An Oshkosh Corporation Company

Service and Maintenance Manual

Model
E300AJ
E300AJP

S/N 0300138358
to Present

P/N - 3121253

October 24, 2013

ANSI

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

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

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

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

⚠ WARNING

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

B HYDRAULIC SYSTEM SAFETY

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

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

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SECTION NO. **TITLE** **PAGE NO.**

SECTION 3 - CHASSIS & TURNTABLE

SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating specifications - E300AJ

Capacity: Unrestricted:	500 lbs. (227 kg)
Maximum Travel Grade, stowed Position (Gradeability)	25%
Maximum Travel Grade, stowed Position (Side Slope)	5°
Drive Speed (High Drive) - 200 ft. (60.9 M)	45-50 sec
Drive Speed (Above Horz.) - 50 ft. (15.24 M)	55-68 sec (0.6 mph[0.9 kph])
Gross Machine Weight - Approximate	15060 lbs. (6831 kg)
Ground Bearing Pressure - Maximum	170 psi (11.95 kg/ cm^2)
Maximum System Voltage	48V DC
Maximum Main Relief Hyd. Pressure	3000 psi (207 bar)

Table 1-2. Operating specifications - E300AJP

Capacity: Unrestricted:	500 lbs. (227 kg)
Maximum Travel Grade, stowed Position (Gradeability)	25%
Maximum Travel Grade, stowed Position (Side Slope)	5°
Drive Speed (High Drive) - 200ft. (60.9 m)	45-50 sec (3 mph [4.8 kph])
Drive Speed (Above Horz.) - 50 ft. (15.24 M)	55-68 sec (0.6 mph[0.9 kph])
Gross Machine Weight- Approximate	15400 lbs. (6985 kg)
Ground Bearing Pressure - Maximum	170 psi (11.95 kg/ cm^2)
Maximum System Voltage	48V DC
Maximum Main Relief Hyd. Pressure	3000 psi (207 bar)

1.2 DIMENSIONAL DATA

Table 1-3. Dimensional Data - E300AJ

Turning Radius (Inside)	5 ft. (1.52 m)
Turning Radius (Outside)	10ft. 2in. (3.1 m)
Machine Height (stowed)	6ft. 7in. (2.01 m)
Machine Length (stowed)	18ft. 2in. (5.54 m)
Up and Over Platform Height	13ft. 2in. (4.01 m)
Horizontal Reach Up and Over	20ft. 3in. (6.17 m)
Machine Width	4ft. (1.22 m)
Wheel Base	5ft. 5in. (1.65 m)
Platform Height	30ft. 2in. (9.19m)
Ground Clearance	4in. (10 cm)

Table 1-4. Dimensional Data - E300AJP

Turning Radius (Inside)	5 ft. (1.52 m)
Turning Radius (Outside)	10ft. 2in. (3.1 m)
Machine Height (stowed)	6ft. 7in. (2.01 m)
Machine Length (stowed)	18ft. 10in. (5.74 m)
Up and Over Platform Height	13ft. 2in. (4.01 m)
Horizontal Reach Up and Over	20ft. 1in. (6.12 m)
Machine Width	4ft. (1.22 m)
Wheel Base	5ft. 5in. (1.65 m)
Platform Height	29ft. 5in. (8.97 m)
Ground Clearance	4in. (10 cm)

1.3 CAPACITIES

Table 1-5. Capacities

Hydraulic Oil Tank	2.9 Gal. (11 L) 2.1 Gal. (8 L) to Full Mark
Drive Hub*	25.5 oz. (0.75 L)(1/2 Full)
*Drive hubs should be one half full of lubricant.	

1.4 TIRES

Table 1-6. Tires

Size	25x7x12
Maximum Tire Load	8200 lbs. (3719 kg)
Type	Solid Non-Marking

1.5 HYDRAULIC OIL

NOTE: *Refer to Figure 1-1., Hydraulic Oil Specifications.*

Table 1-7. Hydraulic Oil

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

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

NOTE: *Machines may be equipped with Mobil EAL224H biodegradable and non-toxic hydraulic oil. This is vegetable oil based and 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: *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. If use of hydraulic oil other than Mobil DTE 11M is desired, contact JLG Industries for proper recommendations.*

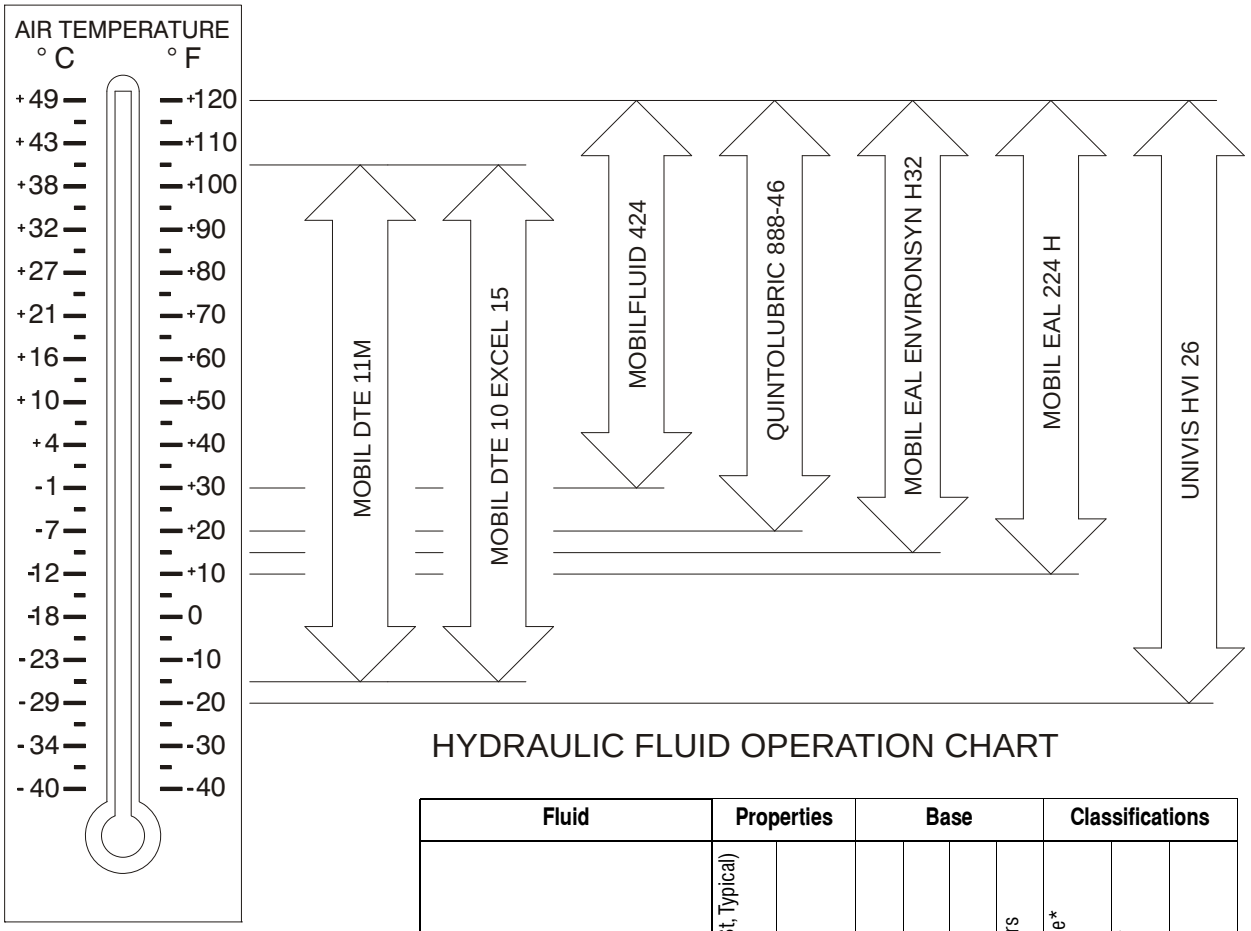
1.6 MAJOR COMPONENT WEIGHTS

⚠ 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 1-8. Critical Stability Weights

Components	LBS.	KG.
Counterweight (AJ)	6188	2807
Counterweight (AJP)	6348	2880
Tire and Wheel	120	54.4
Platform (including console)	169	78
Battery (minimum each) - 305AH	87	39.5
Battery (minimum each) - 375AH & UL	110	50



HYDRAULIC FLUID OPERATION CHART

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 11M	15	140	X						
Mobil DTE 10 Excel 15	15	168	X					X	
Univis HVI 26	26	376	X						
Mobil EAH 224 H	36	212		X			X	X	
Mobil EAL Envirosyn H32	32	147			X		X	X	
Quintolubric 888-46	50	185				X	X	X	X

* Readily biodegradable classification indicates one of the following:
CO_2 Conversion > 60% per EPA 560/6-82-003
CO_2 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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NOTICE

MACHINE OPERATION USING NON-JLG APPROVED HYDRAULIC FLUIDS OR OPERATION OUTSIDE OF THE TEMPERATURE BOUNDRIES OUTLINED IN THE HYDRAULIC FLUID OPERATION CHART MAY RESULT IN PREMATURE WEAR OR DAMAGE TO COMPONENTS OF THE HYDRAULIC SYSTEM.

Figure 1-1. Hydraulic Oil Specifications

1.7 FUNCTION SPEEDS

Table 1-9. Function Speeds

Function	Speed in seconds (unless otherwise noted)
Main Lift Up	24-27
Main Lift Down	20-23
Swing - Right & Left	75-90
Telescope Out	8-12
Telescope In	8-12
Platform Rotate, Left and Right* *Max. 15% difference between left and right	20-24
Jib Up	22 - 25
Jib Down	22 - 25
Jib Swing (300AJP)	20-35
Lower Lift Up	17 - 20
Lower Lift Down	17 - 20
Travel Speed (Forward & Reverse) High drive	3 mph (4.8 kmh) (45-50 sec / 200 ft.)
Travel Speed (Forward & Reverse) Boom Above Horizontal	0.3 mph (0.5 kmh) (110-120 sec / 50ft.)

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Test Notes

1. Stop watch should be started with the function, not with the controller or switch.
2. Drive test results reflect standard size tires.
3. All speed tests are run from the platform. These speeds do not reflect the ground control operation.
4. The platform speed knob control must be at full speed (turned clockwise completely).
5. Function speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 75° F (24° C).
6. Some flow control functions may not work with the speed knob clicked into the creep position.

Machine Orientation When Doing Speed Tests

NOTE: *All tests are to be performed on a smooth, level surface.*

Lift: Boom Retracted. Telescope Retracted. Lift Up, Record Time, Lift Down, Record Time.

Swing: Boom at Full Elevation. Telescope Retracted. Swing the Turntable to the end stop. Swing the Opposite Direction, Record Time.

Telescope: Boom at Full Elevation; Telescope Retracted; Telescope Out, Record Time. Telescope In, Record Time.

Drive: Test to be done on a smooth level surface. Start approximately 25 ft. (7.62 m) from starting point so that the unit is at maximum speed when starting the test. Results should be recorded for a 200 ft. (60.96 m) course. Drive Forward, record time. Drive Reverse, Record Time.

Drive (Above Horizontal): Test should be done on a smooth level surface. The Platform Speed Knob should be selected out of the creep speed. This verifies that the switches are working when the boom is above horizontal. Results should be recorded for a 50 ft. 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 the Jib down. Jib Up, Record Time. Jib Down, Record Time.

Lower Lift: Upper 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 Swing fully to Left. Swing fully to Right, Record Time. Swing fully to Left, Record Time.

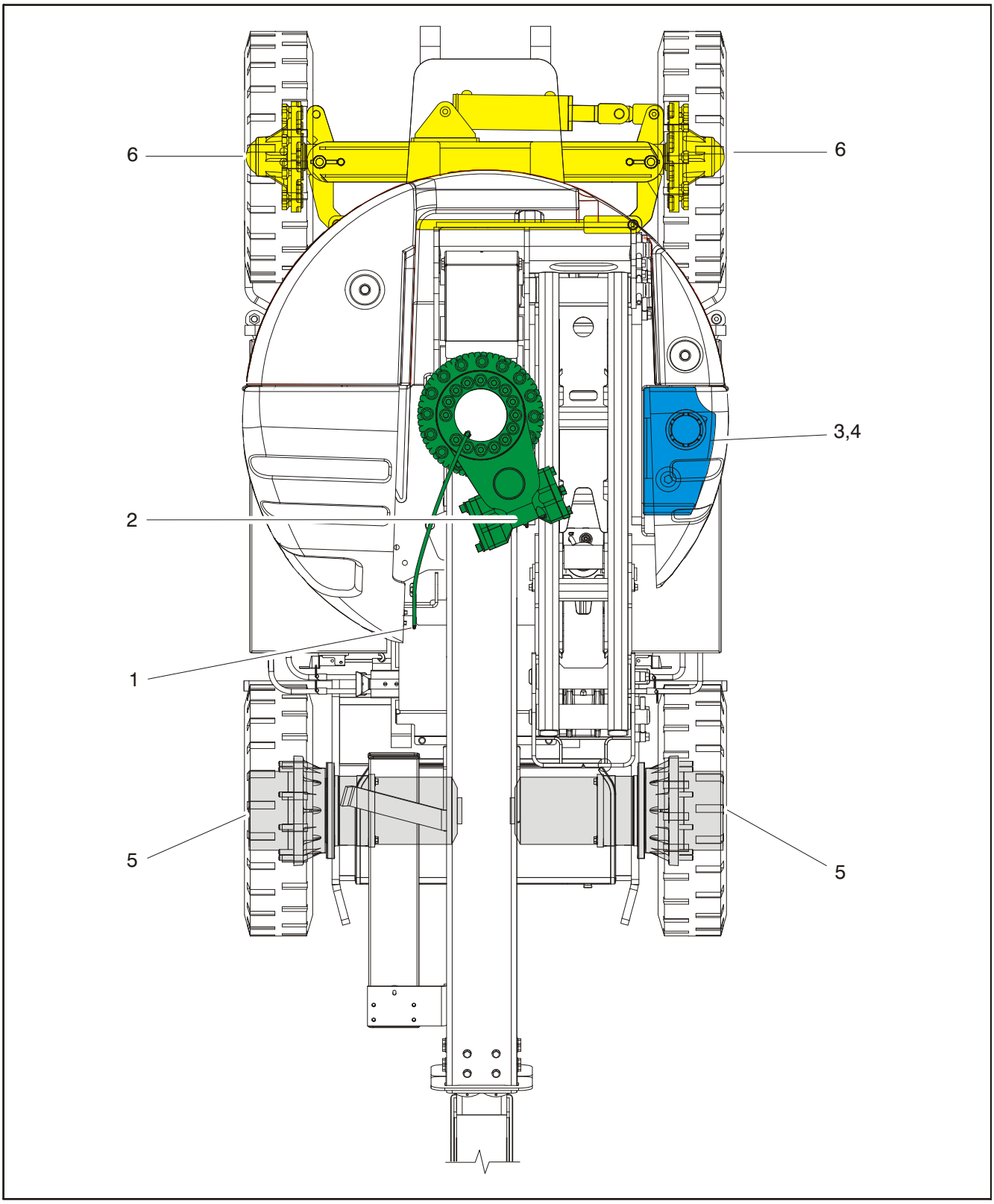


Figure 1-2. Operator Maintenance and Lubrication Diagram

1.8 OPERATOR MAINTENANCE

NOTE: *The following numbers correspond to those in Figure 1-2., Operator Maintenance and Lubrication Diagram.*

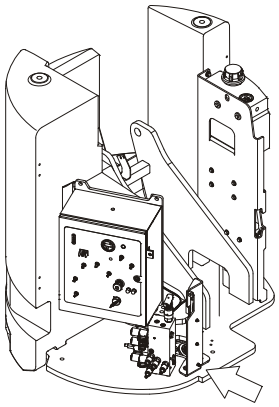
Table 1-10. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350 degrees F. Excellent water resistance and adhesive qualities; and being of extreme pressure type (Timken OK 40 pounds minimum).
EPGL	Extreme Pressure Gear Lube (oil) meeting API Service Classification GL-5 or Mil-Spec Mil-L-2105.
HO	Hydraulic Oil. Mobil DTE-11M
BG*	Bearing Grease (JLG Part No. 3020029) Mobilith SHC 460.
LL	Synthetic Lithium Lubricant, Gredag 741 Grease. (JLG Part No. 3020022)
*MPG may be substituted for these lubricants, if necessary, but service intervals will be reduced.	

NOTICE

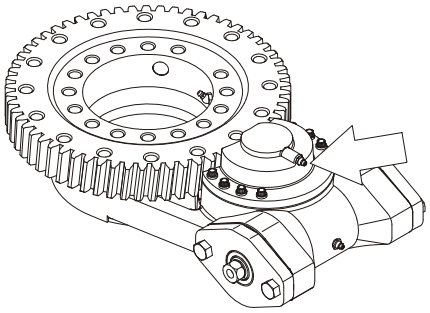
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

1. Swing Bearing

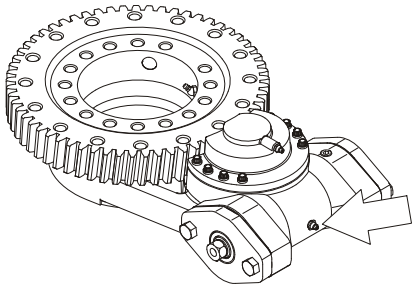


Lube Point(s) - Remote Fitting
Capacity - A/R
Lube - BG
Interval - Every 3 months or 150 hrs of operation
Comments - Apply grease and rotate in 90 degree intervals until bearing is completely lubricated

2. Swing Bearing/Worm Gear Teeth



Lube Point(s) - Grease Fittings
Capacity - A/R
Lube - BG
Interval - A/R

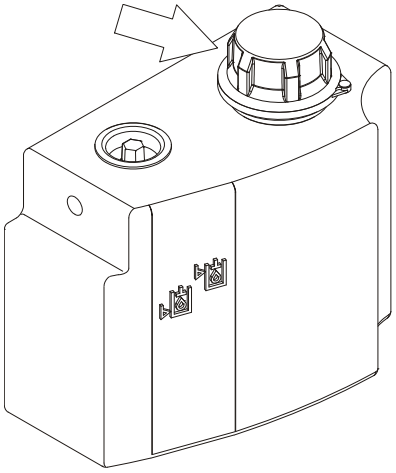


Lube Point(s) - Grease Fittings
Capacity - A/R
Lube - Mobile SHC 007
Interval - A/R

⚠ CAUTION

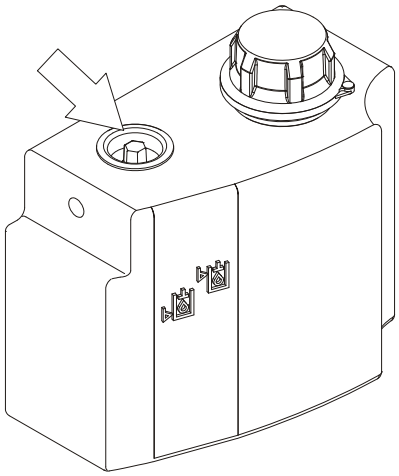
DO NOT OVERGREASE BEARINGS. OVERGREASING BEARINGS WILL RESULT IN DAMAGE TO OUTER SEAL IN HOUSING.

3. Hydraulic Tank



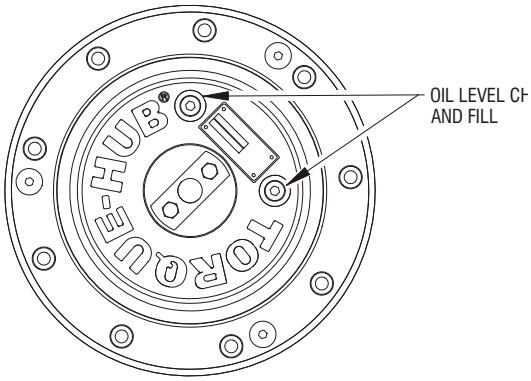
Lube Point(s) - Fill Cap
Capacity - 2.9 Gal. (11 L), 2.1 Gal. (8 L) to Full Mark
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.
Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate all systems a minimum of two complete cycles and recheck oil level in reservoir.

4. Hydraulic Return Filter



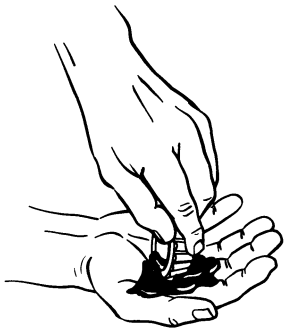
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.
Comments - Under certain conditions, it may be necessary to replace the hydraulic filter on a more frequent basis.

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. Wheel Bearings



Lube Point(s) - Repack
Capacity - A/R
Lube - MPG
Interval - Every 2 years or 1200 hours of operation

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NO. 5000059 REV. J

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

	REFERENCE JLG ANEROBIC 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 1-3. Torque Chart (SAE Fasteners - Sheet 1 of 7)

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

NO. 5000059 REV. J

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

Figure 1-4. Torque Chart (SAE Fasteners - Sheet 2 of 7)

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

NO. 5000059 REV. J

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

Figure 1-5. Torque Chart (SAE Fasteners - Sheet 3 of 7)

SOCKET HEAD CAP SCREWS										
Zinc Yellow Chromate Fasteners (Ref 4150707)*										
Size	TPI	Bolt Dia	Tensile Stress Area	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]
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	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	775	1055	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NO. 5000059 REV. J

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

Figure 1-6. Torque Chart (SAE Fasteners - Sheet 4 of 7)

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

NO. 5000059 REV. J

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

Figure 1-7. Torque Chart (METRIC Fasteners - Sheet 5 of 7))

			Values for Zinc Yellow Chromate Fasteners (Ref 4150707) CLASS 10.9 METRIC 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™) 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]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25.2	22.7	18.9
8	1.25	36.60	22.8	36.5	32.8	27.4
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

NO. 5000059 REV. J

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

Figure 1-8. Torque Chart (METRIC Fasteners - Sheet 6 of 7)

			Magni Coating (Ref 4150701)*			
			CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*			
Size	PITCH	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K = .17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K = .16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K = .15
		Sq mm	kN	[N.m]	[N.m]	[N.m]
3	0.5	5.03				
3.5	0.6	6.78				
4	0.7	8.78				
5	0.8	14.20				
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	54
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	220.0	900	845	790
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

NO. 5000059 REV. J

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

Figure 1-9. Torque Chart (METRIC Fasteners - Sheet 7 of 7)

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.

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 Operator's 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 Preventative 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 Preventative 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.

Preventative 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 Preventative 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.
Preventative 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. JLG Industries recommends changing the hydraulic oil annually.

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 TEST

Maximum acceptable cylinder drift is to be measured using the following methods.

Platform Drift

Measure the drift of the platform to the ground. Lower booms (if equipped) slightly elevated, main boom fully extended with the rated load in the platform and power off. Maximum allowable drift is 2 inches (5 cm) in 10 minutes. If the machine does not pass this test, proceed with the following.

Cylinder Drift

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	0.0038	0.10
9	228.6	0.0030	0.08

Drift is to be measured at the cylinder rod with a calibrated dial indicator. The cylinder oil must be at ambient temperature and temperature stabilized.

The cylinder must have the normal load, which is the normal platform load applied.

If the cylinder passes this test, it is acceptable.

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

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.)

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Boom Assembly	9					
Boom Weldments				1,2,4	1,2,4	
Hose/Cable Carrier Installations				1,2,9,12	1,2,9,12	
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				1,2,3	1,2,3	
Platform Assembly	9					
Platform	1,2				1,2	
Railing	1,2			1	1,2	
Gate			5	1	1,5	
Floor	1,2			1	1,2	
Rotator		9,5		15		
Lanyard Anchorage Point	2			1,2,10	1,2,10	
Turntable Assembly	9					
Swing Bearing or Worm Gear				1,2,14	1,2,3,13,14	
Oil Coupling		9				
Swing Drive System				11	11	
Turntable Lock				1,2,5	1,2,5	
Hood, Hood Props, Hood Latches				5	1,2,5	
Chassis Assembly	9					
Tires	1	16,17		16,17,18	16,17,18	
Wheel Nuts/Bolts	1	15		15	15	
Wheel Bearings						14,24
Oscillating Axle/Lockout Cylinder Systems					5,8	
Outrigger or Extendable Axle Systems				5,8	5,8	
Steer Components						
Spindle Thrust Bearing/Washers					1,2	
Drive Motors						
Drive Hubs				11	11	

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Functions/Controls	9					
Platform Controls	5	5		6	6	
Ground Controls	5	5		6	6	
Function Control Locks, Guards, or Detents	1,5	1,5		5	5	
Footswitch	1,5			5	5	
Emergency Stop Switches (Ground & Platform)	5			5	5	
Function Limit or Cutout Switch Systems	5			5	5	
Capacity Indicator					5	
Drive Brakes				5		
Swing Brakes				5		
Manual Descent or Auxiliary Power				5	5	
Power System	9					
Engine Idle, Throttle, and RPM				3	3	
Engine Fluids (Oil, Coolant, Fuel)	11	9,11		11	11	
Air/Fuel Filter		1,7		7	7	
Exhaust System			1,9	9	9	
Batteries	5	1,9			19	
Battery Fluid		11		11	11	
Battery Charger		5			5	
Fuel Reservoir, Cap, and Breather	11,9		2	1,5	1,5	
Hydraulic/Electric System	9					
Hydraulic Pumps		1,9		1,2,9		
Hydraulic Cylinders		1,9,7	2	1,2,9	1,2,9	
Cylinder Attachment Pins and Pin Retainers		1,9		1,2	1,2	
Hydraulic Hoses, Lines, and Fittings		1,9	12	1,2,9,12	1,2,9,12	
Hydraulic Reservoir, Cap, and Breather	11	1,9	2	1,5	1,5	24
Hydraulic Filter		1,9		7	7	
Hydraulic Fluid	11			7,11	7,11	
Electrical Connections		1		20	20	
Instruments, Gauges, Switches, Lights, Horn		1			5,23	
General						
Operation and Safety Manuals in Storage Box	21			21	21	
ANSI and AEM Manuals/Handbooks Installed					21	
Capacity Decals Installed, Secure, Legible	21			21	21	

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
All Decals/Placards Installed, Secure, Legible	21			21	21	
Walk-Around Inspection Performed	21					
Annual Machine Inspection Due				21		
No Unauthorized Modifications or Additions				21	21	
All Relevant Safety Publications Incorporated				21	21	
General Structural Condition and Welds				2,4	2,4	
All Fasteners, Pins, Shields, and Covers				1,2	1,2	
Grease and Lubricate to Specifications				22	22	
Function Test of All Systems	21			21	21, 22	
Paint and Appearance				7	7	
Stamp Inspection Date on Frame					22	
Notify JLG of Machine Ownership					22	

Footnotes:

[1] Prior to use each day; or at each Operator change

[2] Prior to each sale, lease, or delivery

[3] In service for 3 months or 150 Hours; or Out of service for 3 months or more; or Purchased used

[4] Annually, no later than 13 months from the date of the prior inspection

Performance Codes:
1 - Check for proper and secure installation
2 - Visual inspection for damage, cracks, distortion or excessive wear
3 - Check for proper adjustment
4 - Check for cracked or broken welds
5 - Operates Properly
6 - Returns to neutral or "off" position when released
7 - Clean and free of debris
8 - Interlocks function properly
9 - Check for signs of leakage
10 - Decals installed and legible
11 - Check for proper fluid level
12 - Check for chafing and proper routing
13 - Check for proper tolerances
14 - Properly lubricated
15 - Torqued to proper specification
16 - No gouges, excessive wear, or cords showing
17 - Properly inflated and seated around rim
18 - Proper and authorized components
19 - Fully charged
20 - No loose connections, corrosion, or abrasions
21 - Verify
22 - Perform
23 - Sealed Properly
24 - Drain, Clean, Refill

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES AND WHEELS

Tire Wear and Damage

Inspect tires daily for wear or damage. Tires with worn edges or distorted profiles require replacement. Tires with significant damage in the tread area or side wall, require immediate evaluation before replacing the machine into service.

Wheel and Tire Replacement

Replacement wheels must have the same diameter and profile as the original. Replacement tires must be the same size and rating as the tire being replaced.

Wheel Installation

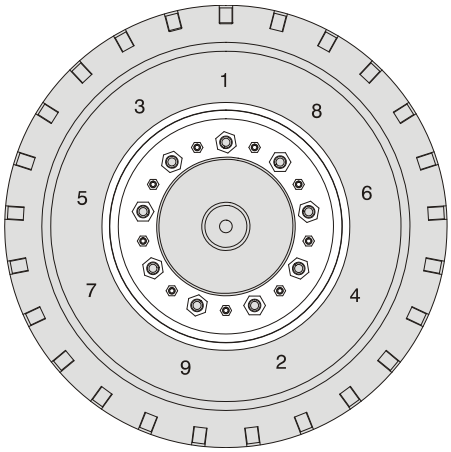
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ WARNING

WHEEL NUTS MUST BE INSTALLED AND MAINTAINED AT THE PROPER TORQUE TO PREVENT LOOSE WHEELS, BROKEN STUDS, AND POSSIBLE 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 first 50 hours of operation and after each wheel removal. Check the torque as outlined in Section 2.

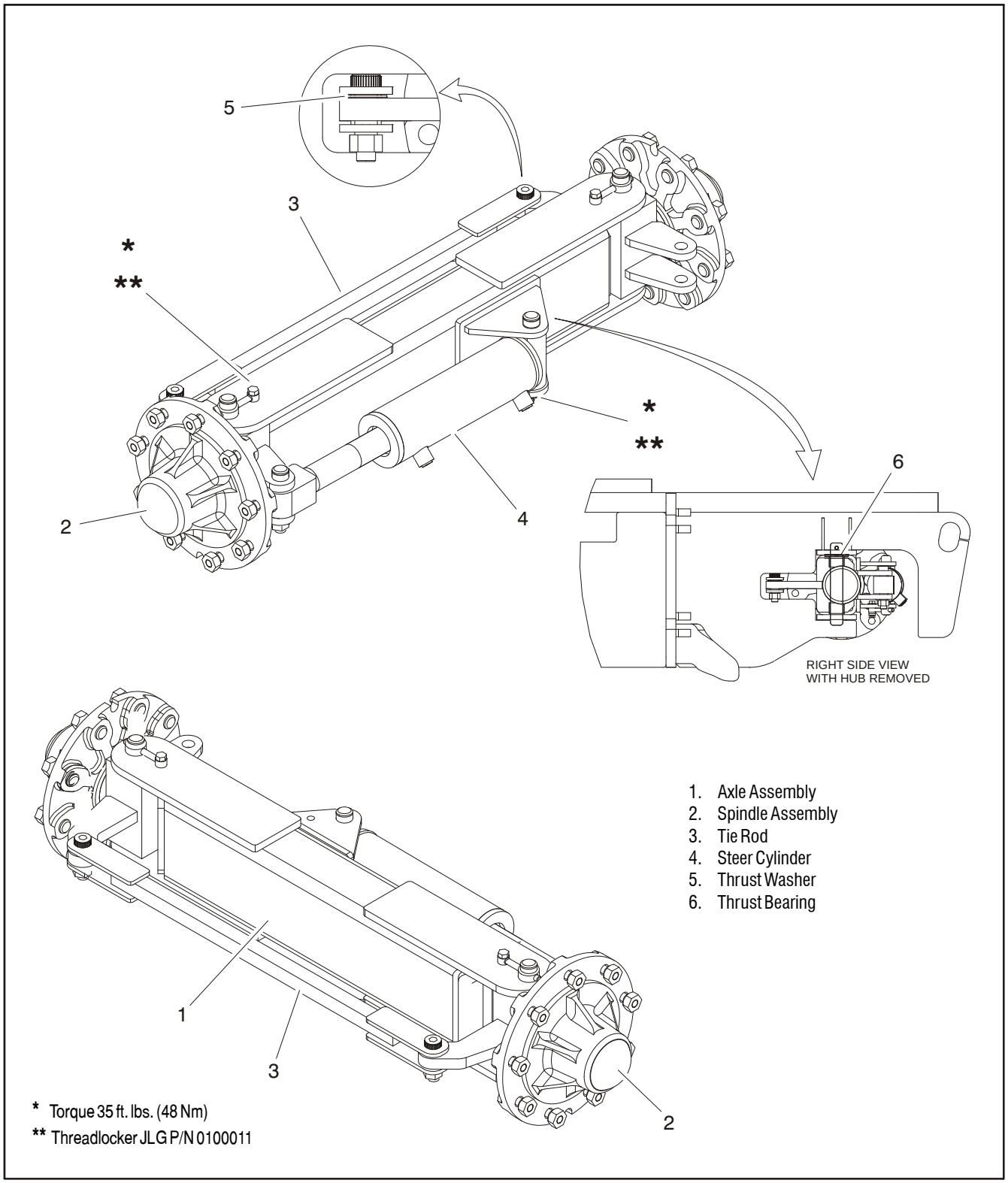


Figure 3-1. Steering Installation

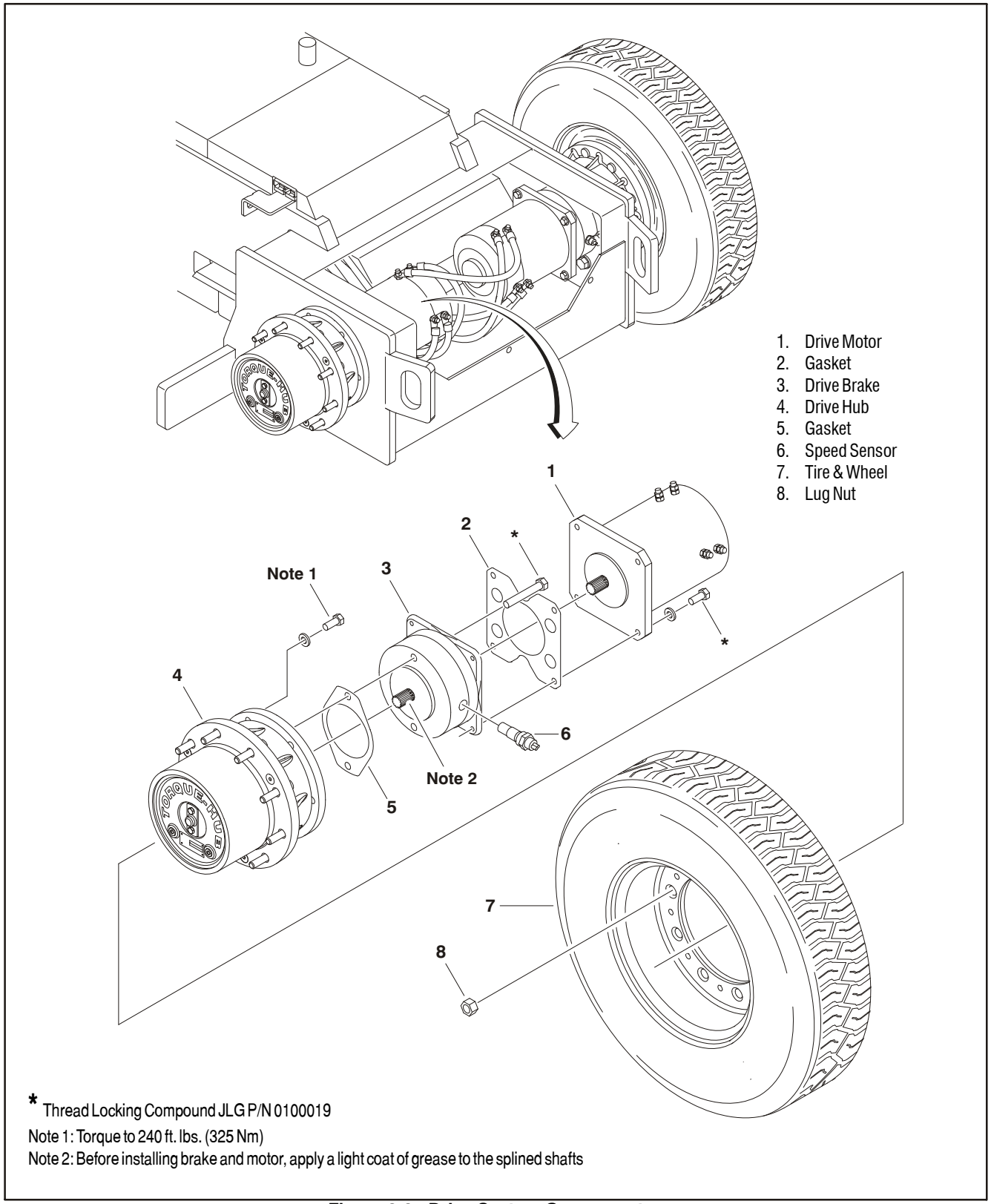


Figure 3-2. Drive System Components

3.2 SPINDLE

Setting Wheel Bearing End Play

NOTICE

BE SURE NOT TO OVER-TIGHTEN THE SPINDLE NUT.

1. Tighten the spindle nut to assure the bearings are properly seated.
2. Loosen the spindle nut completely until the nut can be turned by hand.
3. Tighten the spindle nut by hand using a socket without rotating the hub.
4. If the cotter pin can be assembled with the spindle nut finger tight, insert cotter pin without backing the nut off. If the cotter pin cannot be assembled with the spindle nut hand tight, tighten the spindle nut to the nearest available slot and insert cotter pin. If more than ½ of the cotter pin hole in the spindle can be seen in a slot, back nut off to nearest slot and insert pin.
5. Check the unit for end play by moving the hub up & down parallel along the centerline of the spindle. If you can feel excessive end play (over the 0.010" [0.25 mm] specification), recheck the nut to see what is causing the excessive end play. Keep in mind that there can be some movement and still be within the 0.010" (0.25 mm) maximum specification. If there is no way of getting the excessive end play out by using your fingers, a socket or wrench may have to be used to set the end play.
6. The units should be checked visually to make sure the cotter pins are installed and that the correct components have been used. Each unit must also be checked for the proper feel to make sure there isn't excessive end play and the hubs turn freely.
7. Insert the dust cap and check to make sure the cotter pin is not going to interfere. Cap must be pressed all the way down. The unit should be checked again to assure it spins freely after the dust cap is installed.

Specifications

The end play specification is 0.001"/0.010" (0.025 / 0.254 mm) for all units.

Checking

The end play is checked by clamping the spindle in a fixture or vise and moving the hub parallel to the spindle centerline without rocking the hub. If the end play is set properly the following should apply:

1. Hub should rotate freely when spun by hand.
2. The hub should not be noticeably loose when moved parallel with spindle centerline.

Greasing Requirements

Hub assemblies shall have grease packed in the bearings via an appropriate greasing spindle or by hand. In either method, the bearing must be greased so the grease is forced thru the entire bearing cavity and thru the rollers of both inner and outer bearings.

Dust or grease caps used shall have grease applied to the inside of the cap.

The bearing cavity shall be filled 50 - 80% full of grease on all applications.

Dust or grease caps shall also be filled 10-20% full of grease on all applications prior to final assembly.

Visually verify that grease has flowed thru all rollers of the inner and outer bearings.

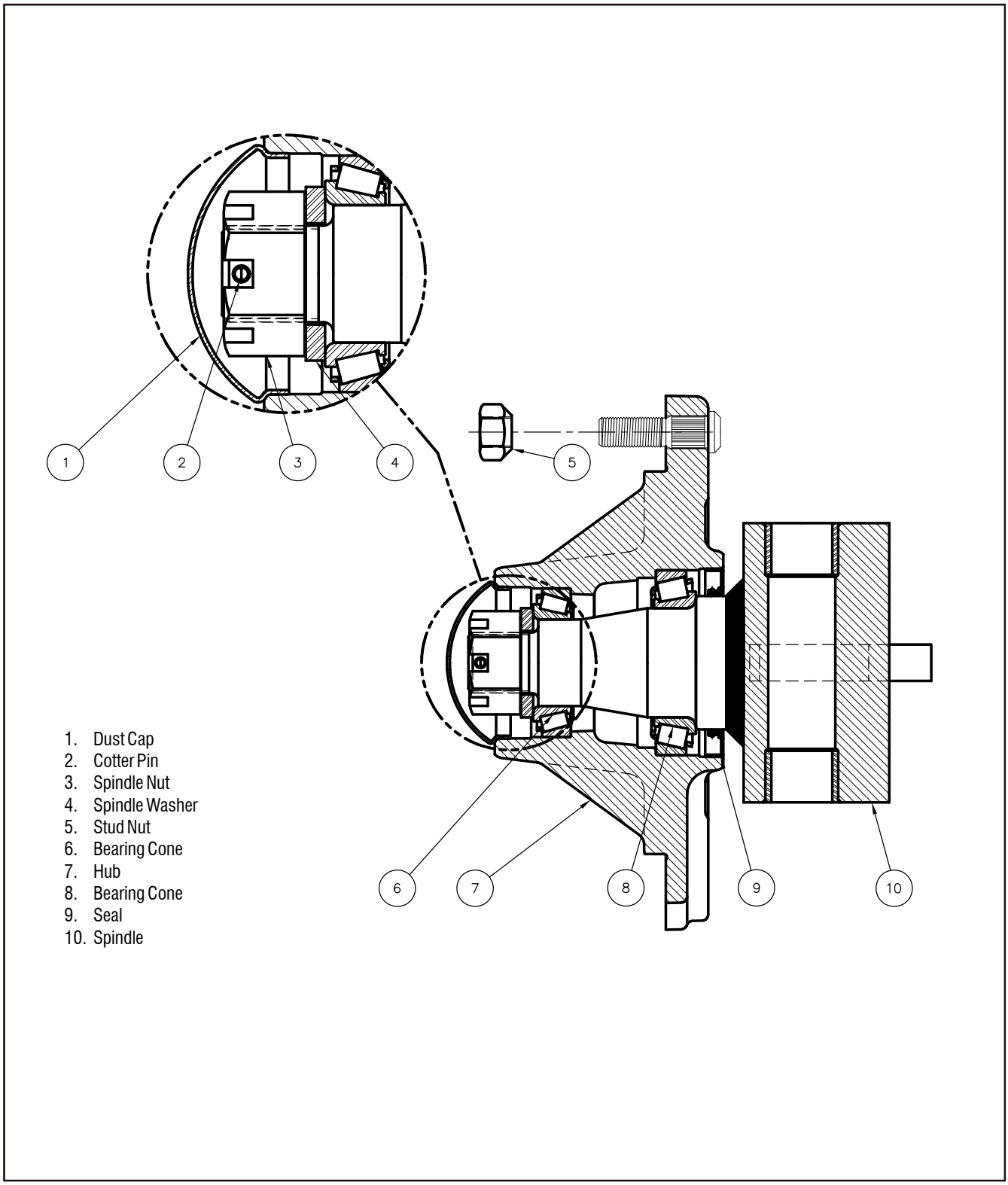


Figure 3-3. Spindle Assembly

3.3 DRIVE HUB

Roll and Leak 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.

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.

Main Disassembly

1. Perform Roll Check and Leak Check if applicable prior to disassembling the unit.
2. Drain oil from unit. Note the condition and volume of the oil.
3. Remove Coupling (7) from Spindle End first.
4. Remove Retaining Ring (6G) by prying the open end of Retaining Ring out of the groove in the Ring Gear (1F) with a screwdriver, then grasp the loose end with pliers and pull the Retaining Ring completely out of the groove.
5. Remove the Cover Subassembly (6) from the unit. The unit can be carefully pressurized with air to pop the cover out of the unit. Washer (2) may have to be removed separately because of the loose attachment.
6. Remove the First Stage Sun Gear (10) if applicable.

NOTE: *On units with ratios greater than 36:1 numerically, there will not be a separate First Stage Sun Gear (10), as the gear teeth will be integral to the Input Shaft (9).*

7. Remove the Input Carrier Sub-assembly (3). Continued on next page.
8. Remove the Second Stage Sun Gear (11).
9. Remove the Input Shaft (9).

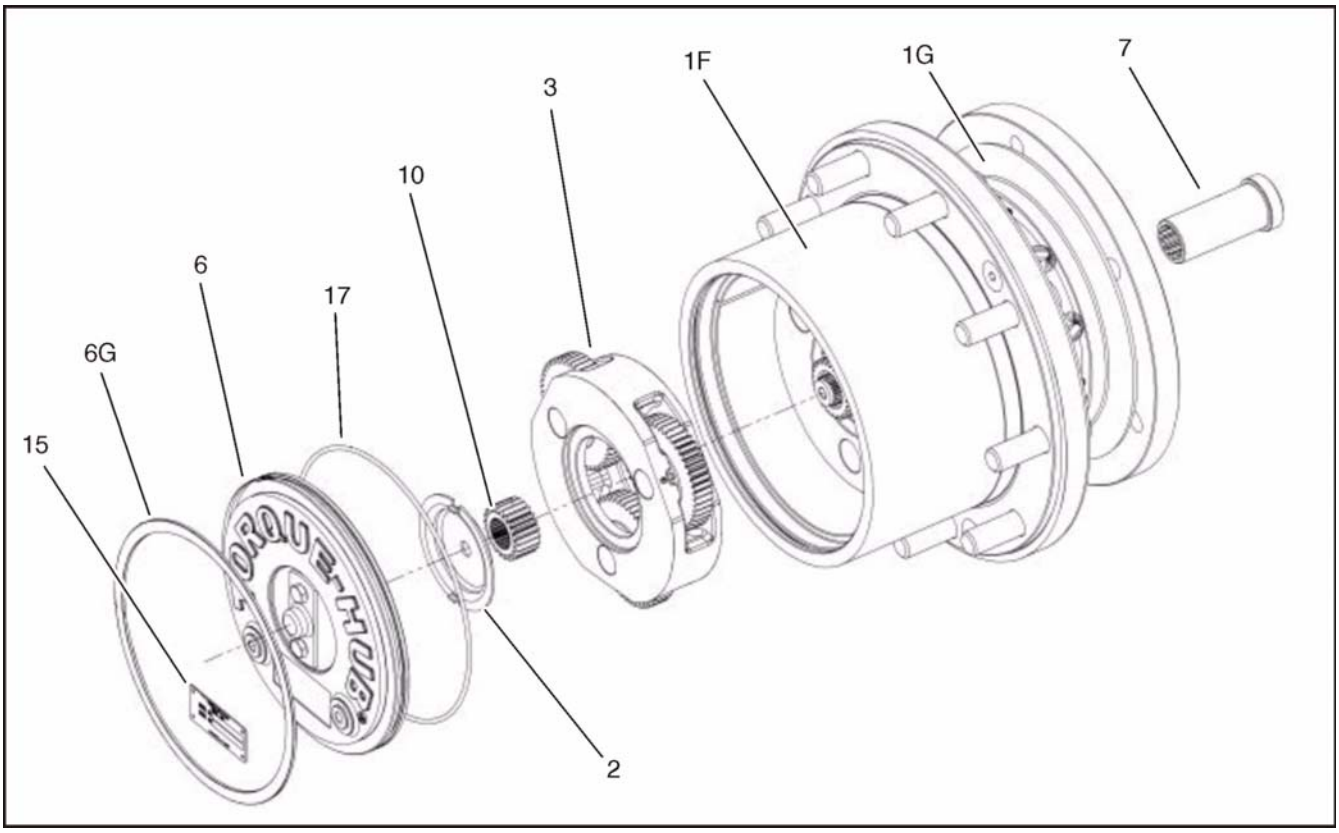
NOTE: *On units with a ratio 48:1, the Sun Gear (11) and the Input Shaft (9) will need to be removed together.*

10. Remove the Output Stage Carrier Sub-assembly (4)

11. Loosen and remove the three Flat Head Bolts (19) that retain the Ring Gear (1F) to the Housing (1G).

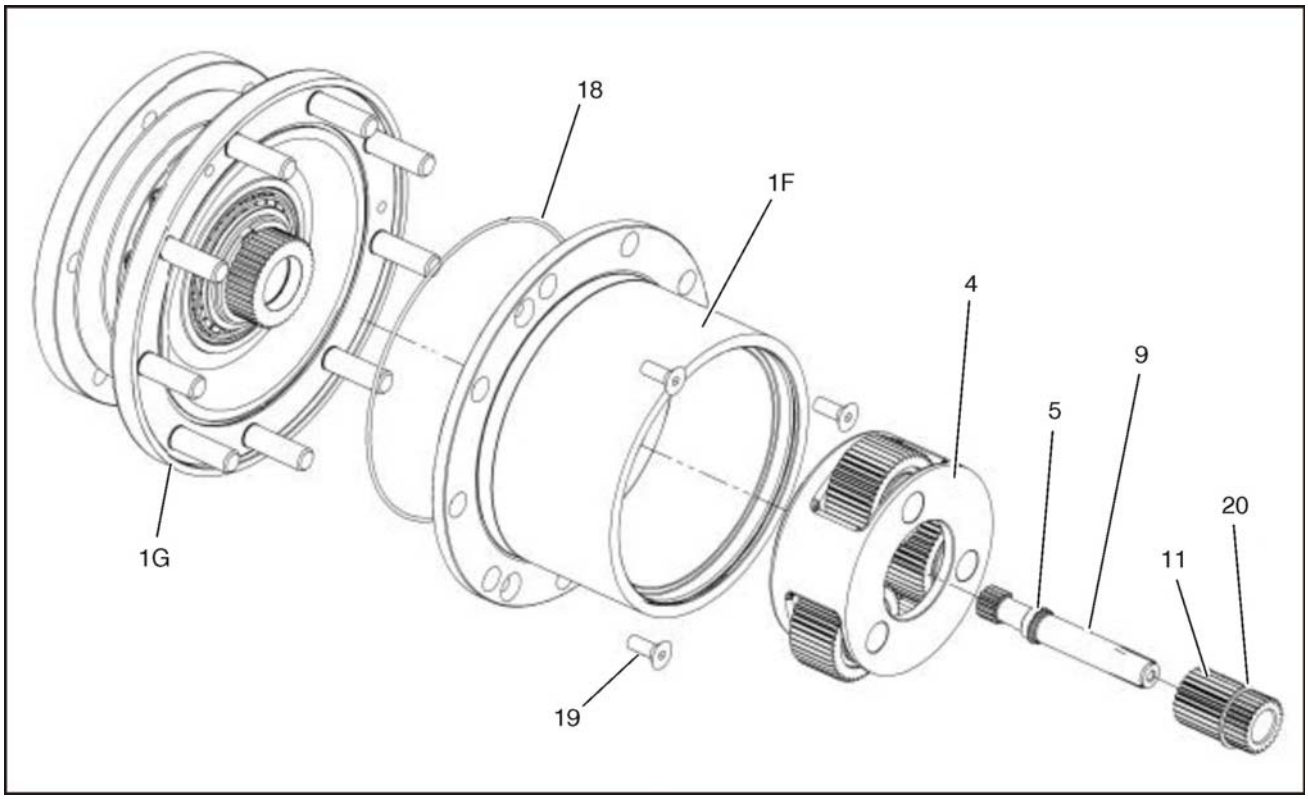
12. Lift the Ring Gear (1F) off of the Housing (1G).

13. Remove the O-ring (18) from between the Housing (1G) and the Ring Gear (1F).



1F. Ring Gear
1G. Housing
2. Washer
3. Input Carrier Subassembly
4. Output Carrier Subassembly
6. Cover Assembly
6G. Retaining Ring
7. Coupling
9. Input Shaft
10. First Stage Sun Gear
11. Second Stage Sun Gear
15. I.D. Plate
18. O-ring
19. Flat Head Bolts

Figure 3-4. Main Disassembly Drawing 1

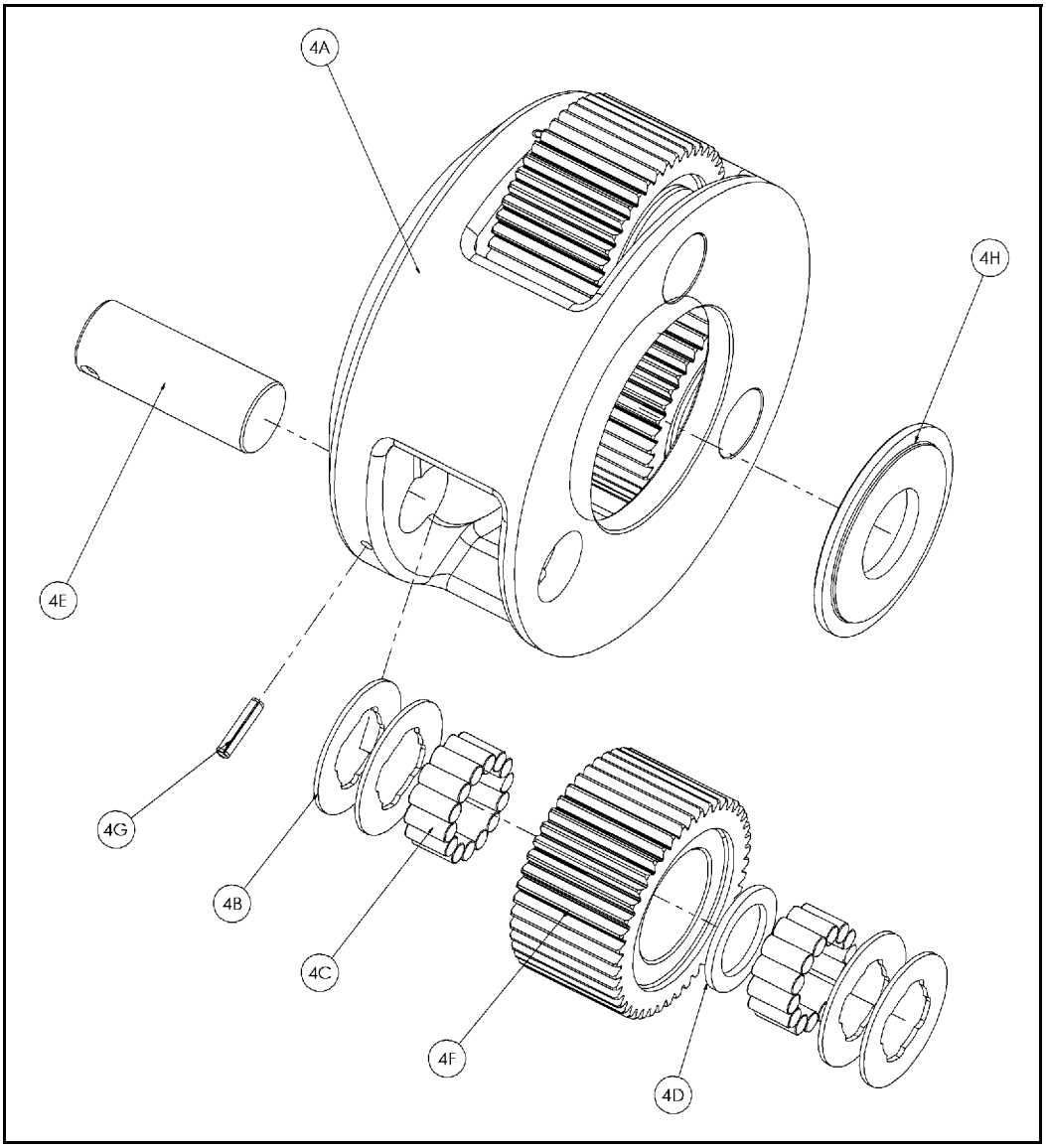


1F. Ring Gear
1G. Housing
4. Output Carrier Subassembly
5. Retaining Ring
6. Cover Assembly
6G. Retaining Ring
9. Input Shaft
10. First Stage Sun Gear
11. Second Stage Sun Gear
18. O-ring
19. Flat Head Bolts
20. Retaining Ring

Figure 3-5. Main Disassembly Drawing 2

Output Carrier Disassembly

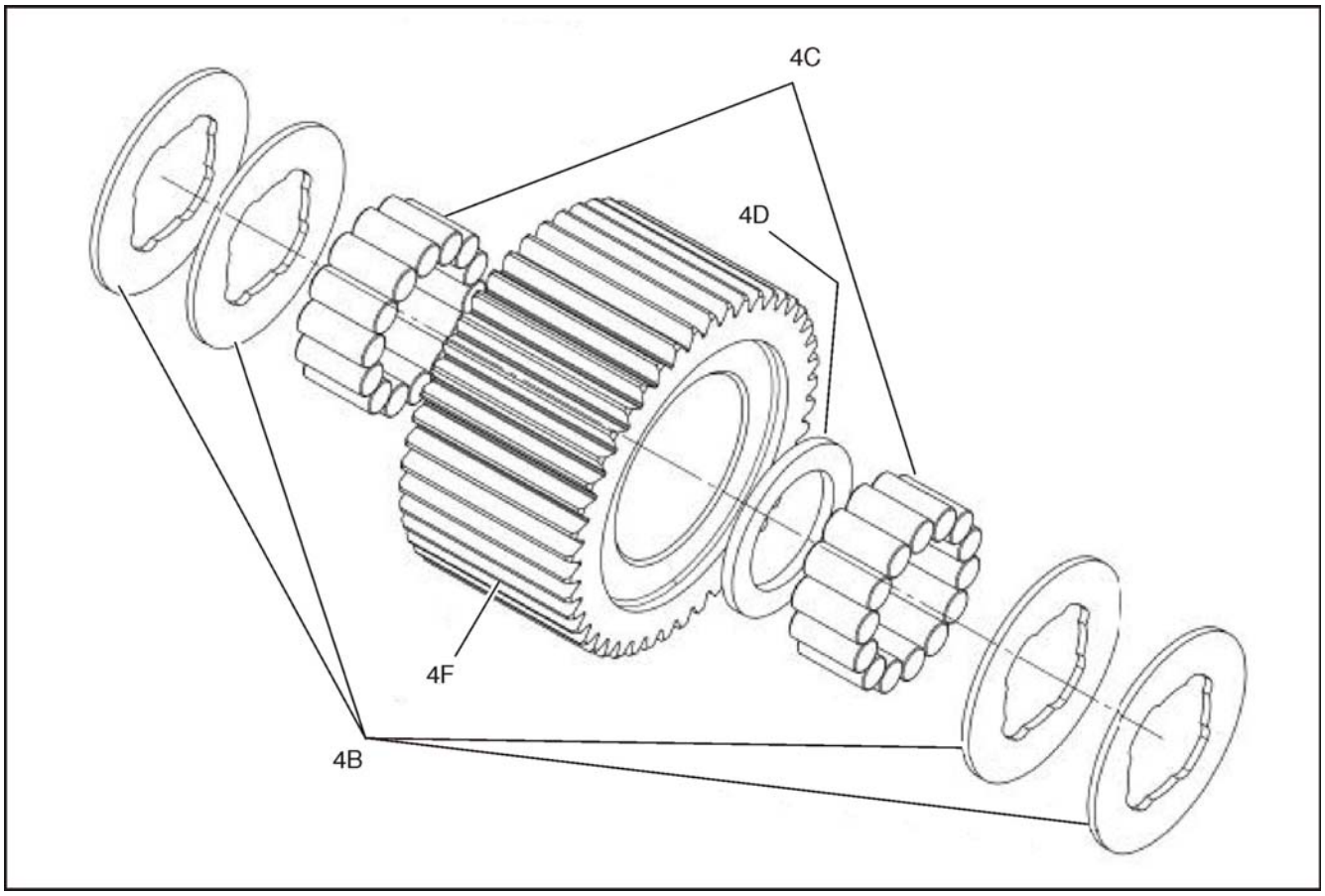
1. Using a 1/8" diameter punch, drive the Roll Pin (4G) into the Planet Shaft (4E) until it bottoms against the Carrier (3A).
2. Using a soft face hammer, tap the Planet Shaft (4E) out of the Carrier (4A).
3. Using a 1/8" diameter punch, drive the Roll Pin (4G) out of the Planet Shaft (4E). NOTE: The Roll Pins (4G) should not be reused when reassembling the unit.
4. Slide the Planet Gear Sub-assembly (4) out of the Output Carrier (4A) being careful to not drop the Needle Bearings (4C) in the process.



4A	Output Carrier	4E	Planet Shaft
4B	Thrust Washer	4F	Planet Gear
4C	Needle Bearing	4G	Roll Pin
4D	Thrust Spacer	4H	Thrust Washer

Figure 3-6. Output Carrier

5. Remove 4 Thrust Washers (4B), 28 Needle Rollers (4C) and the Thrust Spacer (4D) from the Second Stage Planet Gear (4F).
6. Repeat Steps 1 though 5 for the remaining two Planet Gears (4F).
7. Remove the Thrust Washer (4H) from the counterbore in the Output Carrier (4A).



4B Thrust Washer
4C Needle Bearing
4D Thrust Spacer
4F Planet Gear

Figure 3-7. Planet Gear

Input Carrier Disassembly

1. Using a 1/8" diameter punch, drive the Roll Pin (4G) into the Planet Shaft (3E) until it bottoms against the Carrier (3A).
2. Using a soft face hammer, tap the Planet Shaft (3E) out of the Carrier (3A).
3. Using a 1/8" diameter punch, drive the Roll Pin (4G) out of the Planet Shaft (3E). NOTE: The Roll Pins (4G) should not be reused when reassembling the unit.
4. Slide the Planet Gear (3F) and the two Thrust Washers (3B) out of the Carrier (3A).
5. Remove the 14 needle Bearings (3C) from the bore of the Planet Gear (3F).
6. Repeat steps 1 through 5 for each of the two remaining planet gears.

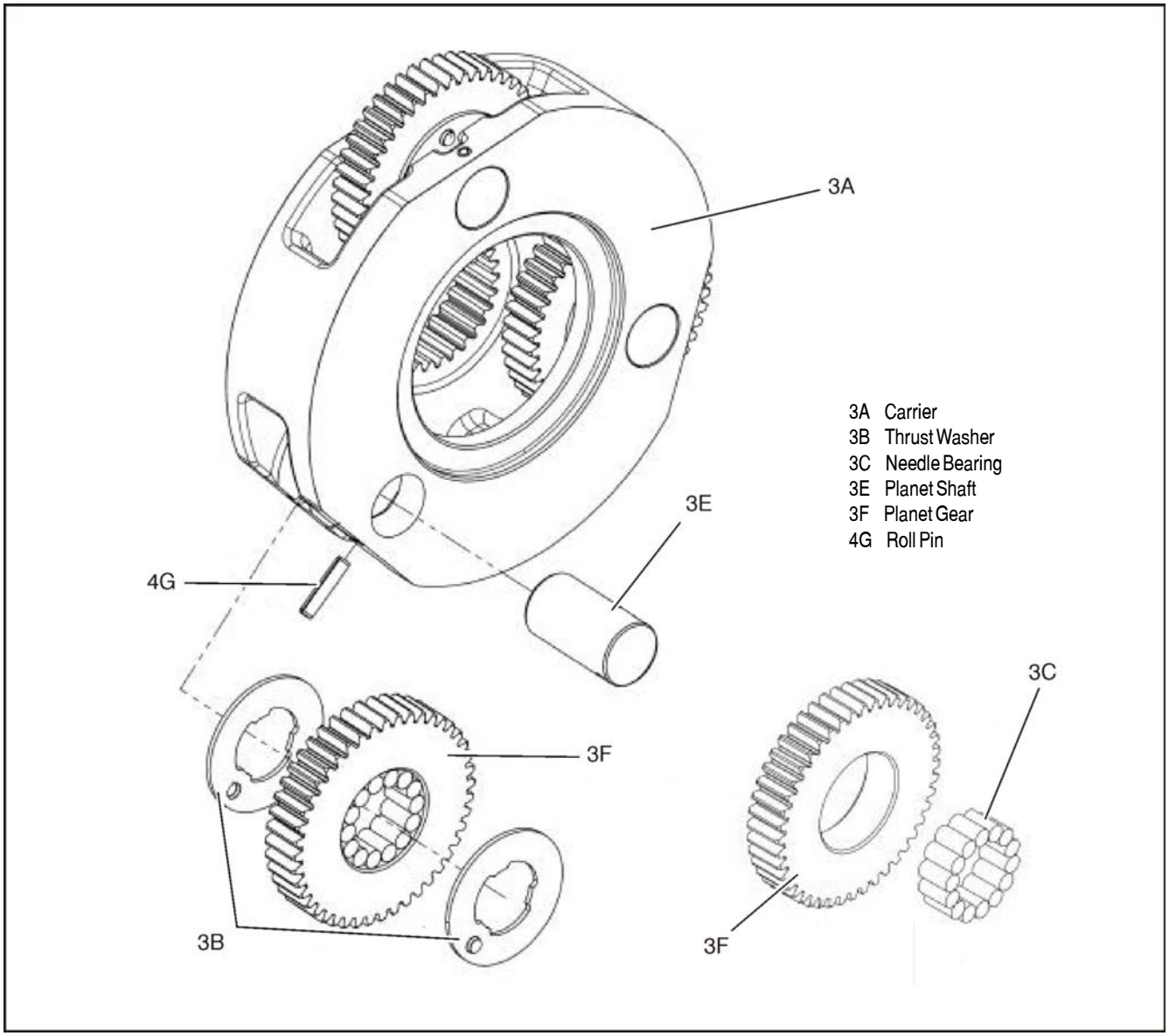


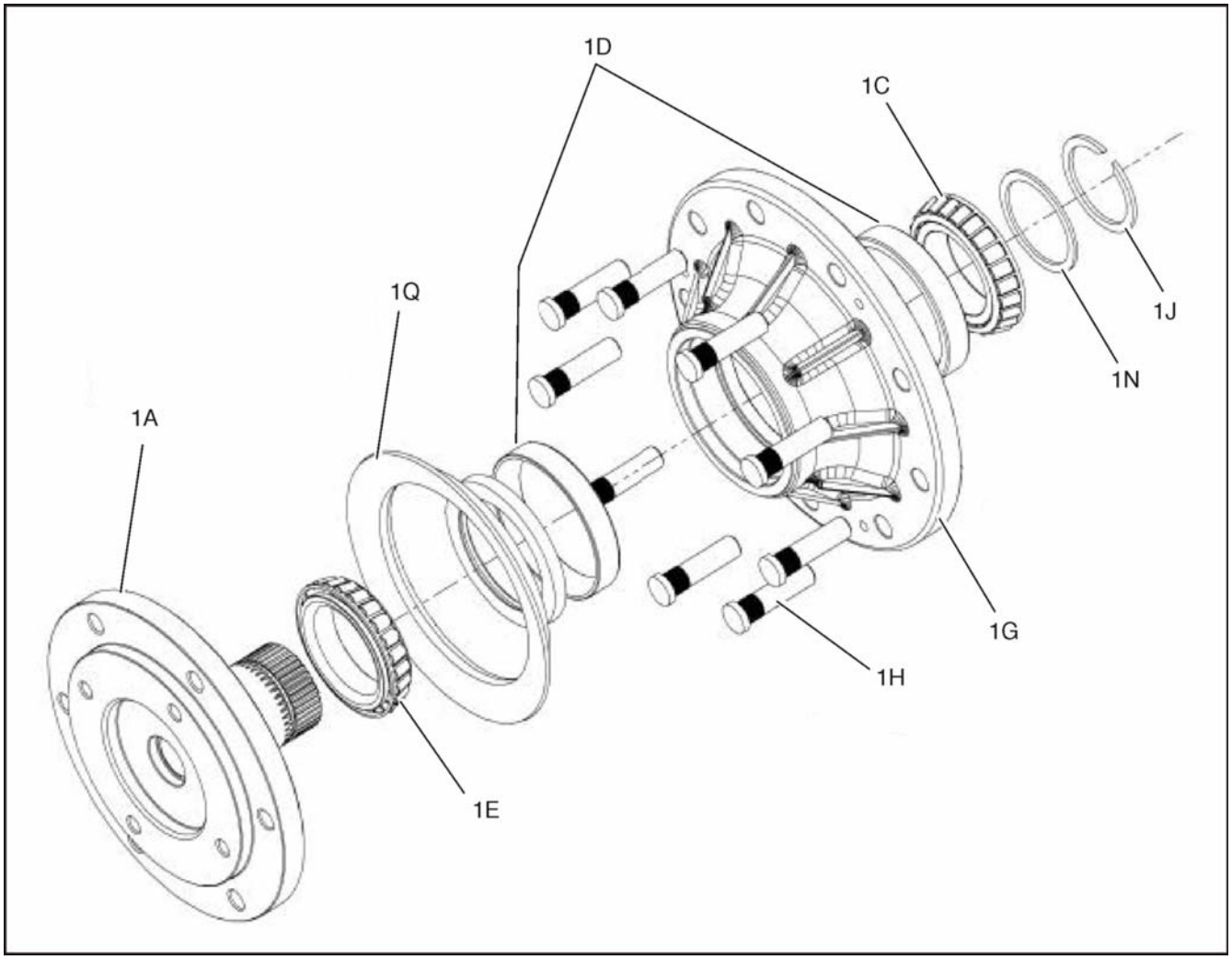
Figure 3-8. Input Carrier

Hub-Spindle Disassembly

1. Place unit on bench with Spindle (1 A) end down.
2. Remove Retaining Ring (1J) with appropriate tool.
3. Remove Spacer (1N).
4. Remove Bearing Cone (1C) from Bearing Cup (1D) in Hub (1G).
5. Lift Hub (1G) off of Spindle (1 A). Remove Boot Seal (1Q) from Hub (1G) if applicable.
6. If necessary, press 9 Studs (1H) out of Hub (1G). Locate Hub (1G) on Seal (1B) end.
7. Remove Seal (1B) from Hub (1G).

NOTE: *The Seal (1B) should NOT be reused when reassembling the unit.*

8. Remove Bearing Cone (1E) from Hub (1G).
9. Using a soft steel rod, knock both Bearing Cups (1D) out of Hub (1G).

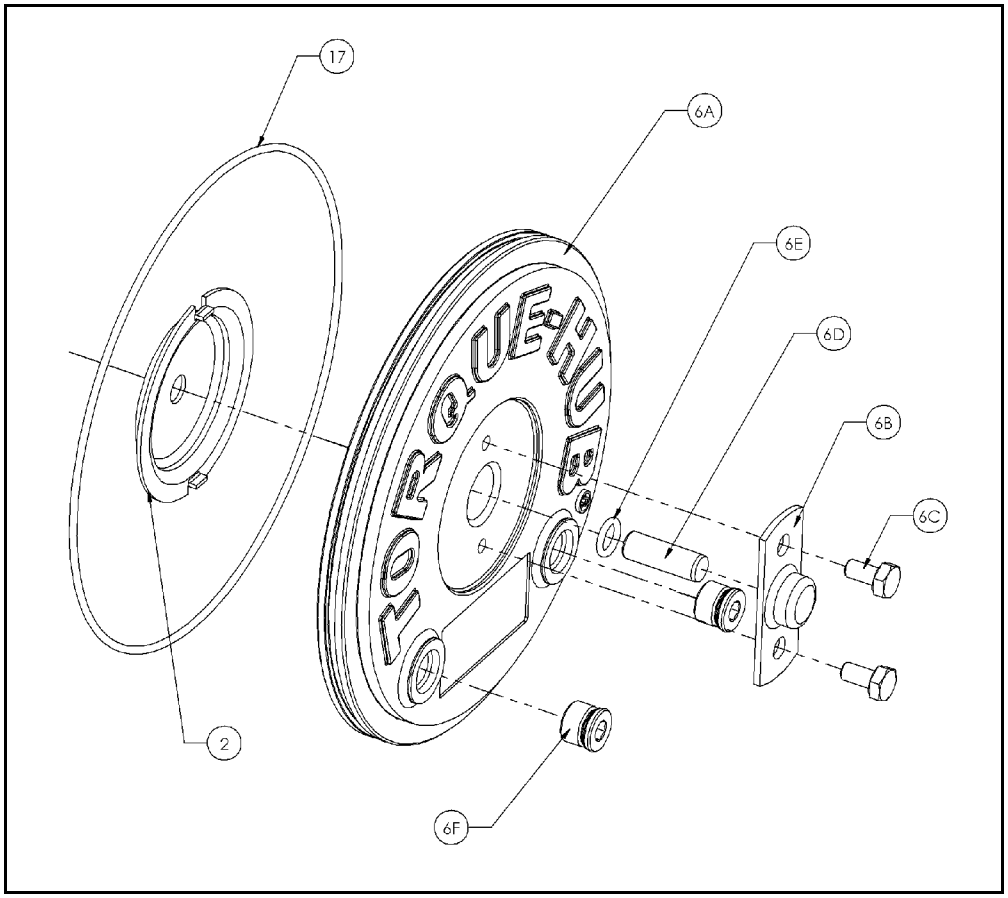


1A Spindle
1D Tapered Bearing Cup
1E Tapered Bearing Cone
1G Hub(Housing)
1H Stud
1J Retaining Ring Ext.
1N Spacer
1Q Seal Boot

Figure 3-9. Hub Spindle

Cover Disassembly

1. Remove O-Ring (17) from groove in Cover (6A).
2. Remove Thrust Washer (2) from Cover (6A) pockets.
3. Unscrew two Hex Head Bolts (6C) and remove Disengage Cap (6B) from Cover (6A).
4. Pull Disengage Rod (6D) out from Cover (6A).
5. Use appropriate tool to remove O-ring (6E) from internal groove in Cover (6A).
6. Remove two O-Ring Pipe Plugs (6F) from Cover (6A).



2 Thrust Spacer
3A Input Carrier
6A Cover
6B Disengage Cap
6C Bolt, Hex
6D Disengage Rod
6E O-ring
6F Pipe Plug
17 O-ring

Figure 3-10. Cover Assembly

Input Carrier Assembly

(Refer to Figure 3-8., Input Carrier)

1. Apply a liberal coat of grease to the bore of one Input Planet Gear (3F).
2. Line the inside of the Planet Gear (3F) with 14 Needle Rollers (3C).

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. Set Carrier (3A) in an upright position.
4. Insert a Planet Shaft (3E) into the planet shaft hole in the end of the Carrier (3A) opposite the splined end. The end of the planet shaft that does NOT have the roll pin hole should be inserted into the carrier FIRST.
5. Place one Thrust Washer (3B) onto the end of Planet Shaft (3E). Make sure the flat faces towards the inside of the carrier and make sure the button fits in the pocket on the inside of the Carrier (3A) towards the OD.
6. Following the thrust washer, place Planet Gear (3F) with needle rollers, onto Planet Shaft (3E).
7. Following the planet gear, place one more Thrust Washer (3B) onto Planet Shaft (3E). Align the Thrust Washer (3B) in the same manner described in Step 5.
8. Now insert Planet Shaft (3E) through the opposite planet shaft hole on Carrier (3A). Use an alignment punch or similar tool to align the roll pin holes on Carrier (3A) and Planet Shaft (3E).

NOTE: *Be sure not to hit the Planet Gears (3F) when driving in the Roll Pins (4G).*

9. Drive Roll Pin (4G) down into the aligned roll pin holes. Pin should be flush with the flat of carrier.
10. Repeat Steps 1-9 for the installation of the two remaining Planet Gears (3F).

NOTE: *Some grease may need to be applied to the Thrust Washers (3B) to hold them in place while installing the planet gears.*

Output Planet Gear Assembly

(Refer to Figure 3-7., Planet Gear)

1. Apply a liberal coat of grease to the bore of one Output Planet Gear (4F).
2. Line the inside of the Planet Gear (4F) with 14 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 Output Planet (4F).
4. Repeat Step 2 to put in second roll of Needle Rollers (4C).
5. Apply grease to hold two Thrust Washers (4B) together and onto Output Planet Gear (4F) counterbore. Do the same to the other side.
6. Repeat Steps 1 -5 to finish the assembly of the two remaining Output Planet Gears (4F).

Output Carrier Assembly

(Refer to Figure 3-6., Output Carrier)

1. Place Thrust Washer (4H) into counterbore of Carrier (4A). BE SURE the small diameter side of Washer (4H) facing planet gear side.
2. Place Planet Gear Sub-assembly (4) into Carrier (4A). Visually align the planet gear bore with one of the planet shaft holes on the Carrier (4A).
3. Insert a Planet Shaft (4E) into the planet shaft hole described in Step 2 on Carrier (4A). The end of the planet shaft that does NOT have the roll pin hole should be inserted into the Carrier (4A) 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 Carrier (4A) and Planet Shaft (4E).

NOTE: *Be sure not to hit the Planet Gears (4F) when driving in Roll Pins (4G).*

5. Drive Roll Pin (4G) down into the aligned roll pin holes. Pin should be flush with OD of Carrier (4A).
6. Repeat Steps 1-5 for the installation of the two remaining Planet Gears (4F).

Hub-Spindle Assembly

(Refer to Figure 3-9., Hub Spindle)

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

1. Place Hub (1G) into pressing base. Press nine Studs (1H) into Hub.

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

NOTE: *Spray a generous amount of oil on bearings during installation.*

2. Press Bearing Cup (1D) into Hub (1G) using appropriate pressing tool.
3. Turn hub over and press Bearing Cup (1D) into hub using appropriate pressing tool.
4. Place Bearing Cone (1E), into Bearing Cup (1D).
5. Grease Seal (1B) lip and press seal into Hub (1G) using appropriate tool until seal is flush with end of hub.
6. Press Seal Boot (1Q) onto Hub (1G) if required. Turn Hub (1G) over and lower onto Spindle (1A).
7. Install Bearing Cone (1C) into Bearing Cup (1D).
8. Place Bearing Spacer (1N) on top of Bearing Cone (1C).
9. Using appropriate tool, install Retaining Ring (1J) into Spindle (1A) groove. Make sure ring is completely seated in groove.

NOTE: *Extra bearing pre-load caused by using tool in Step #9 must be removed. This should be done by placing a tool (NOT THE SAME TOOL USED IN STEP #9) on the end of the spindle, and then striking the tool with a piece of barstock. This should be adequate to remove any additional bearing pre-load.*

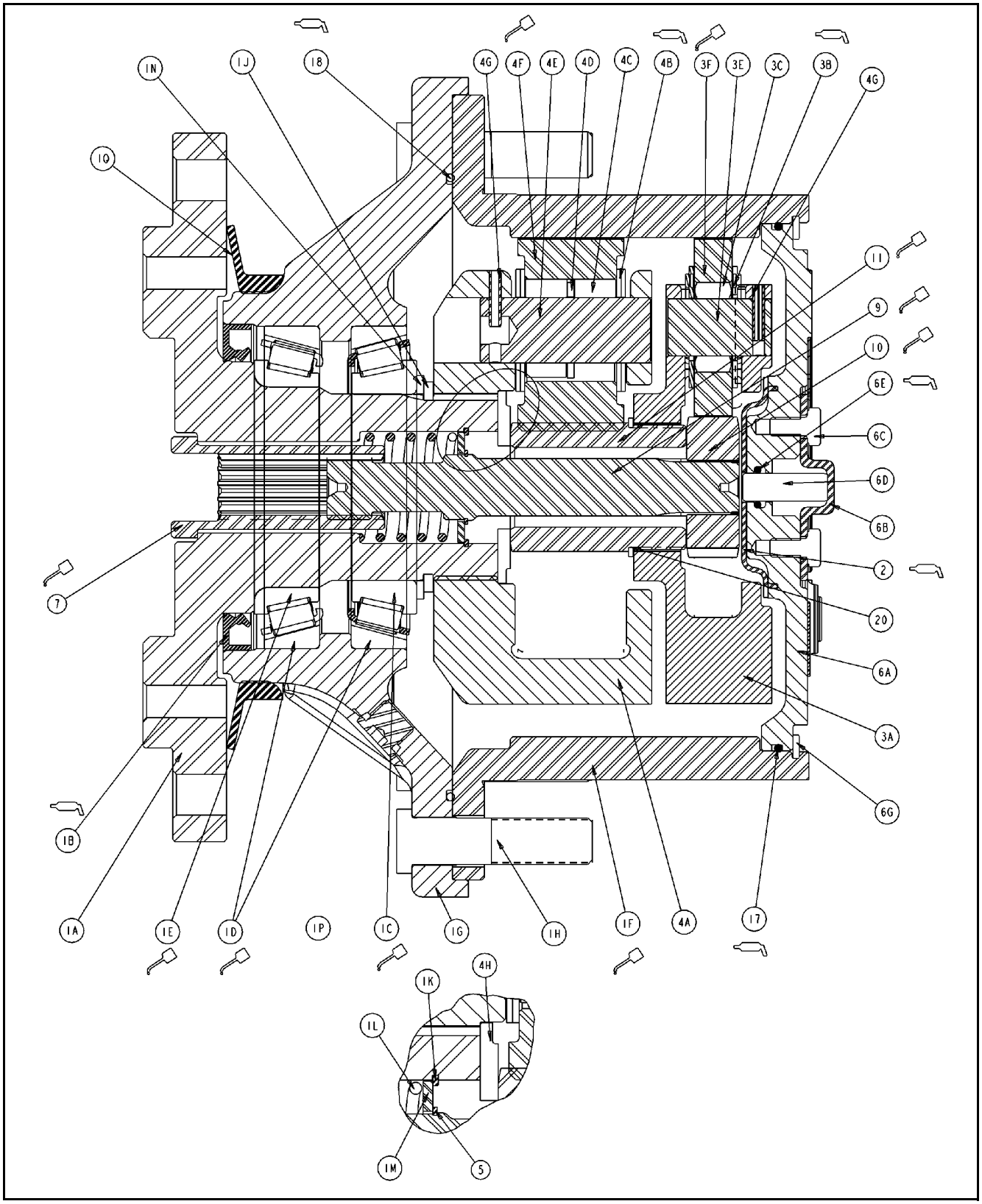


Figure 3-11. Hub Assembly - Sheet 1 of 2

1A Spindle
1B Lip Seal
1C Tapered Bearing Cone
1D Tapered Bearing Cup
1E Tapered Bearing Cone
1F Ring Gear
1G Hub(Housing)
1H Stud
1J Retaining Ring Ext.
1K Retaining Ring Int.
1L Spring (1.460,1.500)
1M Thrust Washer
1Q Seal Boot
2 Thrust Spacer
3A Input Carrier
3B Thrust Washer
3C Needle Bearing
3E Planet Shaft
3F Planet Gear
4A Output Carrier
4B Thrust Washer
4C Needle Bearing
4D Thrust Spacer
4E Planet Shaft
4F Planet Gear
4G Roll Pin
4H Thrust Washer
5 Retaining Ring - Ext
6A Cover
6B Disengage Cap
6C Bolt, Hex (.250-20 Unc, .500 Gr5)
6D Dowel Pin
6E O-ring
6F Pipe Plug
6G Retaining Ring - Int 7.086
7 Coupling
9 Input Shaft
10 Input Sun Gear
11 Output Sun Gear
15 ID Plate
16 Drive Screw
17 O-ring
18 O-ring
19 Bolt, Flat Head - Hex Skt (.375-16)
20 Retaining Ring - Ext.

Figure 3-12. Hub Assembly - Sheet 2 of 2

Cover Subassembly

(Refer to Figure 3-10., Cover Assembly)

1. Grease O-Ring (6E) and insert into internal groove in Cover (6A).
2. Assemble Disengage Cap (6B) onto Cover (6A) using two Hex Head Bolts (6C). Torque bolts to 70-80 in-lbs.
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 either end first.*

4. Grease Face of Thrust Washer (2) and place in Cover (6A) making sure that tangs on washer seat into pockets in cover.
5. Install O-Ring Pipe Plugs (6F) into Cover (6A). The plugs should be hand tight according to SAE standard.

Main Assembly

(Refer to Figure 3-4., Main Disassembly Drawing 1 and Figure 3-5., Main Disassembly Drawing 2)

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

1. Place Hub-Spindle Sub-Assembly on the bench.
2. Grease O-Ring (18) and place it into groove of Hub (1G).
3. Place Ring Gear (1F) onto Hub (1G). Align the three shipping Cap Screw Holes on Hub (1G) and Ring Gear (1F).
4. Install three shipping Cap Screws (19) into ring gear and hub. Torque them to 15-20 ft-lbs.

NOTE: *The output carrier sub-assembly does not need timed with the spindle splines.*

5. Place Output Carrier Sub-Assembly (4) into mesh with Spindle (1A) splines.
6. Place External Retaining Ring (5) over 13T spline to the retaining groove on Input Shaft (9).

NOTE: *For ratio 48:1, assemble Output Sun Gear (11) over Input Shaft (9) first, then install External Retaining Ring (5).*

7. Using appropriate tool to install Retaining Ring (20) into groove on Output Sun (11)
8. Place Input Shaft (9) spline end into mesh with Internal Coupling (7) splines.
9. With the modified spline end facing up, place the Output Sun Gear (11) into mesh with the output planet gears.
10. Place Input Carrier Sub-Assembly (3) onto Output Sun Gear (11) splines. Drop Input Sun (10) into mesh with planet gears for specific ratios, if required. (No timing required)
11. Grease O-Ring (17) and insert into groove in Cover Sub-Assembly (6).
12. Install Cover Sub-Assembly (6) into Ring Gear (1F) counterbore and install Retaining Ring (6G) into groove in Ring Gear (1F).
13. Attach ID Tag (15) onto unit using Drive Screws (16).
14. Check disconnect, roll and air check unit.
15. Insert Plastic Plug (12) into place if applicable.

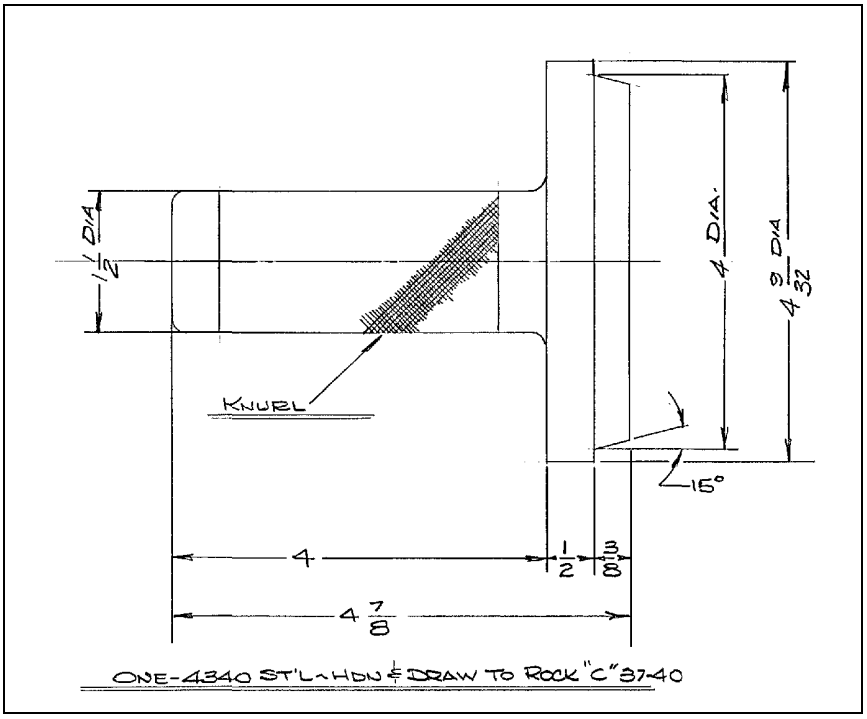


Figure 3-13. Cup Pressing Tool

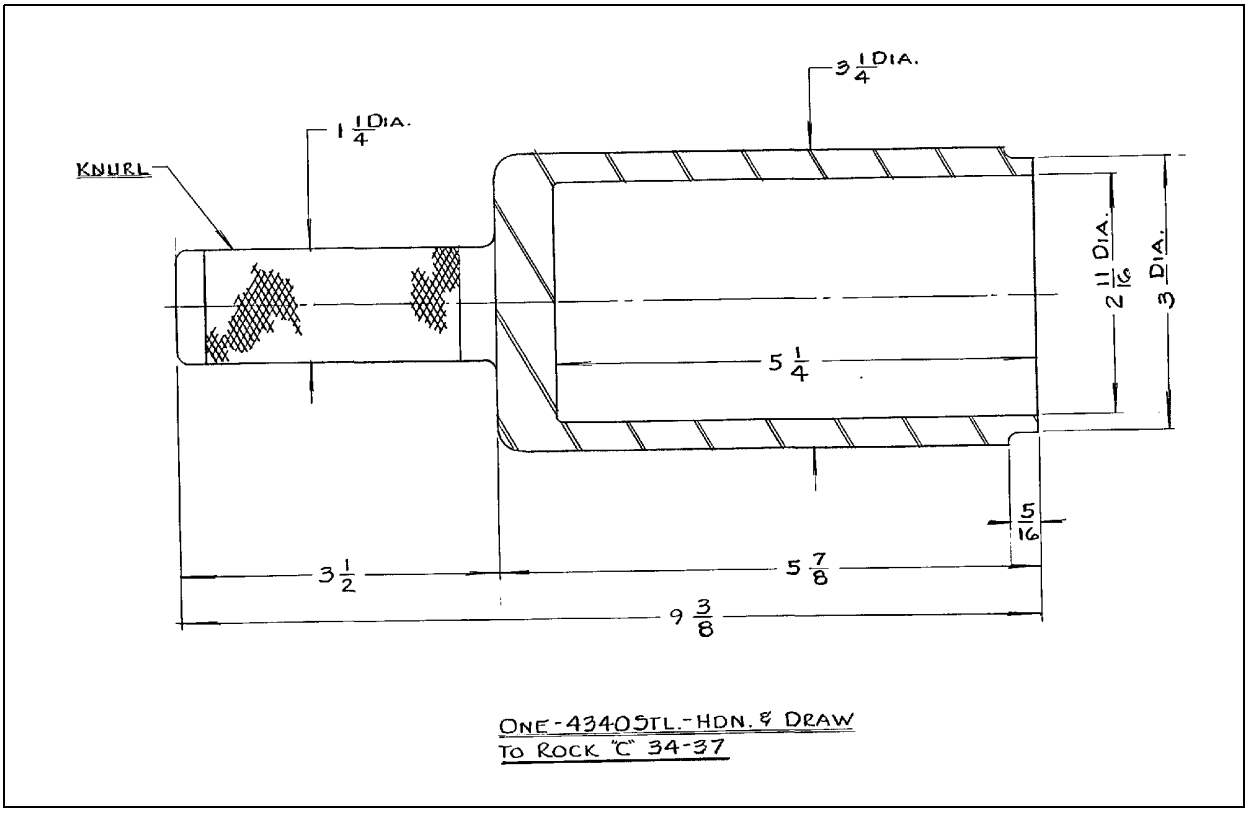


Figure 3-14. Cup Pressing Tool

3.4 DRIVE BRAKE - MICO

Disassembly

1. Remove pressure plate (3) from cover (21) by removing the capscrews (1) and washers (2).

⚠ CAUTION

PRESSURE PLATE IS UNDER SPRING TENSION OF APPROXIMATELY 1500 LBS (680 KGF). THE FOUR CAP SCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE, 3000 LBS (1361 KGF) MINIMUM, THE PRESSURE PLATE CAN BE HELD IN POSITION WHILE REMOVING THE CAP SCREWS AND WASHERS

2. Remove case seal (4) from cover (21).
3. Remove piston (7) from pressure plate (3).
4. Remove o-ring (5), back-up ring (6), o-ring (8) and back-up ring (9) from piston (7).

NOTICE

IF THE SENSOR RING (12) IS DAMAGED OR NEEDS REPLACED, THE ENTIRE BRAKE MUST BE REPLACED AS A UNIT. THE SENSOR RING IS NOT AVAILABLE AS A SERVICE PART.

5. Remove stack assembly, consisting of stator disc (11), sensor ring (12), rotor disc (13), and plate (14) from cover (21).
6. Remove dowel pins (20), springs (15) and spring retainer (16) from cover (21).

NOTE: *Note number and pattern of springs for reassembly purposes.*

7. Remove retaining ring (17) from cover (21).
8. Remove shaft (10) by pressing or using a soft mallet on male end of the shaft.
9. Remove retaining ring (19) and bearing (18) from shaft (10).
10. Press rotary oil seal (20) from cover (18).

Assembly

NOTE: *Lubricate all rubber components from the repair kit with clean type fluid used in the system.*

1. Clean all parts thoroughly before assembly.
2. Press new rotary seal (22) into cover (21). **Note direction of seal**
3. Install new bearing (18) and retaining ring (19) on shaft (10).
4. Install shaft assembly and retaining ring (17) in cover (21).

NOTE: *Be sure to use the same number of springs and spring pattern as recorded during disassembly. This should be five red springs evenly spaced.*

5. Install dowel pins (20), spring retainer (16) and springs (5) in cover plate (21).
6. Position plate (14) on springs (15). **NOTE**: **Disc (13 &11) and plate (14) must remain dry during installation. No oil residue must be allowed to contaminate disc surfaces.**
7. Place a new rotor disc (13), including speed sensor ring (12), on the shaft (10) until it contacts the plate (14). Install stator disc (11).
8. Install new o-ring (5), new back-up ring (6), new o-ring (8) and new back-up ring (9) on piston (7). Note order of o-rings and backup rings. Insert piston (7) into pressure plate (3). Be careful not to shear o-rings or back-up rings.
9. Install new case seal (4) in cover (21).
10. Position pressure plate (3) on cover (21) aligning dowel pins (20) with holes in pressure plate.

NOTE: *A hydraulic press will simplify installation of pressure plate on cover. Clamp pressure plate in position while tightening the cap screws.*

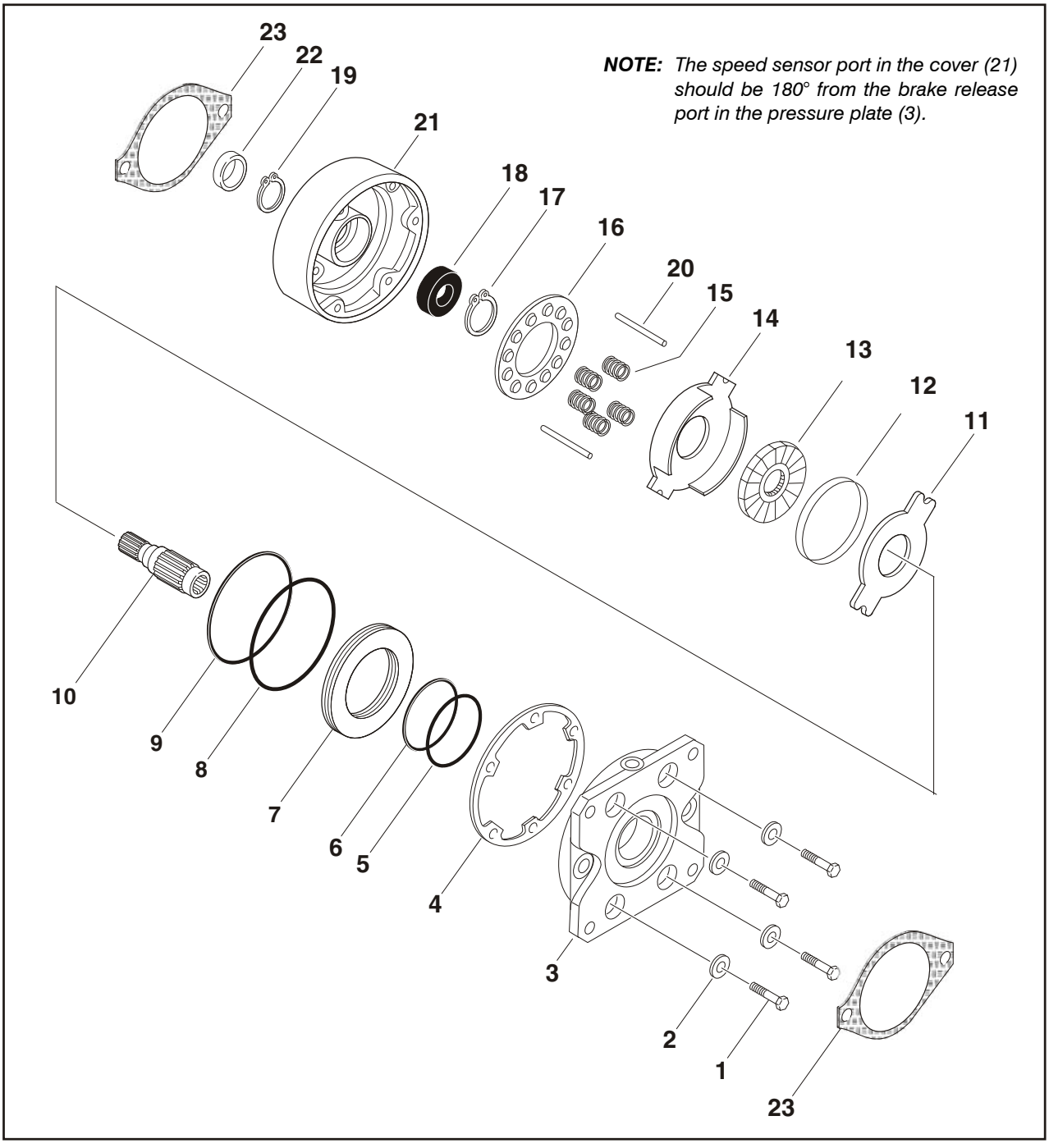
11. Install capscrews (1) and washers (2) and tighten evenly to draw pressure plate (3) to cover (21). Torque capscrews to 55 ft.lbs. (74.6 Nm).

⚠ CAUTION

IF HYDROSTATIC BENCH TESTING IS PERFORMED ON THE BRAKE ASSEMBLY, RELEASE PRESSURE SHOULD NOT EXCEED 2000 PSI (137.9 BAR) UNLESS TWO ADDITIONAL BOLTS ARE USED FOR SUPPLEMENTAL CLAMPING.

Bleeding

1. Install brake in system and connect pressure lines.
2. Bleed pressure release section of brake by pressurizing side inlet port and allowing air to escape from top port. Pressure should not exceed 100 psi (6.9 bar) during bleeding.
3. Apply sufficient pressure to release brake and check for proper operation in system.



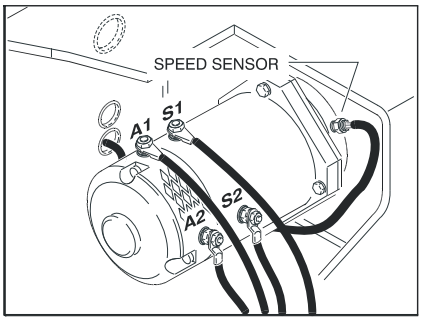
1. Capscrew	7. Piston	13. Rotor Disc	19. Retaining Ring
2. Washer	8. O-ring	14. Plate	20. Dowel Pin
3. Pressure Plate	9. Backup Ring	15. Spring	21. Cover
4. Case Seal	10. Shaft	16. Spring Retainer	22. Rotary Oil Seal
5. O-ring	11. Stator Disc	17. Retaining Ring	23. Gasket
6. Backup Ring	12. Sensor Ring	18. Bearing	

Figure 3-15. Drive Brake

Table 3-2. Drive Brake Diagnosis

Problem	Cause	Explanation	Corrective Action
Brake slips	Excessive pressure In hydraulic system	If there is back pressure in the actuation line of the brake, holding torque will be reduced.	Check filters. hose size, restrictions in other hydraulic components.
	Oil In brake if designed for dry use	Wet linings generate 67% of the dry torque rating. If the brake has oil In it, check the type of oil hydraulic or gearbox. 1. Gearbox oil 2. Hydraulic oil	Replace oil seal in brake. Check motor seal. Check piston seals. Note: Internal components will need to be inspected, cleaned, and replaced as required.
	Springs broken or have taken a permanent set	Broken or set springs can cause reduced torque - rare occurrence.	See spring replacement
Brake drags or runs hot	Low actuation pressure	The brake should be pressurized to minimum of 1.38 bar (20 psi) over the full release pressure under normal operating conditions. Lower pressures will cause the brake to drag thus generating heat.	Place pressure gauge in bleed port & check pressure with system on.
	Bearing failure	If the bearing should fall. a large amount of drag can be generated.	Replace bearing.
Brake will not release	Stuck or clogged valve	Brakes are designed to come on when system pressure drops below stated release pressure. If pressure cannot get to brake, the brake will not release.	Place pressure gauge in bleed port - check for adequate pressure. Replace defective line or component.
	Bad o-rings	Release piston will not hold pressure, brake will not release.	Replace o-rings.
	Discs frozen	These brakes are designed for only limited dynamic braking. A severe emergency stop or prolonged reduced release pressure operation may result in this type of damage.	Replace disc stack.

3.5 SPEED SENSOR ADJUSTMENT



⚠ WARNING

FOR PROPER DRIVE OPERATION, THE SPEED SENSORS (2) MUST BE PROPERLY INSTALLED AND ADJUSTED. THE SENSOR OPERATES ON A LEADING PULSE TO SHOW DIRECTION. IF INSTALLED INCORRECTLY, THE SENSOR WILL NOT BE ABLE TO SENSE THE PROPER DIRECTION. IF BOTH SENSORS ARE INSTALLED INCORRECTLY, THE JLG CONTROL SYSTEM WILL THINK THE MACHINE IS ON A HILL AND THE MACHINE WILL GO INTO FULL SPEED MODE IMMEDIATELY. IF ONLY ONE SENSOR IS INSTALLED WRONG, THE CONTROLLER SENSES A PROBLEM AND THE MACHINE WILL ONLY DRIVE AT CREEP SPEED. IF BOTH SENSORS ARE ADJUSTED TOO FAR OUT, THE CONTROL SYSTEM WILL NOT DRIVE THE MACHINE.

Adjustment Procedure

1. Back off the locking nut and o-ring.
2. Thread the sensor in until it bottoms out. (do not force).

NOTE: *There are two notches on each speed sensor.*

3. Back-off 3/4 to 1 turn and align the notches according to the inside notch on each speed sensor. If there are no notches, align the speed sensor wires as shown in Figure 3-16., Speed Sensor Orientation.
4. Use a 1/2” wrench to hold the sensor and a 11/16” wrench to snug the lock nut to the brake.

Speed Sensor Installation Verification

The motor controller averages the readings from the right and left speed sensors and therefore, it can be difficult to detect if the speed sensors are adjusted properly. When the positrac keeps coming in and out while on level surfaces, this is a sure indication that one of the speed sensors is not adjusted properly.

The worse case condition of speed sensor misadjustment occurs when both sensors are installed in a manner that allows them to indicate the exact opposite direction that the machine is traveling. This situation causes the controller to believe that the machine is rolling in opposite direction than that selected by the operator. The controllers reaction to this situation is to put more power into the drive motors to attempt to overcome the fact that it believes the machine is rolling backwards. This presents itself as uncontrolled movement in the direction selected by the operator until the controller recognizes that it is placing maximum power in the motors and the controller and the speed sensors are still reporting movement in the opposite direction. The controller responds by shutting down drive and reporting flash code 5/5- Vehicle Runaway Check Speed Encoders.

If either speed sensor is disconnected or faulty, the controller will recognize this condition and immediately report flash code 5/5 - Left or Right speed Encoder Faulty.

Verification w/ Analyzer Procedure

The motor controller averages the readings from the right and left speed sensors and therefore, it can be difficult to detect if the speed sensors are adjusted properly. Often operators report that posi-track keeps coming in and out while driving on level surfaces. This is a sure sign that one of the two speed sensors is not adjusted properly.

The worst case condition of speed sensor maladjustment occurs when both sensors are installed in a manner that allows them to indicate the exact opposite direction that the machine is traveling. This situation causes the controller to believe that the machine is rolling in the opposite direction than that selected by the operator. The controller's reaction to this situation is to put more power into the drive motors to attempt to overcome the fact that it believes the machine is rolling backwards. This presents itself as uncontrolled movement in the direction selected by the operator until the controller recognizes that it is placing maximum power in the motors and the speed sensors are still reporting movement in the opposite direction. If either speed sensor is disconnected or faulty, the controller will recognize this condition and immediately report an error message pertaining to a Left or Right Speed Encoder Faulty message.

NOTICE

THE FOLLOWING PROCEDURE USING THE ANALYZER WILL HELP VERIFY THAT THE SPEED SENSORS ARE INSTALLED CORRECTLY. THIS PROCEDURE REQUIRES A LARGE SPACE CLEAR OF OBSTRUCTIONS. THE OPERATOR SHOULD BE FAMILIAR WITH JLG EQUIPMENT AND BE PREPARED TO USE THE FOOTSWITCH TO STOP THE MACHINE. READ AND UNDERSTAND THIS ENTIRE PROCEDURE PRIOR TO BEGINNING.

1. Before beginning this procedure ensure that there is at least 10 ft in front and in back of the machine that is clear of obstruction. Be sure that all other personnel stand clear of the machine during this procedure.
2. Unplug the left speed sensor from the posi-track tilt module.
3. Power up the machine in platform mode and plug in the analyzer in the platform.
4. Use the right and left cursor keys on the analyzer to highlight "DIAGNOSTICS" and press enter.
5. Use the right and left cursor keys on the analyzer to highlight "DRIVE" and press enter.
6. Use the right and left cursor keys to display "SPEED 0%" on the analyzer.
7. While watching the analyzer display select drive forward. Be ready to remove your foot from the footswitch if the machine lunges forward.
8. The analyzer display should ready the following if the right speed sensor is adjusted properly: "SPEED 20% FWD".
9. If the right speed sensor is adjusted improperly, the analyzer will display "SPEED 20% REV" and the machine will lunge forward.
10. Adjust the right speed sensor using the above illustration as a guide until the analyzer displays "SPEED 20% FWD" when forward is selected in the platform. The percentage displayed is not critical, just the direction.
11. After obtaining the display in step 10, operate the machine in both the forward and reverse directions. The machine should be controllable in both directions and will only drive at a maximum of creep speed. The display on the analyzer should match the direction selected.
12. After completing adjustment of the right sensor, plug the left sensor into the posi-tilt module.
13. Unplug the right sensor from the power module.
14. Power up the machine in platform mode and plug in the analyzer in the platform.
15. Use the right and left cursor keys on the analyzer to highlight diagnostics and press enter.
16. Use the right and left cursor keys on the analyzer to highlight drive and press enter.
17. Use the right and left cursor keys to display "SPEED 0%" on the analyzer.

18. While watching the analyzer display select drive forward. Be ready to remove your foot from the footswitch if the machine lunges forward.

19. The analyzer display should ready the following if the left speed sensor is adjusted properly: "SPEED 20% FWD".

20. If the left speed sensor is adjusted improperly, the analyzer will display "SPEED 20% REV" and the machine will lunge forward.

21. Adjust the left speed sensor using the above illustration until the analyzer displays "SPEED 20% FWD" when forward is selected in the platform. The percentage displayed is not critical, just the direction.

22. After obtaining the display in step 10, operate the machine in both the forward and reverse directions. The machine should be controllable in both directions and will only drive at a maximum of creep speed. The display on the analyzer should match the direction selected.

23. Plug in the right sensor to the power module.

24. Test the machine. The machine should now have maximum drive speed available in both directions and should be controllable in both directions. The analyzer display should match the direction selected.

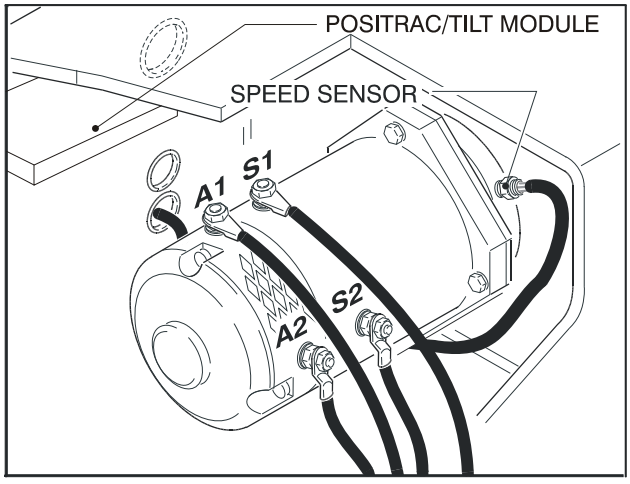
3.6 POSITRAC/TILT MODULE

When installing a new positrac/tilt module, Refer to JLG Control System Analyzer Kit instructions. Use a standard bubble level in two different directions to ensure that the machine's frame is level prior to installing the new positrac/tilt module.

1. Place the machine on a flat, level surface. Check for level by placing a bubble level on the frame in both directions.
2. Plug in the analyzer (Analyzer - p/n 1600244, Cable - p/n 1600633) into port J9 on the power module or port J1 on the platform module.
3. Use the right arrow key to curse over to "ACCESS LEVEL 2". Depress Enter.
4. Use Up/Down arrow keys to enter the following password "33271". Depress Enter.
5. Use the right arrow key to curse over to "LEVEL VEHICLE". Hit Enter. Depress Enter again.
6. Verify that the tilt reading is now "0.0; 0.0".

⚠ WARNING

TO ASSURE PROPER OPERATION, THE MACHINE MUST BE LEVEL WHEN ADJUSTING OR INSTALLING AND CALIBRATING A NEW POSITRAC/TILT MODULE



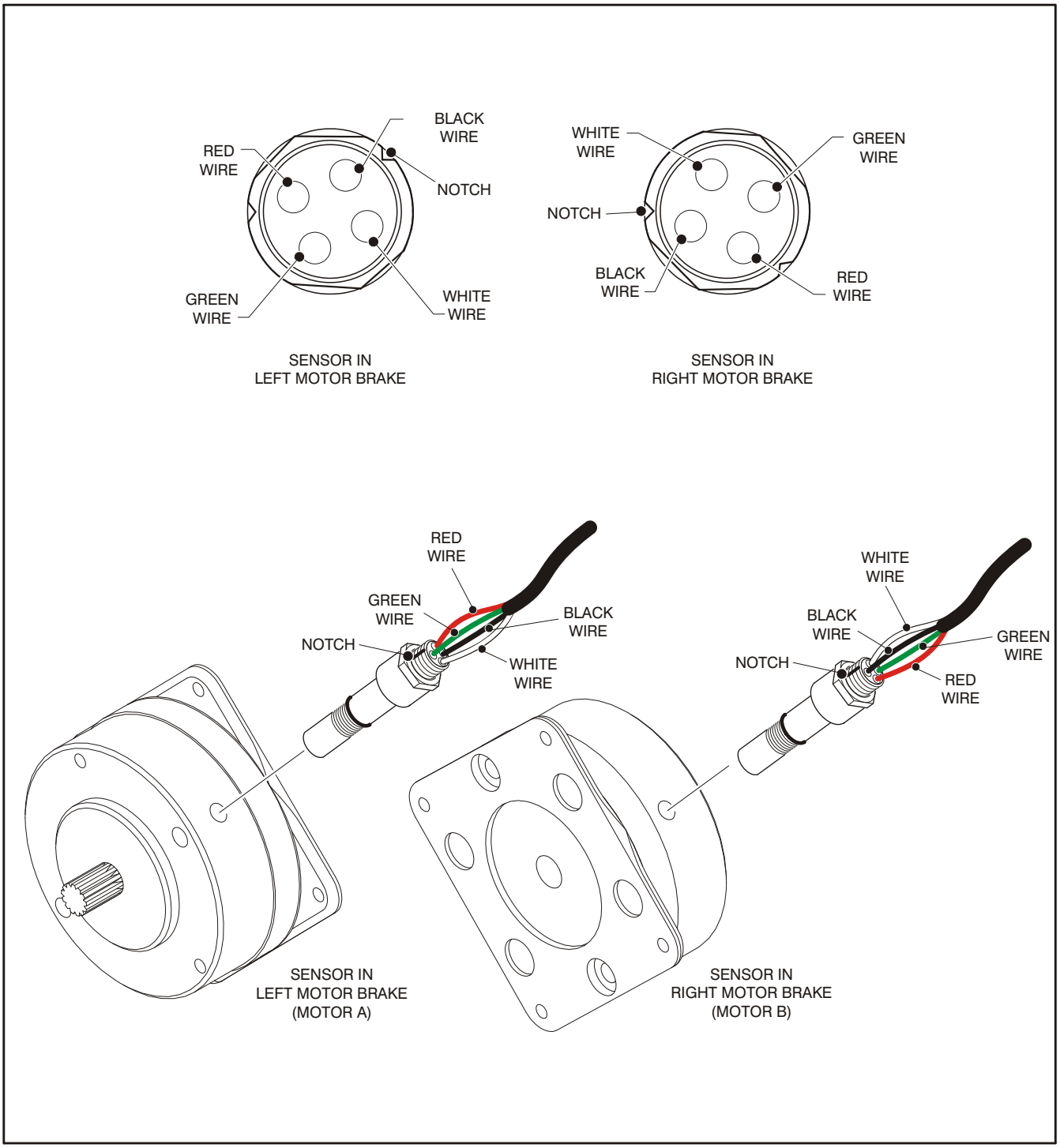


Figure 3-16. Speed Sensor Orientation

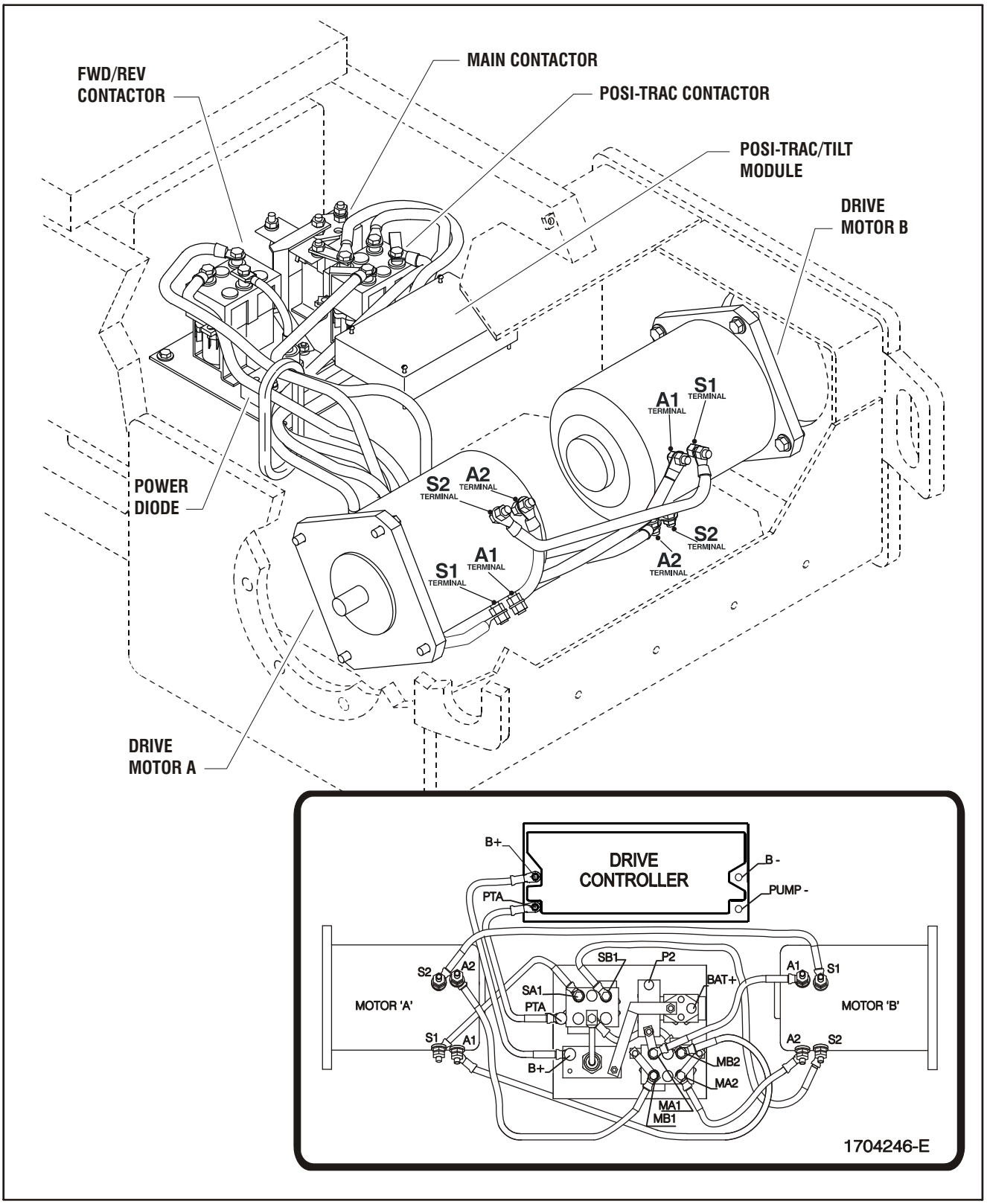


Figure 3-17. Frame Mounted Electrical Components

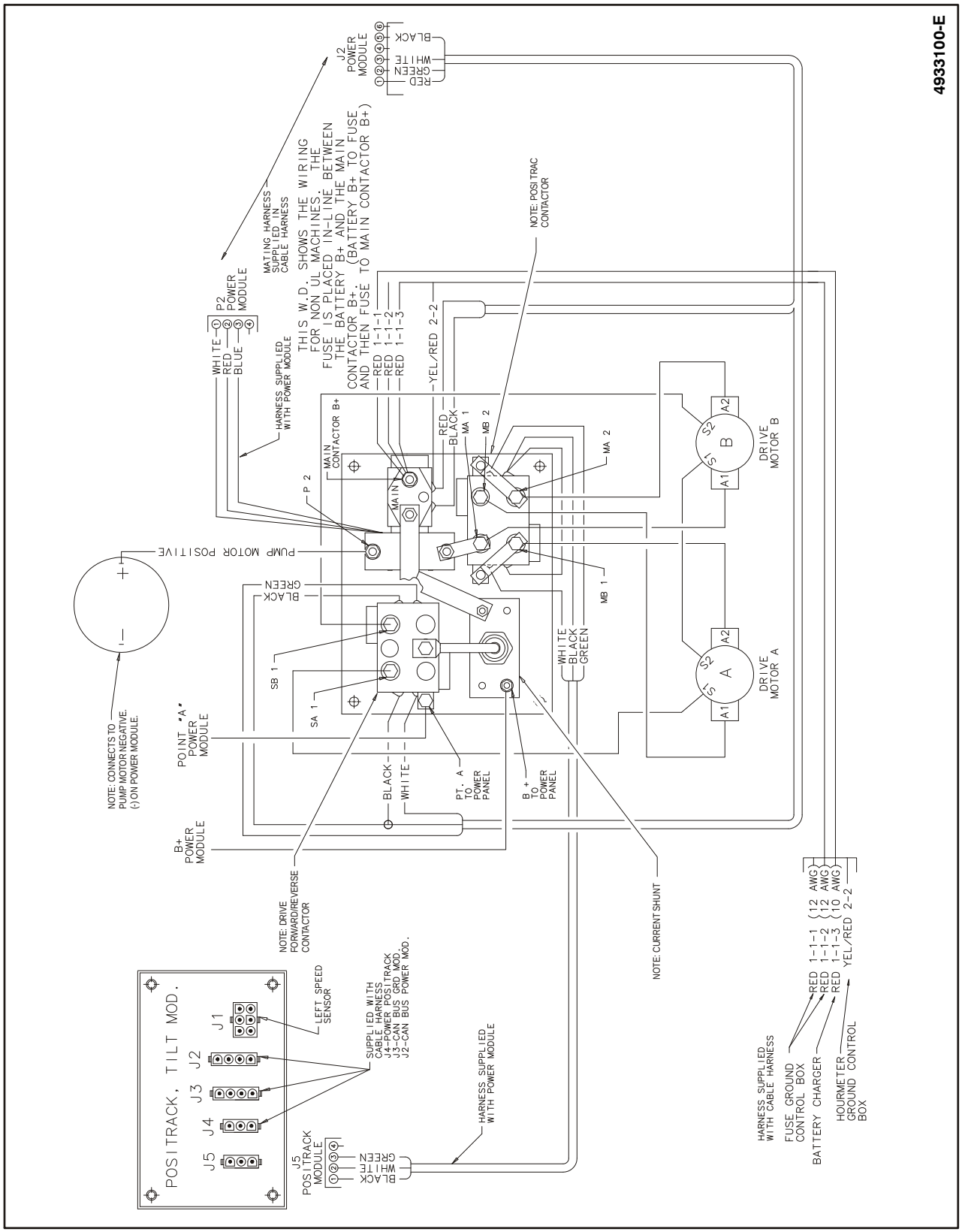


Figure 3-18. Contactor Wiring Diagram

3.7 SWING MOTOR

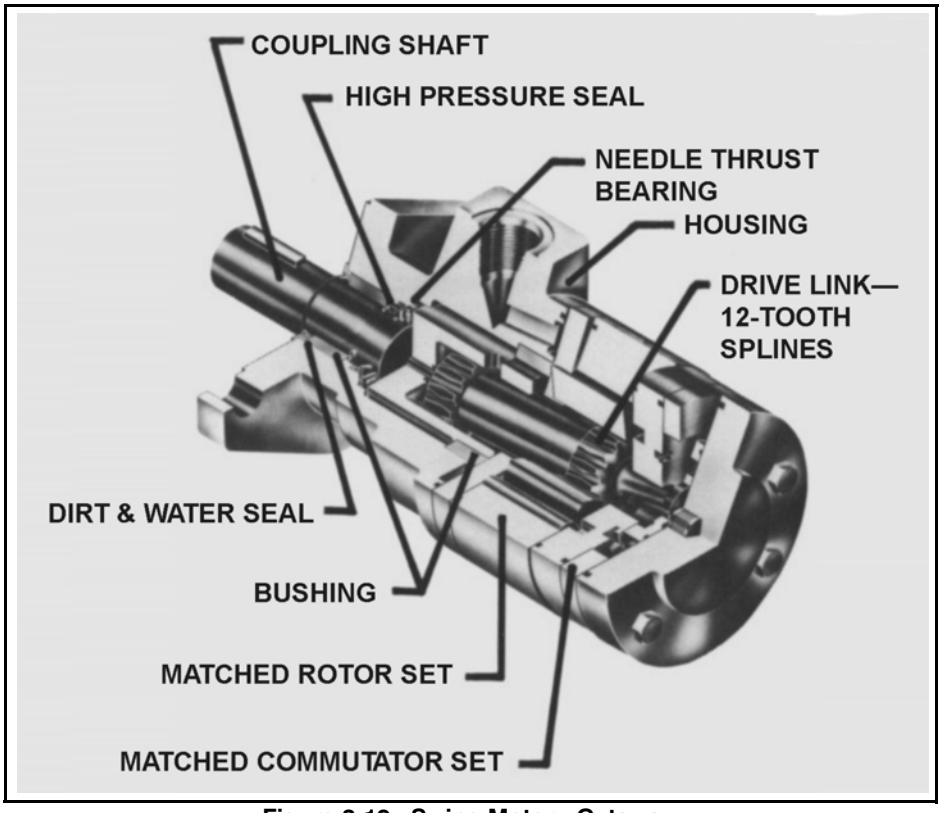


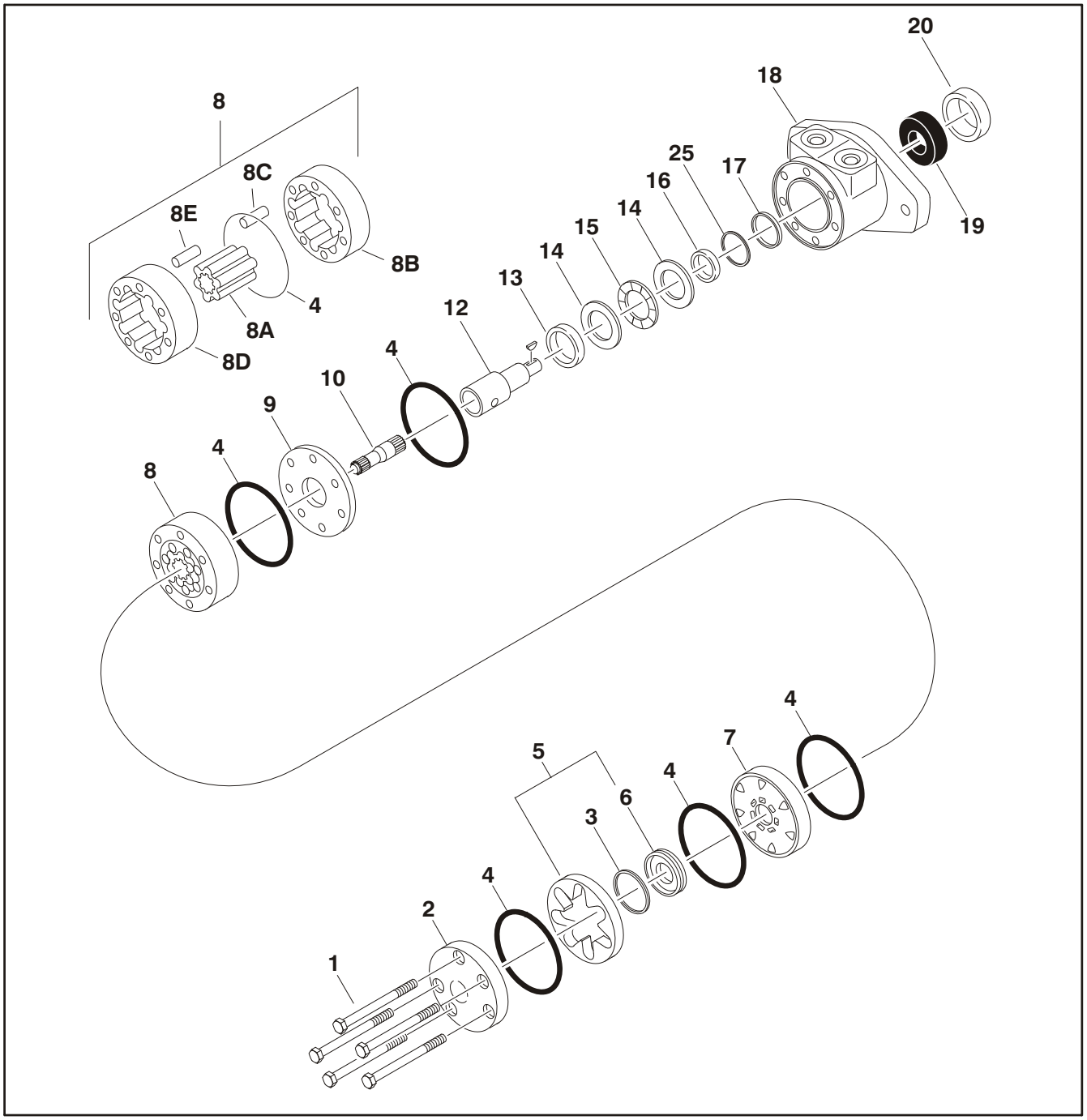
Figure 3-19. Swing Motor - Cutaway

⚠ 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.

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.
	2. High internal motor leakage	Replace worn rotor set by disassembling unit.
	3. Severely worn or damaged internal splines.	Replace rotor set, drive link and coupling shaft by disassembling unit.
	4. Excessive heat.	Locate excessive heat source (usually a restriction) in the system and correct the condition.
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.



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 3-20. Swing Motor - Exploded View

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.

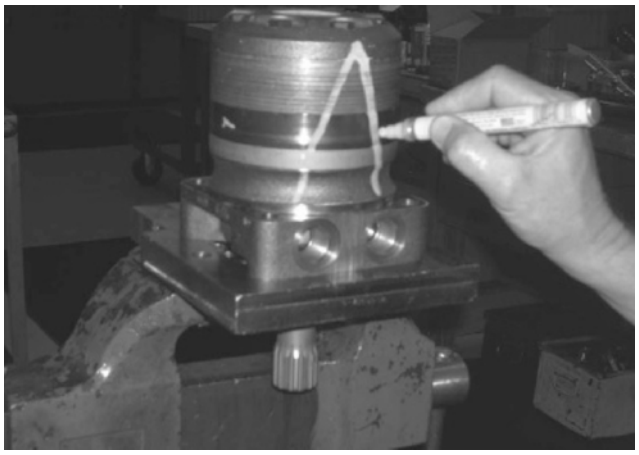
⚠ CAUTION

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

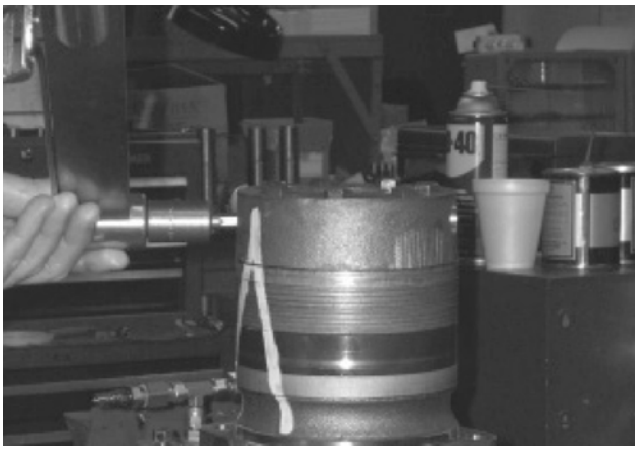
1. Place the motor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings if applicable.

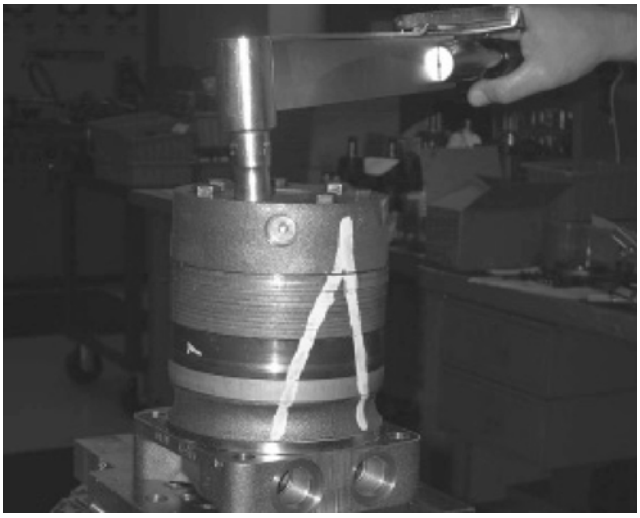


⚠ WARNING

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

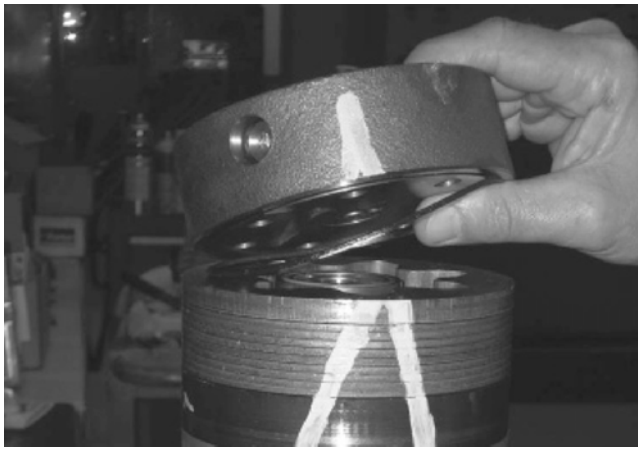
2. Scribe an alignment mark down and across the motor components from end cover (2) to housing (18) to facilitate reassembly orientation where required.



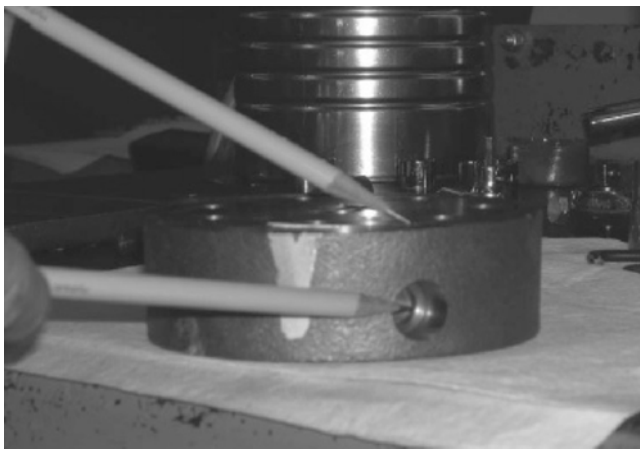


3. Remove the special ring head bolts (1) using an appropriate 1/2 or 9/16 inch size socket. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts.

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

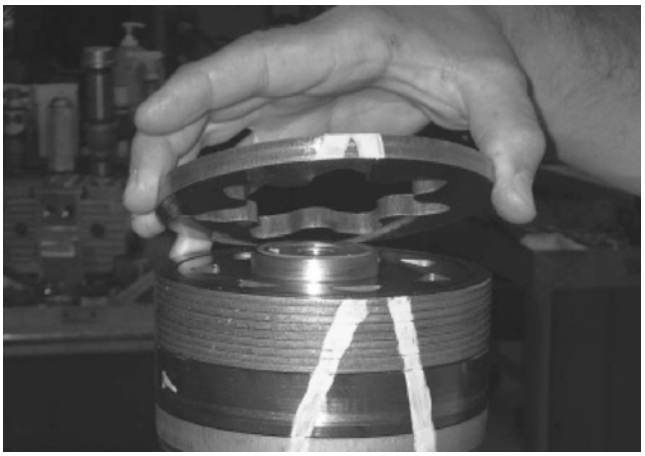


5. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary.



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.*

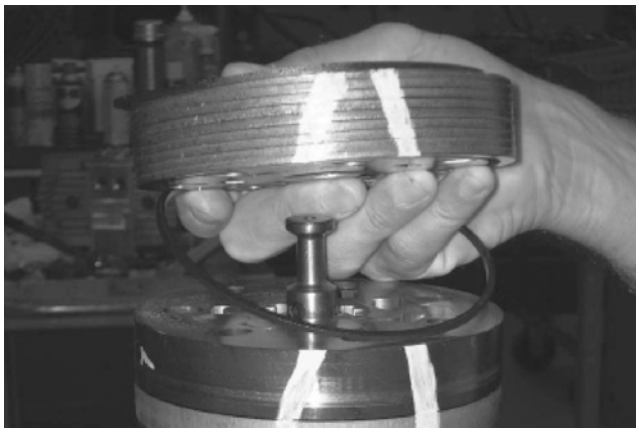
6. Remove commutator ring (6). Inspect commutator ring for cracks, or burrs.



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.



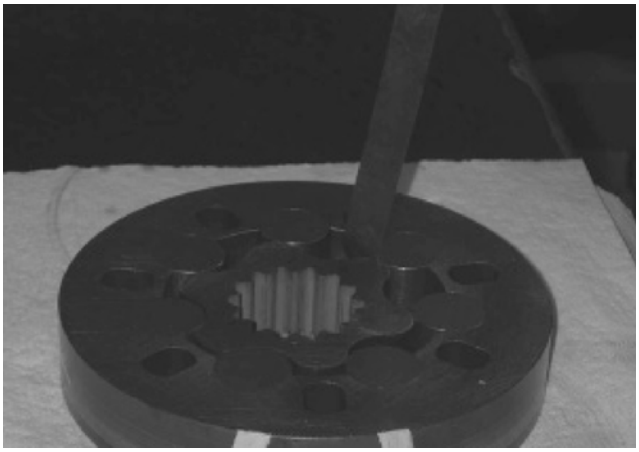
NOTE: *The manifold is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to ensure that same surface is reassembled against the rotor set.*

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.*

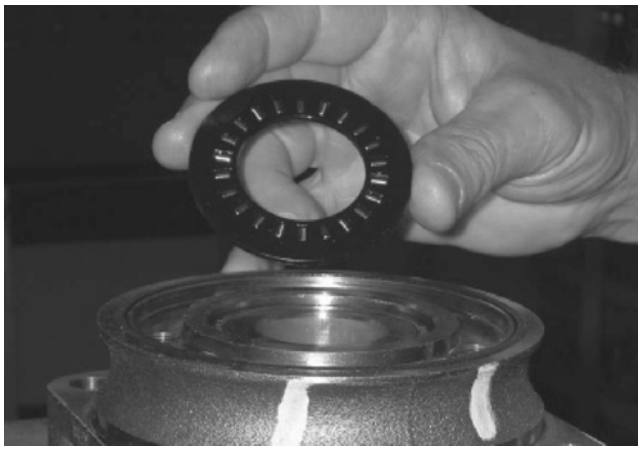
10. Place rotor set (8) and wear plate (9) on a flat surface and center rotor in stator such that two rotor lobes (180 degrees apart) and a roller vane centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is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



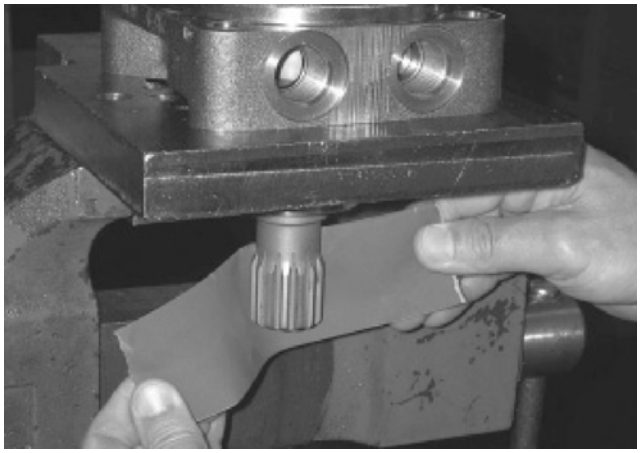
NOTE: *If rotor set (8) has two stator halves and two sets of seven vanes as shown, check the rotor lobe to roller vane clearance at both ends of rotor.*

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).

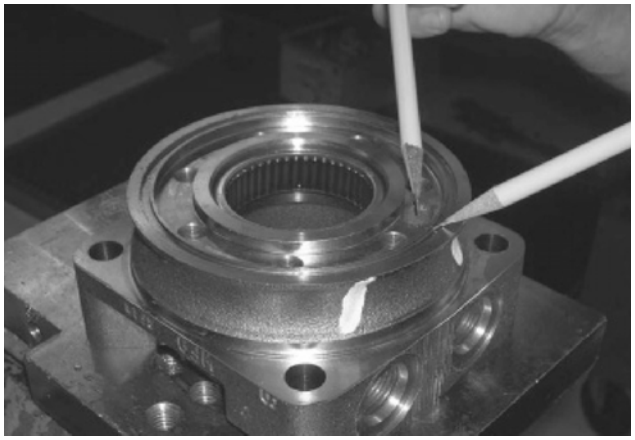
16. Remove thrust bearing (15) and thrust washer (14). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.

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

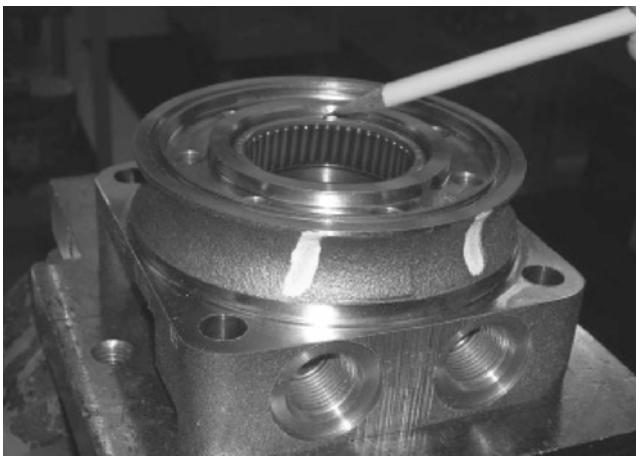
18. Remove housing (18) from vise, invert it and remove and discard seal (20). A blind hole bearing or seal puller is required.

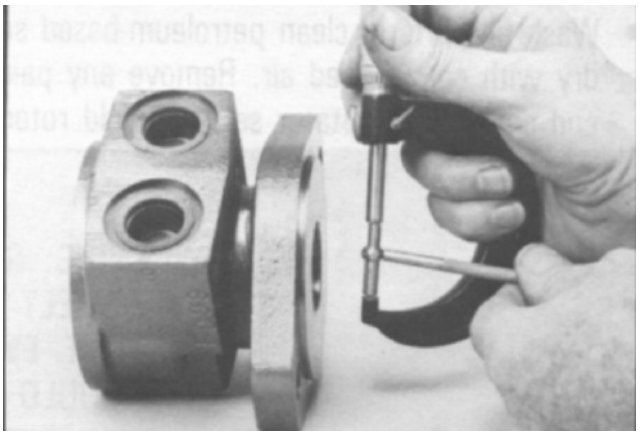
19. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or cor-

rosion. 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.

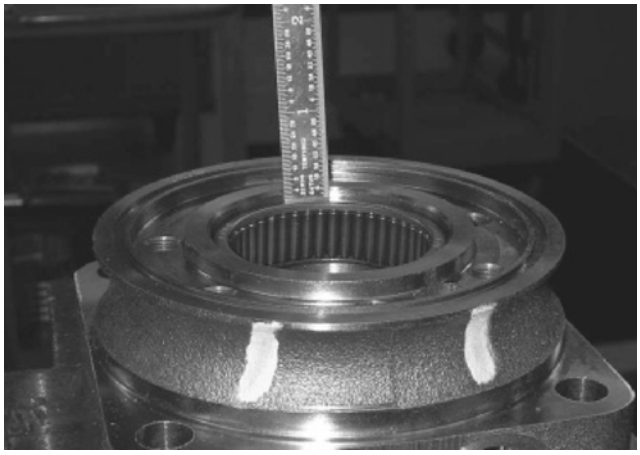
   The housing requires the use of bearing mandrel to press bearing/ bushing (19) into the housing to a required depth of 0.151/0.161 inches (3.84/4.09 mm) from the end of the bearing counterbore.

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 COR-

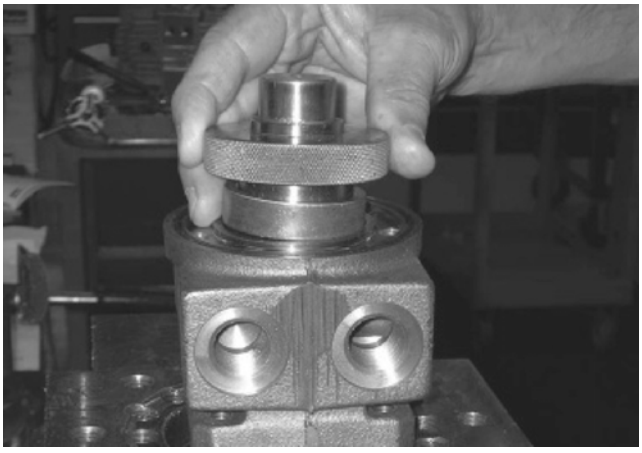
RECT RELATIONSHIP TO ADJACENT COMPONENTS WHEN ASSEMBLED.



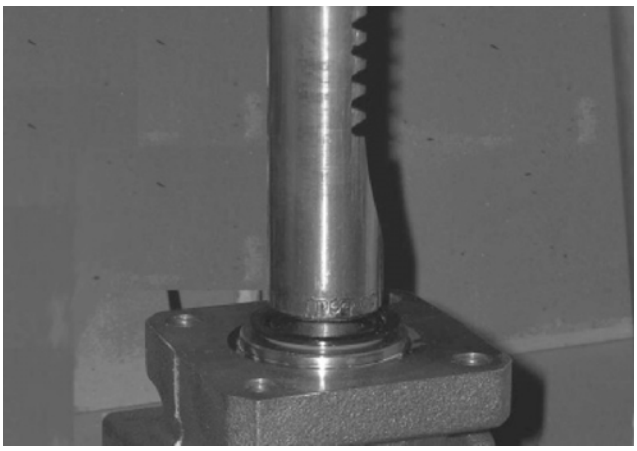
⚠ CAUTION

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.

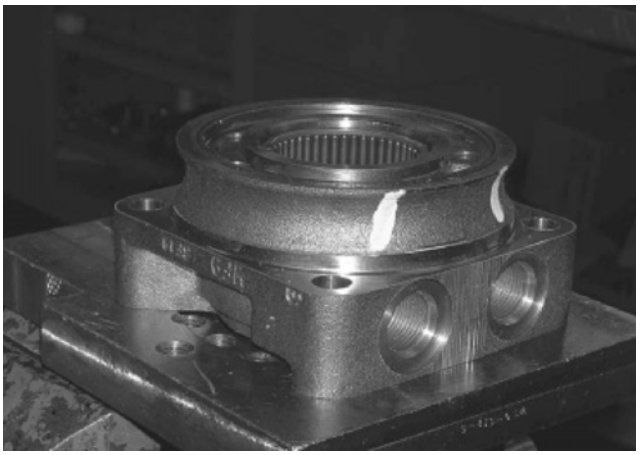
2. The inner housing bearing/bushing (13) can now be pressed into its counter-bore in housing (18) flush to 0.03 inch (0.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19).



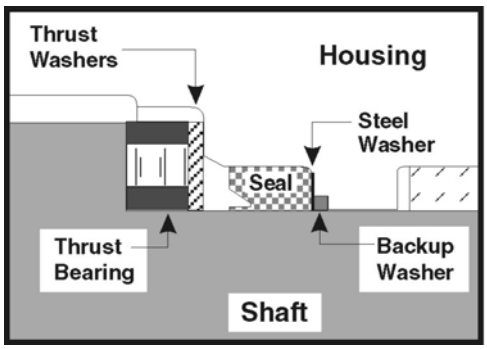
3. Press a new dirt and water seal (20) into the housing (18) outer bearing counterbore. The dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



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



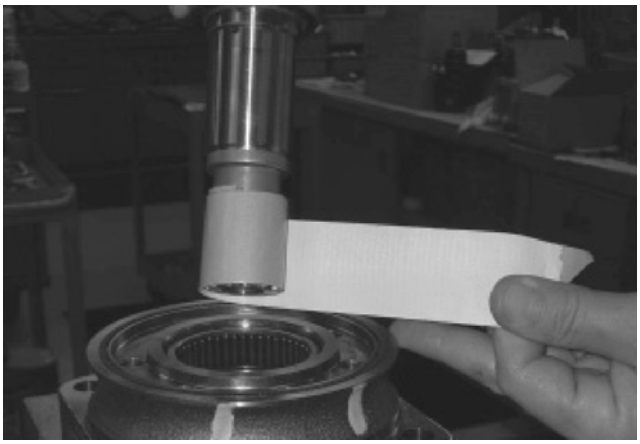
5. Assemble a new backup ring (17), new backup washer (25) and new seal (16) with the seal lip facing toward the inside of the motor, into their respective counterbores in housing (18).



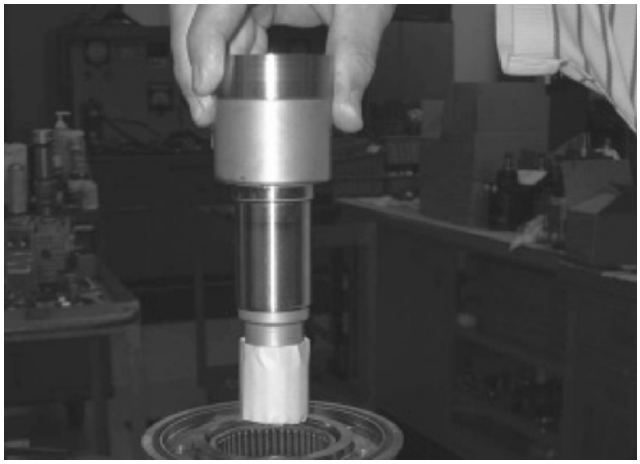
6. Assemble thrust washer (14) then thrust bearing (15) that was removed from the motor.

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.



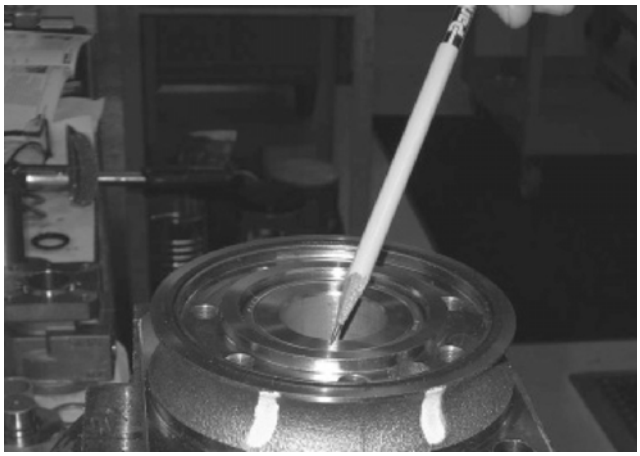
8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12) into housing (18), seating it against the thrust bearing (15).



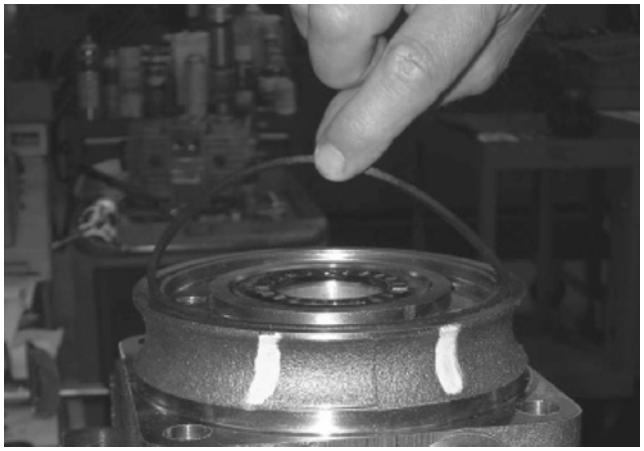
⚠ CAUTION

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.*

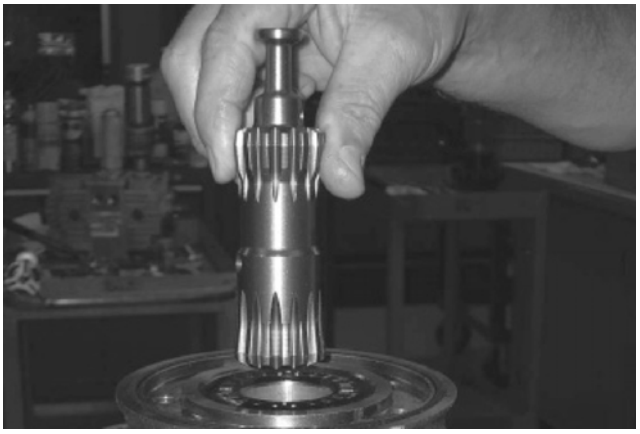


9. Apply a small amount of clean grease to a new seal ring (4) and insert it into the housing (18) seal ring groove.



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.*

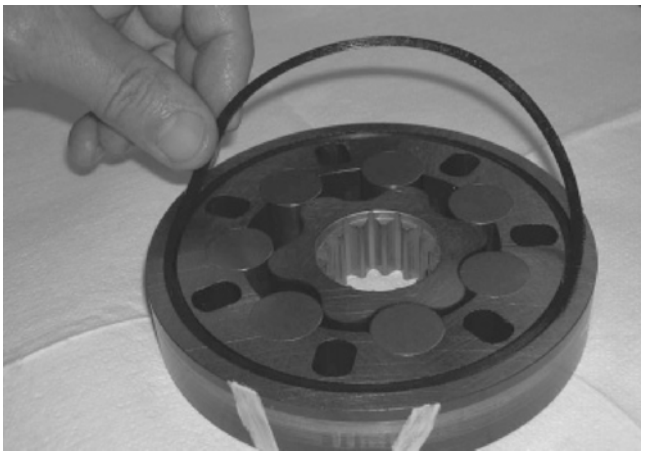
10. Install drive link (10) the long splined end down into the coupling shaft (12) and engage the drive link splines into mesh with the coupling shaft splines.



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.



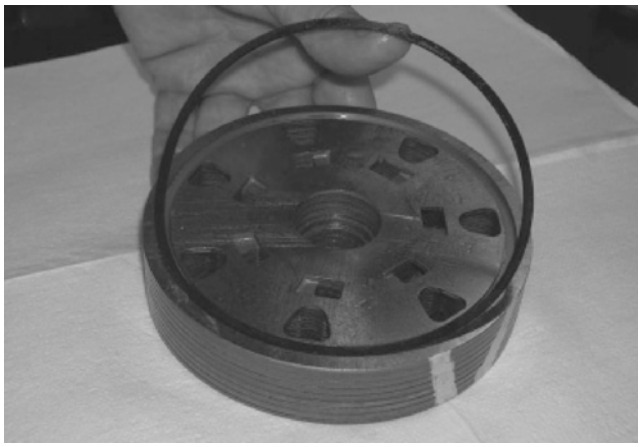
13. Install the assembled rotor set (8) onto wear plate (9) with rotor counterbore and seal ring side down and the splines into mesh with the drive link splines.

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."*

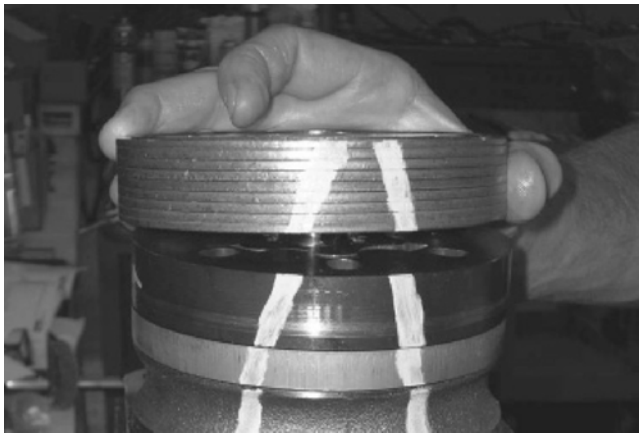
NOTE: *The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the 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.

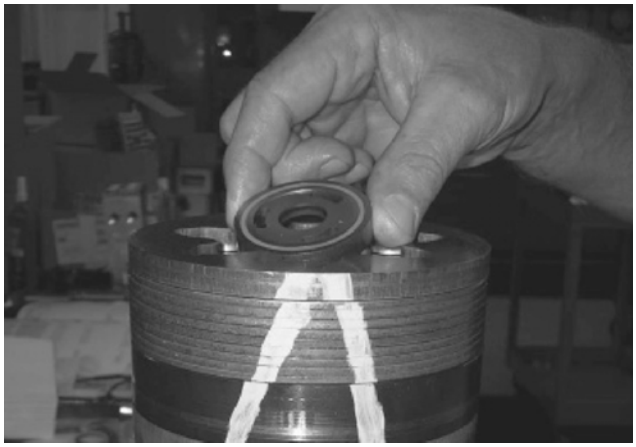


16. Apply grease to a new seal ring (4) and insert it in the seal ring groove exposed on the manifold.

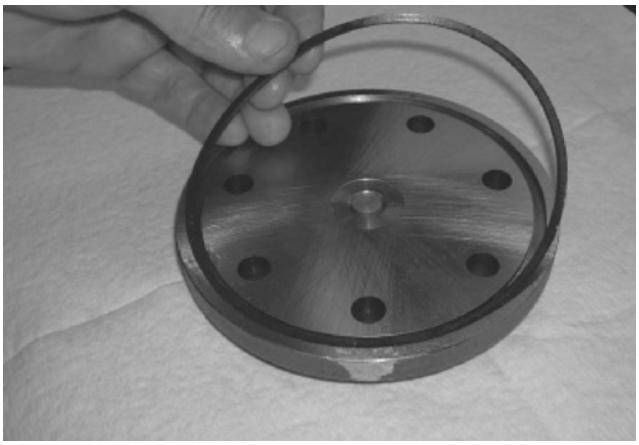
17. Assemble the commutator ring (6) over alignment studs onto the manifold.

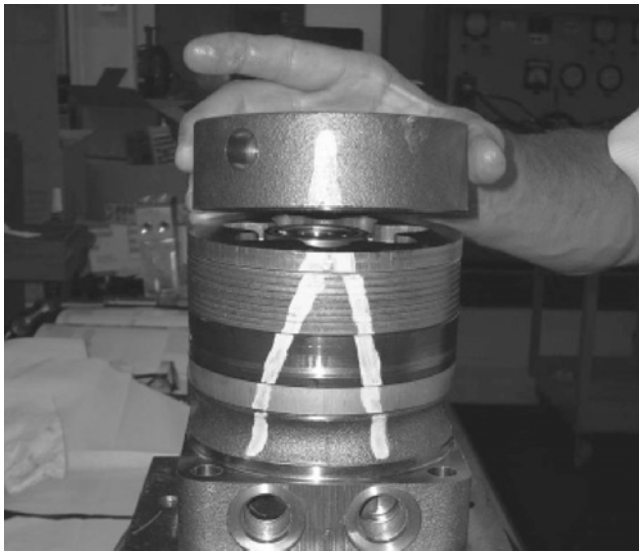
18. Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end

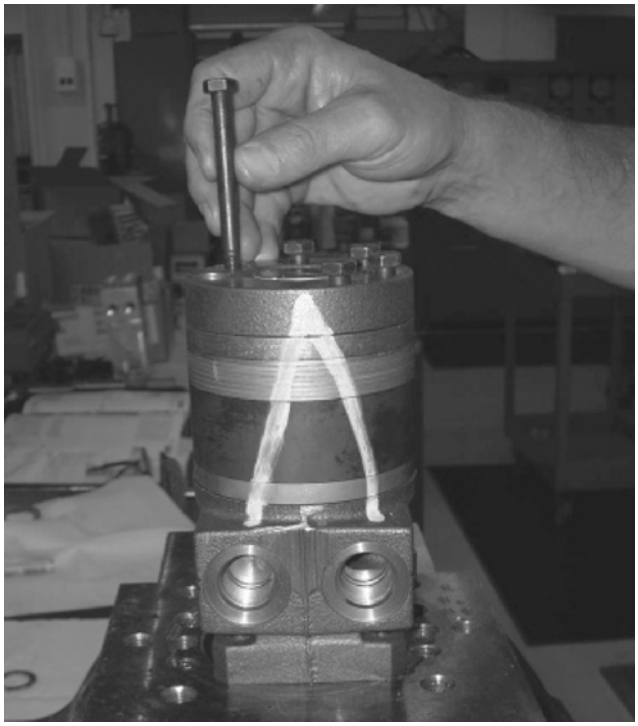
of drive link (10) onto manifold (7) with seal ring side up.



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.



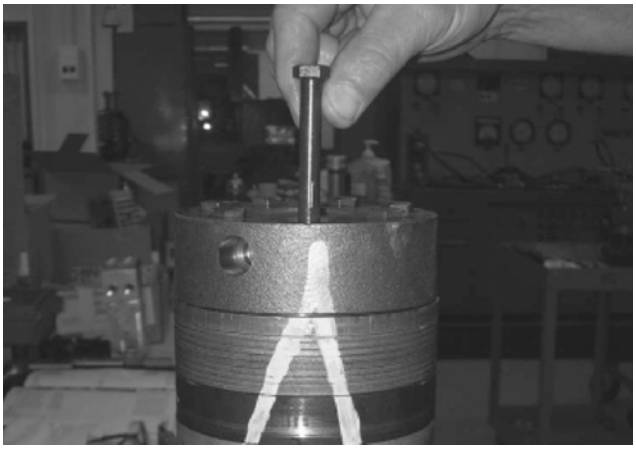


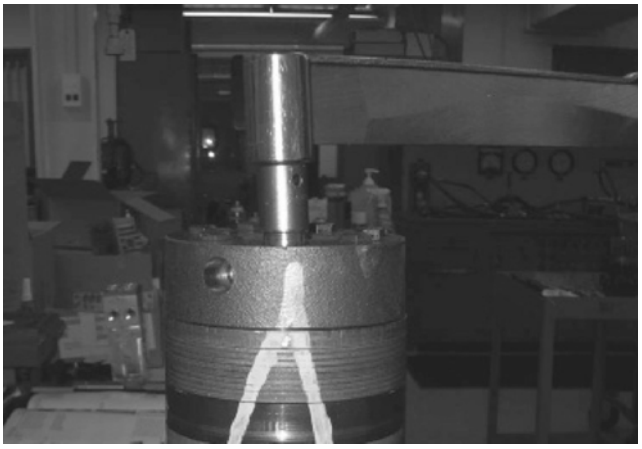


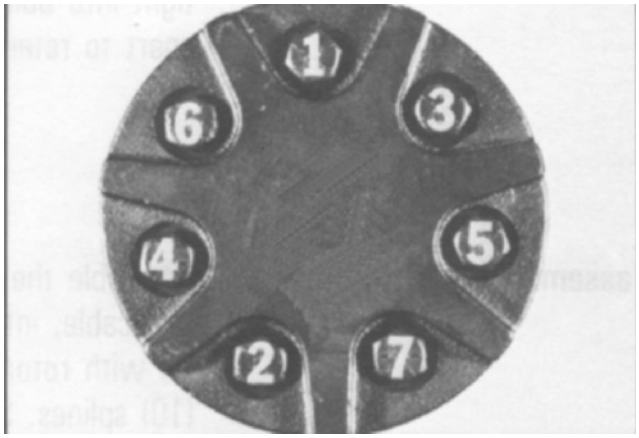
NOTE: *If the end cover has a valve (24) or has five bolt holes, use the line you previously scribed on the cover to radially align the end cover into its original position.*

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).







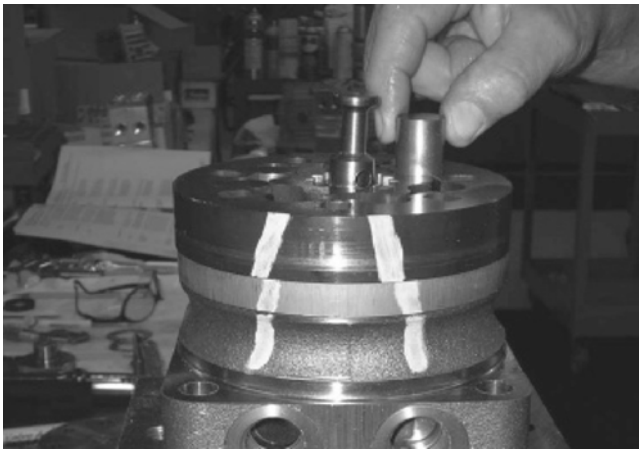
One Piece Stator Construction

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 fl at 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.

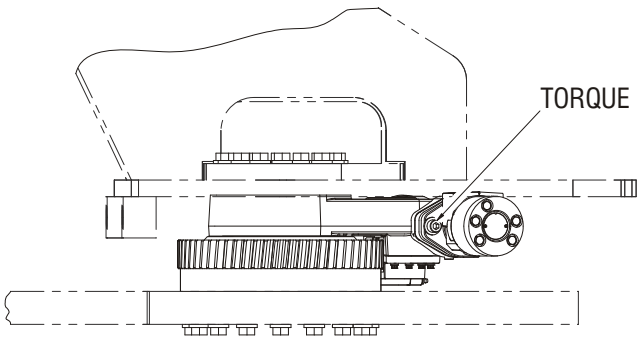
2. Check motor for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 N m)

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 Torque

When installing the swing motor onto the swing drive, torque apply threadlocker JLG P/N 0100019 to the threads of the retaining bolts and torque to 85 ft.lbs. (115 Nm).



3.8 SWING DRIVE

NOTE: *The swing drive must be removed from the machine to be serviced.*

The swing drive has five major components; the housing, worm, worm gear, output pinion, and gear/pinion cap.

Tools required:

- hydraulic press
- 5/16" 12 point socket
- 7/16" socket
- 3/4" socket
- torque wrench (80 lb-ft)
- steel hammer
- soft face hammer
- bearing puller (external and internal)
- large flat blade screw driver

NOTE: *Also needed are a shim and seal kit, 3/4" steel rod at least 10" long, LocTite #515, Mobil SHC 007 grease (available as SW007GK), Mobil SHC 460 grease, LocTite 242/243 for bolts and any other parts that may be worn out.*

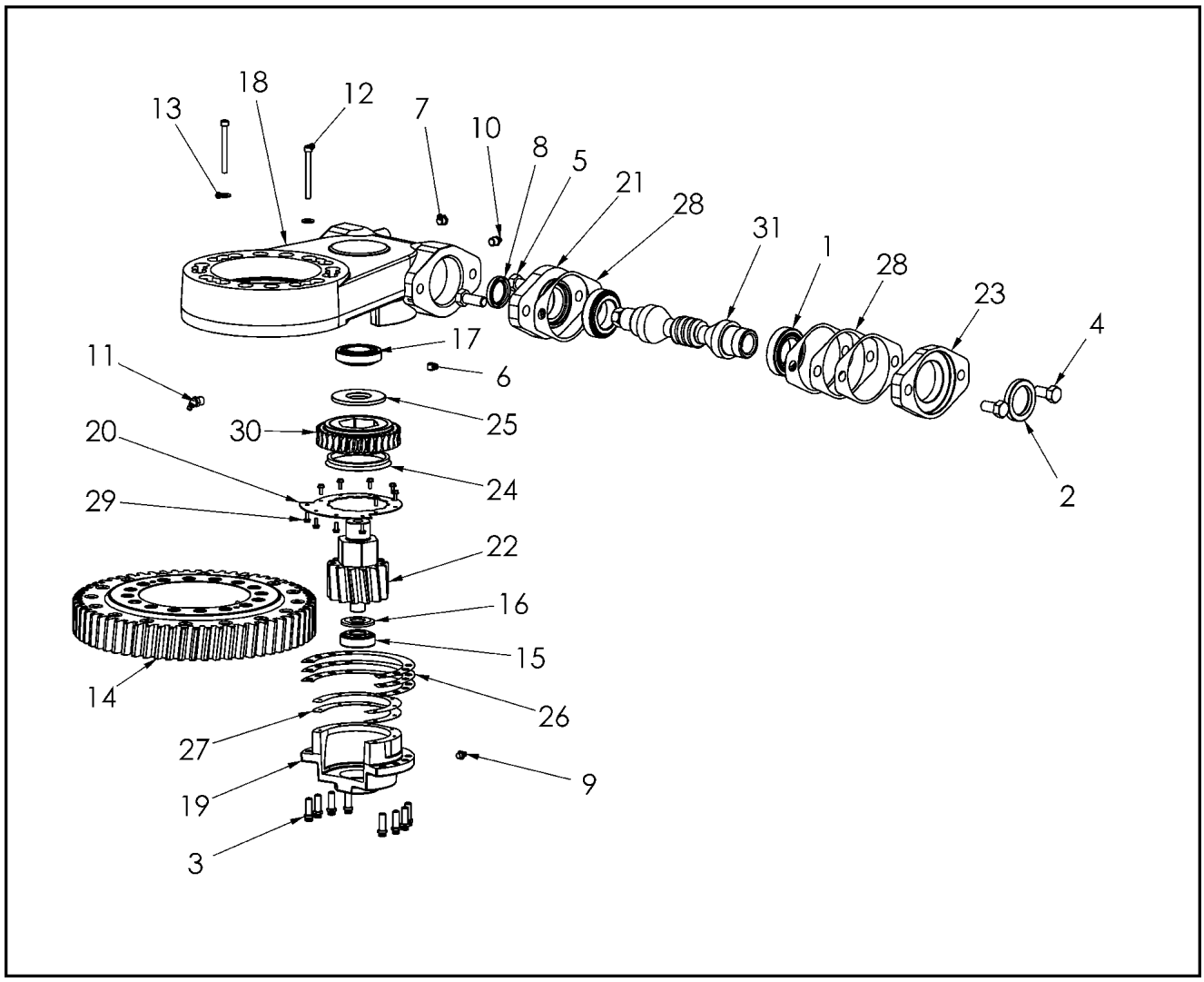
Disassembly

1. Remove the slew ring (14) by removing the two 1/4" bolts (12) and washers (13) that hold the slew ring to the housing.

2. Remove four #6 machine screws (29) that are located on cover plate (20) immediately in front of Pinion (22).

3. Remove eight 5/16" 12 point capscrews (3) from gear/pinion cap (19). Pry the cap from the housing. The cover plate (20) will come off with cap. Note where sealant is on Cover and plate so when assembling sealant can be applied in the same place. Note number and color of shims (26) between the cap and housing. Remove six small screws (29) from cover plate. Pry the cover plate (20) from cap (19) and discard the cover plate. Note the number and color of shims between cover plate and cap.

4. Remove the Pinion and Gear assembly (15, 16, 17,22,24,25,30) from the housing. The assembly lifts directly upward from the housing.



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

Figure 3-21. Swing Drive - Exploded View

5. Using a press, disassemble the pinion and gear assembly. Support the worm gear (30) on the press with the pinion (22) down allowing room for pinion to be pressed out of gear. Press pinion out of bearing (17) spacer (25) and worm gear (30) Pressing on end of pinion. Remove face seal (24) from face of worm gear (30). Note how the seal is assembled.
6. Remove the bearing (15) and Nilos Ring (16) from the pinion (22) using an external bearing puller or press.
7. Remove the motor and motor adapter (23) and shims (28).
8. Remove 1/2" bolts (5) from the Worm Cap (21) using 3/4" socket. Remove the shim (28) and seal (8) and discard.
9. Remove the worm (31) from the housing (18) by pushing it from the motor end using steel rod and a hammer. The bearing cup (1) on the hex end of the worm will be forced out of the housing. Once the bearing cup (1) has come out of housing, use a soft hammer to tap the worm on the hex end to remove the other bearing cup (1) out the other end of housing.
10. Remove both bearings (1) from the worm (31) worm using external bearing puller or press.
11. The bearing cup (17) can be removed from the housing (18) by lifting it out (this is not a press fit just a close slip fit).
12. The bearing cup (15) can be removed from the cap (19) using a small pry bar, or by welding a small bead of weld on the internal diameter of cup, this is a press fit.

Assembly

1. Press the bearing cup (15) into the cap (19).
2. Place the bearing cup (17) into the housing (18).
3. Put the face seal (24) onto the hub of the worm gear (30) with the flap of the seal pointing away from gear.
4. Place the worm gear (30) onto the press with the face seal up and press the pinion (22) into the worm gear. Place the Nilos Ring (16) onto the pinion so the cup shape is up and press the bearing (15) onto the pinion tight to the Nilos Ring.
5. Turn the assembly over and place the spacer (25) on the pinion against the gear hub so the large chamfer on the I.D. of spacer is against the bronze gear. Press the bearing (17) onto the pinion tight to the spacer and gear.
6. Place the pinion/gear assembly into the housing. Place the gear cap (19) and shims (26) over the gear/pinion assembly to achieve a slight preload on the pinion bearings. Remove the cap and shims and set the shims aside. Install a new cover plate (20) onto the cap using 6 screws (29) and shims (27) equal to or close to equal to the total thickness of shims set aside during Disassembly. Apply sealant (LocTite #515) to both sides of each of these shims and tighten the screws taking care not to twist these screws off. Clean extra sealant from the surfaces of the cover plate. Apply a small amount of grease to this flap. Set this assembly to the side.
7. Install the bearing (1) on the bore end of the worm (31) only. This is almost a slip fit, may have to be lightly tapped with soft hammer.
8. Install the worm (31) into the housing (18), hex end first.
9. On the bore end of the worm, install the bearing cup (1) into the worm bore of the housing. Also on the bore end of worm (31), install the motor adapter (23) and 1 shim (28 yellow) to the housing using 1/2-13 x 1" bolts (4) and sealant. Torque to 75 ft.lbs. (101.5 Nm). These bolts will be replaced with motor bolts when the motor is mounted.
10. Install the bearing cone (1) on the hex end of the worm (31). Place a bearing cup (1) over the bearing and lightly tap the cup into the bore using a soft hammer.

11. Install the worm cap (21) using proper shims (28) to achieve 0.000 to 0.001" (0.000 to 0.025 mm) end play. Apply LocTite 242 to end of 1/2-13 x 1.25" grade 5 bolts (5) and LocTite #515 sealant to shims. Torque the bolts to 75 lbs-ft (101.5 Nm).

12. Place the pinion/gear assembly into the housing so the gear teeth mesh with the worm gear teeth. The worm or gear set may have to be turned by hand to achieve this.

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

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

15. Apply LocTite 242 to the end of eight 5/16" 12 point screws (3) and torque to 20 ft.lbs. (27 Nm).

16. Install 4 small screws (29) through the cover plate (20) and into the housing (18). Tighten the screws taking care not the twist the screws off.

17. Install the seal (8) in the worm cap at the hex end of the worm.

18. Install the slew ring (14) using two 1/4" bolts (12) and washers (13). Adjust backlash with the pinion to 0.008/0.012" (0.203/0.304 mm) and torque bolts to 10 ft.lbs. (13.5 Nm).

19. Fill the unit with SHC 007 grease (available as SW007GK) and grease the pinion bearing (15) thru the fitting (9) with Mobil SHC 460 grease.

3.9 SWING BEARING

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 threadlocker JLG P/N 0100019. After replacing and retorquing bolt or bolts recheck all existing bolts for looseness.*

1. Check the frame to bearing bolts as follows:
   a. On a firm level surface, elevate the fully retracted boom to full elevation.
   b. At the position indicated on Figure 3-24., 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.
   c. Assure that the 0.0015” feeler gauge will not penetrate under the bolt head to the bolt shank.
   d. Swing the turntable 90 degrees, and check some selected bolts at the new position.
   e. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.
2. Check the turntable to bearing bolts as follows:
   a. On a firm level surface, elevate the fully retracted boom to full elevation.
   b. At the positions indicated on Figure 3-24., 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.

c. Lower the main boom to horizontal and fully extend the boom.

d. At the position indicated on Figure 3-24., Swing Bearing Tolerance Boom Placement try and insert the.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

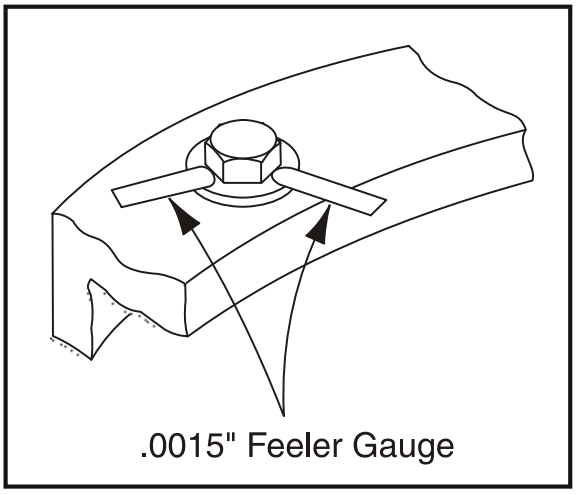


Figure 3-22. Swing Bearing Feeler Gauge Check

Wear Tolerance

1. With the boom positioned over the side of the machine, the Upper Boom horizontal with telescope fully extended and Tower Boom raised half way (approx 37°)See Figure 3-25., Swing Bearing Tolerance Boom Placement, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-23., Swing Bearing Tolerance Measuring Point)
2. At the same point, with the boom positioned over the side of the machine, the Upper Boom fully extended and fully retracted, the platform rotated max. to the side, and the Tower Boom fully elevated, (See Figure 3-24., Swing Bearing Tolerance Boom Placement) using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable (Figure 3-23., Swing Bearing Tolerance Measuring Point).

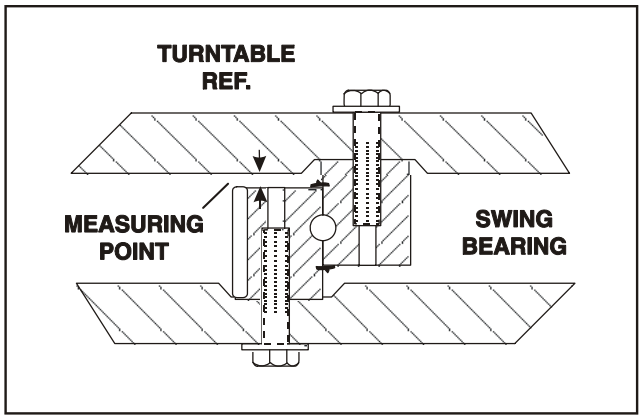


Figure 3-23. Swing Bearing Tolerance Measuring Point

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.

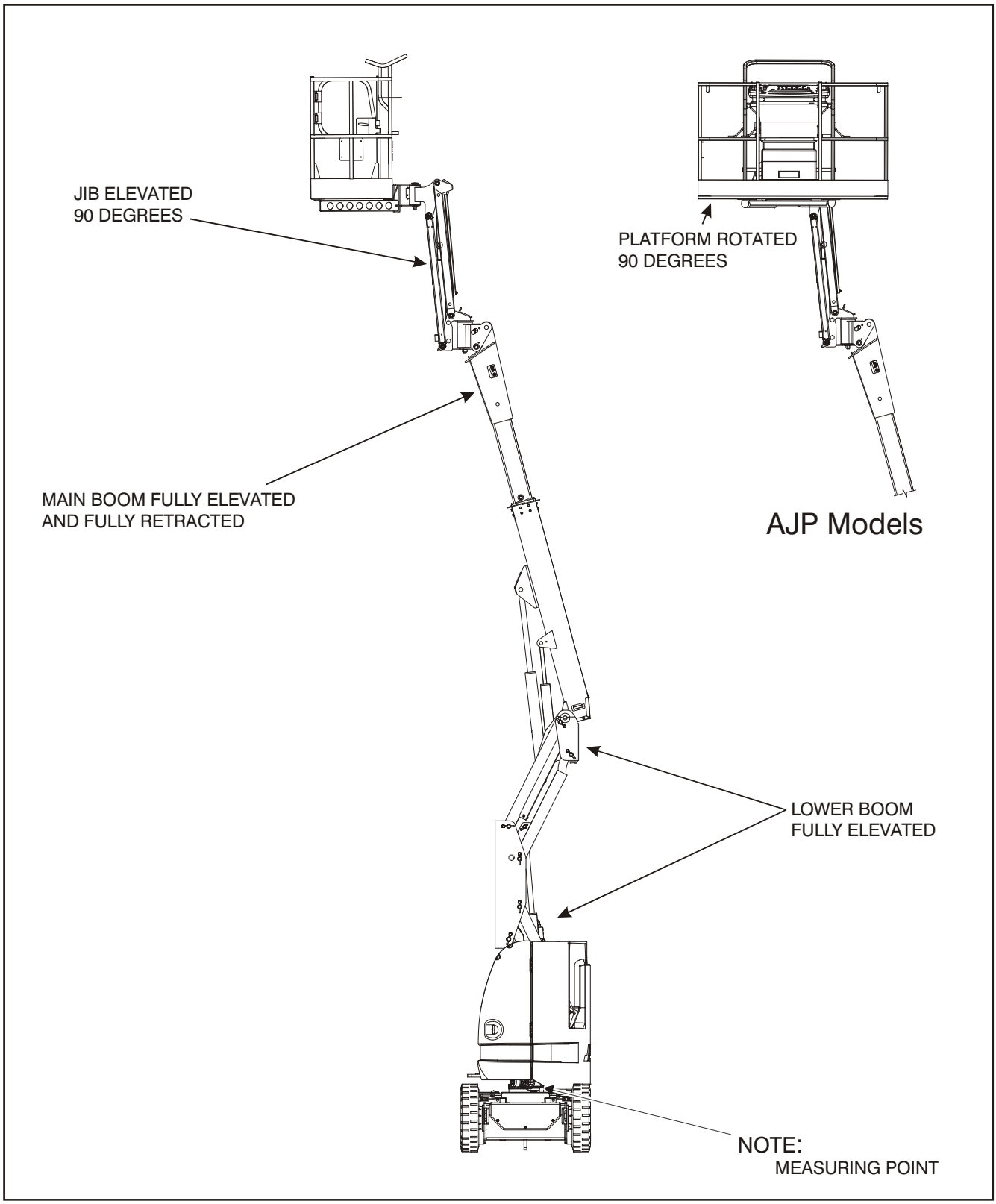


Figure 3-24. Swing Bearing Tolerance Boom Placement

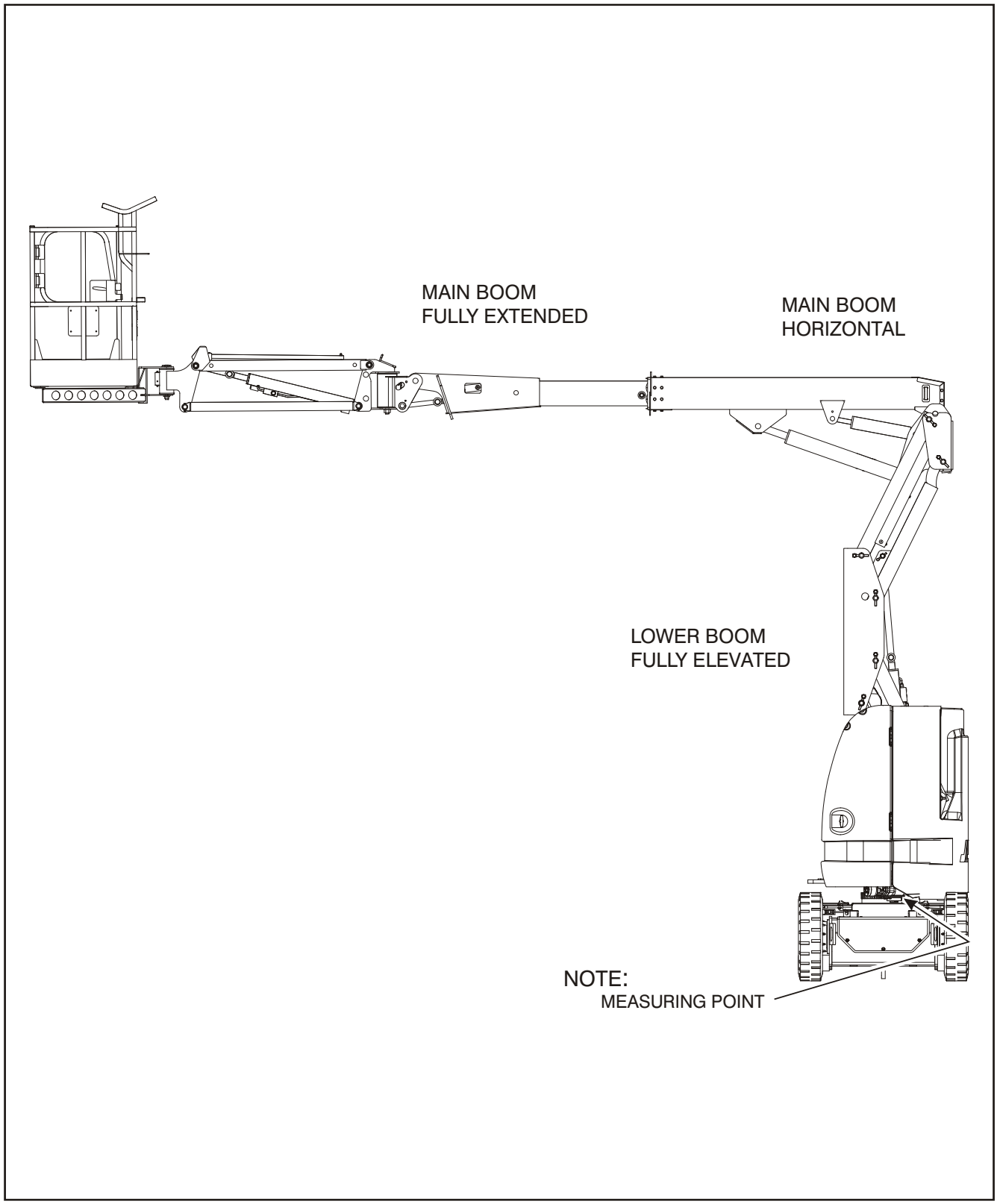
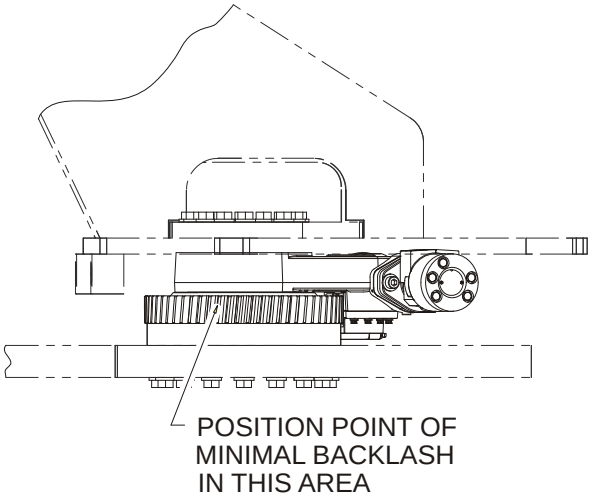


Figure 3-25. Swing Bearing Tolerance Boom Placement

Replacement of Swing Bearing

1. Removal.
   a. Attach an adequate support sling to the boom and draw all slack from sling. Prop or block the boom if feasible.
   b. Tag and disconnect hydraulic lines running through center of turntable and frame. Use a suitable container to retain any residual hydraulic fluid. Cap lines and ports.
   c. Attach suitable overhead lifting equipment to the base of turntable weldment.
   d. Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This will aid in aligning the bearing upon installation. Remove bolts, nuts and washers which attach the turntable to the bearing inner race. Discard nuts and bolts.
   e. Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame mounted components.
   f. Carefully place the turntable on a suitably supported trestle.
   g. Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing and rotation box assembly from the frame; move to a clean, suitably supported work area.
   h. Remove the two cap screws securing the bearing to the rotation box to separate the two for inspection.

2. Installation.
   a. Install bearing to rotation box with two cap screws, so that fill plug of bearing is as close to gear as bolt pattern will allow. Do not tighten cap screws.
   b. Line up high spot (blue) of bearing as shown below. Set backlash to 0.008 - 0.010 inch (0.20 - 0.25 mm). Tighten cap screws as shown in Figure 3-26., Swing Bearing Torque Sequence.



   c. Grease bearing with Mobilith SHC Bearing Grease. Grease fitting is remotely mounted.
   d. Using suitable lifting equipment, install bearing/ rotation box assembly to frame with soft spot (red) 90 degree relative to load axis. If reusing old bearing, ensure that scribed line of outer race of the bearing aligns with the scribed mark on the frame.

⚠ CAUTION

JLG INDUSTRIES RECOMMENDS THAT ALL REMOVED GRADE 8 BEARING NUTS AND BOLTS BE DISCARDED AND REPLACED WITH NEW NUTS AND BOLTS. SINCE THE SWING BEARING IS THE ONLY STRUCTURAL LINK BETWEEN THE FRAME AND TURNTABLE, IT IS IMPERATIVE THAT SUCH REPLACEMENT HARDWARE MEETS JLG SPECIFICATIONS. USE OF GENUINE JLG HARDWARE IS HIGHLY RECOMMENDED.

   e. Apply a light coating of threadlocker JLG P/N 0100019 to the new bearing bolts and loosely install the bolts and washers through the frame and outer race of bearing.

NOTICE

IF COMPRESSED AIR OR ELECTRICALLY OPERATED IMPACT WRENCH IS USED FOR TIGHTENING THE BEARING ATTACHMENT BOLTS, THE TORQUE SETTING ACCURACY OF THE TOOL SHOULD BE CHECKED PRIOR TO USE.

f. Following the torque sequence diagram shown in Figure 3-26., Swing Bearing Torque Sequence, tighten the bolts to an initial torque of 140 ft. lbs. (190 Nm). Then following the same sequence, tighten to a final torque of 190 ft. lbs. (260 Nm).

g. Remove lifting equipment from bearing.

h. Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.

i. Carefully lower the turntable onto the swing bearing. Ensure that the scribed line of the inner race of the bearing aligns with the scribed mark on the turntable. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft centerline of the turntable.

j. Apply a light coating of threadlocker JLG P/N 0100019 to the new bearing bolts and install through the turntable and inner race of bearing.

k. Following the torque sequence shown in Figure 3-26., Swing Bearing Torque Sequence, tighten the bolts to an initial torque of 150 ft. lbs. (200 Nm). Then following the same sequence, tighten the bolts to 210 ft. lbs (285 Nm).

l. Remove the lifting equipment.

m. Route hydraulic lines through center of turntable and frame and connect as tagged prior to removal.

n. Using all applicable safety precautions, activate the hydraulic system and functionally check swing system for proper and safe operation.

Swing Bearing Torque Value

Install bolts with threadlocker JLG P/N 0100019 - 190 ft. lbs. (260 Nm).

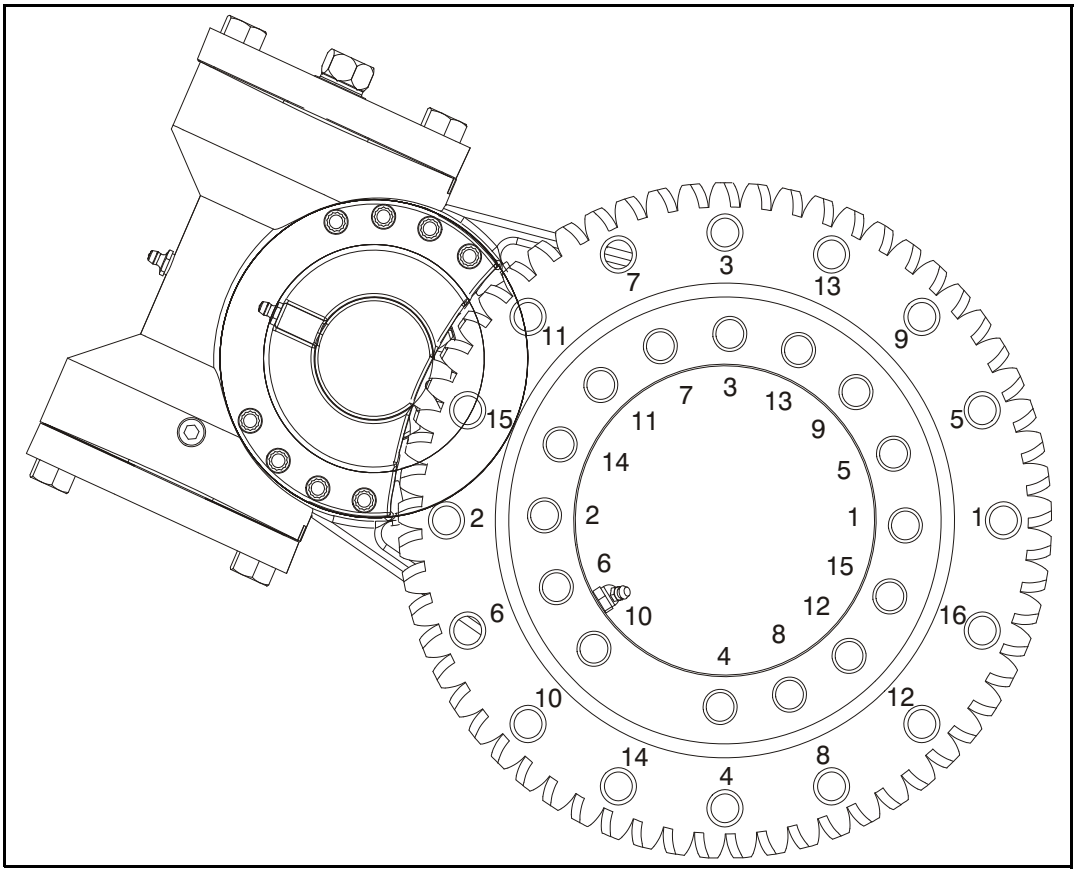


Figure 3-26. Swing Bearing Torque Sequence

3.10 BATTERY MAINTENANCE AND CHARGING

⚠ WARNING

TO AVOID INJURY FROM AN EXPLOSION, DO NOT SMOKE OR ALLOW SPARKS OR A FLAME NEAR BATTERY DURING SERVICING. ALWAYS WEAR EYE AND HAND PROTECTION WHEN SERVICING BATTERIES.

Battery Maintenance, Quarterly

1. Open battery compartment cover to allow access to battery terminals and vent caps.

⚠ CAUTION

WHEN ADDING WATER TO BATTERIES, ADD WATER UNTIL ELECTROLYTE COVERS PLATES. DO NOT CHARGE BATTERIES UNLESS ELECTROLYTE COVERS THE PLATES.

NOTE: *When adding distilled water to batteries, non-metallic containers and/or funnels must be used.*

To avoid electrolyte overflow, add distilled water to batteries after charging.

When adding water to the battery, fill only to level indicated or 3/8" above separators.

2. Remove all vent caps and inspect electrolyte level of each cell. Electrolyte level should be to the ring approximately one inch from top of battery. Fill batteries with distilled water only. Replace and secure all vent caps.
3. Remove battery cables from each battery post one at a time, negative first. Clean cables with acid neutralizing solution (e.g. baking soda and water or ammonia) and wire brush. Replace cables and/or cable clamp bolts as required.
4. Clean battery post with wire brush then re-connect cable to post. Coat non-contact surfaces with mineral grease or petroleum jelly.
5. When all cables and terminal posts have been cleaned, ensure all cables are properly positioned and do not get pinched. Close battery compartment cover.
6. Start hydraulic system and ensure that it functions properly.

Battery Charging, Daily

NOTE: *To avoid excessive battery charging time, do not allow batteries to become completely discharged.*

NOTE: *To avoid electrolyte overflow, add distilled water to batteries after charging.*

NOTE: *When adding water to the battery, fill only to level indicated or 3/8" above separators.*

1. Charge batteries at the end of each work day, or when machine performance is significantly reduced due to batteries becoming discharged.
2. Charge batteries in accordance with the following procedure:
   a. Open battery compartment, and battery charger compartment covers.

⚠ WARNING

WHEN BATTERY CHARGER IS TO BE USED, CHARGING HARNESS MUST BE PLUGGED INTO A GROUNDED RECEPTACLE. IF RECEPTACLE IS NOT GROUNDED AND A MALFUNCTION SHOULD OCCUR, THE MACHINE COULD CAUSE SERIOUS ELECTRICAL SHOCK.

   b. Remove charging harness cable and connect to a receptacle or the correct voltage.
   c. Allow batteries to charge until 100% LED is illuminated.

NOTE: *When batteries are completely charged, disconnect charging harness cable from receptacle. Store charging harness cable.*

   d. Ensure battery cables are positioned and are not pinched. Close and secure all compartment doors.

3.11 BATTERY CHARGER

⚠ WARNING

LEAD ACID BATTERIES MAY GENERATE EXPLOSIVE HYDROGEN GAS DURING NORMAL OPERATION. KEEP SPARKS, FLAMES, AND SMOKING MATERIALS AWAY FROM BATTERIES. PROVIDE ADEQUATE VENTILATION DURING CHARGING. NEVER CHARGE A FROZEN BATTERY. STUDY ALL BATTERY MANUFACTURERS' SPECIFIC PRECAUTIONS SUCH AS RECOMMENDED RATES OF CHARGE AND REMOVING OR NOT REMOVING CELL CAPS WHILE CHARGING.

⚠ WARNING

RISK OF ELECTRIC SHOCK. CONNECT CHARGER POWER CORD TO AN OUTLET THAT HAS BEEN PROPERLY INSTALLED AND GROUNDED IN ACCORDANCE WITH ALL LOCAL CODES AND ORDINANCES. A GROUNDED OUTLET IS REQUIRED TO REDUCE RISK OF ELECTRIC SHOCK - DO NOT USE GROUND ADAPTERS OR MODIFY PLUG. DO NOT TOUCH UNINSULATED PORTION OF OUTPUT CONNECTOR OR UNINSULATED BATTERY TERMINAL. DISCONNECT THE AC SUPPLY BEFORE MAKING OR BREAKING THE CONNECTIONS TO THE BATTERY WHILE CHARGING. DO NOT OPEN OR DISASSEMBLE CHARGER. DO NOT OPERATE CHARGER IF THE AC SUPPLY CORD IS DAMAGED OR IF THE CHARGER HAS RECEIVED A SHARP BLOW, BEEN DROPPED, OR OTHERWISE DAMAGED IN ANY WAY - REFER ALL REPAIR WORK TO QUALIFIED PERSONNEL. NOT FOR USE BY CHILDREN.

Operating Instructions

NOTICE

ALWAYS USE A GROUNDED OUTLET. WHEN USING AN EXTENSION CORD, AVOID EXCESSIVE VOLTAGE DROPS BY USING A GROUNDED 3-WIRE 12 AWG CORD.

1. The charger will automatically turn on and go through a short self-test. All LED's will flash in an up-down sequence for two seconds. The yellow "Charging" LED will turn on and a trickle current will be applied until a minimum voltage is reached.
2. Once a minimum battery voltage of 2 volts per cell is detected, the charger will enter the constant-current charging stage and the yellow LED will remain on. The length of charge time will vary by input voltage and ambient temperature.
3. When the green "Charged" LED turns on, the batteries are completely charged. The charger may now be unplugged from AC power. If left plugged in, the charger will automatically restart a complete charge cycle if battery voltage drops below a minimum voltage or 30 days have elapsed.
4. If a fault occurred during charging, the red "Fault" LED will flash with a code corresponding to the error.

Maintenance Instructions

1. For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to level specified by battery manufacturer. Follow the safety instructions recommended by the battery manufacturer.
2. Make sure charger connections to battery terminals are tight and clean.
3. Do not expose charger to oil or to direct heavy water spraying when cleaning vehicle.

Battery Charger Fault Codes

If a fault occurred during charging, the red "Fault" LED will flash with a code corresponding to the error. Refer to the table following for the flash codes and their removal.

Table 3-12. Battery Charger Fault Codes (Delta-Q)

Flash(s)	Fault	Fault Removal
1	Battery voltage high	Auto-recover - Indicates a high battery pack voltage
2	Battery voltage low	Auto-recover - Indicates either a battery pack failure, battery pack not connected to charger or battery volts per cell is less than 0.5 VDC. Check the battery pack and connections
3	Charge time-out	Indicates the batteries did not charge in the allowed time. This could occur if the batteries are a larger capacity than the algorithm is intended for or if the batteries are damaged old or in poor condition.
4	Check battery	Indicates the batteries could not be trickle charged up to the minimum voltage per cell level required for the charge to be started.
5	Over-temperature	Auto-recover - Indicates charger has shut down due to high internal temperature
6	QuiQ fault	Indicates that the battery will not accept charge current, or an internal fault has been detected in the charger. This fault will nearly always be set within the first 30 seconds of operation. Once it has been determined that the batteries and connections are not faulty and fault 6 is again displayed after interrupting AC power for at least 10 seconds, the charger must be brought to a qualified service depot.

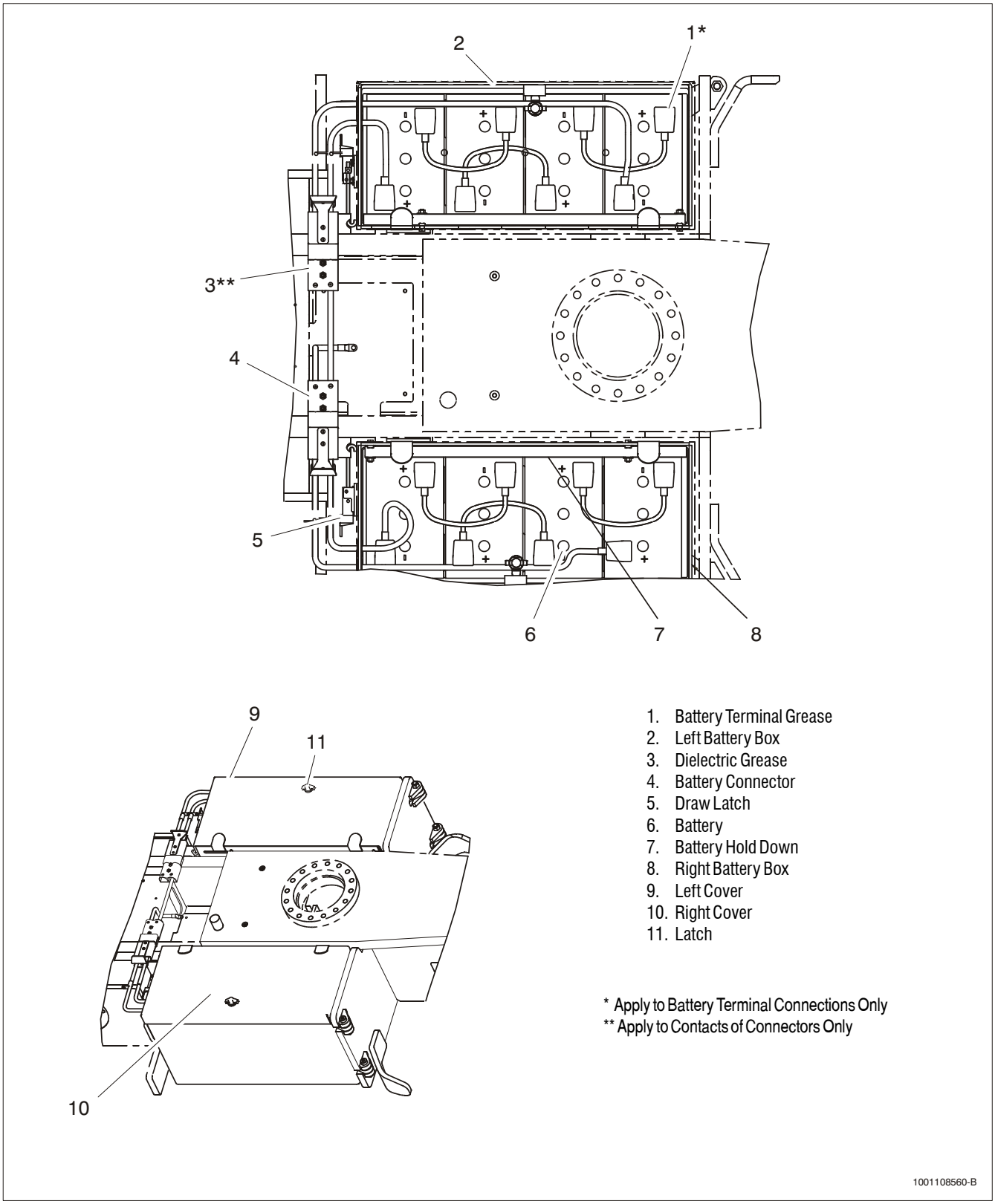


Figure 3-27. Battery Boxes

NO LIGHTS AT ALL

No Lights at all indicate that AC power to the charger is not connected or that the AC voltage is too low. It could also indicate an internal failure in the charger.

1. Check the connections to AC power. Check for AC voltage between 90 and 260 VAC at the charger.
2. If the AC voltage is verified to be correct at the connection to the charger, and the charger still displays no lights at all, return the charger for service.

FAULT LED FLASHING

The Fault LED flashes to indicate the microcontroller inside the battery charger has detected a fault. The fault detected is indicated by the number of flashes. Count the number of flashes to determine the fault.

With any battery system, the most common problem will be a faulty battery connection. Because of the high likelihood of a battery connection problem, it is always worthwhile to confirm that all connections are good before checking for any other problems.

[1 Flash] - High Battery Voltage

1. Indicates a high battery voltage. Check that the battery charger voltage is consistent with the battery pack voltage. The first two digits of the four digit model name indicate the battery voltage the charger supports.
2. Check for wiring errors.
3. This fault will automatically clear and the charger will restart charging when this problem is removed.
4. High battery voltage could also occur if there is another source charging the battery. Disconnect any other sources during charging.
5. If this problem does not clear after the battery voltage is confirmed to be less than 2.4V per cell, return the charger for service.

[2 Flashes] - Low Battery Voltage

1. Indicates either a battery failure, no battery connected, or a lower than expected battery voltage. Check the battery and battery connections.
2. Check the nominal battery voltage. The first two digits of the four digit model name indicate the battery voltage the charger supports. Confirm that a nominal battery voltage is the same as the charger voltage.
3. This fault will clear automatically when the low battery voltage problem is rectified.
4. If this problem does not clear after the battery voltage is confirmed to be higher than 1.0V per cell and all connections are good, return the charger for service.

[3 Flashes] - Charge Timeout

Indicates the battery failed to charge within the allowed time. This could occur if the battery is of larger capacity than the algorithm is intended for. In unusual cases it could mean charger output is reduced due to high ambient temperature. It can also occur if the battery is damaged, old, or in poor condition.

1. Check the battery for damage such as shorted cells and insufficient water. Try the charger on a good battery.
2. If the same fault occurs on a good battery, check the connections on the battery and connection to AC, and the AC voltage itself.
3. Confirm that the nominal battery pack voltage is the same as the battery charger voltage.
4. This fault must be cleared manually by unplugging the AC, waiting 30 seconds and reconnecting the AC power.
5. If a charger displays this fault on a battery pack, and the pack is of questionable status, reset the charger by disconnecting AC for 30 seconds, and then reconnect the AC to start a new charge cycle. After a few charge cycles, this problem could stop occurring as the pack "recovers."

[4 Flashes] - Check Battery

This fault indicates the battery pack could not be trickle charged up to the minimum level required for the normal charge cycle to be started.

1. Check that none of the battery pack connections between modules are reversed or incorrectly connected.
2. Check that one or more cells in the battery are no shorted.
3. Confirm that the nominal battery pack voltage is the same as the battery charger voltage.
4. Try the charger on a good battery.
5. If this fault occurs, the battery is likely in poor condition. Try to recover the pack with a charger that can charge the individual cells - such as an automotive charger. Be sure to set this charger to the appropriate voltage - 6V per 6V battery, 12V per 12V string/ battery.

[5 Flashes] - Over Temperature

This fault indicates the charger has become too hot during operation. Though not damanging to the charger, charge time will be extended significantly.

1. This fault indication will not clear automatically, but the charger will restart charging automatically when the temperature drops. The fault indicaiton must be cleared manually by unplugging the AC, waiting 30 seconds and reconnecting the AC power.
2. If possible, move the machine to a cooler location.
3. Confirm that dirt or mud is not blocking the cooling fins of the charger. Clean the charger. Rinse the charger with a low pressure hose if required. Do no use high pressure. Do not us a pressure washer.

[6 Flashes] - Over Load/Over Temperature

This fault indicates that the batteries will not accept charge current, or an internal fault has been detected in the charger. This fault will nearly always be set within the first 30 seconds of operation. If it occurs after the charger has started charging normally, be sure to make a note of it.

1. Remove excessive AC loads from inverter if installed.
2. Try to clear the fault by unplugging the AC, waiting 30 seconds and reconnecting the ac power.
3. Check all battery connections. Look for a high resistance connection.The most likely reason for this fault is a fault in the battery such as a bad battery connection, an open cell, or insufficient water.
4. This fault will occur if an internal fuse inside the charger blows. If the green wire is shorted to ground even momentarily, this fuse will blow. To check the fuse, measure with an ohmmeter between the green and red wires with the AC disconnected. If a short circuit is not measured, the fuse has blown. Return unit to a service depot to have this fuse replaced.
5. If this fault occurs after battery charging has started, confirm that AC power was not interrupted and that all battery connections are good.
6. If all battery connections are good, an internal fault has been detected and the charger must be brought to a qualified service depot.

Excessive Battery Watering Requirements or Strong Sulphur (Rotten Egg) Smell

These symptoms indicate over-charging or high battery temperature. These symptoms are unlikely to be caused by too high a charge current since the maximum charge current of the charger will be small compared to even a moderately sized battery pack. The most likely cause for this problem is incorrect charge algorithm setting and/or high ambient temperatures.

1. Confirm that the battery pack is not too small - usually > 50Ah.
2. Confirm that the nominal battery voltage matches the charger output voltage.
3. Confirm the correct battery charge algorithm. If the battery pack is new, the algorithm will need to be changed if the pack is not the same as the old one. for instructions on how to determine and change the battery charge algorithm see the following sub-section.
4. If the output voltage of the charger seems excessive, return the charger for service. Contact JLG to get the expected battery voltage settings for the charger in question. Be sure to have the charger's serial number and charge algorithm setting available when calling.

Checking/Changing the Battery Charger Algorithm

The charger is pre-loaded with programming algorithms for the specific batteries detailed in Table 3-4, Battery Algorithms.

NOTE: *Contact JLG if your specific battery model is not listed.*

Each time AC power is applied with the battery pack not connected, the charger enters an algorithm select/display mode for approximately 11 seconds. During this time, the current Algorithm # is indicated on the Yellow Charging LED. A single digit Algorithm # is indicated by the number of blinks separated by a pause. A two digit Algorithm # is indicated by the number of blinks for the first digit followed by a short pause, then the number of blinks for the second digit followed by a longer pause.

To check / change the charging algorithm:

1. Disconnect the charger positive connector from the battery pack. Apply AC power and after the LED test, the Algorithm # will display for 11 seconds.
2. To change the algorithm, touch the connector to the battery's positive terminal for 3 seconds during the 11 second display period and then remove. The Algorithm # will advance after 3 seconds. Repeat this procedure until the desired Algorithm # is displayed. A 30 second timeout is extended for every increment. Incrementing beyond the last Algorithm will recycle back to the first Algorithm. When the desired Algorithm is displayed, touch the charger connector to the battery positive terminal until the output relay makes a clicking noise (approx. 10 seconds). The algorithm is now in the permanent memory.
3. Remove the AC power from the charger and reconnect the charger's positive connector to the battery. It is recommended to check a newly changed algorithm by repeating the above steps 1 and 3.

Table 3-4. Battery Algorithms

Algorithm #	JLG P/N	Battery Type	Proper Algorithm Setting
173	1001114782	DISCOVER EV 305A-A	43

3.13 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 proximity switch mounted under the turntable, a "target" mounted to the frame, an indicator light and an override switch on the platform display panel. The proximity switch trips when the turntable is swung +/- 28 degrees off center of the normal driving position. This occurs roughly 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 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 the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

3.14 HOODS

The right hood weighs 15 lbs. (6.8 kg) and the left hood weighs 10.3 lbs. (4.7 kg). See Figure 3-28., Hoods

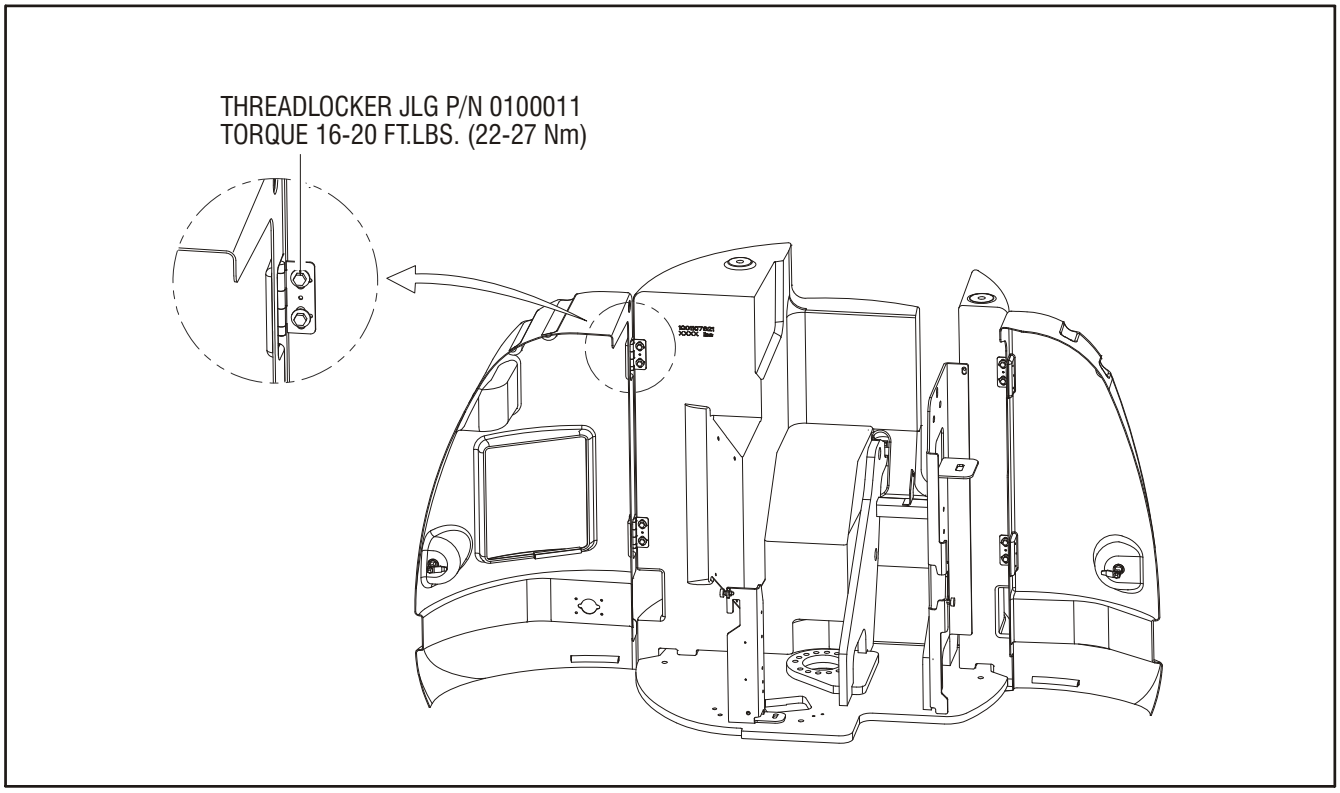


Figure 3-28. Hoods

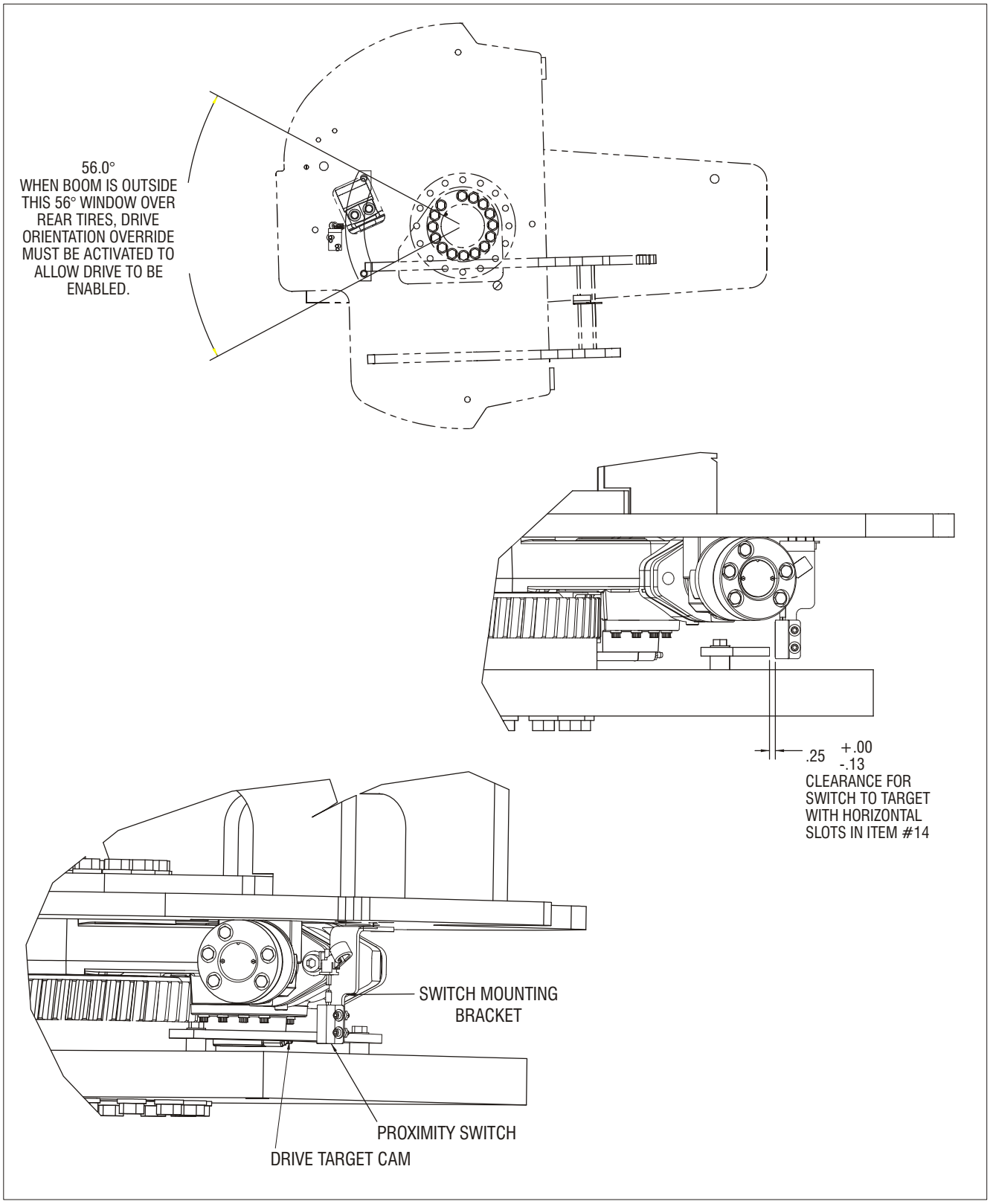


Figure 3-29. Drive Orientation Switch

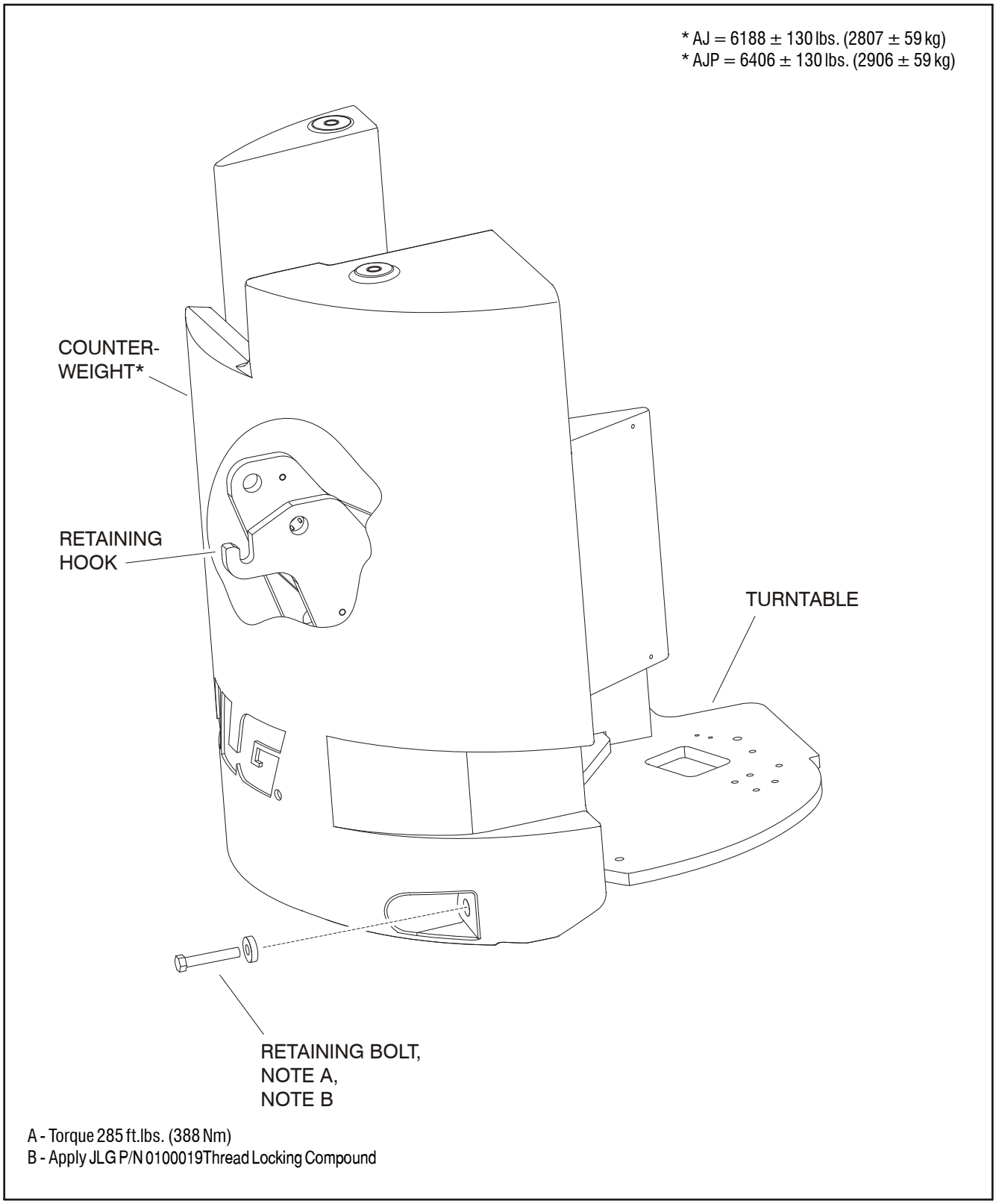


Figure 3-30. Counterweight

NOTES:

SECTION 4. BOOM & PLATFORM

4.1 BOOM MAINTENANCE

Removal of the Main Boom

NOTICE

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

1. Raise the boom to a horizontal position.
2. Place blocking in the tower boom for support and prevent it from lowering.

NOTE: *The jib/platform assembly weighs approximately 500 lbs. (230 kg).*

3. Support the weight of the jib/platform assembly using adequate lifting or blocking equipment.

NOTE: *The main boom assembly weighs approximately 475 lbs. (216 kg).*

4. Support the weight of the main boom with an adequate lifting device.
5. Tag and disconnect all electrical lines running to the platform.
6. Tag and disconnect all hydraulic lines running to the plaform rotator, jib rotator (if equipped), and jib cylinder. Cap or plug all openings.
7. Remove the hose cover from the top of the jib and remove the hydraulic hoses from the jib.

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

8. Remove the retaining bolt, keeper, and pin that secures the level cylinder to the jib.
9. Remove the retaining bolt, keeper, and pin that secures the main boom to the jib.
10. Remove the jib and platform assembly from the boom.
11. Tag and disconnect the hydraulic lines running to the level cylinder. Cap or plug all openings.
12. Remove the cable cover from the side of the main boom.
13. Tag and disconnect all the hose/line couplings found behind the cable cover. Cap or plug all openings. Remove the clamp blocks securing the hoses/lines.
14. Unbolt the power track from the boom and remove the power track and hoses/lines from the boom.
15. Remove the cover at the rear of the boom.
16. Tag and disconnect the hydraulic lines running to the telescope cylinder. Cap or plug all openings.

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

17. Remove the retaining bolt, keeper, and pin that secures the upper lift cylinder rod end to the main boom.

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

18. Remove the retaining bolt, keeper, and pin that secures the master cylinder rod end to the main boom.
19. Remove the retaining bolt, keeper, and pin that secures the main boom to the upper upright.
20. Remove the boom from the machine and place it on suitable blocking.

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.

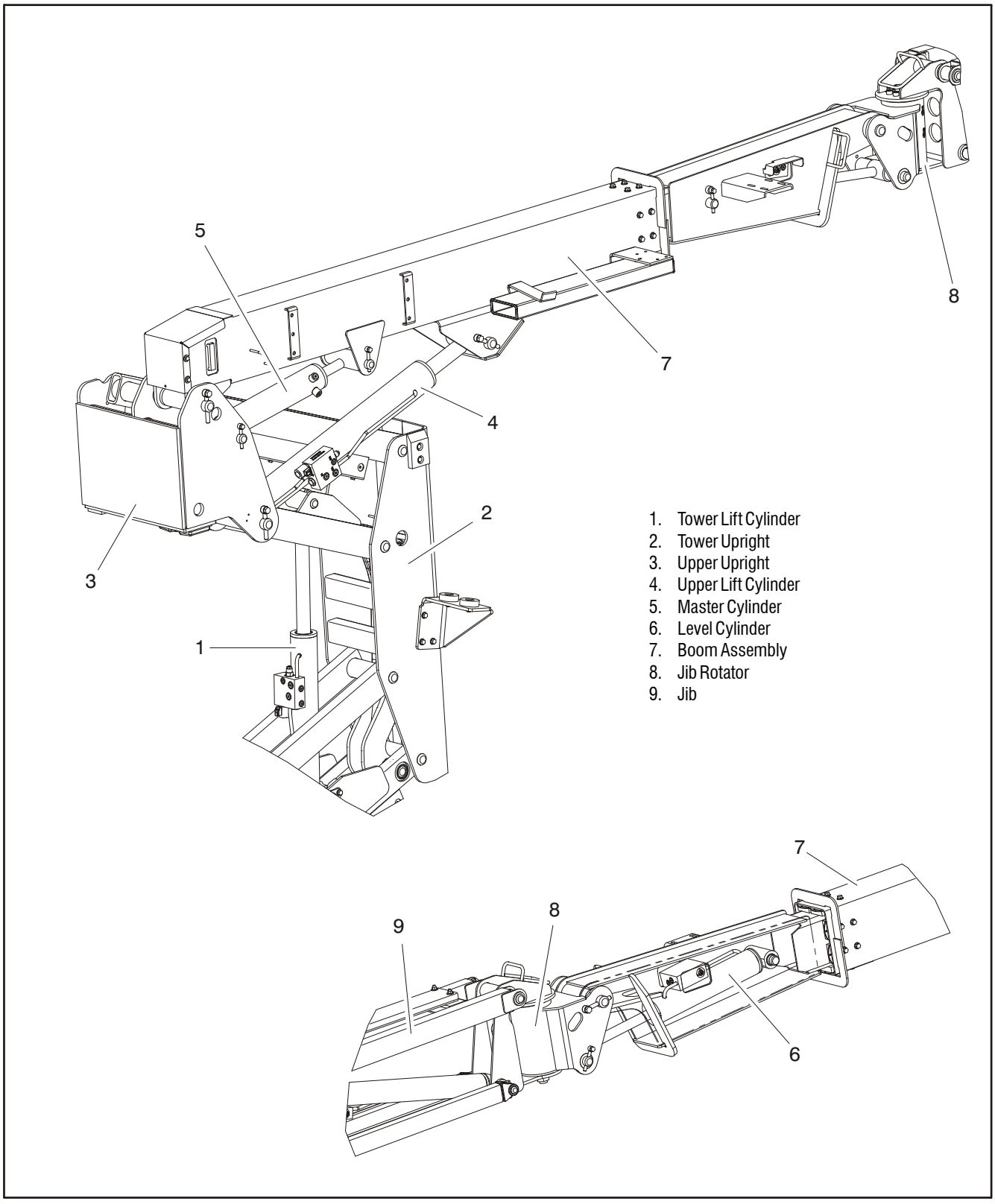


Figure 4-1. Boom Assembly

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. Lubricate the boom sections as shown in Figure 4-2., Boom Lubrication Instructions.
2. 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.
3. 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.
4. 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).
5. 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.
6. 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.
7. 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).

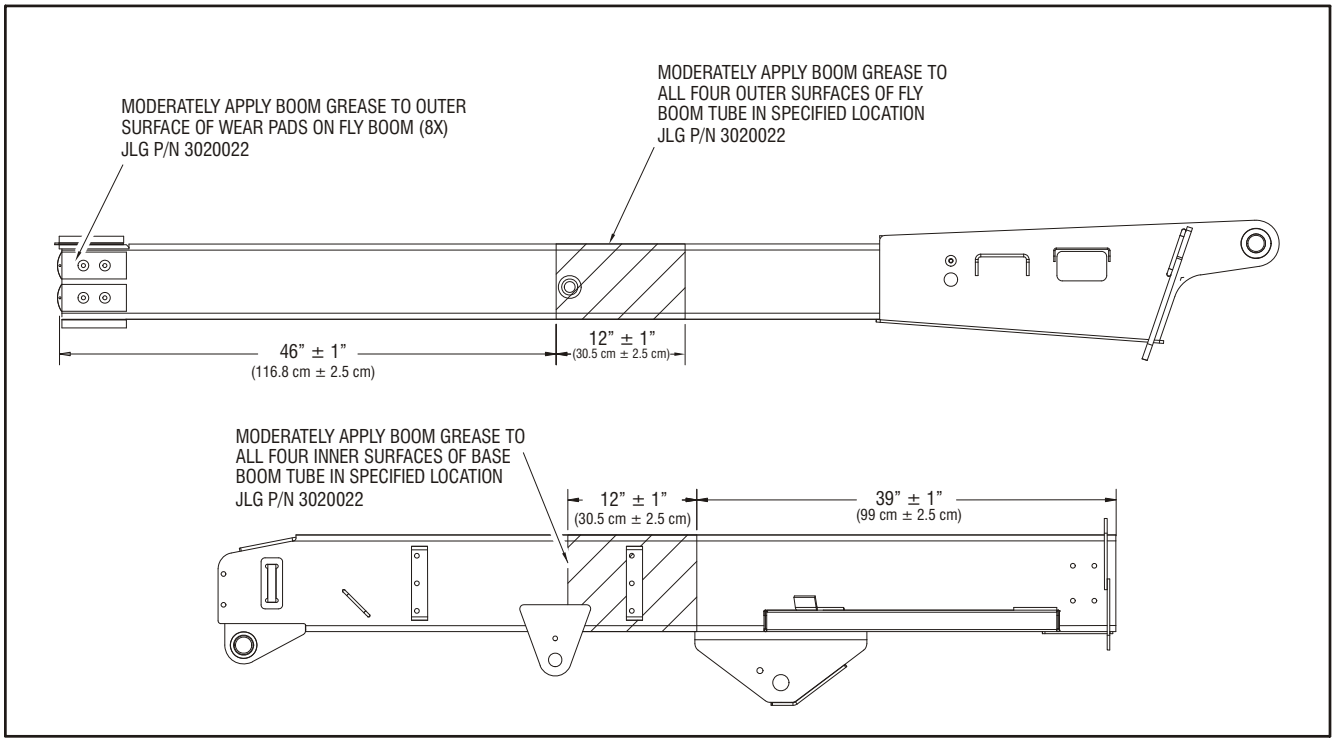


Figure 4-2. Boom Lubrication Instructions

Installation of the Main Boom

NOTE: *The main boom assembly weighs approximately 475 lbs. (216 kg).*

1. Using suitable lifting equipment, position boom assembly into the upper upright so the boom pivot holes in both the boom and upright are aligned.
2. Using JLG P/N 0100011 thread locking compound or equivalent, install the retaining bolt, keeper, and pin that secures the main boom to the upper upright. Torque the retaining bolt to 85 ft.lbs. (116 Nm).
3. Using JLG P/N 0100011 thread locking compound or equivalent, install the retaining bolt, keeper, and pin that secures the master cylinder rod end to the main boom. Torque the retaining bolt to 35 ft.lbs. (48 Nm).
4. Using JLG P/N 0100011 thread locking compound or equivalent, install the retaining bolt, keeper, and pin that secures the upper lift cylinder rod end to the main boom. Torque the retaining bolts to 85 ft.lbs. (116 Nm).
5. Connect the hydraulic lines running to the telescope cylinder as tagged during removal.
6. Install the cover at the rear of the boom.
7. Install the power track and hoses/lines onto the boom support brackets and secure in place with the retaining hardware. Refer to Figure 4-3., Power Track Hoses.

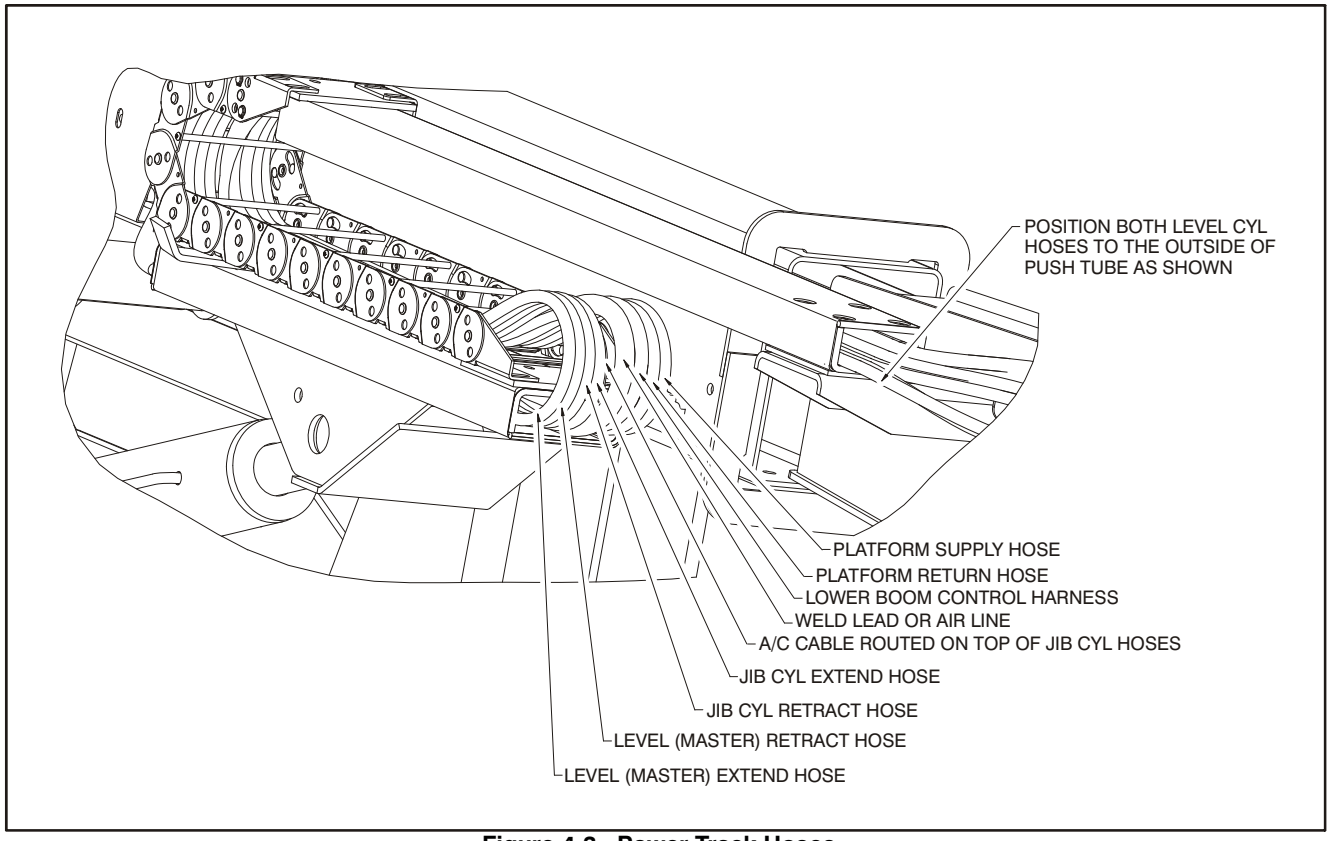


Figure 4-3. Power Track Hoses

8. Connect all the hose/line couplings on the side of the boom as tagged during removal. Install the clamp blocks securing the hoses/lines. Refer to Figure 4-4., Clamp Block Installation.
9. Install the cable cover onto the side of the main boom.
10. Connect the hydraulic lines running to the level cylinder as tagged during removal.
11. Align the jib and platform assembly with the attach points on the boom.
12. Using JLG P/N 0100011 thread locking compound or equivalent, install the retaining bolt, keeper, and pin that secures the main boom to the jib. Torque the retaining bolt to 85 ft.lbs. (116 Nm).

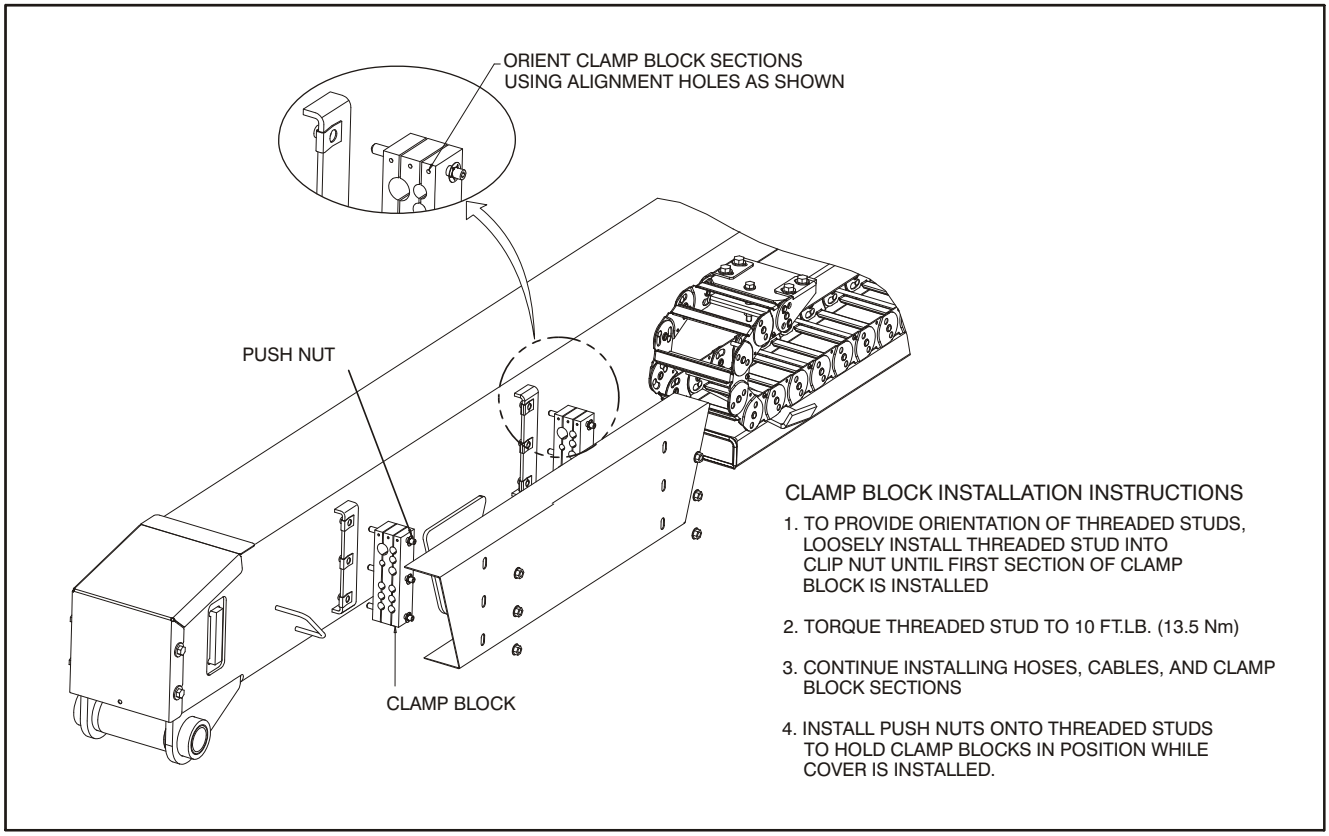
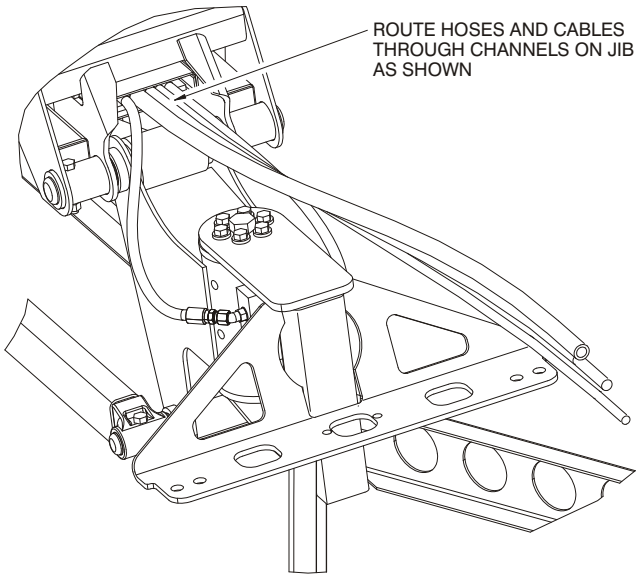


Figure 4-4. Clamp Block Installation

13. Using JLG P/N 0100011 thread locking compound or equivalent, install the retaining bolt, keeper, and pin that secures the level cylinder to the jib. Torque the retaining bolt to 35 ft.lbs. (48 Nm).

14. Route the hydraulic hoses on top of the jib and install the hose cover.



15. Connect all hydraulic lines running to the plaform rotator, jib rotator (if equipped), and jib cylinder as tagged during removal.

16. Connect all electrical lines running to the platform as tagged during removal.

17. Using all safety precautions, operate machine systems and extend and retract boom for four or five cycles, checking for proper operation.

18. Shut down the machine and check for leakage.

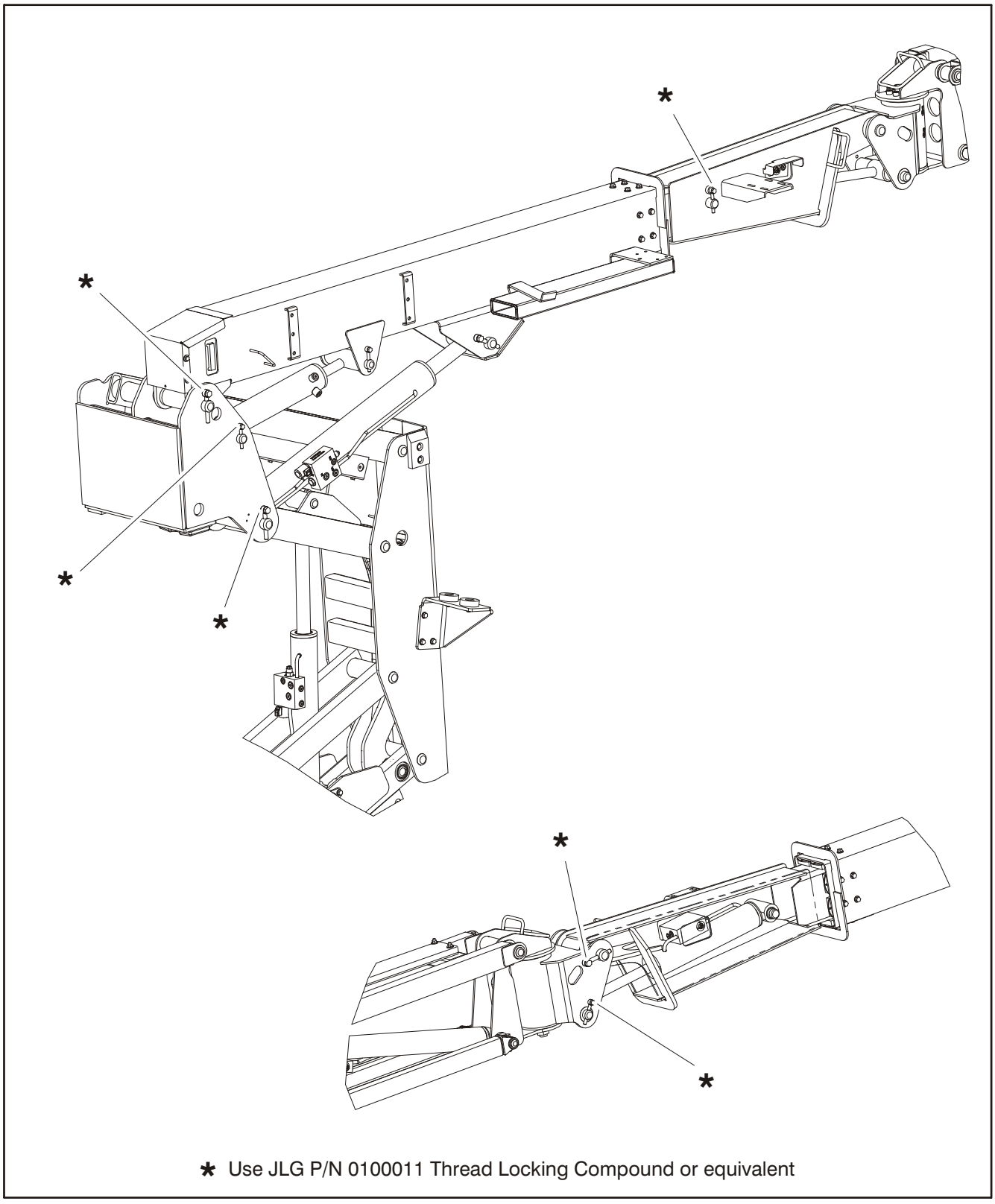


Figure 4-2. Boom Thread Locking Compound Location

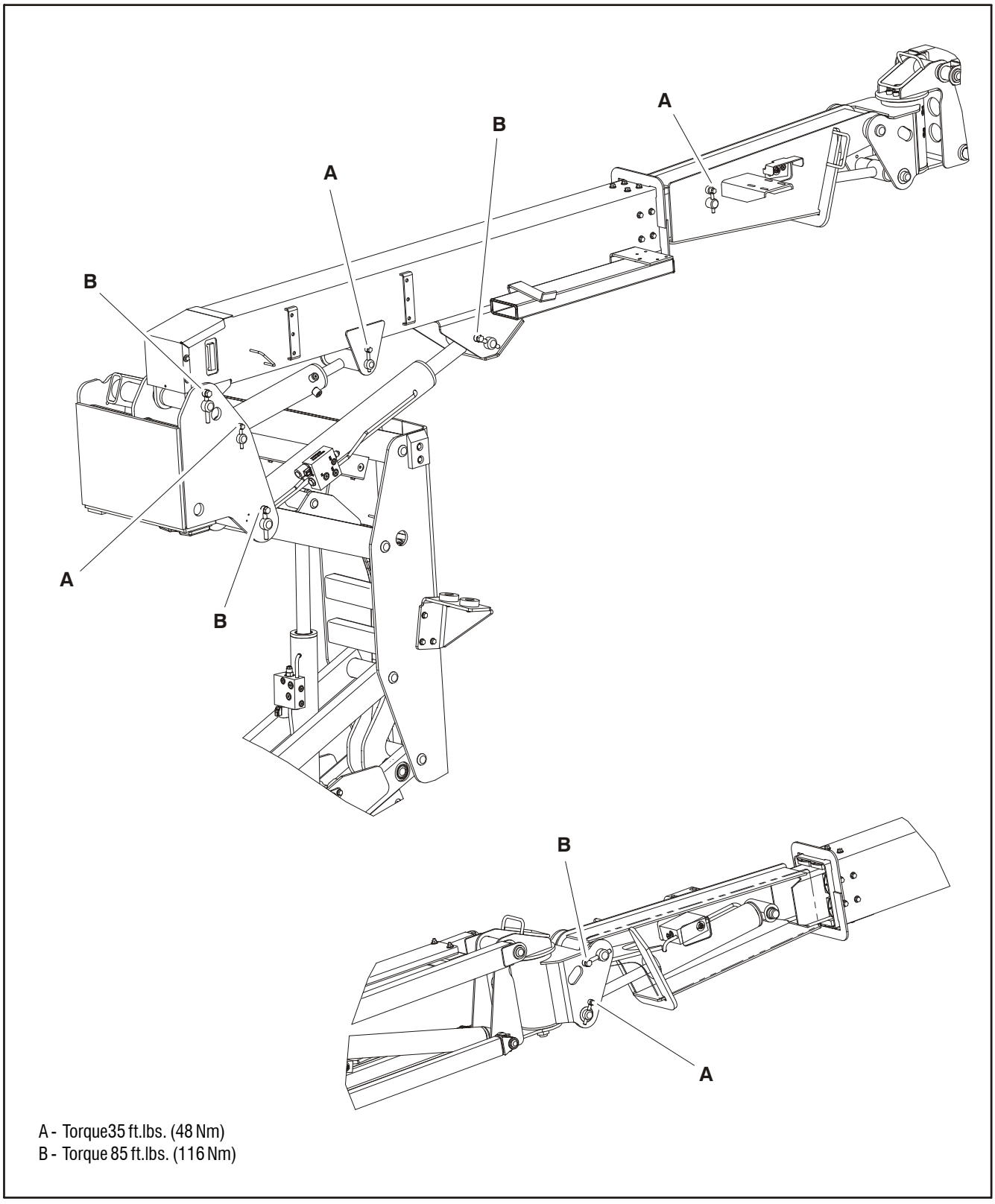
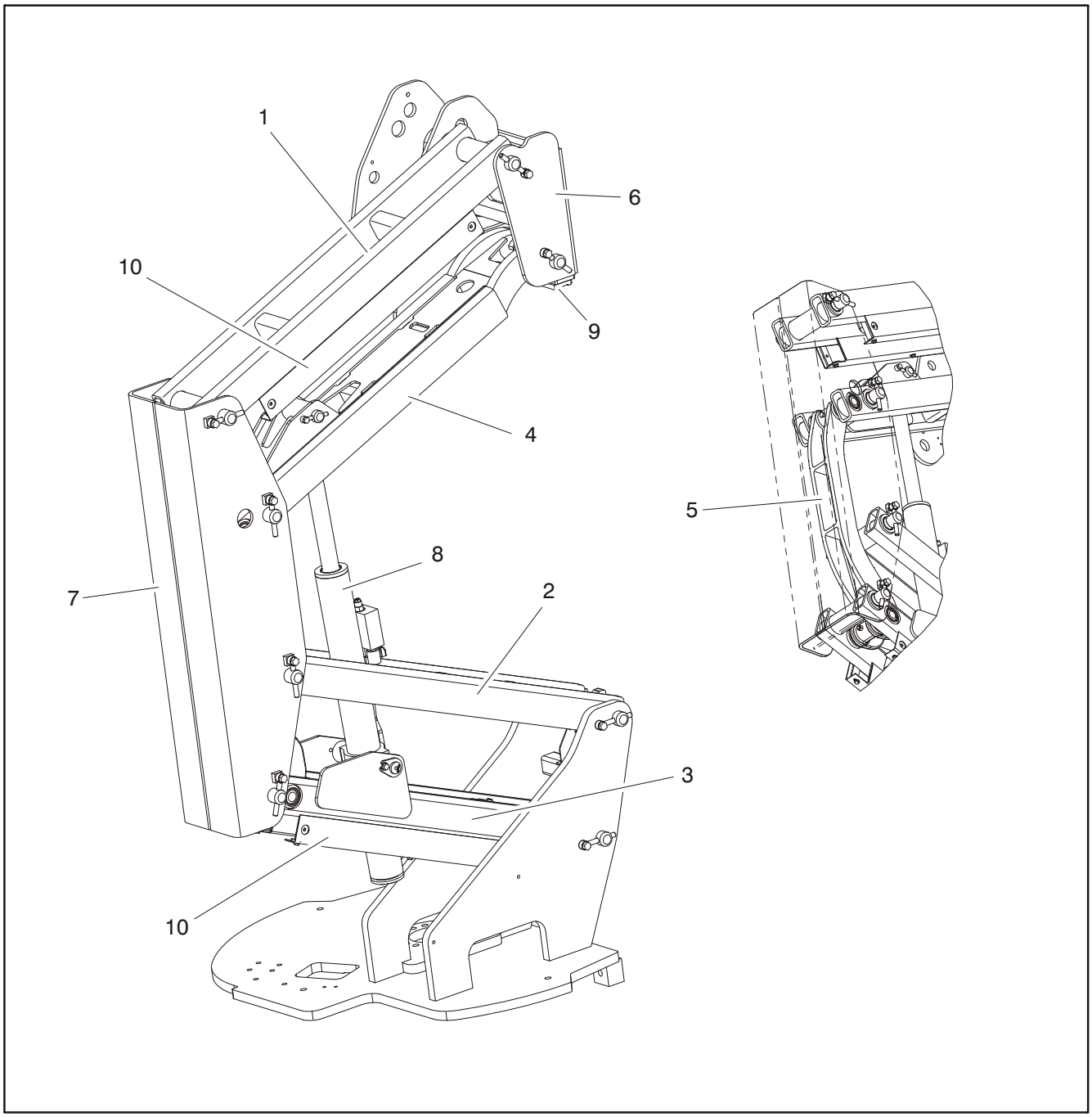


Figure 4-3. Boom Torque Values



1. Link
2. Level Link
3. Lower Boom
4. Mid Boom
5. Timing Link
6. Upper Upright
7. Tower Upright
8. Tower Lift Cylinder
9. Bumper
10. Hose Channel

Figure 4-4. Lower Boom

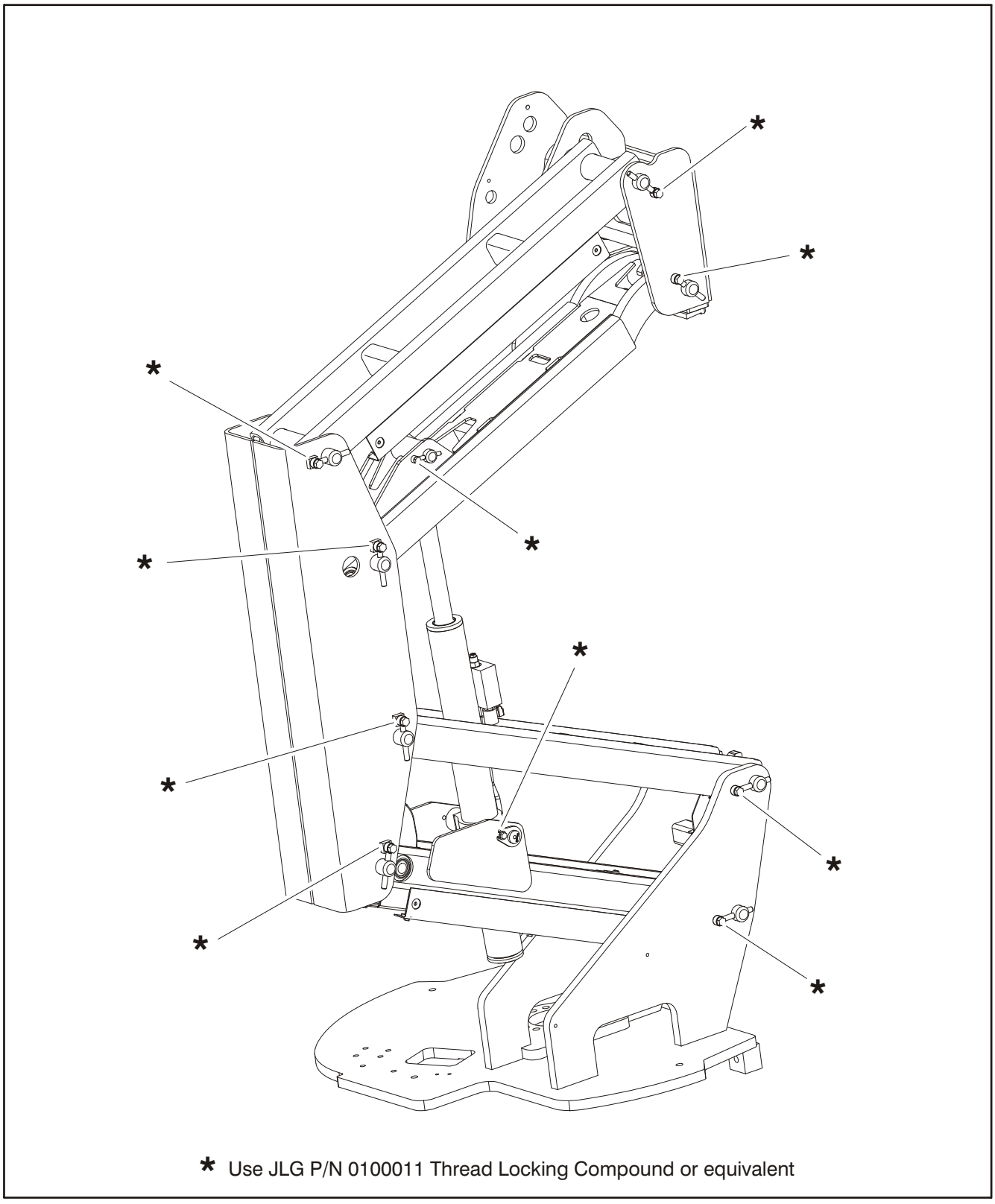


Figure 4-5. Lower Boom Thread Locking Compound Location

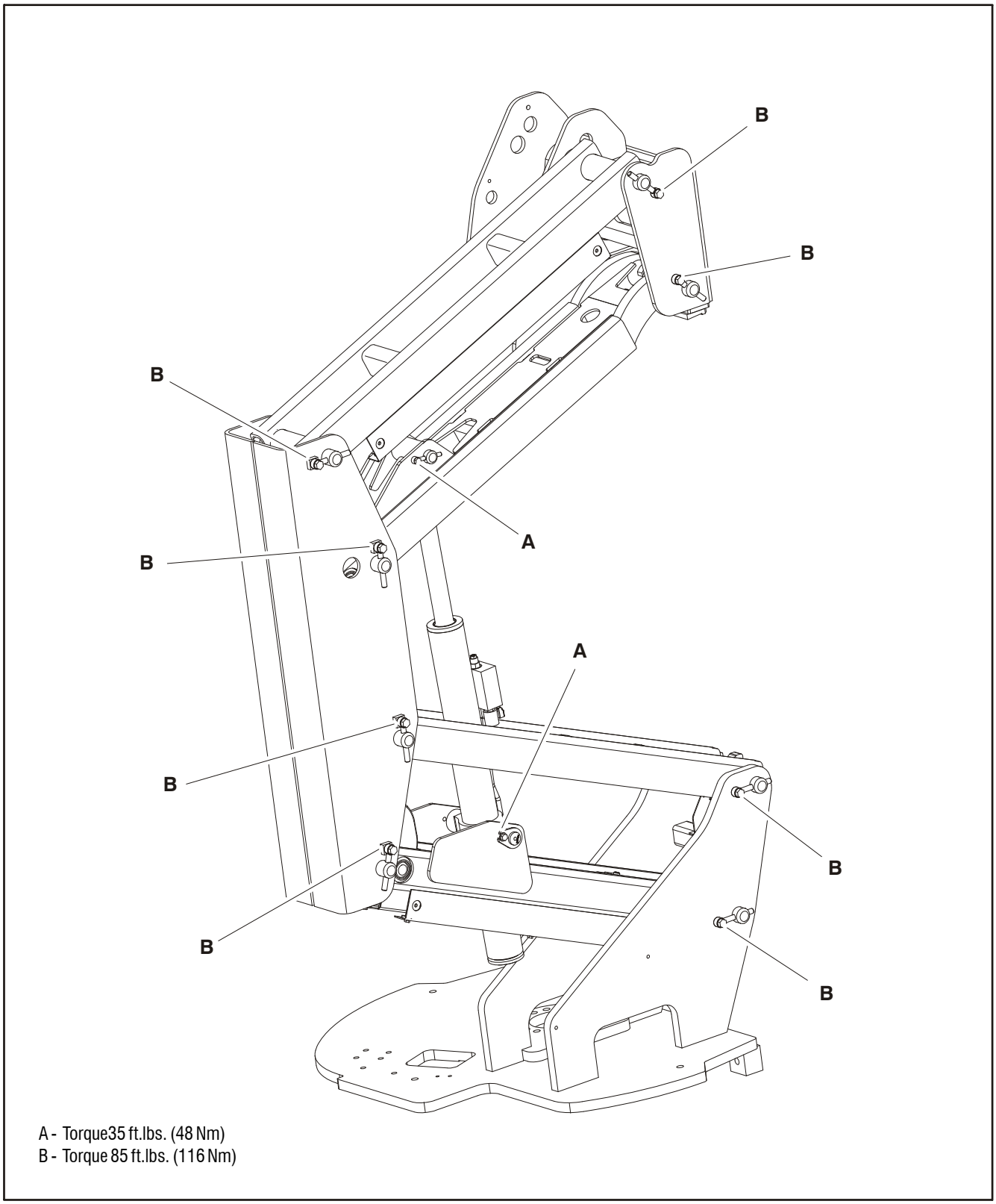


Figure 4-6. Lower Boom Torque Values

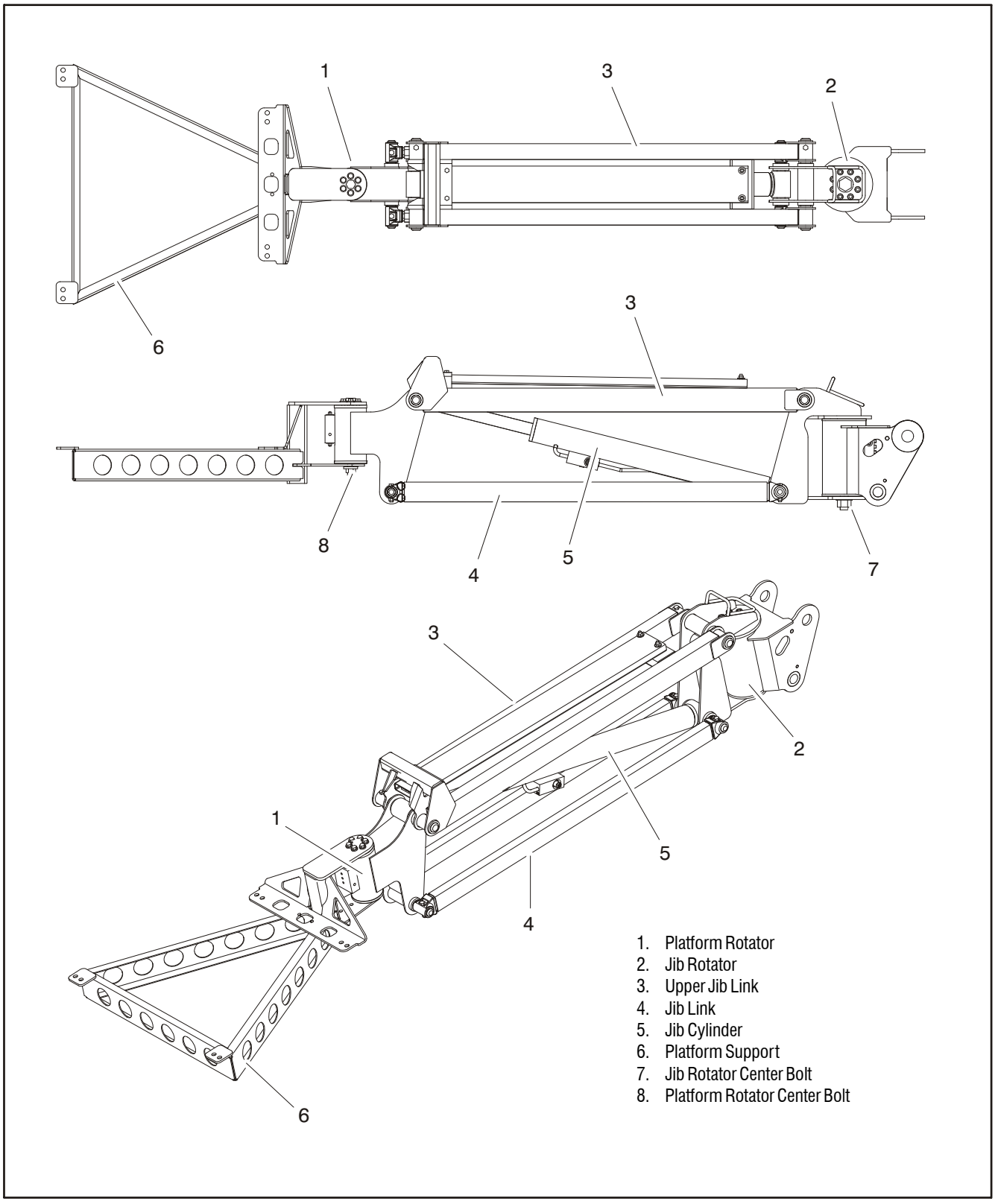
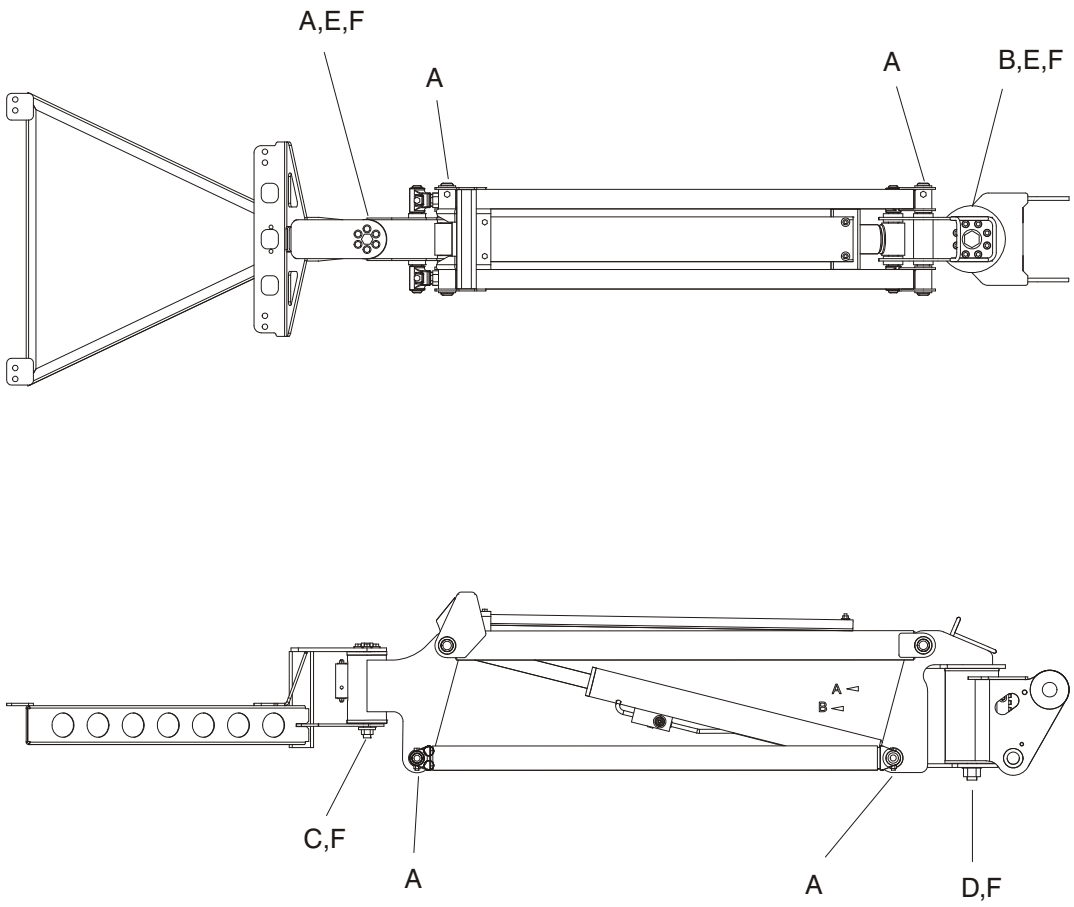


Figure 4-7. AJP Jib



NOTE: *If any rotator bolts are replaced, all bolts on the rotator should be retorqued.*

A	Torque to 35 ft.lbs. (48 Nm)
B	Torque to 85 ft.lbs. (115 Nm)
C	Torque to 250 ft. lbs. (339 Nm)
D	Torque to 480 ft. lbs. (650 Nm)
E	JLG P/N 0100011 Thread Locking Compound
F	Check torque every 150 hours of operation

Figure 4-8. AJP Jib Torque Values

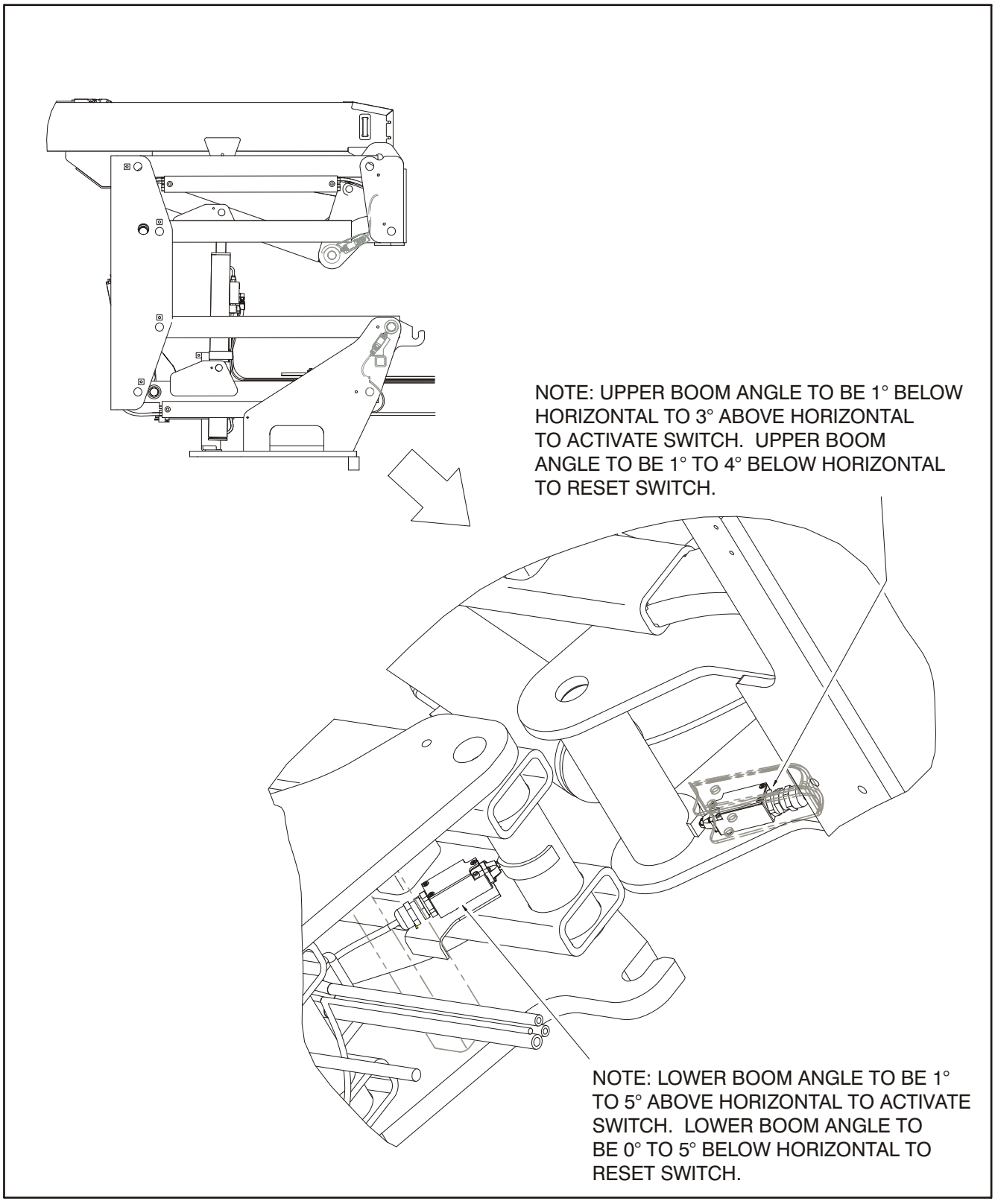


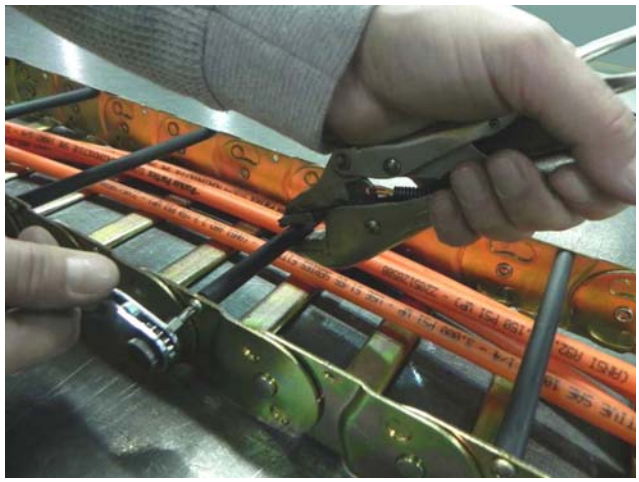
Figure 4-9. Boom Limit Switches

4.2 POWERTRACK MAINTENANCE

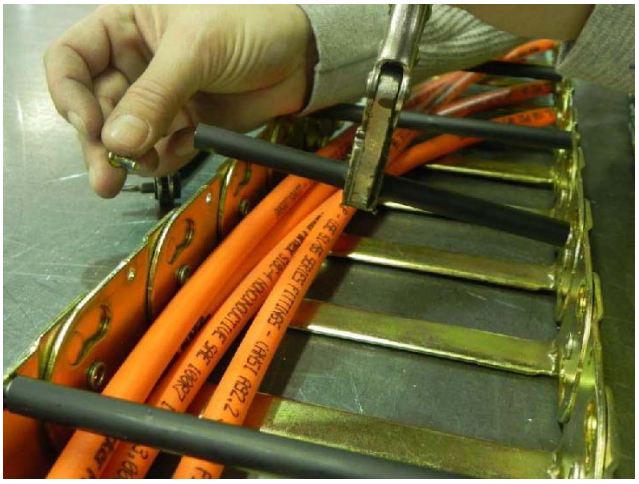
Removing a Link

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

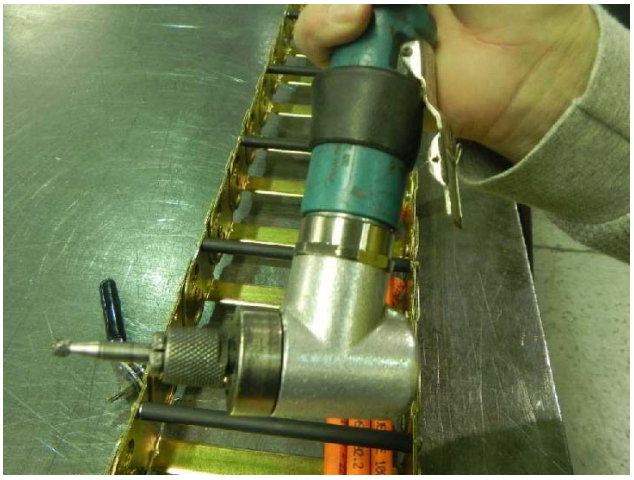
1. Clamp the bar and poly roller tightly so they do not spin when removing the screw. With a small ¼" ratchet and a t-20 torx bit, remove the 8-32 x 0.500 screw from one side.

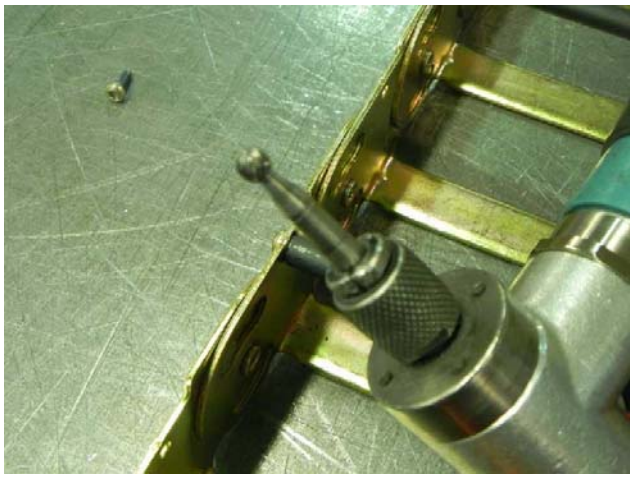


2. Repeat step 1 and remove the screw from the other side of track. Remove the bar/poly roller from the powertrack. .



3. To remove a link, the rivets holding the links together must be removed. Use a right-angle pneumatic die grinder with a ¼" ball double cut bur attachment.

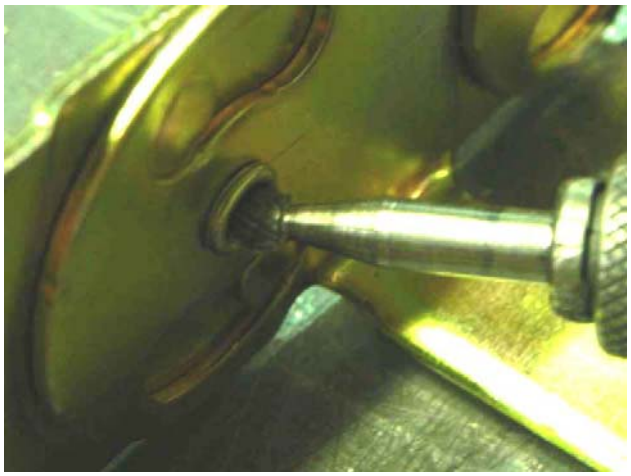


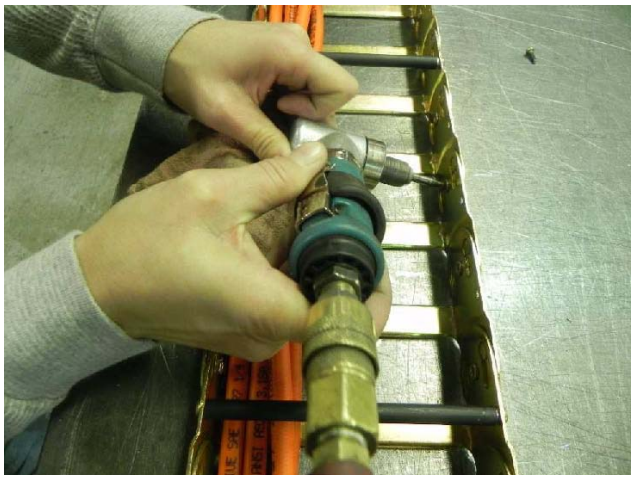


NOTICE

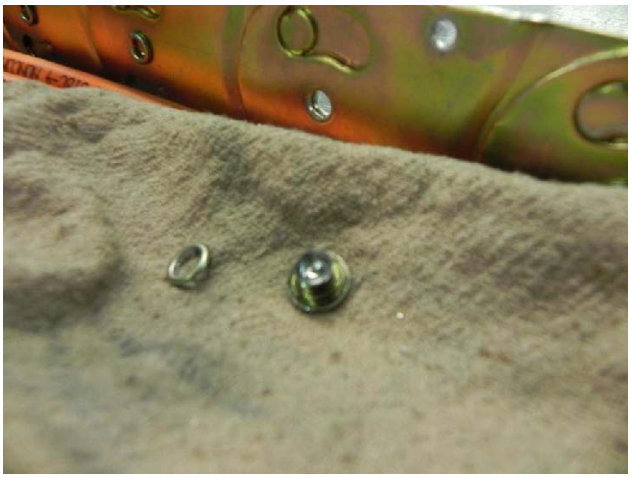
MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.

4. insert the tool into the rolled over end of the rivet as shown. Grind out the middle of the rivet until the rolled over part of the rivet falls off. Repeat this step for all the rivets that must be removed.



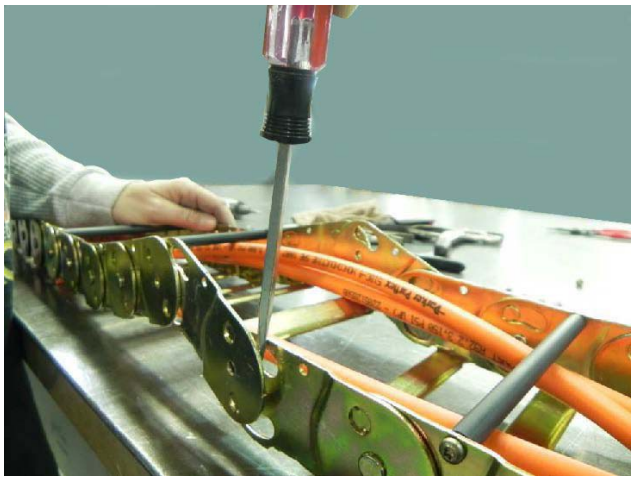


5. After grinding it may be neccesary to help the rivet out by using a center punch with a hammer.

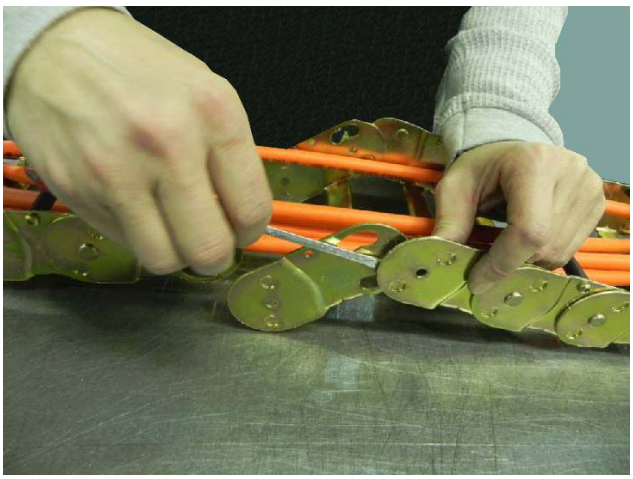


NOTE: *It may be necessary to loosen the fixed end brackets from the machine in order to twist and pull the track section enough to disconnect the links.*

6. Using a flat head screwdriver between the links, twist the screwdriver and pull the links apart.



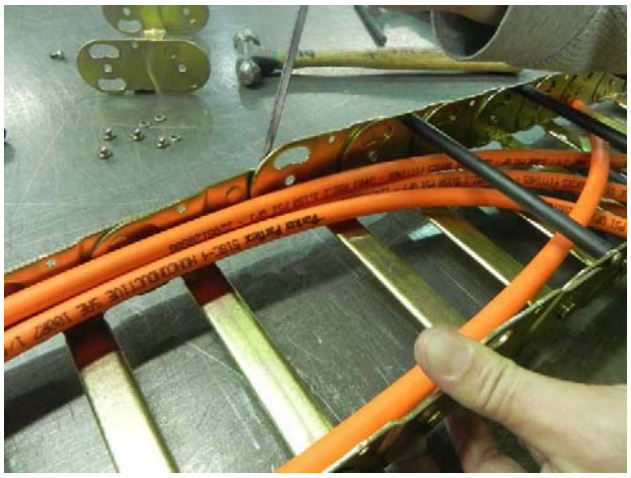
7. Remove the link from the other section of the powertrack using a screwdriver.

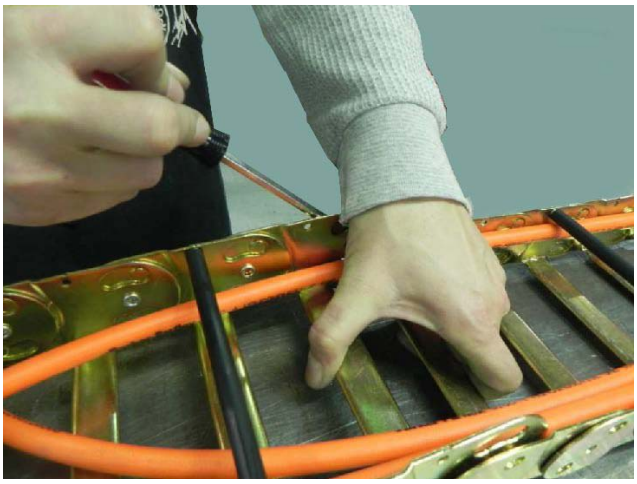


Installing a New Link

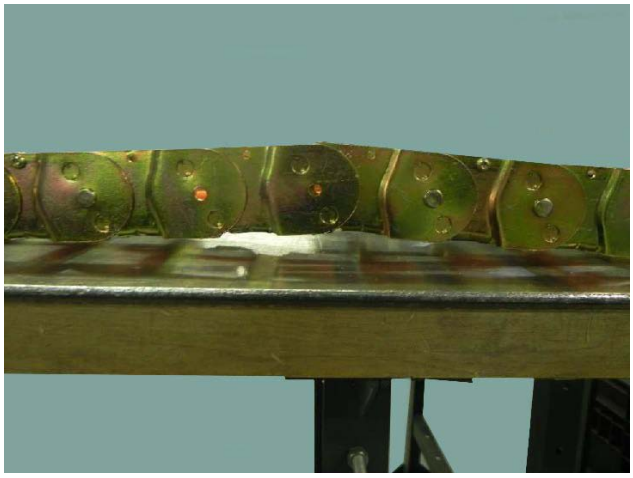
1. Squeeze the peanut cut out end of the new link into the half-shear (female) end of the track section.

2. Spread apart the half-shear (female) end of the new link and slide the peanut end of the track section into it. a screwdriver may be necessary to do this.

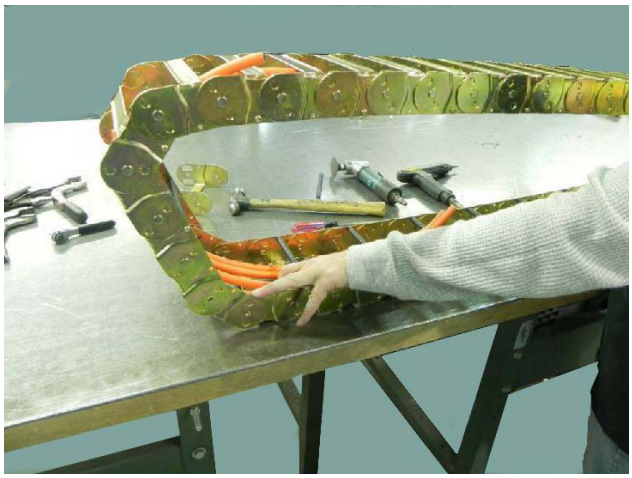


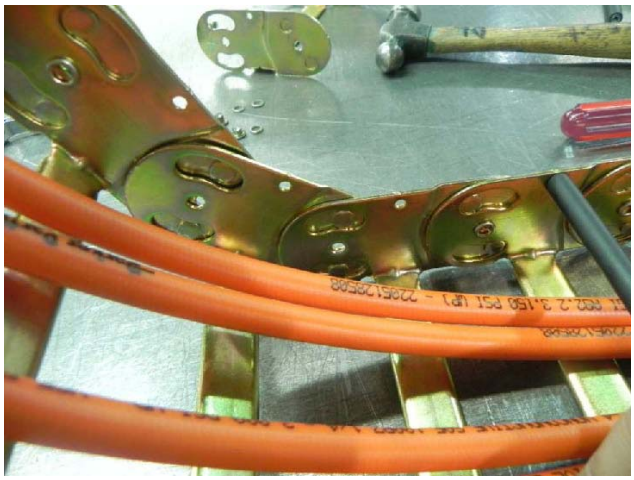


3. After the new link is installed in the powertrack the round half-shears will not fit properly in the peanut cut-outs yet.

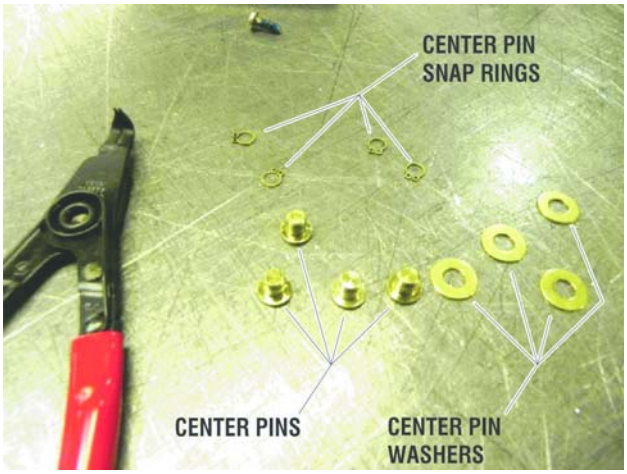


4. Pull the moving end out over the track so that the new connection is positioned in the curve of the powertrack. In this position the round half-shears will rotate into the peanut cut outs.





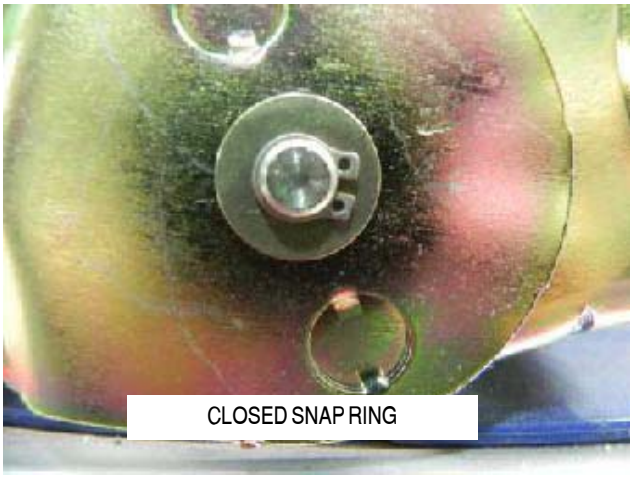
5. The parts shown below will be used to connect the new link to the powertrack.



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

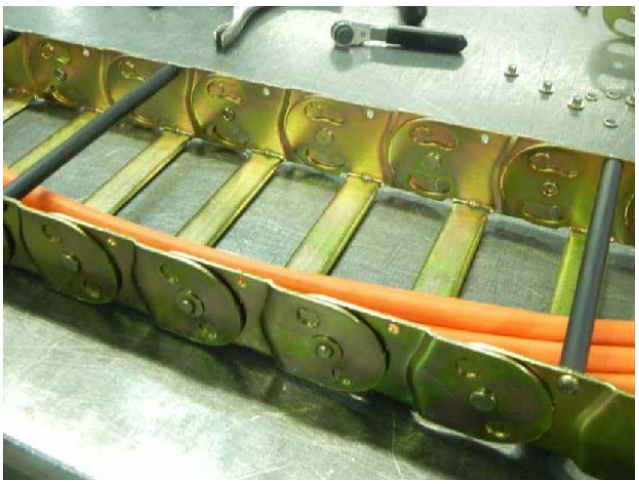
7. Install the snap ring in the groove on the pin. Repeat the pin installation steps for all center holes that have the rivets removed.

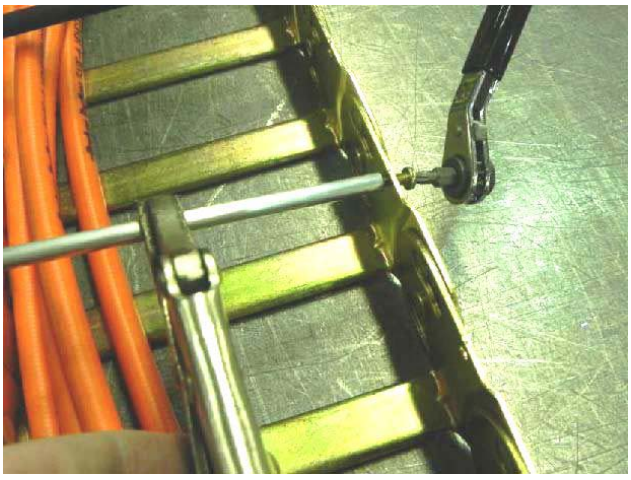
NOTE: *When installing snap rings make sure they are seated in pin groove and closed properly.*



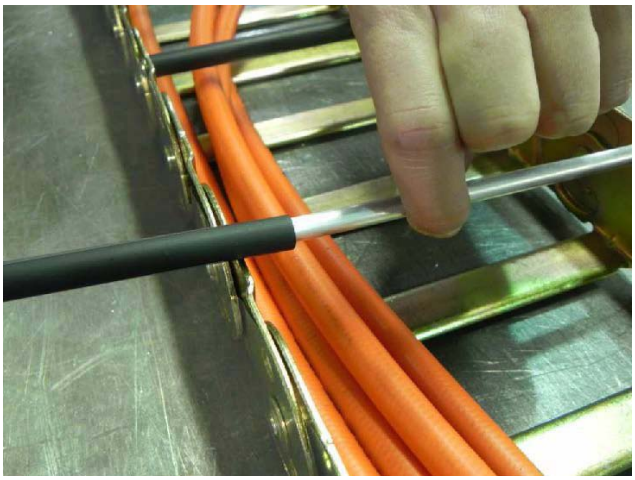
8. Hold new aluminum round bar tightly, then install new 8-32 x 0.500 self-threading torx head screw into one end.

NOTE: *Maximum tightening torque is 18-20 in-lbs.*

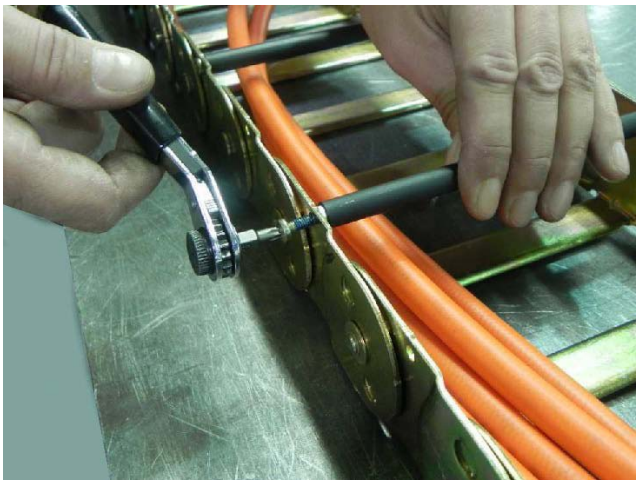




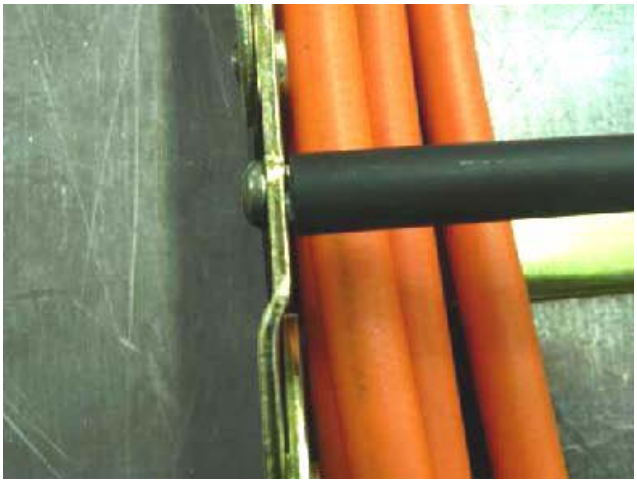
9. Pull up on the other end of the round bar and slide the new poly roller onto the bar.



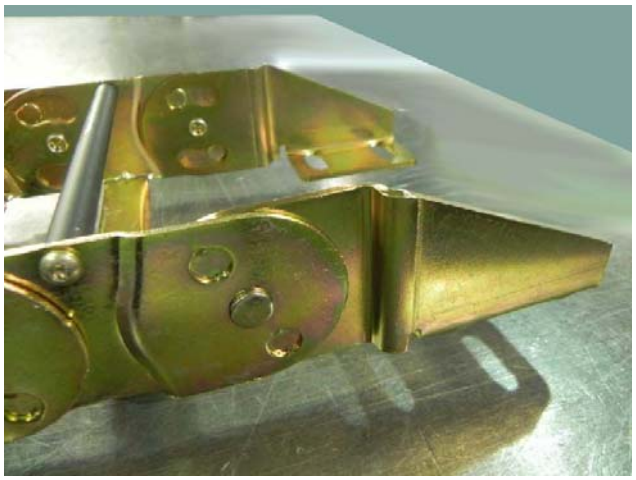
10. Install a new 8-32 x 0.500 self threading screw on the other side.



NOTE: *When tightening screws make sure screw head is seated against link with no space in between the link and underside of screw head. Maximum tightening torque is 18-20 in-lbs.*



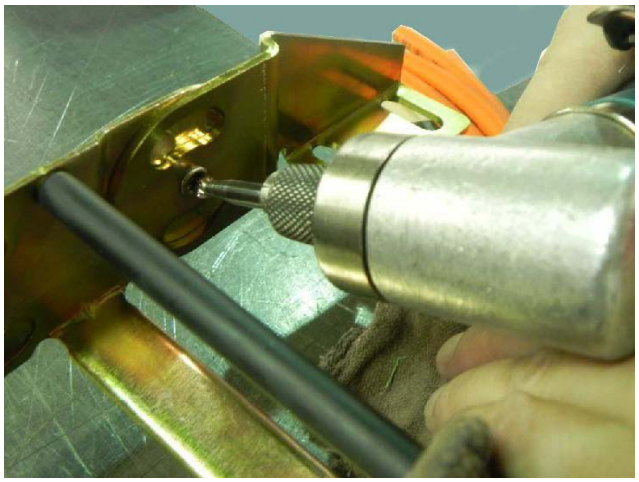
Replacing Fixed End Brackets



1. Remove the rivets the same way as shown under the link removal instructions.

NOTICE

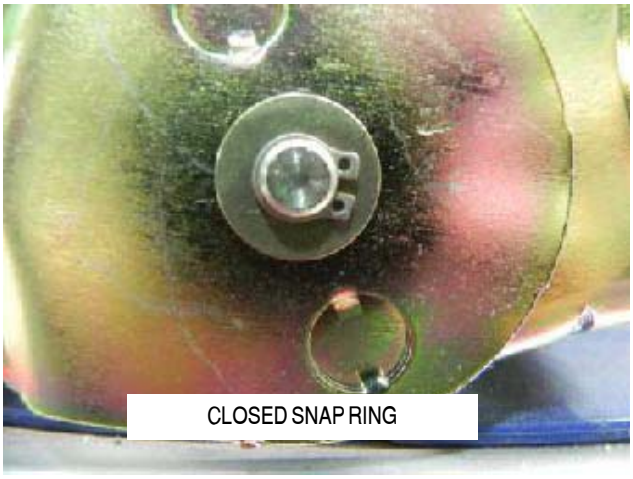
MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.



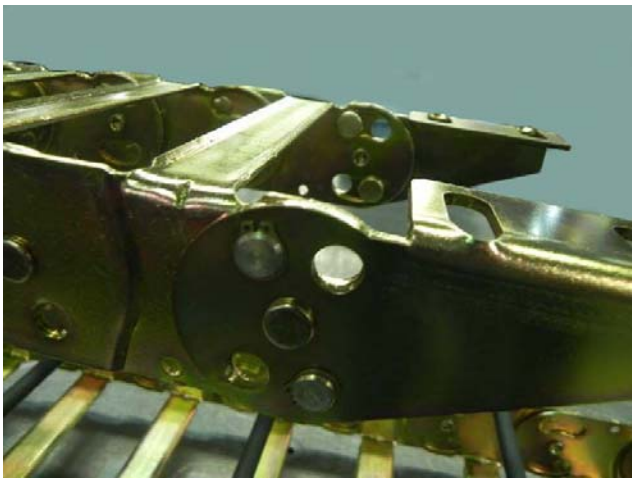
2. Parts used: Bracket Center Pin and Center Pin Snap Ring.

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

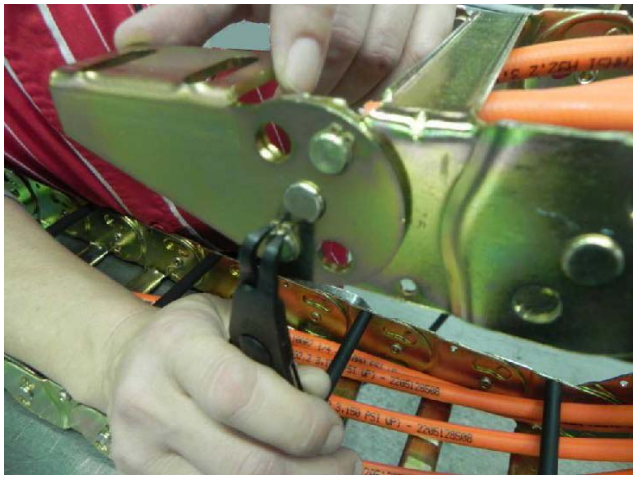
NOTE: *When installing snap rings make sure they are seated in pin groove and closed properly.*



Replacing Moving End Brackets

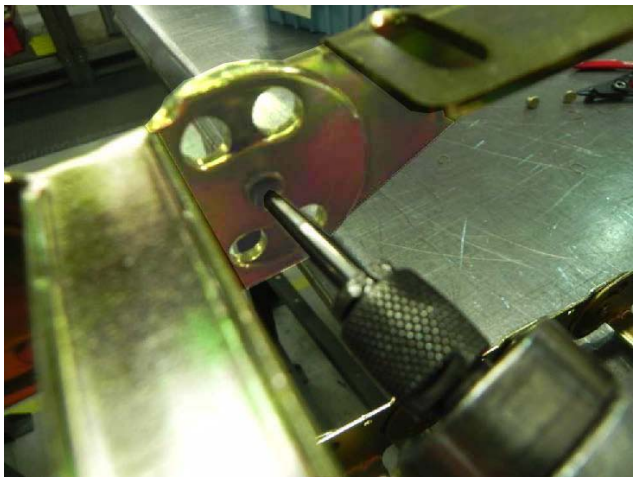


1. Remove existing pins and center rivet. Remove the rivet the same way as shown in the link removal instructions. Repeat on other bracket if replacing it as well.

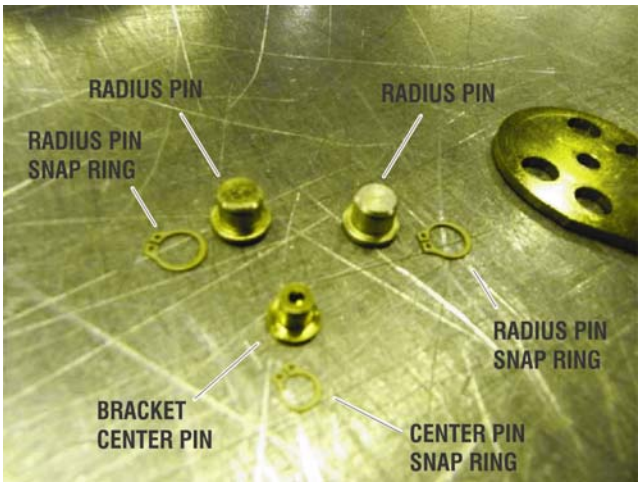


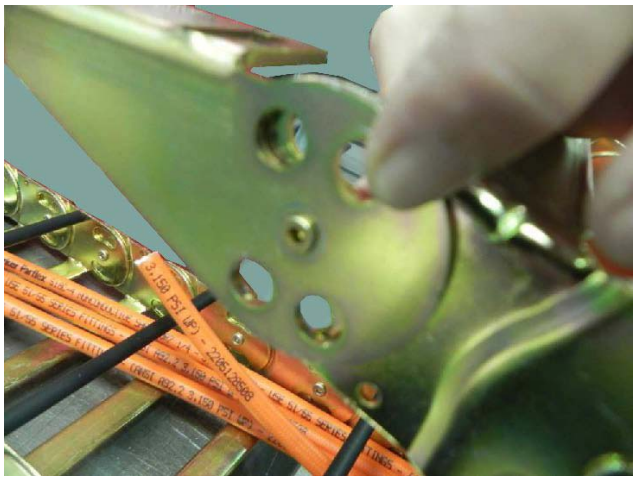
NOTICE

MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.

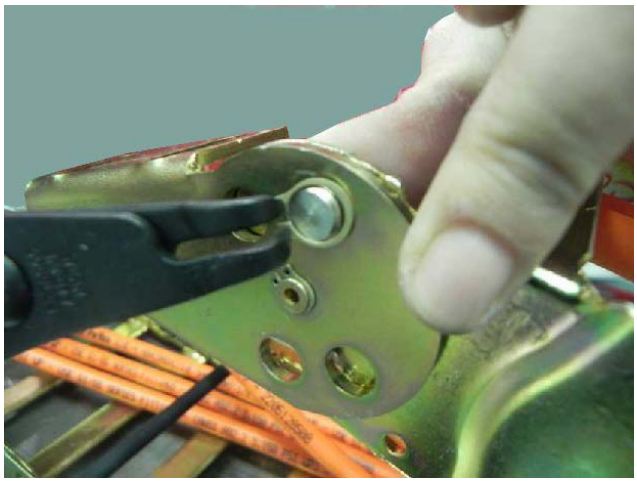


2. Take new bracket and install center pin with snap ring.

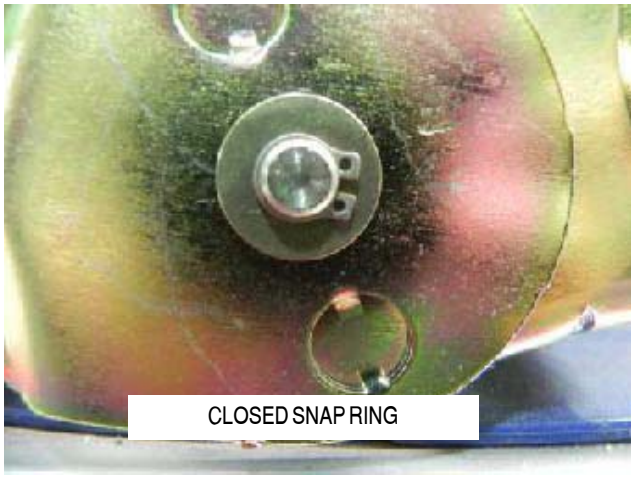




3. Install radius pins into their original locations and install snap rings. Repeat with other moving end if replacing as well.



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



4. When complete make sure that both brackets rotate correctly.

4.3 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 Operation & Safety Manual and 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.

4.4 TILT SENSOR CHECK

⚠ CAUTION

PERFORM TILT SENSOR CHECK PROCEDURE A MINIMUM OF EVERY SIX MONTHS TO ENSURE PROPER OPERATION AND ADJUSTMENT OF SWITCH.

1. Check chassis out of level indicator light located on the platform control console by driving, with the machine in level position, up a suitable ramp of at least 6° slope. Check the out of level alarm, with the machine on the ramp, raise the upper boom until it is parallel with the chassis. DO NOT RAISE ABOVE THE PARALLEL POSITION. If the light does not illuminate, return the machine to a level surface, shut down the machine, and contact a qualified technician before resuming operation.
2. If necessary, verify the tilt sensor with the analyzer. Refer to Section 3.

4.5 FOOTSWITCH ADJUSTMENT

Adjust switch so that functions will operate when pedal is at center of travel. If switch operates within last 1/4 inch (6.35 mm) of travel, top or bottom, it should be adjusted.

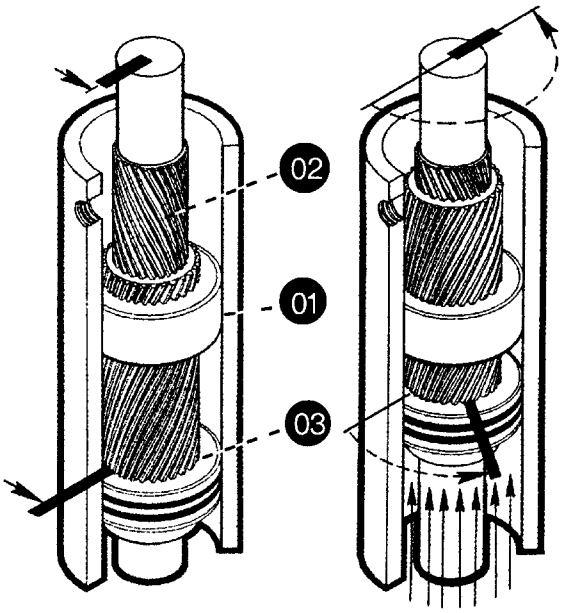
4.6 BOOM LIMIT SWITCHES

Refer to Figure 4-9., Boom Limit Switches for adjustments to be made of the two Limit Switches which bolt in place on the main boom upright and turntable.

4.7 ROTARY ACTUATOR

Theory of Operation

The rotary actuator is a simple mechanism that uses the sliding spline operating concept to convert linear piston motion into powerful shaft rotation. Each actuator is composed of a housing with integrated gear teeth (01) and only two moving parts: the central shaft with integrated bearing tube and mounting flange (02), and the annular piston sleeve (03). Helical spline teeth machined on the shaft engage matching splines on the in- side diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage with matching splines in the housing. As hydraulic pressure is applied, the piston is displaced axially within the housing - similar to the operation of a hydraulic cylinder - while the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the actuator, preventing piston movement and locking the shaft in position.



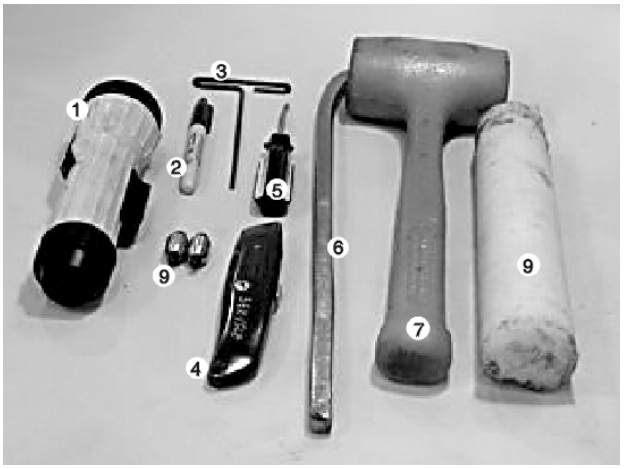
Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.

As fluid pressure is applied, the piston is displaced 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.

The shaft is supported radially by the large upper radial bearing and the lower radial bearing. 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.

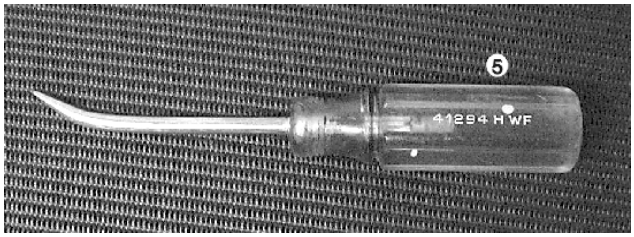
Required Tools

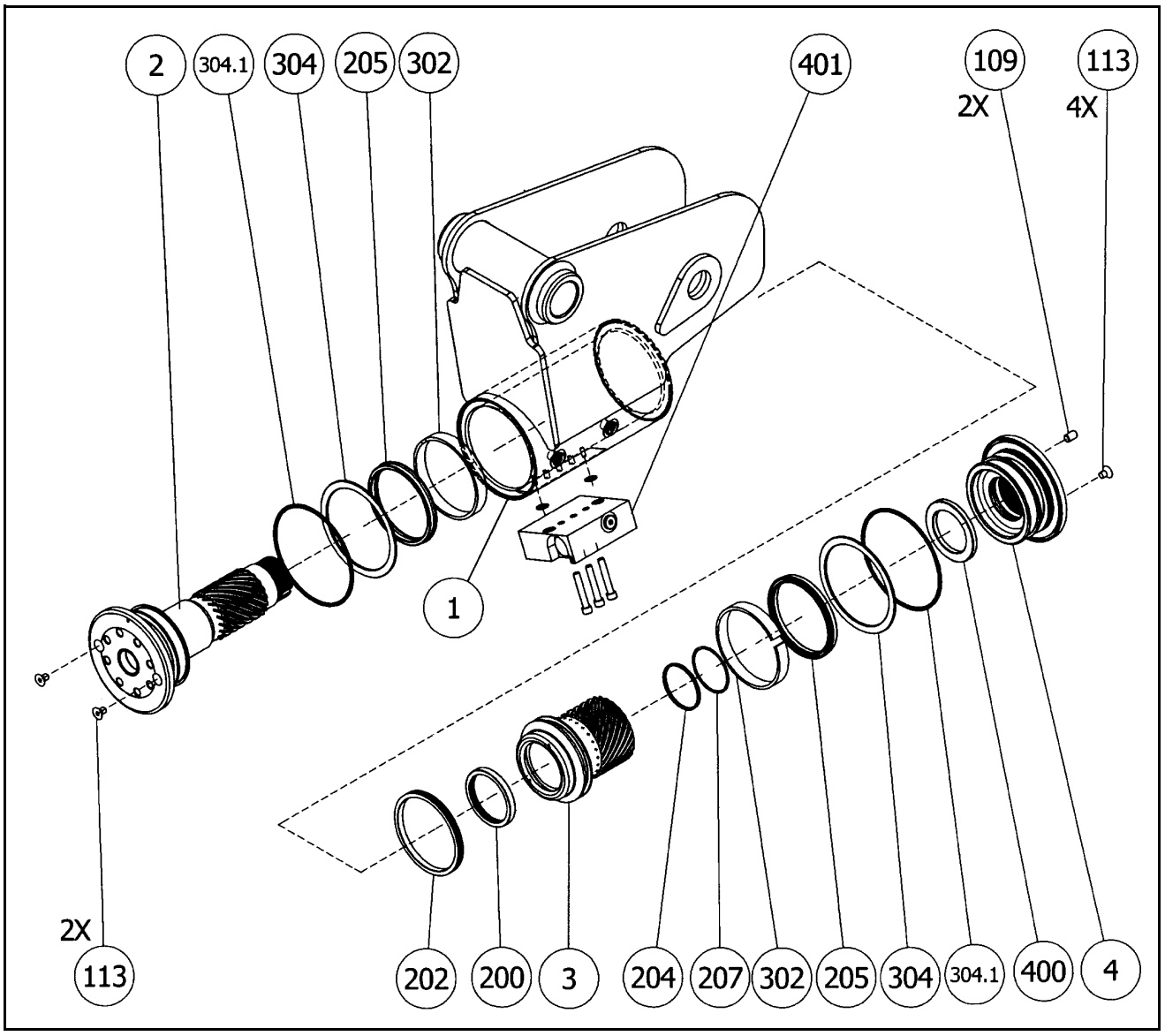
Upon assembly and disassembly of the actuator there are basic tools required. The tools and their intended functions are as follows:



1. Flashlight - helps examine timing marks, component failure and overall condition.
2. Felt Marker - match mark the timing marks and outline troubled areas.
3. Allen wrench - removal of port plugs and set screws.
4. Box knife - removal of seals.
5. Seal tool - assembly and disassembly of seals and wear guides.
6. Pry bar - removal of end cap and manual rotation of shaft.
7. Rubber mallet- removal and installation of shaft and piston sleeve assembly.
8. Nylon drift - installation of piston sleeve
9. End cap dowel pins - removal and installation of end cap (sold with Helac seal kit).

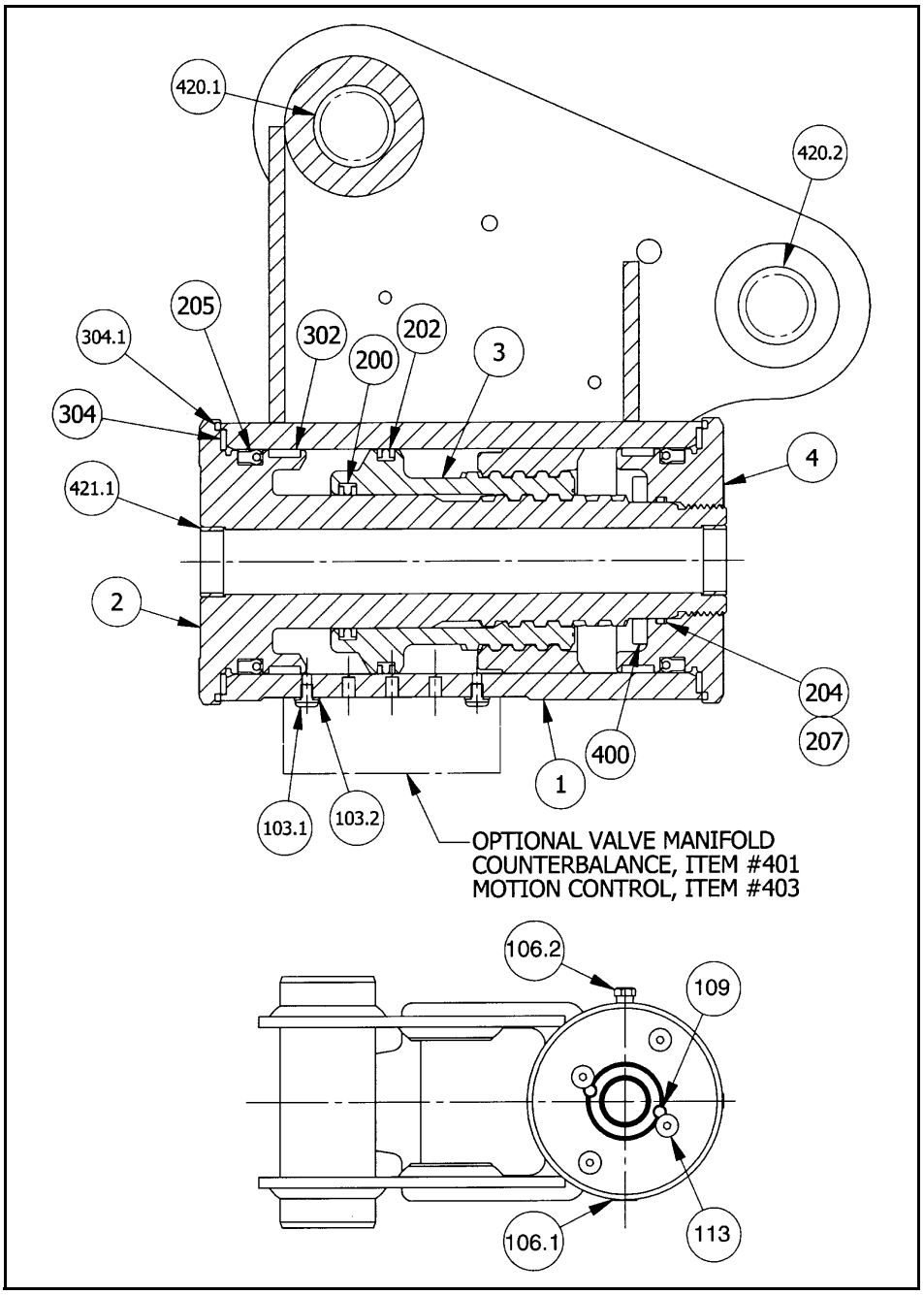
The seal tool is merely a customized standard flat head screwdriver. To make this tool you will need to heat the flat end with a torch. Secure the heated end of the screwdriver in a vice and physically bend the heated end to a slight radius. Once the radius is achieved round off all sharp edges of the heated end by using a grinder. There may be some slight modifications for your own personal preference.





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 4-10. Rotary Actuator - Exploded View



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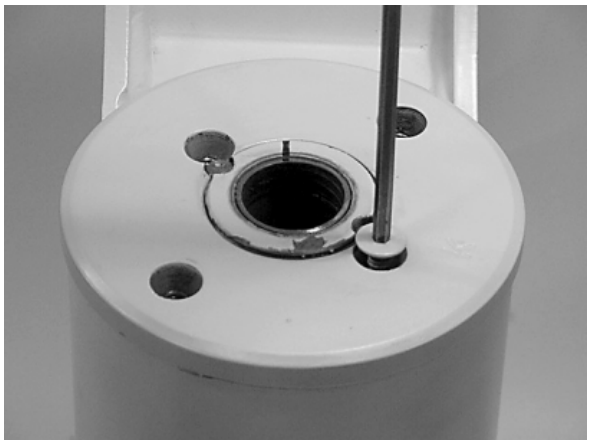
3. Piston Sleeve	106.1. Port Plug	204. O-ring		420.2 Bushing
4. End Cap	106.2. Port Plug	205. Cup Seal		421.1 Bushing
	109 . Lock Pin	207. Backup Ring		
	113. Capscrew	304.1. Wiper Seal		

Figure 4-11. Rotary Actuator - Assembly Drawing

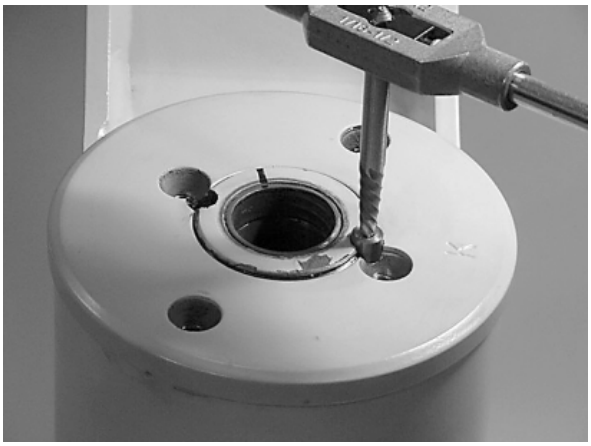
Disassembly

1. Remove the capscrews (113) over end cap lock pins (109).



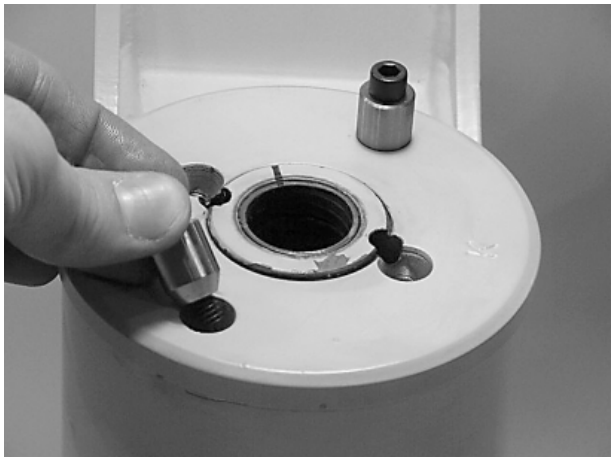
2. Using a 1/8” (3.18mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/16” (4.76mm).

3. Remove the lock pins using an ”Easy Out” (a size #2 is shown).



If the pin will not come out with the ”Easy Out”, use 5/1 6” drill bit to a depth of 1/2” (12.7mm) to drill out the entire pin.

4. Install the end cap (4) removal tools provided with the Helac seal kit.

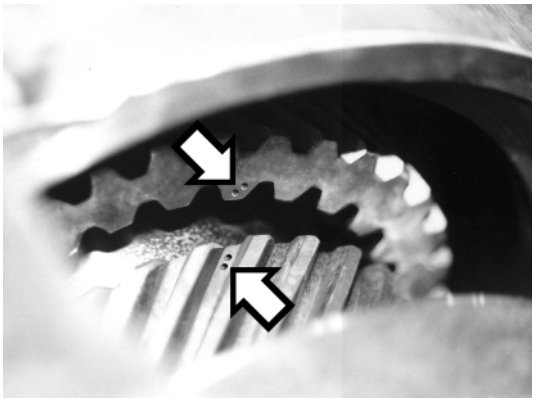


5. Using a metal bar, or something similar, unscrew the end cap (4) by turning it counter clockwise.

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

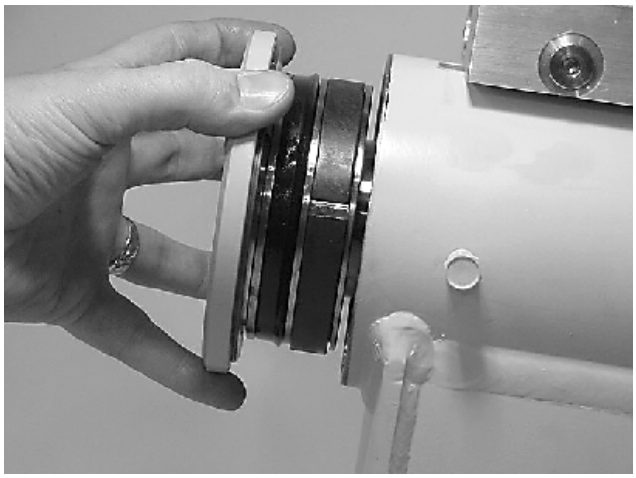
7. Remove the stop tube if included. The stop tube is an available option to limit the rotation of the actuator.

8. Every actuator has timing marks for proper engagement.



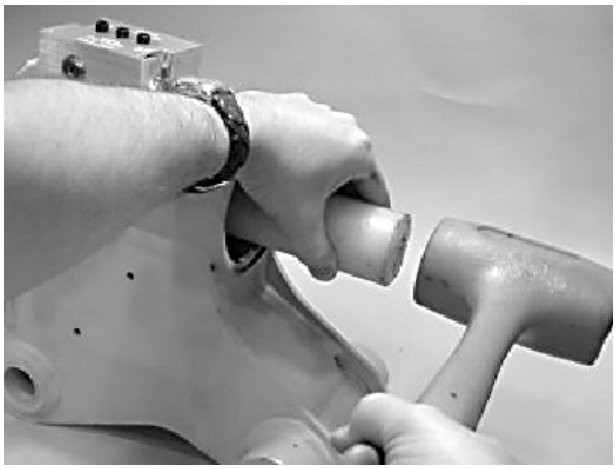
9. Prior to removing the shaft, (2), use a felt marker to clearly indicate the timing marks between shaft and piston. This will greatly simplify timing during assembly.

10. Remove the shaft (2). It may be necessary to strike the threaded end of the shaft with a rubber mallet.

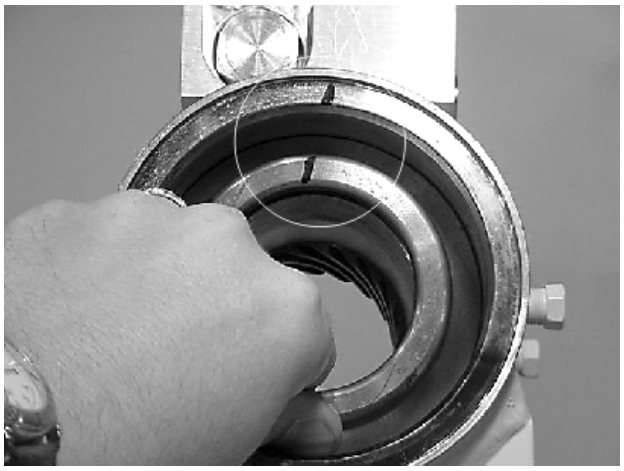


11. Before removing the piston (3), mark the housing (1) ring gear in relation to the piston O.D. gear. There should now be timing marks on the housing (1) ring gear, the piston (3) and the shaft (2).

12. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is not damaged.

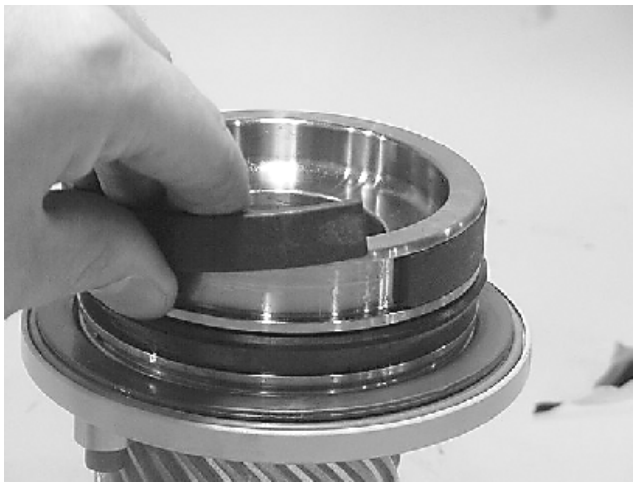


13. At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.

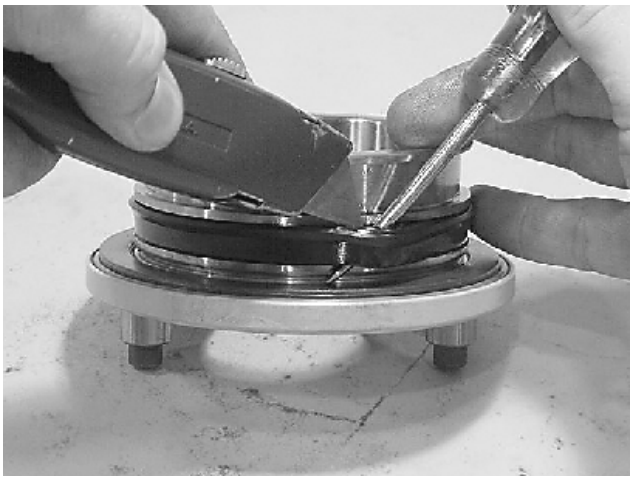


14. Remove the o-ring (204) and backup ring (207) from end cap (4) and set aside for inspection.

15. Remove the wear guides (302) from the end cap (4) and shaft (2).



16. To remove the main pressure seals (205), it is easiest to cut them using a sharp razor blade being careful not to damage the seal groove.



17. Remove the thrust washers (304), from the end cap (4) and shaft (2).

18. Remove the wiper seal (304.1) from its groove in the end cap (4) and shaft (2).

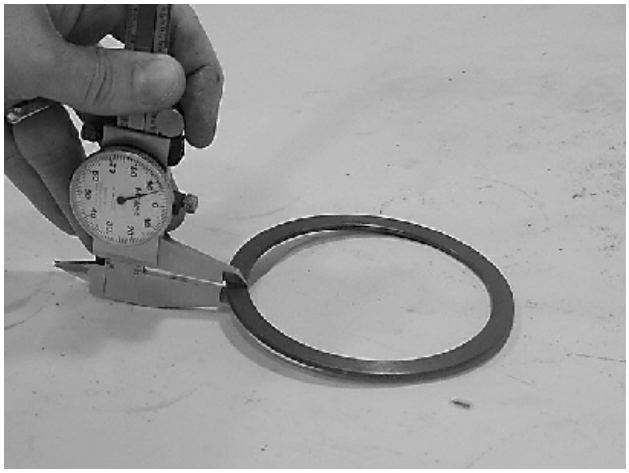
19. Remove the piston O.D. seal (202).

20. Remove the piston I.D. seal (200). You may now proceed to the inspection process.

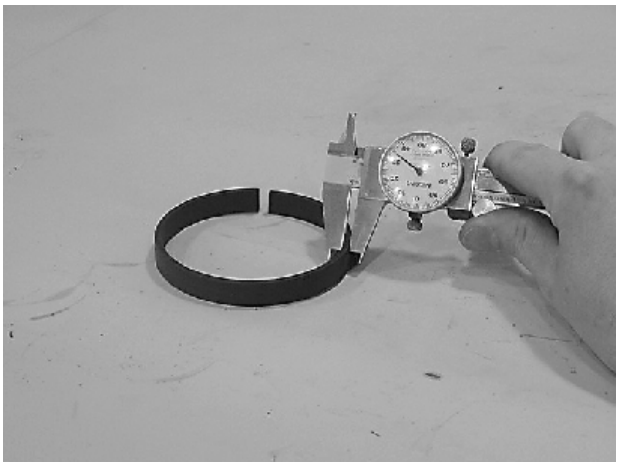
Inspection

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

2. Inspect the thrust washers (304) for rough or worn edges and surfaces. Measure it's thickness to make sure it is within specifications (Not less than 0.092" or 2.34 mm).

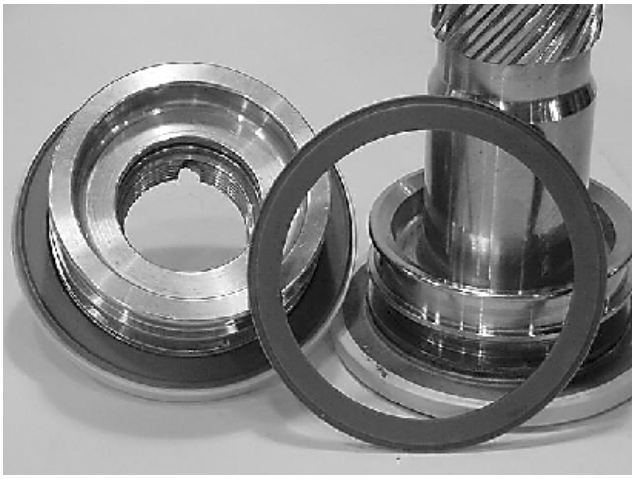


3. Inspect the wear guide condition and measure thickness (not less than 0.123" or 3.12 mm).

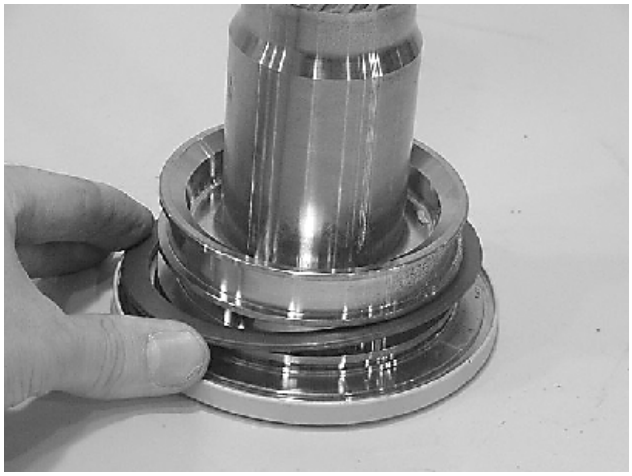


Assembly

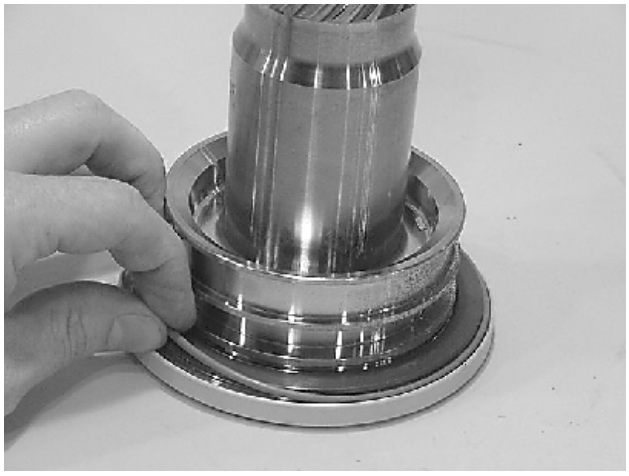
1. Gather all the components and tools into one location prior to re-assembly. Use the cut away drawing to reference the seal orientations.



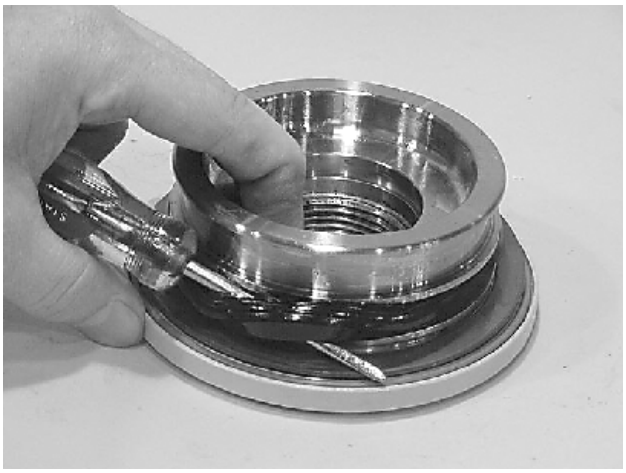
2. Install the thrust washer (304) onto shaft (2) and end cap (4).



3. Install the wiper seal (304.1/green 0-ring) into it's groove 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 inner T-seal (200) into the piston (3) using a circular motion.

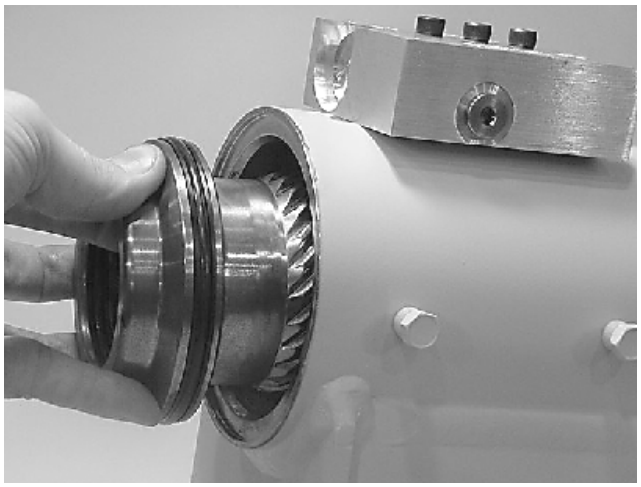
   Install the outer T-seal (202) by stretching it around the groove in a circular motion.

Each T-seal has 2 back-up rings (see drawing for orientation).

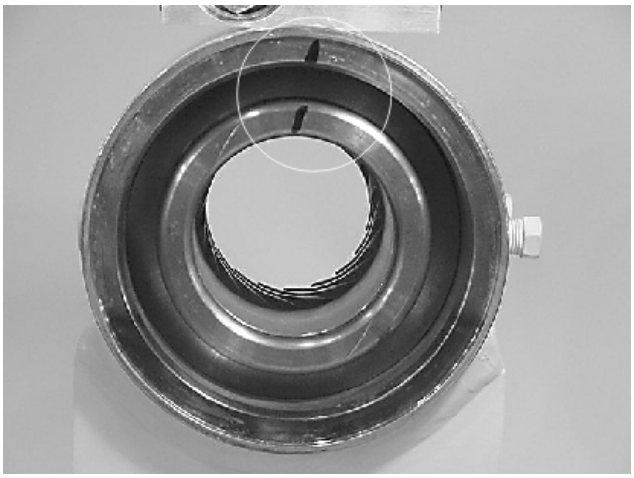
Beginning with the inner seal (200) insert one end of b/u ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly.

Repeat this step for the outer seal (202).

7. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) is touching inside the housing bore.

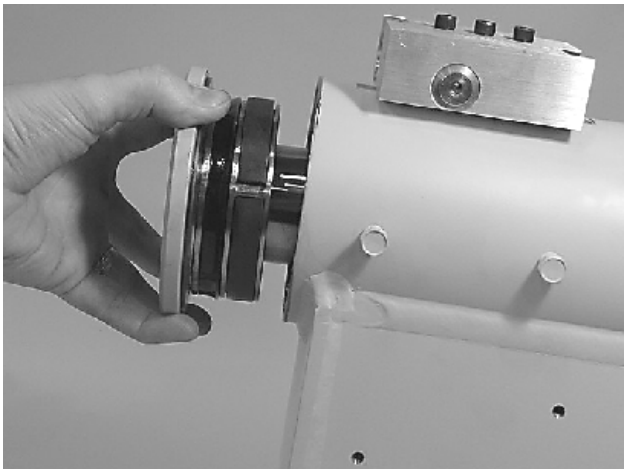


8. Looking from the angle shown, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly line up as shown. Using a rubber mallet, tap the piston into the housing up to the point where the gear teeth meet.

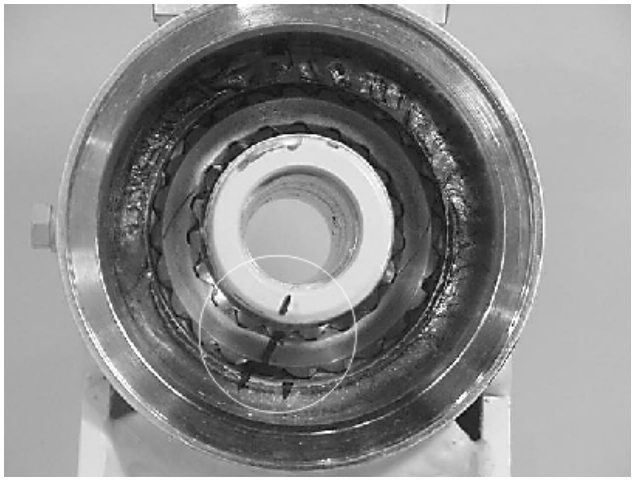


9. Looking from the opposite end of the housing (1) you can see if your timing marks are lining up. When they do, tap the piston (3) in until the gear teeth mesh together. Tap the piston into the housing the rest of the way until it bottoms out.

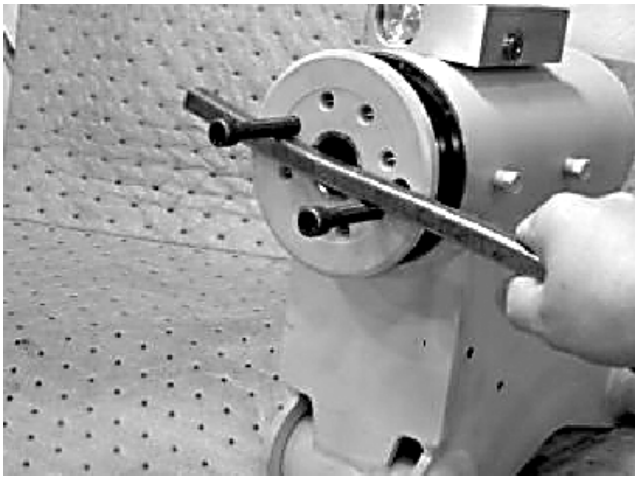
10. Install the shaft (2) into the piston (3). Be careful not to damage the seals. Do not engage the piston gear teeth yet.



11. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.

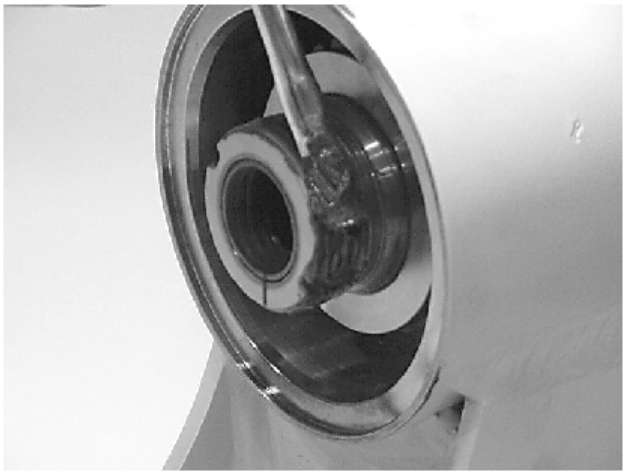


12. Install 2 bolts in the threaded holes in the flange. Using a bar, rotate the shaft in a clockwise direction until the wear guides are seated inside the housing bore.



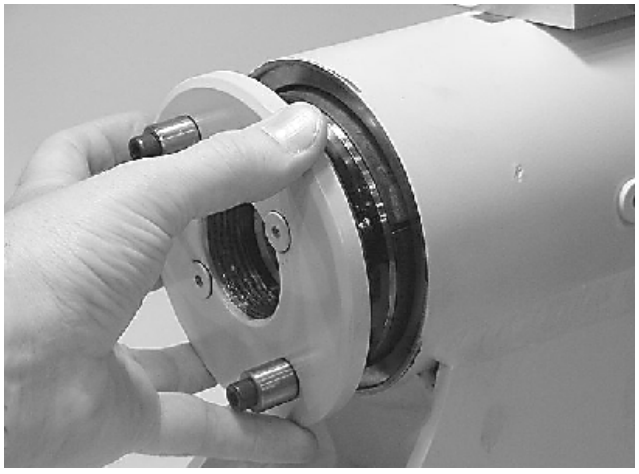
13. Install the stop tube onto the shaft end. Stop tube is an available option to limit the rotation of an actuator.

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

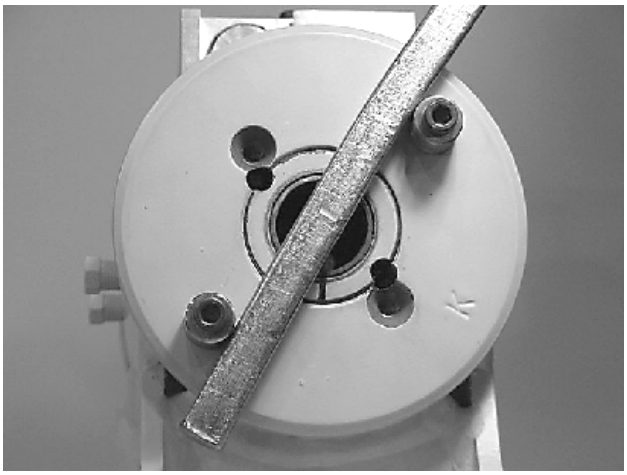


15. Install the 0-ring (204) and back-up ring (207) into the inner seal groove on the end cap (4).

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

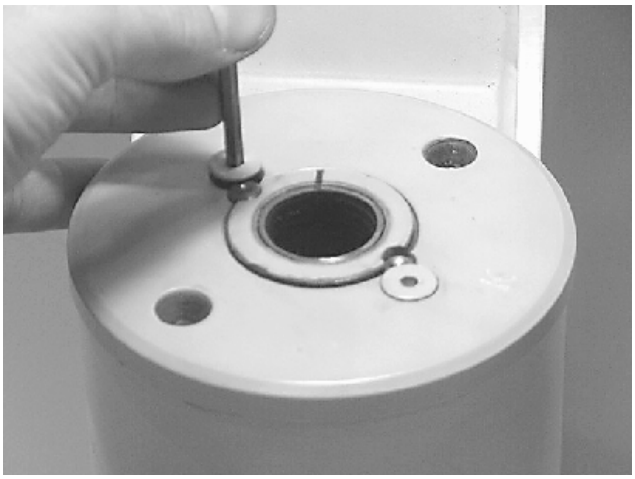


17. Tighten the end cap (4). In most cases the original holes for the lock pins will line up.



18. Place the lock pins (109) provided in the Helac seal kit in 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 them to 25 in. lbs. (2.825 Nm).



Installing Counterbalance Valve

Refer to Figure 4-12., 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.

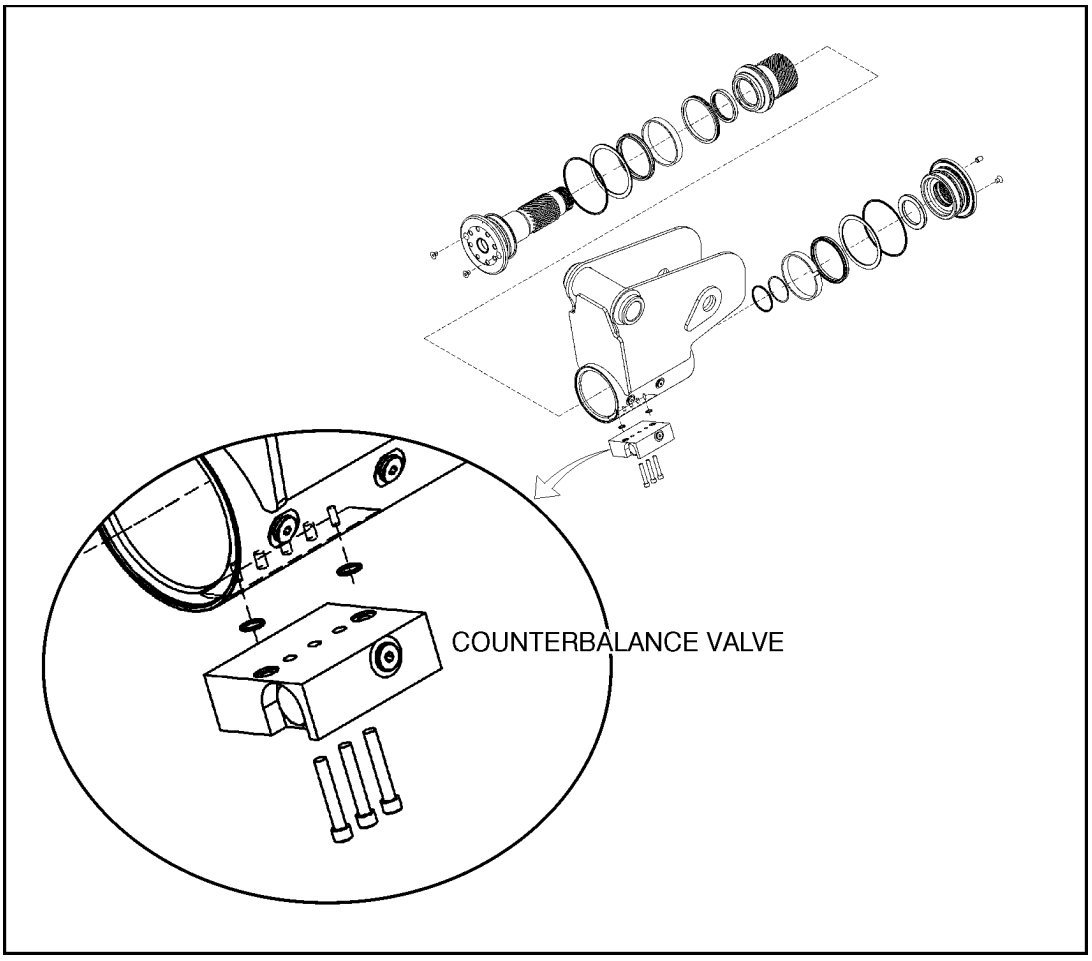


Figure 4-12. Rotator Counterbalance Valve

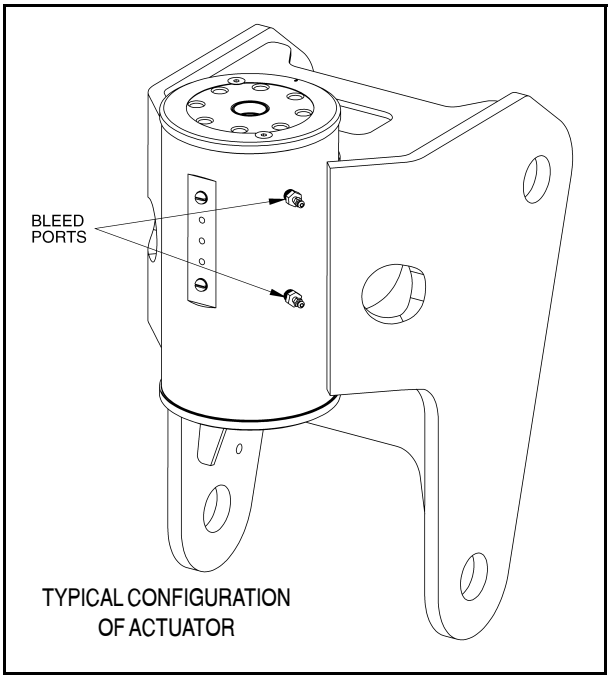
Installation and Bleeding

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 re-built 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

NOTES:

SECTION 5. HYDRAULICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

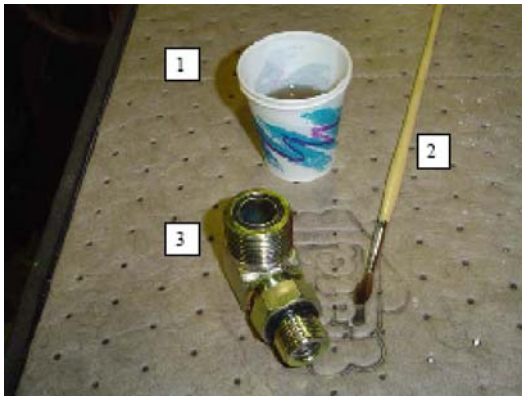
When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

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

Disassembly

NOTE: *Disassembly of the cylinder should be performed on a clean work surface in a dirt free work area.*

1. Drain the oil from the cylinder.
2. Place the cylinder in a suitable holding fixture.
3. Position the cylinder vertically or horizontally.
4. Use the bottom and pin hole to prevent the cylinder from turning and secure the axis.

NOTE: *If there is a valve block that interferes with securing the cylinder, remove the block.)*

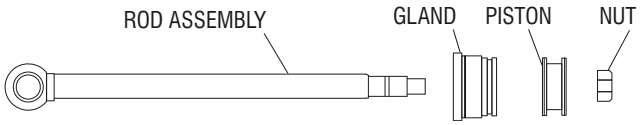
5. Unscrew the cylinder head.
6. Unscrew the gland 1 or 2 times with a spanner tool.

ROD DISASSEMBLY

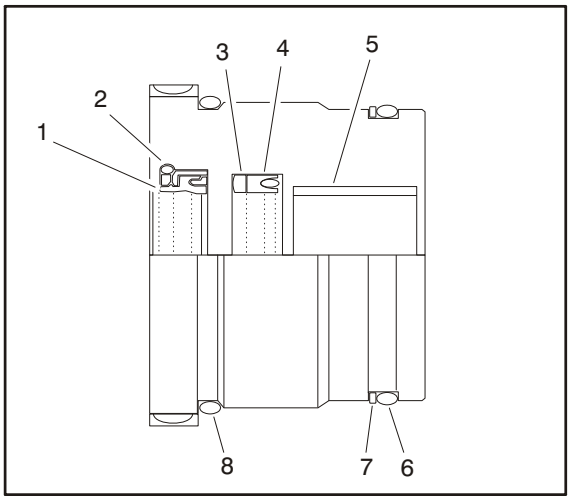
NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, GLAND AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH CAN CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACE.

7. With the tube clamped securely, apply the pressure to the devise and withdraw the Rod assembly from the cylinder barrel.
8. Withdraw the piston nut piston gland as below.



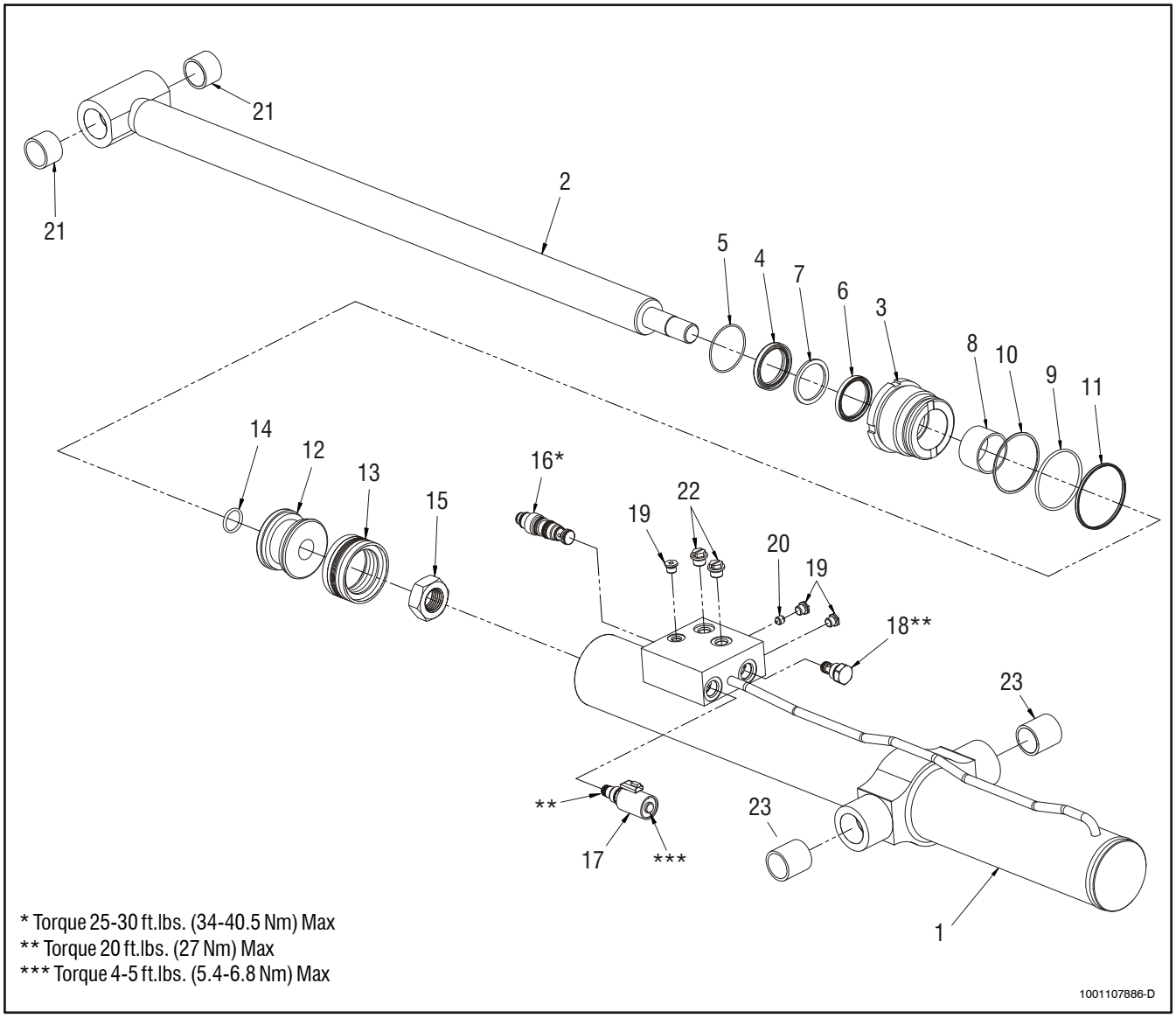
GLAND SEAL DISASSEMBLY



1. Dust Ring
2. Retaining Ring
3. Backup Ring
4. Rod Seal
5. Bushing
6. O-ring
7. Backup Ring
8. O-ring

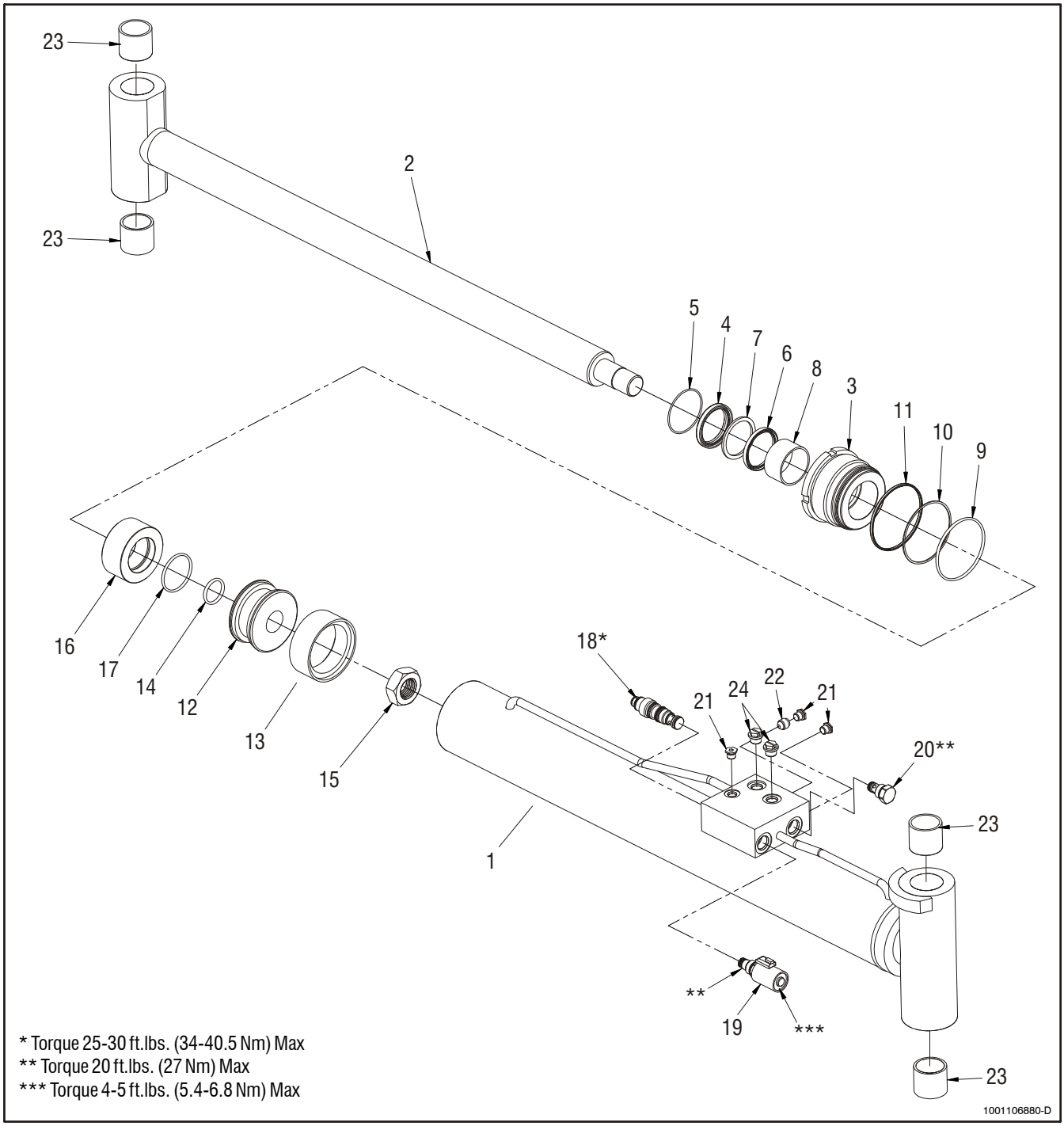
Figure 5-1. Gland Seal Disassembly

1. Withdraw the rod seal carefully with a tool which is not sharp so as to not damage the seals.
2. Remove the retaining ring with a screwdriver prior to removing the dust wiper.
3. Since the dust wiper is pressurized, tap it and then withdraw the dust wiper by using a tool such as a screwdriver.



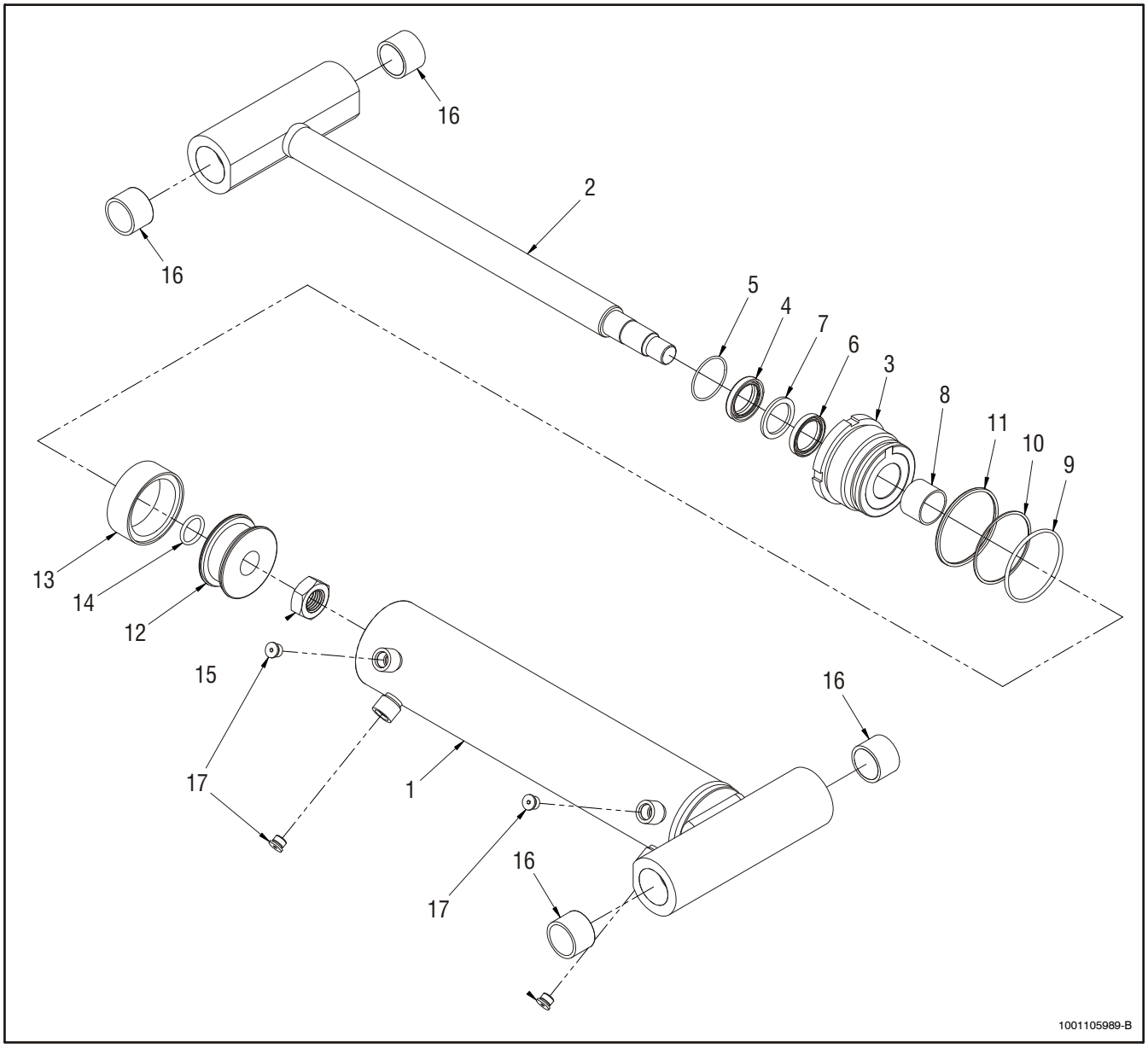
1. Tube Assembly
2. Rod Assembly
3. Gland
4. Dust Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Bushing
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-ring
15. Hex Nut
16. Counterbalance Valve
17. Poppet Valve
18. Check Valve
19. Plug
20. Orifice
21. Bearing
22. Plug
23.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

Figure 5-2. Tower Lift Cylinder



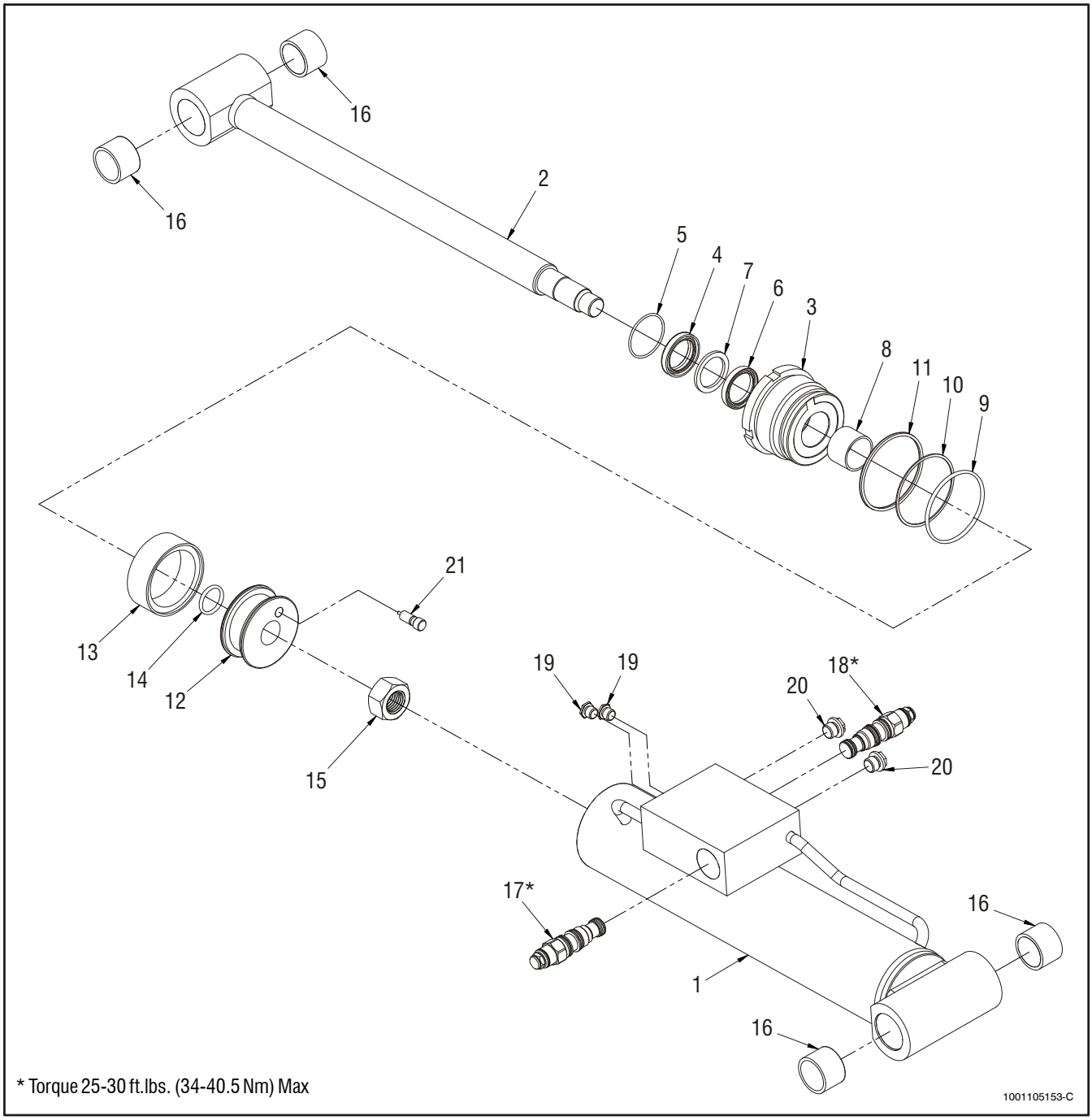
1. Tube Assembly	6. Rod Seal	11. O-ring	16. Spacer	21. Plug
2. Rod Assembly	7. Backup Ring	12. Piston	17. O-ring	22. Orifice
3. Gland	8. Bushing	13. Piston Seal	18. Counterbalance Valve	23. Bearing
4. Dust Wiper	9. O-ring	14. O-ring	19. Poppet Valve	24. Plug
5. Retaining Ring	10. Backup Ring	15. Hex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

Figure 5-3. Upper Lift Cylinder



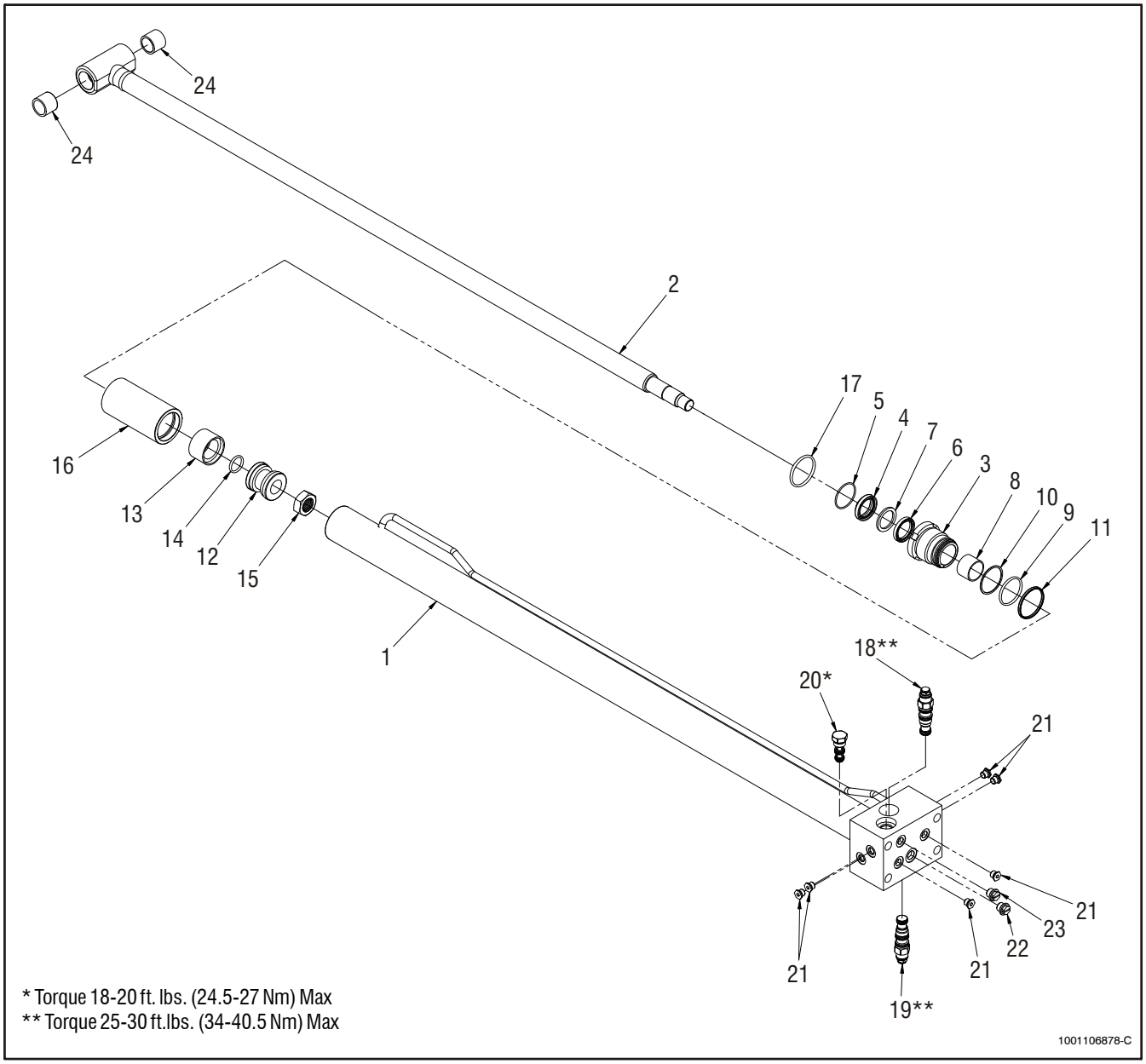
1. Tube Assembly
2. Rod Assembly
3. Gland
4. Dust Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Bushing
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-ring
15. Hex Nut
16. Bearing
17. Plug

Figure 5-4. Master Cylinder



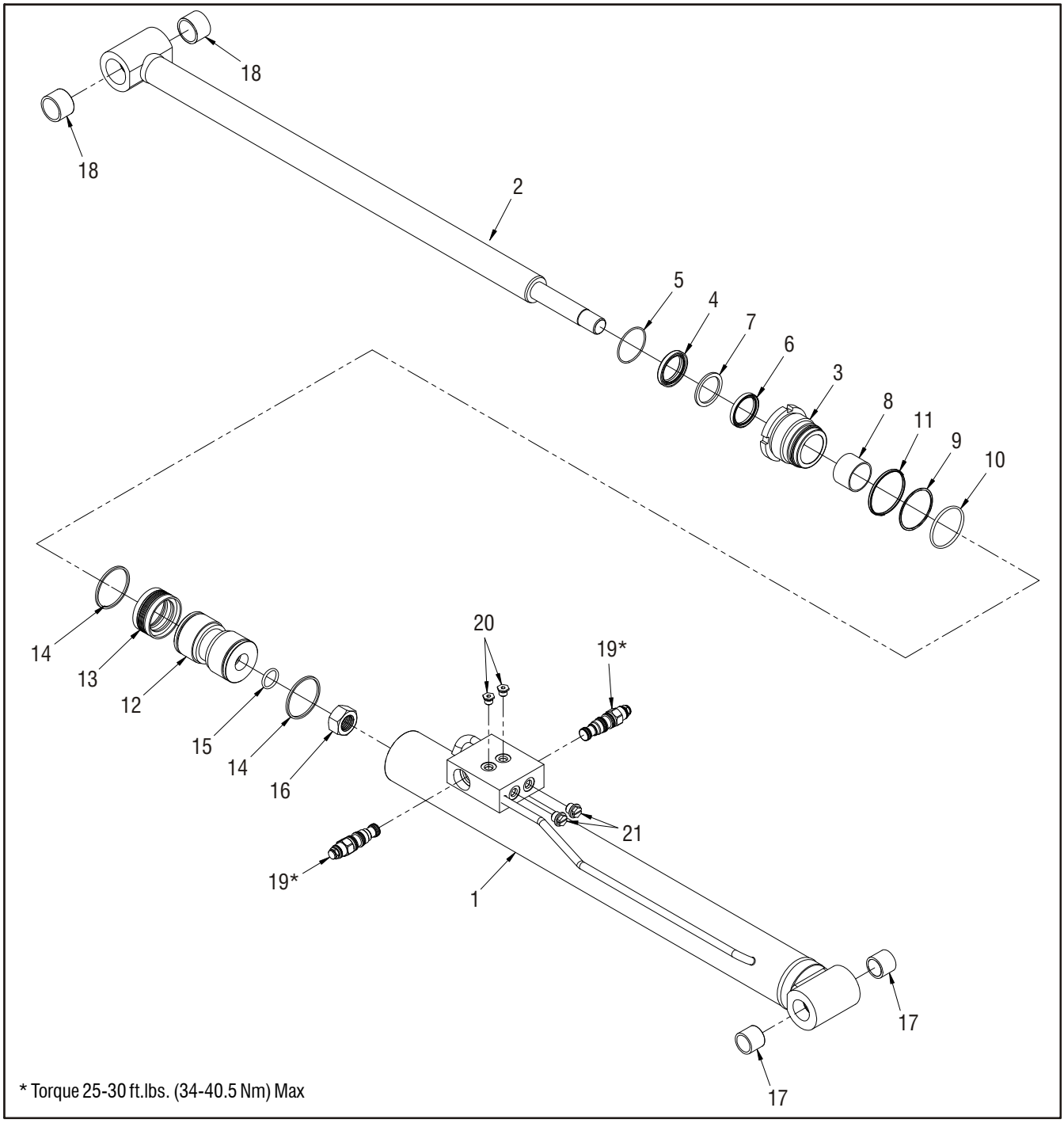
1. Tube Assembly
2. Rod Assembly
3. Gland
4. Dust Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Bushing
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-ring
15. Hex Nut
16. Bearing
17. Counterbalance Valve
18. Counterbalance Valve
19. Plug
20. Plug
21. Phase Valve

Figure 5-5. Level Cylinder



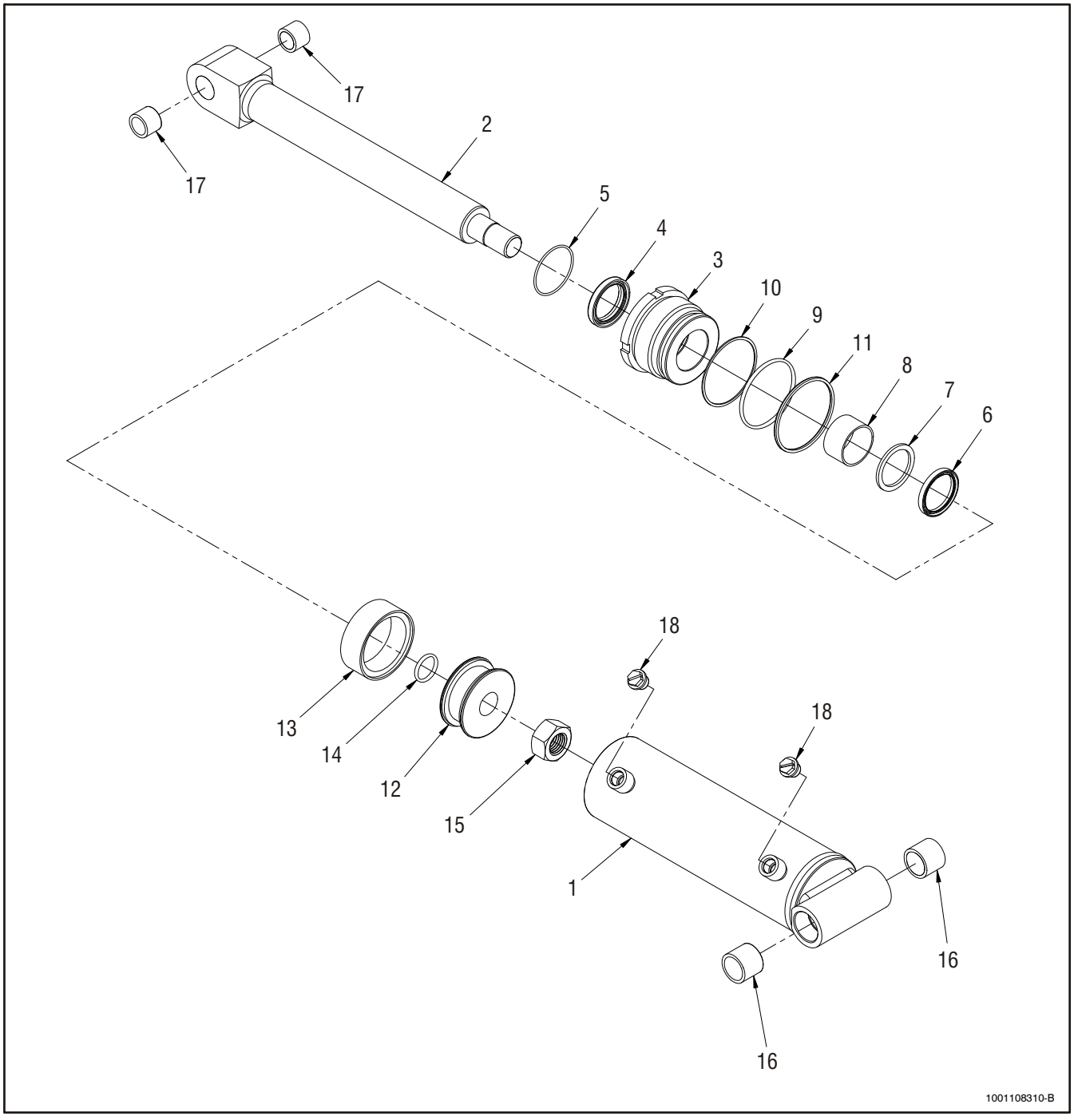
1. Tube Assembly	6. Rod Seal	11. O-ring	16. Spacer	21. Plug
2. Rod Assembly	7. Backup Ring	12. Piston	17. O-ring	22. Dust Plug
3. Gland	8. Bushing	13. Piston Seal	18. Counterbalance Valve	23. Dust Plug
4. Dust Wiper	9. O-ring	14. O-ring	19. Counterbalance Valve	24. Bearing
5. Retaining Ring	10. Backup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

Figure 5-6. Telescope Cylinder - AJ



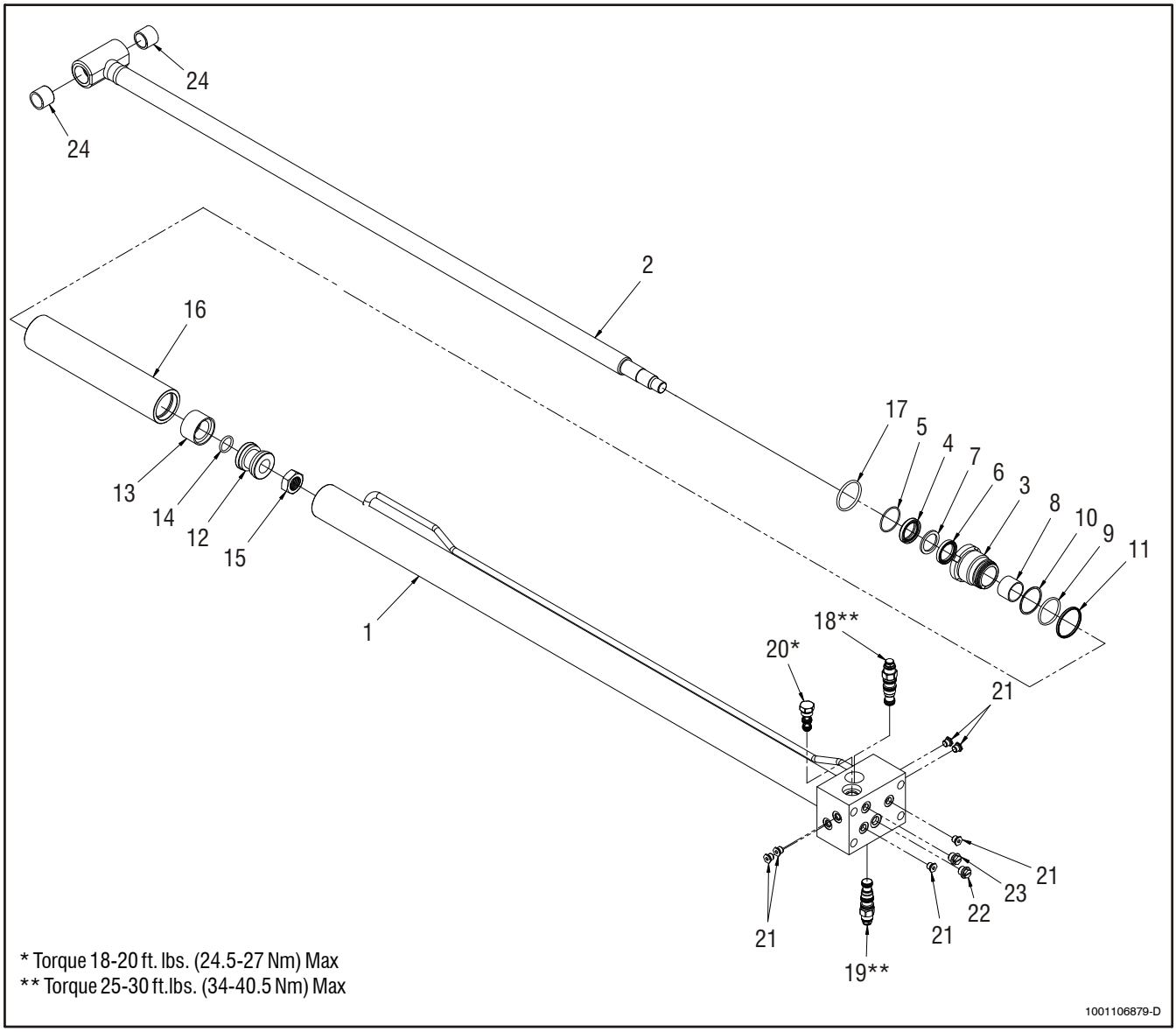
1. Tube Assembly	6. Rod Seal	11. O-ring	16. Hex Nut	21. Plug
2. Rod Assembly	7. Backup Ring	12. Piston	17. Bearing	
3. Gland	8. Bushing	13. Piston Seal	18. Bearing	
4. Dust Wiper	9. O-ring	14. Piston Ring	19. Counterbalance Valve	
5. Retaining Ring	10. Backup Ring	15. O-ring	20. Plug	

Figure 5-7. Jib Cylinder



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

Figure 5-8. Steer Cylinder

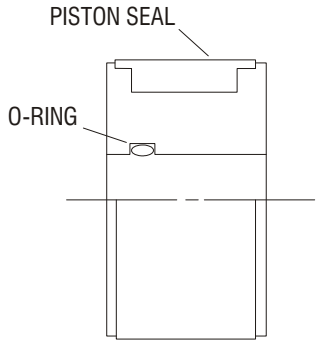


1. Tube Assembly
2. Rod Assembly
3. Gland
4. Dust Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Bushing
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-ring
15. Hex Nut
16. Spacer
17. O-ring
18. Counterbalance Valve
19. Counterbalance Valve
20. Load Shuttle Valve
21. Plug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

Figure 5-9. Telescope Cylinder - AJP

4. Withdraw the O-ring and back up ring carefully as not to damage the seals.
5. It is impossible to disassemble the bushing because it is pressed on. Remove it by using a press.

PISTON SEAL DISASSEMBLY



1. The piston seal is used in pairs and the ring at the outer diameter is easily removed by hand. Remove the inner rubber ring carefully with the disassembly tool so as not to cause damage to a processed good.
2. Carefully remove the o-ring and back up ring with the disassembly tool as not to cause damage to the seals.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the rod threads for the additional damage. If necessary, dress rod threads.
3. Inspect the inside of the cylinder barrel for any damage. Inspect the inside diameter for tapering or ovality.
4. Inspect the barrel threads for the damage and dress threads as necessary.
5. Inspect the piston surface for the damage. Replace the piston if necessary.
6. Inspect the piston threads for damage.
7. Inspect the seal and o-ring grooves for burrs and sharp edges. Dress the surface as necessary.
8. Inspect the cylinder head inside diameter for damage, ovality and tapering. Replace as necessary.
9. Inspect the head threads for damage. Dress the threads as necessary.
10. Inspect the gland seal and o-ring grooves for the burr and sharp edge. Dress the surface as necessary.
11. Inspect the cylinder head outside diameter for damage, ovality and tapering. If necessary, replace it.
12. Inspect rod and tube bearings for signs of excessive wear or damage.

Assembly

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. Refer to the JLG parts manual.*

GLAND, PISTON SEAL ASSEMBLY

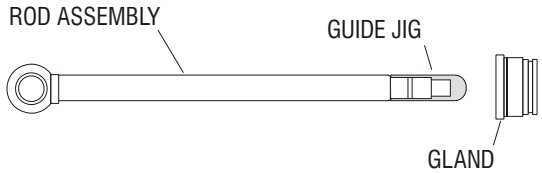
1. Install the new rod seal into the applicable cylinder gland grooves by hand.
2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.
3. Place the o-ring and back up seal in the outside grooves of the cylinder gland.
4. Install a washer ring onto the rod and carefully install the gland on the rod ensuring that the wiper and rod seals are not damaged or dislodged. Push the head gland along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.

NOTE: *The main boom telescope cylinder piston has an o-ring installed inside the spacer.*

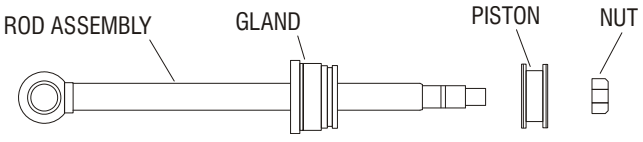
6. If applicable, correctly place the o-ring in the inner piston diameter groove. The back up ring side facing the o-ring is grooved.

GLAND, PISTON, PISTON NUT ASSEMBLY

1. Clamp the rod assembly
2. Use a guide jig so as not to cause damage to the inner seal of the gland and assemble it.



3. Assemble the piston onto the rod assembly



4. Push the piston to the rod assembly to the end of the thread and then install the piston nut. When installing the piston nut, gland and valve, refer to Table 5-1, Cylinder Assembly Torques.

Table 5-1. Cylinder Assembly Torques

Cylinder	Torque Value *	
	Cylinder Head	Piston Nut
Tower Lift	463 lb. ft. (628 Nm)	267 lb. ft. (362 Nm)
Upper Lift	550 lb. ft. (746 Nm)	528 lb. ft. (716 Nm)
Master	463 lb. ft. (628 Nm)	267 lb. ft. (362 Nm)
Level	463 lb. ft. (628 Nm)	267 lb. ft. (362 Nm)
Telescope (AJ)	318 lb. ft. (431 Nm)	267 lb. ft. (362 Nm)
Jib	405 lb. ft. (549 Nm)	267 lb. ft. (362 Nm)
Steer	463 lb. ft. (628 Nm)	267 lb. ft. (362 Nm)
Telescope (AJP)	318 lb. ft. (431 Nm)	267 lb. ft. (362 Nm)
* All torque values ± 10%		

Table 5-2. Cylinder Valve Torques

Cylinder	Valve	Ft. Lbs.	Nm
Tower Lift	Counterbalance	25-30	34-40.5
	Poppet	19-21	25-28
	Check Valve	20	27
	Coil Nut	4-5	5-6
Upper Lift	Counterbalance	25-30	34-40.5
	Poppet	19-21	25-28
	Check Valve	20	27
	Coil Nut	4-5	5-6
Level	Counterbalance	25-30	34-40.5
Telescope-AJ	Counterbalance	25-30	34-40.5
	Load Shuttle	18-20	24.5-27
Jib	Counterbalance	25-30	34-40.5
Telescope-AJP	Counterbalance	25-30	34-40.5
	Load Shuttle	18-20	24.5-27

5. Assemble the rod assembly equipped with gland, piston and piston nut to the barrel assembly horizontally (avoid pushing it off-center, which could cause damage to the piston seal or the outside of the piston).

6. Push the gland thread until it meets the barrel threads, and then assemble the gland to the barrel.

Phase Check Cartridge

The phase valve is a back-to-back pair of check valves, one of which is mechanically actuated. This valve is installed in the piston of the level cylinder and is used to keep the master and level cylinders in phase.

NOTE: *Activating the Level Override Up circuit for 30 seconds can bleed the level circuit.*

TEST PROCEDURE

1. Place the machine in the following position:

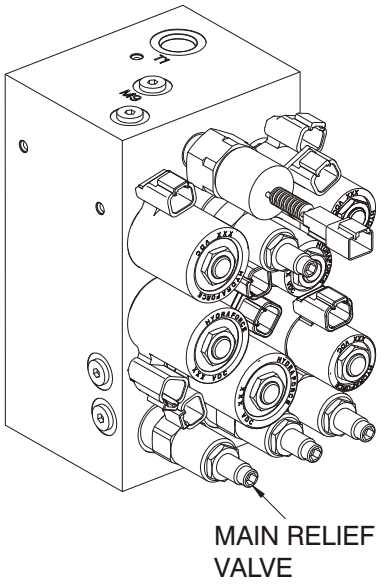
- Firm and level surface
- Upper boom horizontal (level)
- Upper boom fully retracted
- Jib down
- Platform empty

2. With no load in the platform, activate Level Up for approximately 20 seconds. If the Upper Boom rises, the phase valve is not functioning correctly and must be replaced.

5.3 PRESSURE SETTING PROCEDURE

Adjustments made at the Main Valve Bank

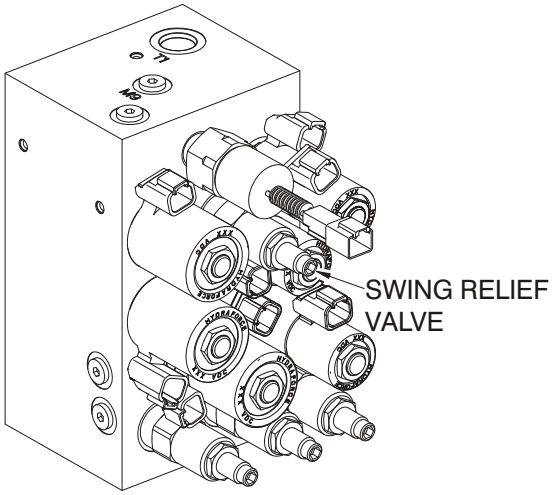
MAIN PRESSURE RELIEF VALVE – 3000 PSI (207 BAR)



1. Install pressure gauge at port MP of Main Valve Bank.

2. Actuate and hold Telescope In to “end of stroke” & take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase setting or counter-clockwise to reduce the setting accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

SWING RIGHT / LEFT – 750 PSI (52 BAR)



1. Install pressure gauge at port MP of Main Valve Bank.

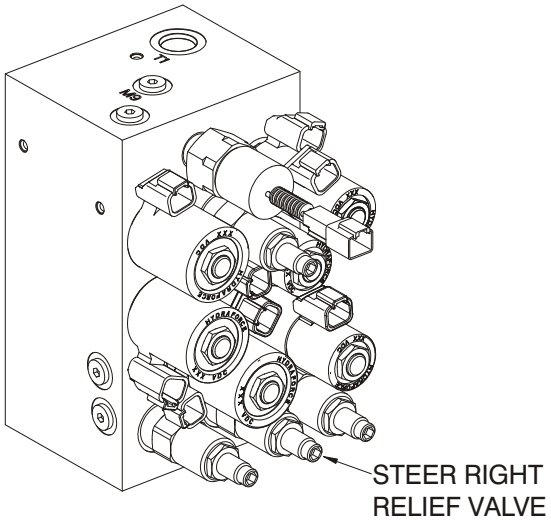
2. Activate Swing Right or Left and hold to the turntable stop. Take pressure reading.
3. After loosening the relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.

⚠ CAUTION

USE CAUTION NOT TO EXCEED A RELIEF VALVE SETTING OF 750 PSI (51 BAR) AS COMPONENTS OF THE SWING CIRCUIT CAN BE DAMAGED.

4. Tighten relief valve jam nut and repeat step 2 to verify setting.

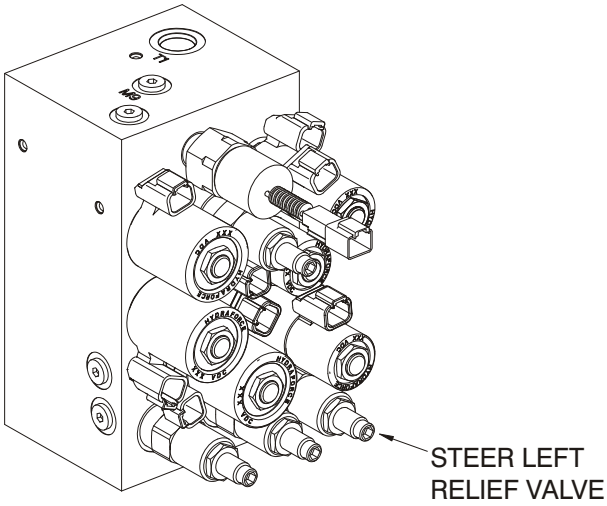
STEER RIGHT – 1400 PSI (97 BAR))



1. Install pressure gauge at port MP of Main Valve Bank.

2. Activate Steer Right and hold to end of stroke. Take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

STEER LEFT – 2000 PSI (138 BAR)

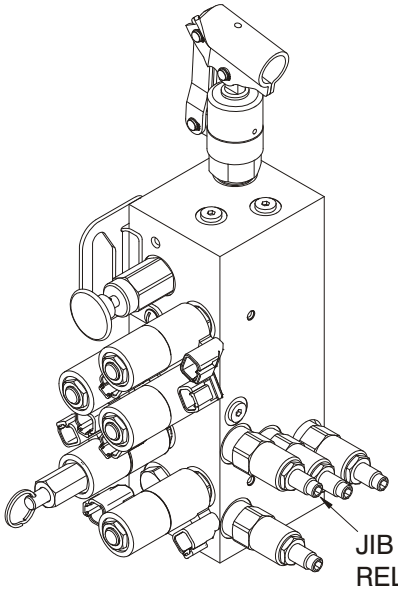


1. Install pressure gauge at port MP of Main Valve Bank.

2. Activate Steer Left and hold to end of stroke. Take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

Adjustments made at the Boom Function Valve Bank

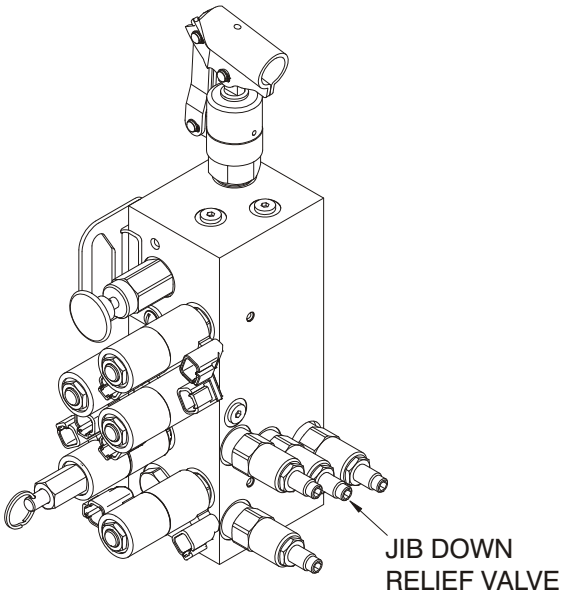
JIB LIFT UP – 2000 PSI (138 BAR)



1. Install pressure gauge at port MP of Main Valve Bank.

2. Activate Jib Lift Up and hold to end of stroke. Take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

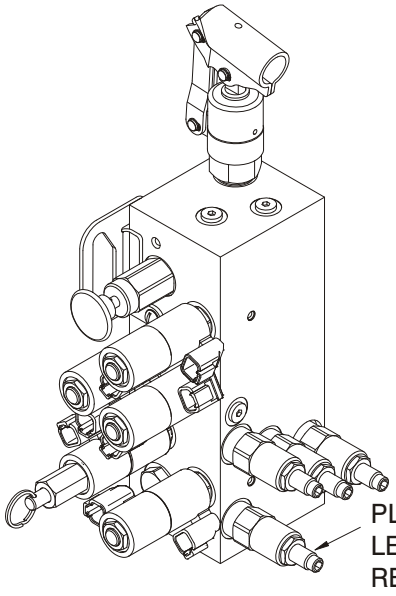
JIB LIFT DOWN – 1200 PSI (83 BAR)



1. Install pressure gauge at port MP of Main Valve Bank.

2. Activate Jib Lift Down and hold to end of stroke. Take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

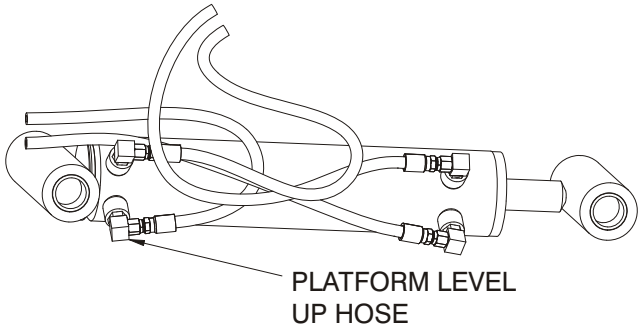
PLATFORM LEVEL UP – 3000 PSI (207 BAR)



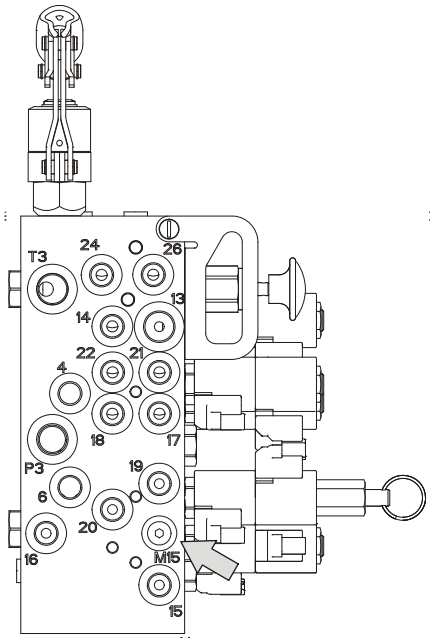
1. Refer to the Main Pressure Relief Valve procedure and temporarily set Main Pressure Relief Valve to 3300 psi (227.5 Bar).
2. Disconnect, cap, & plug the platform level up hose & adapter either at the platform level master cylinder or at port 15 of the Boom Function Valve.

⚠ CAUTION

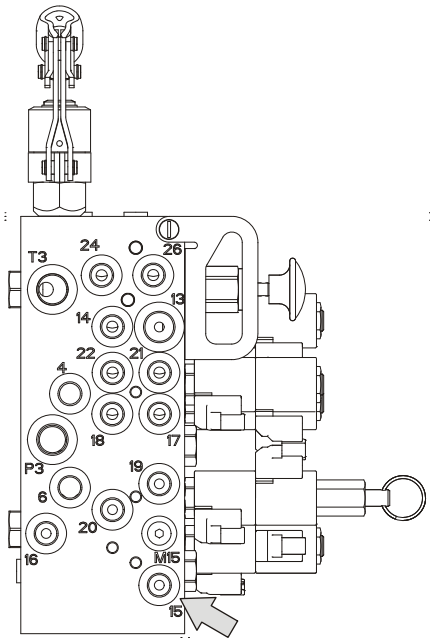
USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE.



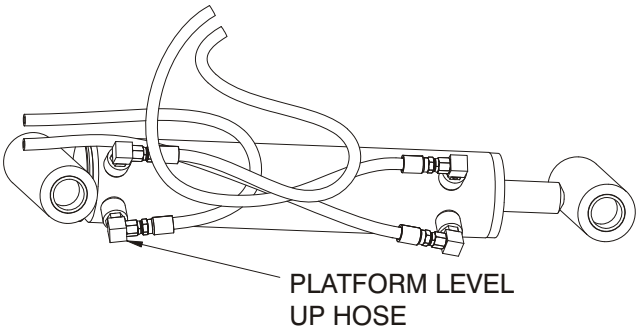
3. Install a pressure gauge in one of the following locations:
   - at port M15 of Boom Function Valve



   - at port 15 of Boom Function Valve



- at end of platform level up hose (do not use this location if port 15 was chosen in step 2.)



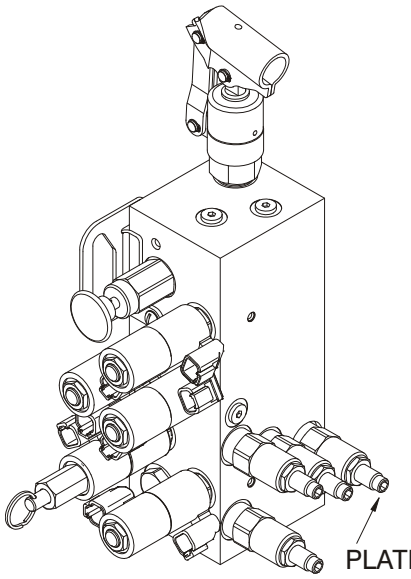
4. Activate Platform Level Up and hold. Take pressure reading.
5. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
6. Tighten relief valve jam nut. Repeat step 4 and verify the pressure setting.
7. Reconnect the platform level up hose that was disconnected in Step 2.

⚠ WARNING

USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE

8. Refer to the Main Pressure Relief Valve procedure and return Main Pressure Relief Valve to 3000 psi (207 Bar).

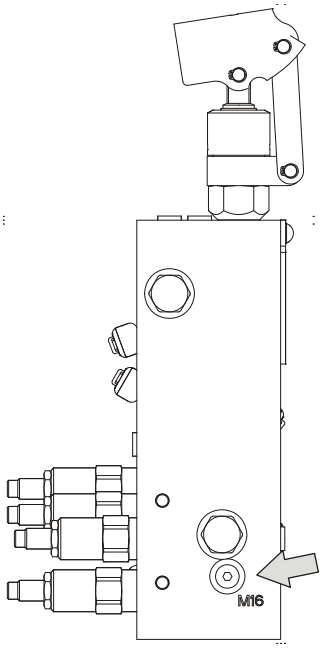
PLATFORM LEVEL DOWN – 1200 PSI (83 BAR)



There are two different methods that can be used to set the Platform Level Down pressure, Option 1 and Option 2. They are outlined as follows.

Option 1:

1. Install pressure gauge at port “M16” of Boom Function Valve Bank.

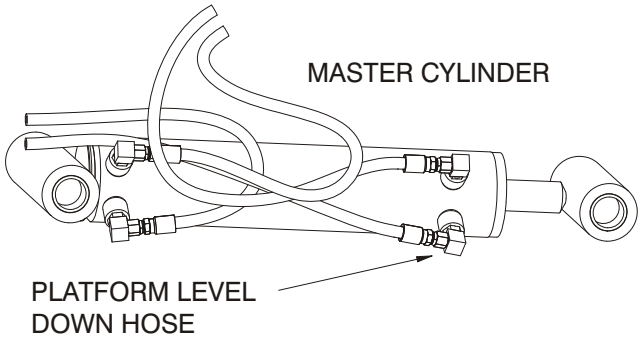


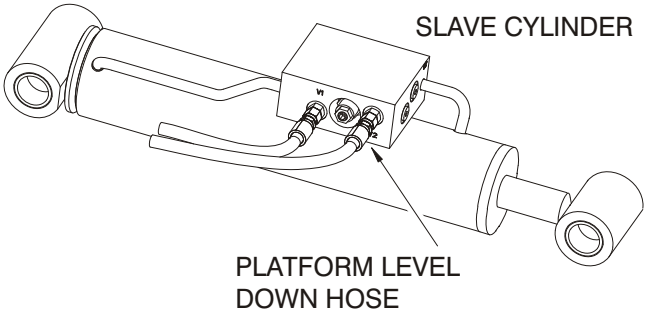
2. Activate Upper Lift Up and hold to end of stroke.
3. Activate Platform Level Down to end of stroke. Take pressure reading.

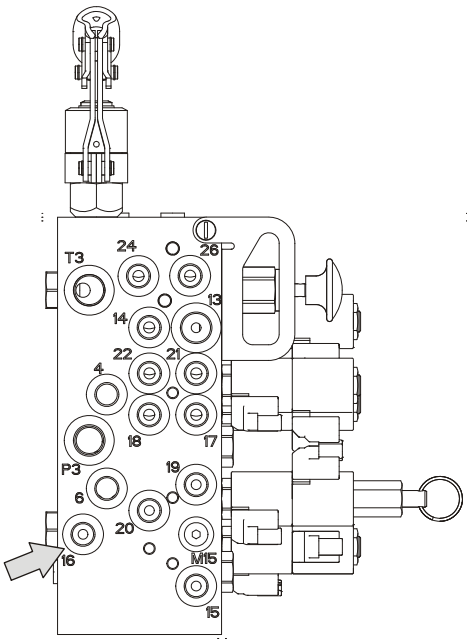
4. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
5. Tighten relief valve jam nut. Repeat step 3 and verify the pressure setting.

Option 2:

1. Disconnect, cap, and plug the platform level down hose and adapter either at the platform level master cylinder, at the platform level slave cylinder, or at port “16” of the Boom Function Valve Bank.







⚠ WARNING

USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE

2. Install pressure gauge in one of the following locations:

- at port “16” of Boom Function Valve Bank
- at end of platform level down hose which was disconnected in step 1 (do not use this location if port “16” was chosen in step 1).

3. Activate Platform Level Down and hold. Take pressure reading.
4. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
5. Tighten relief valve jam nut. Repeat step 3 and verify the pressure setting.
6. Reconnect the platform level down hose that was disconnected in step 1.

⚠ WARNING

USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE.

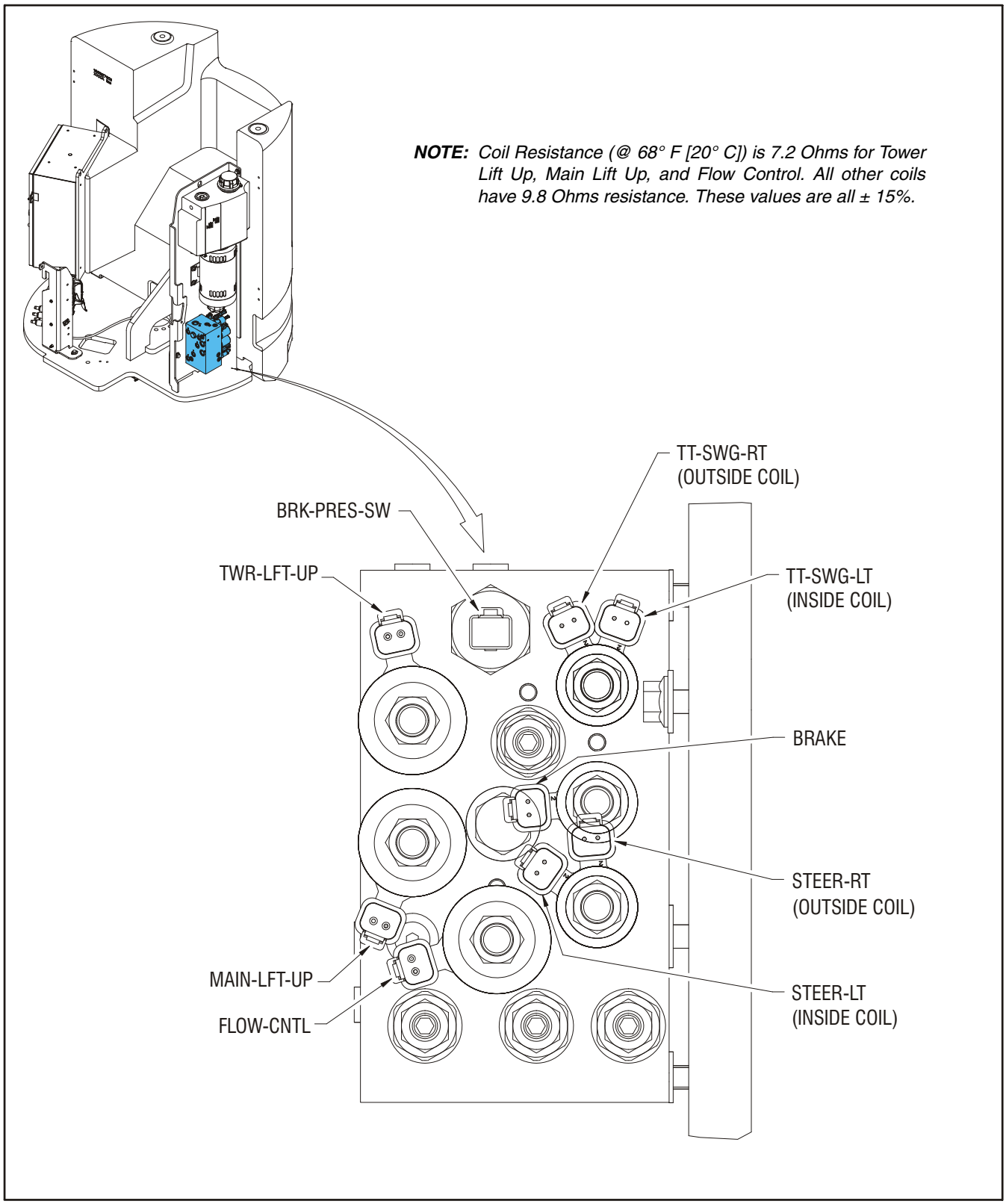


Figure 5-10. Main Control Valve - Sheet 1 of 2

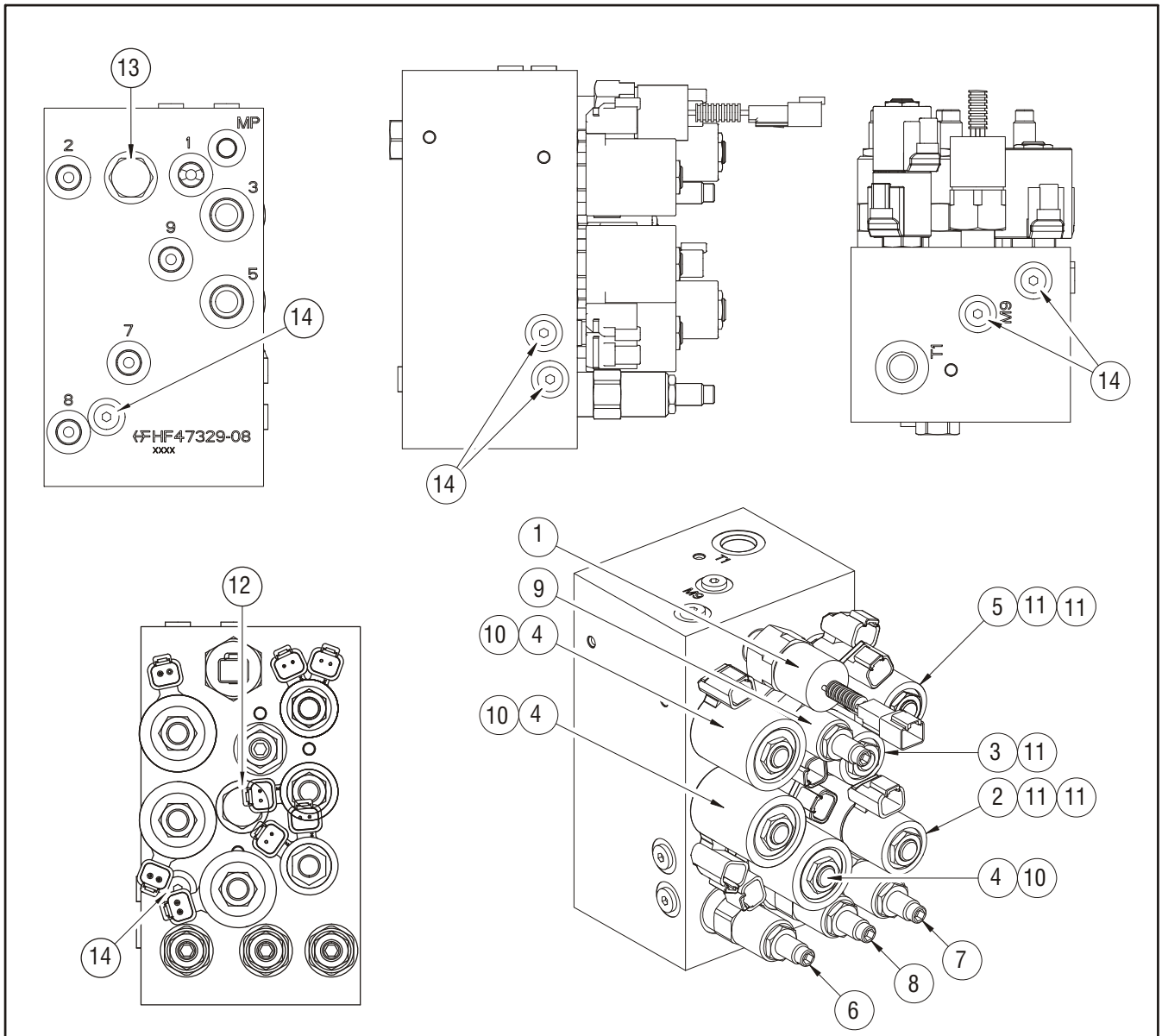


Table 5-3. Main Valve Torques

#	Description	Ft. Lbs.	Nm		#	Description	Ft. Lbs.	Nm
1	Pressure Switch	15	20		8	Relief Valve	20	27
2	Solenoid Valve	20	27		9	Relief Valve	20	27
3	Solenoid Valve	20	27		10	Coil	5	7
4	Solenoid Valve	25	34		11	Coil	5	7
5	Solenoid Valve	20	27		12	Valve	20	27
6	Relief Valve	20	27		13	Load Sense Valve	20	27
7	Relief Valve	20	27		14	Port Plug	15	20

Figure 5-11. Main Control Valve - Sheet 2 of 2

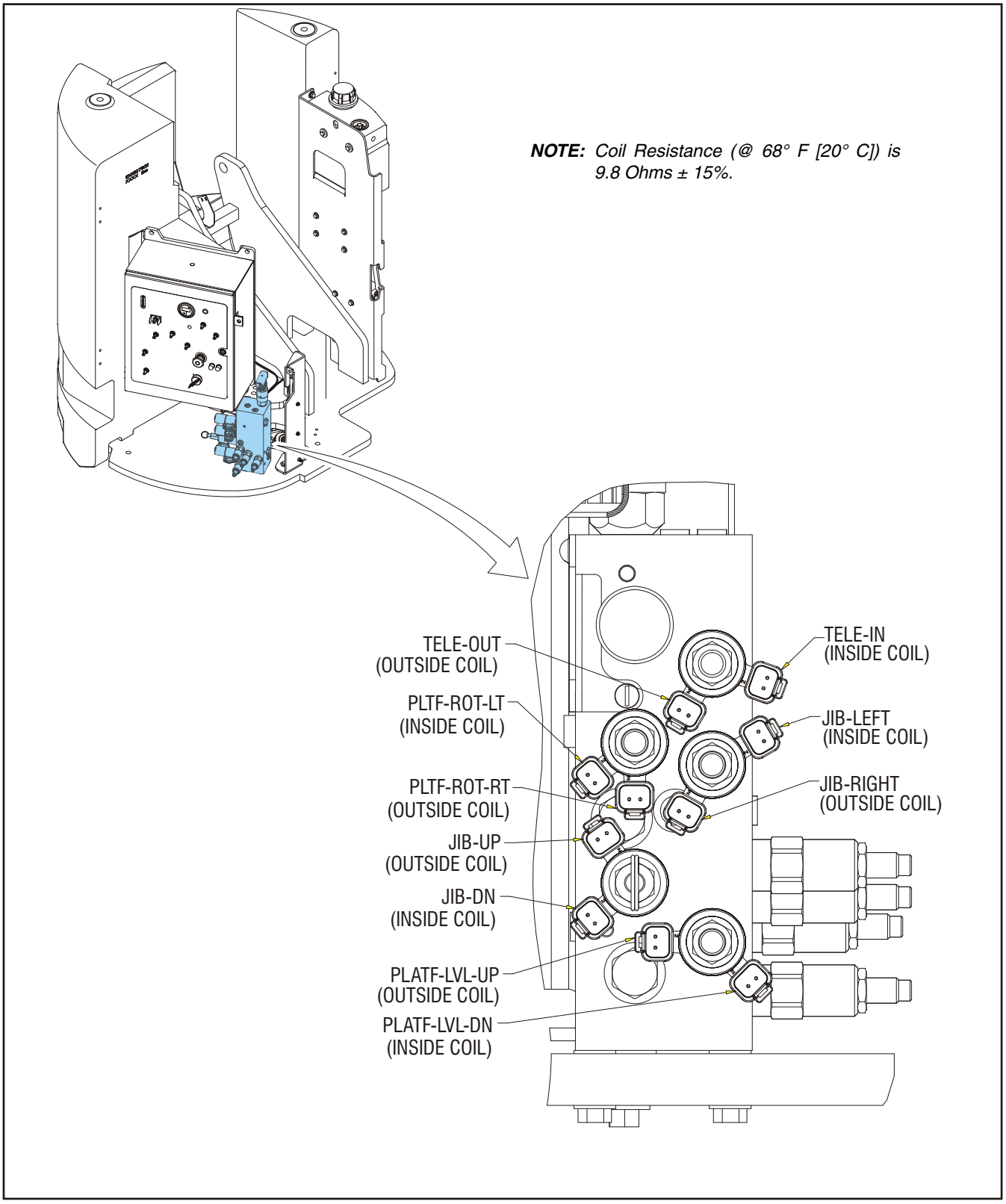


Figure 5-11. Boom Function Valve - Sheet 1 of 2

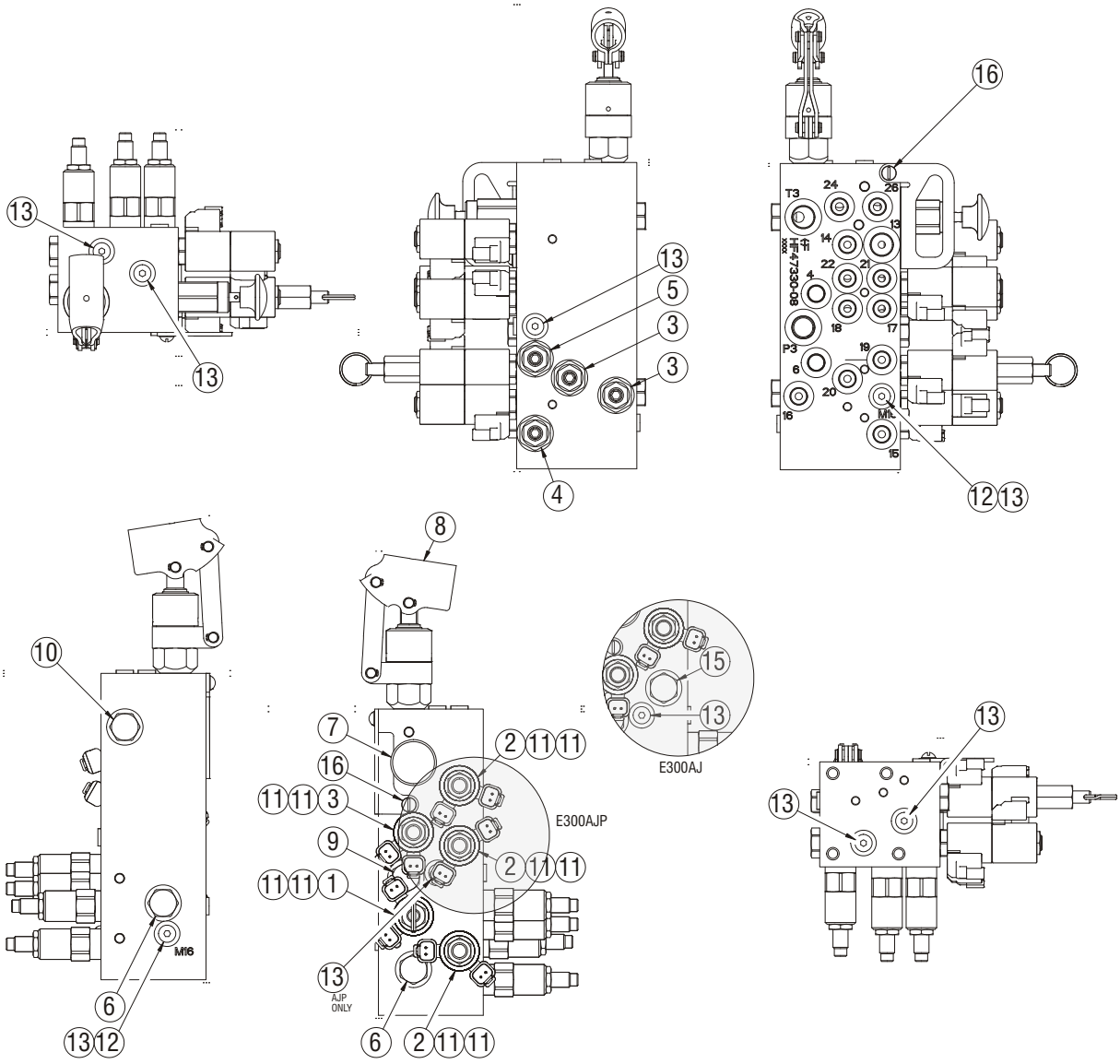
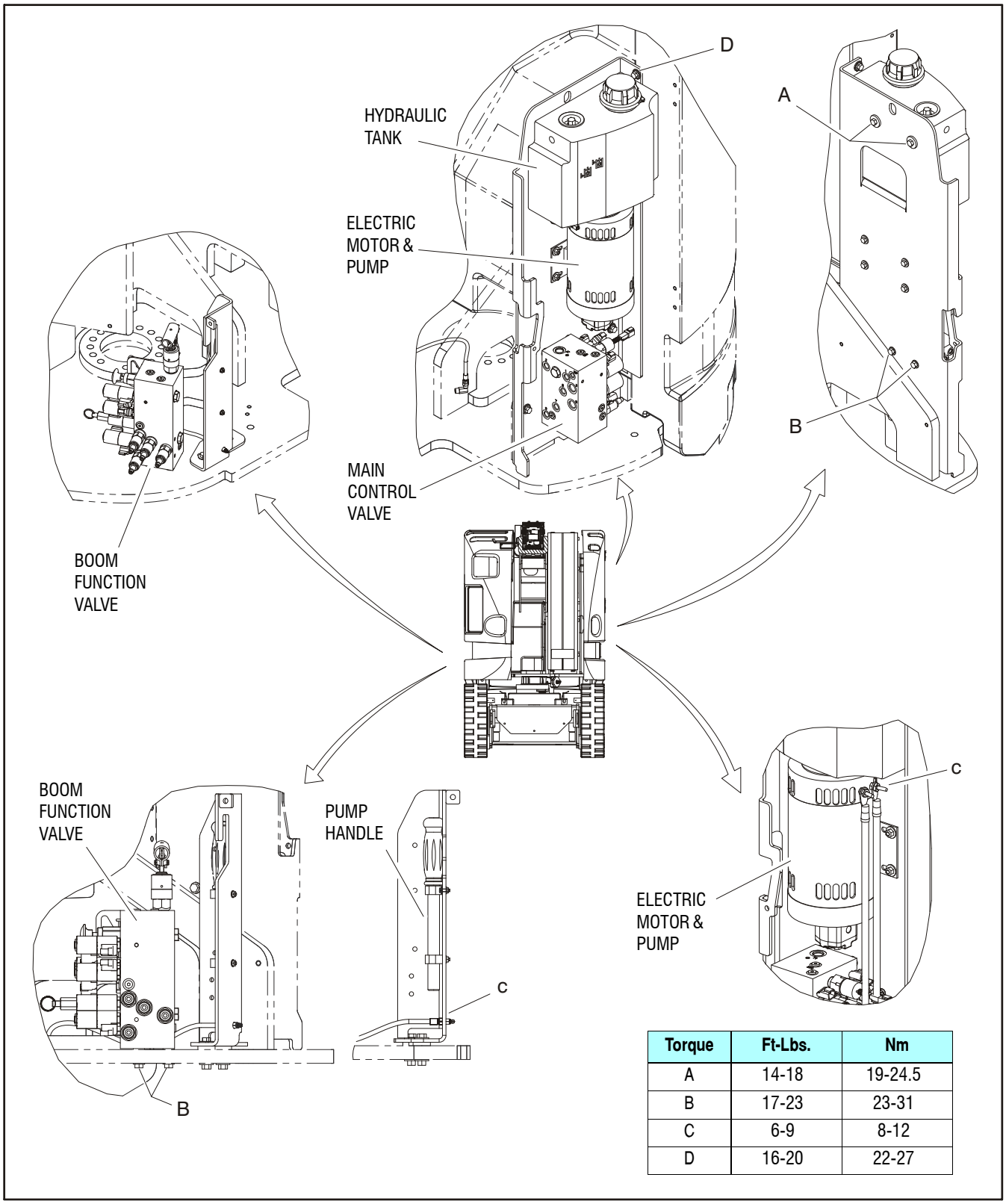


Table 5-4. Boom Function Valve Torques

#	Description	Ft. Lbs.	Nm	#	Description	Ft. Lbs.	Nm	#	Description	Ft. Lbs.	Nm
1	Solenoid Valve	20	27	7	Manual Valve	25	34	13	Port Plug	15	20
2	Solenoid Valve	20	27	8	Hand Pump	30	40.5	14	Port Plug	25	34
3	Relief Valve	20	27	9	Check Valve	20	27	15	Valve	20	27
4	Relief Valve	25	34	10	Check Valve	20	27	16	Screw	5	7
5	Relief Valve	20	27	11	Coil	5	7				
6	Valve	20	27	12	Orifice Plug	4	5				

Figure 5-12. Boom Function Valve - Sheet 2 of 2



Torque	Ft-Lbs.	Nm
A	14-18	19-24.5
B	17-23	23-31
C	6-9	8-12
D	16-20	22-27

Figure 5-12. Hydraulic Components Location

5.4 INITIAL HYDRAULIC PUMP START-UP PROCEDURE

This procedure must be used when the hydraulic pump or pump/motor assembly is removed or replaced to ensure there is no air trapped in the hydraulic system. Having air in the system can cause damage to the pump.

Procedure

1. Fill the hydraulic reservoir approximately 3/4 full of hydraulic fluid.

2. Unscrew the breather/filler cap from the reservoir.
3. Connect a pressure test hose to the MP port on the Main Control Valve.

4. Insert the other end of the pressure test hose into the hydraulic reservoir's breather/filler port.

NOTE: *Steps 5 and 6 require an assistant.*

5. From the Ground Control Console, momentarily (1 second maximum) activate the platform rotate switch and release.

6. Continue activating the platform rotate switch momentarily until the assistant sees a clear, uniform stream of hydraulic fluid flowing from the test hose into the hydraulic reservoir.

NOTE: *An audible change in the tone of the gear pump should be heard when the air is purged from the gear pump.*

7. Disconnect the pressure test hose from the MP port on the Main Control Valve.
8. Remove the hose end from the hydraulic reservoir's breather/filler port.
9. Install the breather/filler cap.

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 48 volt based motor control unit installed on the boom lift.

The JLG Control System has reduced the need for exposed terminal strips, diodes and trimpots and 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 motor controller will control current output, as programmed for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed into the motor controller. The motor controller also features an adjustable time limit for positive traction.

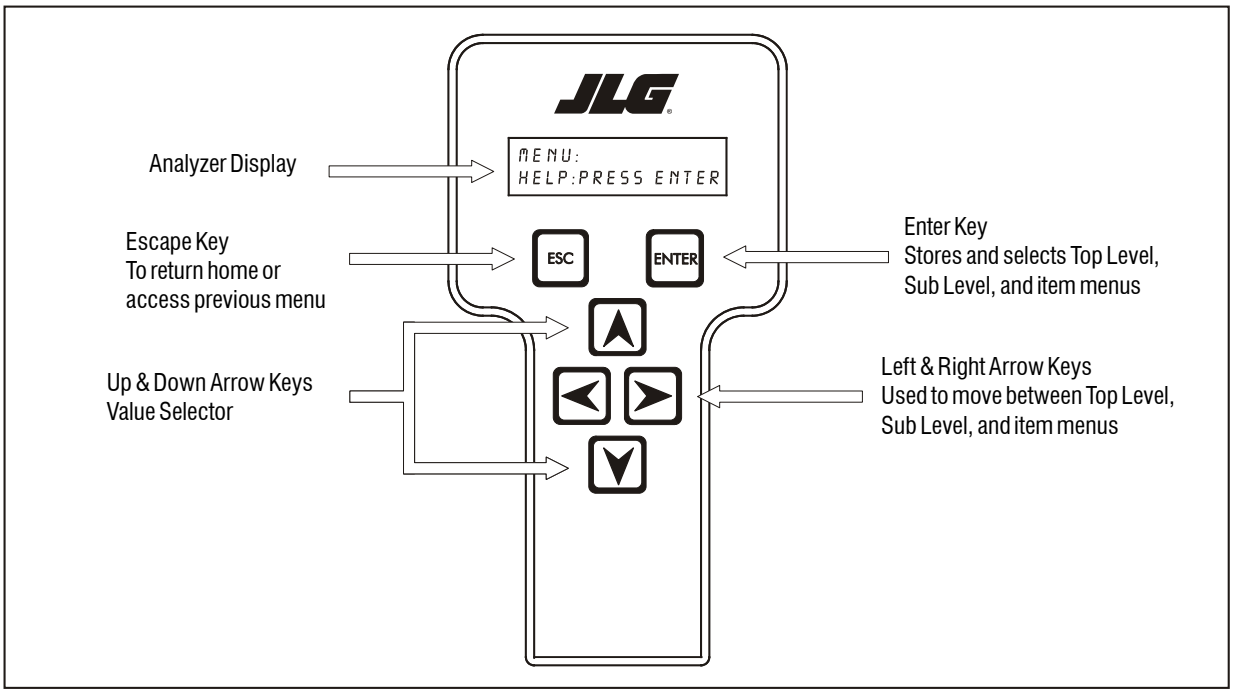


Figure 6-1. Hand Held Analyzer

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 an hour meter, beacon light, function cut-out, and ground alarm. These options may be added later but must be programmed into the motor 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.*

The following instructions are for using the hand held analyzer.

To Connect the JLG Control System Analyzer

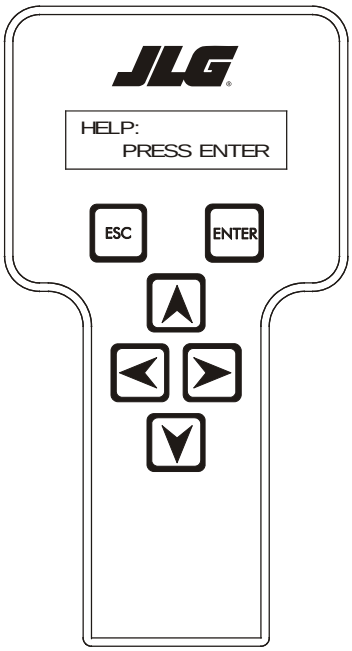
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

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

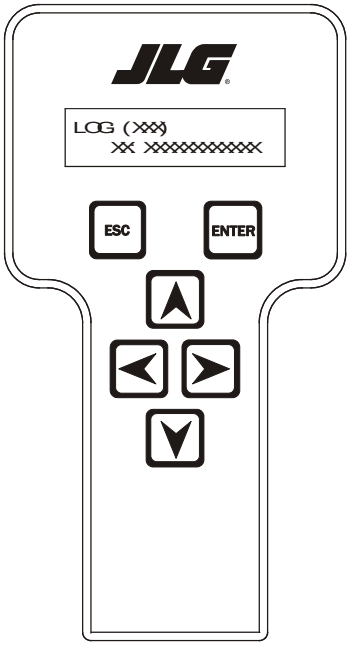
At this point, using the **RIGHT** and **LEFT** arrow keys, you can move between the top level menu items. To select a displayed menu item, press **ENTER**. To cancel a selected menu item, press ESC.; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

HELP
DIAGNOSTICS
ACTIVATE TEST
ACCESS LEVEL
PERSONALITIES
MACHINE SETUP
LEVEL VEHICLE (level 1 only)
CALIBRATIONS (view 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:



LOGGED HELP
1: STARTUP (2/1)

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. **STARTUP (2/1)** indicates a power up.

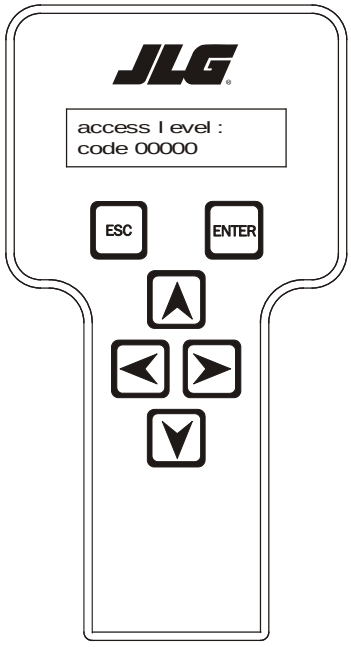
When a top level menu is selected, a new set of menu items may be offered: for example:

DRIVE
BOOM
SYSTEM
DATALOG
VERSIONS

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 access level 2. 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 access level 2 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 **ACCESS LEVEL** menu. For example:



ACCESS LEVEL:
CODE 00000

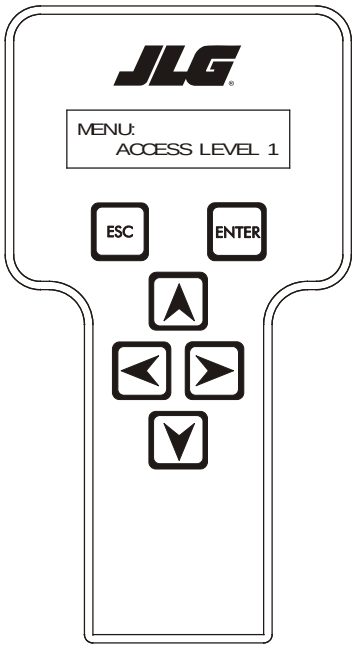
Press **ENTER** to select the **ACCESS LEVEL** menu.

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:

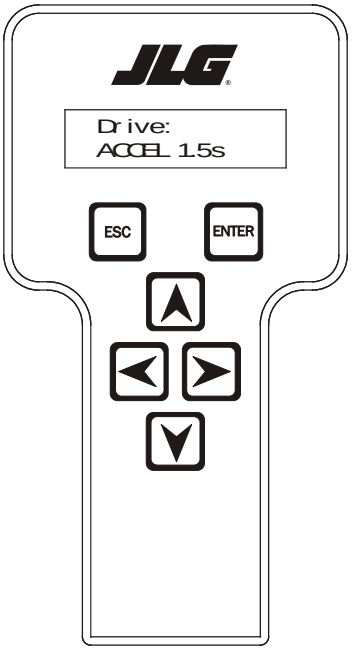


MENU:
ACCESS LEVEL 1

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 access to level 1, and a personality item is selected, press the UP or DOWN arrow keys to adjust its value, for example:

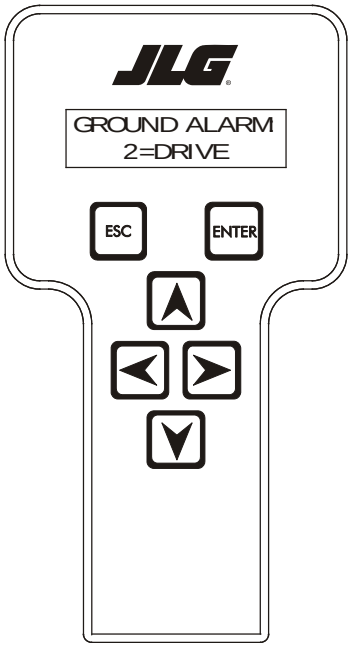


DRIVE:
ACCEL 1.5s

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 access level 1.

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 6-3, Personality Ranges/Defaults for the recommended factory settings.*

NOTE: *Password 33271 will give you access to level 1, which will permit you to change all machine personality settings.*

There is a setting that JLG strongly recommends that you do not change. This setting is so noted below:

ELEVATION CUTBACK

⚠ WARNING

CHANGING THIS SETTING MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

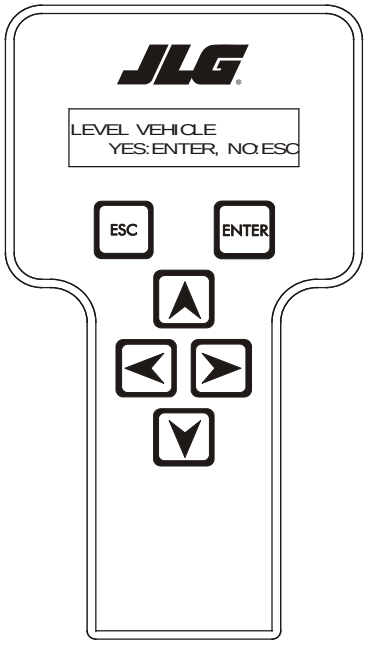
NOTICE

ITS 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 (30.5CM) 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.

Level Vehicle Description

⚠ WARNING

DO NOT LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.



LEVEL VEHICLE
YES:ENTER, NO:ESC

Not available at password level 2 ENTER confirms that vehicle is currently level, and zeroes the tilt sensor measurements

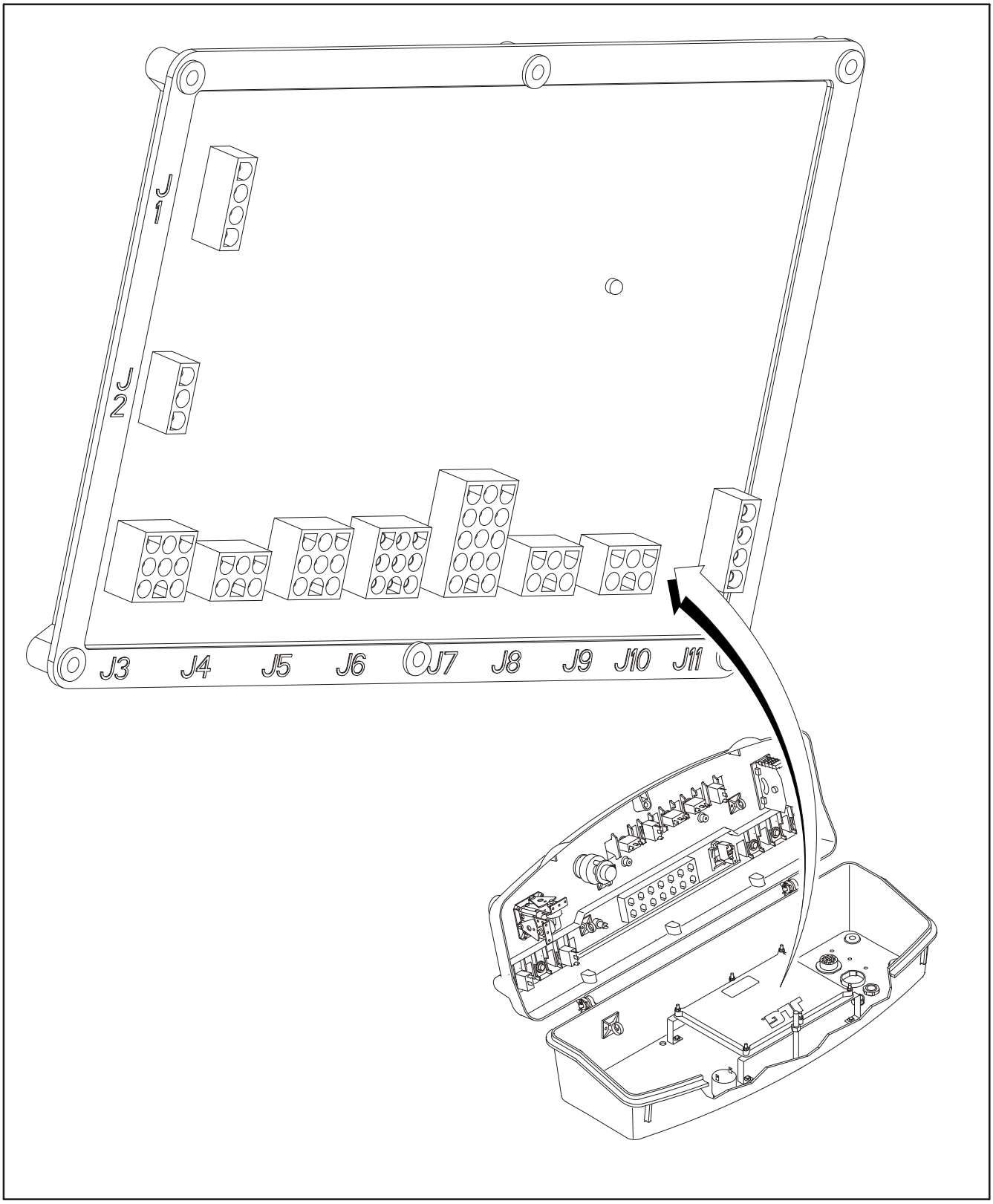


Figure 6-2. Platform Control Module Location - Sheet 1 of 2

POSITION	MATING CONNECTOR	MATING TERMINAL	PIN	FUNCTION	TYPE	
J1	4460321	4460226	1	ANALYZER PWR (12V)	POWER	OUTPUT
		4460226	2	RS-232 RECEIVE	SERIAL	INPUT
		4460226	3	RS-232 TRANSMIT	SERIAL	OUTPUT
		4460226	4	ANALYZER GROUND	POWER	OUTPUT
J2	4460326	4460226	1	N/C	N/C	N/C
		4460226	2	N/C	N/C	N/C
		4460226	3	LSS GROUND	N/C	N/C
J3	4460265	4460226	1	ANALOG POWER SUPPLY	AN-PWR	OUTPUT
		4460226	2	ANALOG MAIN LIFT INPUT	ANALOG	INPUT
		4460226	3	ANALOG GROUND RETURN	AN-PWR	INPUT
		4460226	4	ANALOG PWR SUPPLY	AN-PWR	OUTPUT
		4460226	5	ANALOG T/T SWING INPUT	ANALOG	INPUT
		4460226	6	ANALOG GROUND RETURN	AN-PWR	INPUT
		4460226	7	ANA MAIN LIFT CENTER TAP	ANALOG	INPUT
		4460226	8	ANA SWING CENTER TAP	ANALOG	INPUT
		4460226	9	N/C	N/C	N/C
J4	4460225	4460226	1	POWER OUTPUT (12V)	POWER	OUTPUT
		4460226	2	N/C	N/C	N/C
		4460226	3	CREEP SWITCH INPUT	DIGITAL	INPUT
		4460226	4	ANALOG PUMP SPEED INPUT	ANALOG	INPUT
		4460226	5	N/C	N/C	N/C
		4460226	6	ANALOG GROUND RETURN	AN-PWR	INPUT
J5	4460265	4460226	1	ANALOG PWR SUPPLY	AN-PWR	OUPUT
		4460226	2	ANALOG DRIVE INPUT	ANALOG	INPUT
		4460226	3	ANALOG GROUND RETURN	AN-PWR	INPUT
		4460226	4	STEER LEFT INPUT	DIGITAL	INPUT
		4460226	5	STEER RIGHT INPUT	DIGITAL	INPUT
		4460226	6	POWER OUTPUT (12V)	POWER	OUPUT
		4460226	7	ANALOG CENTER TAP	ANALOG	INPUT
		4460226	8	N/C	N/C	N/C
		4460226	9	N/C	N/C	N/C
J6	4460265	4460227	1	CREEP INDICATOR	DIGITAL	OUPUT
		4460227	2	LSS INDICATOR	DIGITAL	OUPUT
		4460227	3	PLATFORM ALARM	DIGITAL	OUPUT
		4460227	4	TRACTION CNTL INDICATOR	DIGITAL	OUPUT
		4460227	5	ENABLE INDICATOR	DIGITAL	OUPUT
		4460227	6	FAULT INDICATOR	DIGITAL	OUPUT
		4460227	7	DRIVE ORIENT INDICATOR	DIGITAL	OUPUT
		4460227	8	GROUND RETURN	POWER	INPUT
		4460227	9	TILT INDICATOR	DIGITAL	OUPUT

POSITION	MATING CONNECTOR	MATING TERMINAL	PIN	FUNCTION	TYPE	
J7	4460434	4460226	1	FSWIN	DIGITAL	INPUT
		4460226	2	SOFT TOUCH O/R INPUT	DIGITAL	INPUT
		4460226	3	PLATF LEVEL DOWN INPUT	DIGITAL	INPUT
		4460226	4	PLATF LEVEL UP INPUT	DIGITAL	INPUT
		4460226	5	BASKET ROT RIGHT INPUT	DIGITAL	INPUT
		4460226	6	BASKET ROT LEFT INPUT	DIGITAL	INPUT
		4460226	7	TELESCOPE OUT INPUT	DIGITAL	INPUT
		4460226	8	TELESCOPE IN INPUT	DIGITAL	INPUT
		4460226	9	TOWER LIFT DOWN INPUT	DIGITAL	INPUT
		4460226	10	N/C	N/C	N/C
		4460226	11	TOWER LIFT UP INPUT	DIGITAL	INPUT
		4460226	12	TRACTION CONTROL INPUT	DIGITAL	INPUT
		4460226	13	PLATF MOD GND RETURN	POWER	OUTPUT
		4460226	14	POWER OUTPUT (12V)	POWER	OUTPUT
		4460226	15	PLATF MOD PWR SUP (12V)	POWER	INPUT
J8	4460225	4460227	1	JIB UP INPUT	DIGITAL	INPUT
		4460227	2	JIB DOWN INPUT	DIGITAL	INPUT
		4460227	3	JIB SIDESWING LEFT INPUT	DIGITAL	INPUT
		4460227	4	JIB SIDESWING RT INPUT	DIGITAL	INPUT
		4460227	5	POWER OUTPUT (12V)	POWER	OUTPUT
		4460227	6	LSS	DIGITAL	INPUT
J9	4460225	4460227	1	DRIVE ORIENTATION INPUT	DIGITAL	INPUT
		4460227	2	HORN INPUT	DIGITAL	INPUT
		4460227	3	N/C	DIGITAL	INPUT
		4460227	4	N/C	DIGITAL	INPUT
		4460227	5	POWER OUTPUT (12V)	POWER	OUTPUT
		4460227	6	N/C	DIGITAL	INPUT
J11	4460321	4460227	1	N/C	N/C	N/C
		4460227	2	CAN HIGH	SERIAL	I/O
		4460227	3	CAN LOW	SERIAL	I/O
		4460227	4	CAN SHIELD	POWER	DRAIN

Figure 6-3. Platform Control Module Location - Sheet 2 of 2

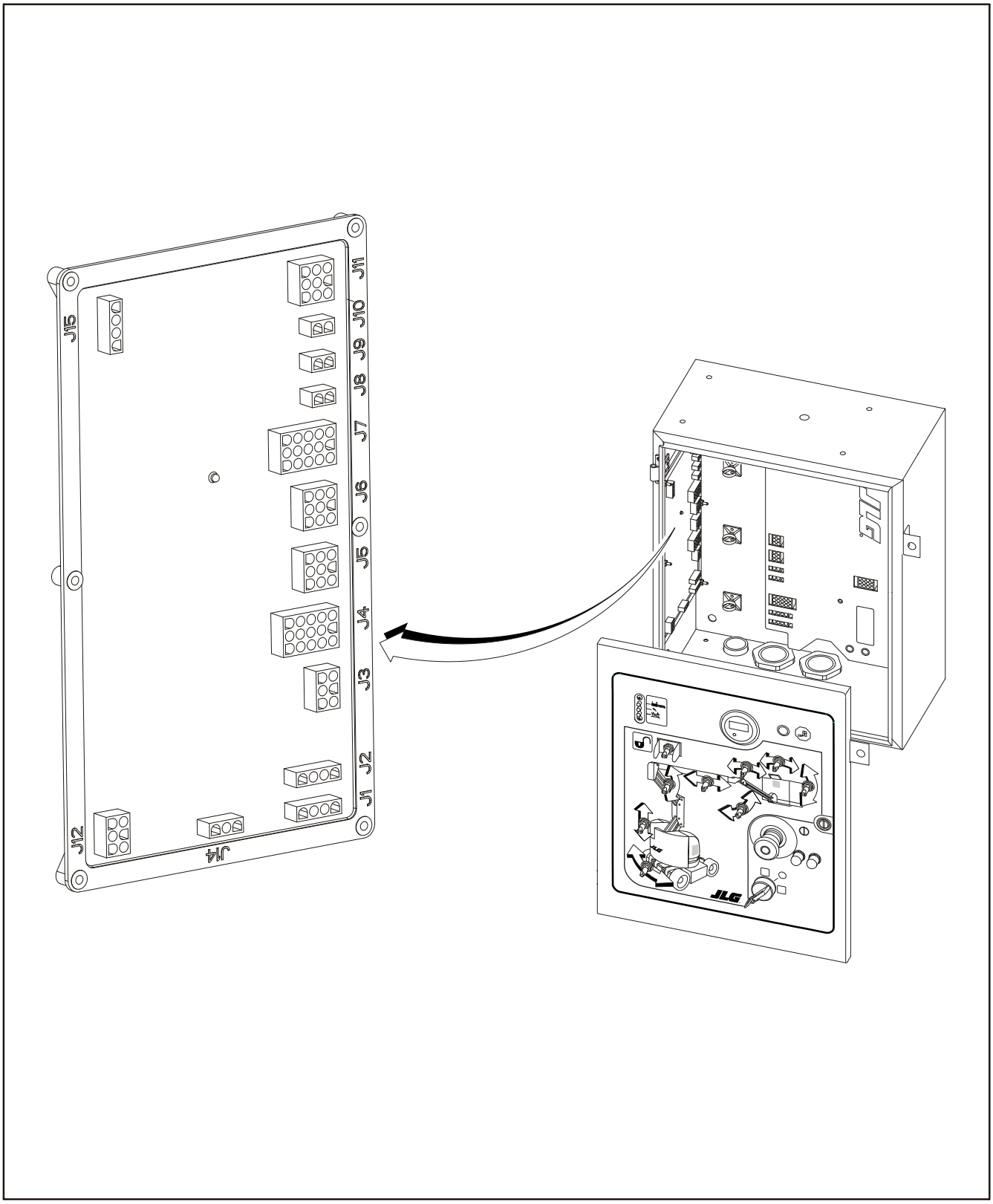


Figure 6-4. Ground Control Module Location - Sheet 1 of 2

POSITION	MATING CONNECTOR	TERMINAL	PIN	FUNCTION	TYPE		
J1	4460321	4460226	1	N/C	N/C	N/C	
		4460226	2	CAN HIGH (1)	SERIAL	I/O	
		4460226	3	CAN LOW (1)	SERIAL	I/O	
		4460226	4	CAN SHIELD (1)	POWER	DRAIN	
J2	4460321	4460226	1	N/C	N/C	N/C	
		4460226	2	CAN HIGH (1)	SERIAL	I/O	
		4460226	3	CAN LOW (1)	SERIAL	I/O	
		4460226	4	CAN SHIELD (1)	POWER	DRAIN	
J4	4460434	4460226	1	TOWER LIFT UP COIL	DIGITAL	OUTPUT	PWM2
		4460226	2	STEER LEFT COIL	DIGITAL	OUTPUT	
		4460226	3	STEER RIGHT COIL	DIGITAL	OUTPUT	
		4460226	4	MAIN LIFT UP COIL	DIGITAL	OUTPUT	PWM4
		4460226	5	MAIN LIFT DOWN COIL	DIGITAL	OUTPUT	PWM6
		4460226	6	TOWER LIFT DOWN COIL	DIGITAL	OUTPUT	PWM1
		4460226	7	T/T SWING LEFT COIL	DIGITAL	OUTPUT	PWM6
		4460226	8	T/T SWING RIGHT COIL	DIGITAL	OUTPUT	PWM8
		4460226	9	PLATF LEVEL UP COIL	DIGITAL	OUTPUT	PWM9
		4460226	10	PLATF LEVEL DOWN COIL	DIGITAL	OUTPUT	
		4460226	11	TELESCOPE IN COIL	DIGITAL	OUTPUT	
		4460226	12	N/C (SPARE PWM)	DIGITAL	OUTPUT	PWM7
		4460226	13	TELESCOPE OUT COIL	DIGITAL	OUTPUT	
		4460226	14	GROUND RETURN	POWER	INPUT	
		4460226	15	FLOW CONTROL COIL	DIGITAL	OUTPUT	PWM4
J5	4460265	4460227	1	PLATF ROTATE LEFT COIL	DIGITAL	OUTPUT	
		4460227	2	JIB SWING LEFT COIL	DIGITAL	OUTPUT	
		4460227	3	BRAKE RELEASE COIL	DIGITAL	OUTPUT	
		4460227	4	JIB UP COIL	DIGITAL	OUTPUT	
		4460227	5	PLATF ROTATE RIGHT COIL	DIGITAL	OUTPUT	
		4460227	6	MOTION ALARM (PWM)	DIGITAL	OUTPUT	PWM3
		4460227	7	JIB SWING RIGHT COIL	DIGITAL	OUTPUT	
		4460227	8	GROUND RETURN	POWER	INPUT	
		4460227	9	JIB DOWN COIL	DIGITAL	OUTPUT	
J6	4460265	4460226	1	N/C	DIGITAL	INPUT	
		4460226	2	N/C	DIGITAL	INPUT	
		4460226	3	N/C	DIGITAL	INPUT	
		4460226	4	N/C	DIGITAL	INPUT	
		4460226	5	JIB SWING LEFT INPUT	DIGITAL	INPUT	
		4460226	6	JIB SWING RIGHT INPUT	DIGITAL	INPUT	
		4460226	7	BRAKE SWITCH INPUT	DIGITAL	INPUT	
		4460226	8	POWER OUTPUT (12V)	POWER	OUTPUT	
		4460226	9	N/C	DIGITAL	INPUT	

POSITION	MATING CONNECTOR	TERMINAL	PIN	FUNCTION	TYPE		
J7	4460434	4460227	1	TOWER LIFT UP INPUT	DIGITAL	INPUT	
		4460227	2	TOWER LIFT DOWN INPUT	DIGITAL	INPUT	
		4460227	3	MAIN LIFT UP INPUT	DIGITAL	INPUT	
		4460227	4	MAIN LIFT DOWN INPUT	DIGITAL	INPUT	
		4460227	5	T/T SWING LEFT INPUT	DIGITAL	INPUT	
		4460227	6	T/T SWING RIGHT INPUT	DIGITAL	INPUT	
		4460227	7	PLATF LEVEL UP INPUT	DIGITAL	INPUT	
		4460227	8	PLATF LEVEL DOWN INPUT	DIGITAL	INPUT	
		4460227	9	TELESCOPE IN INPUT	DIGITAL	INPUT	
		4460227	10	TELESCOPE OUT INPUT	DIGITAL	INPUT	
		4460227	11	BASKET ROT LEFT INPUT	DIGITAL	INPUT	
		4460227	12	BASKET ROT RIGHT INPUT	DIGITAL	INPUT	
		4460227	13	JIB UP INPUT	DIGITAL	INPUT	
		4460227	14	POWER OUTPUT (12V)	POWER	OUTPUT	
		4460227	15	JIB DOWN INPUT	DIGITAL	INPUT	
J8	4460320	4460226	1	CHGR INTERLOCK INPUT	DIGITAL	INPUT	
		4460226	2	POWER OUTPUT (12V)	POWER	OUTPUT	
J9	4460320	4460227	1	ELEVATION LIMIT INPUT	DIGITAL	INPUT	
		4460227	2	POWER OUTPUT (12V)	POWER	OUTPUT	
J10	4460320	4460226	1	DRIVE ORIENT SW INPUT	DIGITAL	INPUT	
		4460226	2	POWER OUTPUT (12V)	POWER	OUTPUT	
J11	4460265	4460227	1	LSS INDICATOR	DIGITAL	OUTPUT	
		4460227	2	N/C	DIGITAL	OUTPUT	
		4460227	3	NOT POPULATED	DIGITAL	OUTPUT	
		4460227	4	GROUND ALARM POWER	DIGITAL	OUTPUT	
		4460227	5	NOT POPULATED	DIGITAL	OUTPUT	
		4460227	6	N/C	DIGITAL	OUTPUT	
		4460227	7	N/C	DIGITAL	OUTPUT	
		4460227	8	GROUND RETURN	POWER	INPUT	
		4460227	9	N/C	DIGITAL	OUTPUT	
J12	4460225	4460227	1	12V POWER INPUT	POWER	INPUT	
		4460227	2	PLATF PWR PASS THRU	POWER	OUTPUT	
		4460227	3	12 POWER INPUT	POWER	INPUT	
		4460227	4	PCB GROUND CONCTN	POWER	INPUT	
		4460227	5	PCB GROUND CONCTN	POWER	OUTPUT	
		4460227	6	PCB GROUND CONCTN	POWER	OUTPUT	
J14	4460326	4460227	1	CAN HIGH (2)	SERIAL	I/O	
		4460227	2	CAN LOW (2)	SERIAL	I/O	
		4460227	3	CAN SHIELD (2)	POWER	DRAIN	
J15	4460321	4460227	1	ANALYZER POWER	POWER	OUTPUT	
		4460227	2	ANALYZER RS-232 Rx	SERIAL	INPUT	
		4460227	3	ANALYZER RS-232 Tx	SERIAL	INPUT	
		4460227	4	ANALYZER GROUND	POWER	INPUT	

Figure 6-5. Ground Control Module Location - Sheet 2 of 2

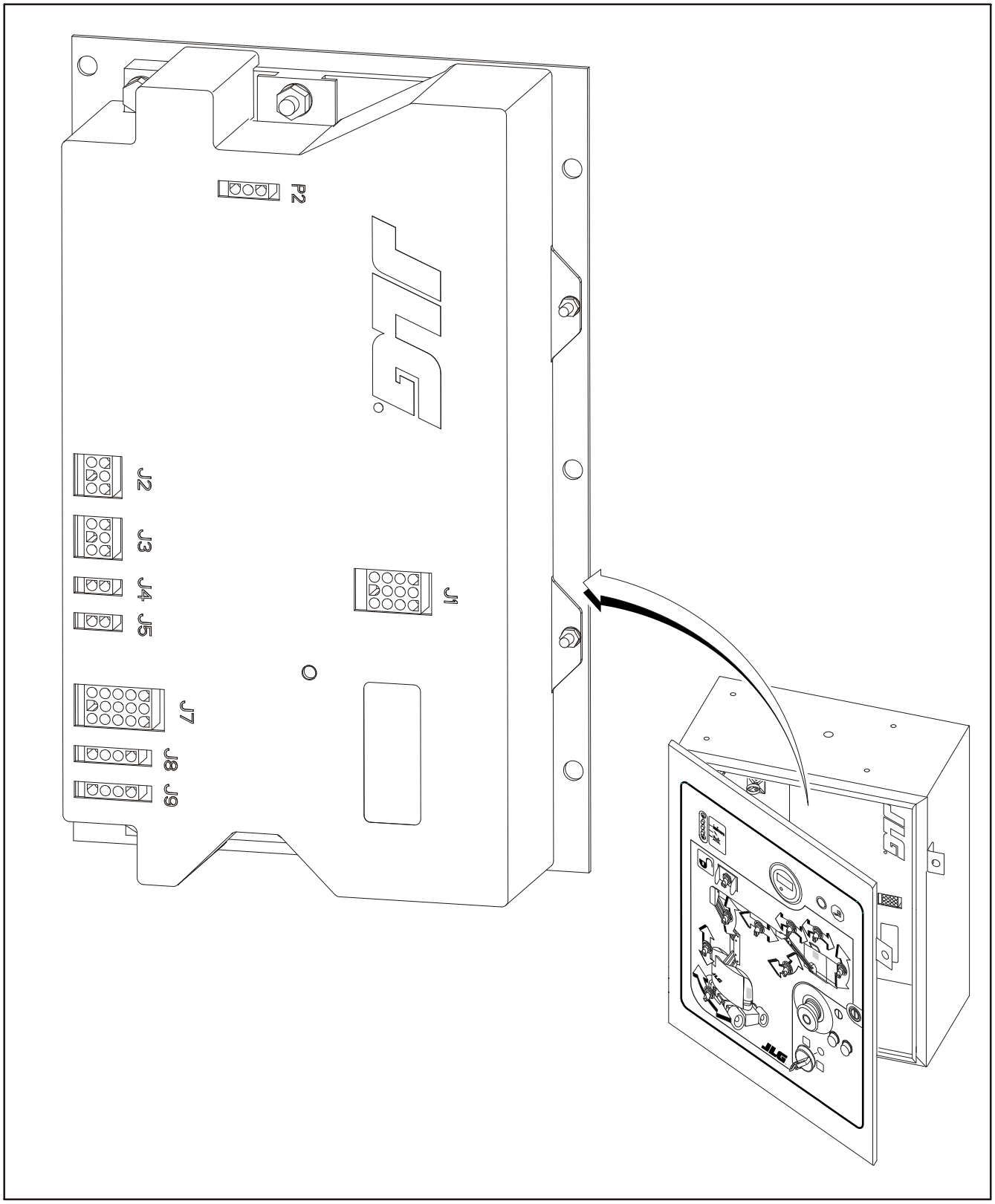


Figure 6-6. Power Module Location - Sheet 1 of 2

CONNECTOR	PIN	TAGNAME	FUNCTION	TYPE	
J1	1	PLTEMS	PLATFORM EMS	VBAT	INPUT
	2	GNDEMS	GROUND EMS	VBAT	INPUT
	3	FSW IN	FOOTSWITCH	DIGITAL	INPUT
	4	IGN	GROUND MODULE POWER	+12V	OUTPUT
	5	FSW OUT	FOOTSWITCH SIGNAL PASSTHROUGH	DIGITAL	OUTPUT
	6	IGN	GROUND MODULE POWER	+12V	OUTPUT
	7	IGN	TILT MODULE POWER	+12V	OUTPUT
	8	GND	GROUND MODULE GROUND	GROUND	INPUT
	9	N/C	NOT CONNECTED	+12V	OUTPUT
	10	GND	TILT MODULE GROUND	GROUND	INPUT
	11	GND	GROUND MODULE GROUND	GROUND	INPUT
	12	N/C	NOT CONNECTED	GROUND	INPUT
J2	1	CONT	MAIN CONTACTOR	DIGITAL	OUTPUT
	2	FWD	DRIVE FORWARD	DIGITAL	OUTPUT
	3	REV	DRIVE REVERSE	DIGITAL	OUTPUT
	4	N/C	NOT CONNECTED	GROUND	INPUT
	5	GND	GROUND	GROUND	INPUT
	6	N/C	NOT CONNECTED	GROUND	INPUT
J3	1	IGN	SPEED ENCODER POWER	+12V	OUTPUT
	2	SPD	SPEED ENCODER SIGNAL	DIGITAL	INPUT
	3	GND	SPEED ENCODER GROUND	GROUND	INPUT
	4	DIR	SPEED ENCODER DIRECTION	DIGITAL	INPUT
	5	N/C	NOT CONNECTED	N/C	N/C
	6	N/C	NOT CONNECTED	N/C	N/C
J4	1	N/C	NOT CONNECTED	DIGITAL	INPUT
	2	N/C	NOT CONNECTED	+12V	OUTPUT
J5	1	N/C	NOT CONNECTED	DIGITAL	INPUT
	2	N/C	NOT CONNECTED	+12V	OUTPUT
J7	1	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	2	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	3	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	4	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	5	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	6	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	7	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	8	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	9	N/C	NOT CONNECTED	DIGITAL	INPUT
	10	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	11	N/C	NOT CONNECTED	N/C	N/C
	12	N/C	NOT CONNECTED	DIGITAL	INPUT
	13	N/C	NOT CONNECTED	DIGITAL	OUTPUT
	14	N/C	NOT CONNECTED	GROUND	INPUT
	15	N/C	NOT CONNECTED	+12V	OUTPUT
J8	1	N/C	NOT CONNECTED	N/C	N/C
	2	CANH	CAN HIGH	SERIAL	I/O
	3	CANL	CAN LOW	SERIAL	I/O
	4	CANSHD	CAN SHIELD	GROUND	INPUT
J9	1	ANLPWR	ANALYZER POWER	+12V	OUTPUT
	2	ANLRX	ANALYZER RS-232 Rx	SERIAL	INPUT
	3	ANLTX	ANALYZER RS-232 Tx	SERIAL	OUTPUT
	4	ANLGND	ANALYZER GROUND	GROUND	INPUT
P2	1	SHNTREF	SHUNT REFERENCE	ANALOG	INPUT
	2	TRATCUR	TRACTION CURRENT SHUNT	ANALOG	INPUT
	3	PUMPCUR	PUMP CURRENT SHUNT	ANALOG	INPUT

Figure 6-7. Power Module Location - Sheet 2 of 2

CONNECTOR	PIN	TAG NAME	FUNCTION	TYPE	
J1	1	ENCPWR	POWER OUTPUT (12V)	POWER	OUTPUT
	2	SPD	SPEED	DIGITAL	INPUT
	3	GND	GROUND RETURN	POWER	INPUT
	4	DIR	DIRECTION	DIGITAL	INPUT
	5	N/C	N/C	N/C	N/C
	6	N/C	N/C	N/C	N/C

CONNECTOR	PIN	TAG NAME	FUNCTION	TYPE	
J2	1	N/C	N/C	N/C	N/C
	2	CANH	CAN HIGH	SERIAL	I/O
	3	CANL	CAN LOW	SERIAL	I/O
	4	SHD	CAN SHIELD	POWER	DRAIN

CONNECTOR	PIN	TAG NAME	FUNCTION	TYPE	
J3	1	N/C	N/C	N/C	N/C
	2	CANH	CAN HIGH	SERIAL	I/O
	3	CANL	CAN LOW	SERIAL	I/O
	4	SHD	CAN SHIELD	POWER	DRAIN

CONNECTOR	PIN	TAG NAME	FUNCTION	TYPE	
J4	1	FSWIN	FOOR SWITCH INPUT	DIGITAL	INPUT
	2	ING	12V POWER INPUT	POWER	INPUT
	3	GND	PCB GROUND COONECTION	POWER	OUTPUT

CONNECTOR	PIN	TAG NAME	FUNCTION	TYPE	
J5	1	GND	GROUND RETURN	POWER	INPUT
	2	ARMB	ARMATURE B	POWER	OUTPUT
	3	ARMA	ARMATURE A	POWER	OUTPUT

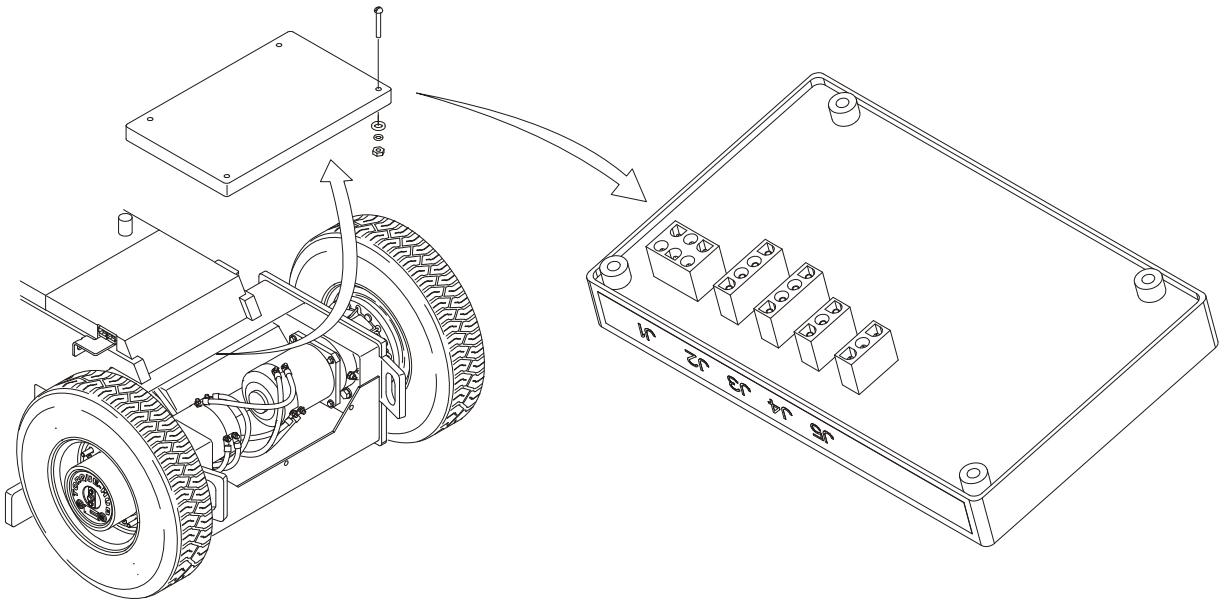


Figure 6-8. Tilt Module Location

Table 6-1. Analyzer Abbreviations

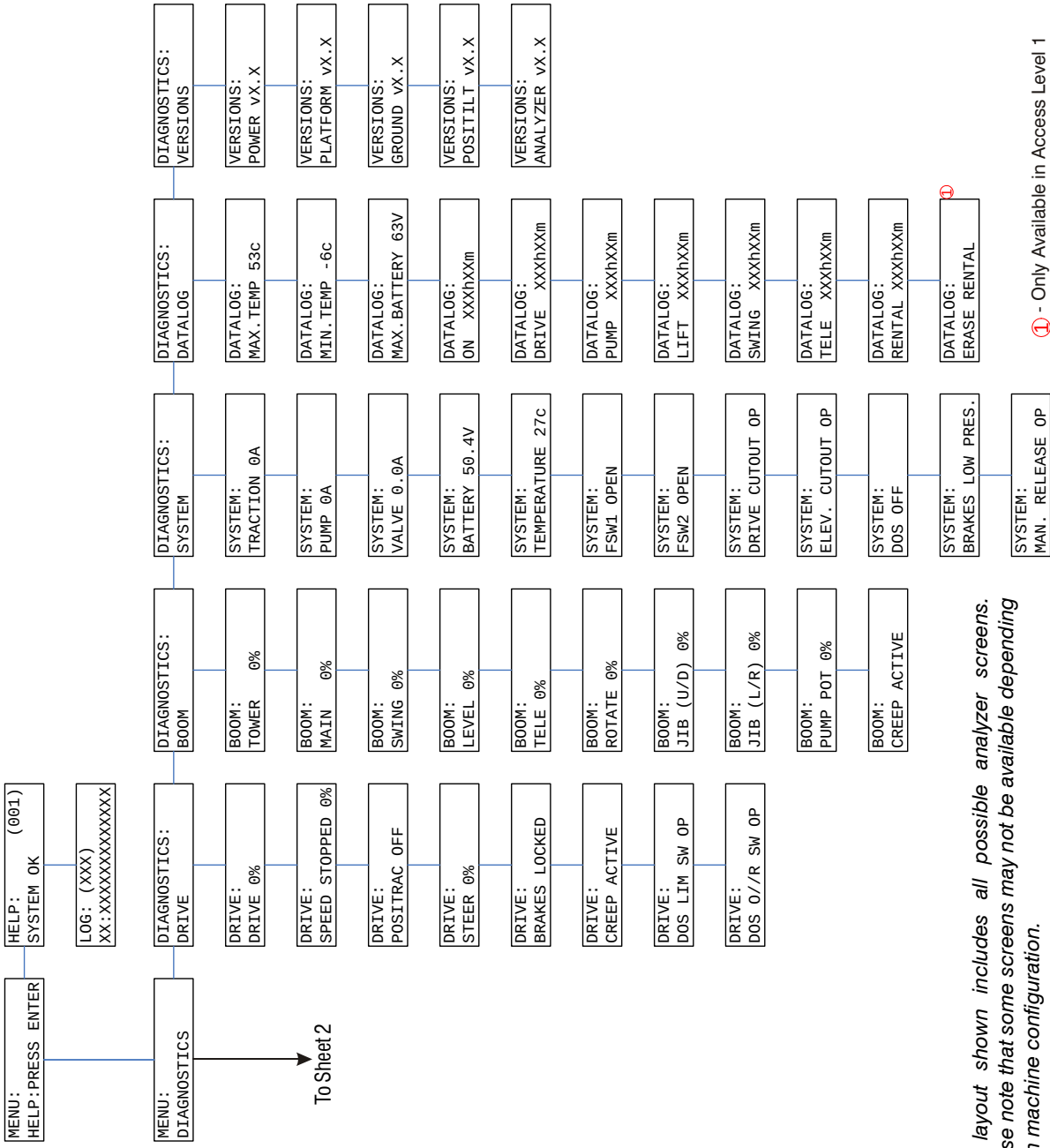
ABBREVIATION	MEANING
ACCEL	ACCELERATE
ACT	ACTIVE
A/D	ANALOG DIGITAL CONVERTER COUNT
AMB.	AMBIENT
ANG	ANGLE
AUX	AUXILIARY
BCS	BOOM CONTROL SYSTEM
BM	BOOM LENGTH ANGLE MODULE
BLAM	BOOM LENGTH ANGLE MODULE
BR	BROKEN
BSK	BASKET
CAL	CALIBRATION
CL	CLOSED
CM	CHASSIS MODULE
CNTL	CONTROL
CNTRL	CONTROL
C/O	CUT 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
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
ROT.	ROTATE
RT	RIGHT

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
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



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-9. Analyzer Flow Chart (Software Version 3.x) - Sheet 1 of 3

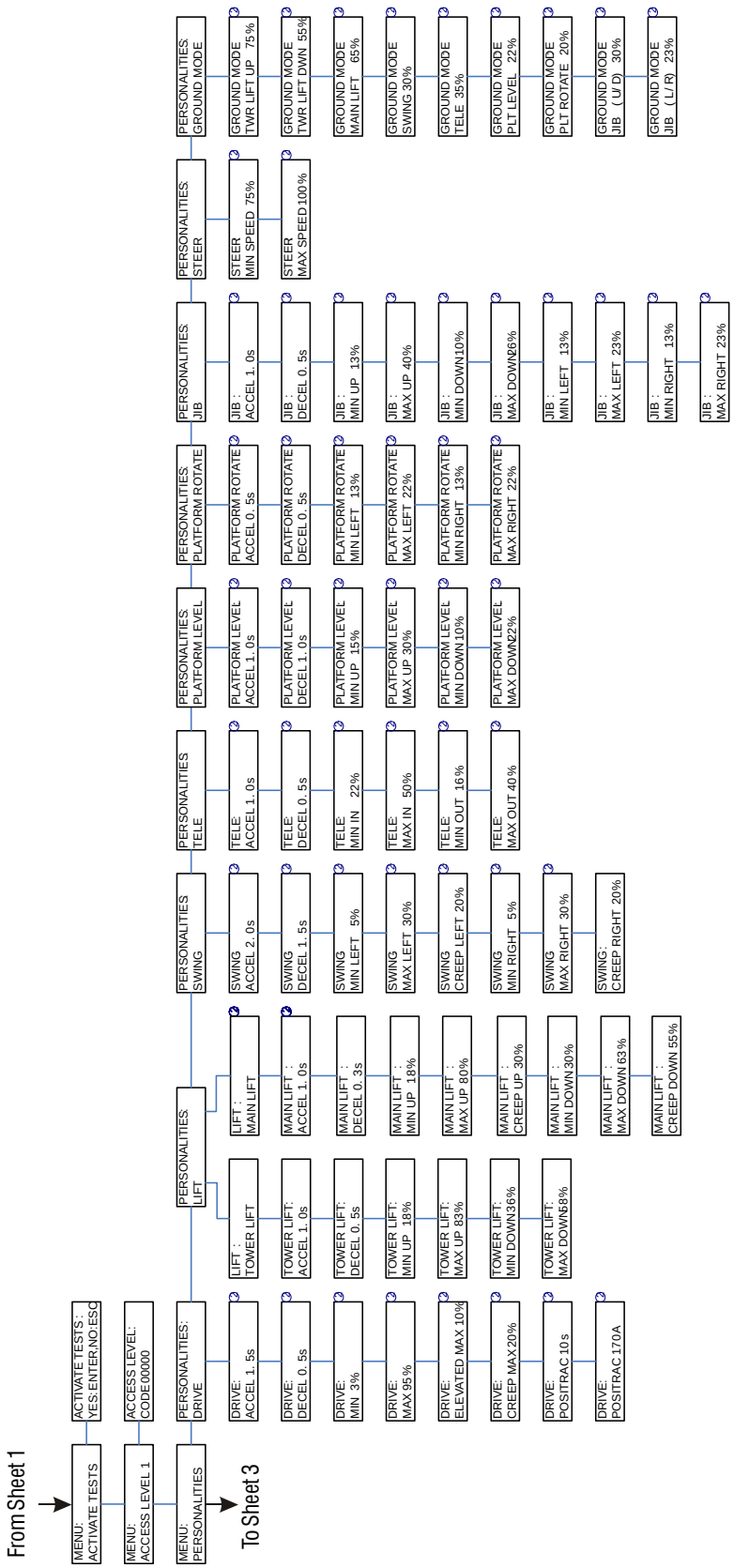
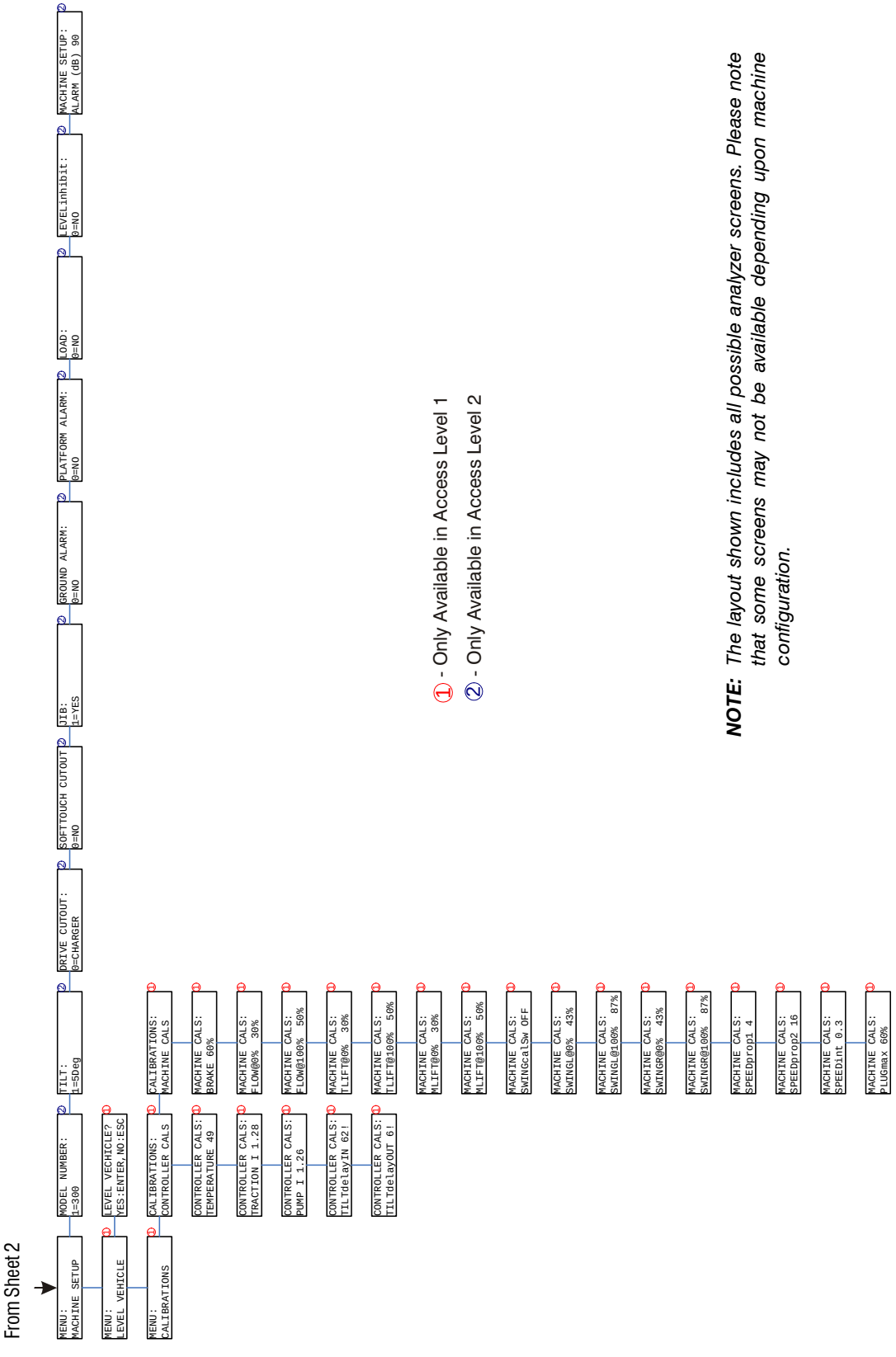


Figure 6-10. Analyzer Flow Chart (Software Version 3.x) - Sheet 2 of 3

NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*



① - Only Available in Access Level 1

② - Only Available in Access Level 2

NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-11. Analyzer Flow Chart (Software Version 3.x) - Sheet 3 of 3

Table 6-2. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
NOTE: *When configuring the E300 machine, 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 values.*			
1 (Model #)	1 2 3	300 400 450	1
2 (Tilt Switch)	1 2 3 4	**5Deg -** reduces the maximum speed of all boom functions to creep when tilted and above elevation. Reduces drive speed to creep when tilted. **Domestic and Japan** **3Deg** - reduces the maximum speed of all boom functions to creep when tilted and above elevation. Reduces drive speed to creep when tilted. **European and Australian** **3Deg CUTOUT** - drive and reduce boom functions to creep speed when tilted and above elevation. Reduces drive speed to creep when tilted only. **Option** **3Deg CUTOUT BOOM** - cuts out drive, telescope out, Main boom, lift up and reduces all other boom functions to creep speed when tilted and above elevation. **Option** **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 tilted and above elevation.	1
3 (Drive Cutout)	0 1 2	**CHARGER -** Battery Charger Cutout-cuts out drive when the battery charger is plugged in. **CHARGER & BOOM -** Battery Charger Cutout and Simultaneous Drive and Boom Functions disabled above elevation. **Europe and Australia** **CHARGER & ELEV -** Battery Charger Cutout and Drive Cutout above elevation. **Option**	0
4 (Soft Touch)	0 1	**NO -** No Function Cutout **BOOM & DRIVE -** Cuts out all functions when switch opens. **Option**	0
5 (JIB)	0 1 2	**NO -** JIB Not installed. **YES -** JIB installed which has up and down movements only. **Option** **SIDESWING -** JIB installed which has up and down movements and side to side movements. **Option**	0
6 (Ground Alarm)	0 1 2 3	**NO -** No ground alarm installed. **DRIVE -** Travel alarm- Sounds when the drive function is active. Option **LIFT DOWN -** Descent Alarm- Sounds when either lift down is active. Option **BOOM & DRIVE -** Motion alarm- Sounds when any function is active. **Option**	0

Table 6-2. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
7 (Platform Alarm)	0 1	**No** - Sounds continuously when above elevation and tilted only. **Fault Code** - Sounds continuously when above elevation and tilted, and in conjunction with fault code flashes. **Option**	0
8 (Load)	0 1 2 3	NO - No Load Cell Installed WARN ONLY - Warn if overload is detected CUTOUT PLT - Cuts out Platform functions if overload is detected CUTOUT ALL - Cuts out ALL functions if overload is detected	0
9 (Level inhibit)	0 1	NO ELEV - Platform level can not operated when boom is raised above transport position	0
10 (ALARM dB)		Adjusts output of alarm Range 90 - 107 dB	90

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Table 6-3. Personality Ranges/Defaults

Adjustment	Adjustment Range	Default Value
DRIVE		
ACCEL	0.5 to 5 sec	1.5s
DECEL	0.1 to 2 sec	0.5s
MIN	0 to 25%	3%
MAX	0 to 100%	95%
ELEVATED MAX	0 to 25%	20%
CREEP MAX	0 to 45%	30%
POSITRAC	0 to 60 sec	10s
POSITRAC	50 to 250 amps	170A
LIFT LOWER LIFT		
ACCEL	0.5 to 5 sec	1.0s
DECEL	0.1 to 3.0 sec	0.5s
MIN UP	0 to 50%	18%
MAX UP	0 to 100%	83%
MIN DOWN	0 to 50%	36%
MAX DOWN	0 to 100%	58%
LIFT UPPER LIFT		
ACCEL	0.5 to 5 sec	1.0s
DECEL	0.1 to 3 sec	0.3s
MIN UP	0 to 50%	18%
MAX UP	0 to 100%	80%
CREEP UP	0 to 50%	30%
MIN DOWN	0 to 50%	20%
MAX DOWN	0 to 100%	63%
CREEP DOWN	0 to 80%	55%
SWING		
ACCEL	0.5 to 5 sec	2.0s
DECEL	0.1 to 3 sec	1.5s
MIN LEFT	0 to 50%	5%
MAX LEFT	0 to 100%	30%
CREEP LEFT	0 to 100%	20%
MIN RIGHT	0 to 50%	5%
MAX RIGHT	0 to 100%	30%
CREEP RIGHT	0 to 100%	20%
TELE		
ACCEL	0.5 to 5 sec	1.0s
DECEL	0.1 to 3 sec	0.5s
MIN IN	0 to 50%	22%
MAX IN	0 to 100%	45%

Table 6-3. Personality Ranges/Defaults

Adjustment	Adjustment Range	Default Value
MIN OUT	0 to 50%	16%
MAX OUT	0 to 100%	35%
PLATFORM LEVEL		
ACCEL	0.5 to 5 sec	1.0s
DECEL	0.1 to 3 sec	1.0s
MIN UP	0 to 50%	15%
MAX UP	0 to 80%	30%
MIN DOWN	0 to 50%	10%
MAX DOWN	0 to 80%	22%
PLATFORM ROTATE		
ACCEL	0.1 to 5 sec	0.5s
DECEL	0.1 to 3 sec	0.5s
MIN LEFT	0 to 50%	13%
MAX LEFT	0 to 100%	22%
MIN RIGHT	0 to 50%	13%
MAX RIGHT	0 to 100%	22%
JIB		
ACCEL	0.5 to 5.0 sec	1.0s
DECEL	0.1 to 3 sec	0.5s
MIN UP	0 to 50%	13%
MAX UP	0 to 100%	40%
MIN DOWN	0 to 50%	10%
MAX DOWN	0 to 100%	26%
MIN LEFT	0 to 50%	13%
MAX LEFT	0 to 100%	23%
MIN RIGHT	0 to 50%	13%
MAX RIGHT	0 to 100%	23%
STEER		
MIN SPEED	0 to 100%	75%
MAX SPEED	0 to 100%	100%
GROUND MODE		
L.LIFT UP	0 to 100%	75%
L.LIFT DOWN	0 to 100%	55%
UPPER LIFT	0 to 100%	65%
SWING	0 to 100%	30%
TELE	0 to 100%	35%
PLT.LEVEL	0 to 100%	22%
PLT.ROTATE	0 to 100%	20%
JIB (U/D)	0 to 100%	30%
JIB (L/R)	0 to 100%	23%
NOTE: *Personality settings can be adjusted anywhere within the adjustment range in order to achieve optimum machine performance.*		

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Table 6-4. E300 Diagnostic Fault Codes

DTC	Flash Code	Fault Message	Description
001	00	EVERYTHING OK	The "normal" help message in platform mode
002	00	GROUND MODE OK	The "normal" help message in ground mode
0010	00	RUNNING AT CUTBACK - OUT OF TRANSPORT POSITION	Drive speed is limited to "ELEVATED MAX" while the vehicle is out of transport position.
0011	00	FSW OPEN	A drive or boom function has been selected but footswitch is open.
0012	00	RUNNING AT CREEP - CREEP SWITCH OPEN	All function speeds are limited to creep because the creep switch is open.
0013	00	RUNNING AT CREEP - TILTED AND ABOVE ELEVATION	All function speeds are limited to creep because the vehicle is tilted and above elevation.
0032	00	PUMP MOTOR AT CURRENT LIMIT	Pump current has reached controller current limit or safe operating area limit.
0033	00	TRACTION MOTOR AT CURRENT LIMIT	Traction current has reached controller current limit or safe operating area limit.
0034	00	DRIVING AT CREEP - TILTED	Drive speed is limited to creep because the vehicle is tilted.
211	21	POWER CYCLE	The normal help message is issued at each power cycle.
212	21	KEYSWITCH FAULTY	Both Platform and Ground modes are selected simultaneously.
213	21	FSW FAULTY	Both Footswitch Inputs are closed for more then one second.
221	22	FUNCTION PROBLEM - HORN PERMANENTL Y SELECTED	Input was CLOSED during startup
224	22	FUNCTION PROBLEM - STEER LEFT PERMANENTLY SELECTED	The Steer Left Switch was closed during power-up.
225	22	FUNCTION PROBLEM - STEER RIGHT PERMANENTLY SELECTED	The Steer Right Switch was closed during power-up.
227	22	STEER SWITCHES FAULTY	Both Steer Left and Steer Right inputs are closed simultaneously.
2211	22	FSW INTERLOCK TRIPPED	The Footswitch was closed for more then seven seconds.
2212	22	DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	A drive function was selected with Footswitch open.
2213	22	STEER LOCKED - SELECTED BEFORE FOOTSWITCH	A steer function was selected with Footswitch open.
2221	22	LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	A lift / swing function was selected with Footswitch open.
2222	22	WAITING FOR FSW TO BE OPEN	The Footswitch was closed during Platform selection.
2245	22	FUNCTION PROBLEM - JIB SWING LEFT PERMANENTLY SELECTED	Input was CLOSED during startup
2246	22	FUNCTION PROBLEM - JIB SWING RIGHT PERMANENTLY SELECTED	Input was CLOSED during startup
2247	22	FUNCTION PROBLEM - PLATFORM ROTATE LEFT PERMANENTLY SELECTED	Input was CLOSED during startup
2248	22	FUNCTION PROBLEM - PLATFORM ROTATE RIGHT PERMANENTLY SELECTED	Input was CLOSED during startup
2249	22	FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED	Input was CLOSED during startup
2250	22	FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED	Input was CLOSED during startup
2251	22	FUNCTION PROBLEM - TELESCOPE IN PERMANENTLY SELECTED	Input was CLOSED during startup

Table 6-4. E300 Diagnostic Fault Codes

DTC	Flash Code	Fault Message	Description
2252	22	FUNCTION PROBLEM - TELESCOPE OUT PERMANENTLY SELECTED	Input was CLOSED during startup
2253	22	FUNCTION PROBLEM - SWING LEFT PERMANENTLY SELECTED	Input was CLOSED during startup
2254	22	FUNCTION PROBLEM - SWING RIGHT PERMANENTLY SELECTED	Input was CLOSED during startup
2255	22	FUNCTION PROBLEM - MAIN LIFT UP PERMANENTLY SELECTED	Input was CLOSED during startup
2256	22	FUNCTION PROBLEM - MAIN LIFT DOWN PERMANENTLY SELECTED	Input was CLOSED during startup
2257	22	FUNCTION PROBLEM - TOWER LIFT UP PERMANENTL Y SELECTED	Input was CLOSED during startup
2258	22	FUNCTION PROBLEM - TOWER LIFT DOWN PERMANENTLY SELECTED	Input was CLOSED during startup
2259	22	FUNCTION PROBLEM - DRIVE FORWARD PERMANENTLY SELECTED	Input was CLOSED during startup
2260	22	FUNCTION PROBLEM - DRIVE REVERSE PERMANENTL Y SELECTED	Input was CLOSED during startup
2261	22	FUNCTION PROBLEM - MULTIPLE SWITCHES PERMANENTL Y SELECTED	Input was CLOSED during startup
2262	22	FUNCTION PROBLEM - PLATFORM LEVEL UP PERMANENTLY SELECTED	Input was CLOSED during startup
2263	22	FUNCTION PROBLEM - PLATFORM LEVEL DOWN PERMA-NENTL Y SELECTED	Input was CLOSED during startup
2264	22	FUNCTION PROBLEM - DOS DOWN PERMANENTL Y SELECTED	Input was CLOSED during startup
2265	22	FUNCTION PROBLEM - POSI DOWN PERMANENTL Y SELECTED	Input was CLOSED during startup
2266	22	LIFT/SWING JOYSTICK FAULTY	Joystick was out of the Neutral position during startup
2267	22	DRIVE/STEER JOYSTICK FAULTY	Joystick was out of the Neutral position during startup
2268	22	JOYSTICKS FAULTY	Both Joysticks are faulty, or one joystick is faulting the 5 volt supply to both joysticks.
2376	23	SWING SWITCH FAULTY	Both states actively HIGH in Ground Mode
2387	23	JIB LIFT SWITCH FAULTY	Both states actively HIGH
2388	23	JIB SWING SWITCH FAULTY	Both states actively HIGH
2389	23	PLATFORM ROTATE SWITCH FAULTY	Both states actively HIGH
2390	23	TELESCOPE SWITCH FAULTY	Both states actively HIGH
2391	23	MAIN LIFT SWITCH FAULTY	Both states actively HIGH
2392	23	TOWER LIFT SWITCH FAULTY	Both states actively HIGH
2393	23	PLATFORM LEVEL SWITCH FAULTY	Both states actively HIGH
2394	23	PUMP POT FAULTY	Creep pot is OPEN circuit
2395	23	FUNCTION SWITCHES FAULTY	Function switch has both direction selected at the same time
253	25	DRIVE PREVENTED - CHARGER CONNECTED	Driving is not possible while the vehicle is charging
254	25	DRIVE & LIFT UP PREVENTED - CHARGER CONNECTED	Drive or Lift is not possible while the vehicle is charging AND is configured to prevent all motion.
2510	25	DRIVE PREVENTED - BRAKES NOT RELEASING	No Brake pressure was detected when running the pump motor and energizing the brake valve

Table 6-4. E300 Diagnostic Fault Codes

DTC	Flash Code	Fault Message	Description
2514	25	BOOM PREVENTED - DRIVE SELECTED	Boom functions are not possible while the vehicle is being driven AND is configured to not allow simultaneous drive & boom operation.
2516	25	DRIVE PREVENTED - ABOVE ELEVATION	Driving is not possible while Boom functions are selected AND is configured to not allow simultaneous drive & boom operation.
2517	25	DRIVE PREVENTED - TILTED & ABOVE ELEVATION	Driving is not possible while the vehicle is tilted and above elevation AND is configured to prevent drive while tilted and above elevation.
2518	25	DRIVE PREVENTED - BOOM SELECTED	Driving is not possible while the vehicle boom functions are selected AND is configured to not allow simultaneous drive & boom operation.
2536	25	ALL FUNCTIONS PREVENTED - FUNCTION CUTOUT	Machine Setup's set for "1 =CHARGER & BOOM" and machine is above elevation
2542	25	FUNCTION PREVENTED - BRAKES ELECTRONICALL Y RELEASED FOR TOWING	Indicates Manual Brake release active in Ground mode
2548	25	SYSTEM TEST MODE ACTIVE	System test mode active
2549	25	DRIVE & BOOM PREVENTED - SOFT TOUCH ACTIVE	Machine Setup's SOFT TOUCH is set for "2=BOOM & DRIVE" and Soft touch switch is OPEN
2550	25	BOOM PREVENTED - FUNCTION CUTOUT ACTIVE	Machine Setup's DRIVE CUTOUT is set for "1 =CHARGER & BOOM" and machine is above elevation
2551	25	TELESCOPE OUT PREVENTED - TIL TED & ABOVE ELEVATION	Telescope OUT is not possible while the vehicle is tilted and above elevation AND is configured to prevent drive while tilted and above elevation.
2552	25	LIFT UP PREVENTED - TILTED & ABOVE ELEVATION	Lift UP is not possible while the vehicle is tilted and above elevation AND is configured to prevent drive while tilted and above elevation.
2553	25	LEVELING PREVENTED - ABOVE ELEVATION	Machine Setup's LEVEL inhibit is set for "1 =ELEV" and machine is above elevation
2554	25	DRIVE PREVENTED - SPEED SENSORS FAULTY	Both Speed sensor input voltages are out of range
2555	25	FUNCTION PREVENTED - SELECTED BEFORE FSW	Function switch was selected before and during foot switch closure
2556	25	FUNCTION PREVENTED - SELECTED BEFORE EMS	Function was CLOSED at power up
321	32	LINE CONTACTOR WELDED OR MISWIRED	The capacitor bank charge did not decrease from battery supply when line contactor was de-energized (this could be caused due to a power wiring error)
325	32	LINE & DIRECTION CONTACTORS MISWIRED	When the line contactor was closed, traction point A went HIGH (and the capacitor bank charge did not increase to battery supply) - this occurs if the line contactor coil wiring is swapped with that for a direction contactor coil
33300	33	LINE CONTACTOR COIL - OPEN CIRCUIT	The capacitor bank did not increase to battery supply when the line contactor was CLOSED
33301	33	LINE CONT ACTOR COIL - SHORT TO GROUND	Line contactor was not energized when required, due to over current protection
33361	33	DIRECTION CONTACTOR COIL - OPEN CIRCUIT	Traction point A is collapsing when the traction MOSFETs are pulsed. This maybe due to an open circuit traction motor or power wiring error

Table 6-4. E300 Diagnostic Fault Codes

DTC	Flash Code	Fault Message	Description
33364	33	FORWARD CONTACTOR COIL - OPEN CIRCUIT	Traction point A did not go HIGH when forward contactor was energized. This maybe due to an open circuit traction motor or power wiring error
33369	33	REVERSE CONTACTOR COIL - OPEN CIRCUIT	Traction point A did not go HIGH when reverse contactor was energized. This maybe due to an open circuit traction motor or power wiring error
33370	33	FORWARD CONTACTOR COIL - SHORT CIRCUIT	The forward contactor was not energized when required, due to over current protection
33371	33	REVERSE CONTACTOR COIL - SHORT CIRCUIT	The reverse contactor was not energized when required, due to over current protection
33411	33	VALVE SUPPLY OVERLOADED	There is a high current draw from the valve supply when no valve is energized; this maybe due to a wiring error at the ground module
421	42	POWER MODULE TOO HOT - PLEASE WAIT	Controller heat sink temperature reached 75*C, the controller is shut down until it cools to below 70*C
441	44	BATTERY VOLTAGE TOO LOW - SYSTEM SHUTDOWN	Battery voltage is below 33 volts EMS recycle is required
442	44	BATTERY VOLTAGE TOO HIGH - SYSTEM SHUTDOWN	Battery voltage is above 62 volts, EMS recycle is required
445	44	BATTERY VOLTAGE LOW	Battery voltage is below 40 volts, this is only a warning, the controller does not shut down
469	46	VEHICLE OVERSPEED	Speed in the wrong direction was measured with the traction motor full ON. This maybe due to a faulty speed sensor being installed incorrectly; it could also be due to a speed sensor fault or faults for NO VEHICLE MOVEMENT DETECTED with the vehicle on a grade
4610	46	RIGHT SPEED SENSOR - NOT RESPONDING PROPERL Y	The right speed sensor is indicating an impossible number of pulses, this maybe due to a faulty speed sensor
4611	46	LEFT SPEED SENSOR - NOT RESPONDING PROPERL Y	The left speed sensor is indicating an impossible number of pulses, this maybe due to a faulty speed sensor
4615	46	SPEED SENSOR - INVALID READING	Both speed sensors are indicating impossible number of pulses, this maybe due to a faulty speed sensor
4616	46	BRAKES DID NOT LOCK	Brake pressure did not clear when the brake valve was de- energized
4617	46	NO VEHICLE MOVEMENT DETECTED AT MAXIMUM POWER	No speed was measured with the traction motor full ON. This could be due to a traction motor fault, a power wiring error, a speed sensor fault, the brakes not releasing (though brake pressure is OK) or the vehicle being overloaded so that the motor cannot turn the wheels
661	66	CANBUS FAILURE - POWER MODULE	Power Module CAN communication lost.
662	66	CAN BUS FAILURE - PLATFORM MODULE	Platform Module CAN communication lost.
6631	66	CAN BUS FAILURE - GROUND MODULE	Ground Module CAN communication lost.
6636	66	CANBUS FAILURE - TILT MODULE	Tilt Module CAN communication lost.
772	77	STALLED TRACTION MOTOR OR POWER WIRING ERROR	The power module traction MOSFET protection circuit is active, This is due to a massive current drain and could be a stalled traction motor or a power wiring error
773	77	CAPACITOR BANK FAULT - CHECK POWER CIRCUITS	The capacitor bank is not charging, this maybe due to a power wiring error causing illegal current drain or a very low battery voltage

Table 6-4. E300 Diagnostic Fault Codes

DTC	Flash Code	Fault Message	Description
776	77	STALLED PUMP MOTOR OR POWER WIRING ERROR	The power module pump MOSFET protection circuit is active, This is due to a massive current drain and could be a stalled pump motor or a power wiring error
777	77	OPEN CIRCUIT PUMP MOTOR WIRING	Pump point A is collapsing when the pump MOSFETs are pulsed, this maybe due to an OPEN circuit pump motor or a power wiring error
7734	77	TRACTION A HIGH - CHECK POWER CIRCUITS	Traction point A is near battery supply when neither direction contactor is energized and the traction MOSFETs are OFF, this maybe due to a welded direction contactor or a power wiring error
7735	77	TRACTION A LOW - CHECK POWER CIRCUITS	Traction point A is near ZERO volts when neither direction contactor is energized and the traction MOSFETs are OFF, this maybe due to a power wiring error
7736	77	TRACTION MOTOR OVERLOADED	The traction motor has been operating in current limit at a low percentage on for a long time greater than 10 seconds
7737	77	PUMP MOTOR OVERLOADED	The pump motor has been operating in current limit at a low percentage on for a long time greater than 10 seconds
7738	77	PUMP A LOW - CHECK POWER CIRCUITS	Pump point A is near ZERO volts when the pump MOSFETs are OFF, this maybe due to a power wiring error
7739	77	B+ AND A CROSSED - CHECK POWER CIRCUITS	startup test detected B+ is connected to point A and point A is connected to B+
7740	77	TRACTION CURRENT AT ZERO - CHECK SHUNT WIRING	Traction current is at ZERO, this maybe due to an open circuit between the current measurement shunt and the power module
826	82	RUNNING AT CREEP - PLATFORM OVERLOADED	All functions at creep, the Load Sensing System indicates the Platform is overloaded AND is configured to warn only while the Platform is overloaded.
827	82	DRIVE & BOOM PREVENTED - PLATFORM OVERLOADED	Driving and boom functions are not possible while the Load Sensing System indicates the Platform is overloaded AND is configured to prevent drive and boom functions while the Platform is overloaded.
99125	99	POWER MODULE FAILURE - HWFS CODE 2	Hardware failsafe tests did not com plete because traction point A is not safe, or the hardware failsafe is permanently tripped
99126	99	POWER MODULE FAILURE - HWFS CODE 3	Hardware failsafe tests did not complete because a contactor was energized when all should be turned off
99127	99	POWER MODULE FAILURE - HWFS CODE 4	Hardware failsafe tests did not complete because the hardware failsafe tripped immediately when the traction MOSFETs were turned ON
99128	99	POWER MODULE FAILURE - HWFS CODE 10	Hardware failsafe tests failed because the hardware failsafe did not trip within the allowed test time
99129	99	POWER MODULE FAILURE - HWFS CODE 11	Hardware failsafe tests failed because the hardware failsafe tripped too slowly
99130	99	POWER MODULE FAILURE - HWFS CODE 12	Hardware failsafe tests failed because the hardware failsafe tripped too Quickly
99131	99	POWER MODULE FAILURE - HWFS CODE 13	Hardware failsafe tests failed because the hardware failsafe remained tripped when the traction MOSFETs were turned OFF
99132	99	POWER MODULE FAILURE - HWFS CODE 14	Hardware failsafe tests failed because the hardware failsafe the line contactor could not be energized when the hardware failsafe was tripped

Table 6-4. E300 Diagnostic Fault Codes

DTC	Flash Code	Fault Message	Description
99133	99	POWER MODULE FAILURE - HWFS CODE 15	Hardware failsafe tests failed because the hardware failsafe the contactor drive failsafe did not trip within the allowed test time
99134	99	POWER MODULE FAILURE - HWFS CODE 16	Hardware failsafe tests failed because the hardware failsafe the contactor drive failsafe tripped tooslowly
99135	99	POWER MODULE FAILURE - HWFS CODE 17	Hardware failsafe tests failed because the hardware failsafe the drive contactor failsafe tripped too quickly
99136	99	POWER MODULE FAILURE - HWFS TEST STALLED	Hardware failsafe tests did not complete, but no reason can be determined
99137	99	POWER MODULE FAILURE - LINE CONTACTOR DRIVER	The line contactor energized when the footswitch was CLOSED before it was ON, this maybe due to a failed driver within the power module, or a power wiring error
99138	99	POWER MODULE FAILURE - TEMPERATURE SENSOR	The temperature sensor measurement is invalid, this maybe due to a disconnected wire within the power module.
99139	99	POWER MODULE FAILURE - CONTACTOR CODE 1	A contactor remained energized when turned OFF
99140	99	TILT MODULE FAILURE - INTERNAL ERROR	Startup test detected faulty tilt sensors, or voltages on the tilt sensor are bad (could be caused if positilt is mounted upside down or vertical
99141	99	GROUND MODULE - OBSOLETE ON THIS VEHICLE	The power module determined the hardware version of the Ground module was incompatible with the current software
99142	99	48V PROTECTION TRIPPED	The power module is not receiving acknowledgements from the platform module or ground module to transmitted data, and the protection circuit which supplies the platform and ground modules has tripped. This maybe due to wiring problems at the platform or groundmodule.

System Self Test

The system self test is utilized to locate typical problems. See Table 6-5, System Test Descriptions for information concerning the tests performed and available messages in this mode.

1. When the key switch is in the platform position and the self test enabled, the self test function will test all valves, contactors, platform inputs, indicator lamps, and system alarms for various fault conditions.

   When the key switch is in the ground position, the self test function will test all valves, the line contactor, ground control inputs, and the ground alarm output for various fault conditions.

2. In order to test the inputs on the machine, the controller will ask the service technician to perform various tasks at the appropriate operator control station. An example of this is “Close TWR U Switch”. The controller expects the operator to close the tower lift up switch. When the controller sees that the tower lift up switch has been closed, it will move on to the next input. If the switch is faulty or the wiring is faulty, the controller will not move on to the next input. The controller will continue to wait for the closure of the input. If the operator knows the switch is faulty and wants to continue the tests he must simply press the enter key on the analyzer to continue.

3. After the controller has conducted the tests from the chosen operator station, it will display “TESTS COMPLETE”. This indicates that the controller has checked all inputs and outputs for that station.

NOTICE

IN ORDER FOR THE MACHINE TO FUNCTION AFTER THE SELF TEST IS COMPLETE, POWER MUST BE RECYCLED USING THE EMS OR THE KEY SWITCH.

Table 6-5. System Test Descriptions

ACTIVATE TESTS YES:ENTER, NO:ESC	Not available once tests are activated ENTER activates system tests NOTE: cannot be done while controller is in use (footswitch closed) and for a short time afterwards
RUN SYSTEM TEST	ENTER starts system test Not available until tests are activated Displays messages while system test runs Some messages are prompts, requiring user intervention. ENTER can be pressed if a fault is found, to confirm that the fault has been noted and to continue the system test. NOTE: a flashing message is critical, and prevents the system test running

Table 6-6. System Test Messages

RUNNING	Initial display when system test is run; certain "critical" checks are made. **Problems which can be reported** include: ONLY 1 ANALYZER! Do not connect two Analyzers while running the system test. BAD POWER WIRING The capacitor bank is not charged or pump point A is low or traction point A is high or low. Check all power wiring. LINE CONT WELDED The capacitor bank is at battery voltage. Check line contactor. Check all power wiring. BATTERY TOO LOW The system test cannot run with battery voltage below minimum. BATTERY TOO HIGH The system test cannot run with battery voltage above maximum. CHECK CAN WIRING The system test cannot run in platform mode unless data is being received from the platform, ground and positrac/tilt modules. The system test cannot run in ground mode unless data is being received from the ground and positrac/tilt modules. CHECK LEFT SPD. There is an open- or short- circuit in the left speed encoder wiring. Check left speed encoder. CHECK RIGHT SPD. There is an open- or short- circuit in the right speed encoder wiring. Check right speed encoder. CHECK SHUNT The traction current measurement is open-circuit. Check wiring between power module contactor panel. BAD PUMP WIRING Pump point A is not high, probably caused by an open-circuit pump motor or wiring. Check all power wiring. Check pump motor. BAD POWER WIRING Traction point A is high, probably caused by incorrect faction motor wiring. Check all power wiring. Check traction motor. BAD POWER MODULE An internal problem was detected in the power module. HIGH TILT ANGLE The vehicle is very tilted, or the tilt sensor has been damaged. Check tilt sensor. HOT POWER MODULE The heat sink temperature exceeds 75°C; this is only a warning. BAD I/O PORTS The controller detected a problem with its internal circuits at switch on. If other problems are also detected, the controller may need replacing. SUSPECT EEPROM The controller detected a problem with its EEPROM stored personality settings at switch on. Check and, if necessary correct, all personality settings. WAIT:CAPBANK HI This message can be displayed if the system test is run shortly after the vehicle was used; after a short wait, it should clear. OPEN FWS In platform mode, the footswitch must be open at the start of the test. CLOSE FWS In platform mode, the footswitch must be closed when this message is displayed; the foot switch MUST BE KEPT CLOSED during the valve & contactor tests. BAD FWS The two footswitch signals are not changing together, probably because one is open-circuit. One footswitch signal ("FSW1") is routed to the power module, the other ("FSW2") is routed to the platform module. Check footswitch and wiring.

Table 6-6. System Test Messages

TESTING VALVES	Indicates that the valve test is beginning. Each valve is alternately energized and de-energized; checks are made for open-and short- circuit valve coils. The valves are tested in the order: STEER L, STEER R, BRAKE, FLOW, TWR U, MAIN U, SWING L, SWING R, LEVEL U, LEVEL D, ROTATE L, ROTATE R, JIB U, JIB D, JIB L, JIB R, TELE I, TELE O NOTE: in platform mode, the footswitch must be closed. NOTE: jib valves are not tested if JIB = NO NOTE: left/right jib are not tested unless jib = side swing. NOTE: Tower Down and Main Down valves are not be tested by system test. **Problems which can be reported include:** CANT TEST VALVES There is a wiring problem which prevents the valve test from functioning correctly. Check valve wiring. Check ground alarm wiring. valve name S/C The named valve is drawing too much current so is presumed to be short-circuit. Check valve wiring. valve name O/C The named valve is drawing too little current so is presumed to be open-circuit. Check valve wiring.
VALVE TEST DONE	Indicates that the valve test is complete (with or without faults).
TESTING CONTS	Indicates that the contactor test is beginning. In platform mode, the forward & reverse direction contactors are energized and de-energized; checks are made that they close & open correctly and for short-circuit coils. In platform and ground mode, the line contactor is energized and de-energized; checks are made that it closed & opened correctly and for a short-circuit coil. In platform mode, the positrac contactors are energized and de-energized; checks are made for short-circuit and open-circuit coils. **Problems which can be reported include:** CANT TEST CONTS There is a wiring problem which prevents the contactor test from functioning correctly. Check power wiring. Check contactor wiring. BAD CONT WIRING There is a wiring problem which caused the capacitor bank to be charged when a direction contactor was energized; probably the wiring to the contactor coils is incorrect. Check contactor wiring. Check power wiring. contname WELDED The named contactor appears to have not opened. Check named contactor. Check power wiring. contname COIL S/C The named contactor coil overloaded its driver circuit so is presumed to be short-circuit. Check contactor wiring. contname DIDN'T CLOSE The named contactor appears to have not closed. Check contactor wiring. Check power wiring.
CONT TEST DONE	Indicates that the contactor test is complete (with or without faults).

Table 6-6. System Test Messages

CHECKING INPUTS	Indicates that the inputs test is beginning. Every input is checked to ensure that it is in its "normal" position; function switches should be open, cutout switches should be closed, joysticks should be in neutral. In platform mode, inputs are tested in the order: MAIN U, MAIN D, SWING L, SWING R, SWING JOY, LEVEL U, LEVEL D, PUMP POT, ROTATE L, ROTATE R, TWR U, TWR D, JIB U, JIB D, JIB L, JIB R, TELE I, TELE O, DRIVE FWD, DRIVE REV, DRIVE JOY, STEER L, STEER R, POSITRAC, DRIVE C/O, ELEV C/O, FUNC. C/O, SOFT TOUCH, LOAD CELL, BRAKE PRES In ground mode, inputs are tested in the order: ROTATE L, ROTATE R, LEVEL U, LEVEL D, JIB U, JIB D, JIB L, JIB R, TELE I, TELE O, MAIN U, MAIN D, TWR U, TWR D, SWING L, SWING R, ELEV. C/O, FUNC. C/O, LOAD CELL, BRAKE PRES, MAN. BRAKE NOTE: switches which are not in use (due to the settings of machine digits) are not checked. NOTE: the pump pot is checked only for a wire-off condition; it can be at any demand from creep to maximum. **Problems which can be reported include:** CHECK switch name The named switch is not in its "normal" position. Check switch & wiring. CHECK switch name JOY. The named joystick appears to be faulty. Check joystick.
INPUTS DONE	Indicates that the inputs test is complete (with or without faults).
TESTING LAMPS	Indicates that the lamps test is beginning. Each lamp is energized in turn; a prompt asks for confirmation that the lamp is lit - ENTER must be pressed to continue the test. Lamps are tested in the order: ENABLE, FAULT, TILT, CREEP, POSITRAC, LOAD CELL NOTE: lamps which are not in use (due to the settings of machine digits) are not checked. NOTE: lamps are only tested in platform mode. **Problems which can be reported include:** lamp name S/C A short-circuit condition appeared while the named lamp was being tested, presumably because it is short-circuit.
LAMP TEST DONE	Indicates that the lamps test is complete.
TESTING ALARMS	Indicates that the alarms test is beginning. Each alarm is energized in turn; a prompt asks for confirmation that the alarm is sounding - ENTER must be pressed to continue the test. Alarms are tested in the order: P.ALARM, G.ALARM. NOTE: the platform alarm is only tested in platform mode. NOTE: the ground alarm is not tested if GROUND ALARM = NO. **Problems which can be reported include:** alarm name S/C A short-circuit condition appeared while the named alarm was being tested, presumably because it is short-circuit.
ALARM TEST DONE	Indicates that the alarms test is complete.

Table 6-6. System Test Messages

TEST ALL INPUTS?	Prompts whether to check every operator input. If ESC is pressed, the system test ends. If ENTER is pressed, each operator input is prompted for in turn. In platform mode, operator inputs are tested in the order: POSITRAC, MAIN U, MAIN D, SWING L, SWING R, LEVEL U, LEVEL D, PUMP POT, CREEP, ROTATE L, ROTATE R, TWR U, TWR D, JIB U, JIB D, JIB L, JIB R, TELE I, TELE O, DRIVE FWD, DRIVE REV, STEER L, STEER R In ground mode, operator inputs are tested in the order: ROTATE L, ROTATE R, LEVEL U, LEVEL D, JIB U, JIB D, JIB L, JIB R, TELE I, TELE O, MAIN U, MAIN D, TWR U, TWR D, SWING L, SWING R NOTE: the jib switches are not tested if JIB = NO. Prompts displayed during the operator input test include: CLOSE switch name The named switch should be closed. OPEN switch name The named switch should be opened. joystick name direction TO MAX The named joystick should be pushed to its full extent in the named direction. joystickname direction TO MIN The named joystick should be returned to neutral from the named direction. PUMP POT TO MAX The pump pot should be turned to maximum. PUMP POT TO MIN The pump pot should be turned to minimum. MULTIPLE CLOSURE More than one operator input is closed; if only one has been operated, there could be a short between two inputs.
TESTS COMPLETE	Indicates that the system test is complete. Any problems reported should have been noted and should now be rectified. Press ESC to return to the RUN SYSTEM TEST Analyzer menu.

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

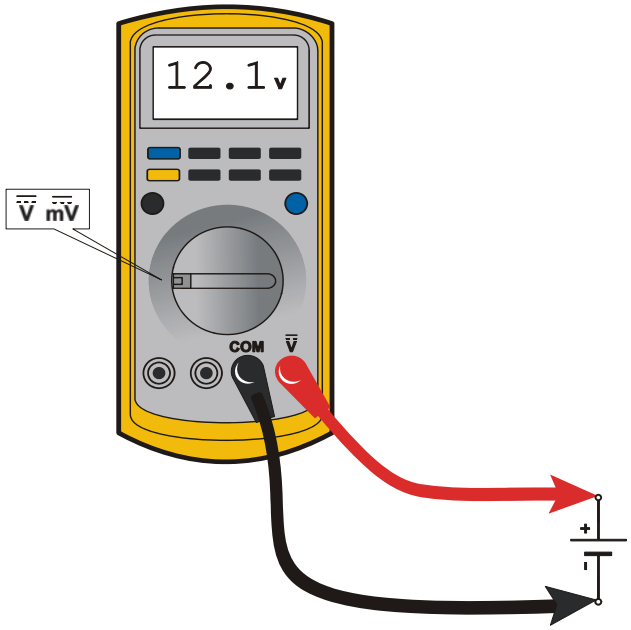


Figure 7-1. Voltage Measurement (DC)

- 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

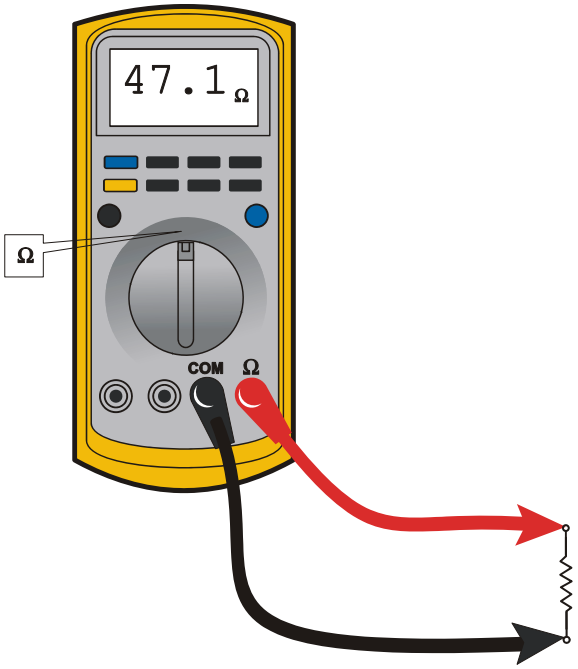


Figure 7-2. Resistance Measurement

- 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

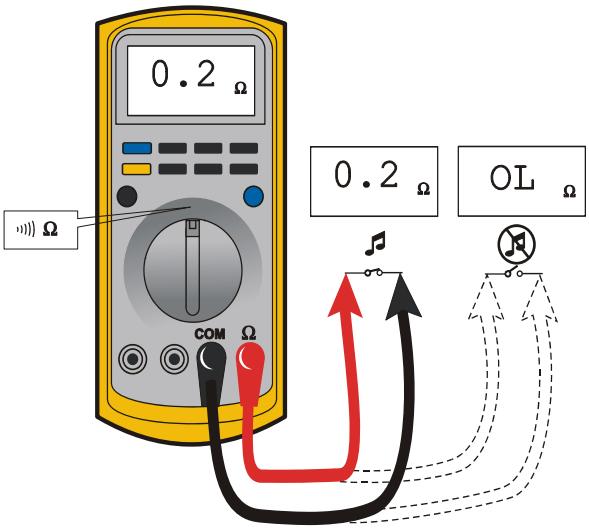


Figure 7-3. Continuity Measurement

- 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

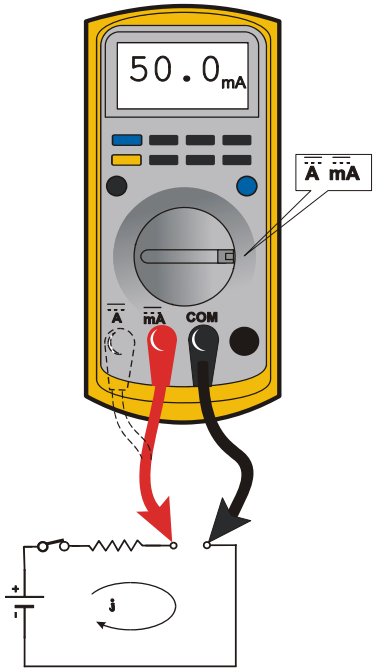


Figure 7-4. Current Measurement (DC)

- 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.*

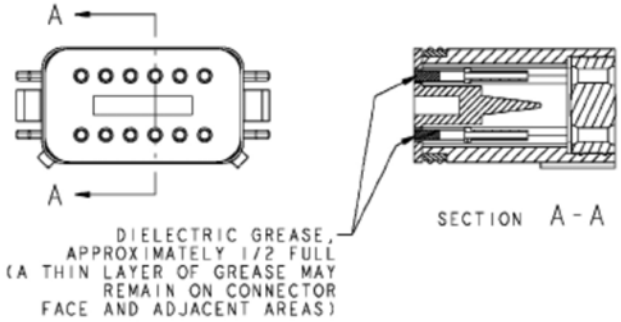
When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

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 female contact. 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 Female Contacts

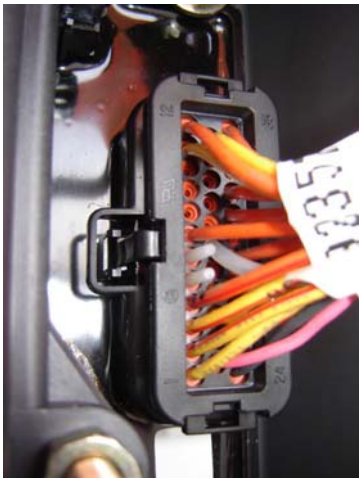
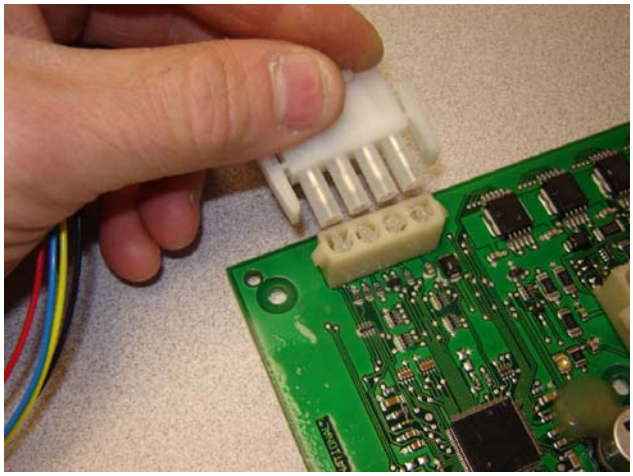


Figure 7-6. Use of Seal Plugs

AMP Mate-N-Lok

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 1250AJP Rotary Angle Sensors are examples of components with the M12 connector system.

AMP JUNIOR TIMER

This type of connector uses 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 EMR2 engine control module from Deutz employs this connector system (for example).

7.4 AMP CONNECTOR

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-7.). Proceed as follows:

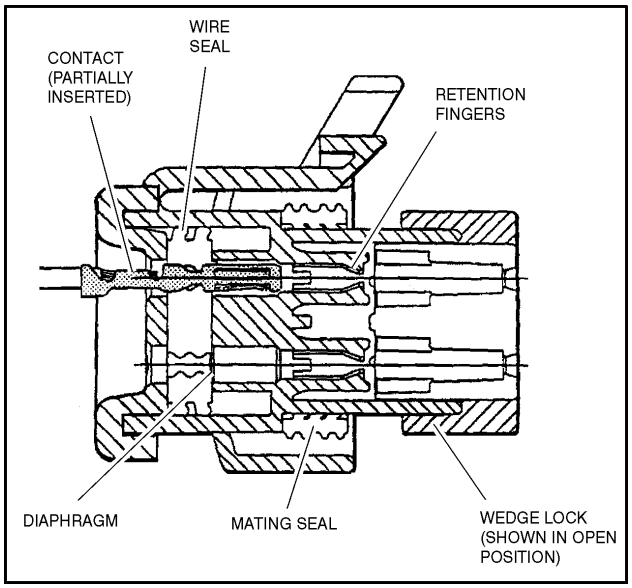


Figure 7-7. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-9.).
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 7-9.).

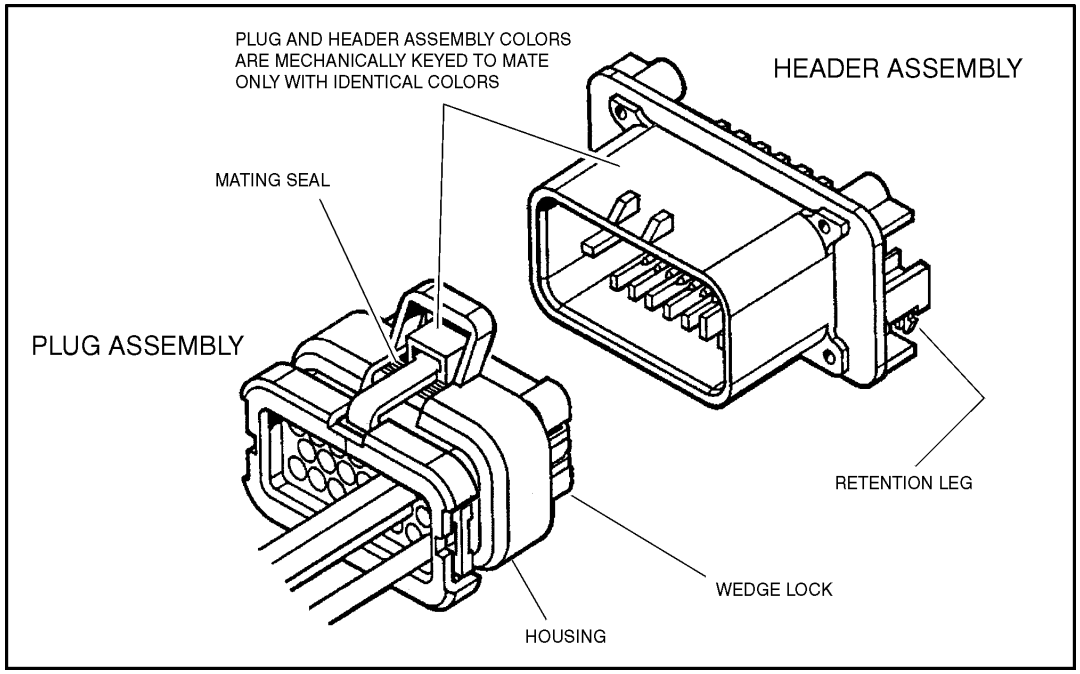


Figure 7-8. AMP Connector

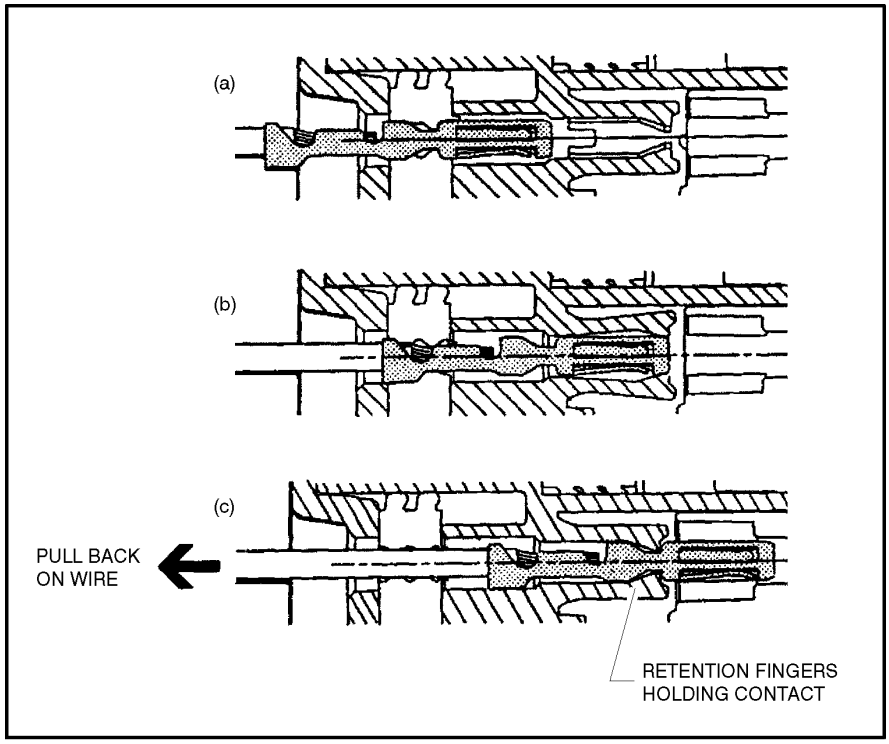


Figure 7-9. Connector Assembly Figure 2

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 7-10.).

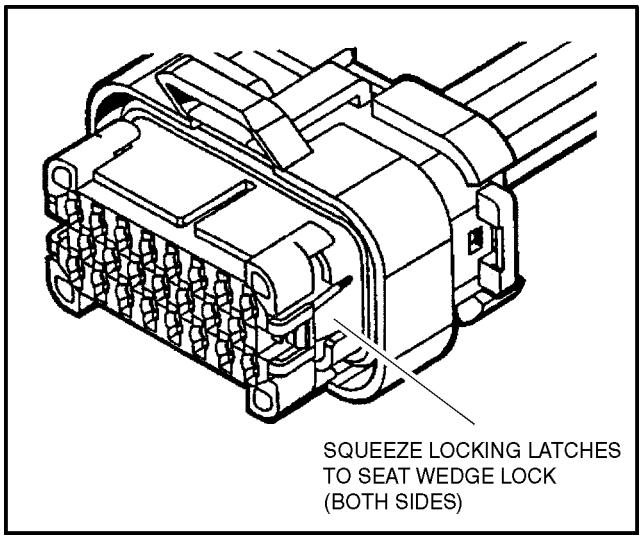


Figure 7-10. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-11.).

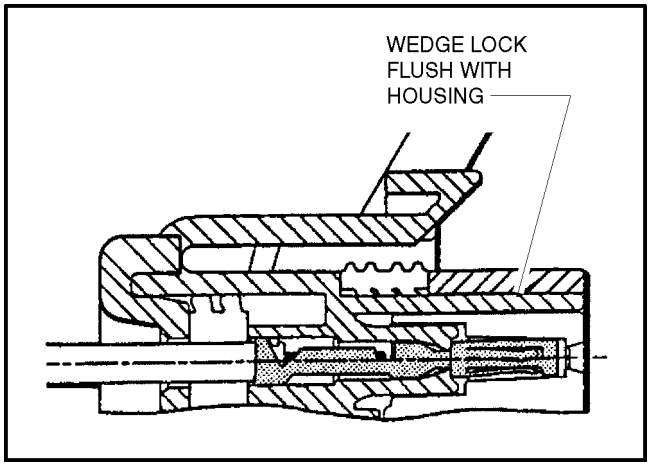


Figure 7-11. Connector Assembly Figure 4

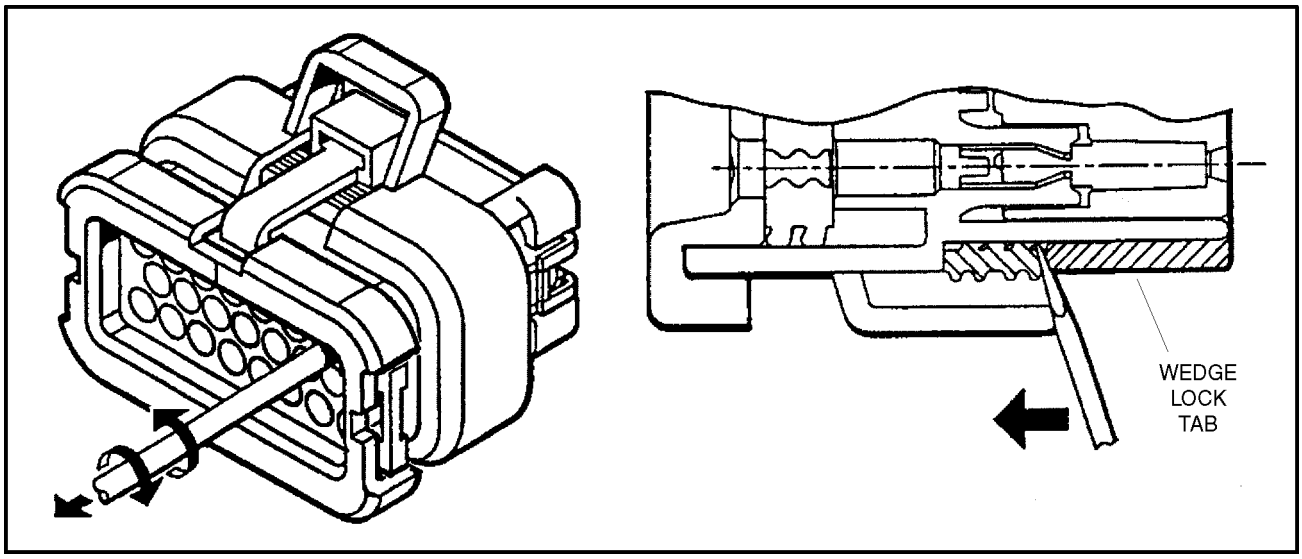


Figure 7-12. Connector Disassembly

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.

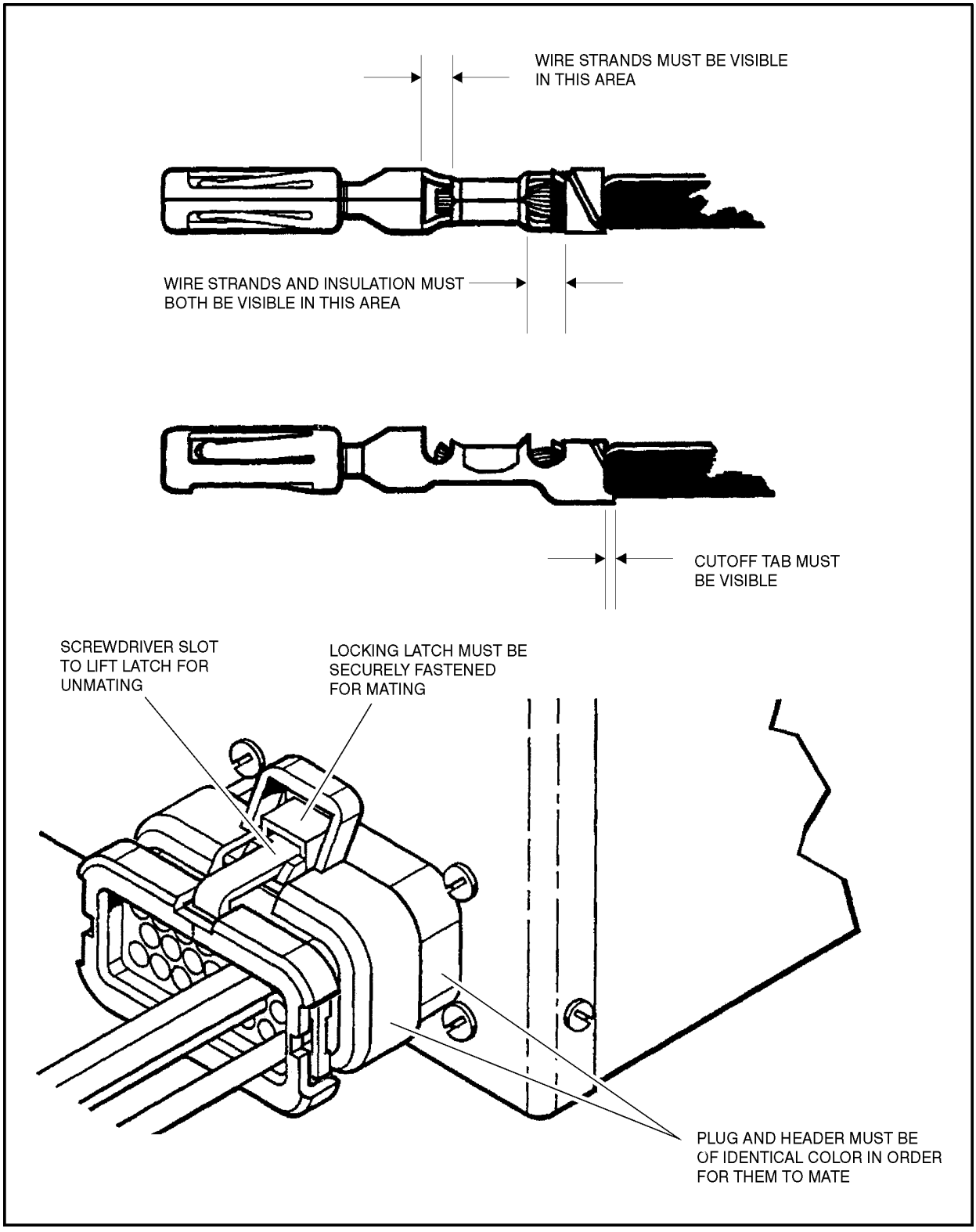


Figure 7-13. Connector Installation

7.5 DEUTSCH CONNECTORS

DT/DTP Series Assembly

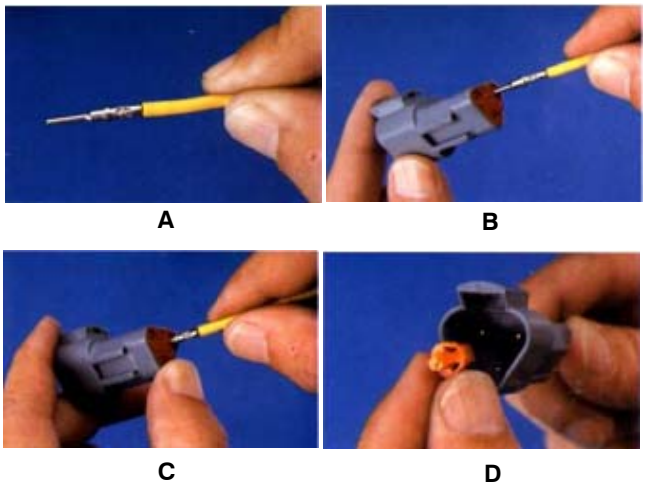


Figure 7-14. DT/DTP Contact Installation

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

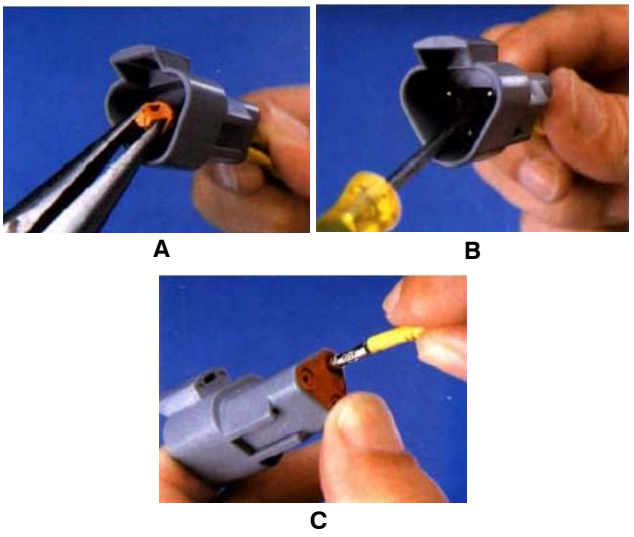


Figure 7-15. DT/DTP Contact Removal

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

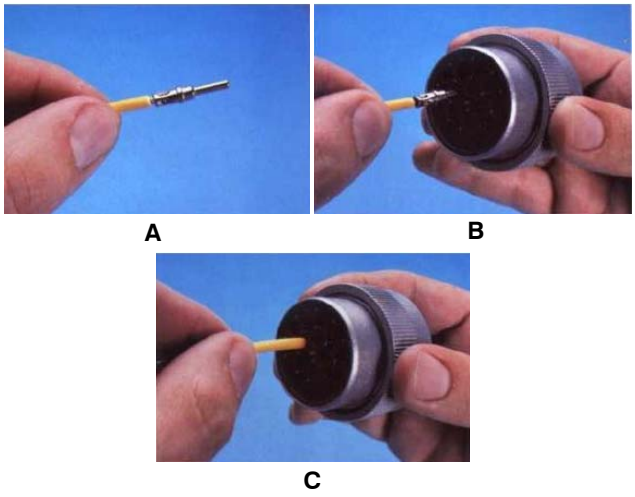


Figure 7-16. HD/HDP Contact Installation

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.

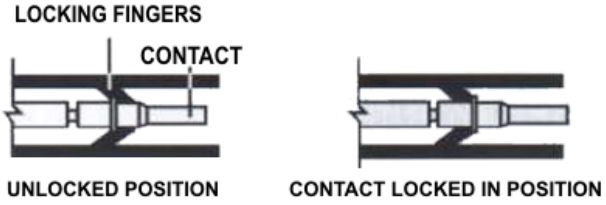


Figure 7-17. HD/HDP Locking Contacts Into Position

NOTE: *For unused wire cavities, insert sealing plugs for full environmental sealing*

HD30/HDP20 Series Disassembly

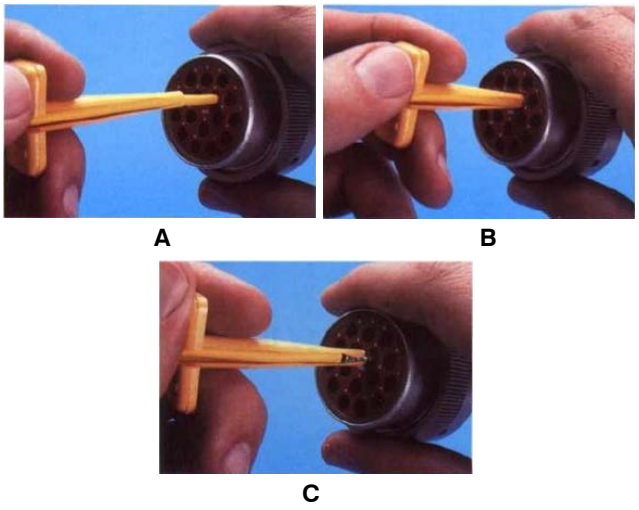


Figure 7-18. HD/HDP Contact Removal

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.

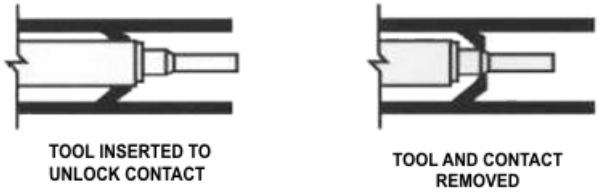


Figure 7-19. HD/HDP Unlocking Contacts

NOTE: *Do Not twist or insert tool at an angle.*

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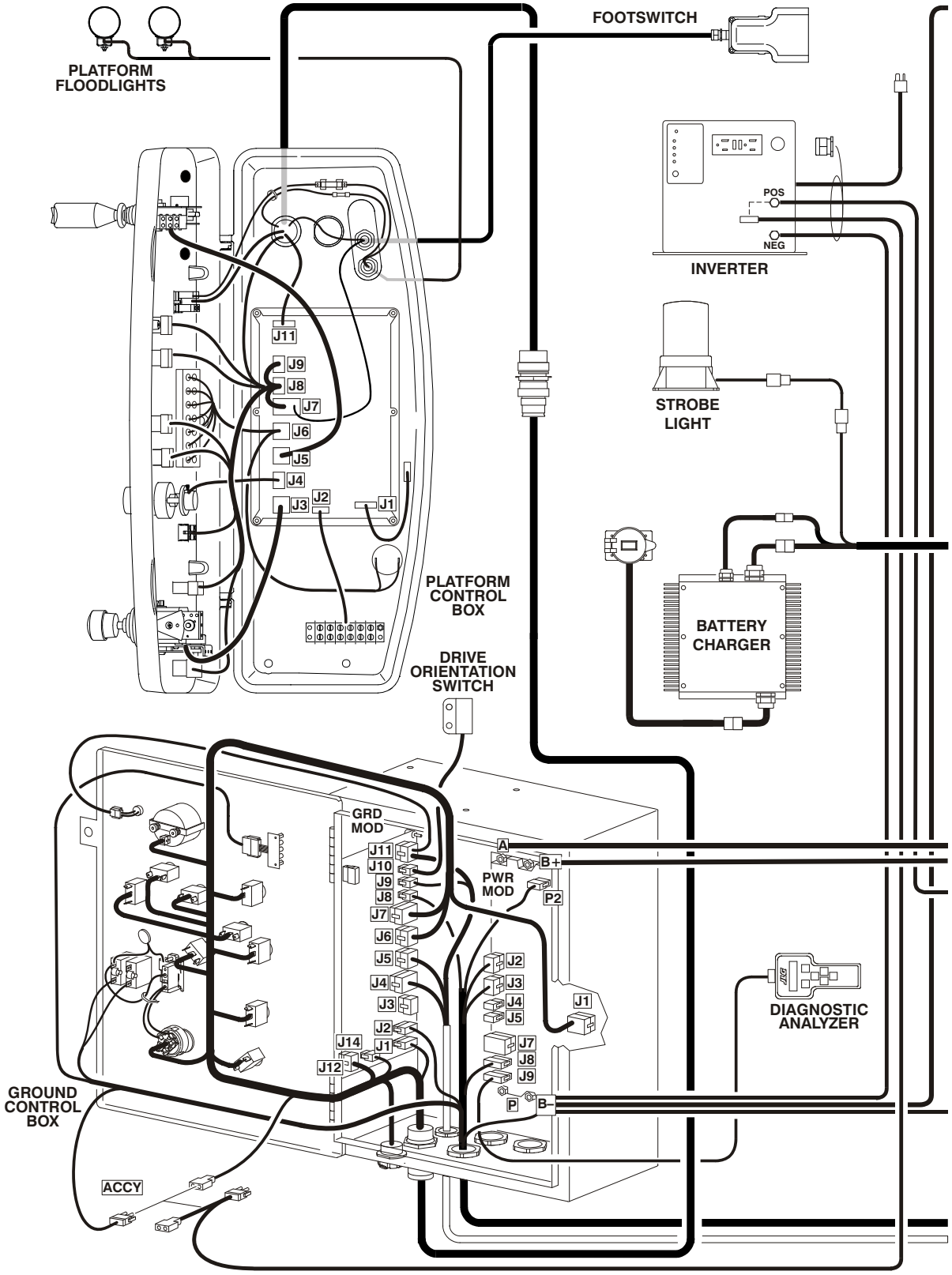


Figure 7-20. Electrical Components - Sheet 1 of 2

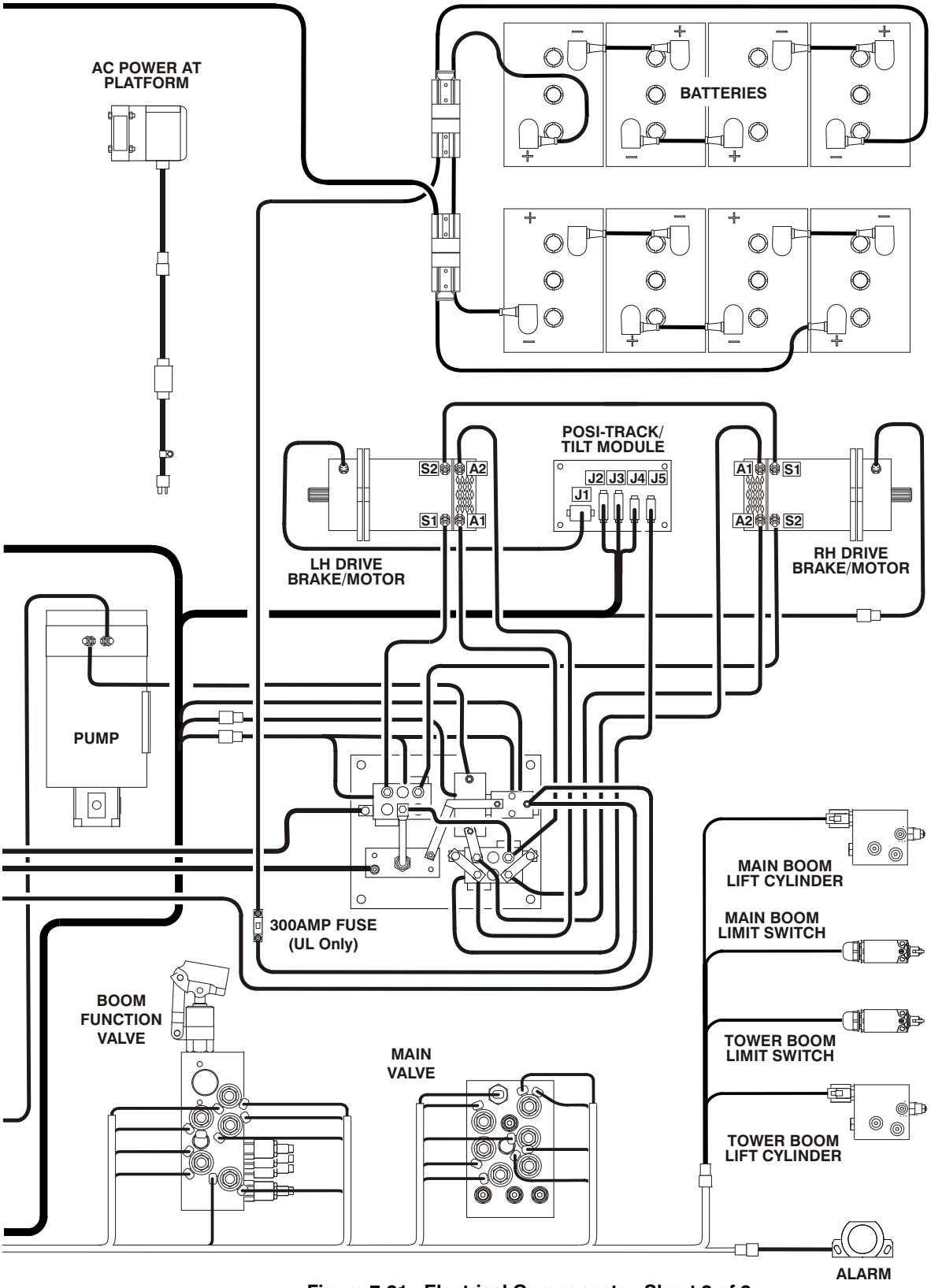


Figure 7-21. Electrical Components - Sheet 2 of 2

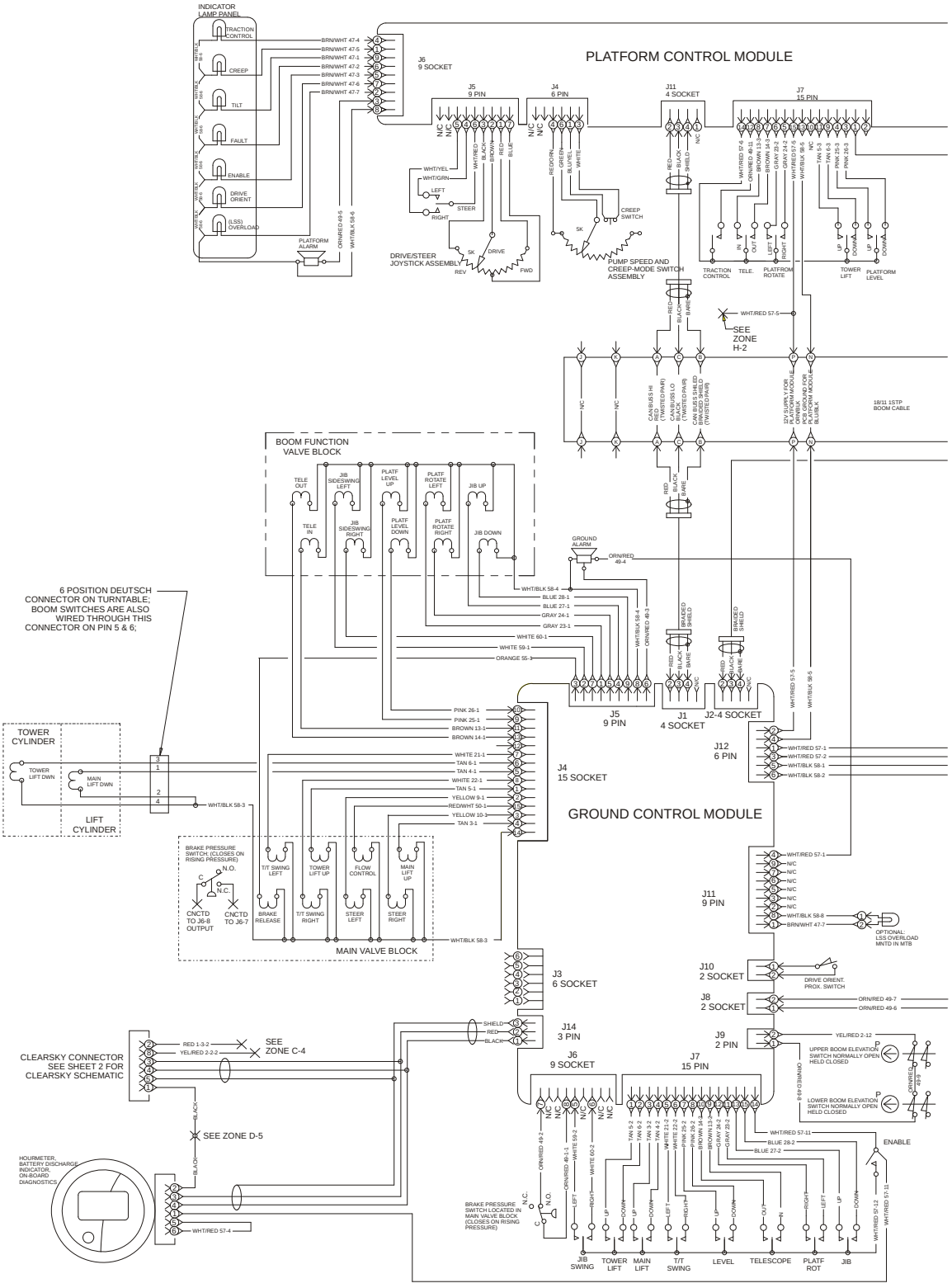
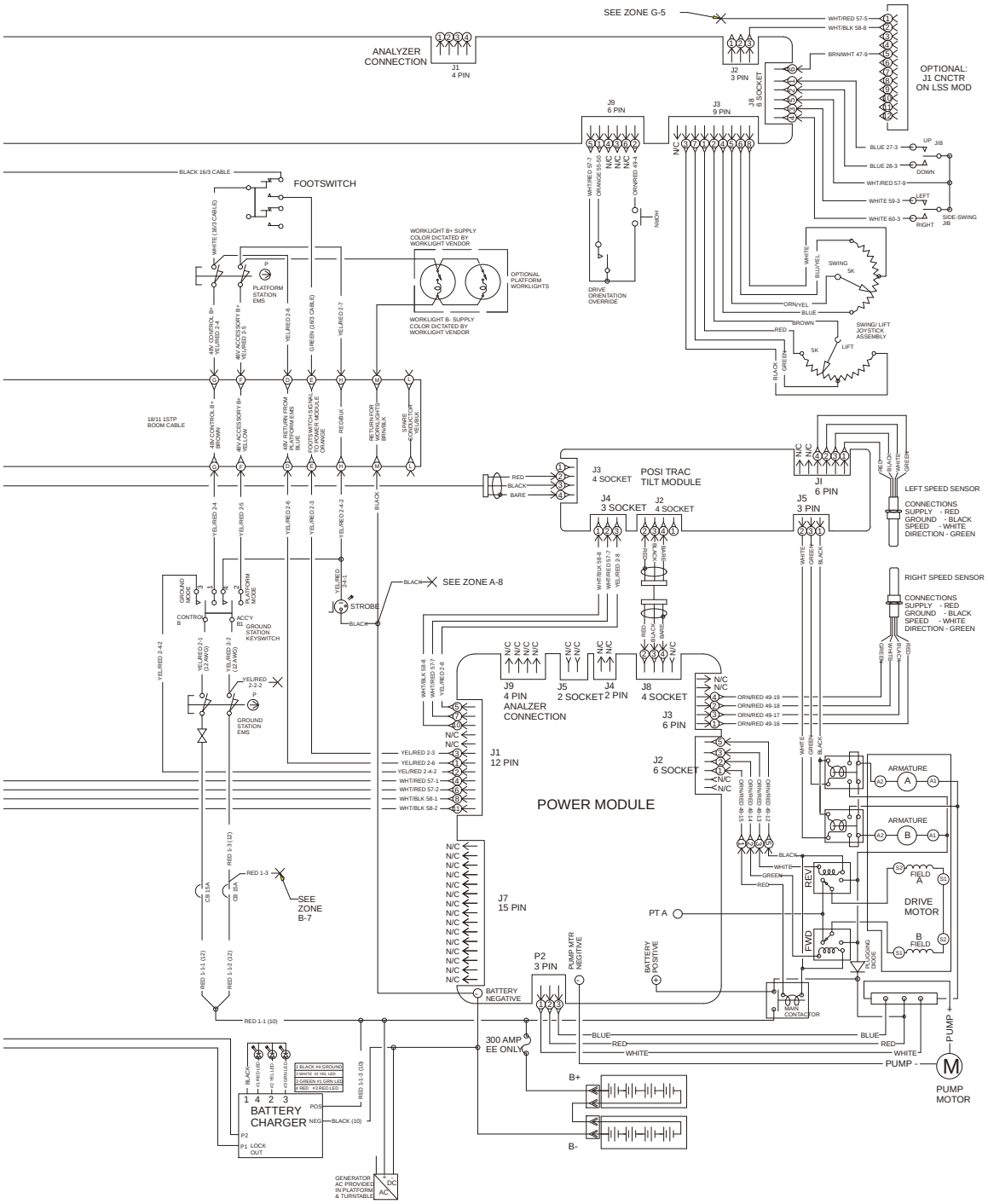


Figure 7-22. Electrical Schematic - Sheet 1 of 2



1001108541-B

Figure 7-23. Electrical Schematic - Sheet 2 of 2

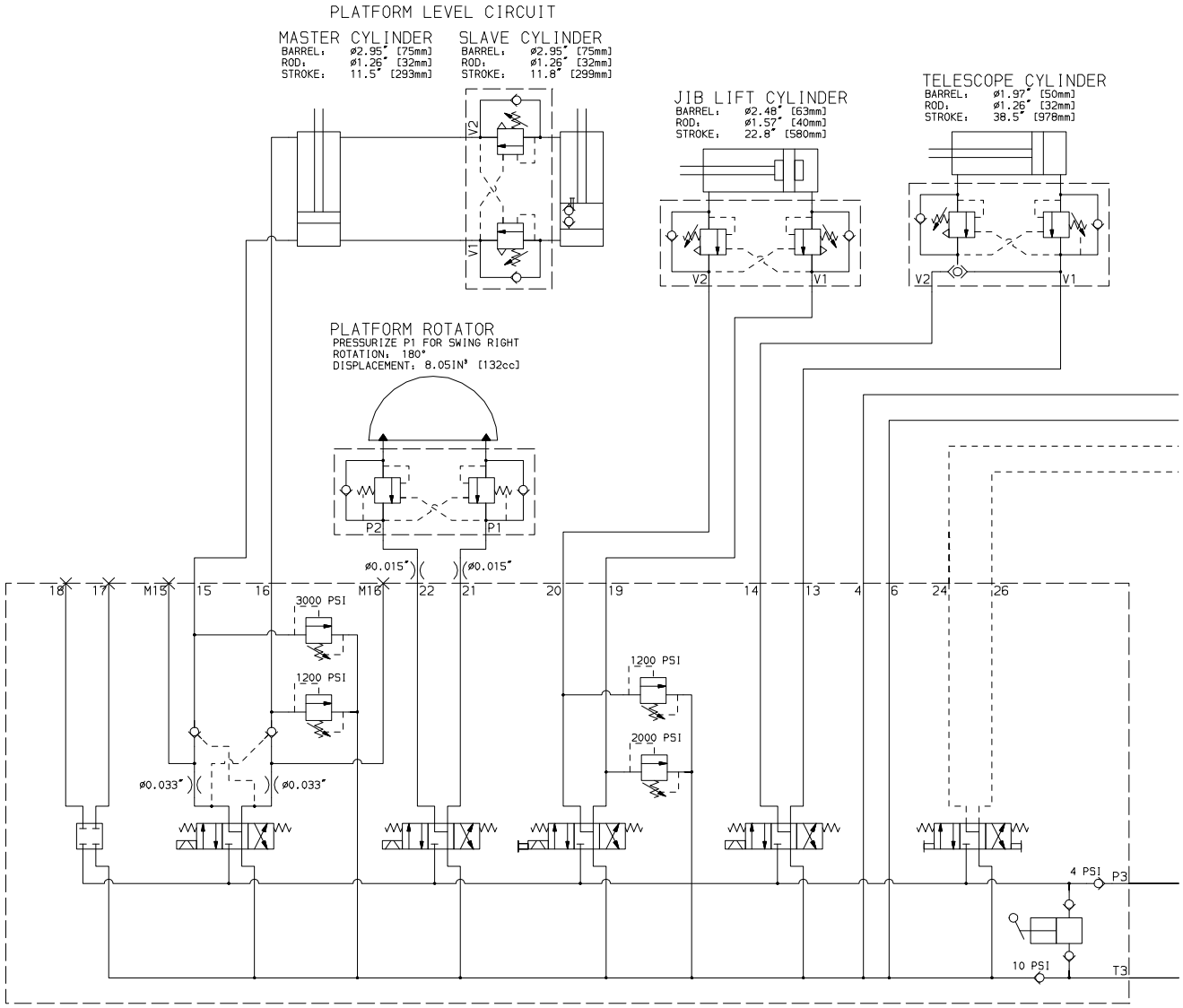
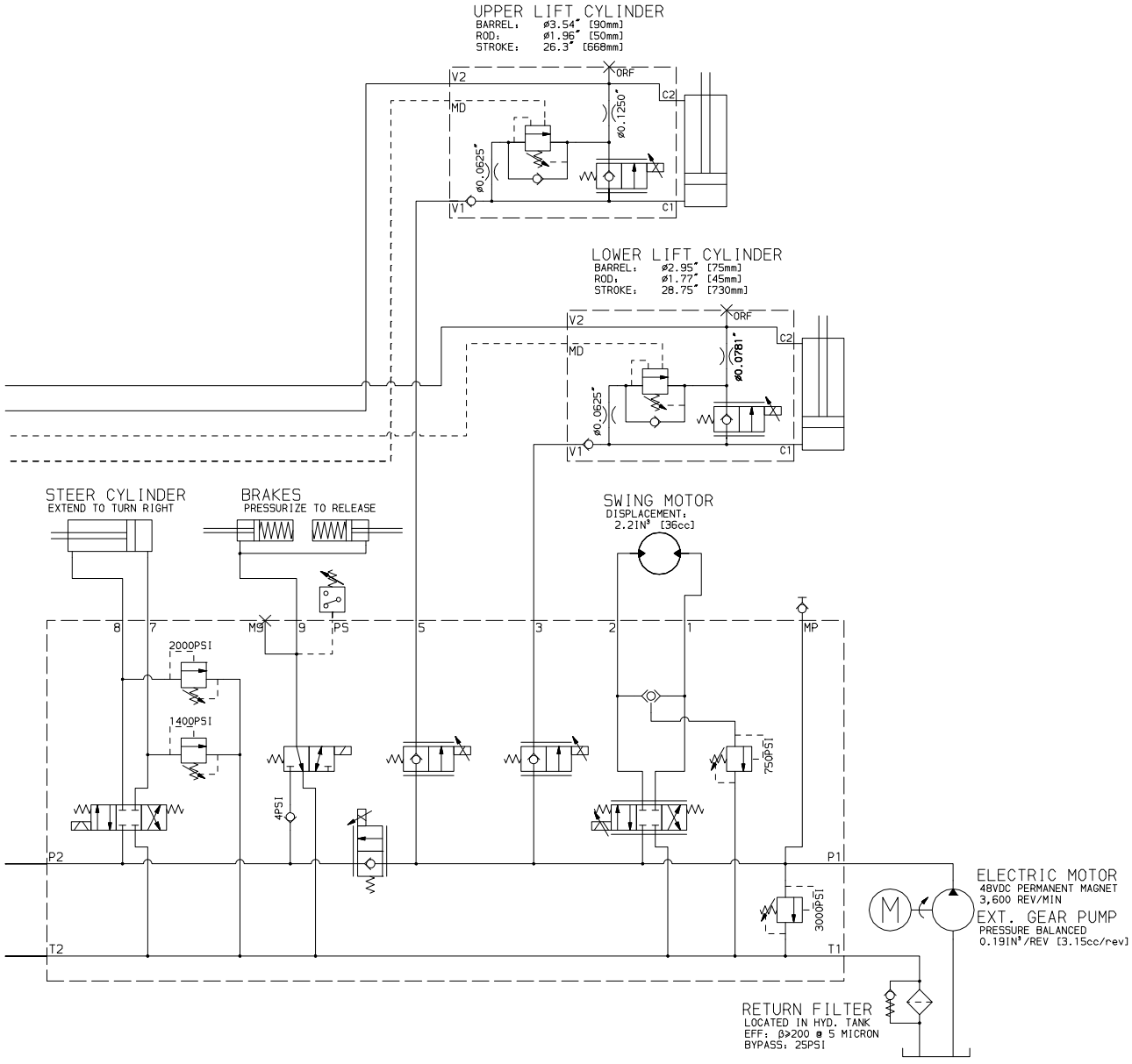


Figure 7-24. Hydraulic Schematic - E300AJ - Sheet 1 of 2



1001112910-A

Figure 7-25. Hydraulic Schematic - E300AJ - Sheet 2 of 2

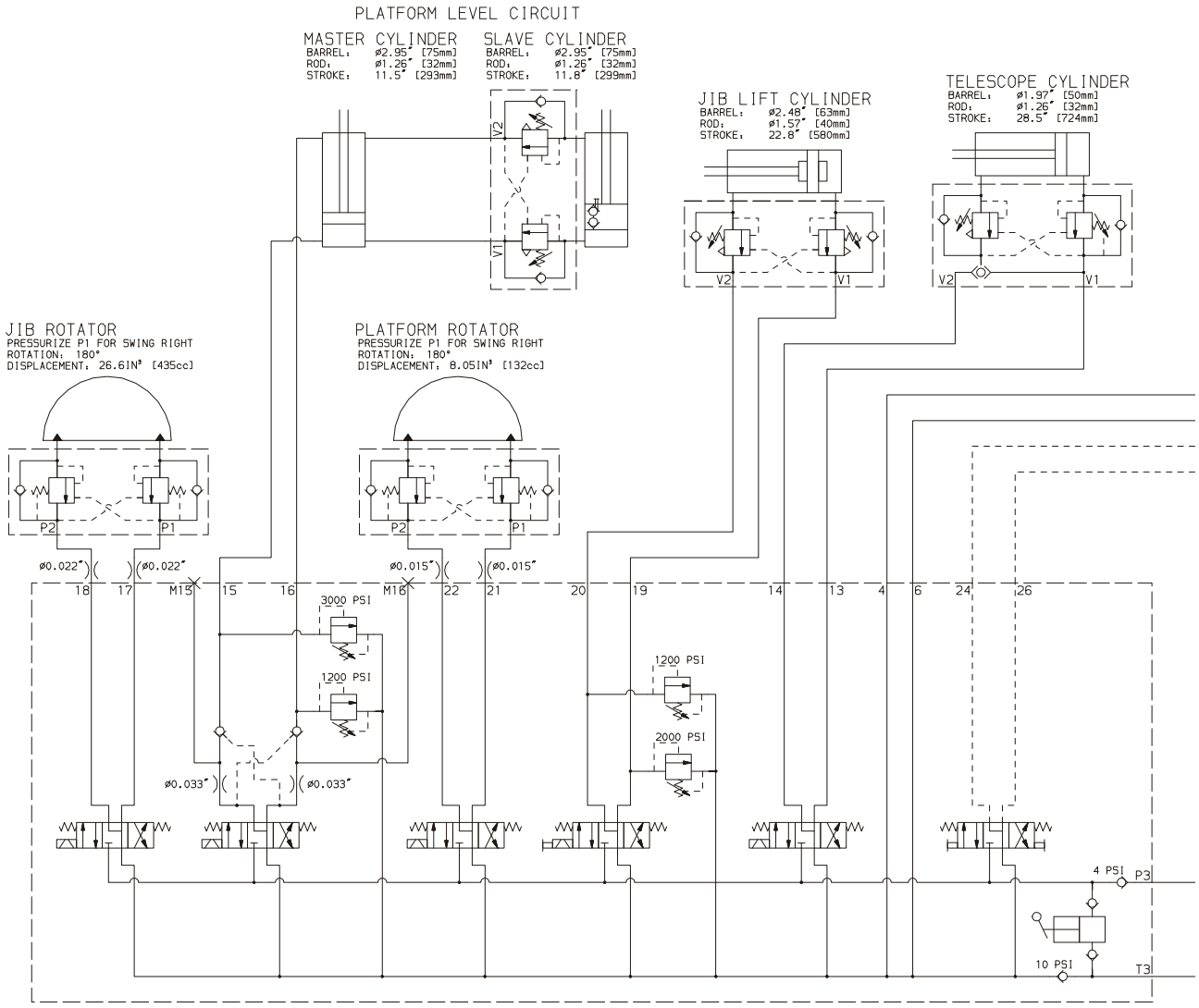
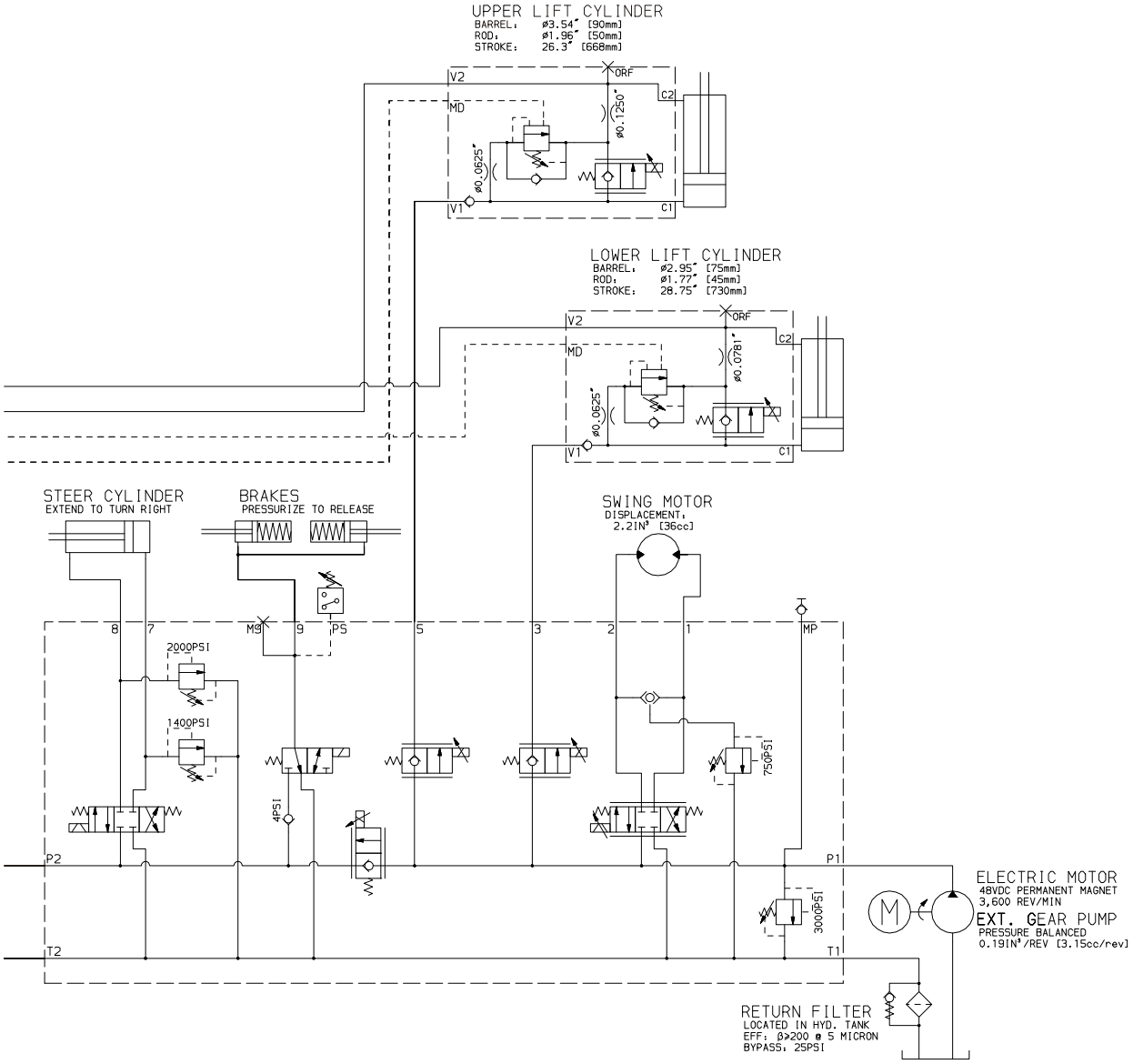


Figure 7-26. Hydraulic Schematic - E300AJP - Sheet 1 of 2



1001112910-A

Figure 7-27. Hydraulic Schematic - E300AJP - Sheet 2 of 2

NOTES:

PROPOSITION 65 WARNING

- **Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm.**
- **Batteries also contain other chemicals known to the State of California to cause cancer.**
- **Wash hands after handling.**

⚠ WARNING: ⚠

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

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