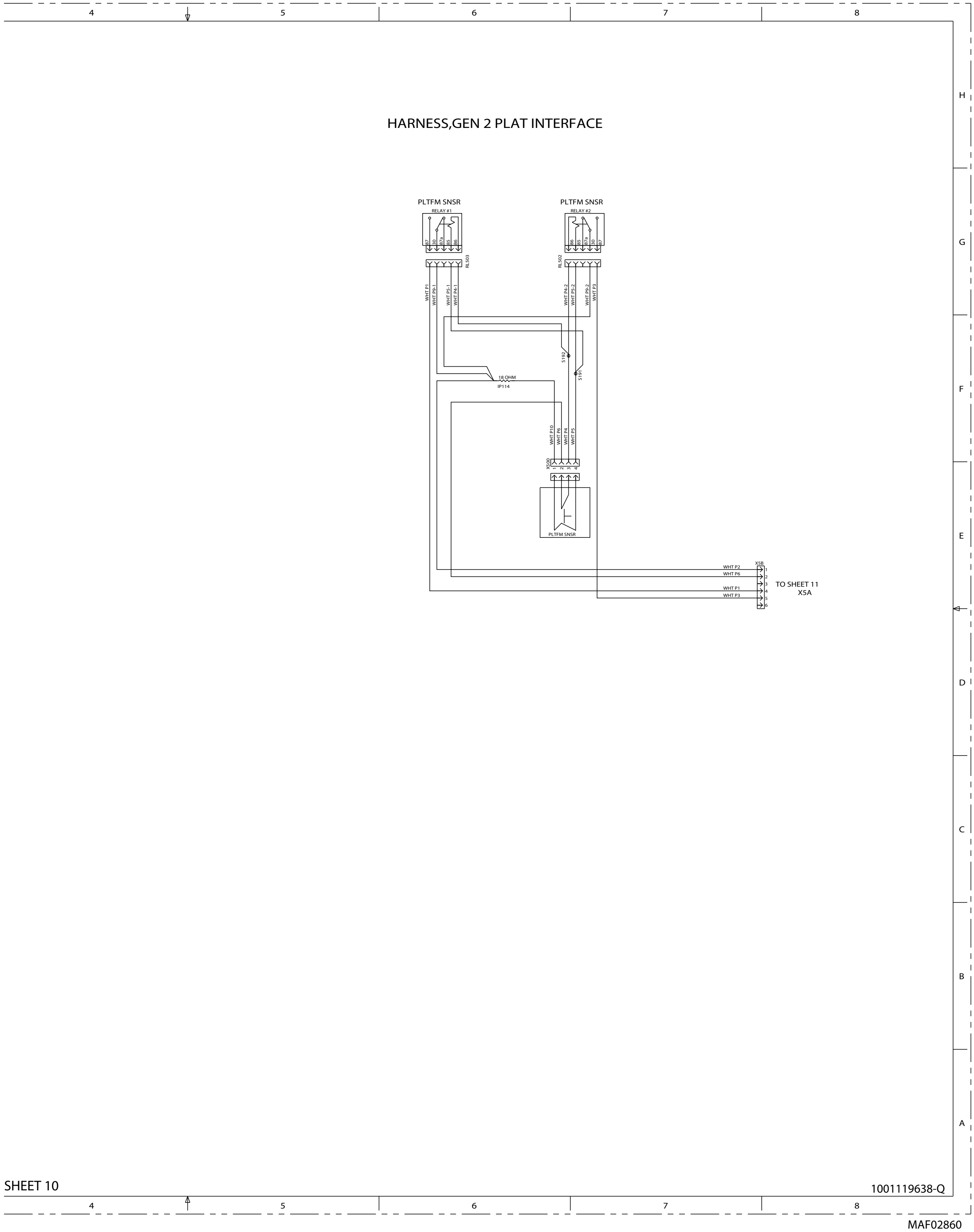


Figure 7-42. Electrical Schematic - Sheet 18 of 20

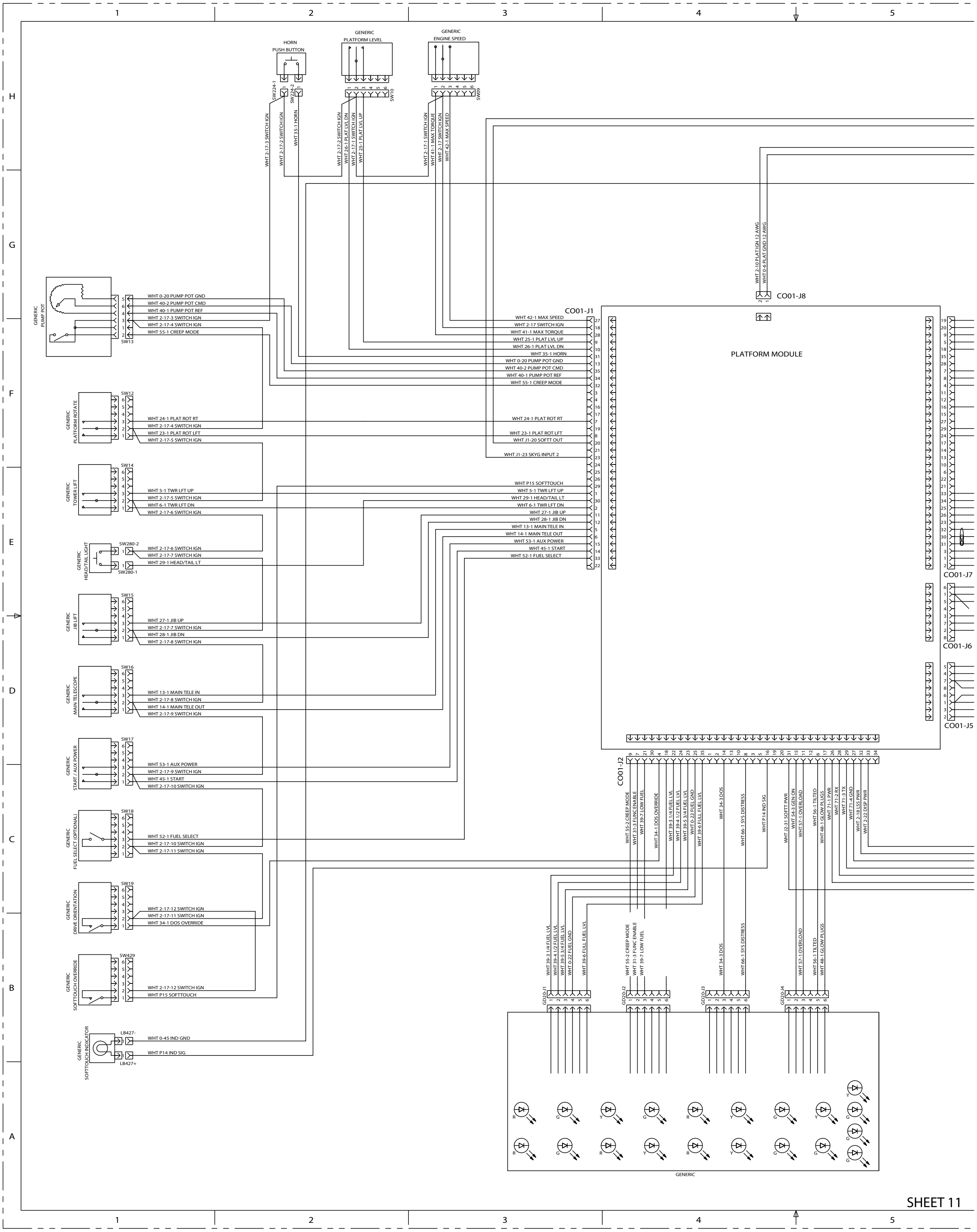


Figure 7-43. Electrical Schematic - Sheet 19 of 20

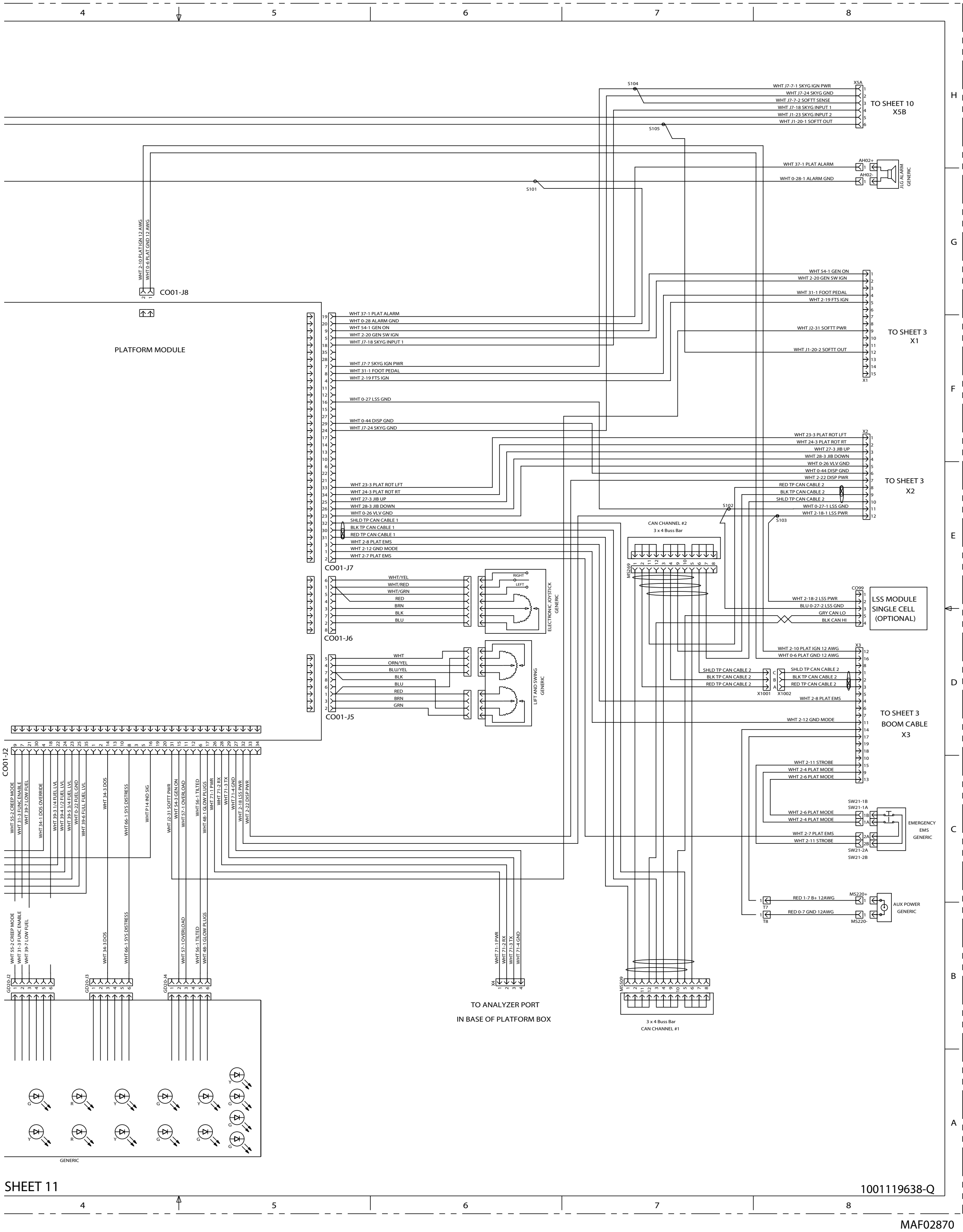


Figure 7-44. Electrical Schematic - Sheet 20 of 20

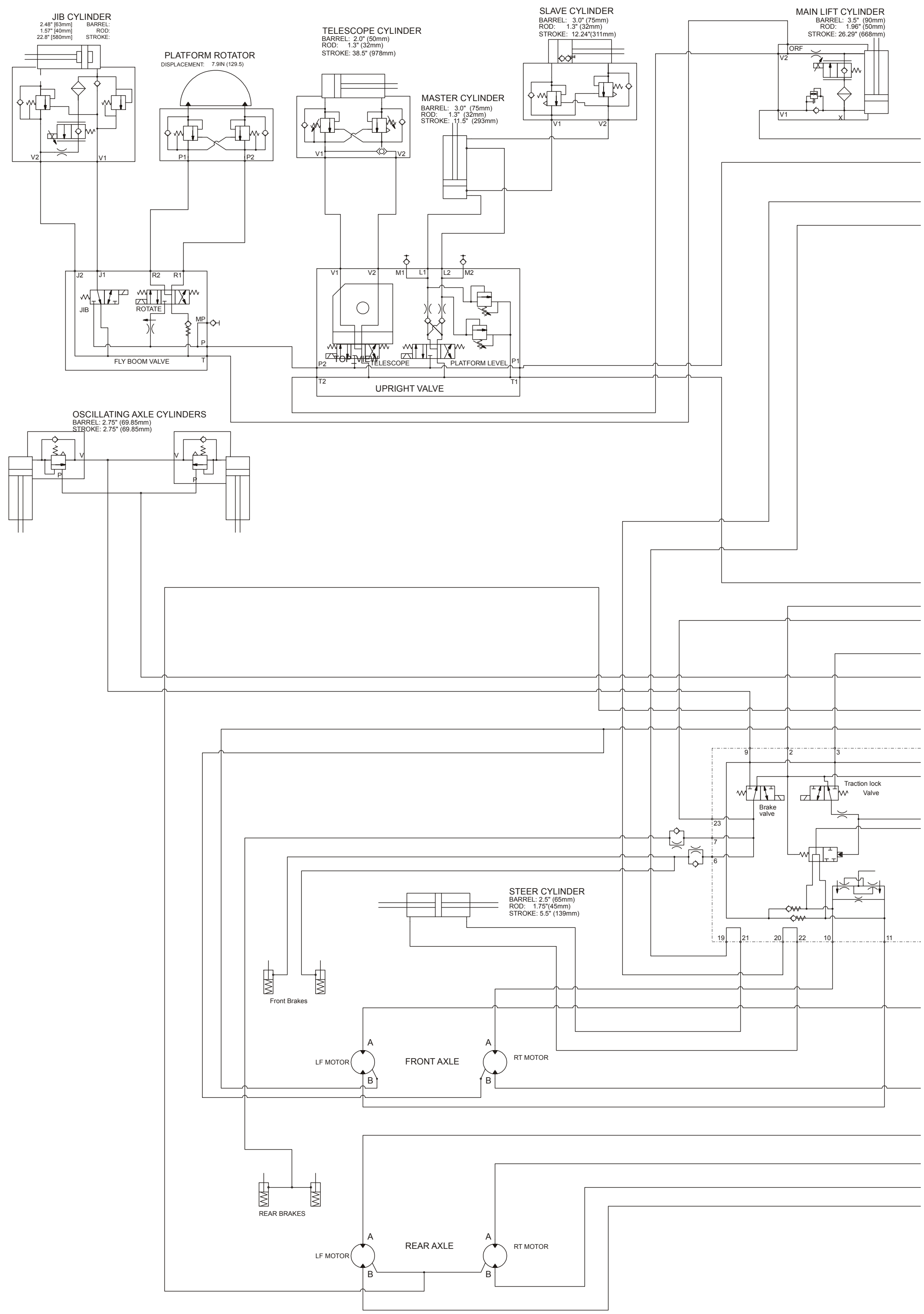
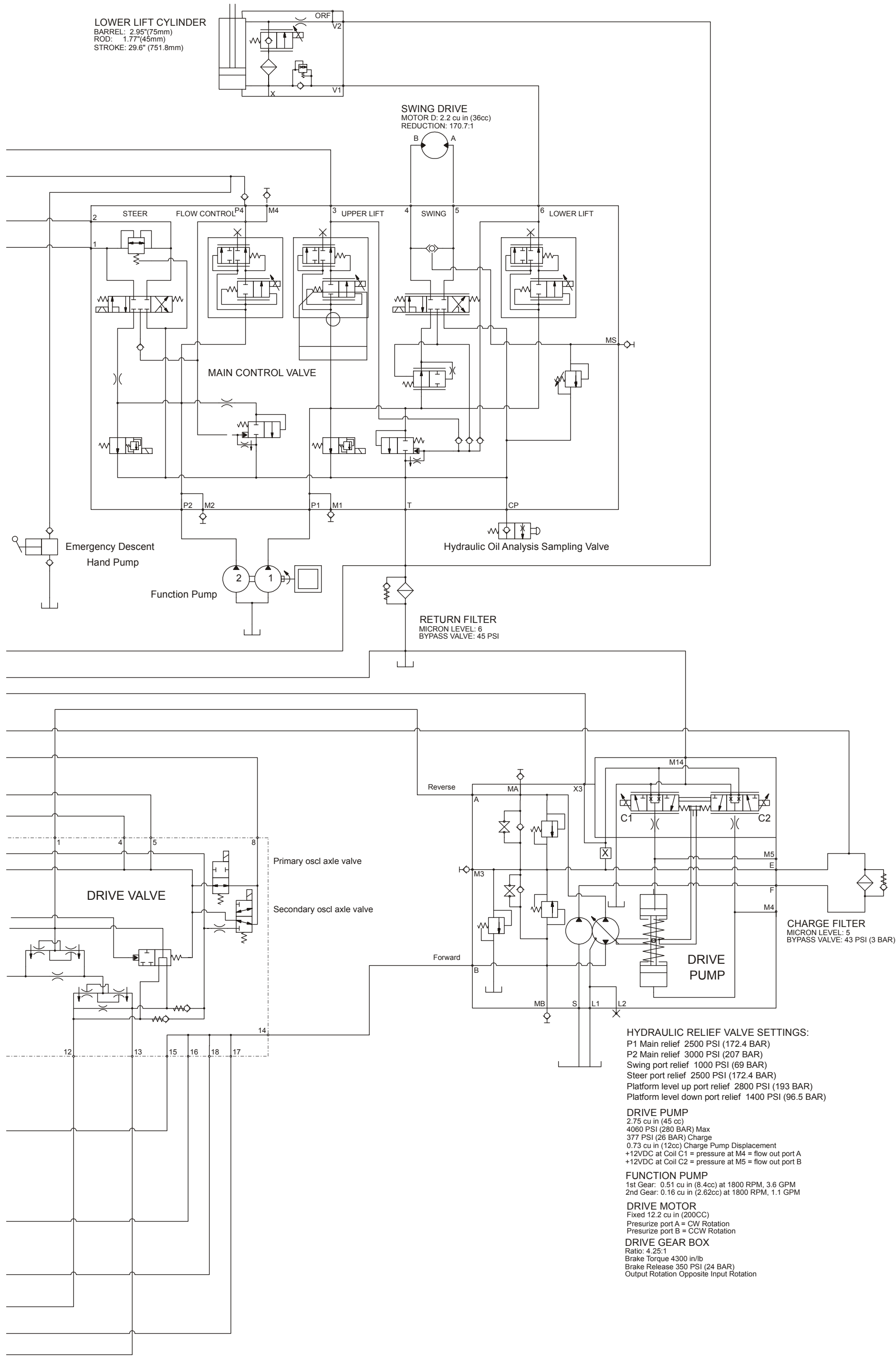


Figure 7-45. Hydraulic Schematic - Sheet 1 of 2



1001120020-C

Figure 7-46. Hydraulic Schematic - Sheet 2 of 2

NOTES:

3121259

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