



An Oshkosh Corporation Company

Service and Maintenance Manual

Model T350

PN-3121198

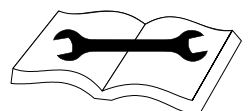
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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

This section contains general safety precautions which must be observed during aerial platform maintenance. 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 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 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 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 the machines hydraulic systems operate at extremely high potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system.

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



C MAINTENANCE

⚠ WARNING

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

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

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating & Towing Specifications

Tongue Weight (ANSI): Note: Tongue weight may increase with options.	250 lbs. (113 kg)
Maximum Allowable Tow Speed: (Do NOT exceed legal speed limit)	65 mph (105 kph)
Maximum Work Load (Capacity) w/Rotator	440 lbs. (200 kg)
Maximum Work Load (Capacity) w/o Rotator	500 lbs. (227 kg)
Maximum Work Load (Capacity) w/Rotator & Panel Tray	320 lbs. (145 kg)
Maximum Work Load (Capacity) w/o Rotator & w/Panel Tray	350 lbs. (158 kg)
Material Hook Capacity (Optional)	500 lbs. (227 kg)
Accessory Tray Capacity	250 lbs.* (114 kg)
Panel Tray Capacity w/Rotator	70 lbs. (32 kg)
Panel Tray Capacity w/o Rotator	100 lbs. (45 kg)
Swing	410° non-continuous
Max. Vertical Platform Height (Unrestricted)	35 ft. (10.6 m)
Vertical Reach (unrestricted)	35 ft. (10.4 m)
Horizontal Reach from center line of machine	20 ft. (6.1 m)
from outrigger pad edge	14 ft. (4.27 m)
Up and Over Clearance	15 ft. (4.57 m)
Maximum Outrigger Load	1950 lbs. (885 kg)
Maximum Ground Bearing Pressure	22.5 psi (1.58 kg/cm ²)
Maximum Travel Gradeability - (ANSI/CSA/AUS)	20%
Maximum Travel Gradeability - (CE)	15%
Maximum Side slope - (ANSI, CSA, AUS)	11°
Maximum Side slope - (CE)	8.5°
Max. Hydraulic System Pressure	2700 psi. (186 Bar)
Maximum Operating Wind Speed	28 mph (12.5 m/s)
Maximum Horizontal Manual Force	90 lb. force (400 N)
Electrical System Voltage - Electric Machine	24 volts
Electrical System Voltage - Gas Machine	12 volts
Gross Machine Weight (Platform Empty) ANSI/CSA/Australian Machines Note: Machine weight may increase with options.	3400 lbs. (1542 kg)
Gross Machine Weight (Platform Empty) CE Machines Note: Machine weight may increase with options.	3748 lbs. (1700 kg)
* Do NOT exceed axle rating or GVW rating.	

1.2 DIMENSIONAL DATA

Table 1-2. Dimensional Data

Overall Length	
Surge Brake, 2" ball	20 ft 5 in (6.2 m)
Surge Brake, 2" ball w/platform rotator	20 ft 11 in (6.4 m)
Electric brake, 2" ball	20 ft 3 in (6.2 m)
Electric brake, 2" ball w/ platform rotator	20 ft 9 in (6.3 m)
Surge Brake Combination, 2" ball	21 ft 9.5 in (6.6 m)
Overall Height - (ANSI/CSA)	6 ft 6.25 in (2 m)
Overall Height - (CE)	5 ft 11 in (1.8 m)
Overall Width - (Outriggers Up)	4 ft 11.25 in (1.5 m)
Overall Width - (Outriggers Down - ANSI)	10 ft 5.5 in (3.2 m)
Overall Width - (Outriggers Down - CE)	11 ft 3 in (3.4 m)

1.3 CAPACITIES

Table 1-3. Capacities

Fuel Tank	1.525 Gallon (5.77 Liters)
Hydraulic Tank	
Filling Volume	4.4 Gallon (16.65 Liters)
Usable Volume	4.0 Gallon (15.1 Liters)
Engine Crankcase	1.16 qt. (1.0 Liter)

1.4 ELECTRIC POWER UNIT

Table 1-4. Electric Power Unit Specifications

		@ 740PSI (51 Bar)	@ 1500PSI (103 Bar)	@ 3000PSI (207 Bar)
Motor	Power	3.0 kW	3.0 kW	3.0 kW
	Voltage	24 VDC	24 VDC	24 VDC
	Amperage	90	140	230
	Speed	4000 rpm	3600 rpm	2900 rpm
	Short Term Operation	9 minutes	6 minutes	2 minutes
	Intermittent Operation	28%	19%	10%
Pump	Flow Rate	3.0 gpm (11.3 lpm)	2.7 gpm (10.2 lpm)	2.2 gpm (8.3 lpm)
	Displacement	0.192 cu.in. (3.15 cc)		

1.5 TIRES

Table 1-5. Tire Specifications

	ANSI / ANSI EXPORT /AUS / CSA	CE / SA
Size	ST 215/75-R14	185-R14C
Load Rating	1870 lbs. @ 50 psi (848 kg @ 350 kPa)	1984 lbs. @ 65 psi (900 kg @ 448 kPa)
Ply Rating/Load Range	C	8/D
Weight	36 lbs. (16 kg)	
Speed Category	--	S
Inflation Pressure	50 psi (350 kPa)	
Wheel Nut Torque	90-120 ft. lbs. (122-164 Nm)	66 ft. lbs. (90 Nm)

1.6 ENGINE

Table 1-6. Engine Specifications

Type	4-stroke, overhead valve, single cylinder
Displacement	16.5 cu.in. (270 cm ³)
Bore x Stroke	3.0 x 2.3 in. (77 x 58 mm)
Max. Output	8.4 hp (6.3 kW) at 3,600 rpm
Max. Torque	14.1 ft.lbs. (19.1 Nm) at 2,500 rpm
Fuel Consumption	3.8 lb/hr (2.4 L/hr) at 3600 rpm
Fuel Type	Unleaded gasoline with a pump octane rating of 86 or higher
Spark Plug	NGK: BPR6ES DENSO: W20EPR-U
Spark Plug Gap	0.028 - 0.031 in. (0.70 - 0.80 mm)

1.7 BATTERY

Table 1-7. Engine Battery Specification

BCI Group Size	51R
Cranking Performance	450 amps @ 0°F (-18°C)
Reserve Capacity	80 minutes @ 80°F (0°C)
Voltage	12V
Capacity	50Ah @ 20hr rate

1.8 BATTERIES (ELECTRIC MACHINES)

Table 1-8. Engine Battery Specifications

	Prior to 0030001804	0030001804 to Present
Type	GC-110VNL	EVC6A-A
Voltage	6-V Deep Cycle	6-Volt
Amp Hour Rating	225Ah @ 20hr	213Ah @ 20hr
Reserve Capacity @ 75 Amps	447 Minutes	492 Minutes
AT -40°F (-40°C) Open Circuit Voltage	Greater or Equal to 6 Volts	
Life Cycle Rating	600 Cycles	
Internal Resistance	No more than 2.5 mOhms @ 70°F (21°C) / 4.0 m Ohms @ 0°F (-18°C)	
Battery Weight (minimum allowable)	60 lbs. (27.12 kg)	66 lbs. (30 kg)

1.9 LUBRICATION

Hydraulic Oil

Table 1-9. 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: Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities.

Table 1-10. Mobilfluid 424 Specification

SAE Grade	10W-30
ISO Grade	55
Gravity, API	29.0
Density, Lb/Gal. 60°F	7.35
Pour Point, Max	-46°F (-43°C)
Flash Point, Min	442°F (228°C)
Viscosity	
Brookfield, cP at -18°C	2700
at 40°C	55 cSt
at 100°C	9.3 cSt
Viscosity Index	152

1.10 COMPONENT WEIGHTS

Table 1-11. Component Weights

Component	Pounds	Kilograms
Frame (bare)	592	269
Turntable (bare)	127	58
Booms & Cylinders Assembly	1144	520
Main Boom	983	284
Engine Assembly (Including Tray)	113	51
Engine (bare)	57	26
Master Cylinder	64	29
Axle	140	64
Platform w/Rotator	137	62
Platform w/o Rotator	83	38

1.11 PRESSURE SETTINGS

Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until the hydraulic system has warmed to normal operating temperatures prior to checking pressures. JLG Industries Inc. also recommends the use of a calibrated gauge. Pressure readings are acceptable if they are within $\pm 5\%$ of specified pressures.

Table 1-12. Pressure Settings

Circuit	PSI	Bar
Main Relief	2700	186
Telescope In	2200	152
Telescope Out	2400	166
Platform Level Up	2200	152
Platform Level Down	2000	138
Swing Right	600-800	41-55
Swing Left	600-800	41-55
Jacks In	2500	172.5

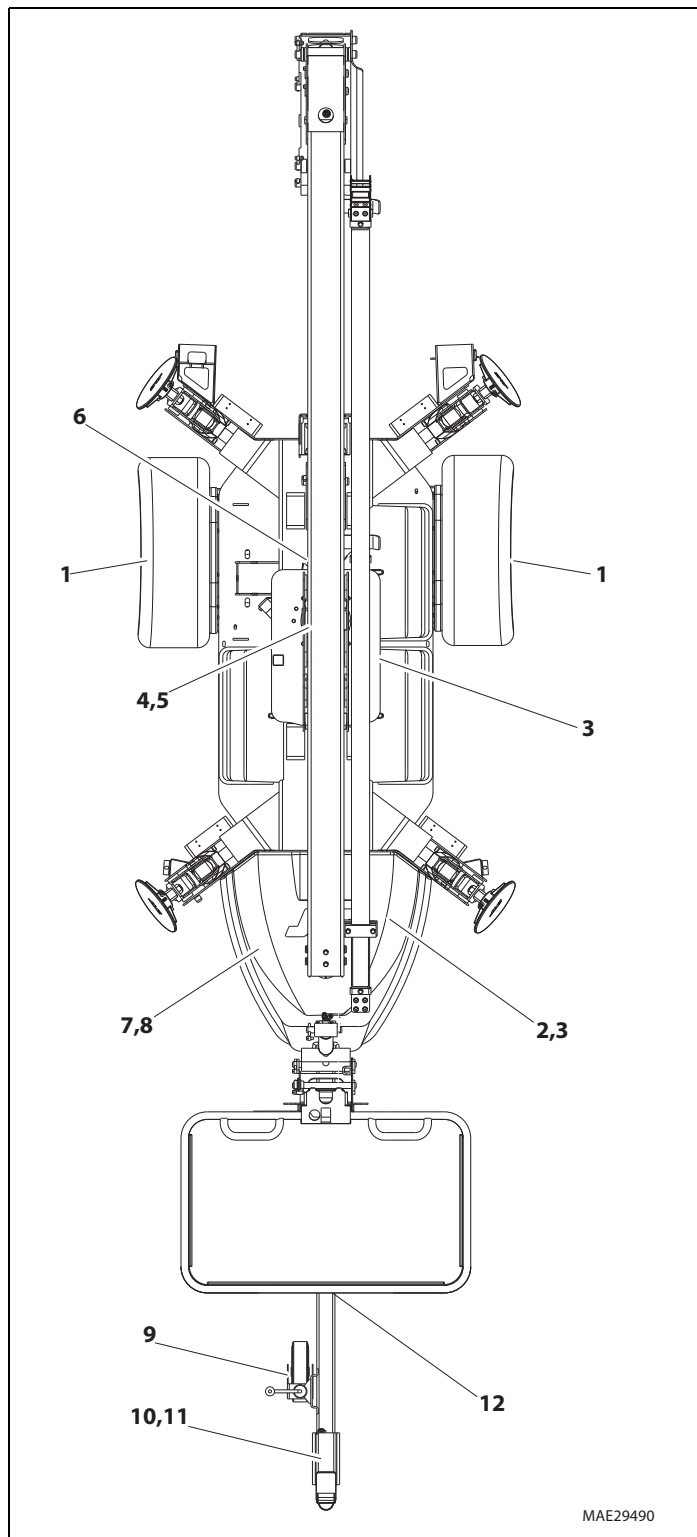


Figure 1-1. Maintenance and Lubrication Diagram

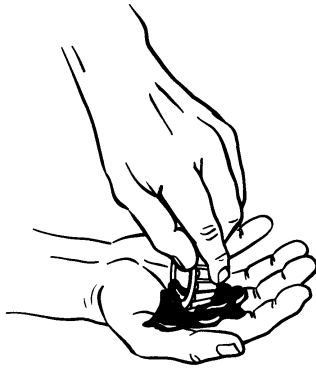
1.12 MAINTENANCE & LUBRICATION

NOTE: 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.

Table 1-13. 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. API Service Classification GL-3, SAE 10W-20, Viscosity Index 152, e.g. Mobilfluid 424.
E0	Engine (crankcase) Oil. Gas - API SF/SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.
OGI	Open Gear Lubricant - Mobiltac 375 or equivalent.

1. Wheel Bearings



Lube - MPG
Interval - every 12 months or 12,000 miles
Comments - Refer to Section 3.6, Hubs, Drums, Wheel Bearings.

2. Hydraulic Oil



Lube Point(s) - Fill Cap
Capacity - 4 gal. (15.1 L)
Lube - HO
Interval - Check oil daily, change after, every 1200 hours of operation.

3. Hydraulic Filter & Breather



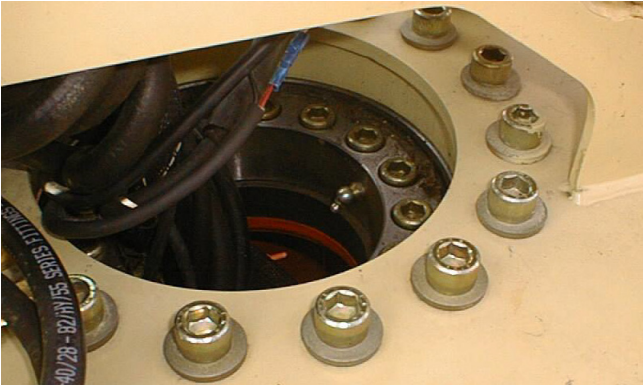
NOTE: The cap securing the filter must be torqued 154 to 170 ft.lbs. (209 to 230.5 Nm).



Interval - 100 hours
Comments - Change after the first 20 hours, then every 100 hours of operation.

SECTION 1 - SPECIFICATIONS

4. Swing Bearing



Lube Point(s) - 1 Grease Fitting

Capacity - As Required

Lube - MPG

Interval - Every month or 50 hours

Comments - Rotate the bearing back and forth to ensure grease is distributed evenly the whole way around the bearing.

5. Swing Bearing Teeth

Lube Point(s) - Spray On

Capacity - As Required

Lube - OGL

Interval - Every month or 50 hours

Comments - More frequent lubrication intervals may be required.

6. Swing Drive



Lube Point(s) - 2 Grease Fittings

Capacity - As Required

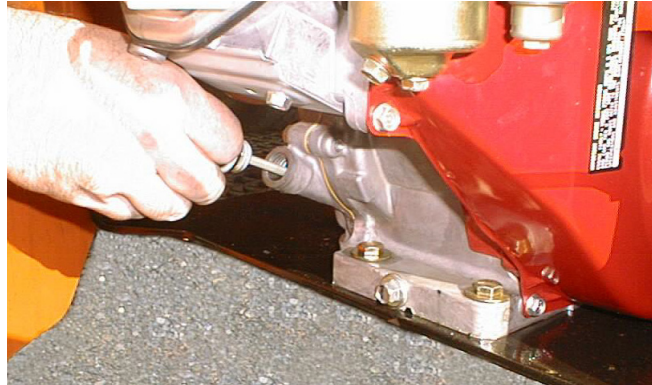
Lube - MPG

Interval - As Required.

⚠ CAUTION

DONOT OVERGREASE BEARINGS. OVERGREASING BEARINGS WILL RESULT IN BLOWING OUTER SEALS IN HOUSING.

7. Engine



Capacity - See Engine Manual.

Lube - EO, 10W30 API SJ

Interval - Check level daily; change per manufacturer's engine manual.

Comments - Adjust final oil level by mark on dipstick.

8. Fuel Tank



a. Engine (Prior to SN 0030004208)

Capacity - 1.6 Gal. (6 L)

Fuel - Gasoline

Interval - Check periodically during each shift.

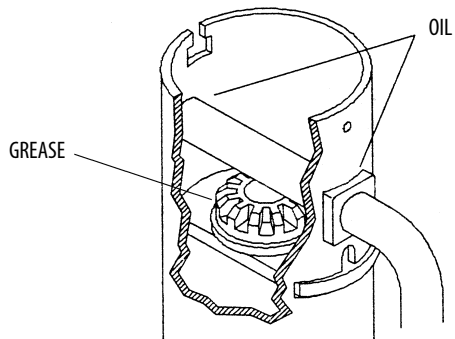
b. Engine (SN 0030004208 to Present)

Capacity - 1.5 Gal. (5.7 L)

Fuel - Gasoline

Interval - Check periodically during each shift.

9. Trailer Jack



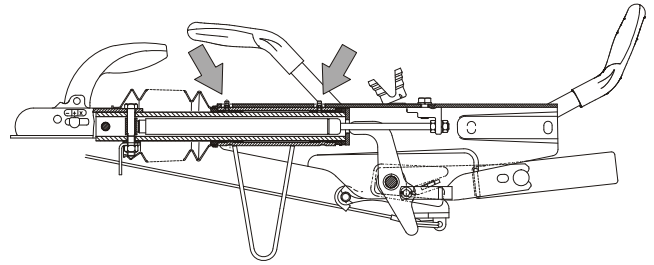
Capacity - As necessary
Lube - MPG & EO
Interval - As necessary.

10. Surge Brake



Lube Point(s) - Fill Cap
Capacity - No more than 1/2" (13 mm) from top of reservoir
Lube - DOT 3 or 4 Brake Fluid
Interval - Check before each tow. Flush the system yearly or when system is known to be contaminated.

11. Coupler & Hitch Ball



Capacity - Coupler 2 Grease Fittings (CE Only); Hitch Ball As necessary
Lube - MPG
Interval - As necessary.

12. Jockey Wheel Bearing (Drive and Set Option Only)



Lube Point(s) - 1 Grease Fittings
Capacity - As Required
Lube - MPG
Interval - As Required.

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)		Torque (Loctite® 263 OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or 271™ OR Vibra-TITE™ 131 or K=0.15)
					IN-LB	[N.m]	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	560	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					
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26					
	24	0.3125	0.0580	3700	19	26	14	19	21	29					
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48					
	24	0.3750	0.0878	5600	35	47	25	34	40	54					
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75					
	20	0.4375	0.1187	7550	55	75	40	54	60	82					
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116					
	20	0.5000	0.1599	10700	90	122	65	88	100	136					
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163					
	18	0.5625	0.2030	12950	120	163	90	122	135	184					
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224					
	18	0.6250	0.2560	16300	170	230	130	176	190	258					
3/4	10	0.7500	0.3340	21300	260	353	200	298	285	388					
	16	0.7500	0.3730	23800	300	407	220	298	330	449					
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646					
	14	0.8750	0.5090	32400	470	637	350	475	520	707					
1	8	1.0000	0.6060	38600	640	868	480	651	675	918					
	12	1.0000	0.6630	42300	700	949	530	719	735	1000					
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142					
	12	1.1250	0.8580	47300	880	1193	660	895	925	1258					
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598					
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768					
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074					
	12	1.3750	1.3150	73900	1680	2278	1260	1708	1750	2380					
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754					
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128					

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

NO. 5000059 REV. K

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

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

Values for Magni Coating Fasteners (Ref 4150701)																	
SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loclote® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.16		Torque (Loclote® 262™ or TITE™ 131) K=0.15		Clamp Load	Torque (Dry or Loclote® 263) K= 0.17		Torque (Loclote® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=16		Torque (Loclote® 262™ or TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]		IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
		In	Sq In	LB	IN-LB	[N.m]	FT-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	FT-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8											
	48	0.1120	0.00661	420	8	0.9											
6	32	0.1380	0.00909	580	14	1.5											
	40	0.1380	0.01015	610	14	1.6											
8	32	0.1640	0.01400	900	25	2.8											
	36	0.1640	0.01474	940	26	2.9											
10	24	0.1900	0.01750	1120	36	4.1											
	32	0.1900	0.02000	1285	42	4.7											
1/4	20	0.2500	0.0318	2020	86	9.7	80	9									
	28	0.2500	0.0364	2320	99	11.1	95	11									
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20	4720	20	25	20	25	20	25
	24	0.3125	0.0580	3700	15	20	15	21	15	20	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34	7000	35	50	35	50	35	50
	24	0.3750	0.0878	5600	30	40	28	38	25	34	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48	9550	60	80	55	75	50	70
	20	0.4375	0.1187	7550	45	60	44	60	40	54	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75	12750	90	120	85	115	80	110
	20	0.5000	0.1599	10700	75	100	71	97	65	88	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109	16400	130	175	125	170	115	155
	18	0.5625	0.2030	12950	105	145	97	132	90	122	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156	20350	180	245	170	230	160	220
	18	0.6250	0.2560	16300	145	195	136	185	125	170	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272	30100	320	435	300	410	280	380
	16	0.7500	0.3730	23800	255	345	238	324	225	306	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435	41600	515	700	485	660	455	620
	14	0.8750	0.5090	32400	400	545	378	514	355	483	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	38600	545	740	515	700	480	653	51500	730	995	685	930	645	875
	12	1.0000	0.6630	42200	600	815	563	765	530	721	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	47500	755	1025	713	969	670	911	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237	142200	3020	4105	2845	3870	2665	3625

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

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

SOCKET HEAD CAP SCREWS															
Magni Coating (Ref 4150701)*							Zinc Yellow Chromate Fasteners (Ref 4150707)*								
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .17		Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.16		Torque (Locitite® 262™ or Vibra-TITE™ 131) K=0.15		Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.18		Torque (Locitite® 262™ or Vibra-TITE™ 131) K=0.15		
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	
4	40	0.1120	0.00604												
	48	0.1120	0.00661												
6	32	0.1380	0.00909												
	40	0.1380	0.01015												
8	32	0.1640	0.01400												
	36	0.1640	0.01474												
10	24	0.1900	0.01750												
	32	0.1900	0.02000												
1/4	20	0.2500	0.0318	2860	122	14	114	13			2860	143	16		
	28	0.2500	0.0364	3280	139	16	131	15			3280	164	19		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25	4720	25	35	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25	5220	25	35	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50	7000	45	60	40	55
	24	0.3750	0.0878	7900	40	55	40	55	35	50	7900	50	70	45	60
7/16	14	0.4375	0.1063	9500	60	80	55	75	50	70	9500	70	95	65	90
	20	0.4375	0.1187	10700	65	90	60	80	60	80	10700	80	110	70	95
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110	12750	105	145	95	130
	20	0.5000	0.1599	14400	100	135	95	130	90	120	14400	120	165	110	150
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155	16400	155	210	140	190
	18	0.5625	0.2030	18250	145	195	135	185	130	175	18250	170	230	155	210
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220	20350	210	285	190	260
	18	0.6250	0.2560	23000	205	280	190	260	180	245	23000	240	325	215	290
3/4	10	0.7500	0.3340	30100	320	435	300	380	280	380	30100	375	510	340	460
	16	0.7500	0.3730	33600	355	485	335	455	315	430	33600	420	570	380	515
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620	41600	605	825	545	740
	14	0.8750	0.5090	45800	570	775	535	730	500	680	45800	670	910	600	815
1	8	1.0000	0.6060	51500	730	995	685	930	645	875	51500	860	1170	775	1055
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015	59700	995	1355	895	1215
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310	68700	1290	1755	1160	1580
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475	77000	1445	1965	1300	1770
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855	87200	1815	2470	1635	2225
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055	96600	2015	2740	1810	2460
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430	104000	2385	3245	2145	2915
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760	118100	2705	3680	2435	3310
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225	126500	3165	4305	2845	3870
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625	142200	3555	4835	3200	4350

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

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

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

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

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

*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

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

Values for Magni Coated Fasteners (Ref 4150701)										
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS					CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*					
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™) K=0.17	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.16	Tor que (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.15	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K= 0.16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0	3.13			
3.5	0.6	6.78	2.95	1.8	1.7	1.5	4.22			
4	0.7	8.78	3.82	2.6	2.4	2.3	5.47			
5	0.8	14.20	6.18	5.3	4.9	4.6	8.85			
6	1	20.10	8.74	9	8.4	7.9	12.5	13	12	11
7	1	28.90	12.6	15	14	13	18.0	21	20	19
8	1.25	36.60	15.9	22	20	19	22.8	31	29	27
10	1.5	58.00	25.2	43	40	38	36.1	61	58	55
12	1.75	84.30	36.7	75	70	66	52.5	105	100	95
14	2	115	50.0	119	110	105	71.6	170	160	150
16	2	157	68.3	186	175	165	97.8	265	250	235
18	2.5	192	83.5	256	240	225	119.5	365	345	325
20	2.5	245	106.5	362	340	320	152.5	520	490	460
22	2.5	303	132.0	494	465	435	189.0	705	685	625
24	3	353	153.5	627	590	555	222.0	905	850	800
27	3	459	198.5	916	860	810	286.0	1315	1235	1160
30	3.5	561	244.0	1245	1170	1100	349.5	1780	1680	1575
33	3.5	694	302.0	1694	1595	1495	432.5	2425	2285	2140
36	4	817	355.5	2176	2050	1920	509.0	3115	2930	2750
42	4.5	1120	487.0	3477	3275	3070	698.0	4985	4690	4395

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

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

*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

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

SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

It is the User's or Operator's primary responsibility to perform a Pre-Start Inspection of the machine prior to use daily or at each change of operator. Reference the 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 on an annual basis, no later than thirteen (13) months from the date of the prior Annual Machine Inspection. JLG Industries recommends this task be performed by a Factory-Trained Service Technician. JLG Industries, Inc. recognizes a Factory-Certified 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	Operator 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 (Recommended)	Service and Maintenance Manual and applicable JLG inspection form.
Preventive Maintenance	At intervals as specified in the Service and Maintenance Manual.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

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

Cleanliness

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

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

Components Removal and Installation

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

Component Disassembly and Reassembly

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

Pressure-Fit Parts

When assembling pressure-fit parts, use an anti-seize or molybdenum disulfide base compound 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. 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.
2. JLG recommends Mobil 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

NOTE: Start-up of hydraulic system with oil temperatures below -20 degrees F (-29 degrees C) is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100VAC heater to a minimum temperature of -20 degrees F (-29 degrees C).

Changing Hydraulic Oil

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

Lubrication Specifications

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

2.4 CYLINDER DRIFT

Theory

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

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

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

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

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 Leakage Test

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

Measure drift at cylinder rod with a calibrated dial indicator.

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

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

Cylinder Bore Diameter		Max. Acceptable Drift in 10 Minutes	
inches	mm	inches	mm
3	76.2	0.026	0.66
3.5	89	0.019	0.48
4	101.6	0.015	0.38
5	127	0.009	0.22
6	152.4	0.006	0.15
7	177.8	0.005	0.13
8	203.2	0.004	0.10
9	228.6	0.0030	0.08

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

Cylinder Thermal Drift

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
 - a. Excessive sloppiness in joints.
 - b. Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
 - a. Frayed or separated fibers on the liner surface.
 - b. Cracked or damaged liner backing.
 - c. Bearings that have moved or spun in their housing.
 - d. Debris embedded in liner surface.
3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):
 - a. Detectable wear in the bearing area.
 - b. Flaking, peeling, scoring, or scratches on the pin surface.
 - c. Rusting of the pin in the bearing area.
4. Re-assembly of pinned joints using filament wound bearings.
 - a. Blow out housing using compressed air 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.
- Unplug all pressure transducers (Refer to Section 6 - JLG Control System)

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. Maintenance Schedule

		INTERVAL			
Item/Function	Method	Break-In	Every 3000 Miles or 3 Months	Every 6000 Miles or 6 Months	Every 12,000 Miles or 1 year
Wheel Lugs ¹	Tighten to specified torque rating	X	X		
Coupler Ball	Check for unusual wear		X		
Safety Chains	Check for unusual wear in links		X		
Brakes ²	Check general operation and proper adjustment	X	X		
Brake Fluid ³	Check reservoir		X		
Breakaway	Check cable and all components		X		
Suspension	Check for worn components or broken springs		X		
Welds	Check welds for cracks or separations			X	
Floor, hinges, door and dividers	Wash both sides. Wash floor. Inspect - repair or replace damaged, worn or broken parts.		X		
Tires	Rotate every 5000 miles Inspect tread and sidewalls thoroughly replace tire when treads are worn, when sidewall has a bulge, or sidewall is worn.			X	
Brakes, electric Magnets Controller (in tow vehicle)	Check wear and current draw Check power output (amperage) and modulation			X	
Roof vents, windows	Clean dirt buildup, lubricate hinges and slides			X	
Brakes - All types	Check for scoring and wearing				X
Jack, drop leg	Grease gears at top				X
Frame members/welds	Inspect all frames members, bolts and rivets. repair or replace damaged worn or broken parts Inspect all welds. repair as needed				X
Wheels - Sealed bearings (hubs), Unsealed bearings, Rims	Check and confirm free running. Replace if not. (sealed bearings are not serviceable) Disassemble/inspect/assemble and repack. replace promptly, if immersed in water. Inspect for cracks and dents. Replace as needed.				X
Axle attachment bolts	Check by dealer				X
Footnote: 1 = Retighten when new and at the first 10, 25 and 50 miles 2 = Adjust after first 200 miles, 3000 mile intervals or as use requires. 3 = 1000 miles or 1 month when used in hot and dry environment.					

[illegible]

SECTION 3. CHASSIS & TURNTABLE

3.1 BREAKING-IN A NEW TRAILER

Retighten Lug Nuts at First 10, 25 & 50 Miles

Wheel lugs can shift and settle quickly after being first assembled, and must be checked after the **first** 10, 25 and 50 miles of driving. Failure to perform this check could result in a wheel coming loose from the trailer, causing a crash leading to death or serious injury.

NOTICE

CHECK LUG NUTS FOR TIGHTNESS ON A NEW TRAILER OR WHEN WHEEL(S) HAVE BEEN REMOUNTED AFTER THE FIRST 10, 25 AND 50 MILES OF DRIVING.

Adjust Brake Shoes at First 200 Miles

Brake shoes and drums experience a rapid initial wear. The brakes must be adjusted after the first 200 miles of use, and each 3,000 miles thereafter. The brakes are adjusted manually. Refer to section 3 for manual brake adjustment.

Synchronizing the Brake Systems

Trailer brakes are designed to work in synchronization with the brakes on the tow vehicle. Do not use either brake system alone to stop the combined tow vehicle and trailer.

When the tow vehicle and trailer braking systems are synchronized, both braking systems contribute to slowing, and the tongue of the trailer will neither dive nor rise sharply.

NOTICE

ROAD TEST THE BRAKES IN A SAFE AREA AT NO MORE THAN 30 M.P.H. BEFORE EACH TOW.

To insure safe brake performance and synchronization, read and follow the axle/brake and the brake controller manufacturers' instructions. If you do not have these instructions, call your dealer or JLG to obtain a copy.

A hard stop is used to:

- Confirm that the brakes work.
- Confirm that the trailer brakes are properly synchronized with the tow vehicle brakes.

3.2 TRAILER INSPECTION AND SERVICE INSTRUCTIONS

Fasteners and Frame Members

Inspect all of the fasteners and structural frame members for bending and other damage, cracks, or failure. Repair or replace any damaged fastener and repair the frame member. If you have any questions about the condition or method of repair of fasteners or frame members, get the recommendation of, or have the repair done by, your dealer.

The various fastener types used on your trailer are:

- Bolts, which are used mainly for attaching door and gate hinges to the trailer body.
- Buck Rivets, which are used to attach the sides and roof panels of the body to each other, and to the frame of the trailer.
- Huck Bolts may be at various locations on the sub-frame. Huck bolts are not user serviceable. If you detect a loose huck bolt fastener, do not tow the trailer. Call your dealer for instructions.

NOTICE

INSPECT FOR BROKEN OR DAMAGED FASTENERS, WELDS OR OTHER DAMAGED PARTS AT LEAST ONCE A YEAR AND HAVE ALL DAMAGED PARTS REPAIRED OR REPLACED.

Brake Shoes and Drums

Properly functioning brake shoes and drums are essential to ensure safety. You must have your dealer inspect these components at least once per year, or each 12,000 miles.

The brakes should be adjusted (1) after the first 200 miles of operation when the brake shoes and drums have "seated," (2) at 3000 miles intervals, (3) or as use and performance requires.

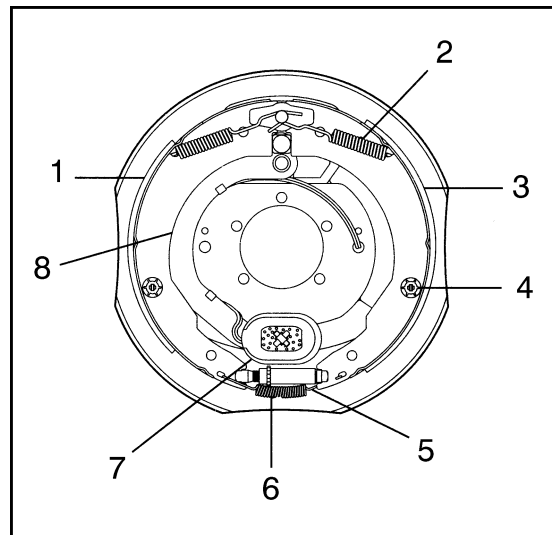
Manually Adjusting Brake Shoes

The manually adjusted brakes should be adjusted in the following manner:

1. Jack up the trailer and secure it on adequate capacity jack stands.
2. Be sure the wheel and brake drum rotate freely.
3. Remove the wheel and brake drum. Because of the special stub axle arrangement, adjustment cannot be made through the backing plate.
4. With a screwdriver or standard adjusting tool, rotate the starwheel of the adjuster assembly to expand the brake shoes. Adjust the brake shoes out until the pressure of the linings against the drum produces a slight drag.
5. Remount the wheel and brake drum.
6. Repeat the above procedure on all brakes.
7. Lower the trailer to the ground.

3.3 ELECTRIC BRAKES

The electric brakes on a trailer are similar to the drum brakes on an automobile. The basic difference is that the automotive brakes are actuated by hydraulic pressure while electric trailer brakes are actuated by an electromagnet. With all of the brake components connected into the system, the brake will operate as follows:



- | | |
|---------------------|----------------------|
| 1. Primary Shoe | 5. Adjuster Assembly |
| 2. Retractor Spring | 6. Adjuster Spring |
| 3. Secondary Shoe | 7. Magnet |
| 4. Hold Down Spring | 8. Actuating Lever |

Figure 3-1. Electric Brake Assembly

When the electrical current is fed into the system by the controller, it flows through the electromagnets in the brakes. The high capacity electromagnets are energized and are attracted to the rotating armature surface of the drums, which moves the actuating levers in the direction that the drums are turning.

The resulting force causes the actuating block at the shoe end of the lever to push the primary shoe out against the inside surface of the brake drum. The force generated by the primary shoe acting through the adjuster assembly then moves the secondary shoe out into contact with the brake drum.

Increasing the current flow to the electromagnet causes the magnet to grip the armature surface of the brake drum more firmly. This results in increasing the pressure against the shoes and brake drums until the desired stop is accomplished.

Brake Controller

A tow vehicle brake controller is required. These controllers have gain control to vary the amount of current to the brakes, and a level control which sets the controller's inertia sensor to sense deceleration. The level adjustment also can be used to vary when the trailer braking is felt. The gain or output control adjustment usually controls the maximum amount of amperage available to the brakes. This can be adjusted for varying trailer loads.

The electric brakes that operate in conjunction with the tow vehicle brakes must be "synchronized" so that braking is properly distributed to the tow vehicle brakes and the trailer brakes. For proper operation and synchronization, read and follow the axle/brake and the brake controller manufacturers' instructions.

Brake Cleaning and Inspection

Your trailer brakes must be inspected and serviced at yearly or 12,000 miles intervals or more often as use and performance requires. Magnets and shoes must be changed when they become worn or scored thereby preventing adequate vehicle braking. Clean the backing plate, electromagnet, and brake shoes. Make certain that all the parts removed are replaced in the same brake and drum assembly. Inspect the magnet arm for any loose or worn parts. Check shoe retractor springs, hold down springs, and adjuster springs for stretch or deformation and replace if required.

Shoes and Linings

A simple visual inspection of your brake linings will tell if they are usable. Replacement is necessary if the lining is worn (to within 1/16" or less), contaminated with grease or oil, or abnormally scored or gouged. It is important to replace both shoes on each brake and both brakes of the same axle. This is necessary to retain the "balance" of your brakes.

3.4 HYDRAULIC (SURGE) BRAKES

In the hydraulic brake system, hydraulic fluid from the master cylinder is used to actuate the hydraulic wheel cylinder, which, in turn, applies force against the brake shoes and drum. The main differences between automotive hydraulic brakes and hydraulic trailer brakes are the actuation systems that transfer the braking signal from the tow vehicle to the brake. A surge tongue actuator is required for a trailer with hydraulic brakes.

The hydraulic brake uses a single acting cylinder. Upon actuation, the primary shoe is pressed against the brake drum, which causes the shoe to move in the direction of rotation. This movement in turn actuates the secondary shoe through the adjuster link assembly. Braking in reverse is significantly less effective than in the forward direction.

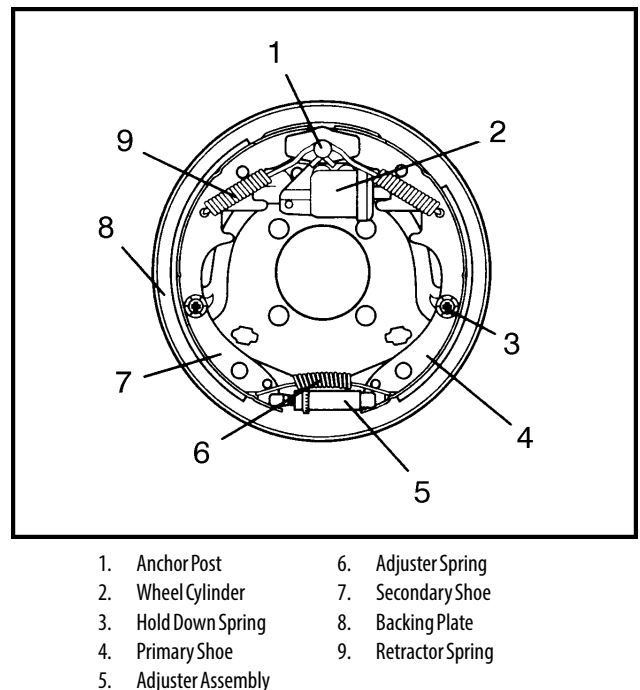


Figure 3-2. Hydraulic Brake Assembly

The hydraulic braking system must be inspected at least as often as the brakes on the tow vehicle, but no less than once per year. This inspection includes an assessment of the condition and proper operation of the wheel cylinders, brake shoes, brake drums and hubs.

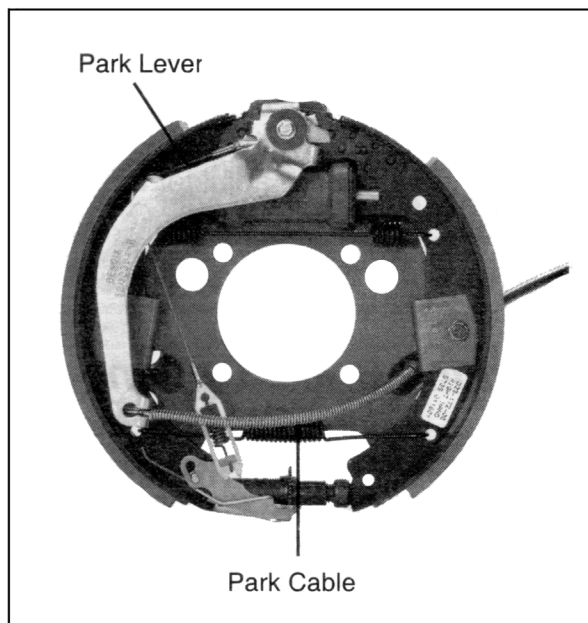
Check the fluid level in the master cylinder reservoir at least every three months. If you tow your trailer an average of 1,000 miles per month in a hot and dry environment, you must check the brake fluid level once a month. The brake fluid reservoir is located on the tongue of the trailer. Fill with DOT 3 or 4 brake fluid.

Self Adjusting Mechanism

The self adjusting feature adjusts the brakes on both forward and reverse stops. Brake adjustment occurs only when lining wear results in enough gap between the shoes and the drum surface. The added clearance allows the adjuster mechanism to rotate the screw assembly at the bottom of the brake. That action expands the distance between the shoes and thus closes the gap to the drum surface.

Parking Brake

The parking brake is cable operated. The parking cable body is mounted to the brake backing plate. The cable end is attached to the internal parking brake lever to actuate the brake. The internal parking brake lever, which is mounted to the secondary shoe, transfers applied cable force through a parking strut which is attached to the primary shoe. This transferred load generates a spreading force between the primary and secondary shoes. The shoes move toward the drum until contact is made. Friction generated between the drum and lining contact surface results in parking brake capability.



General Maintenance

DRUM BRAKE ADJUSTMENT

Brakes should be adjusted (1) after the first 200 miles of operation when the brake shoes and drums have "seated," (2) at 3000 miles intervals, (3) or as used and performance requires. The brakes should be adjusted in the following manner:

⚠ WARNING

DO NOT LIFT OR SUPPORT THE TRAILER ON ANY PART OF THE AXLE OR SUSPENSION SYSTEM. NEVER GO UNDER ANY TRAILER UNLESS IT IS PROPERLY SUPPORTED ON JACK STANDS WHICH HAVE BEEN RATED FOR THE LOAD. IMPROPERLY SUPPORTED VEHICLES CAN FALL UNEXPECTEDLY AND CAUSE SERIOUS INJURY OR DEATH.

1. Jack up trailer and secure on adequate capacity jack stands. check that the wheel and drum rotate freely.
2. Remove the adjusting hole cover from the adjusting slot on the bottom of the brake backing plate.
3. With a screwdriver or standard adjusting tool, rotate the starwheel of the adjuster assembly to expand the brake shoes. Adjust the brake shoes out until the pressure of the linings against the drum makes the wheel very difficult to turn.
4. Rotate the starwheel in the opposite direction until the wheel turns freely with a slight lining drag.
5. Replace the adjusting hole cove and lower the wheel to the ground.
6. Repeat the above procedure on all brakes. For best results, the brakes should all be set at the same clearance.

3.5 MECHANICAL BRAKE

Brake Maintenance

WHEEL BRAKES

The linings of the wheel brakes are wearing parts, so their condition must be checked every 3000 miles (5000 km) or every year, whichever comes first, using the view holes on the wheel backing plates.

If the connecting rod can be pushed in more than approximately 45 mm when the over-run braking system is checked as outlined above, this is a sure sign of advanced wearing of the brake linings. If this is the case, the wheel brakes must be readjusted at a qualified workshop, and if necessary, the brake shoes must be replaced.

WHEEL MOUNTS

The wheel hubs have maintenance-free, double row angular ball bearings.

The sideways bearing play should be checked at intervals of 3000 miles (5000 km) by checking whether the wheels have sideways play when the trailer is jacked up. If there is detectable play, the trailer should be checked at a qualified workshop.

REPLACING BRAKE ASSEMBLY COMPLETE

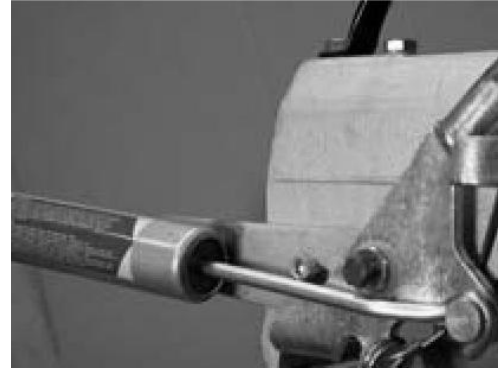
NOTICE

IT IS RECOMMENDED THAT THE BRAKE ASSEMBLIES ARE REPLACED IN AXLE SETS.

1. Follow steps 1 thru 7 of REPLACING BRAKE SHOES.
2. The brake assemblies are left and right specific, check the new assembly against the one fitted noting the position of the brake cable attachment. Remove the four bolts securing the backplate to the axle, remove the old assembly and install the new using the proper torque values.
3. Continue with the procedure under REPLACING BRAKE SHOES, starting at step 18.
4. Follow the procedure under ADJUSTMENT.

REPLACING BRAKE SHOES

Place the trailer on stands with all wheels off of the ground. **WARNING:** The handbrake should be released and the handbrake locking bolt installed.



Some couplings do not have provision for the locking bolt. In this case or if a bolt cannot be used the handbrake lever should be secured in the off position to prevent the handbrake lever from operating.

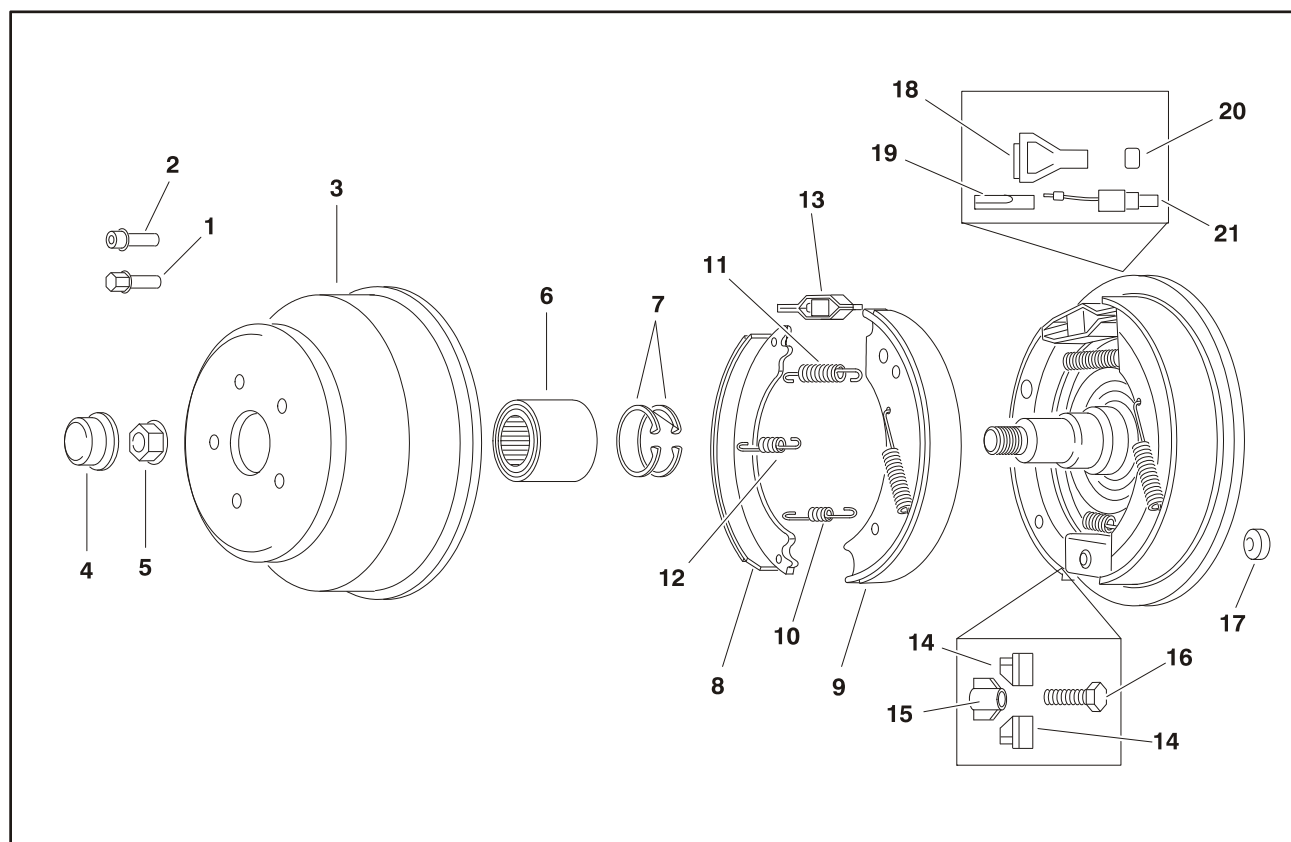
NOTE: *It is recommended that the brake shoes are replaced in axle sets.*

1. Remove the wheels.
2. Remove the hub cap.
3. Slacken off the brake adjuster bolt until free. Some brake assemblies have a ratchet accessible through an opening in the backplate instead of the bolt.
4. Remove the axle nut, this may be a castellated nut retained with a cotter pin or it may be a locknut.
5. Remove the brake drum (hub puller may be required) taking care not to displace the bearings.

⚠ WARNING

AVOID INHALING BRAKE DUST. DON'T USE AN AIR LINE TO CLEAN THE DRUM. CAREFULLY REMOVE THE DUST USING A SMALL BRUSH.

6. Check the condition of the brake drum. Replace the brake drum if deep score marks are visible.



- | | | | |
|----------------------|-----------------------------|---------------------------------|--------------------------|
| 1. Flanged Screw | 7. Circle Clip | 12. Tension Spring (Center) | 17. Adjustment Hole Plug |
| 2. Flanged Screw | 8. Brake Shoe (Secondary) | 13. Compression Spring Spreader | 18. Protective Shield |
| 3. Hub/Drum Assembly | 9. Brake Shoe (Primary) | 14. Adjusting Key | 19. Drawbar Eye |
| 4. Dust Cap | 10. Tension Spring (Top) | 15. Adjusting Bolt | 20. Protective Sleeve |
| 5. Flanged Nut | 11. Tension Spring (Bottom) | 16. Bolt | 21. Brake Cable |
| 6. Bearing | | | |

Figure 3-3. Mechanical Brake Assembly

7. Undo the locknut on the brake rod (front to rear) adjacent to the compensator. Slacken the second nut on the brake rod. Remove the half shell from the backplate and detach the brake cable.
8. Record the orientation of the brake shoes and springs on the backplate to ensure the new shoes and springs are replaced in the same position as the old.



9. With care and using a suitable lever, lift sliding shoe carrier away from expander. Extract expander and retain.
10. Remove brake shoe retaining spring taking care to retain the spring. Keep plate or pin at the rear of the backplate where installed.
11. Lift off whole brake shoe assembly from backplate. Take care not to lose the two adjuster wedges.
12. Examine the components and springs, replace any damaged parts. Clean the mechanism and ensure that all parts are free to move. Do not lubricate.
13. Install the springs on the new brake shoes.
14. Locate the shoes onto the backplate and position onto the adjuster wedges or cam block.
15. Install the retaining springs.
16. Locate the expander into position on the fixed plate.
17. With care, and using a suitable lever, position the expander between the shoes and release the lever.
18. Attach the brake cable and install the half shell. Always replace the brake cables if they show signs of wear, stiffness, damage, or fraying.
19. Install the drum and bearing. Replace the split pin or lock nut depending upon which type of nut is used. If a cotter pin and castellated nut is used, the axle nut must be adjusted to allow the correct bearing clearance. If a locknut is used, it is tightened to a pre-determined torque.
20. Install the hub cap.
21. Repeat the procedure on the other drum.
22. Install the tires and wheels.
23. Follow the procedure under ADJUSTMENT.

ADJUSTMENT

NOTE: When adjusting the brake drum, only turn the wheel in the direction of forward rotation.

1. Turn each wheel in the direction of forward rotation. Turn the brake adjuster bolt clockwise until some resistance is felt as the brake shoes begin to grip the drum, then slowly turn the brake adjuster bolt counterclockwise until the wheel begins to rotate freely again. Alternatively advance the adjuster using a screwdriver through the backplate hole until resistance is felt, then turn back by a few clicks until the wheel begins to rotate freely again.
2. Turn the nut on the brake rod until the nut is in contact with the compensator.

NOTICE

DO NOT OVERTIGHTEN AS THIS WILL CAUSE THE BRAKES TO DRAG AND OVER-HEAT.

NOTICE

DOUBLE CHECK THAT EVERYTHING HAS BEEN REASSEMBLED WITH ALL FASTENERS SECURED.

3. Remove the handbrake locking bolt and operate the handbrake several times to ensure that the compensators are seated. Check the travel of individual brake cables. This should be 2-5 mm. If not, re-adjust the brake as appropriate.
4. With the handbrake engaged, turn each wheel in the reverse direction. They should turn a little and then lock as the auto-reverse mechanism operates. As each wheel is turned there will be a rearward movement of the handbrake lever as the energy store operates. This action should occur once on the rearward turn of each wheel. If any wheel fails to lock, there is too much slack in the system.
5. Check the compensators are at 90° to the brake rod with the brakes applied in forward and reverse. Misalignment can be corrected through adjustment of the cable locking nuts. This is particularly important if a new cable has been installed.
6. Operate the handbrake and leave it on. Lower the trailer to the floor and recheck the torque of the wheel nuts.
7. Please note the brakes will not be 100% effective until the new linings have bedded in.
8. The brake adjustment should be rechecked after a short journey.

CAUTION

THE DRUMS MAY BE HOT.

Adjustment and Readjustment of the Overrun Braking System

ADJUSTING THE BRAKING SYSTEM

Preparations:

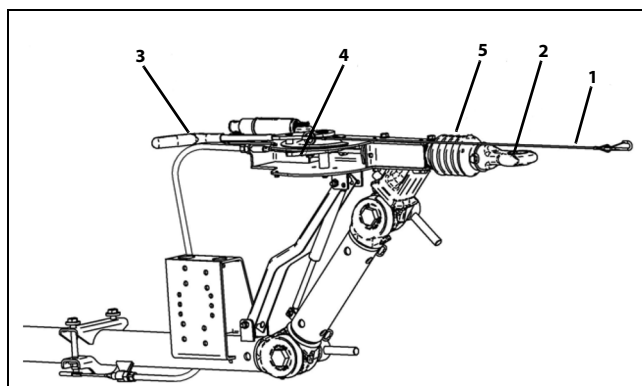
1. Place the trailer on jacks with the wheels off of the ground.
2. Release the handbrake
3. Pull out the drawbar as far as it will go.

Preliminary Requirements:

1. When carrying out adjustments, always start with the wheel brakes.
2. When carrying out adjustments, turn the wheel only in the direction of forward travel.
3. Do not pre-tension the expanding locking mechanism in the brake. If necessary, loosen the brake linkage at the brake compensator.
4. Check the expanding locking mechanism and control cable for ease of movement.

NOTICE

NEVER READJUST THE BRAKING SYSTEM OR BRAKES BY THE BRAKE LINKAGE OR TURNBUCKLES (IF APPLICABLE) IN THE LINKAGE. THE COMPRESSION SPRING MAY ONLY BE LIGHTLY PRE-TENSIONED AND MUST NOT BECOME FULLY COMPRESSED WHEN ACTIVATED!

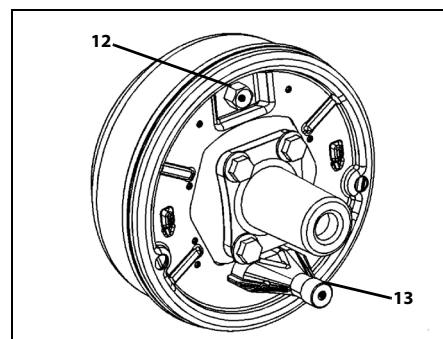


- | | |
|---------------------------|-----------------------|
| 1. Contact Breaking Cable | 4. Transmission Lever |
| 2. Trailer Coupling Ring | 5. Drawbar & Bellows |
| 3. Handbrake Lever | |

Figure 3-4. Overrun Brake System

ADJUSTMENT PROCEDURE

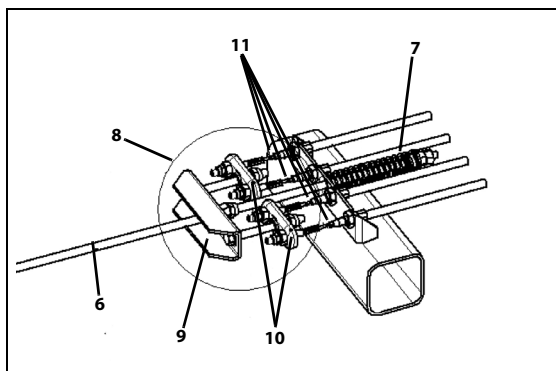
1. Brake
 - a. Loosen the linkage
 - b. Tighten the adjusting screw (12) (on the outside of the brake plate, opposite the cable entry[13]), turning clockwise until the wheel can only be turned with difficulty or not at all.



- | | |
|---------------------|-----------------|
| 12. Adjusting Screw | 13. Cable Entry |
|---------------------|-----------------|

Figure 3-5. Wheel Brake System

- c. Ease off the adjusting screw (12) in the counter-clockwise direction (approximately 1/2 turn) until the wheel turns freely. Slight rubbing noises, which do not effect the free turning of the wheel, are permitted.
- d. When the brake is correctly adjusted, the actuating travel of the control cable (11) will be 5-8 mm.



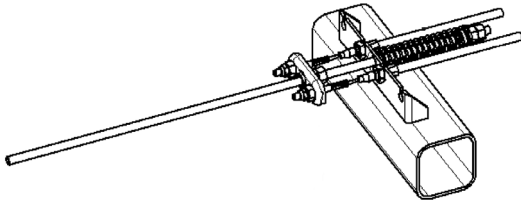
- | | |
|-----------------------|---------------------------------|
| 6. Brake Linkage | 9. Master Compensator |
| 7. Compression Spring | 10. Brake Compensating Balances |
| 8. Brake Compensator | 11. Control Cable |

Figure 3-6. Transmission System for Tandem and Single-Axle Chassis

- e. Repeat the procedure on the other wheel.

2. Brake Compensating System

- a. Preadjust the length of the brake linkage (slight play permitted).
- b. Operate the handbrake lever (3) and check the position of the compensating balances (9 & 10). They should be at right angles to the direction of towing.
- c. If necessary, adjust the position of the balance (10) and control cables (11).
- d. The compression spring may only be lightly pre-tensioned and must not become fully compressed when activated.



3. Brake Linkage

- a. Adjust the brake linkage so that it is free of play longitudinally, without initial tension (reversing lever free of play).
- b. **Readjustment:**
Operate the handbrake lever powerfully several times in order to settle the braking system.

Check the position of the brake compensating balances which should be at right angles to the direction of towing.

Check the play in the linkage; if necessary, adjust the linkage again so that it is free of play, but without initial tension.

Check the position of the handbrake lever; when checking the dead center of the lever, resistance starts 10-15 mm above dead center

Check that the wheels rotate freely with the brake released.

- c. **Final Check:**
Check fastenings for security (secure the hexagon locking nuts to the screw fastenings for the transmission system, control cables, brake compensators, turnbuckle, linkage, etc.)

Check the compression spring for initial tension.

- d. **Test Run:** If necessary, carry out 2-3 brake tests.
- e. **Brake Test:** Recheck the play in the brake linkage and if necessary, readjust the linkage for length free of play; during operating braking with empty trailer should be used maximally 1/2 of the overrun travel.

READJUSTING THE BRAKING SYSTEM

The main purpose of readjusting the braking system is compensate for brake lining wear. To readjust the wheel brakes, follow the instructions under ADJUSTING THE BRAKING SYSTEM. Check the play in the linkage and readjust if necessary.

NOTICE

CHECK THE EXPANDING LOCKING MECHANISM AND CONTROL CABLE. THE EXPANDING LOCK COMPENSATOR MUST NOT BE PRE-TENSIONED IN THE BRAKE. DO NOT ATTEMPT TO COMPENSATE FOR EASE OF MOVEMENT CAUSED BY BRAKE LINING WEAR BY READJUSTING (SHORTENING) THE BRAKE LINKAGE, BY WAY OF THE LINKAGE SCREW FASTENINGS.

1. Readjustment:

- a. Operate the handbrake lever powerfully several times in order to settle the braking system.
- b. Check the position of the brake compensating balances (which should be at right angles to the direction of towing).
- c. Recheck the play in the linkage.
- d. If necessary, adjust the linkage again so that it is free of play, but without the initial tension.
- e. Check the positions of the handbrake lever and compression spring (only light initial tension).
- f. When checking the dead center of the lever, resistance starts 10-15 mm above dead centre.

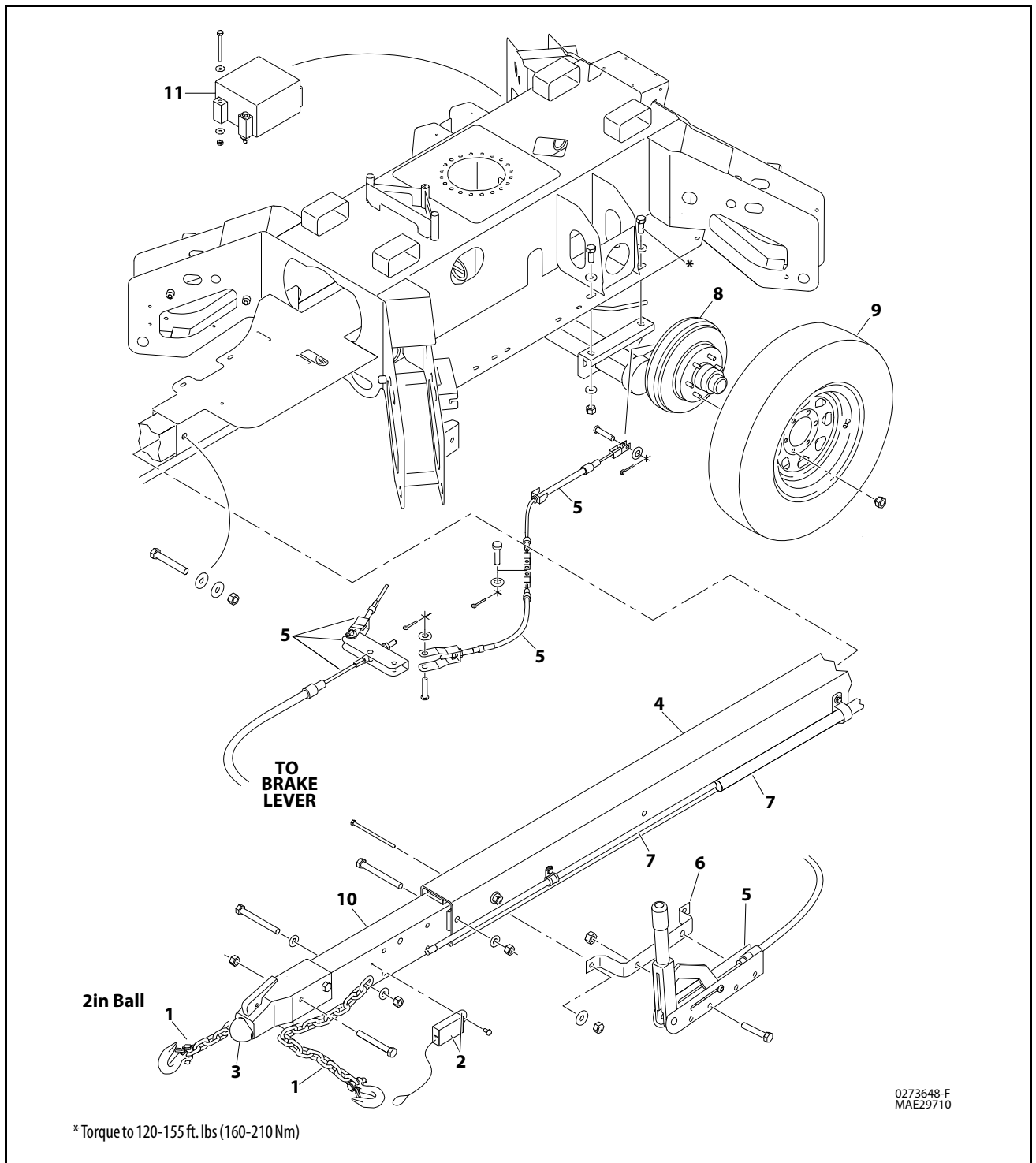
2. Final Check:

- a. Check the screw fastenings for the transmission system (control cables, brake compensators, linkage, etc.)

Troubleshooting

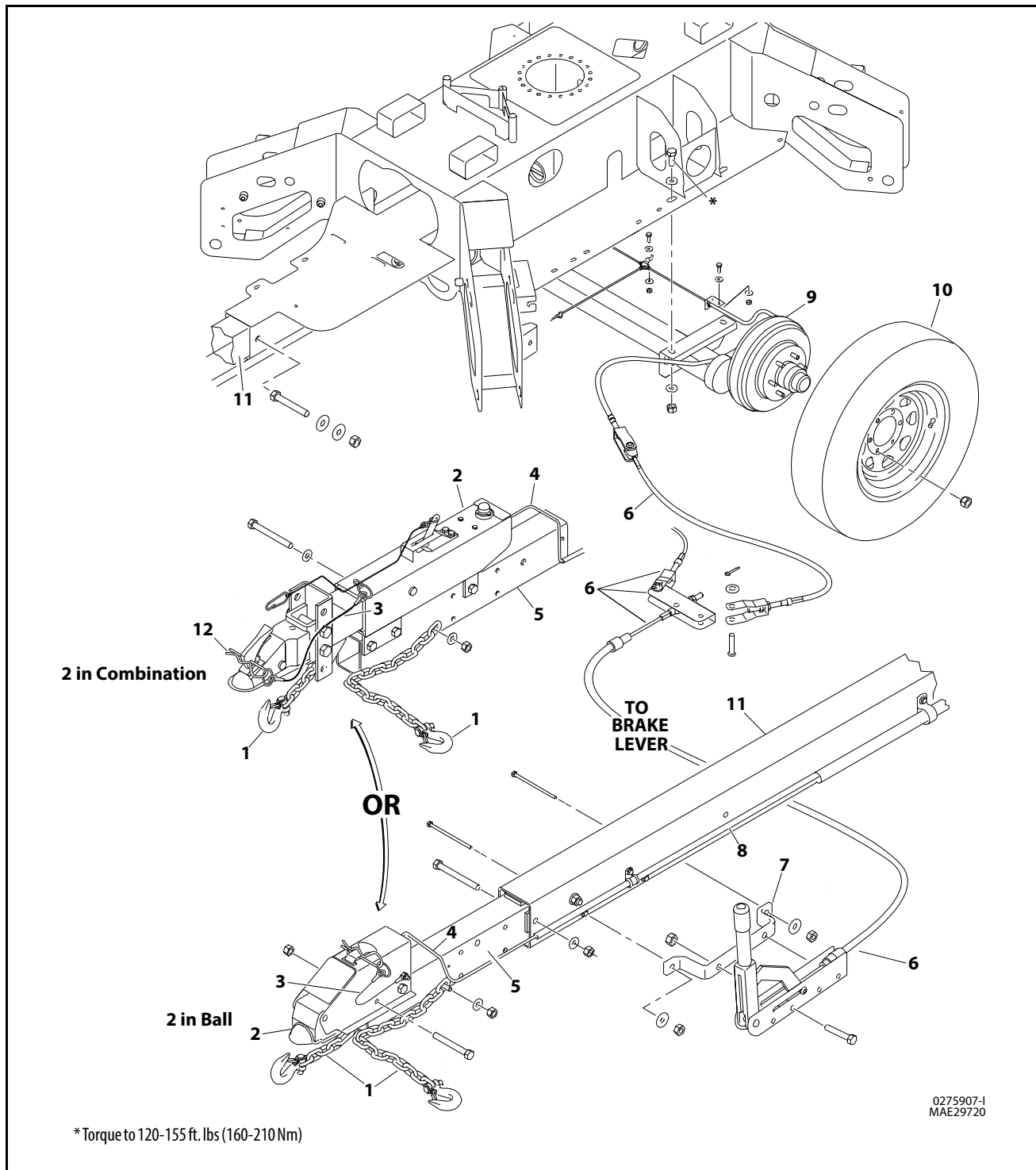
Table 3-1. Malfunctions and Remedies

Malfunction	Cause	Remedy
Insufficient braking effect	Excessive backlash in brake system	Service at qualified workshop
	Brake linings not run in	Actuate hand-brake lever slightly; drive 1-2 miles (2-3 km)
	Brake linings glazed, oily or damaged	Service at qualified workshop
	Overrunning hitch hard to operate	Grease overrunning hitch
	Brake linkage is jammed or deformed	Service at qualified workshop
	Brake Bowden cables rusty or kinked	Service at qualified workshop
Brake reacts by jerks	Excessive backlash in brake system	Service at qualified workshop
	Shock absorber of overrunning hitch defective	Service at qualified workshop
	Backmat brake shoe is jammed in the brake shoe holder	Service at qualified workshop
Trailer is braked unilaterally	Wheel brakes are actuated unilaterally	Service at qualified workshop
Trailer is already braked when the accelerator pedal is released.	Shock absorber of overrunning hitch defective	Service at qualified workshop
Reverse driving hard to accomplish or even impossible	Brake system adjusted too tightly	Service at qualified workshop
	Bowden cables pre-loaded	Service at qualified workshop
	See "Brake reacts by jerks"	Service at qualified workshop
Braking action of handbrake insufficient	Incorrect setting	Service at qualified workshop
		Actuate handbrake lever as far as possible
Wheel brakes get hot	Brake system incorrectly set	Service at qualified workshop
	Wheel brakes dirty	Service at qualified workshop
	Reversing lever of overrunning hitch is jammed	Service at qualified workshop
	Spring type actuator is pre-loaded in zero position; nuts are turned in too far	Service at qualified workshop
	Handbrake lever not or only partially released	Set handbrake lever into zero position
Ball coupling does not rest on ball	Coupling dirty on the inside	Clean and grease properly
	Ball of towing vehicle too big	Check ball diameter: According to DIN 74058 the ball on the tow vehicle must not exceed 50 mm in diameter when new and it must be Ø 49.5 mm. If the ball diameter decreases to less than 49.0 mm, the ball has to be replaced. The ball must be perfectly spherical.



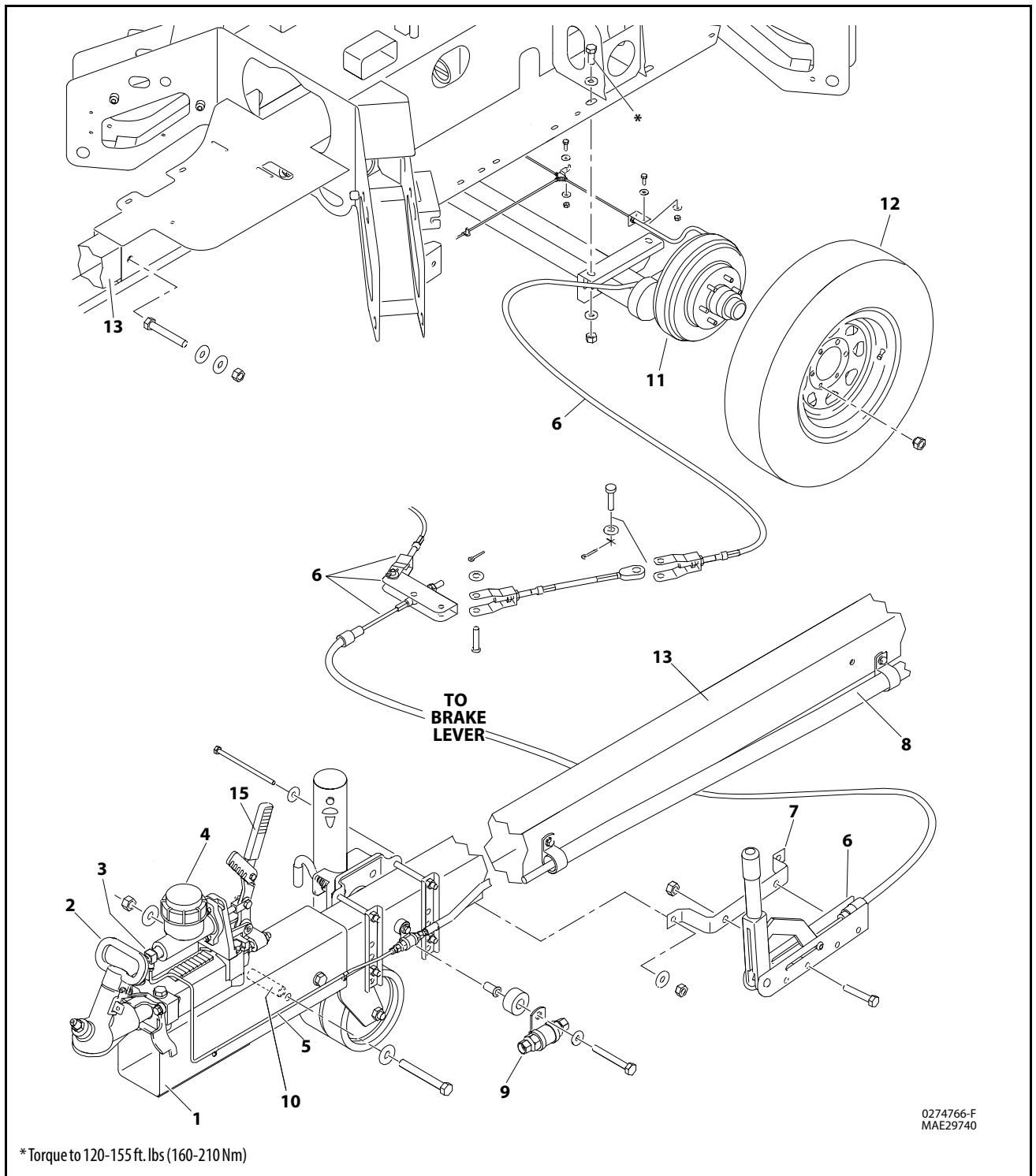
- | | | |
|---------------------|---------------------------------|---------------------|
| 1. Safety Chain | 5. Parking Brake Cable Assembly | 9. Tire Assembly |
| 2. Pin and Cable | 6. Parking Brake Bracket | 10. Tongue Adapter |
| 3. Coupler Assembly | 7. Conduit | 11. Battery Charger |
| 4. Tongue | 8. Electric Brake Assembly | |

Figure 3-7. Axle and Tongue Installation With Electric Brakes (2 in Ball)



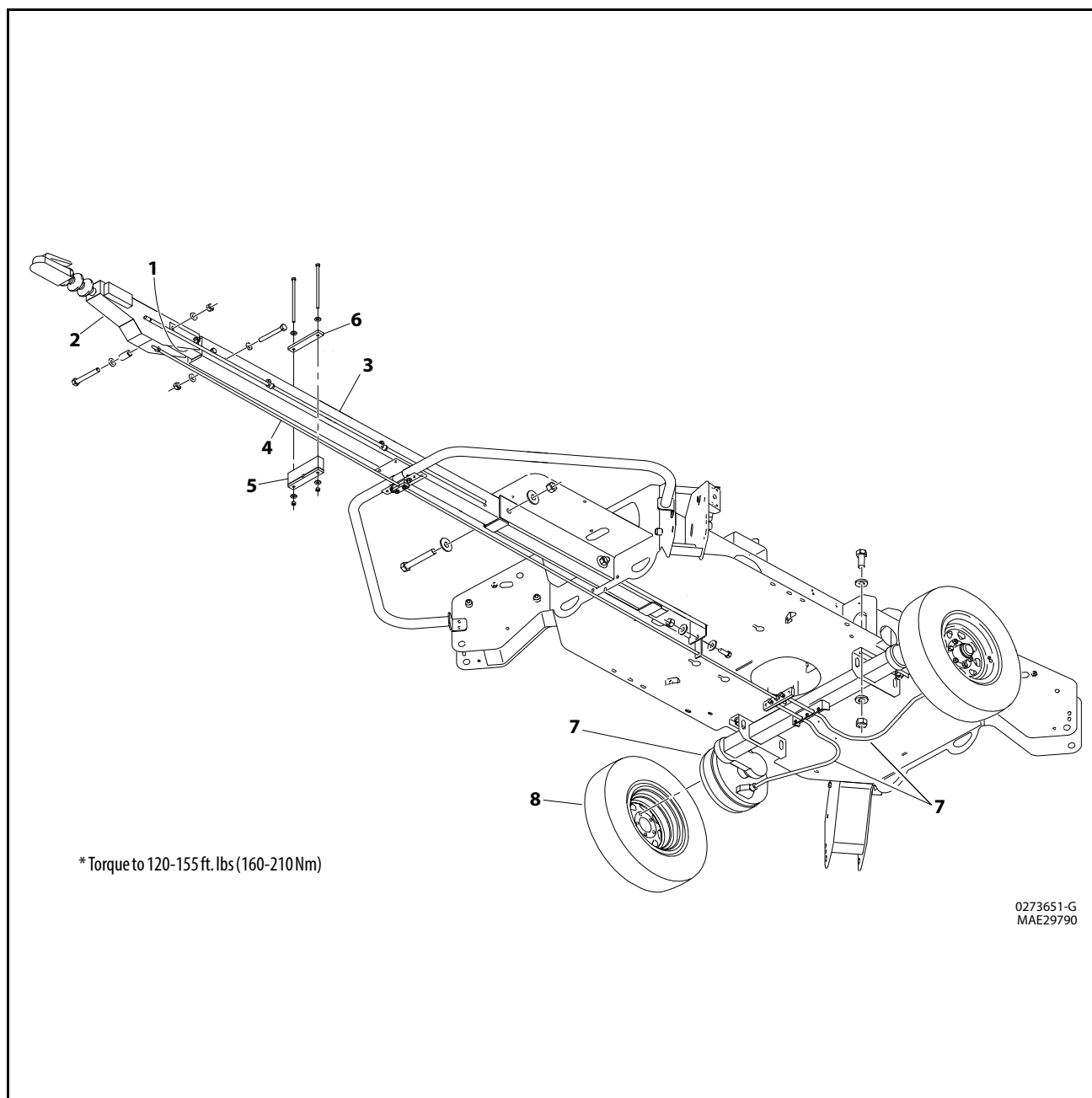
- | | | |
|---------------------|---------------------------------|-----------------------------|
| 1. Safety Chain | 5. Tongue Adapter | 9. Hydraulic Brake Assembly |
| 2. Coupler Assembly | 6. Parking Brake Cable Assembly | 10. Tire Assembly |
| 3. Lanyard Cable | 7. Parking Brake Bracket | 11. Tongue |
| 4. Brake Line | 8. Conduit | 12. Hairpin |

Figure 3-8. Axle and Tongue Installation With Hydraulic Brakes (2 in Ball) - Prior to SN 0030002099



- | | | | |
|----------------------------|---------------------------------|------------------------------|-----------------|
| 1. Tongue Adapter | 5. Brake Line Assembly | 9. Pressure Valve | 13. Tongue |
| 2. Coupler Assembly | 6. Parking Brake Cable Assembly | 10. Spacer | 14. Pin |
| 3. Fitting | 7. Parking Brake Bracket | 11. Hydraulic Brake Assembly | 15. Pivot Lever |
| 4. Brake Cylinder Assembly | 8. Conduit | 12. Tire Assembly | |

Figure 3-9. Axle and Tongue Installation With Hydraulic Brakes (50mm Ball)



- | | | | |
|---------------------|-----------|----------------------|------------------------------|
| 1. Hitch Adapter | 3. Tongue | 5. Brake Rod Support | 7. Mechanical Brake Assembly |
| 2. Coupler Assembly | 4. Rod | 6. Tube Mount Bar | 8. Tire Assembly |

Figure 3-10. Axle and Tongue Installation with Mechanical Brakes (50mm ball)

3.6 HUBS, DRUMS, WHEEL BEARINGS

The wheel bearing configuration consists of opposed tapered roller bearing cones and cups, fitted inside of a precision machined cast hub. This configuration requires a minimal amount of end play be provided at assembly, which is essential to the longevity of the bearing service life. This design is lubricated with grease packed into the bearings.

Hub Removal

1. Elevate and support the machine.

⚠ WARNING

FOLLOW MAINTENANCE PROCEDURES TO PREVENT DAMAGE TO IMPORTANT STRUCTURAL COMPONENTS. DAMAGE TO CERTAIN STRUCTURAL COMPONENTS SUCH AS WHEEL BEARINGS CAN CAUSE THE WHEEL END TO COME OFF OF THE AXLE. LOSS OF A WHEEL END WHILE THE MACHINE IS MOVING CAN CAUSE A LOSS OF CONTROL AND LEAD TO AN ACCIDENT, WHICH CAN RESULT IN SERIOUS INJURY OR DEATH.

2. Using adequate support to the wheel, Remove the nut securing wheel to hub.
3. Remove the wheel.
4. Remove the grease cap by carefully prying progressively around the flange of the cap.
5. Remove the cotter pin from the spindle nut.
6. Unscrew the spindle nut (counterclockwise) and remove the spindle washer.
7. Remove the hub from the spindle, being careful not to allow the outer bearing cone to fall out. The inner bearing cone will be retained by the seal.

Brake Drum Inspection

1. The drum surface (where the brake shoes make contact) should be inspected for excessive wear or heavy scoring. If worn more than 0.020 in. (0.50 mm) oversized, or the drum has worn out of round by more than 0.015 in. (0.38 mm), then the drum surface should be re-machined. If scoring or other wear is greater than 0.090 in. (2.28 mm) on the diameter, the drum must be replaced (i.e. for a 10 in [25.400 cm] drum, no greater than 10.090 in.[25.628 cm]).

NOTE: *It is important to protect the wheel bearing bores from metallic chips and contamination which result from drum turning. Ensure the wheel bearing cavities are clean and free of contamination before reinstalling the bearing and seals. The presence of these contaminants will cause premature wheel bearing failure.*

Bearing Inspection

Wash all grease and oil from the bearing cone using a suitable solvent. Dry the bearing with a clean, lint-free cloth and inspect each roller assembly.

NOTICE

NEVER SPIN THE BEARING WITH COMPRESSED AIR. THIS CAN DAMAGE THE BEARING.

If any pitting, spalling, or corrosion is present, then the bearing must be inspected.

NOTICE

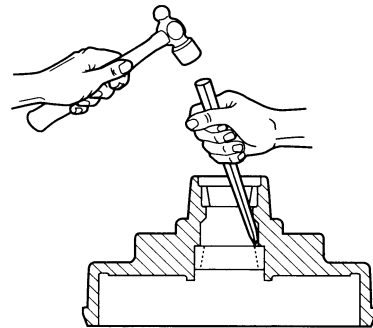
BEARINGS MUST ALWAYS BE REPLACED IN SETS OF A CONE AND CUP.

⚠ CAUTION

BE SURE TO WEAR SAFETY GLASSES WHEN REMOVING OR INSTALLING FORCE FITTED PARTS. FAILURE TO COMPLY MAY RESULT IN SERIOUS EYE INJURY.

When replacing the bearing cup proceed as follows:

1. Place the hub on a flat work surface with the cup to be replaced on the bottom side.
2. Using a brass drift punch, carefully tap around the small diameter end of the cup to drive out.

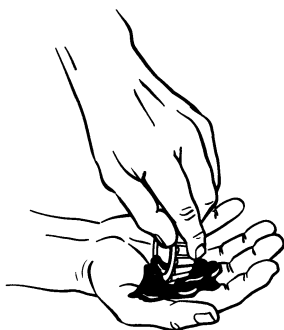


3. After cleaning the hub bore area, replace the cup by tapping in with the brass drift punch. Be sure the cup is seated all the way up against the retaining shoulder in the hub.

Bearing Lubrication

Bearings should be lubricated every 12 months or 12,000 miles. The procedure to repack bearing cones is as follows:

1. Place a quantity of grease into the palm of your hand.
2. Press a section of the widest end of the bearing into the outer edge of the grease pile closest to the thumb forcing grease into the interior of the bearing.



3. Repeat this while rotating the bearing from roller to roller.
4. Continue this process until the entire bearing is completely filled with grease.
5. Before installing, apply a light coat of grease on the bearing cup.

Thickener Type Lithium Complex
 Dropping Point 419° F (215°C) Minimum
 Consistency NLGI No. 2
 Additives EP, Corrosion & Oxidation Inhibitors
 Viscosity Index 80 Minimum

Approved Sources:

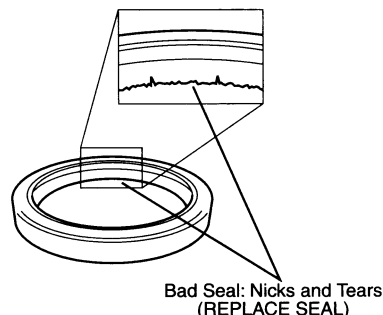
Mobil Oil Mobilgrease HP, Mobilith AW2
 Exxon/Standard Ronex MP
 Kendall Refining Co. Kendall L-427
 Ashland Oil Co. Valvoline Multipurpose GM
 76 Lubricants 76 Multiplex EP
 Citgo Petroleum Lithoplex MP#2
 Mystik Mystik JT-6 Hi Temp Grease
 Pennzoil Premium Wheel Bearing Grease 707L

Seal Inspection and Replacement

Whenever the hub is removed, inspect the seal to assure it is not nicked or torn and is still capable of properly sealing the bearing cavity. If there is any question of condition, replace the seal.

To replace the seal:

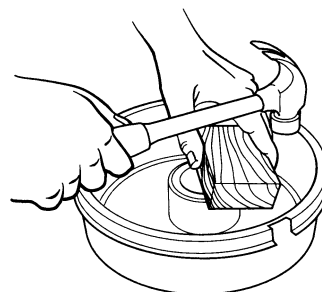
1. Pry the seal out of the hub with a screwdriver. Never drive the seal out with the inner bearing as you may damage the bearing.



2. Apply a sealant, such as PERMATEX, to the outside of the new seal.

NOTE: Permatex sealant should not be used on rubber encased seals.

3. Tap the new seal into place using a clean wooden block.

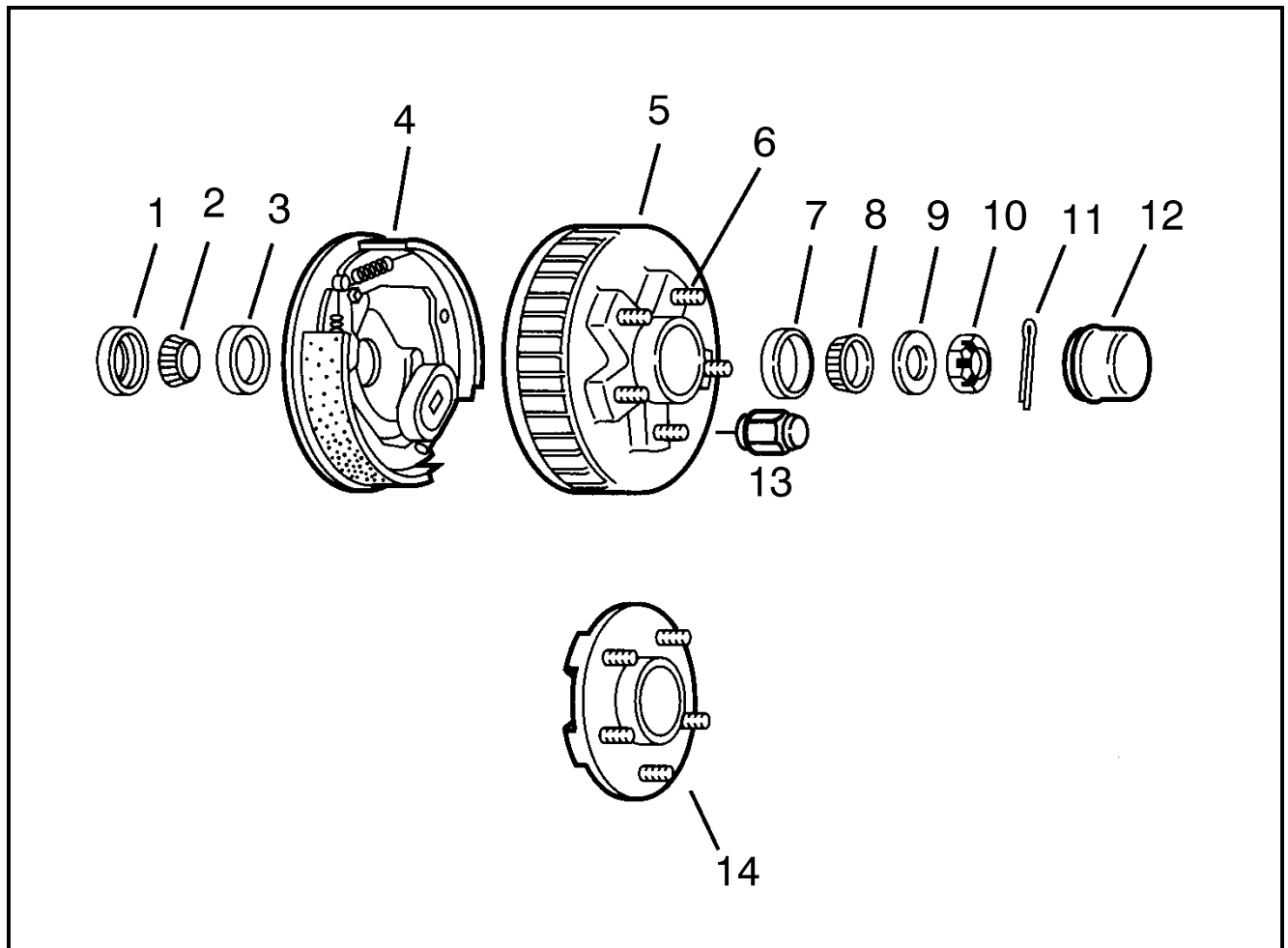


Bearing Adjustment

If the hub has been removed or bearing adjustment is required, the following adjustment procedure must be followed:

1. Rotate the hub assembly slowly while tightening the spindle nut to approximately 50 ft.lbs. (68 Nm).
2. Loosen the spindle nut to remove the torque. DO NOT ROTATE THE HUB.
3. Finger tighten the spindle nut until just snug.
4. Back the spindle nut out slightly until the first castellation lines up with the cotter key hole and insert the cotter pin.
5. Bend over the cotter pin legs to secure the nut.

NOTE: The nut should be free to move with the only restraint being the cotter pin.



- | | | | |
|-----------------------|-----------------------|-------------------|---------------|
| 1. Grease Seal | 5. Hub Assembly | 9. Spindle Washer | 13. Wheel Nut |
| 2. Inner Bearing Cone | 6. Wheel Stud | 10. Spindle Nut | 14. Hub |
| 3. Inner Bearing Cup | 7. Outer Bearing Cup | 11. Cotter Pin | |
| 4. Brake Assembly | 8. Outer Bearing Cone | 12. Grease Cap | |

Figure 3-11. Hub and Brake Assembly

WHEEL CYLINDERS

Inspect for leaks and smooth operation. Clean with brake cleaner and flush with fresh brake fluid. Hone or replace as necessary.

BRAKE LINES

Check for cracks, kinks, or blockage. Flush with fresh brake fluid. Bleed system to remove all air. Replace as necessary.

SHOES AND LININGS

Inspect visually. Replace if the lining is worn to within 1/16" (1.6 mm) or less, contaminated with grease or oil, or abnormally scored or gouged. When replacement is necessary, it is important to replace both shoes on each brake and both brakes of the same axle to maintain balance in the braking system.

After replacement of the brake shoes and linings, the brakes must be re-burnished to seat in the new components. This should be done by applying the brakes 20 to 30 times from an initial speed of 40 mph, slowing the vehicle to 20 mph. Allow ample time for the brakes to cool between applications. This procedure allows the brake shoes to seat in to the drum surface.

HARDWARE

Check all hardware. Check shoe retractor spring, hold down springs, and adjuster springs for stretch or wear. Replace as required.

DRUMS

Check drums for scoring, cracking, or uneven wear. Turn drum smooth only if under maximum diameter. Replace as necessary.

3.7 TIRES & WHEELS

Tire Inflation

Tire pressure is the most important factor in tire life. Inflation pressure should be as recommended and stated on the sidewall of the tire. Pressure should be checked cold before operation. Do not bleed air from tires when they are hot. Check inflation pressure weekly during use to insure the maximum tire life and tread wear.

Tire Wear

Inspect tires periodically for wear or damage. Tires with less than 1/16" (2 mm) tread depth or visible wear bands require replacement.

A bubble, cut or bulge in a sidewall can result in a tire blowout. Inspect both sidewalls of each tire for any bubble, cut or bulge; and replace a damaged tire before towing the trailer.







WARNING

WORN, DAMAGED OR UNDER-INFLATED TIRES CAN CAUSE LOSS OF CONTROL, RESULTING IN DAMAGE, SERIOUS INJURY OR DEATH. INSPECT TIRES BEFORE EACH TOW.

The following tire wear diagnostic chart will help you pinpoint the causes and solution of tire wear problems.

Table 3-2. Tire Wear

Wear Pattern		Cause	Action
	Center Wear	Over Inflation	Adjust Pressure to value specified in Section 7
	Edge Wear	Under Inflation	Adjust Pressure to value specified in Section 7
	Cupping	Out of balance	Check bearing adjustment and balance tires
	Flat Spots	Wheel lockup and tire skidding	Avoid sudden stops when possible and adjust brakes.

Tire Replacement

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

- Equal or greater ply/load rating and size of original
- Tire tread contact width equal or greater than original
- Wheel diameter, width, and offset dimensions equal to the original

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

Wheel Replacement

Replacement wheels must have the same diameter, width, and profile as the original. Replacement tires must be the same size, ply rating, and load range as the tire being replaced. Refer to the Vehicle Identification plate on the chassis for wheel and tire specifications.

Wheel Installation

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

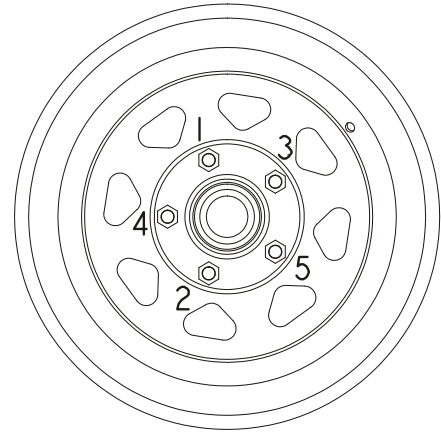
⚠ WARNING

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

Tighten the lug nuts to the proper torque for the axle size on your trailer, 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 chart.

Table 3-3. Wheel Torque Chart - ANSI, ANSI Export, CSA, Aus

TORQUE SEQUENCE - Ft Lbs (Nm)		
1st Stage	2nd Stage	3rd Stage
20-25 (25-35)	50-60 (70-80)	90-120 (120-163)

Table 3-4. Wheel Torque Chart - CE

TORQUE SEQUENCE - Ft Lbs (Nm)		
1st Stage	2nd Stage	3rd Stage
15 (20)	35 (50)	66 (90)

4. Wheel nuts should be torqued before first road use and after each wheel removal. Check and torque after the first 10 miles, 25 miles, and again at 50 miles. Check periodically thereafter.

Lug Nuts (Bolts)

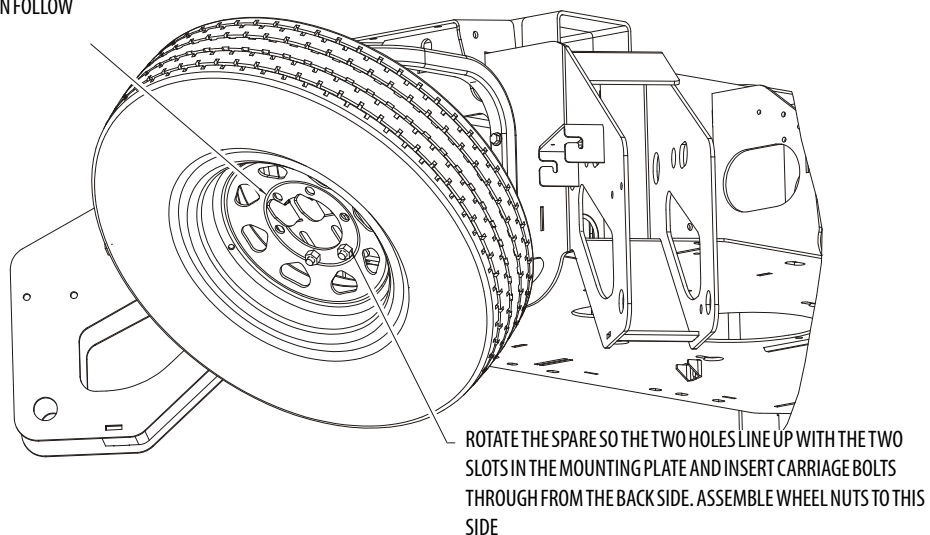
Lug nuts are prone to loosen right after a wheel is mounted to a hub. When driving on a remounted wheel, check to see if the lug nuts are tight after the first 10, 25 and 50 miles of driving and before each tow thereafter.

⚠ WARNING

CHECK LUG NUTS FOR TIGHTNESS ON A NEW TRAILER OR WHEN WHEEL(S) HAVE BEEN REMOUNTED AFTER THE FIRST 10, 25 AND 50 MILES OF DRIVING.

METAL CREEP BETWEEN THE WHEEL RIM AND LUG NUTS WILL RESULT IN A WHEEL COMING OFF, LEADING TO DEATH OR SERIOUS INJURY. TIGHTEN LUG NUTS BEFORE EACH TOW.

PLACE THE SPARE ON THE HOOK PROVIDED ON THE MOUNTING FIXTURE AND THEN FOLLOW DIRECTIONS BELOW



INSERT CARRIAGE BOLTS SO THAT THE SQUARE NECKS ARE IN SLOTS ON THIS SIDE AS SHOWN

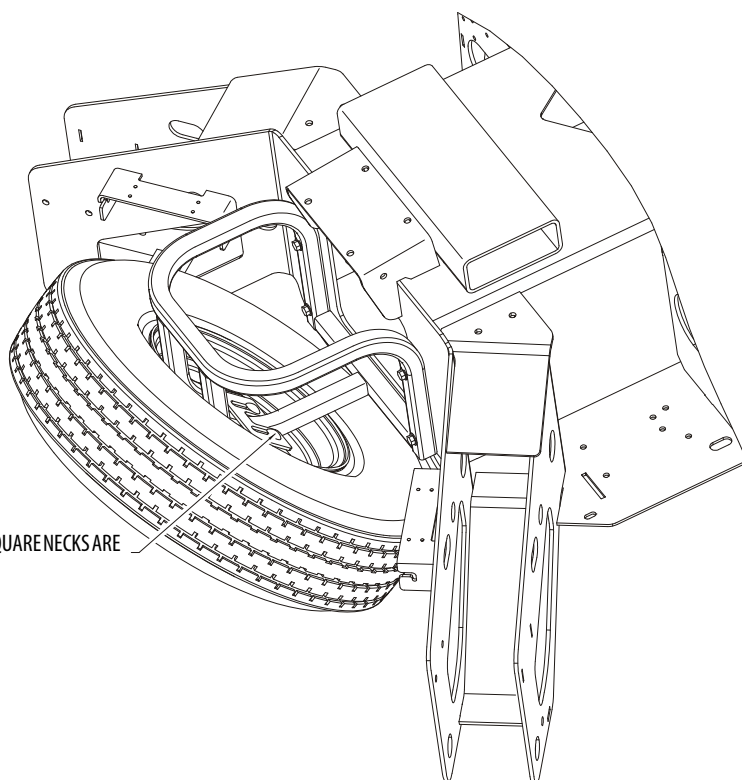


Figure 3-12. Spare Tire (Optional)

3.8 HYDRAULIC BRAKE COUPLER

Troubleshooting

NOTICE

IF ANY OF THE FOLLOWING CONDITIONS DEVELOP, TRAILER MUST NOT BE USED UNTIL PROPER CORRECTIVE ACTION IS TAKEN.

Table 3-5. Surge Brake Troubleshooting

Symptom	Cause	Solution
Squeaking, Clatter, or Chucking	Lack of Hitch Ball Lubrication	Lubricate with conventional automotive grease or commercial lubricant made for hitch balls
	Binding Linkage & Pivots on Brake Actuator	Oil linkage & pivots on brake actuator
	Loose Hitch Ball	Inspect hitch and tighten
	Loose Hitch	Inspect hitch and tighten
	Actuator loose on trailer frame	Inspect brake actuator and tighten
	Hitch ball worn or too small	Replace
	Overheated Brakes	Replace wheel bearing
	Broken Brake Drum(s)	Replace brake drum(s) & check brake shoes
	Low Brake fluid level	Fill & bleed brakes
	Worn out shock absorber	Replace
	Partial application of breakaway cable	Fully release breakaway cable
	Brakes improperly adjusted	Check brakes
	Broken brake return spring	Replace return spring
	Seized actuator master cylinder	Replace/rebuild actuator master cylinder
	Worn out brake shoes	Replace brake shoes and check brake drums
	Leaky wheel cylinders	Replace/rebuild wheel cylinders and replace brake shoes. Clean drums and other hardware.
Release handle does not close easily	Oversized ball	Check ball size
	Ball not fully inserted into socket	Check for proper ball size. Check to see if tongue jack is fully retracted. Hold release handle open when inserting ball.
	Foreign material in actuator socket	Clean and lubricate
Brake Overheating, Side Pull, Brakes do not Operate, Poor Brake Performance	Only one brake is applying	Check brake adjustment
	Leaking wheel cylinder	Check and replace wheel cylinder and bleed brakes
	Seized wheel cylinder piston	Check and rebuild/replace wheel cylinder and bleed system.
	Foreign Material in Brake Unit	Clean thoroughly
	Low hydraulic fluid level	Fill and bleed brakes
	Bent shoulder bolt	Replace
	Bent push rod in the shock absorber	Replace shock absorber
	Damaged socket assembly	Replace actuator
	Broken/Pinched brake lines	Replace
	Brake actuator frame damaged	Replace actuator
	Worn brake shoe(s)	Replace brake shoe(s)
Towing Vehicle Shaking Back and Forth	Worn vehicle suspension	Replace shock absorber
	Hitch not secure	Tighten all bolts and nuts
	Under-sized hitch ball	Replace with proper size

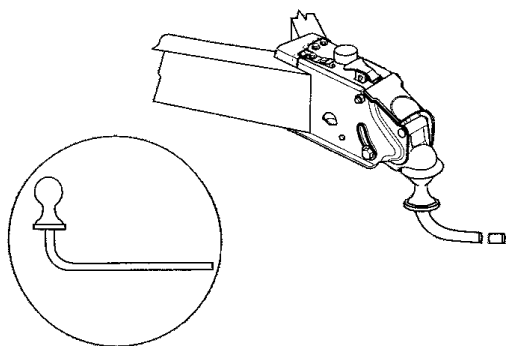
Bleeding the Brake System

NOTICE

DO NOT USE BRAKE FLUID DRAINED FROM THE BRAKE SYSTEM IN REFILLING THE MASTER CYLINDER. USED BRAKE FLUID CAN BE CONTAMINATED FROM THE SYSTEM.

1. Remove the master cylinder filler cap and fill reservoir with DOT type 3 or 4 automotive brake fluid.
2. Check all hydraulic line fittings and connections to make sure they are leak free.
3. At brake assembly, connect a bleeder hose to bleeder fitting on the wheel cylinder and submerge the free end in a container with brake fluid. DO NOT reuse brake fluid.

NOTE: Use a power bleeder or a bar with a 2" (50 mm) hitch ball attached. Do not use the breakaway cable for bleeding the brake system. If a power bleeder is used, air pressure of 35 psi (2.4 Bar) is most effective.

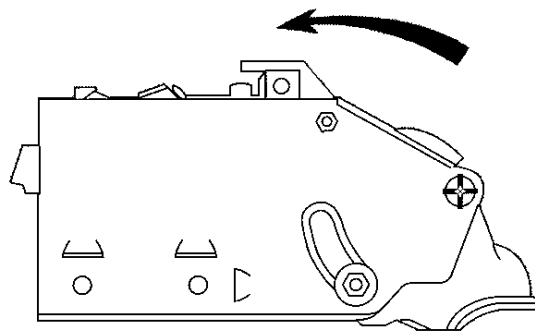


4. Loosen the bleeder fitting at the top of the brake assembly.
5. Apply the actuator and tighten the bleeder fitting. Return the actuator to the forward position. Again, loosen the bleeder valve one turn and apply the actuator. Repeat this procedure until fluid expelled from the bleeder hose is free of air bubbles. It is helpful to lower the trailer tongue to promote air bubble movement in the brake tubing. It is also helpful to tap gently along the brake tubing during the brake bleeding to keep air bubbles from sticking to the inside of the brake tubing. During this procedure, the master cylinder reservoir fluid level must be maintained at no less than 1/2 full and no more than 1/2" (13 mm) from the top of the reservoir.
6. When no air bubbles are visible, close the bleeder valve securely and remove the bleeder hose.
7. Repeat steps 1 thru 6 for the remaining brake.
8. After bleeding has been completed, re-check fluid level in the master cylinder.

Towing

NOTICE

THE TRAILER MAY DISCONNECT IF NOT PROPERLY SECURED. THE RELEASE HANDLE MUST BE FULLY CLOSED BEFORE TOWING. DO NOT FORCE THE RELEASE HANDLE INTO THE CLOSED POSITION.

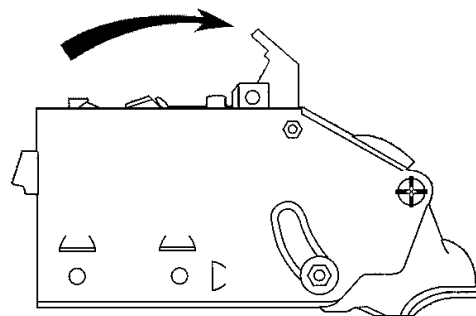


1. Position the actuator ball socket above the ball.

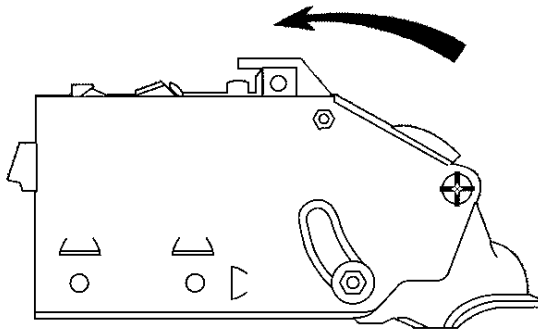
NOTICE

DO NOT DAMAGE THE ACTUATOR WHEN BACKING UP TOWING VEHICLE FOR HOOK-UP.

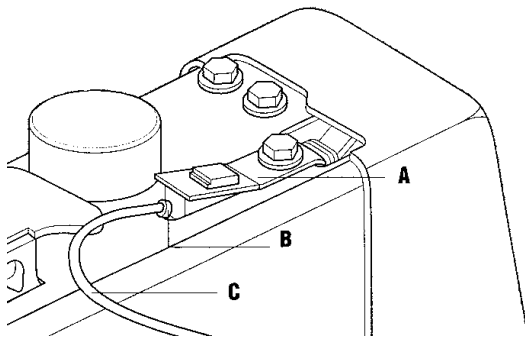
2. Hold the release handle in the open position. Release handle must be held in fully open position to remove from or place on ball.



3. Lower trailer tongue until ball rests in ball socket.
4. Close the release handle. The release handle will close freely with finger pressure when the ball is properly inserted into the ball socket.



5. To make sure actuator is securely latched onto the ball, extend the trailer tongue jack to the ground and lift the tow vehicle and trailer combination 2 to 4 in. (50 to 100 cm). If the ball does not disengage, the actuator is securely attached.
6. Insert a padlock or bolt through the lock hole for theft protection.
7. Connect the breakaway cable solidly to the bumper or frame of tow vehicle as near to the center as possible. Cable must hang clear of trailer tongue and long enough to permit short radius turns without pulling breakaway cable forward.
8. Make sure the breakaway cable (C) is in the released position with the indicator bead (B) touching or resting against the cable spring stop (A) as shown below.



NOTICE

DO NOT USE THE BREAKAWAY CABLE AS A PARKING BRAKE.

NOTICE

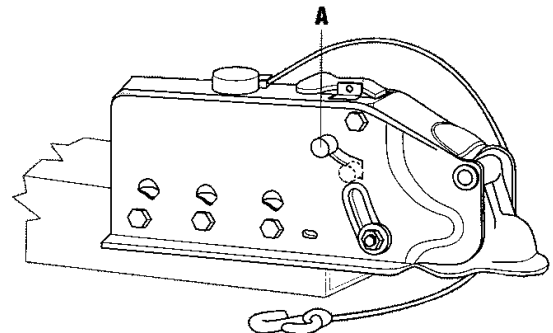
CHECK THE LOCATION OF THE BREAKAWAY CABLE PERIODICALLY DURING EACH TRIP. THE INDICATOR SHOULD REST AGAINST THE SPRING STOP. ACCIDENTAL APPLICATION WILL CAUSE BRAKES TO DRAG AND HEAT UP.

9. Cross safety chains under the tongue and securely attach to bumper or frame of tow vehicle.

NOTICE

FAILURE TO USE SAFETY CHAINS COULD DAMAGE THE TRAILER BOOM.

10. Retract the jack fully. Place the caster wheel in the stowed position.
11. Check for proper tow vehicle to trailer hook-up; the tow vehicle and trailer should be level with positive tongue load.
12. The back-up lever must be positioned in the towing position (A) as shown below.



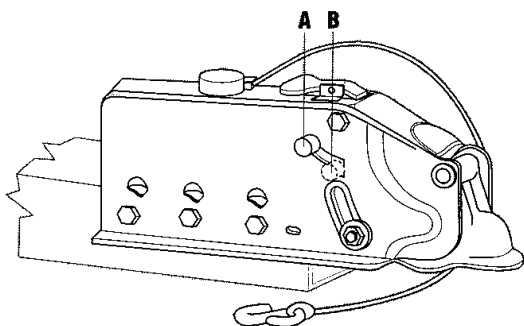
13. You are now ready to tow your vehicle.

NOTICE

AVOID SHARP TURNS. THIS COULD BEND, CREATE EXTREME STRESS, OR FRACTURE EITHER THE ACTUATOR OR TRAILER TONGUE.

Backing Up

1. Follow steps 1 through 13 under Towing.
2. Before backing up a slope or through soft ground, pull the trailer forward slightly to assure the actuator socket is in the fully forward position.
3. Move the lever knob on the side of the actuator downward from the towing position (A) along the curved slot in the actuator frame to the back-up position (B). The slot has a notch at the bottom of its' travel. Plush the lever knob down to engage the locking notch.

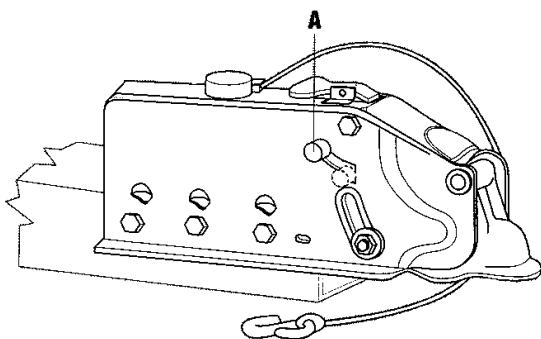


4. Back the trailer up.

NOTICE

AVOID SHARP TURNS. THIS COULD BEND, CREATE EXTREME STRESS, OR FRACTURE EITHER THE ACTUATOR OR TRAILER TONGUE.

5. If the machine is to be uncoupled from the tow vehicle after backing with the lever knob engaged, block all wheels and pull forward slightly to take strain off of the actuator. Uncouple the actuator by lifting the release handle and raising the trailer tongue. Make sure the lever knob is in the towing position (A) when uncoupling from the trailer.



Maintenance

1. Keep all links and pivots lubricated to prevent rusting and ensure ease of operation. Use SAE 30 oil, lubricate inside release handle and inside actuator body from the underside of the actuator.

NOTE: Lubricate the hitch ball with conventional automotive grease or a lubricant made for hitch balls.

2. Check for leaks in the brake system. Periodic checks should be made on all hoses and fittings to guard against cuts and worn hoses which may cause failure (leaks, rupturing under pressure, and collapsing). Replace defective hoses.
3. Check brake fluid level in the master cylinder reservoir. Keep filled to within 1/2" (13 mm) from the top of the reservoir. Use only a DOT type 3 or 4 brake fluid.
4. Flush the system yearly or when system is known to be contaminated.

NOTE: Wheel bearings and seals should be inspected and packed at this time.

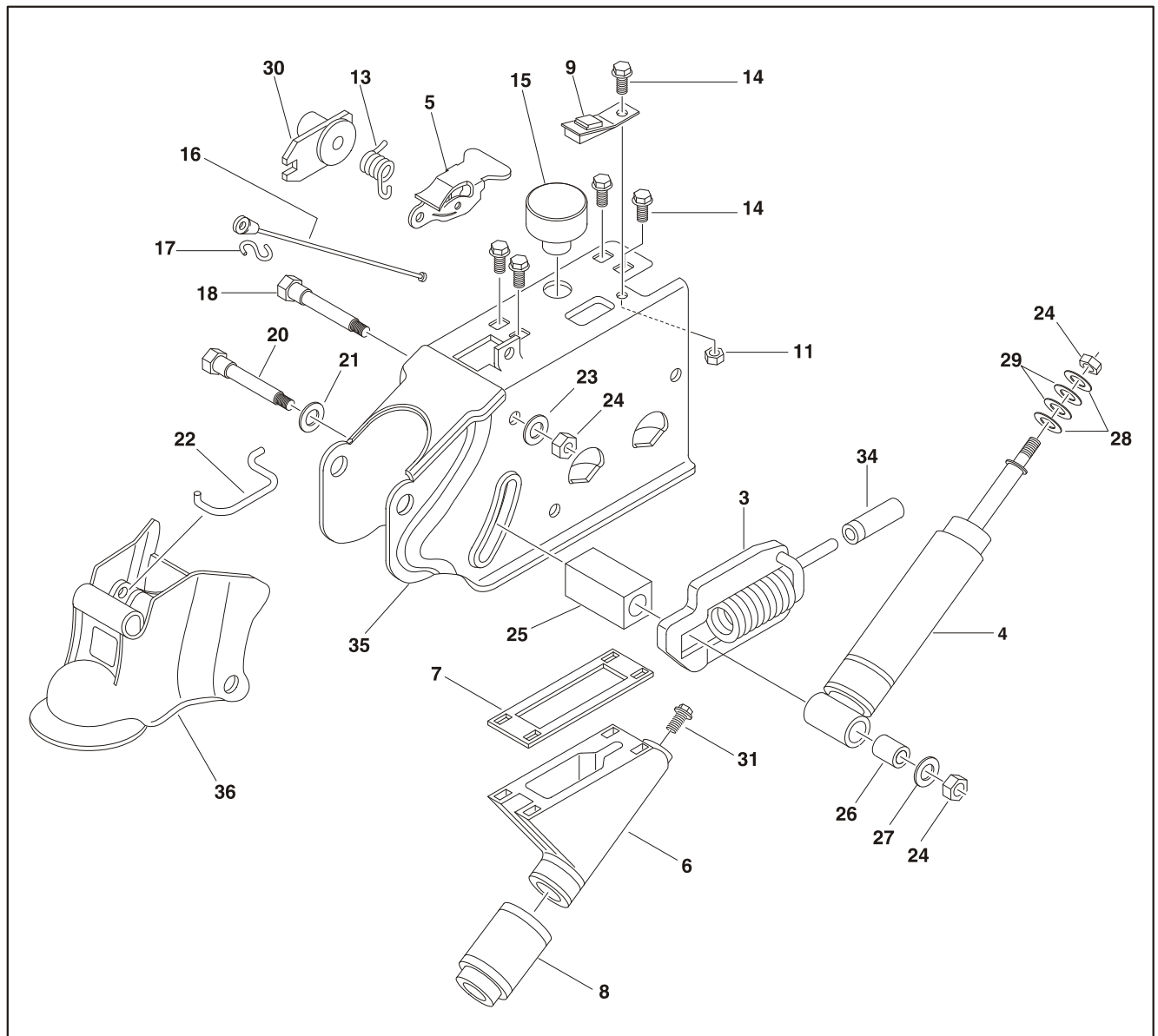
Extended Storage Instructions

Preventative maintenance is recommended for extended periods of storage.

1. Check brake system for proper fluid level in master cylinder, bleed all lines.
2. Lubricate all links and pivots to prevent any rusting.
3. Remove wheel and drum assemblies and spray a good anti-corrosion compound under rubber boot on forward end of brake wheel cylinder. Avoid spraying drum and lining.
4. Grease all bearings and reinstall wheel and drum assemblies.
5. Make sure breakaway cable is fully released.
6. After extended storage, refer to Maintenance to insure trailer readiness for towing.
7. Adjust drum brakes.

Proper Towing Checklist

1. Inspect brake fittings for leaks.
2. Adjust brakes every 2000 miles.
3. Lubricate all mechanical moving parts.
4. Inspect the breakaway cable for any kinks.
5. Verify the correct size ball is used, without chips, dirt, or hairline cracks.
6. Securely attach safety chains to trailer and tow vehicle.
7. For proper braking, trailer should be level when attached to tow vehicle to produce a positive tongue load.
8. DOT 3 or DOT 4 brake fluid should be used in master cylinder and fill it from 1/2 full to 1/2" (13 mm) from top of cylinder reservoir.



- | | | | | | |
|--------------------|--------------|-------------|----------------|----------------|-------------------|
| 1. Not Used | 7. Gasket | 13. Spring | 19. Not Used | 25. Block | 31. Shipping Plug |
| 2. Not Used | 8. Boot | 14. Bolt | 20. Bolt | 26. Bushing | 32. Not Used |
| 3. Push Rod | 9. Stop | 15. Cap | 21. Flatwasher | 27. Flatwasher | 33. Not Used |
| 4. Shock Absorber | 10. Not Used | 16. Lanyard | 22. Link | 28. Flatwasher | 34. Piston |
| 5. Release Handle | 11. Locknut | 17. S-Hook | 23. Flatwasher | 29. Flatwasher | 35. Housing |
| 6. Master Cylinder | 12. Not Used | 18. Bolt | 24. Locknut | 30. Bracket | 36. Hitch |

Figure 3-13. Hydraulic Brake Coupler with 2in Ball - Prior to SN 0030002099

3.9 COMBINATION COUPLER

WARNING

THE WEIGHT RATING OF THE COUPLER IS DEPENDENT UPON THE CORRECT BOLTS BEING USED. USE THE BOLTS PROVIDED WITH THE COUPLER. IF BOLTS ARE MISSING, REFER TO THE PARTS MANUAL AND OBTAIN REPLACEMENT BOLTS OR USE THE EXACT SIZE, GRADE, AND NUMBER OF BOLTS AS SPECIFIED. USING THE WRONG SIZE, GRADE, OR NUMBER OF BOLTS WILL REDUCE THE WEIGHT RATING OF THE COUPLER AND COULD CAUSE SEPARATION OF THE MACHINE FROM THE TOW VEHICLE.

Bleeding the Brake System

1. Remove the bolts and lockwashers that hold the lever guide and flat emergency lever spring.
2. Remove the lever guide and emergency lever spring. Using short strokes, pull forward on the emergency lever, pumping the master cylinder until brake fluid within the master cylinder stops bubbling.
3. Attach a bleeder hose to the bleeder valve on one of the wheels and submerge the other end of the hose into a transparent container partially filled with brake fluid.
4. Loosen the bleeder valve one turn, and while watching the hose in the container, use the emergency lever to pump the master cylinder as long as air bubbles continue to leave the hose. When bubbles stop, close the bleeder valve and repeat the process on the other wheel.

NOTE: Check the fluid level in the master cylinder frequently while bleeding the brakes. Refill as necessary.

5. Once bleeding is completed, refill the master cylinder and attach the cap securely.
6. Replace the emergency lever spring, lever guide, lockwashers, and bolts.
7. Test the brakes by pulling the emergency lever forward until it locks into its second notch position (the lever should be approximately straight up).
8. Attempt to rotate the wheels in a forward direction. If any wheels rotate, the brakes must be adjusted. To adjust the brakes, release the emergency lever from the locked position, set each wheel's brake adjustment up 2 or 3 notches.
9. Repeat the test procedure as necessary.

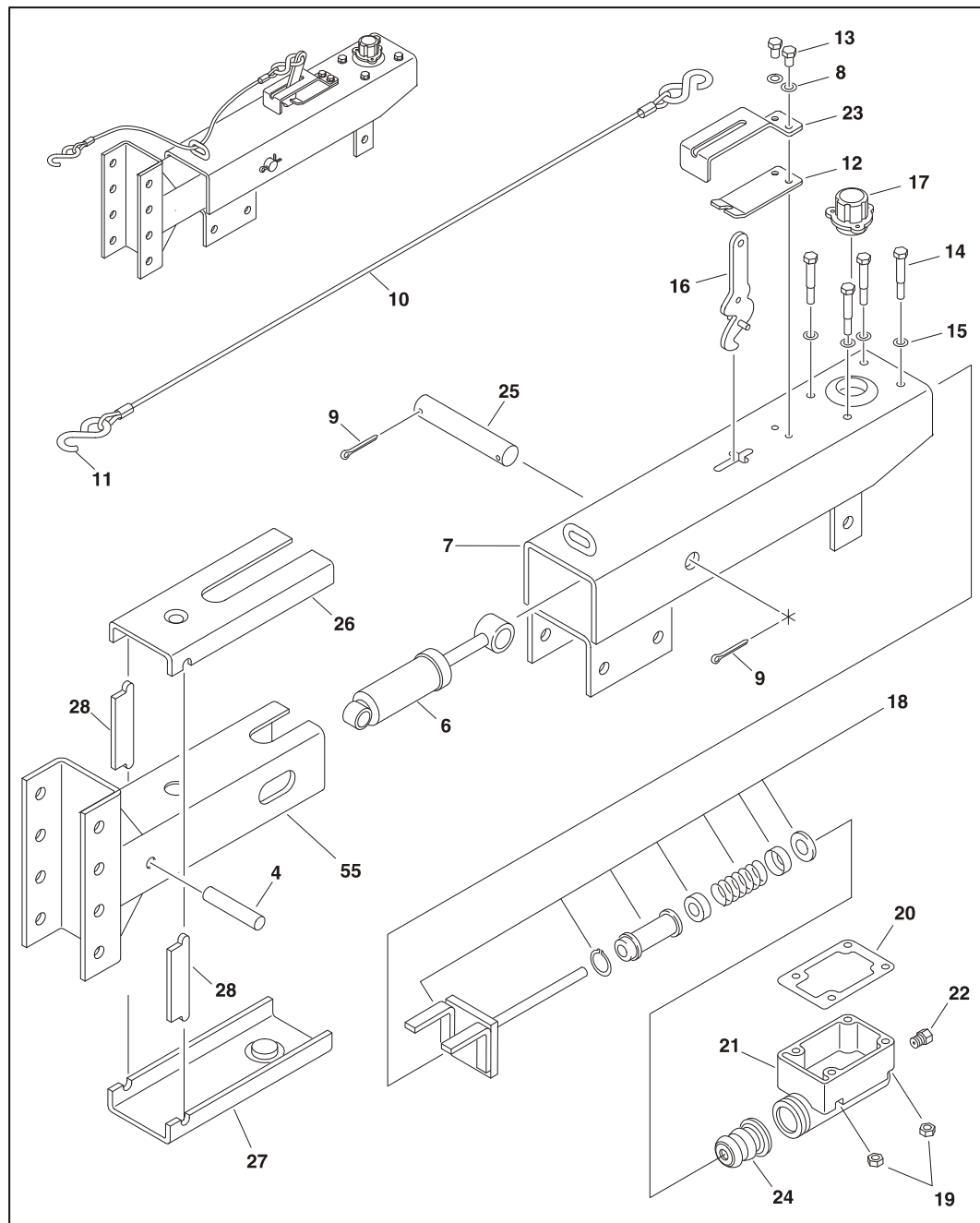
General Maintenance

1. Frequently check brake fluid level. Fluid must be approved, clean, and uncontaminated.
2. Make sure actuator mounting bolts are secure.
3. Inspect the actuator and replace any bent, worn, or damaged parts.
4. Be constantly aware of the system's braking quality, make periodic checks. Consult a certified brake specialist to make necessary adjustments or repairs.

Servicing the Emergency Lever

If the emergency lever of the actuator is applied, it can be disengaged by using a screwdriver to lift upward on the front of the flat emergency lever spring while pulling the lever forward until it is released. A thorough inspection of the emergency lever, emergency lever spring, and cable with S-hooks is required. Damaged parts must be replaced as outlined below:

1. Remove the master cylinder and push rod assembly. Be careful not to get dirt into the master cylinder. A new master cylinder gasket should be used when reinstalling the master cylinder.
2. Remove the cable S-hook from the emergency lever, emergency lever guide and flat emergency lever spring, then pull the lever out of the actuator outer case through the cross-slot in the top.
3. Install the new emergency lever through the cross-slot in top of the outer case. Attach a new emergency lever spring and emergency lever guide.
4. Insert the S-hook on the emergency cable into the hole in the emergency lever and squeeze shut.
5. Add adequate brake fluid to the master cylinder and bleed the brake system.



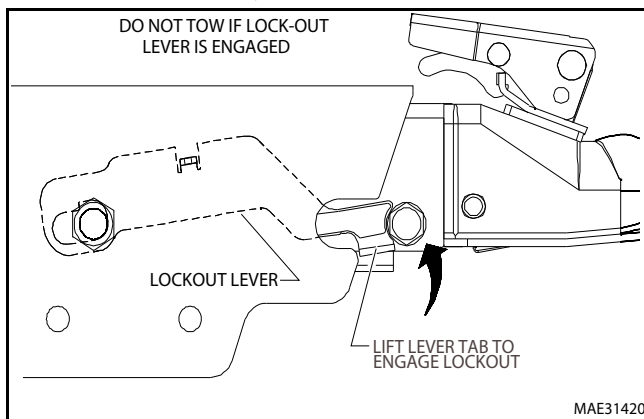
- | | | | | |
|-----------------|----------------------------------|--------------------------------|---------------------------|-----------------------------|
| 1. Not Used | 7. Outer Case | 13. Bolt | 19. Nut | 25. Pin |
| 2. Not Used | 8. Lockwasher | 14. Bolt | 20. Gasket | 26. Upper Slider |
| 3. Not Used | 9. Cotter Pin | 15. Lockwasher | 21. Reservoir | 27. Lower Slider |
| 4. Pin | 10. Cable with Hooks | 16. Lanyard | 22. Fitting w/ Orifice | 28. Side Spacer |
| 5. Not Used | 11. Hook | 17. S-Hook | 23. Emergency Lever Guide | 55. Channel Centered Slider |
| 6. Damper Shock | 12. Emergency Lever Spring Plate | 18. Push Rod & Piston Assembly | 24. Boot | |

Figure 3-14. Hydraulic Brake Coupler with Combination 2in ball - Prior to SN 0030002099

3.10 COUPLER ASSEMBLY (SN 0030002099 TO PRESENT)

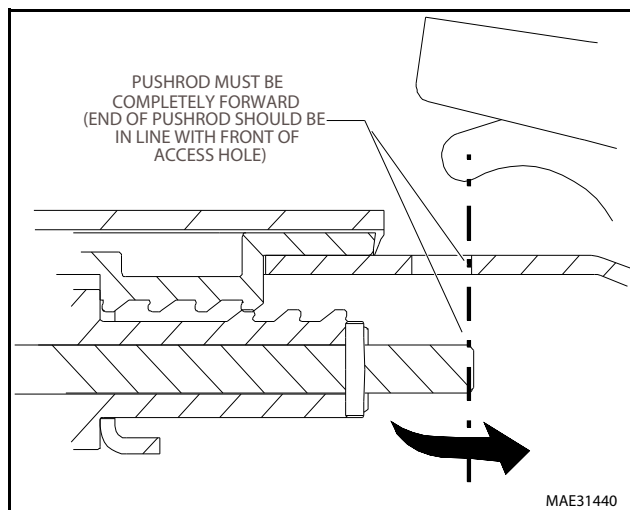
Engaging Manual Lockout Lever

The manual lockout lever is used to control the brake pressure being applied to the trailer when backing up. Having the actuator in the extended position will make it easier to engage the lockout lever. To engage the lockout lever, move the lever back and upwards until the front of the lever nests into the round spacer as shown below. This will prohibit movement of the actuator when backing up. The lockout lever will move to the towing position when you drive forward again.



Insert a flat head screwdriver into the access hole and push down on the pushrod assembly and pivot the pushrod towards the front of the coupler. Make sure the pushrod assembly is moved to its furthestmost forward position (towards the front of the coupler) by pushing down and forward on the rod. Inspect and replace parts as needed.

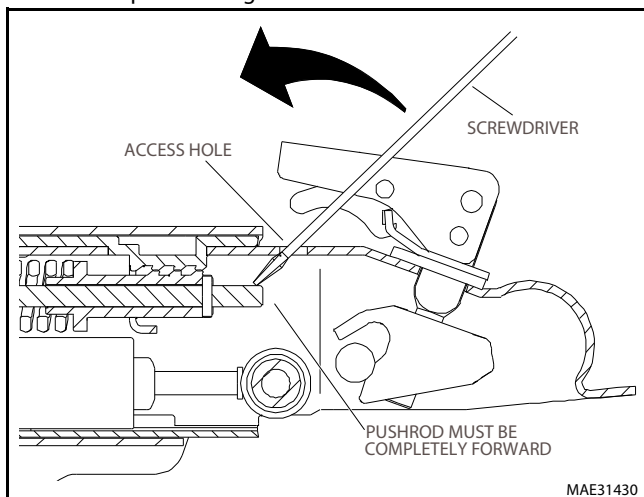
NOTE: The end of the pushrod should line up with the front of the 1/2" access hole.



Servicing the Breakaway Assembly

A thorough inspection of the breakaway assembly is required if it is applied at any time. Damaged parts must be replaced. If there is any damage to the lanyard itself the entire pushrod assembly will need to be replaced.

To disengage the breakaway mechanism, first release the brake line pressure by briefly opening a bleeder valve. Extend the coupler forward to gain access to the 1/2" hole on the top of the coupler housing as shown below.

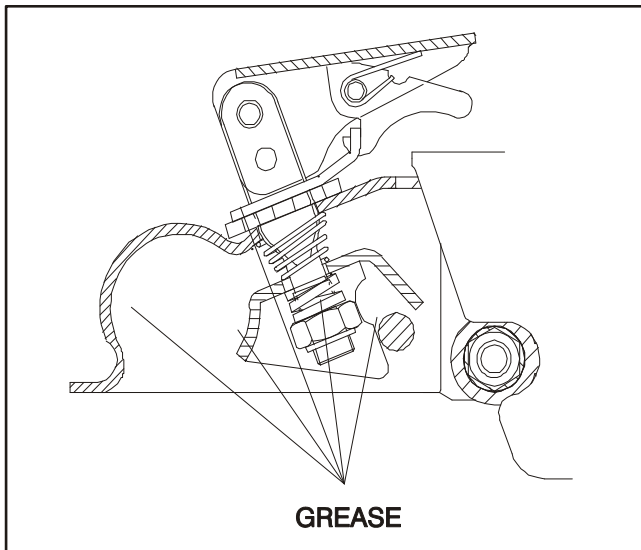


Actuator Maintenance

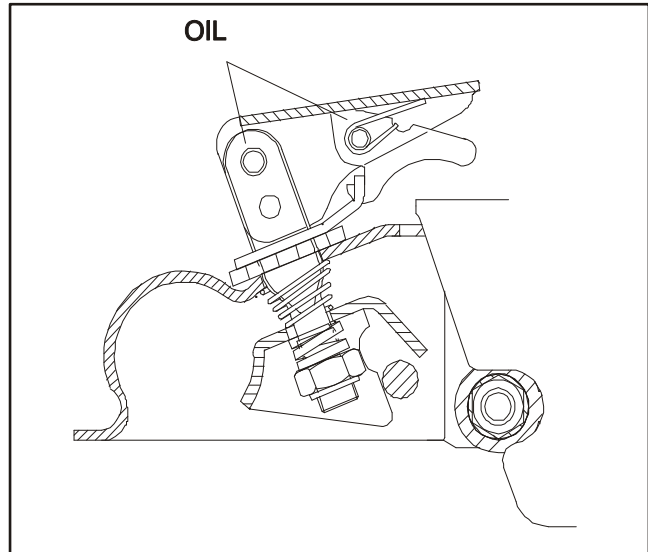
1. Frequently check brake fluid level (fluid must be DOT3 or 4 approved, clean and uncontaminated).
2. Make sure mounting bolts are properly tightened 15 to 20 ft lbs (20 to 27 Nm) without deformation of coupler.
3. Inspect entire actuator, replace any bent, worn or damaged parts immediately.
4. Be constantly aware of systems braking quality, make periodic checks as described in the brakes owners manual. Consult certified brake specialist to make necessary adjustments or repairs. Failure to do so could result in loss of braking.
5. Be sure hydraulic lines and fittings are tight to avoid fluid leaks.

Coupler Maintenance

1. Maintain a film of automotive grease in the ball pocket, ball clamp (front & back), ball clamp spring, where link pin enters housing, and where the housing contacts the bracket hardware.



2. Maintain a film of oil on the pivot points and safety latch spring using SAE 30W motor oil.



3. Keep the ball pocket and mechanism clean because dirt, paint, etc. can hinder proper operation. When parking or storing your trailer, keep the bracket and coupler off the ground so dirt and/or other foreign material will not build up in the coupler ball pocket.
4. Grease pivot hinge with automotive grease.

3.11 HITCH COUPLER & AXLE (CE ONLY)

To insure continuing reliability and road safety in traffic, the maintenance tasks have to be performed at the prescribed intervals. Maintenance, repairs, and replacement of wearing parts for the chassis and the braking system may only be performed by a qualified garage.

Only original JLG parts may be used in order to:

- ensure proper functioning and safety
- preserve all rights under warranty
- prevent the operating license from becoming invalid under national and international regulations.

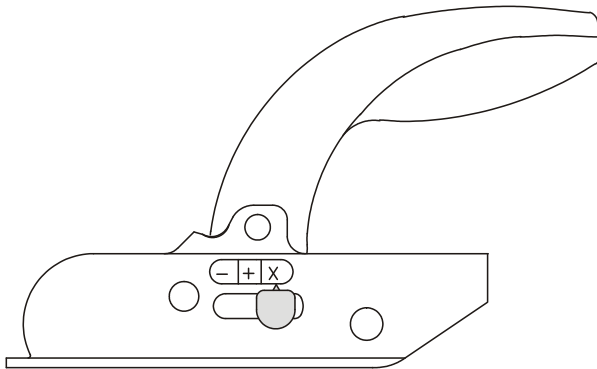
Ball Coupler

The ball coupler is equipped with a safety check indicator. This consists of clearly embossed symbols to which a red-green-red label with the same symbols has been glued and an indicator button. If the label is damaged, it can be removed and the embossed symbols used, or the label can be replaced, in which case the lines dividing the zones on the label and the embossing must be aligned.

UNCOUPLING

To open, pull the coupling handle upwards and then turn it forwards.

The coupling automatically remains in the open position, in which the indicator button points to the red field with the large X.



⚠ WARNING

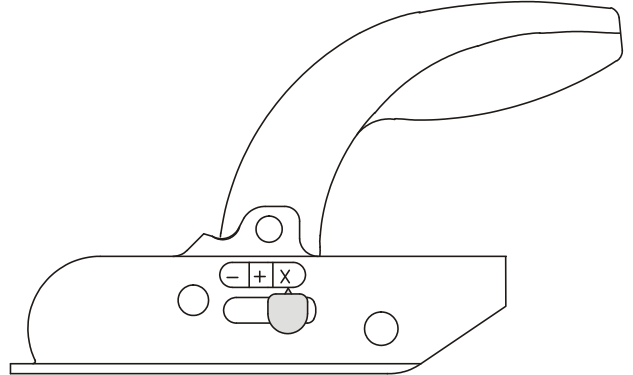
THE TRAILER MUST NEVER BE DRIVEN IN THIS POSITION.

⚠ CAUTION

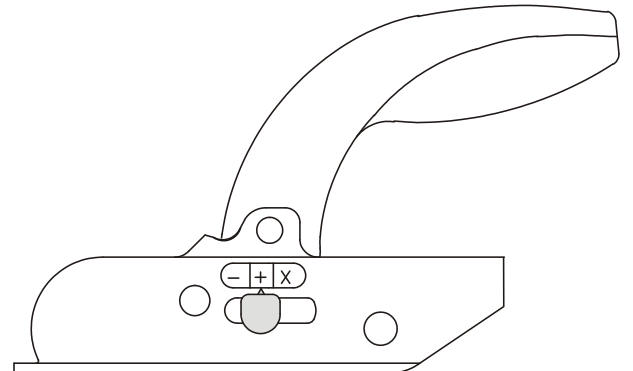
NEVER INSERT YOUR FINGERS IN THE OPEN BALL COUPLER. EVEN SLIGHT PRESSURE ON THE SPHERE CAN TRIGGER THE SPRING-LOAD CLOSING MECHANISM AND RESULT IN INJURY TO THE FINGERS.

COUPLING

To couple the trailer, place the open ball coupler (X position) on the ball of the towing vehicle so that it clicks into place audibly.



When the ball coupler has clicked into place, the indicator jumps to the green zone marked +.



After coupling, it is essential to use the indicator to ensure that the ball coupler has clicked into place on the ball correctly.

If the indicator is in the green + zone, the ball coupler is correctly closed and locked, and the ball on the vehicle still has sufficient wearing reserves.

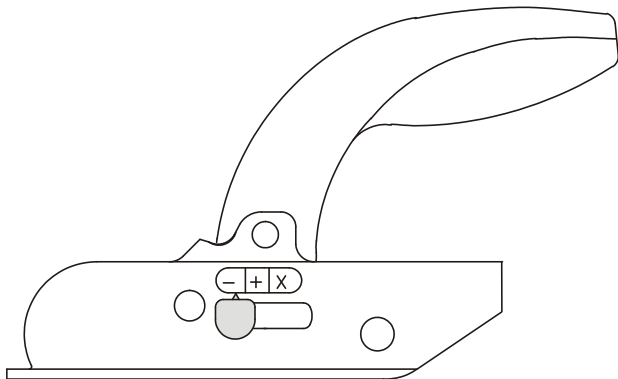
⚠ WARNING

THERE IS NO SAFE CONNECTION BETWEEN THE TOWING VEHICLE AND THE TRAILER UNLESS THIS HAS HAPPENED, AND THE VEHICLE COMBINATION MUST NOT BE USED ON THE ROADS UNTIL THEN. DO NOT FORGET TO RELEASE THE HANDBRAKE ON THE TRAILER, AND TO FIT THE SAFETY CABLE TO THE BALL NECK.

The safety cable has the function of forcing the emergency braking of the trailer if it should separate from the towing vehicle for any reason.

⚠ WARNING

IF THE INDICATOR IS IN THE RED "X" ZONE, THE COUPLING IS NOT PROPERLY CLOSED, AND THE TRAILER MUST **NOT** BE TOWED!



There are three possible causes of this problem:

1. The ball on the towing vehicle is very worn down and the ball coupler cannot grip it properly. A new ball has a diameter of 50.0 mm. If the diameter is worn down to less than 49 mm, even if only in places, it is vital to replace the ball on the towing vehicle.
2. The ball coupler itself is very worn down and no longer grips the ball sufficiently. In this case, the ball coupler must be replaced at a qualified workshop.
3. The closing mechanism in the ball coupler has been triggered, but there is no ball in the coupling. The ball coupler is only lying loose on the ball and is not firmly connected. The coupling will separate from the ball when the towing vehicle drives off. Open the coupling as described earlier and try once more to click the ball coupler correctly into place on the ball.

The coupling mechanism may be stiff due to insufficient lubrication. Carry out the instructions for maintenance and lubrication and try the coupling procedure again.

PERMISSIBLE SUPPORT LOAD

The support load permitted for each particular ball coupler is embossed on the hand lever of the ball coupler.

NOTICE

NEVER DRIVE WITH A NEGATIVE SUPPORT LOAD AS THIS WILL HAVE A NEGATIVE EFFECT ON THE TRAILER'S DRIVING STABILITY.

A negative support load can be avoided or remedied simply by changing the trailer's load.

POSITION OF THE COUPLING POINT ON THE TRAILER

NOTICE

TO ACHIEVE THE CORRECT DRIVING AND BRAKING BEHAVIOR IN THE TRAILER, IT IS ABSOLUTELY ESSENTIAL FOR THE COUPLING HEIGHTS OF THE TOWING VEHICLE AND THE TRAILER TO MATCH.

The position of the coupling point on the trailer must be in a range of 430 ± 35 mm above the horizontal tire contact surface.

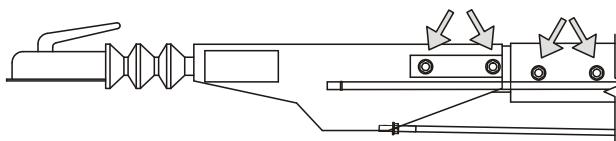
To check the coupling height, the trailer and towing vehicle must be exactly horizontal and fully loaded to make up the permissible total weight. The tire pressure must also conform with the tire manufacturer's specifications.

BALL COUPLER MAINTENANCE

To ensure easy operation and safety, all bolts and movable parts of the ball coupler must be lubricated using commonly available machine oils, or as a substitute, motor oil twice a year, or immediately if the coupling becomes stiff.

The ball mount should also be lightly greased, with the exception of all stabilizer couplings.

The bolts fastening the coupler to the adapter should be torqued to 85 ft.lbs. (115 Nm).



OVER-RUN HITCH MAINTENANCE

Relubricate the over-run hitch after 3000 miles (5000 km) or after one year at the latest, at both grease fittings. All movable parts such as bolts and articulating points on the hand brake lever and the turning lever must also be lightly oiled.

If the connecting rod can be pushed in more than half-way (approximately 45 mm) when the hand brake is on, the braking system must be readjusted.

Check the brake response:

1. Put the handbrake on while the trailer is uncoupled and push the trailer slowly backwards until the handbrake lever has reached the hindmost end position.
2. Push the ball coupler/connecting rod into the over-run hitch. Depending on the over-run hitch, it will require a certain amount of force to push.
3. The connecting rod should then return automatically to zero position by means of the gas cushion in the hydraulic damper. If it takes longer than approximately 30 seconds to return, the over-run hitch must be checked at a qualified workshop.

Coupling Head Maintenance

REPLACING

Prior to replacing the coupling head, it is essential to confirm the condition of the damper. Test the Damper as outlined under DAMPER REACTION TEST.

1. Follow steps 1 thru 4 under Damper Maintenance - REMOVAL.
2. If you have been able to remove the coupling head/eye as instructed under Damper Maintenance - REMOVAL step 4, go to step 5 below, otherwise proceed with step 3.
3. The damper will now be retained between the front coupling/eye bolt and the rear damper bracket. It is now necessary to remove the damper without destroying it. **WARNING: Proceed with caution!** The most efficient method is to remove the rear damper mounting bracket, but depending upon the coupling, there may still be tension in the damper.
4. Place a lever against the rear damper in such a manner that once the mounting bracket bolts are removed the tension can be released slowly. Take the tension and remove the mounting bracket bolts, release the tension in the damper.
5. Inspect the shaft for damage, dress burrs, and clean any dirt as the new coupling will be a close fit on the shaft.
6. If a new bellows is to be fitted cut the tie-wrap and discard the old one, fit the new and secure with a tie-strap.
7. Trial fit the new coupling. It should slide into place without any undue force. DO NOT hammer the coupling into place, this can damage the coupling itself or the over-run mechanism. If it proves to be tight, remove it and thoroughly clean the shaft inspecting for burrs.
8. Fit the bolts, washers and secure with NEW locking nuts and torque to 85 ft. lbs. (115 Nm). DO NOT re-use the old nuts as this is safety critical. Fit the plastic nut covers. Where the damper has been removed ensure that the coupling head rear bolt passes through the hole in the damper body.

NOTE: If there are any doubts about the condition of the damper, install a new one.

9. If the damper has been released the rear mounting bracket will need to be re-fitted. This means that the damper needs to be compressed so the bolts can be installed. **WARNING: Proceed with caution!** Compress

the damper with the lever and secure the mounting bracket bolts.



10. Reinstall the bellows with the coupling/eye horizontal taking care not to tear or damage the material.

If the replacement coupling/eye is a different part than the original:

- a. Always ensure the corresponding length bolts are used.
- b. Always ensure a compatible bellows is used.
- c. Always ensure the hole sizes in the coupling and draw-bar tube match and the correct size bolts are used.

DAMPER REACTION TEST

1. Pull the handbrake lever on as far as possible.
2. Push the ball coupling as far back into the overrunning hitch as it will go. This requires force to compress and should extend smoothly when released.
3. If the draw tube is impossible to compress, compresses with just spring force and no damping resistance, or the extension is very rapid, the damper must be replaced by carefully following the replacement instructions above.

Damper Maintenance

The dampers assembled within the overrun coupling is pressurized. During assembly, the damper is reloaded and compressed in order that the coupling operates correctly. Care must be exercised when working on, handling, and disposing of the coupling/damper. This is especially important if any damage or misuse of the coupling has occurred.

REMOVAL

⚠ WARNING

DO NOT POSITION ANYTHING OR STAND IMMEDIATELY TO THE FRONT OR REAR OF THE COUPLING ASSEMBLY IN CASE A DAMPER FAILS DURING THE PROCESS.

1. Pull back the bellows from the coupling to expose the two retaining bolts.
2. Undo the self locking nut from the rear bolt of the coupling as shown.



3. Remove the rear bolt; force may be required as the damper may still be preloaded. Raise the coupling operating handle in order to fully remove the bolt if necessary.
4. When the rear bolt is removed the damper will move forward to rest upon the front bolt.

In some instances a retaining pin is used; located between the bolt holes. This pin will hold the damper in its original position and will therefore need to be removed in the following manner.

- a. Undo the self locking nut from the front bolt, extract the bolt and remove the head.
- b. Replace both bolts in the draw tube and finger tighten the bolts.

- c. Knock out the retaining pin and remove the rear bolt, this will allow the damper to move forward and contact the front bolt.



5. From underneath, through the bolt hole in the draw tube, drill a 3 mm hole into the damper body to a depth of 8 mm.

⚠ WARNING

OBSERVE NORMAL SAFETY PROCEDURES FOR THE USE OF HAND TOOLS.

WEAR SAFETY GLASSES.

DO NOT LIE IMMEDIATELY UNDERNEATH THE BOLT HOLE WHEN DRILLING.

WHEN THE DRILL PENETRATES THE DAMPER BODY GAS WILL BE ALLOWED TO ESCAPE.

6. The pressure in the damper should now have been discharged. Remove the self locking nut on the front bolt of the coupling head. Remove the bolt and the coupling head. If the bolt is difficult to remove, it indicates that there is still residual force in the damper and step 5 should be repeated.
7. Remove the rear damper bracket retaining bolts. Also remove the nuts and spring washer from the rear of the damper.
8. The de-pressurized damper can now be removed by sliding the damper forward through the draw tube and be disposed off.

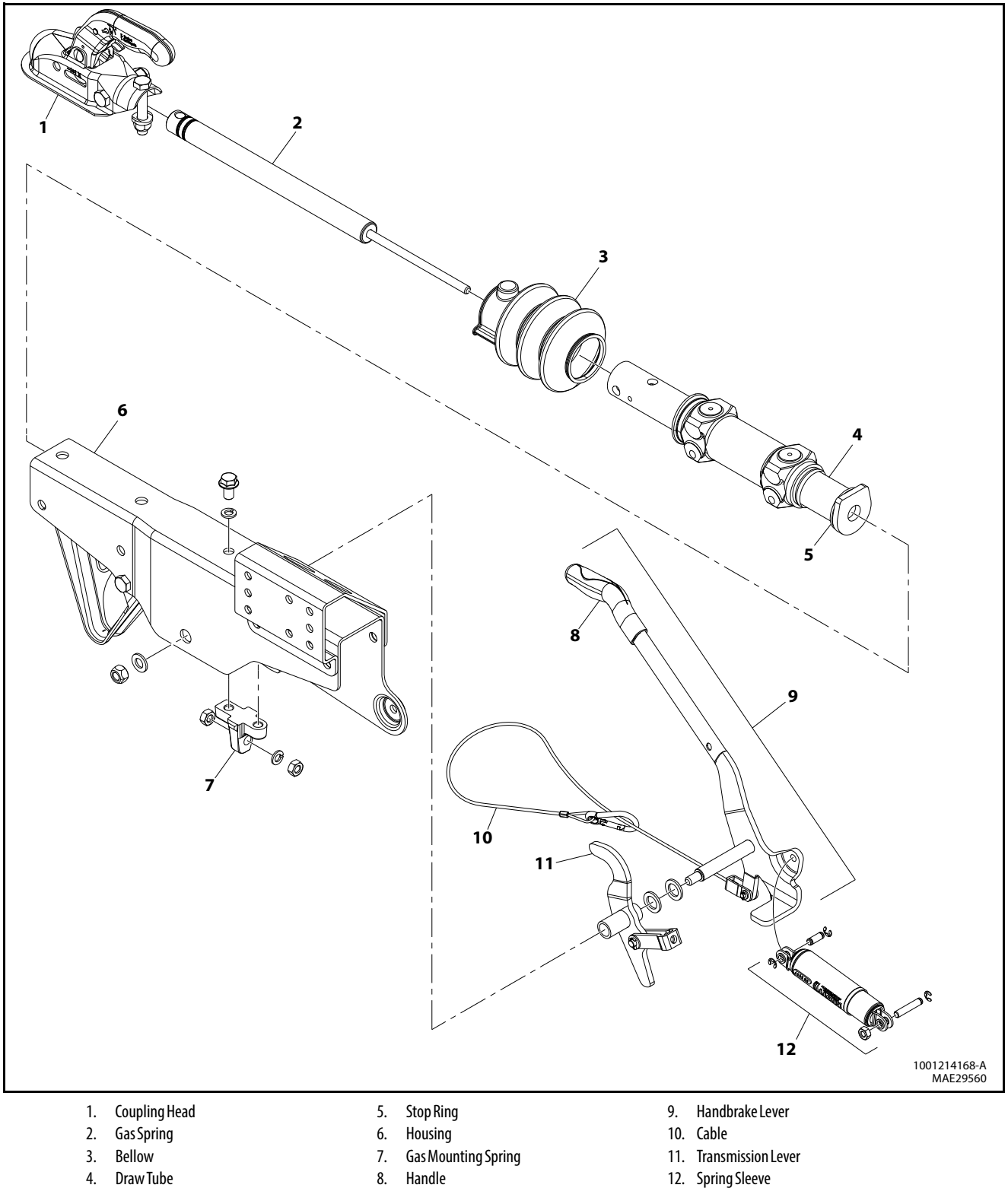
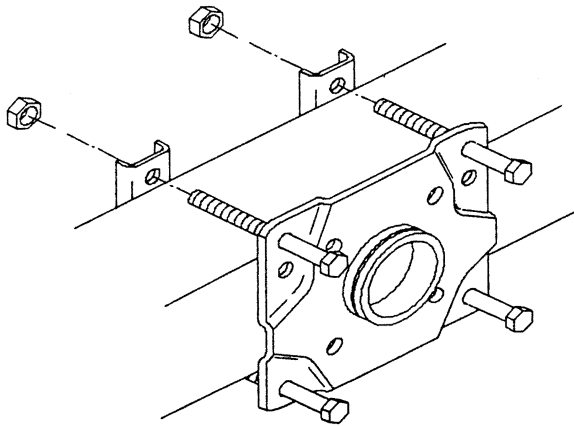


Figure 3-16. Hydraulic Brake Coupler (CE & CSA Spec Machines)

3.12 TRAILER JACK

Installation

1. Place the jack against the trailer tongue and position the mounting straps on the opposite side of the tongue. Place the straps so the flat side is against the tongue.
2. Install the bolts through the bracket and straps. Position the jack so the top bolts rest directly on the top of the tongue and the bottom bolts are as close to the tongue as possible. The gap between the mounting bolts and the trailer tongue is not to exceed 1/16" (1.6 mm).

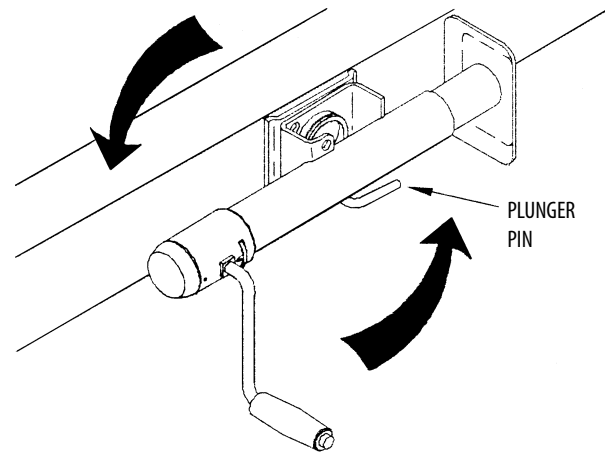


3. Secure the bolts in place with the locknuts. Torque the nuts to 25 ft.lbs. (34 Nm).
4. Check for clearance of handle swing, trailer light cables, and coupler clearance.

Operation

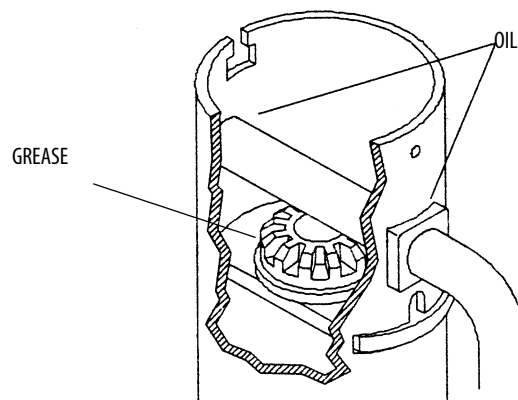
NOTE: To avoid damaging the handle while trailering in the horizontal position, secure the handle to the jack with a bungee cord or rope.

The jack is designed to be swiveled into a horizontal or storage position. In both the vertical and horizontal positions, the plunger must be securely positioned in the mating hole in the mounting bracket. To place the jack into the horizontal position, allow about 2" (5 cm) of ground clearance beneath the wheels. Pull the plunger pin out of the opening and swivel the jack. Rotate either left or right until the plunger pin snaps into the proper mounting bracket hole.



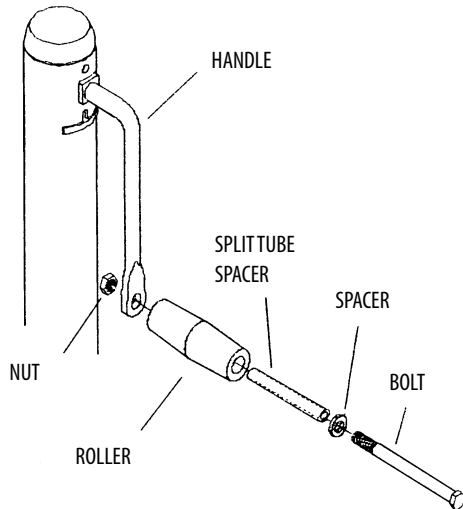
Maintenance

The internal gearing and bearings of the jack must be kept lubricated. Using a needle nose applicator, pump a small amount of automotive grease through the lubrication opening. The lubrication opening can be found on the side of the jack tube, right above the support plate. Rotate the jack handle to distribute the grease evenly. Lightly grease the inner tube of the jack using the same type of grease. A light weight oil must be applied to the handle unit at both sides of the tube. The axle bolt and nut assembly of the caster wheel must also be lubricated with the same light weight oil.



Assembly

HANDLE



1. Place one spacer over the bolt.
2. Lightly grease the split tube spacer.
3. Place the bolt and spacers through the roller. Insert the bolt through the handle.
4. Install the locknut onto the bolt and tighten. Adjust the nut so the bolt no longer turns freely. A minimum of two full bolt threads must be visibly extended through the nut.

CASTER WHEEL

1. Grease the outside of the wheel spacer using standard automotive grease and insert it into the wheel.
2. Place the wheel and spacer into the yoke and align the holes in the wheel with the holes in the yoke.
3. Insert the bolt through both sides of the yoke. Make sure the threads of the bolt are to the outside of the yoke when the yoke hangs down in the trailing position.
4. Install the locknut and tighten until the yoke is just tight enough against the metal spacer to keep the spacer from rotating. Do not overtighten, this can cause the spacer to deform and bind the wheel. The wheel must spin freely.

3.13 SWING MOTOR (PRIOR TO SN 003000641)

NOTE: This motor may also be used on some machines manufactured between SN 003000642 to 0030001050.

Removal

1. Remove the hardware securing the motor to the swing drive.
2. Lift the motor up to gain access to the hydraulic lines and tag and disconnect the lines running to the motor. Cap or plug all openings.

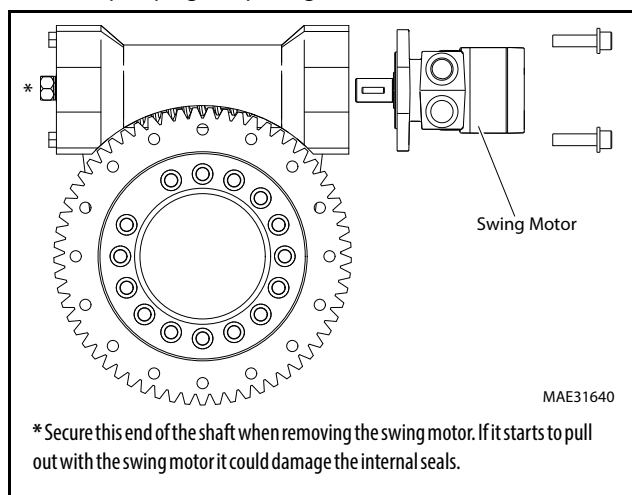


Figure 3-17. Swing Motor- Removal

Disassembly

NOTE: Before disassembling the motor, it is highly recommended that paint or a marker be used to make a V shaped set of lines from the end cover to the housing to aid in proper assembly. It is also important that the steps involving timing be followed carefully to insure proper motor operation.

1. Remove all shaft related components from the shaft (i.e. keys, wire rings, nuts). To aid in assembly of the motor, make a V shaped set of lines from the end cover to the housing using either paint or a marker.
 2. With the shaft facing down, secure the motor in a vise by clamping onto the housing.
 3. Loosen and remove the bolts holding the motor assembly together.
 4. Remove the end cover.
 5. Remove the body seal and discard the seal.
 6. Remove the rotor assembly and wear plate. Remove the body seals from the rotor and housing and discard the seals.
 7. Remove the drive link pin and drive link from the motor and lay aside.
 8. Gently tap the shaft upward through the housing and remove through the rear of the housing. Turn the shaft over and remove the cooling plug.
 9. Remove the housing from the vise and turn over. Pry the dust seal from the housing.
 10. Push the seal carrier, thrust washer, and thrust bearing down and remove from the rear of the housing.
- NOTE:** When removing the seal carrier, thrust washer, and thrust bearing take care not to scratch or nick the housing bore.
11. If a new seal carrier and thrust washer are included in the repair kit, the old items may be discarded. If not, carefully pry the shaft seal, teflon backup seal, and metal backup shim from the seal from the seal carrier and discard the metal backup shim, backup seal, and shaft seal. Lay the seal carrier aside.
 12. Remove the wire ring, metal backup shim, and high pressure seal from the inner bore groove of the housing with a small screwdriver and discard them.
 13. All parts should be cleaned in an oil based solvent and dried using compressed air. All new seals should be lightly coated in clean oil prior to installation.

Assembly

NOTICE

FOR PROPER OPERATION, THE MOTOR DEPENDS ON THE CORRECT ORIENTATION OF PARTS AS WELL AS THE CORRECT INTERNAL TIMING.

1. Place the shaft on a clean flat surface with the output end facing up.
2. Place the thrust bearing, then thrust washer, on the shaft.
3. Install the shaft seal down onto the shaft making sure the lip on the seal faces down. Refer to Figure 3-18., Seal Orientation.

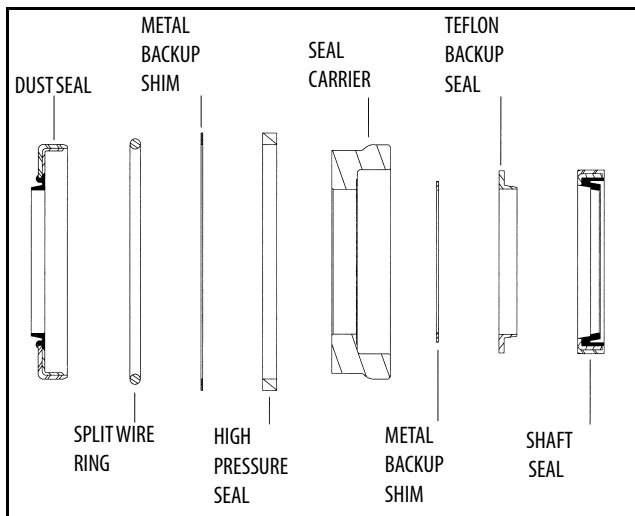


Figure 3-18. Seal Orientation

4. Install the teflon backup seal onto the shaft with the flat side up and the seal lip facing the shaft seal.
5. Place the metal backup shim onto the shaft and against the teflon backup seal.
6. Place the seal carrier onto the shaft (large end down) and carefully press the seal carrier down onto the seal assembly using an arbor press and sleeve to compress the seals into the carrier.
7. Install the high pressure seal into the groove in the housing.
8. Install the metal backup shim against the high pressure seal in the groove in the housing bore by squeezing the shim between the thumb and forefinger to bow shim (bow in the shim should be in the shape of a hill and not a valley for easier installation).
9. While maintaining the bow in the shim, start the shim into the groove and use a small screwdriver to push the shim into the groove. Install the wire ring into the groove making sure the ends are butted.

Shaft Timing Procedure

NOTICE

FOR PROPER OPERATION, THE MOTOR DEPENDS ON THE CORRECT ORIENTATION OF PARTS AS WELL AS THE CORRECT INTERNAL TIMING.

1. Turn shaft over so the output end of the shaft faces down.
2. Install the cooling plug into the shaft making sure the large OD end of the cooling plug faces up.
3. Lower the drive link into the shaft making sure that the timing mark end of the drive link faces up and the timing mark on the end of the drive link is aligned with one of the through holes in the shaft.
4. When the splines contact each other, slowly rotate the drive link counterclockwise until the drive link splines engage with those on the shaft.
5. Turn the housing over so the pilot of the housing faces down and secure the housing in a vise.
6. Without disturbing the seal carrier assembly or drive link, carefully lower the shaft assembly into the housing.
7. To seat the seal carrier against the wire ring, gently tap the drive link down until the end of the shaft is nearly flush with the rear surface of the housing.
8. Place a body seal in the groove in the rear surface of the housing.
9. Using alignment marks as a guide, place the wear plate on the housing making sure the notch in the wear plate is aligned with the port side of the housing as shown in Figure 3-19., Notch Alignment.

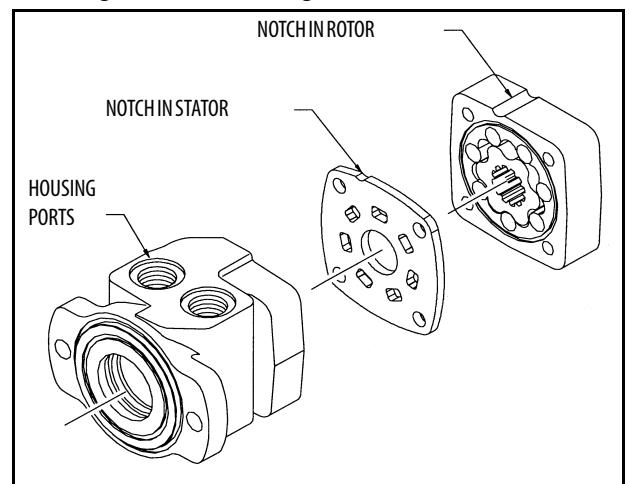


Figure 3-19. Notch Alignment

10. Place a body seal in the grove in the face of the rotor.
11. Lower the rotor onto the drive link making sure the timing mark on the drive link is aligned with a peak on the rotor as shown in Figure 3-20., Timing Mark.

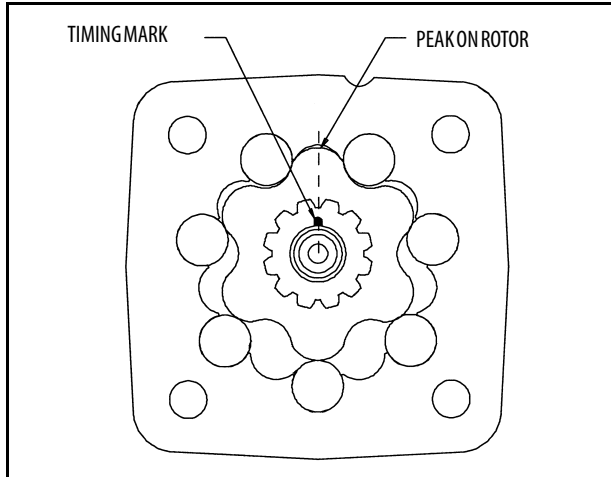


Figure 3-20. Timing Mark

12. Once splines are engaged, rotate rotor so the notch on the rotor is aligned with the notch on the wear plate and the ports on the housing. Refer to Figure 3-19., Notch Alignment.
13. Insert the drive link pin into the end of the drive link making sure the concave end faces up.
14. Place the remaining body seal in the groove in the end cover.
15. Using alignment marks as a guide, place the end cover onto the motor making sure the end of the drive link pin is in the hole in the center of the end cover.
16. Insert the four bolts and torque to an initial value of 10 ft.lbs. (13.5 Nm). Using a criss-cross pattern, apply a final torque of 50 ft.lbs. (68 Nm).
17. Remove the motor from the vise and place on a clean work surface with the shaft facing up. Making sure the lip seal faces up, place the dust seal over the shaft. Using a seal and hammer, carefully drive the dust seal into place.

Installation

1. Connect the two hydraulic lines to the motor as tagged during Removal.

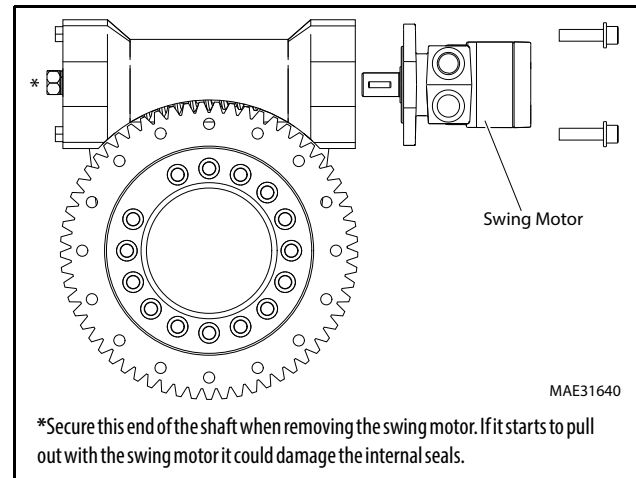
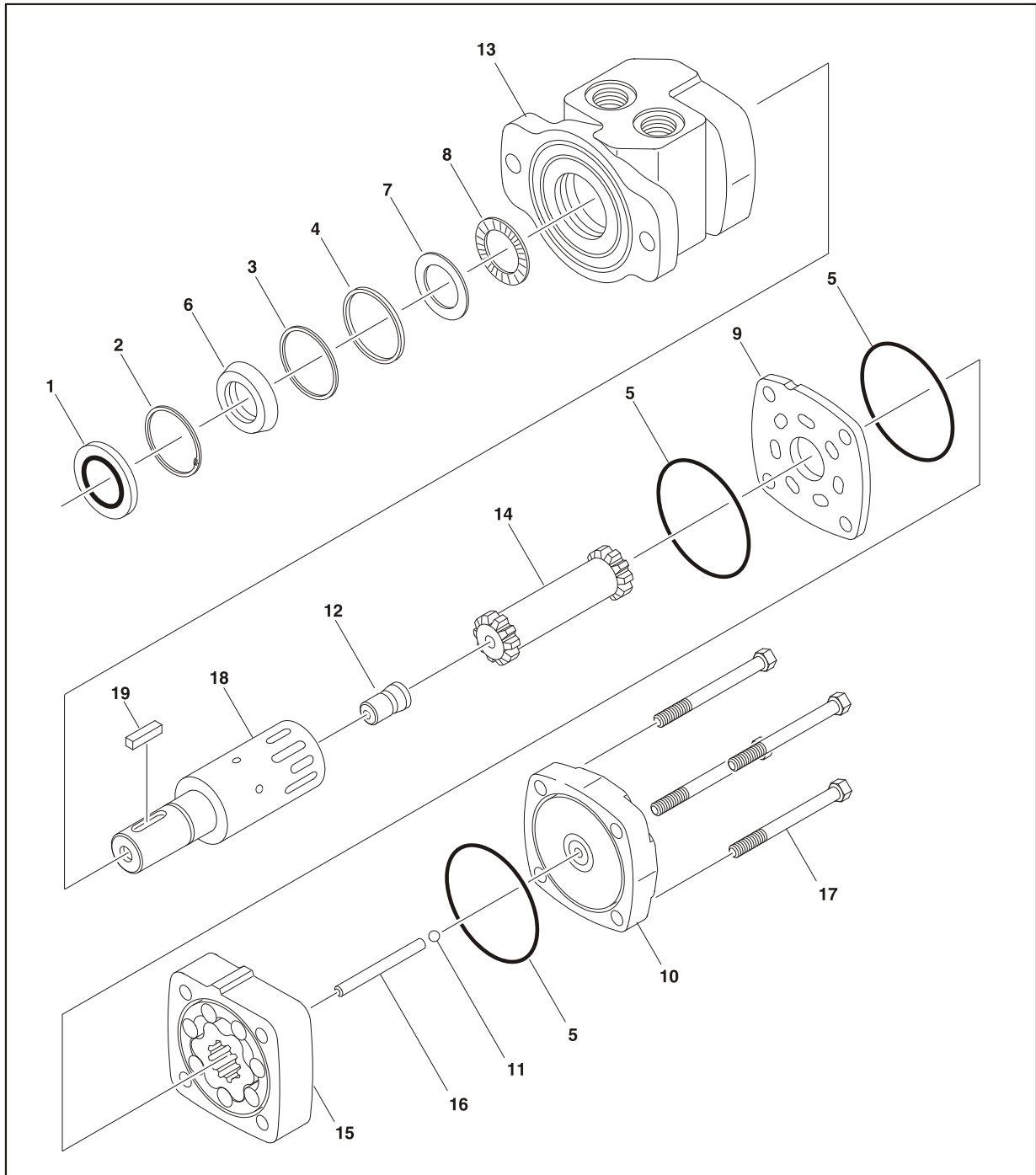


Figure 3-21. Swing motor- Installation

2. Position the motor on the swing drive and secure in place with the retaining bolts. Torque the bolts to 95 ft.lbs. (130 Nm).



- | | | | |
|------------------|-------------------|------------------|--------------------|
| 1. Dust Seal | 6. Shaft Seal | 11. Ball | 16. Drive Link Pin |
| 2. Retainer Ring | 7. Thrust Washer | 12. Cooling Plug | 17. Bolt |
| 3. Backup Shim | 8. Thrust Bearing | 13. Housing | 18. Shaft |
| 4. Housing Seal | 9. Wear Plate | 14. Drive Link | 19. Key |
| 5. Body Seal | 10. End Cover | 15. Rotor Set | |

Figure 3-22. Swing Motor

3.14 SWING MOTOR (SN 0030001051 TO PRESENT)

NOTE: This motor may also be used on some machines manufactured between SN 0030000960 to 0030001050.

Removal

1. Remove the two bolts securing the motor to the swing drive.
2. Lift the motor up to gain access to the hydraulic lines and tag and disconnect the lines running to the motor. Cap or plug all openings.

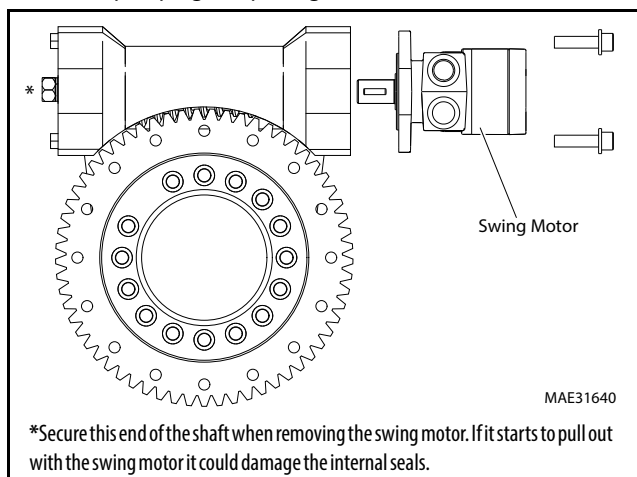
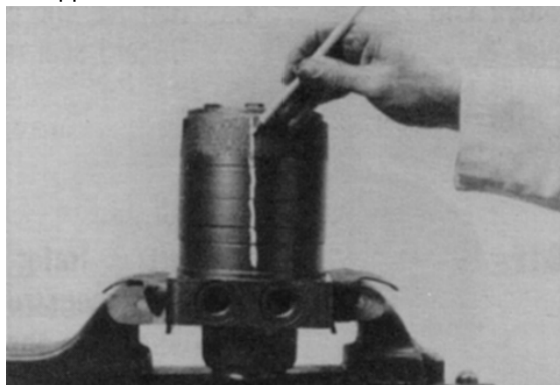


Figure 3-23. Swing Motor- Removal

Disassembly And Inspection

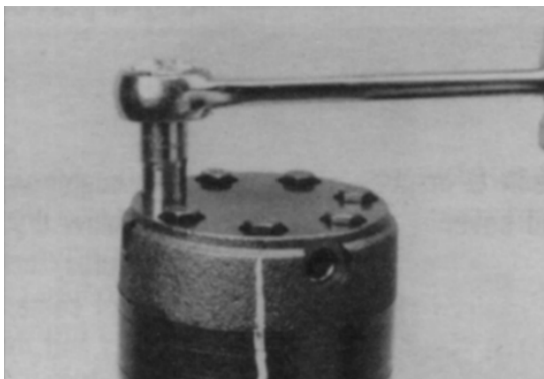
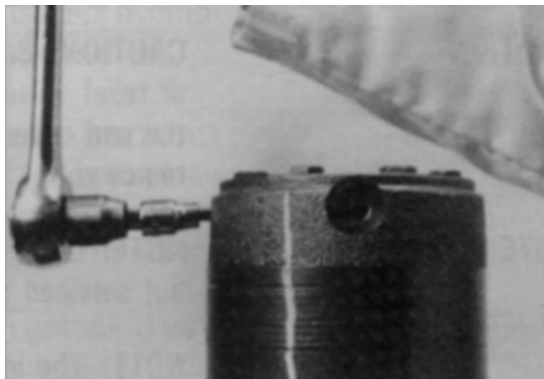
1. Place the Torqlink™ in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings (18A) if applicable.



⚠ CAUTION

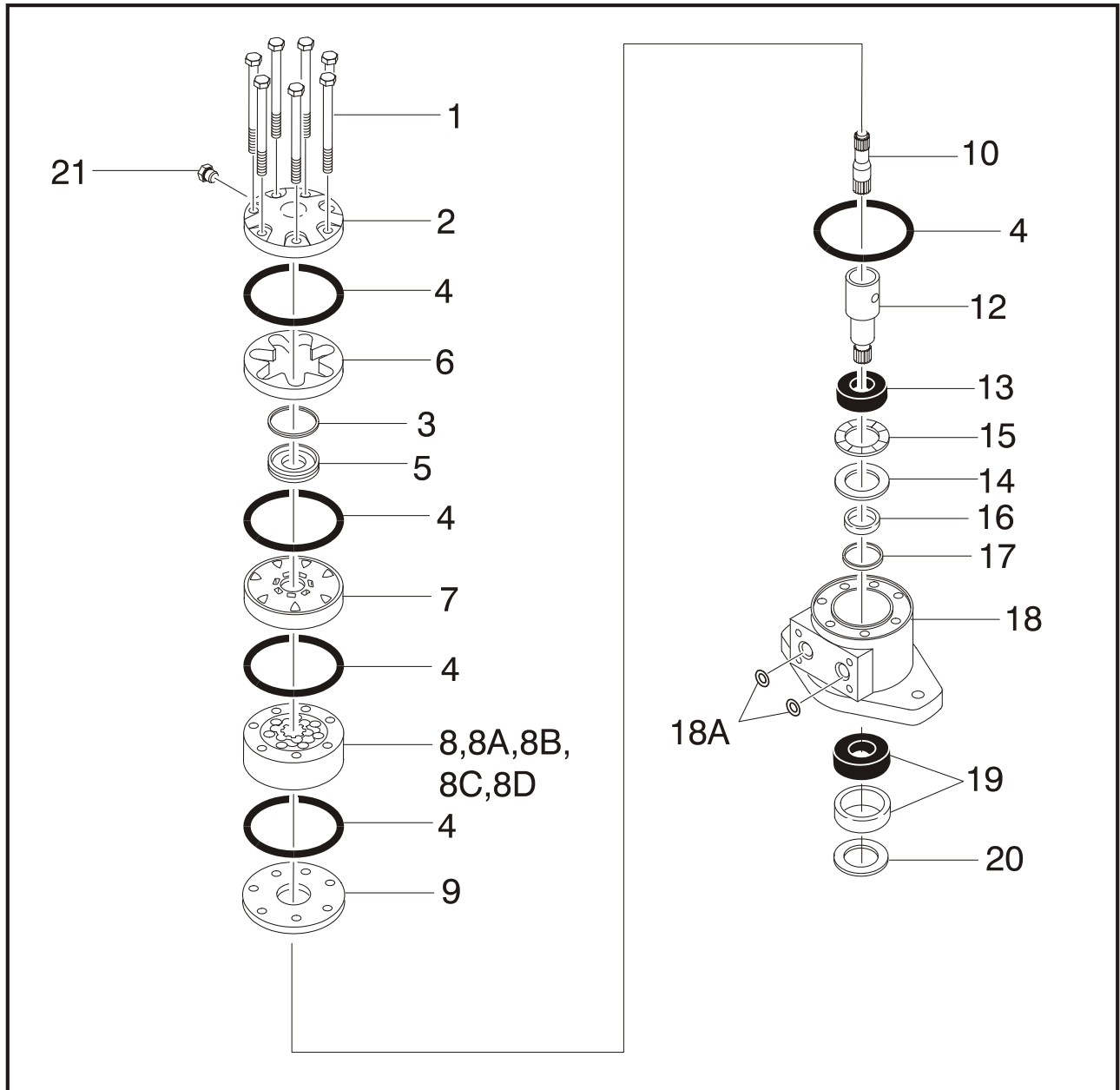
IF THE TORQLINK™ IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

2. Scribe an alignment mark down and across the Torqlink™ components from end cover (2) to housing (18) to facilitate reassembly orientation where required. Loosen two shuttle or relief valve plugs (21) for disassembly later if included in end cover. 3/16 or 3/8 inch Allen wrench or 1 inch hex socket required.



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





- | | | |
|-------------------------|----------------------------|----------------------------|
| 1. Special Bolts | 8B. Stator or Stator Vane | 16. Seal |
| 2. End Cover | 8C. Vane | 17. Back-up Washer |
| 3. Seal Ring-Commutator | 8D. Stator Half | 18. Housing |
| 4. Seal Ring | 9. Wear Plate | 18A. O-Ring |
| 5. Commutator Ring | 10. Drive Link | 19. Bearing/Bushing, Outer |
| 6. Commutator Ring | 12. Coupling Shaft | 20. Dirt & Water Seal |
| 7. Manifold | 13. Bearing/Bushing, Inner | 21. Plug |
| 8. Rotor Set | 14. Thrust Washer | |
| 8A. Rotor | 15. Thrust Bearing | |

Figure 3-24. Swing Drive Motor

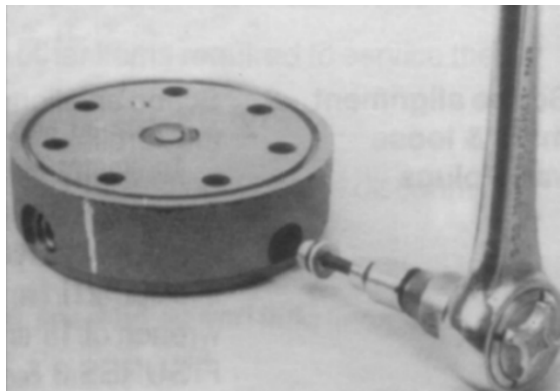
SECTION 3 - CHASSIS & TURNTABLE

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



NOTE: Refer to the appropriate "alternate cover construction" on the exploded view to determine the end cover construction being serviced.

5. If the end cover (2) is equipped with shuttle valve components, remove the two previously loosened plugs (21).

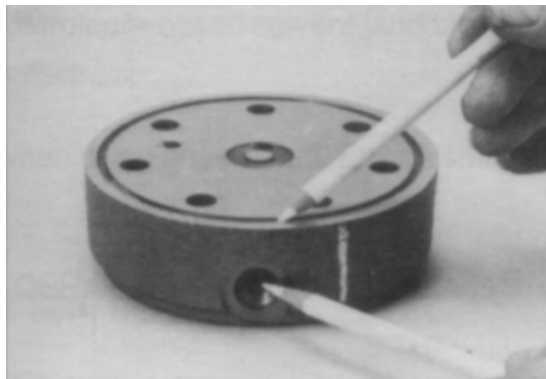


NOTICE

BE READY TO CATCH THE SHUTTLE VALVE OR RELIEF VALVE COMPONENTS THAT WILL FALL OUT OF THE END COVER VALVE CAVITY WHEN THE PLUGS ARE REMOVED.

NOTE: The insert and if included the orifice plug in the end cover (2) must not be removed as they are serviced as an integral part of the end cover.

6. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures, including the internal orifice plug, 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.

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



8. 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.



9. 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 them and if old to ensure that same surface is reassembled against the rotor set.

10. Remove rotor set (8) and warplane (9), together to retain the rotor set in its assembled form, maintaining the same rotor vane (8C) to stator (8B) 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 warplane to work the drive link out of the rotor (8A) and warplane. 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 warplane for cracks, brinelling, or scoring. Discard seal ring (4) that is between the rotor set and wear plate.



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 from Torqlink™ will ensure correct reassembly of rotor into stator and rotor set into Torqlink™. Marking all rotor components and mating spline components for exact repositioning at assembly will ensure maximum wear life and performance of rotor set and Torqlink™.

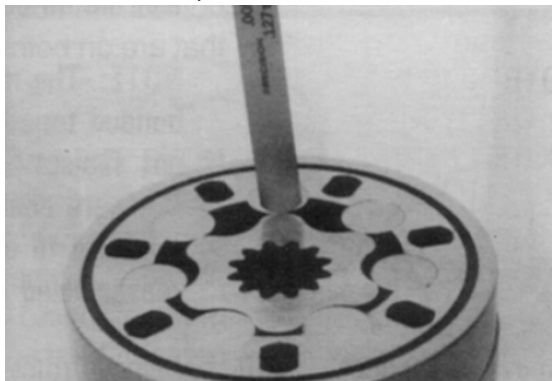


SECTION 3 - CHASSIS & TURNTABLE

NOTE: Series TG Torqlinks™ may have a rotor set with two stator halves (8B) with a seal ring (4) between them and two sets of seven vanes (8C). Discard seal ring only if stator halves become disassembled during the service procedures.

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

11. Place rotor set (8) and wear plate (9) on a flat surface and center rotor (8A) in stator (8B) such that two rotor lobes (180 degrees apart) and a roller vane (8C) 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 (8B & 8D) and two sets of seven vanes (8C & 8E) as shown in the alternate construction TG rotor set assembly view, check the rotor lobe to roller vane clearance at both ends of rotor.

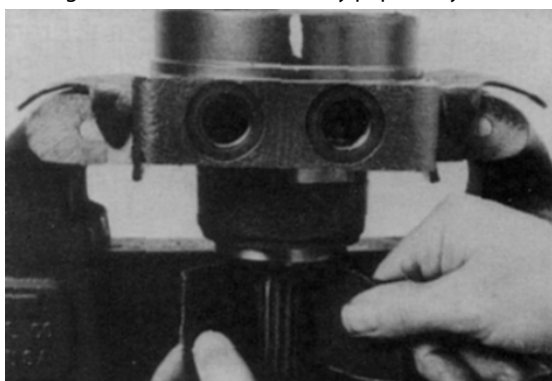
12. Remove drive link (10) from coupling shaft (12) if it was not removed with rotor set and wear plate. Inspect drive link for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. Remove and discard seal ring (4) from housing (18).



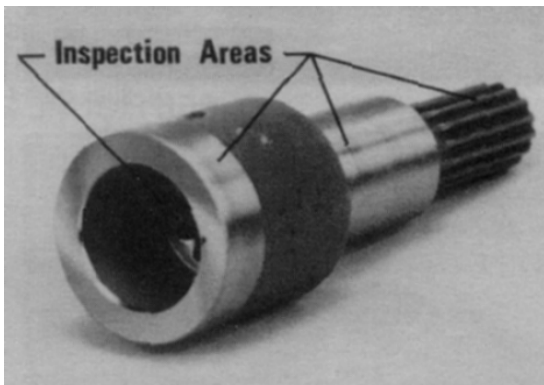
13. Remove thrust bearing (11) from top of coupling shaft (12). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.



14. 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.



15. 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.

16. Remove and discard seal ring (4) from housing (18).
17. Remove thrust bearing (15) and thrust washer (14) Inspect for wear, brinelling, corrosion and a full complement of retained rollers.



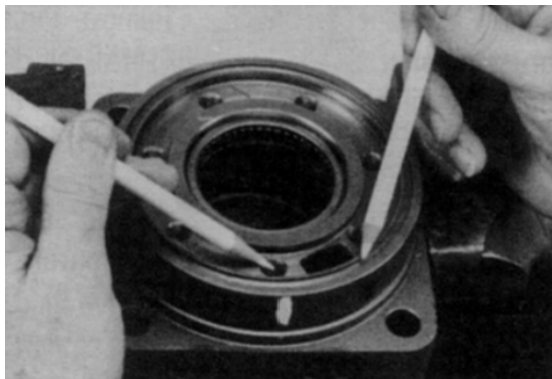
18. Remove seal (16) and back up washer (17) from Small Frame, housing (18). Discard both.



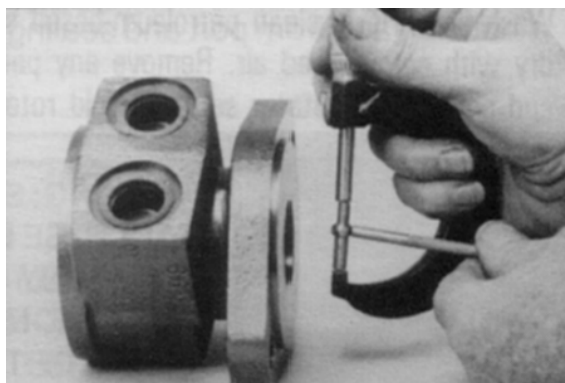
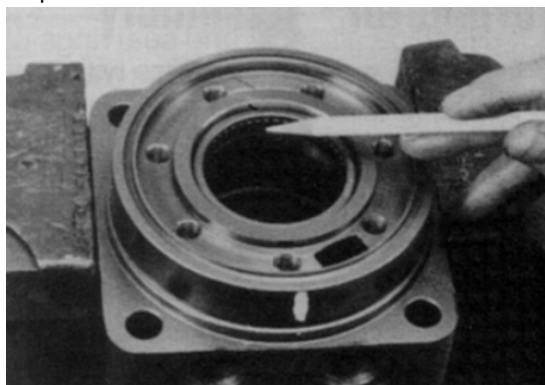
19. Remove housing (18) from vise, invert it and remove and discard seal (20). A blind hole bearing or seal puller is required.



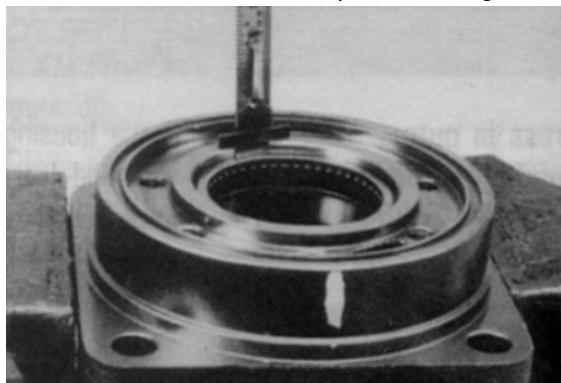
20. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly.



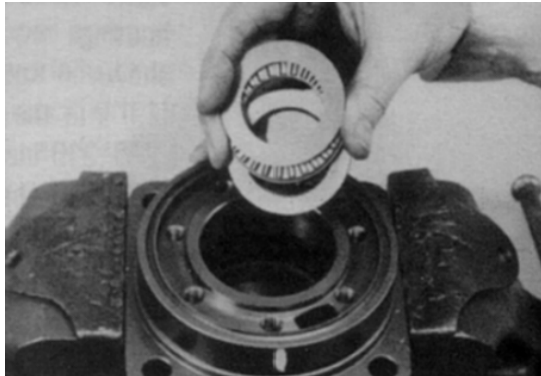
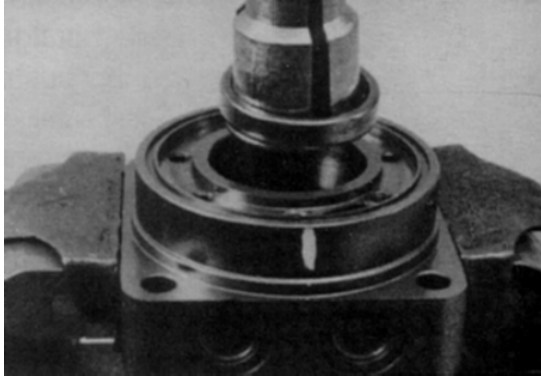
21. If the housing (18) assembly has passed inspection to this point, inspect the housing bearings/bushings (19) and (13) and if they are captured in the housing cavity the two thrust washers (14) and thrust bearing (15). The bearing rollers must be firmly retained in the bearing cages, but must rotate 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 Torqlink™ 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.



22. 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 Torqlink™ unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.

NOTE: Individual seals and seal rings as well as a complete seal kit are available. The parts should be available through most OEM parts distributors or Parker approved Torqlink™ distributors. (Contact your local dealer for availability).

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.

⚠ CAUTION

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, which will control the bearing/ bushing depth.

Torqlink™ housings require 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.





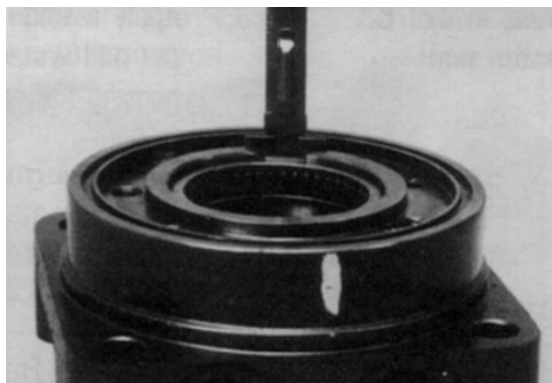
NOTE: Bearing mandrel must be pressed against the lettered end of bearing shell. Take care that the housing bore is square with the press base and the bearing/bushing is not cocked when pressing a bearing/bushing into the housing.

NOTICE

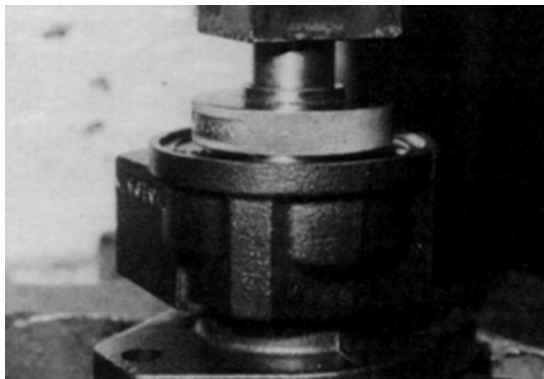
IF THE BEARING MANDREL SPECIFIED IN THE "TOOLS AND MATERIALS REQUIRED FOR SERVICING" SECTION IS NOT AVAILABLE AND ALTERNATE METHODS ARE USED TO PRESS IN BEARING/BUSHING (13) AND (19) THE BEARING/BUSHING DEPTHS SPECIFIED MUST BE ACHIEVED TO INSURE ADEQUATE BEARING SUPPORT AND CORRECT RELATIONSHIP TO ADJACENT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

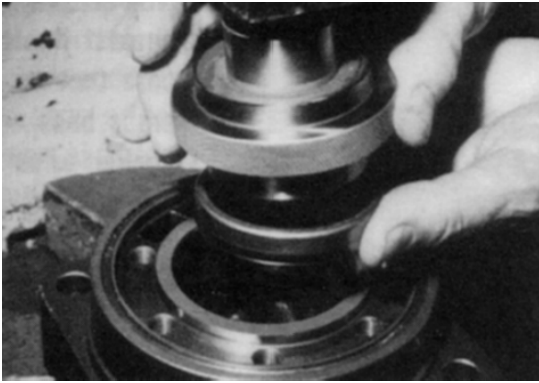
NOTICE

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.



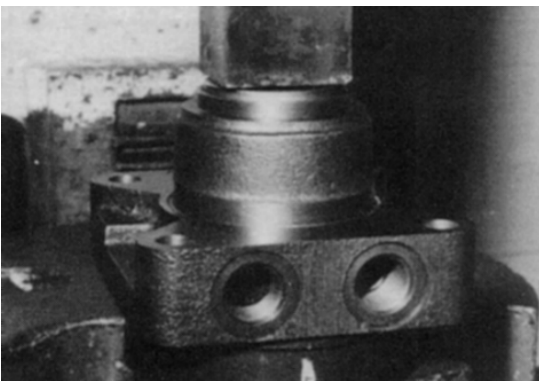
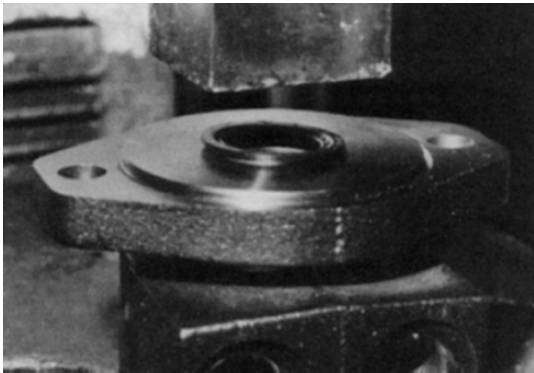
2. The Torqlink™ inner housing bearing/bushing (13) can now be pressed into its counterbore in housing (18) flush to 0.03 inch (.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19).



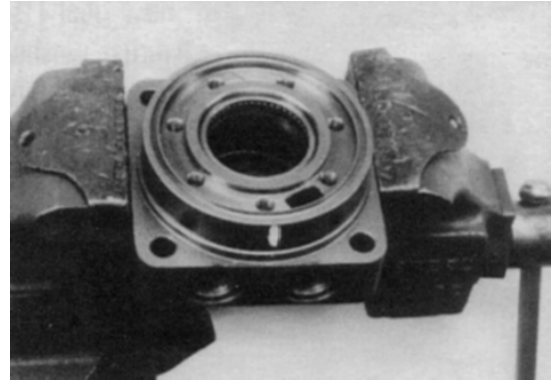


3. Press a **new** dirt and water seal (20) into the housing (18) outer bearing counterbore.

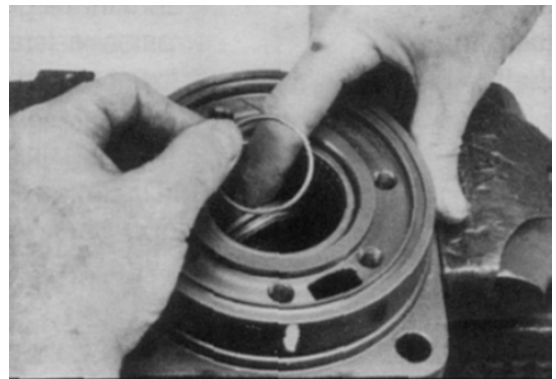
The Torqlink™ dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



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



5. On the Torqlinks™ assemble a **new** backup washer (17) and **new** seal (16) with the seal lip facing toward the inside of Torqlink™, into their respective counterbores in housing (18) if they were not assembled in procedure 2.

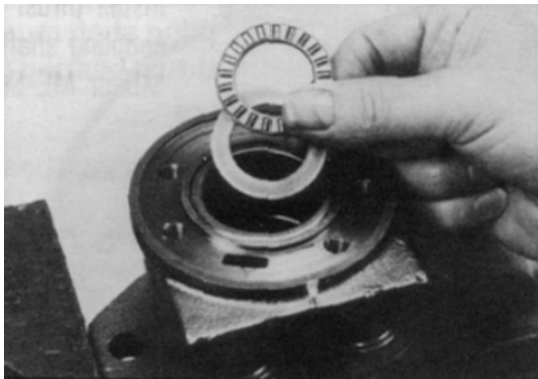


NOTICE

ORIGINAL DESIGN LARGE FRAME, TF & TG TORQLINKS™ THAT DO NOT HAVE BACKUP WASHER (25) WHEN DISASSEMBLED MUST BE ASSEMBLED WITH A NEW BACKUP WASHER (17), NEW BACKUP WASHER (25), AND NEW SEAL (16).

SECTION 3 - CHASSIS & TURNTABLE

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



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

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) in the housings.



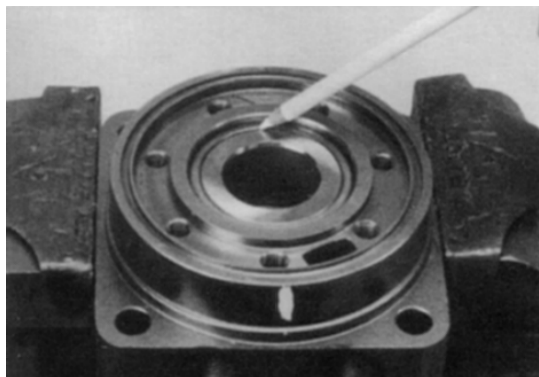
NOTICE

THE OUTER BEARING (19) IS NOT LUBRICATED BY THE SYSTEM'S HYDRAULIC FLUID. BE SURE IT IS THOROUGHLY PACKED WITH THE RECOMMENDED GREASE, PARKER GEAR GREASE SPECIFICATION #045236, E/M LUBRICANT #K-70M.

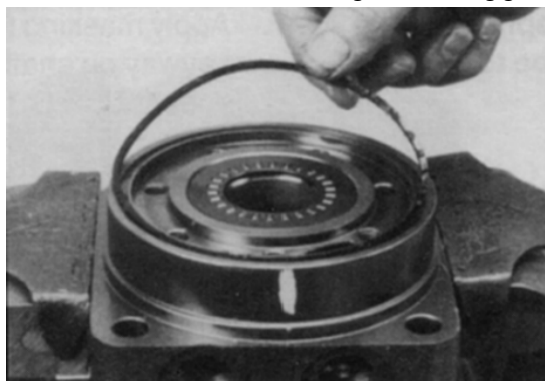
NOTE: Mobil Mobilith SHC® 460

NOTE: A 102Tube (P/N 406010) is included in each seal kit.

NOTE: The coupling shaft (12) will be flush or just below the housing wear plate surface on Torqlinks™ when properly seated. 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.



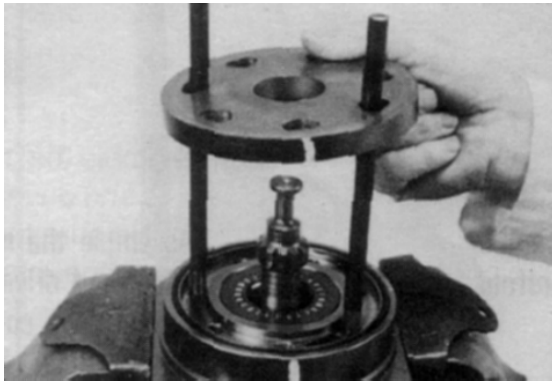
NOTE: One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF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

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.

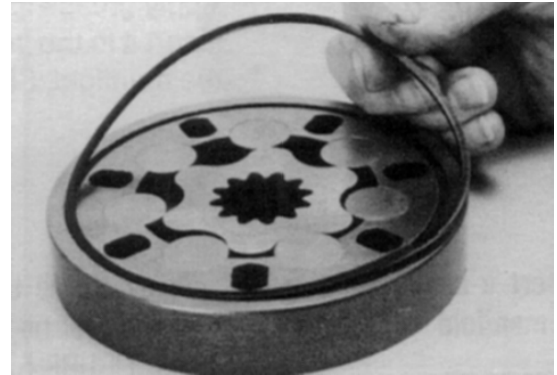


NOTE: Use any alignment marks put on the coupling shaft and drive link before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

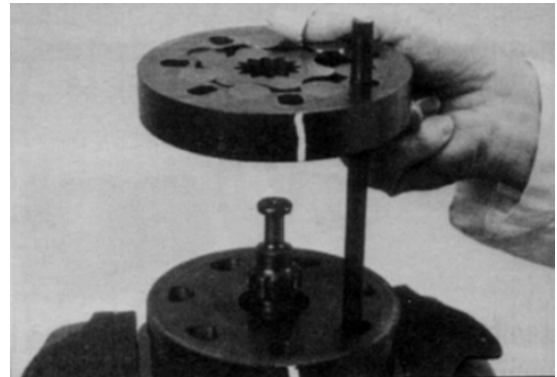
11. Assemble wear plate (9) over the drive link (10) and alignment studs onto the housing (18).



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 (8B).



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

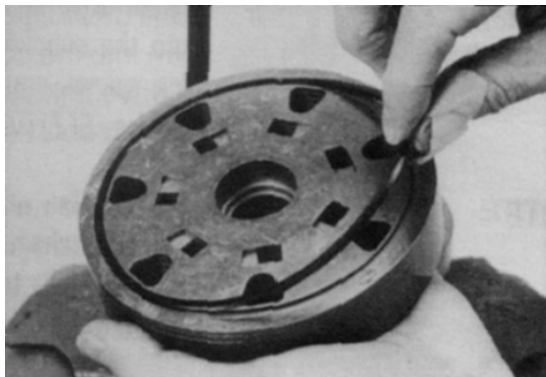


NOTE: It may be necessary to turn one alignment stud out of the housing (18) temporarily to assemble rotor set (8) or manifold (7) over the drive link.

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

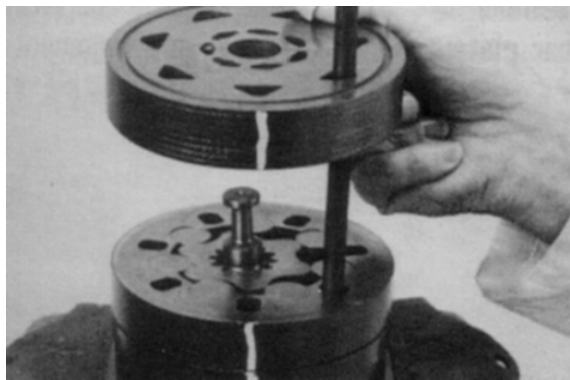
NOTE: The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the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

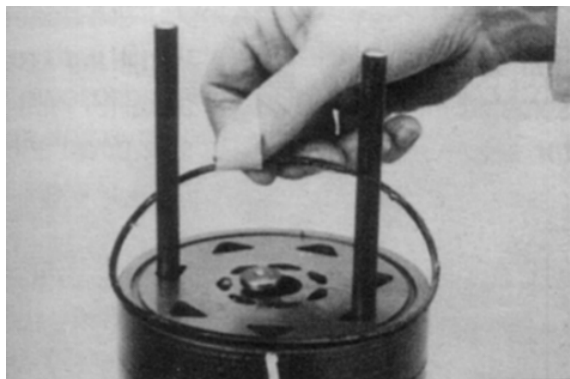


NOTE: The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left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

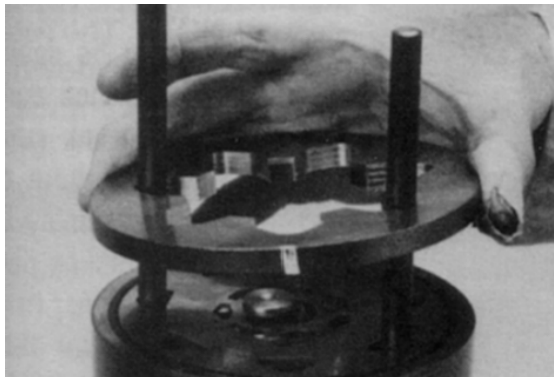
15. Assemble the manifold (7) over the alignment studs and drive link (10) and onto the rotor set. Be sure the correct manifold surface is against the rotor set.



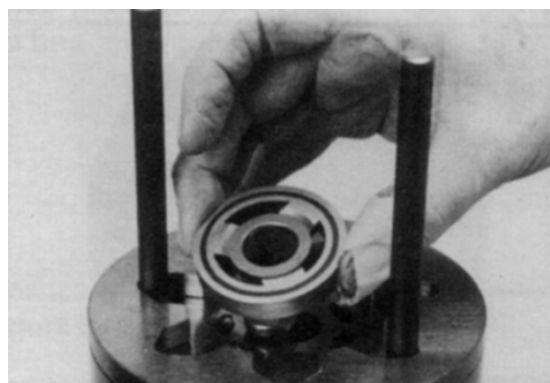
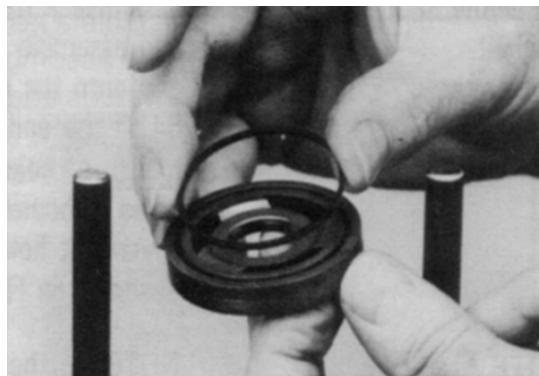
16. Apply grease to a **new** seal ring (4) and insert it in the seal ring groove exposed on the manifold.



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

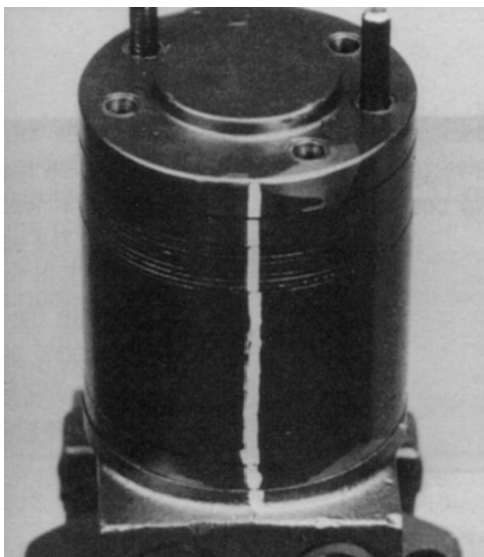
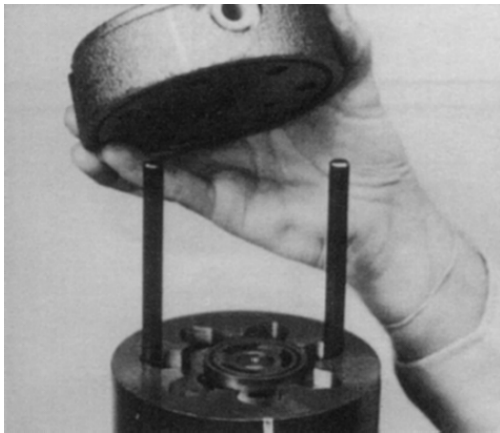
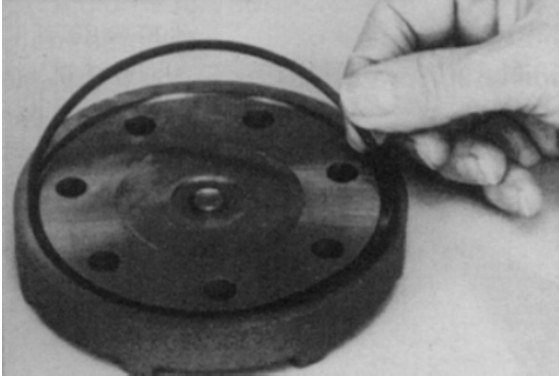


18. Assemble a **new** seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.



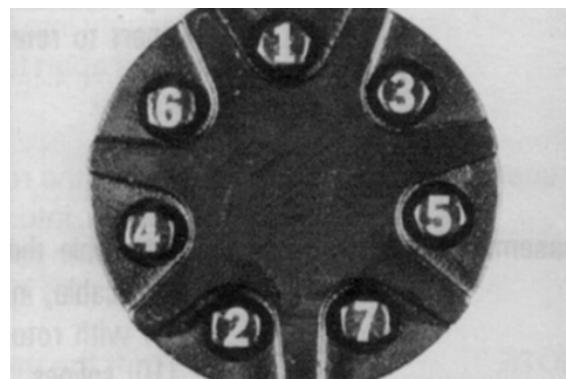
19. If shuttle valve components items #21, were removed from the end cover (2) turn a plug (21), loosely into one end of the valve cavity in the end cover. A 3/16 inch Allen wrench is required.

20. 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.



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.

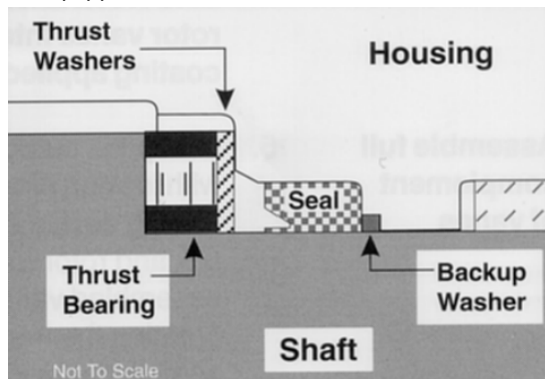
21. Assemble the 5 or 7 special bolts (1) and screw in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 22-26 ft. lbs. 45-55 ft. lbs.(61-75 N m) for the seven 3/8-24 threaded bolts.



NOTE: The special bolts required for use with the relief or shuttle valve (24) end cover assembly (2) are longer than the bolts required with standard and cover assembly. Refer to the individual service parts lists or parts list charts for correct service part number if replacement is required.

22. Torque the two shuttle valve plug assemblies (21) in end cover assembly to 9-12 ft. lbs. (12-16 Nm) if cover is so equipped.

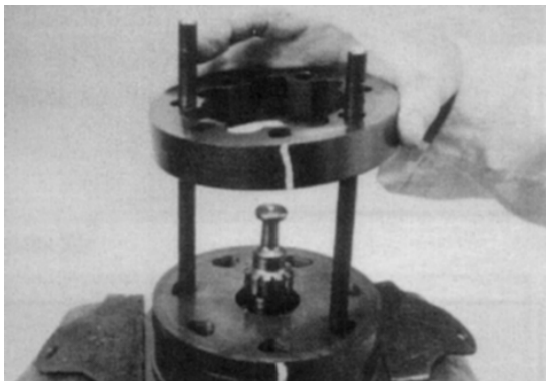
Torque the two relief valve plug assemblies (21) in end cover assembly to 45-55 ft. lbs. (61-75 Nm) if cover is so equipped.



One Piece Stator Construction

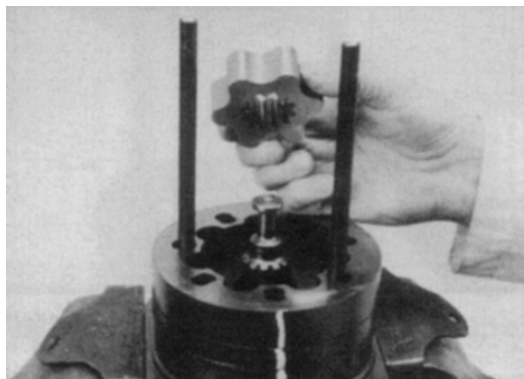
A disassembled rotor (8A) stator (8B) and vanes (8C) that cannot be readily assembled by hand can be assembled by the following procedures.

1. Place stator (8B) onto wear plate (9) with seal ring (4) side down, after following Torqlink™ 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 (8A), counterbore down if applicable, into stator (8B), and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.



NOTE: If the manifold side of the rotor was etched during Torqlink disassembly, this side should be up. If the rotor is not etched and does not have a counterbore, use the drive link spline contact pattern apparent on the rotor splines to determine the rotor side that must be against the wear plate.

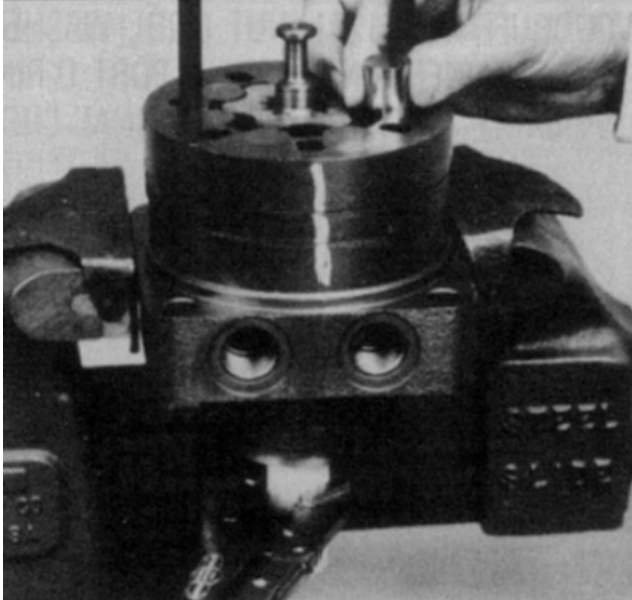
4. Assemble six vanes (8C), or as many vanes that will readily assemble into the stator vane pockets.



NOTICE

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 (8B), 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.

Installation

1. Connect the two hydraulic lines to the motor as tagged during Removal.

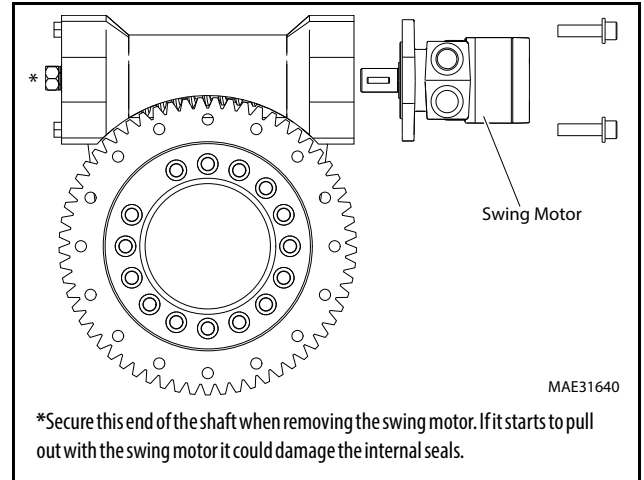


Figure 3-25. Swing Motor- Installation

2. Position the motor on the swing drive and secure in place with the retaining bolts. Torque the bolts to 95 ft.lbs. (130Nm).

3.15 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 loctite #271. After replacing and retorquing bolt or bolts recheck all existing bolts for looseness.

1. Check the frame to bearing attach bolts as follows:
 - a. Fully elevate the main boom.
 - b. Do a visual inspection of the bolts to see if any bolts are missing.
 - c. Place a wrench on each one of the bolts and torque to a 100 ft-lb (135.5 Nm), this should not break the Loctite but ensure the bolts are not loose or broken.

2. Check the turntable to bearing Attach bolts as follows:
 - a. Elevate the fully retracted main boom to full elevation.
 - b. Try to insert the 0.0015" (0.038 mm) feeler gauge between the bolt head and hardened washer at the unloaded side of the turntable bearing.

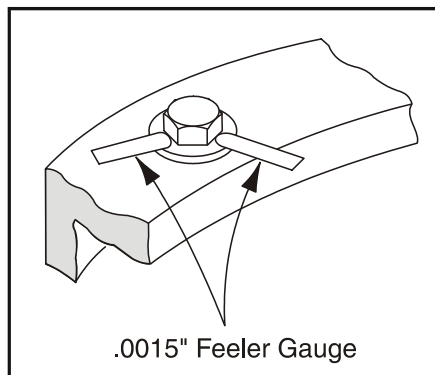
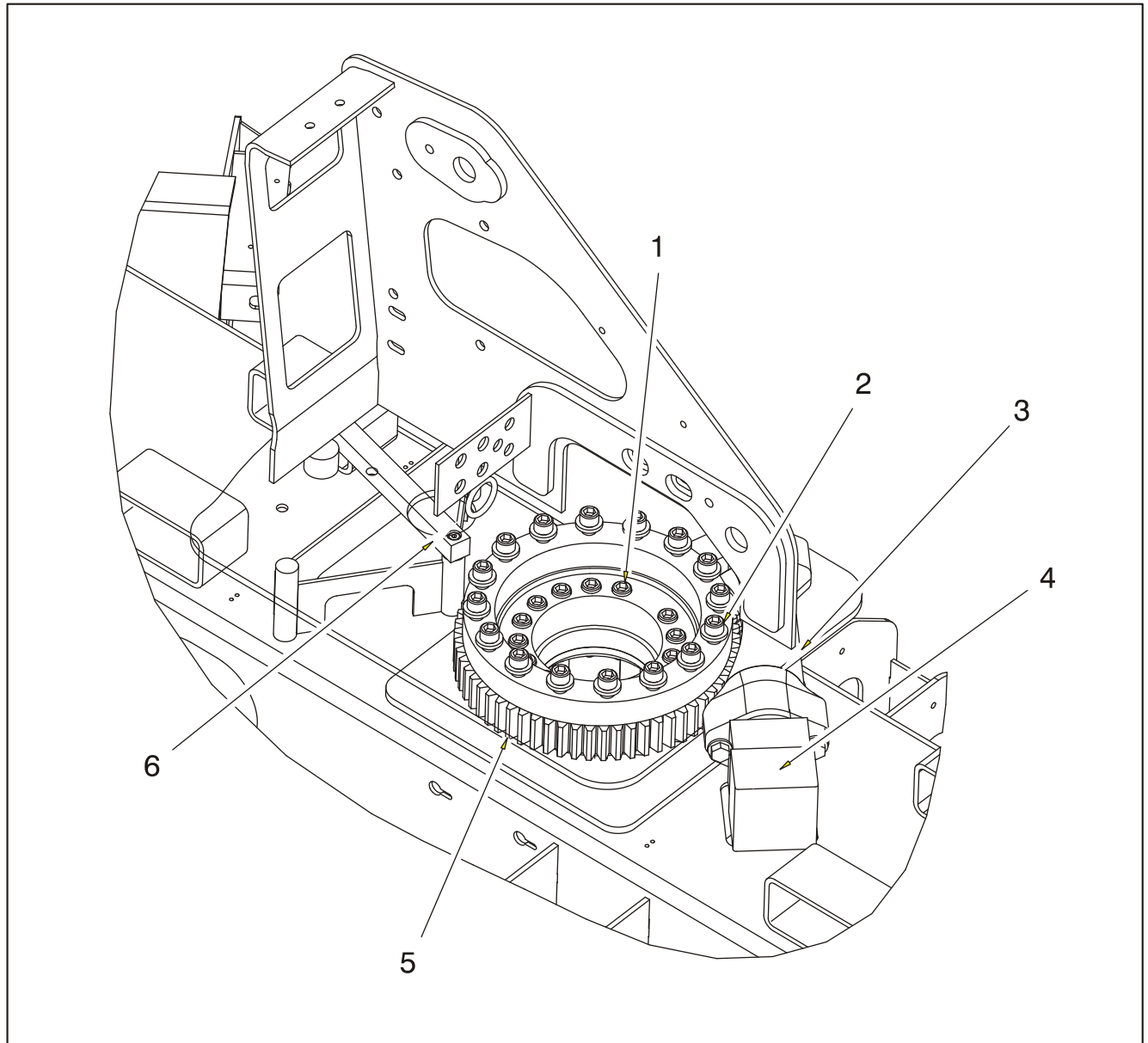


Figure 3-26. Swing Bolt Feeler Gauge Check

- c. Lower the boom to horizontal and fully extend the boom.
- d. Try and insert the 0.0015" (0.038 mm) feeler gauge between the bolt head and hardened washer at the unloaded side of the turntable bearing.



1. Inner Race Bolt
2. Outer Race Bolt
3. Inner Bearing Cup
4. Swing Motor
5. Bearing
6. Swing Arm

Figure 3-27. Swing Bearing

Wear Tolerance

1. From the underside of the machine, at rear center, with the main boom fully elevated and fully retracted, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. See Figure 3-28., Swing Bearing Tolerance Measuring Point.
2. At the same point, with the main boom at horizontal and fully extended, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. See Figure 3-28., 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, disassembled, and inspected for the following:
 - a. Metal particles in the grease
 - b. Increased drive power required
 - c. Noise
 - d. Rough rotation
5. If bearing inspection shows no defects, reassemble and return to service.

NOTICE

THE SWING BEARING IS ONE OF THE MOST CRITICAL POINTS ON AN AERIAL LIFT. IT IS HERE THAT THE STRESSES OF LIFTING ARE CONCENTRATED, AT THE CENTER OF ROTATION. BECAUSE OF THIS, PROPER MAINTENANCE OF THE SWING BEARING BOLTS IS A MUST FOR SAFE OPERATION.

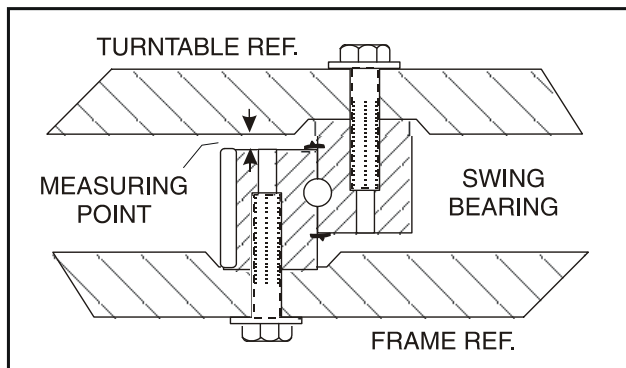


Figure 3-28. Swing Bearing Tolerance Measuring Point

Swing Bearing Removal

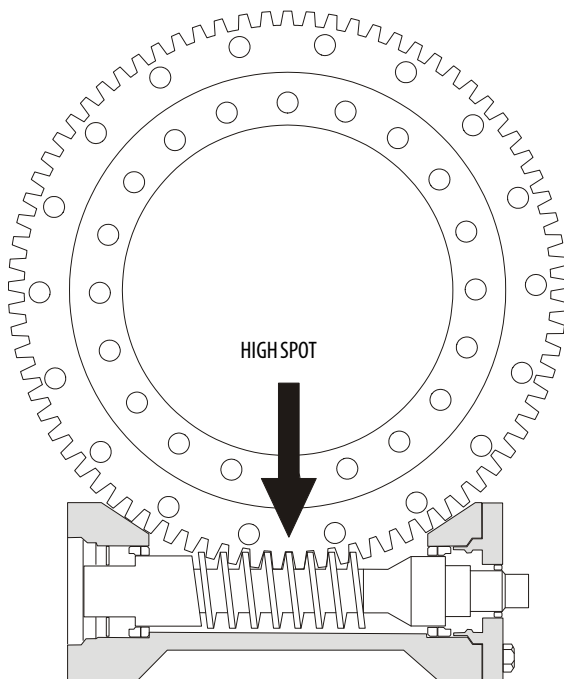
NOTICE

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

1. Remove the boom assembly. Refer to Section 4.3, Boom and Cylinder Assembly.
2. Tag and disconnect the hydraulic lines from the fittings on the turntable. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.
3. Attach suitable overhead lifting equipment to the base of the turntable.
4. 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 the bolts and washers which attach the turntable to the bearing inner race. Discard the bolts.
5. 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.
6. Carefully place the turntable on a suitably supported trestle.
7. 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 from the frame, then move the bearing to a clean, suitably supported work area.

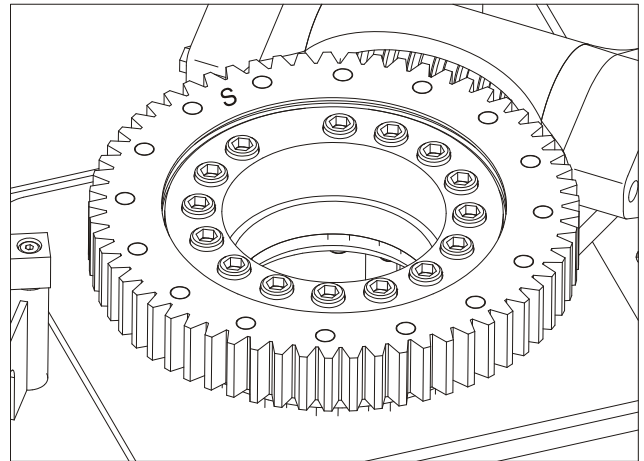
Swing Bearing Installation

1. Place the swing drive on a table.
2. Place the bearing on the housing making sure the grease fitting is aligned in the proper location.
3. On the underside of the bearing, assemble two screws loosely in the counterbored holes.
4. Put the crank in the worm bore and crank the worm gear until the painted area of the bearing teeth is in mesh with the worm.



5. Adjust the bearing until 0.010 - 0.015 inch (0.20 - 0.38 mm) backlash is achieved.
6. Tighten the screws in the counterbored holes.
7. Check that the 0.010 - 0.015 inch (0.20 - 0.38 mm) backlash has been maintained when the painted area of the bearing is in mesh with the worm.

8. Using suitable lifting equipment, carefully lower the swing bearing into position on the frame. Ensure the scribed line of the outer race of the bearing aligns with the scribed line on the frame. If a new swing bearing is used, ensure that the soft spot (stamped with an "S") is in the vicinity shown below (90° relative to the load axis) before securing it to the turntable. If it is not, manually rotate the outer race using the 7/8 hex until the soft spot is located as shown.



NOTICE

JLG INDUSTRIES RECOMMENDS THAT ALL REMOVED BEARING BOLTS BE DISCARDED AND REPLACED WITH NEW 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.

9. Apply a light coating of JLG Threadlocker 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.

10. Refer to the Torque Sequence diagram as shown in Figure 3-30., Swing Bearing Torque Sequence. Spray a light coat of Safety Solvent 13 on the new bearing bolts. Then apply a light coating of JLG Threadlocker 0100019 to the new bearing bolts, and install the bolts and washers through the frame and outer race of the bearing. Note the position of the two shorter bolts as shown below. Tighten all bolts to an initial torque of 115 ft.lbs. (155 Nm) w/Loctite.

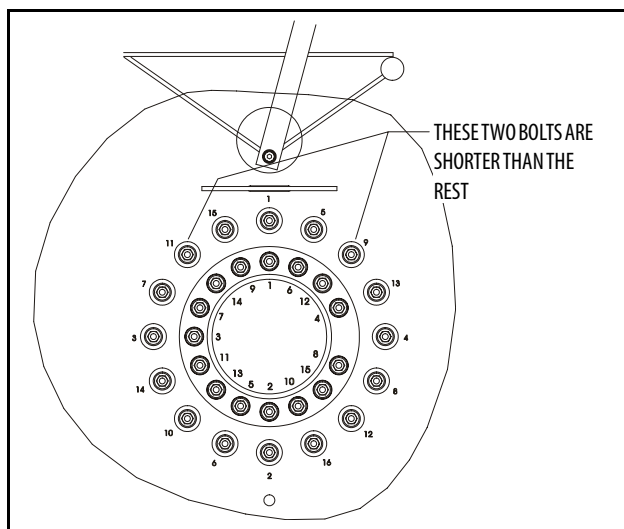


Figure 3-29. Short Bolts

11. Remove the lifting equipment from the bearing.
12. Using suitable lifting equipment, carefully position the turntable assembly above the machine frame.
13. Carefully lower the turntable onto the swing bearing, ensuring that the scribed line of the inner race of the bearing aligns with scribed line on the turntable.
14. Spray a light coat of Safety Solvent 13 on the new bearing bolts. Then apply a light coating of JLG Threadlocker 0100019 to the new bearing bolts, and install the bolts and washers through the turntable and inner race of the bearing.
15. Following the Torque Sequence diagram shown in Figure 3-30., Swing Bearing Torque Sequence, tighten the bolts to a torque of 118 ft.lbs. (160 Nm) w/Loctite.
16. Remove the lifting equipment.
17. Connect the hydraulic lines to the fittings on the turntable as tagged prior to removal.
18. Install the boom assembly. Refer to Section 4.3, Boom and Cylinder Assembly.
19. Using all applicable safety precautions, activate the hydraulic system and check the swing system for proper and safe operation.

Swing Bearing Torque Values

1. Outer Race - 118 ft.lbs. (160 Nm)
2. Inner Race - 118 ft.lbs. (160 Nm)
3. See Swing Bearing Torquing Sequence.

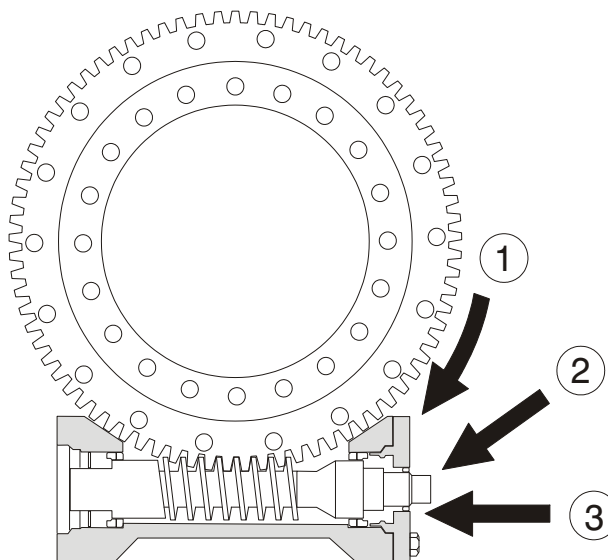
⚠ WARNING

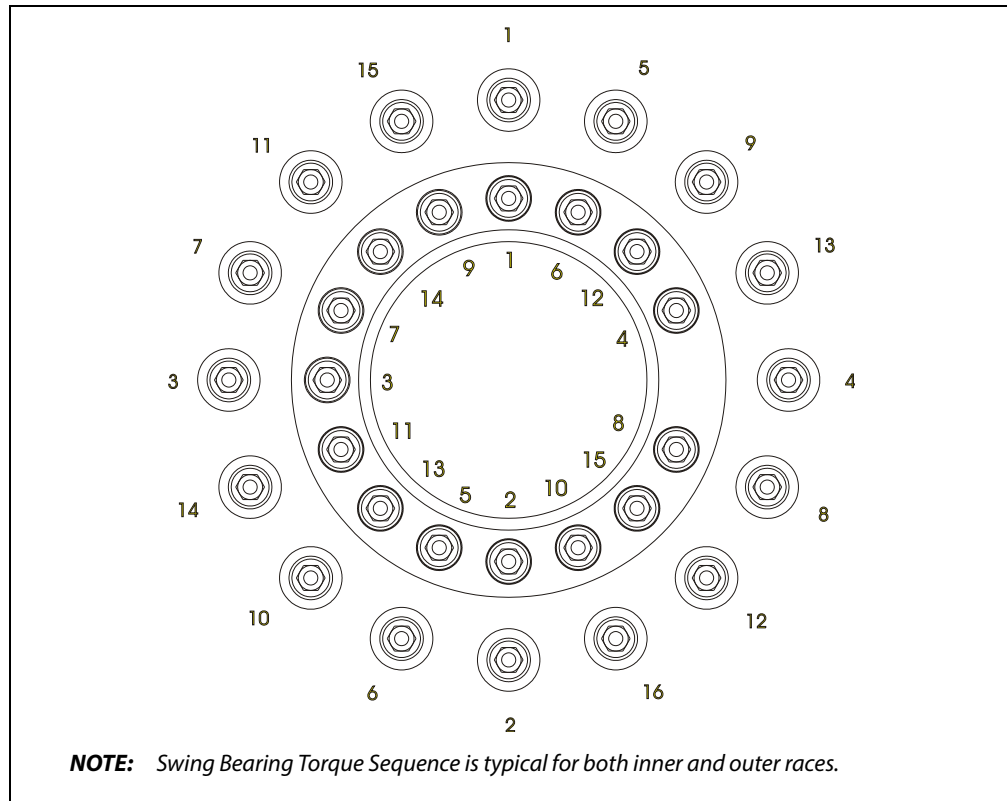
CHECK THE INNER AND OUTER SWING BEARING BOLTS FOR MISSING OR LOOSENESS AFTER FIRST 50 HOURS OF OPERATION, AND EVERY 600 HOURS THEREAFTER.

Swing Drive Checks

There are three visual checks that can be used to determine if the swing drive is worn. Gently rock the boom back and forth and look for the following:

1. Movement of the turntable gear (this indicates the motor is spinning due to a worn out motor or air in the lines)
2. Rotation of the Screw Shaft
3. Screw shaft moving in and out of the end plate



**Figure 3-30. Swing Bearing Torque Sequence**

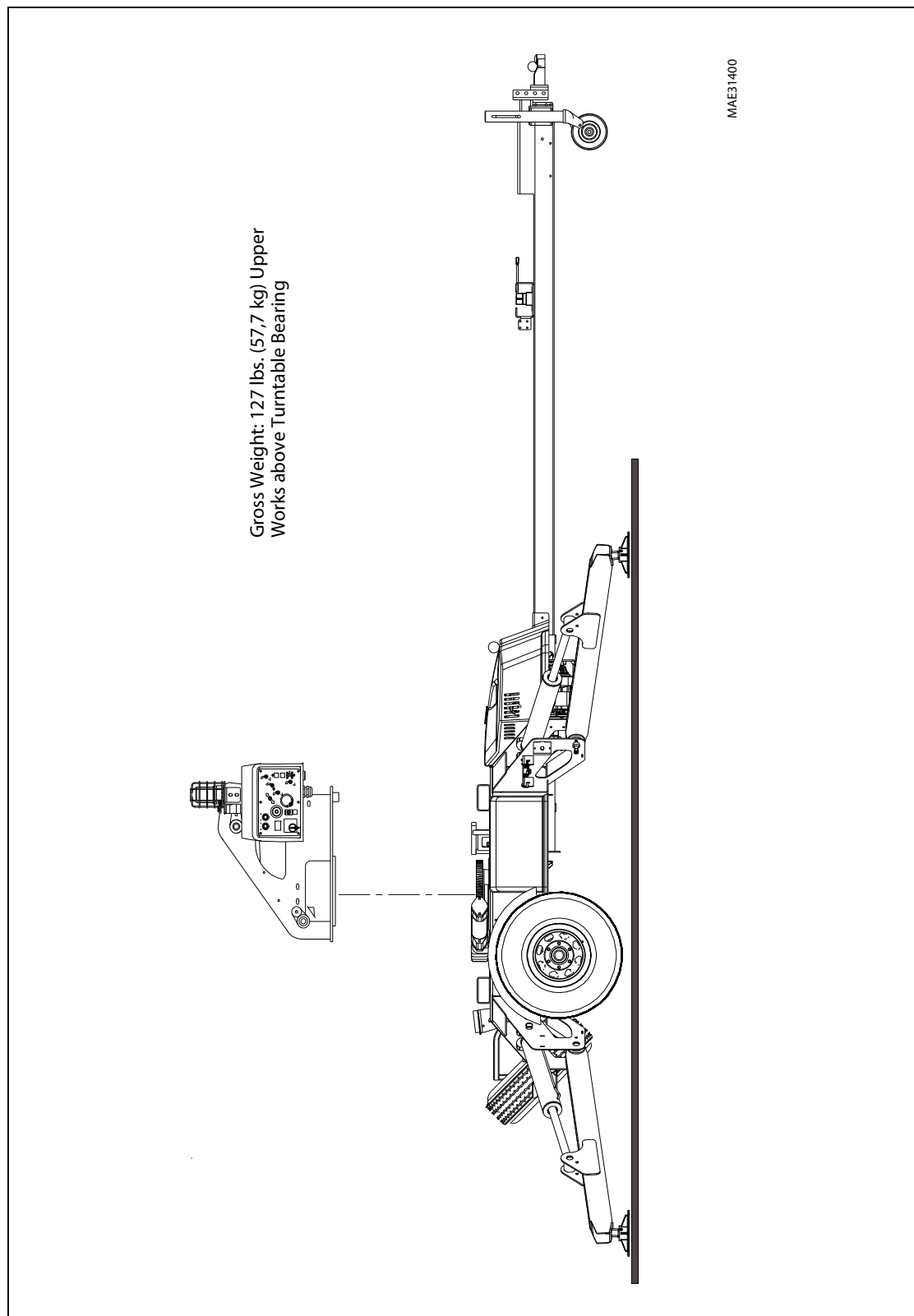


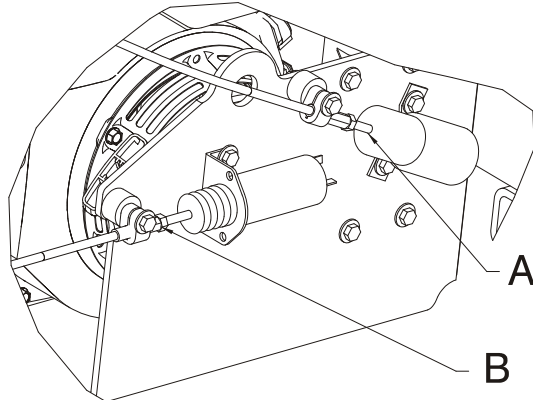
Figure 3-31. Swing bearing Removal

3.16 ENGINE

NOTE: Refer to the engine manufacturer's manual for detailed operating and maintenance instructions.

Throttle & Choke Adjustment

1. Start the engine.



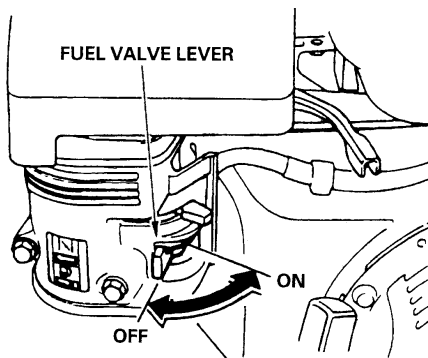
- A SET CABLE HEX TO 2.75" (7 CM) TO FACE OF SOLENOID THEN TIGHTEN JAM NUT FOR THROTTLE
- B SET CABLE HEX TO 2.375" (6 CM) TO FACE OF SOLENOID THEN TIGHTEN JAM NUT FOR CHOKE

2. Hold the throttle open. Adjust the stop screw to 3600 rpm.
3. Release the throttle and set idle to 2000 rpm.
4. Set the choke control cable to 2.375" (6 cm) and tighten the jam nuts.





Fuel Valve Lever

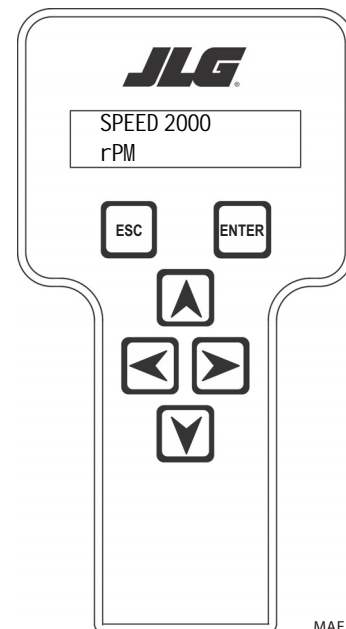
NOTE: The fuel valve is turned off upon delivery and must be turned on prior to use. The fuel valve should be turned off when machine is not being used.

The fuel valve lever must be in the ON position for the engine to run. When the engine is not in use, leave the fuel valve lever in the OFF position to prevent carburetor flooding and to reduce the possibility of fuel leakage.



Checking RPM Level

1. Connect the JLG Analyzer to the ground control box. Refer to Section 6.2, To Connect the JLG Control System Analyzer.
2. Set the Analyzer to Access Level 2. Refer to Section 6.3, Changing Access Level.
3. Use the right arrow key  to scroll to DIAGNOSTICS.
4. Use the down arrow key  to scroll to PLATFORM, then the right arrow key  to scroll over to ENGINE.
5. From ENGINE, use the down arrow key  to scroll to the SPEED display, which will display engine RPM as shown below:



MAE19060

Choke Actuator

If a new carburetor is needed, the choke detent must be removed from the new carburetor in order to make the choke actuator function freely. Use the following procedure.

1. Remove the choke set from the carburetor by carefully opening the slot in the choke shaft to remove the choke plate and pull the shaft out the top.
2. Carefully file or grind the choke detent away.
3. Replace the choke shaft and choke plate.

Checking Oil Level

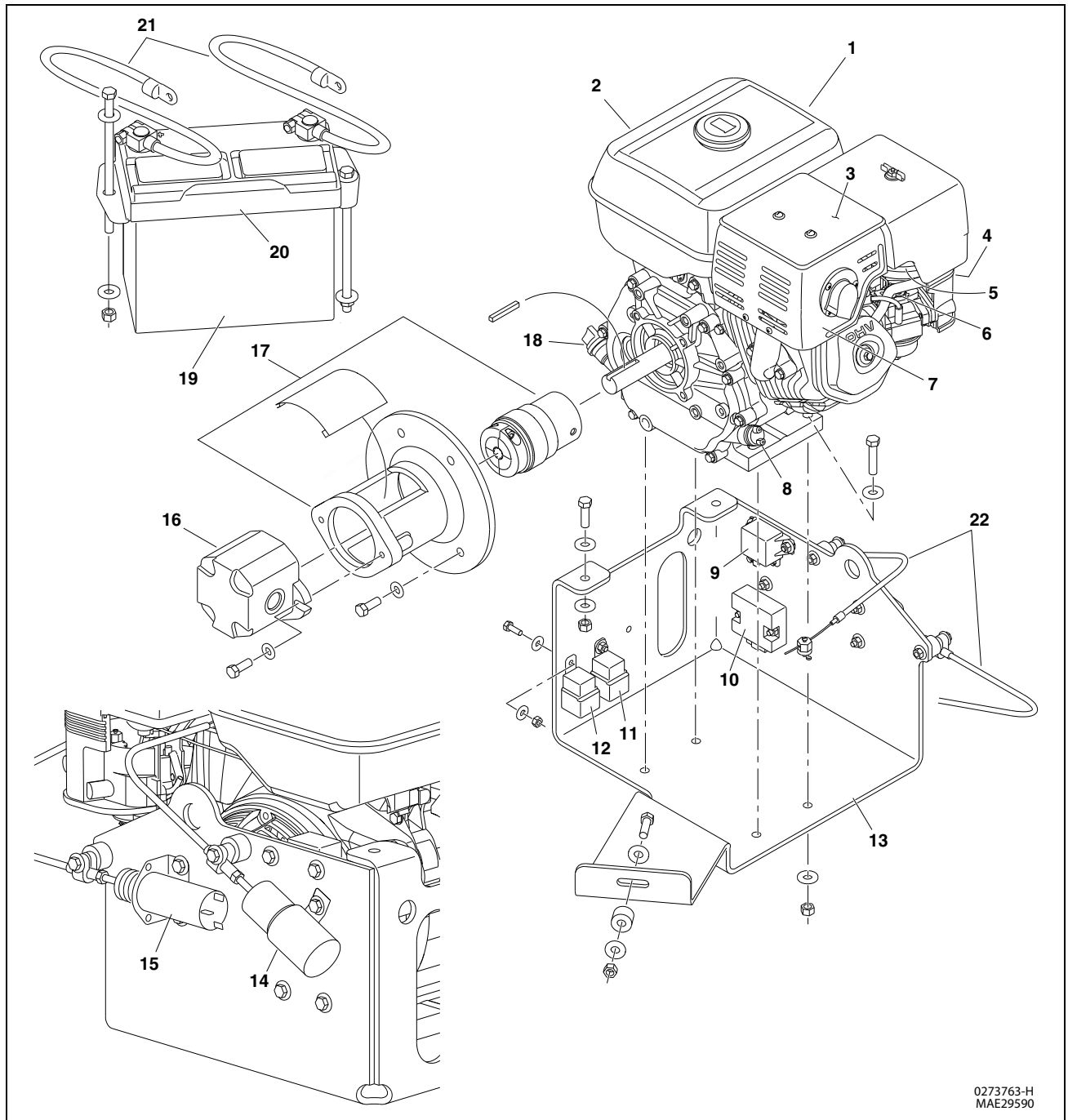
1. Make sure the machine is level.
2. Switch the engine off before checking oil level.
3. Remove the valve compartment cover to gain access to the engine.



4. Remove the dipstick.



5. Wipe the dipstick with non-fibrous, clean cloth.
6. Fully seat the dipstick and remove again.
7. Check the oil level, and if necessary, top the oil level with an approved grade and type of oil as outlined in the engine manufacturer's operator's manual.



- | | | | | |
|--------------------|-----------------------|--------------------------------|-----------------------------|-----------------------|
| 1. Engine Assembly | 6. Carburetor | 11. Choke Relay | 15. Choke Solenoid Actuator | 19. Battery |
| 2. Fuel Tank | 7. Muffler | 12. Engine Stop Relay | 16. Gear Pump | 20. Battery Hold-Down |
| 3. Heat Shield | 8. Dipstick | 13. Engine Mounting Plate | 17. Pump Coupling | 21. Battery Cable |
| 4. Starter | 9. Throttle Relay | 14. Throttle Solenoid Actuator | 18. Oil Fill Plug | 22. Throttle Cable |
| 5. Air Filter | 10. Voltage Regulator | | | |

Figure 3-32. Engine Assembly

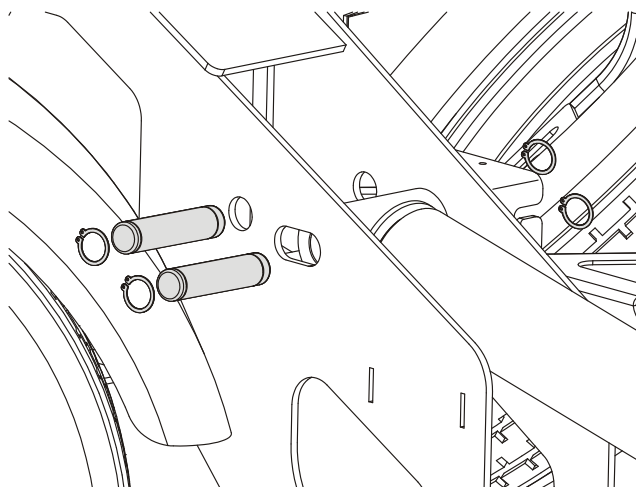
3.17 OUTRIGGER CYLINDER AND STABILIZER

Removal

1. Using the analyzer and service mode, lower the outrigger cylinder to be removed but DO NOT lower enough that the outrigger is supporting any of the machine's weight.
2. Place an appropriate lifting strap around the cylinder and use an adequate lifting device to support the weight of the cylinder.

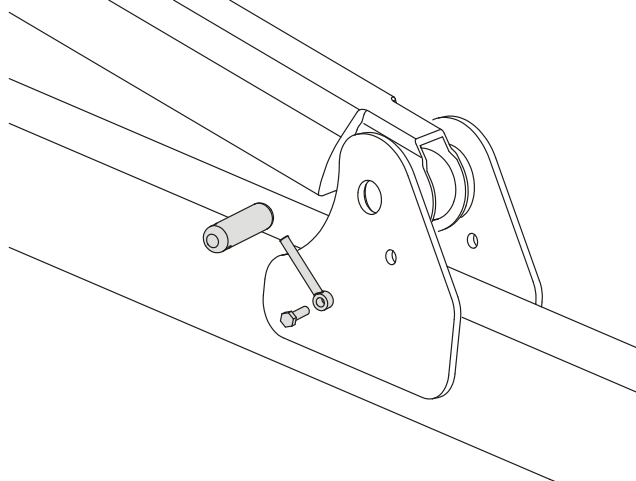
NOTE: The outrigger cylinder weighs approximately 48 lbs. (22 kg).

3. Use the lifting device to fully support the weight of the outrigger cylinder. With the weight of the cylinder relieved, remove the retaining clips securing the outrigger pin and outrigger cam pin and remove the two pins.



4. Lift the outrigger cylinder slightly up out of the frame to gain better access to the hydraulic lines running to the cylinder. Tag and disconnect the lines from the cylinder and cap or plug all openings.

5. At the opposite end of the cylinder, remove the bolt and keeper securing the pin and remove the pin.



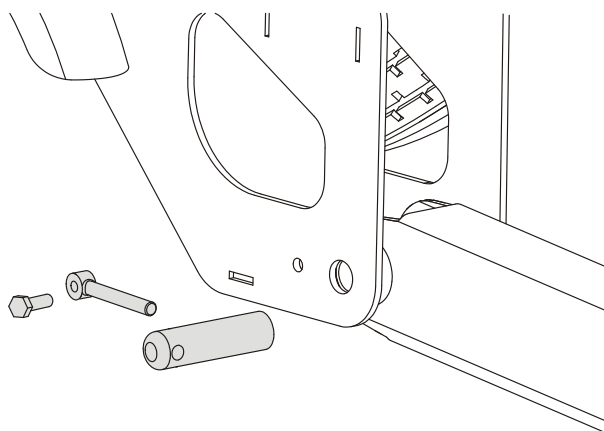
6. Remove the cylinder from the machine. If necessary, remove the cylinder cover from the cylinder.

NOTE: Steps 7 and 8 are only necessary if removing the stabilizer.

7. Place adequate blocking under the stabilizer to support it.

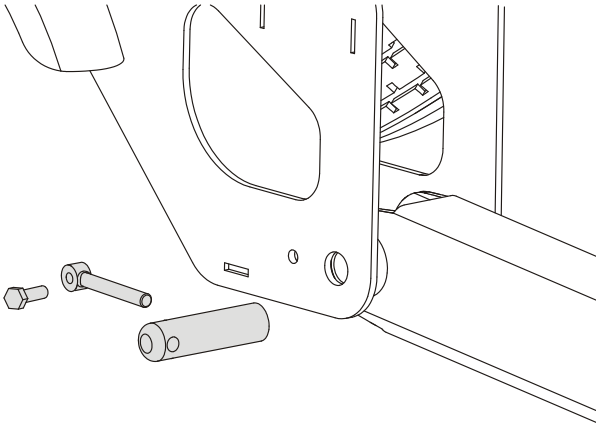
NOTE: The stabilizer on ANSI spec machines weighs approximately 42 lbs. (19 kg). The stabilizer on CE spec machines weighs approximately 46 lbs. (21 kg).

8. Remove the bolt and keeper securing the pin that connects the stabilizer to the frame and remove the pin.



Installation

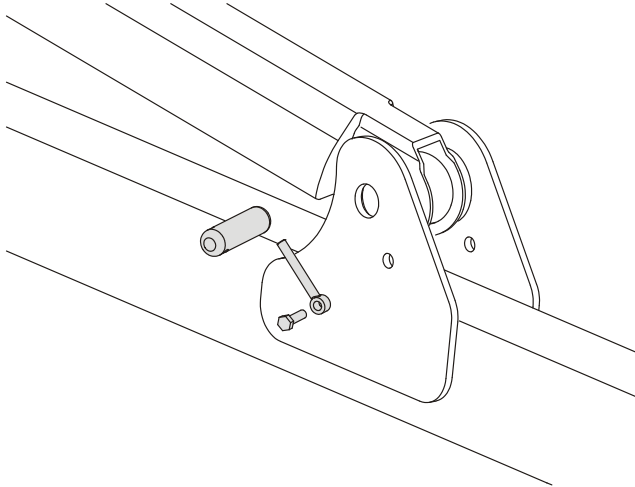
1. If removed, position the stabilizer in place on the frame and install the pin, keeper, and bolt that connects the stabilizer to the frame.



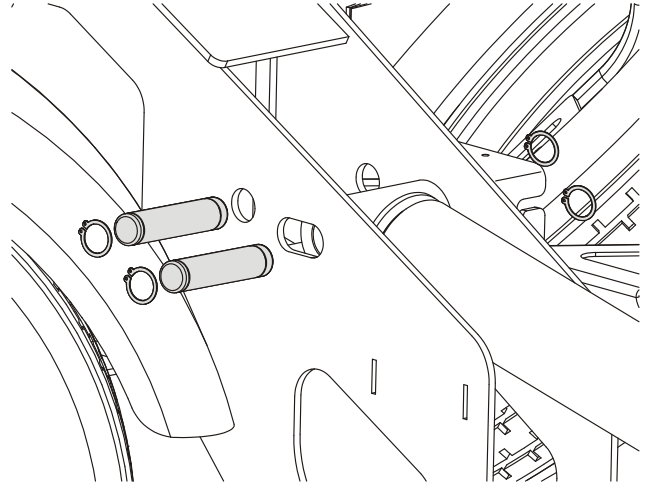
2. If removed, install the cylinder cover on the cylinder. Using an adequate lifting device, position the cylinder in place on the machine.

NOTE: The outrigger cylinder weighs approximately 48 lbs. (22 kg).

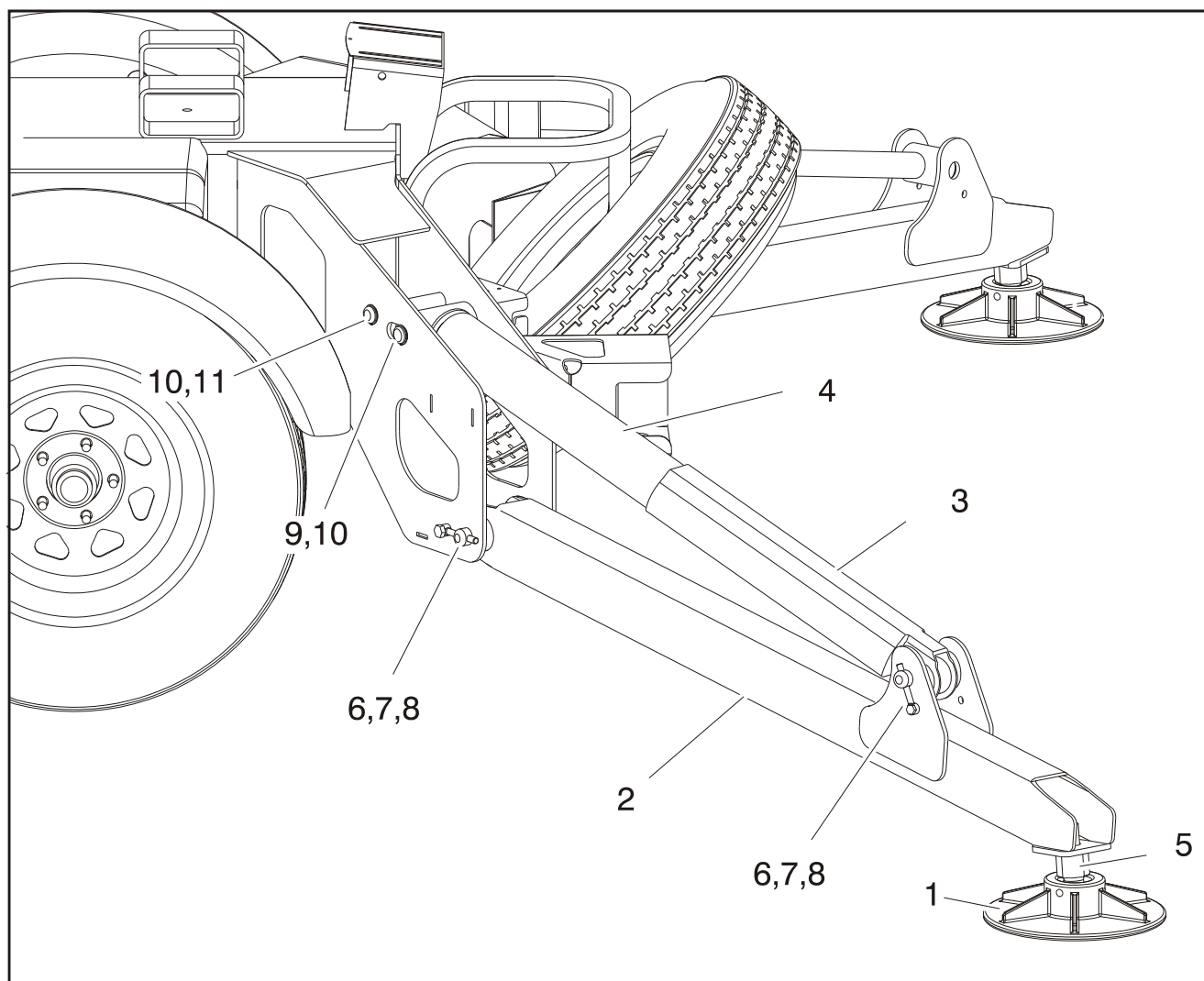
3. Install the bolt and keeper securing the pin at the pad end of the stabilizer and install the pin.



4. Lift the outrigger cylinder slightly up out of the frame to gain better access to the hydraulic lines running to the cylinder. Connect the lines to the cylinder as tagged during disassembly.
5. Install the outrigger pin and outrigger cam pin and secure in place with the retaining clips.



6. Using the analyzer and service mode, raise the outrigger.
7. Function the outriggers several times to check for proper operation and any leakage.



- | | |
|-------------------|-----------------------|
| 1. Outrigger Pad | 7. Keeper |
| 2. Stabilizer | 8. Pin |
| 3. Cylinder Cover | 9. Outrigger Pin |
| 4. Cylinder | 10. Retaining Cup |
| 5. Pad Rod | 11. Outrigger Cam Pin |
| 6. Bolt | |

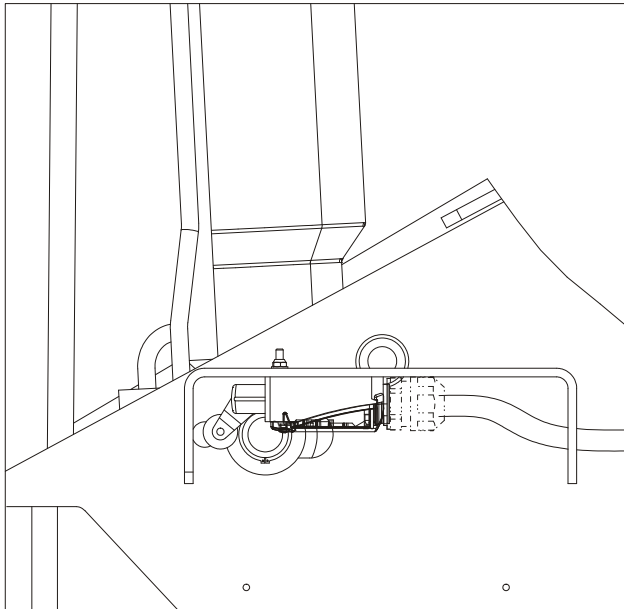
Figure 3-33. Outrigger Assembly

3.18 OUTRIGGER LIMIT SWITCHES

A mechanical limit switch at each outrigger senses the outrigger has been set. The control system reports status of each outrigger through the analyzer and also displays a solid lit LED at the ground control when set. All outriggers must be set prior to leveling. In addition, unset outriggers are reported to the controls system, and the machine functions will be cut back in the event two outriggers are unset or if one outrigger is unset and the machine is tilted ($>2.0^\circ$).

Adjustment

Adjust the limit switch position so the switch is activated when the outriggers are fully retracted (pin to the left side of the slot) as shown below and the switch resets when the outriggers are down and set (pin to the right side of the slot).



3.19 AUTOMATIC LEVELING SENSING SYSTEM

When all outriggers are set, the system looks at the angle reported by the bi-directional tilt sensor mounted on the ground board. The system automatically adjusts the outriggers until the chassis is level within 1.0° a compound angle prior to allowing operating the boom above elevation.

3.20 PROCEDURE FOR RETRACTING OUTRIGGERS USING SERVICE HARNESS (OPTIONAL)

NOTE: Outrigger harness P/N 4923341 is an accessory that must be purchased separately.

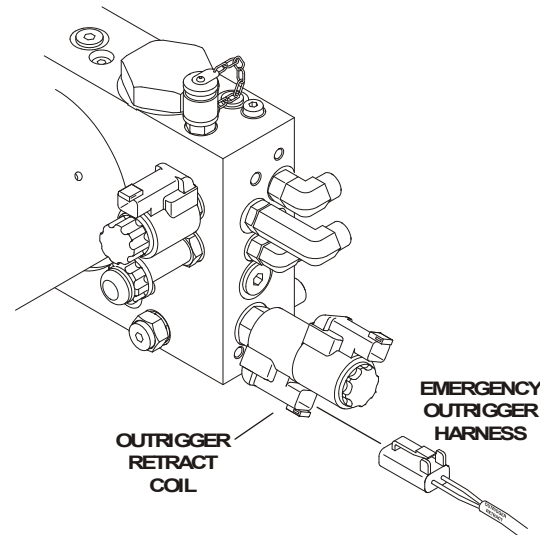
⚠ WARNING

TIP OVER HAZARD

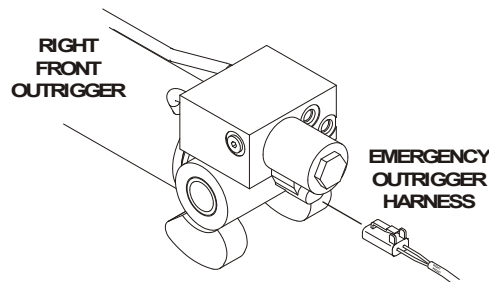
⚠ CAUTION

BEFORE RETRACTING THE OUTRIGGERS, MAKE SURE THE BOOM IS FULLY RETRACTED, LOWERED, AND SWUNG INTO STOWED POSITION. REMOVE ALL PERSONNEL FROM PLATFORM. REFER TO THE MACHINE OPERATION AND SAFETY MANUAL, SECTION 6, FOR THE MANUAL DESCENT PROCEDURES. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DEATH OR SERIOUS INJURY.

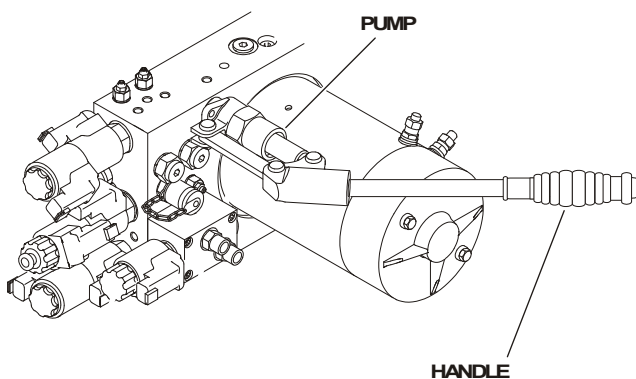
1. To begin the outrigger retract procedure, locate the outrigger retract coil wire connected to the control valve located in the valve compartment and disconnect the connector from coil.
2. Utilizing the service outrigger retract harness (JLG P/N 4923341), locate the wire labeled outrigger retract and plug into the outrigger retract connector on the control valve.



3. On the right front outrigger cylinder, remove the electrical connector from the electrical solenoid. Plug the service outrigger retract harness plug labeled right front outrigger into the outrigger cylinder connection.



4. Repeat step 3 for the left front, right rear, and left rear outriggers.
5. Power to operate the retract function can be supplied from any 12 volt power source. Connect the harness' red alligator clip to positive and the black alligator clip to negative.
6. Located on the harness is a push button switch. Pushing the switch will activate all five solenoids, the four on the outrigger cylinders and the one on the control valve. At this point the outriggers will automatically begin retracting until the tires and tongue jack are resting on the ground.
7. To complete the retraction of the outriggers, the hand pump located on the control valve must be utilized. The pump handle is located inside the valve compartment. Insert the handle into the pump jack on the control valve. Pump the handle until all outrigger are fully retracted. Remove the pump handle and store in the control valve compartment.



8. Disconnect the service outrigger harness from the four outriggers and control valve. Reconnect the wiring connectors to each cylinder's solenoid and the solenoid on the control valve.

3.21 DRIVE & SET

The Drive & Set Option is used to position the machine after it has been towed to the job site. Before the drive function can be operated, the machine must be in the stowed position and the hand brake set. The control system senses this by using a proximity switch on the frame to see that the boom is completely lowered, by the telescope limit switch to see that the boom is fully retracted, and by a proximity switch near the brake release cylinder to see that the brake is set.

Pushing down on the Drive Engagement Release Valve causes hydraulic oil to extend the Drive Engage Cylinder.

Hydraulic flow from the drive enable valve is routed to the flow divider which, in turn, provides flow to the Drive Directional Valve. The Drive Directional Valve receives electrical signals through the control system from the joystick in the platform to route the flow to the drive motors in the appropriate manner to achieve drive in the desired direction.

The Drive & Set system consists of the Propulsion Module, Drive Enable Valve, Drive Directional Valve, Flow Divider, Manual Pull Valve, Drive Motors, Drive Wheels, Brake Release Cylinder, and Drive Engage Cylinder.

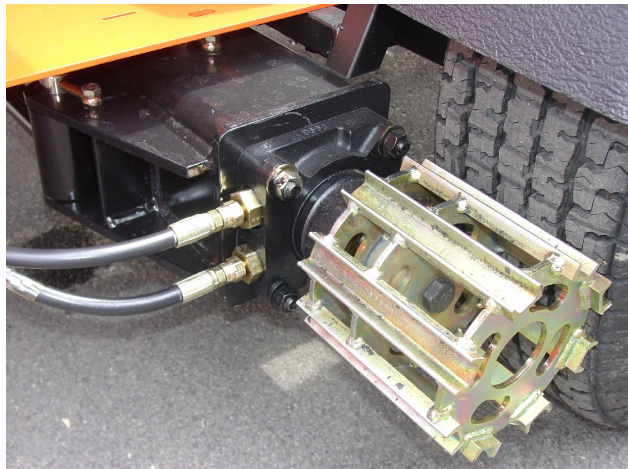
The Propulsion Module is located in the frame near the battery charger. It is used to control the Drive Directional Valve and the Drive Enable Valve. The module is connected to and communicates with the Ground Control Module through the CAN-BUS system.



The Drive Enable Valve sends oil to either the Main Valve Bank for boom functions or the Drive Directional Valve. A filter, check valve, priority flow valve, and relief valve are also housed in this manifold block.



The left and right Drive Motors are attached to Friction Drive Wheels. The Drive Engage Cylinder pushes the Drive Motor/ Friction Drive Wheel assembly against the trailer tires. The drive motors can turn in either direction for steering and positioning the machine.



In order to use Drive & Set, the following conditions must be met:

- The machine must be stowed
- Turntable position so basket is over tongue
- Telescoped fully in
- Boom not elevated
- Hand brake set

When driving, no boom functions are available.

To drive:

1. Satisfy position sensors
2. Turn Selector switch to drive or O/R set
3. Push the green enable button (no time limit to function start)
4. Pull the Enable trigger
5. Joystick must be moved within 7 seconds (after 7 seconds, begin with trigger switch again)

Drive & Set Interlocks

1. Turntable position switch

Proximity switch below the tower link (on boom rest) to sense boom is on rest. This switch will self monitor and be able to sense it is alive upon power up.

2. Hand brake set switch

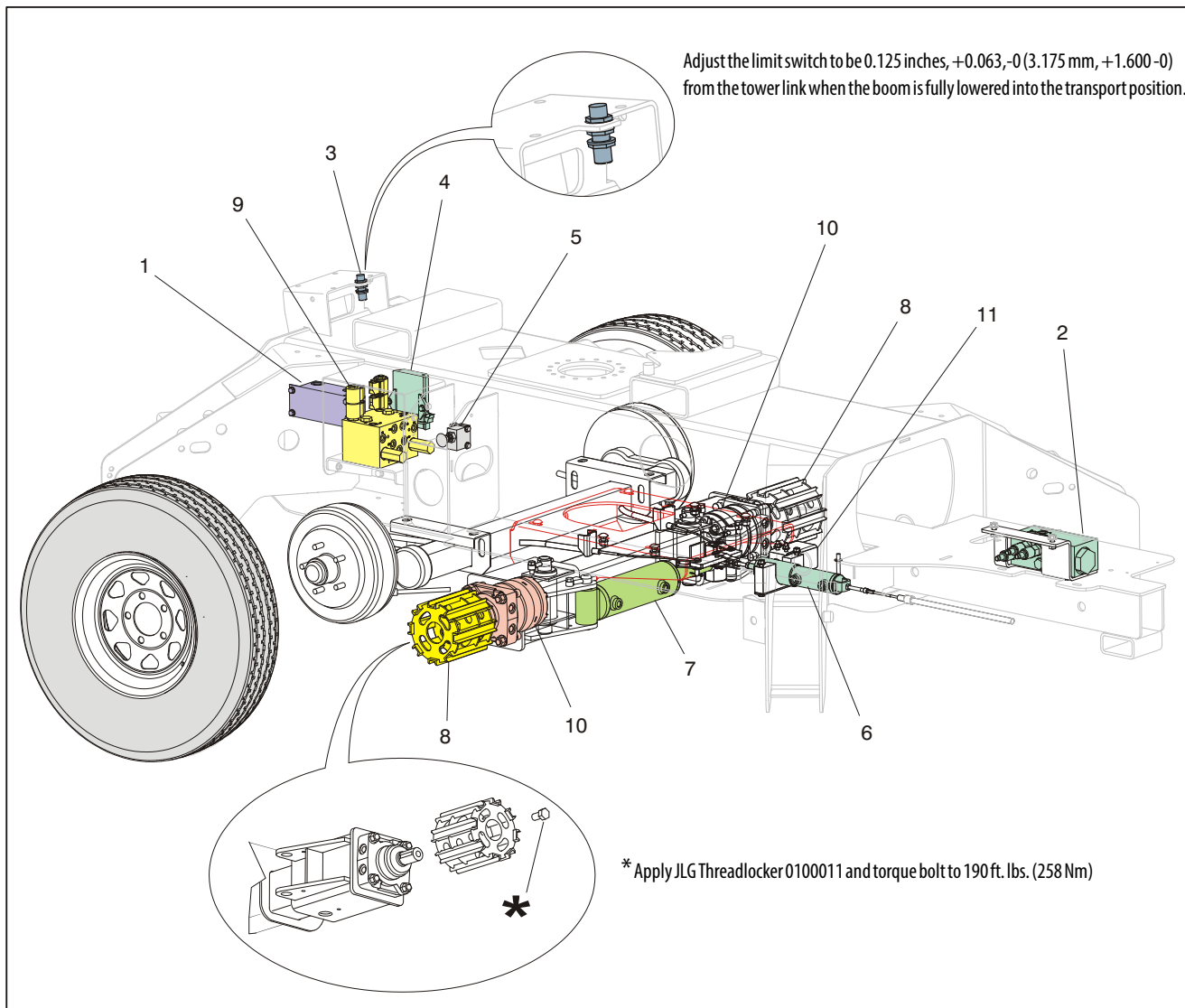
Proximity Switch to sense location of brake release cylinder.

3. Telescope Switch

Mechanical switch that can sense the boom is telescoped fully or in some position not fully telescoped.

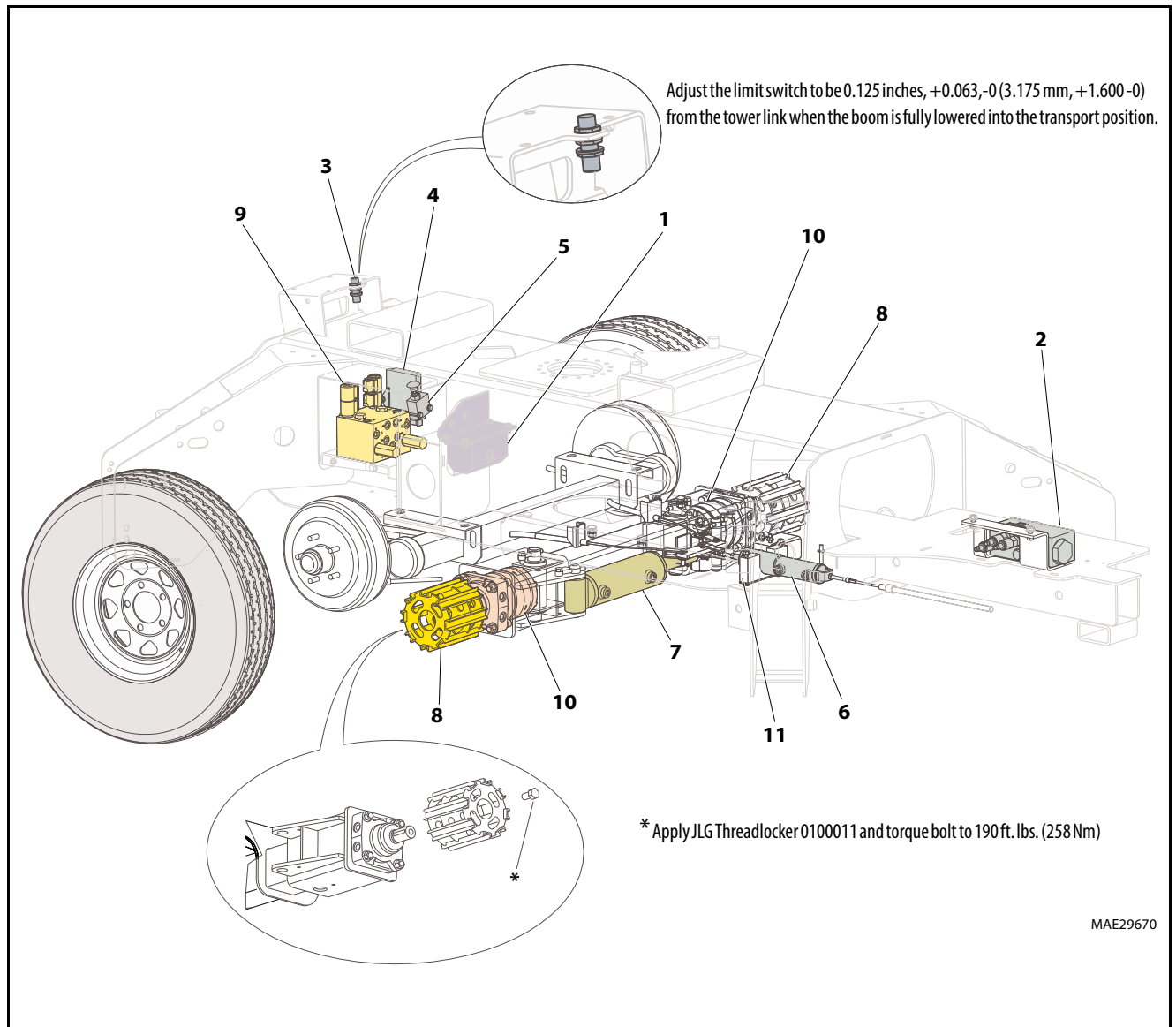
4. Elevation switch

Mechanical switch on the lift cylinder that can sense main boom above horizontal.



- | | | | |
|-----------------------|-----------------------------------|----------------------------|----------------------|
| 1. Flow Divider | 4. Propulsion Module | 7. Drive Engage Cylinder | 10. Drive Motor |
| 2. Drive Enable Valve | 5. Drive Engagement Release Valve | 8. Friction Drive Wheel | 11. Proximity Sensor |
| 3. Proximity Sensor | 6. Brake Release Cylinder | 9. Drive Directional Valve | |

Figure 3-34. Drive and Set - Sheet 1 of 3



- | | | | |
|-----------------------|-----------------------------------|----------------------------|----------------------|
| 1. Flow Divider | 4. Propulsion Module | 7. Drive Engage Cylinder | 10. Drive Motor |
| 2. Drive Enable Valve | 5. Drive Engagement Release Valve | 8. Friction Drive Wheel | 11. Proximity Sensor |
| 3. Proximity Sensor | 6. Brake Release Cylinder | 9. Drive Directional Valve | |

Figure 3-35. Drive and Set - Sheet 2 of 3

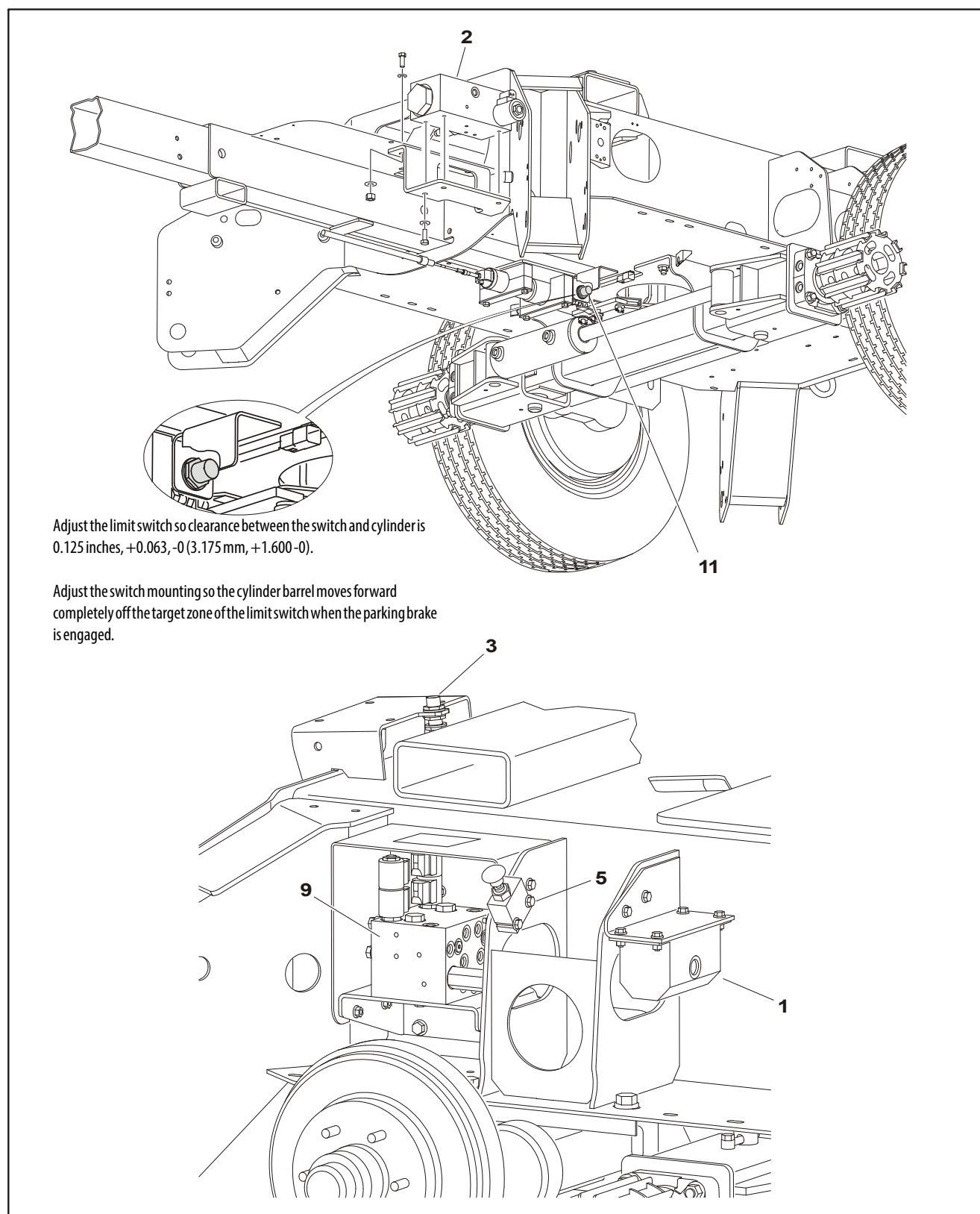


Figure 3-36. Drive and Set - Sheet 3 of 3

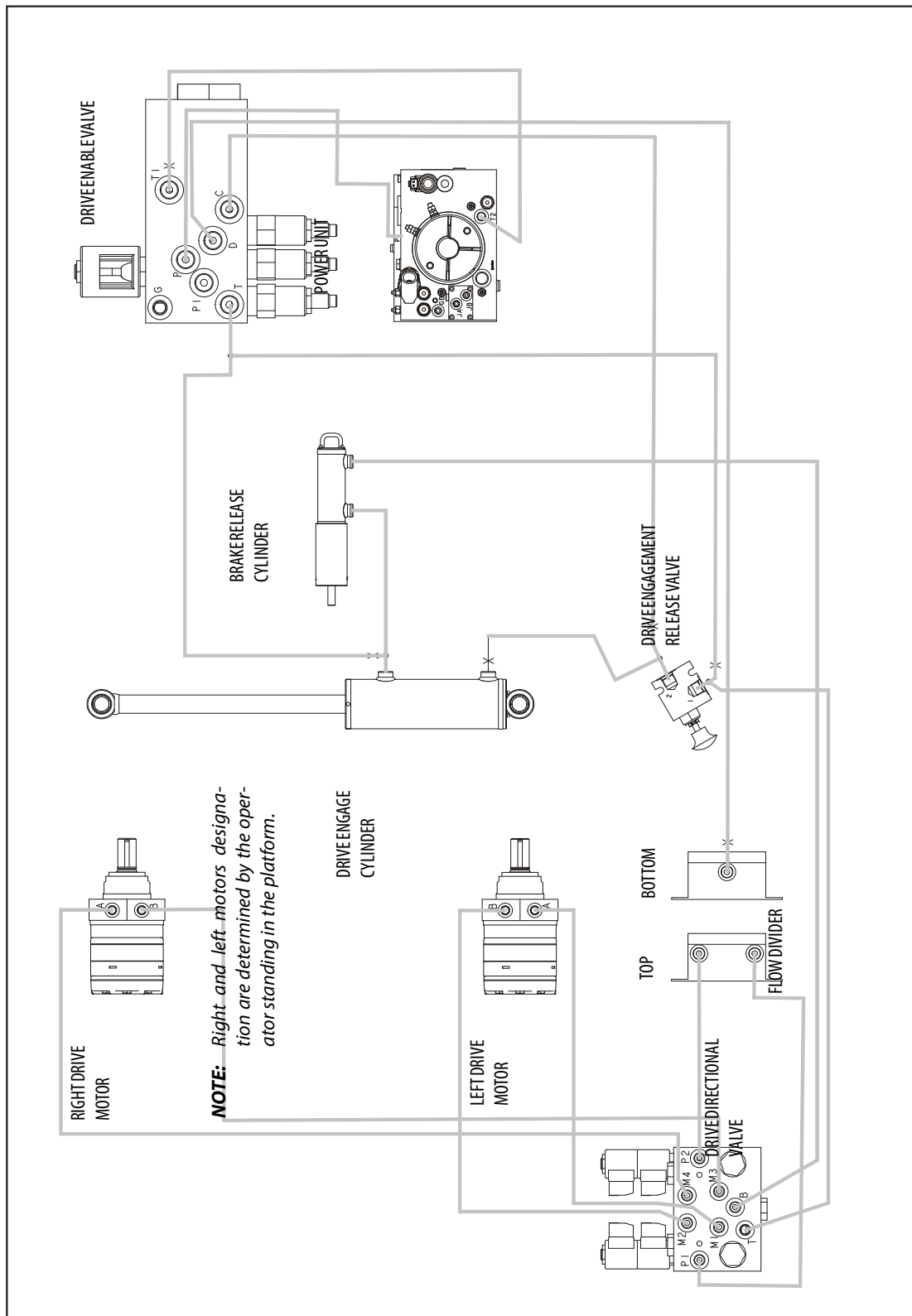


Figure 3-37. Drive and Set Circuit

3.22 WHEEL DRIVE

Removal

1. Tag and disconnect parking brake cables from machine.

NOTICE

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

2. Tag and disconnect the hydraulic lines from the drive motor. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Tag and disconnect the hydraulic lines from the drive engage cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
4. Remove hardware securing friction drive wheel. Remove friction drive wheel.
5. Remove drive engage cylinder. Refer Section 3.24, Drive Engage Cylinder.
6. Remove retaining bolt, keeper pin, and pin (1) securing drive set assembly. Remove drive set assembly from the machine.

NOTE: *The drive motor weighs approximately 34.5 lbs. (16 kg).*

7. Remove hardware securing drive motor to the spindle. Remove drive motor.
8. Place drive motor on suitable and clean workspace.

Installation

1. Align and install drive motor to spindle and secure with hardware.

NOTE: *The drive motor weighs approximately 34.5 lbs. (16 kg).*

2. Install pin (1), keeper pin, and retaining bolt securing drive set assembly.
3. Align and install friction drive wheel, secure with hardware. Torque to 190 ft. lbs. (258 Nm).
4. Install drive engage cylinder. Refer Section 3.24, Drive Engage Cylinder.
5. Reconnect all hydraulic lines as tagged during removal.
6. Reconnect parking brake cables to machine.

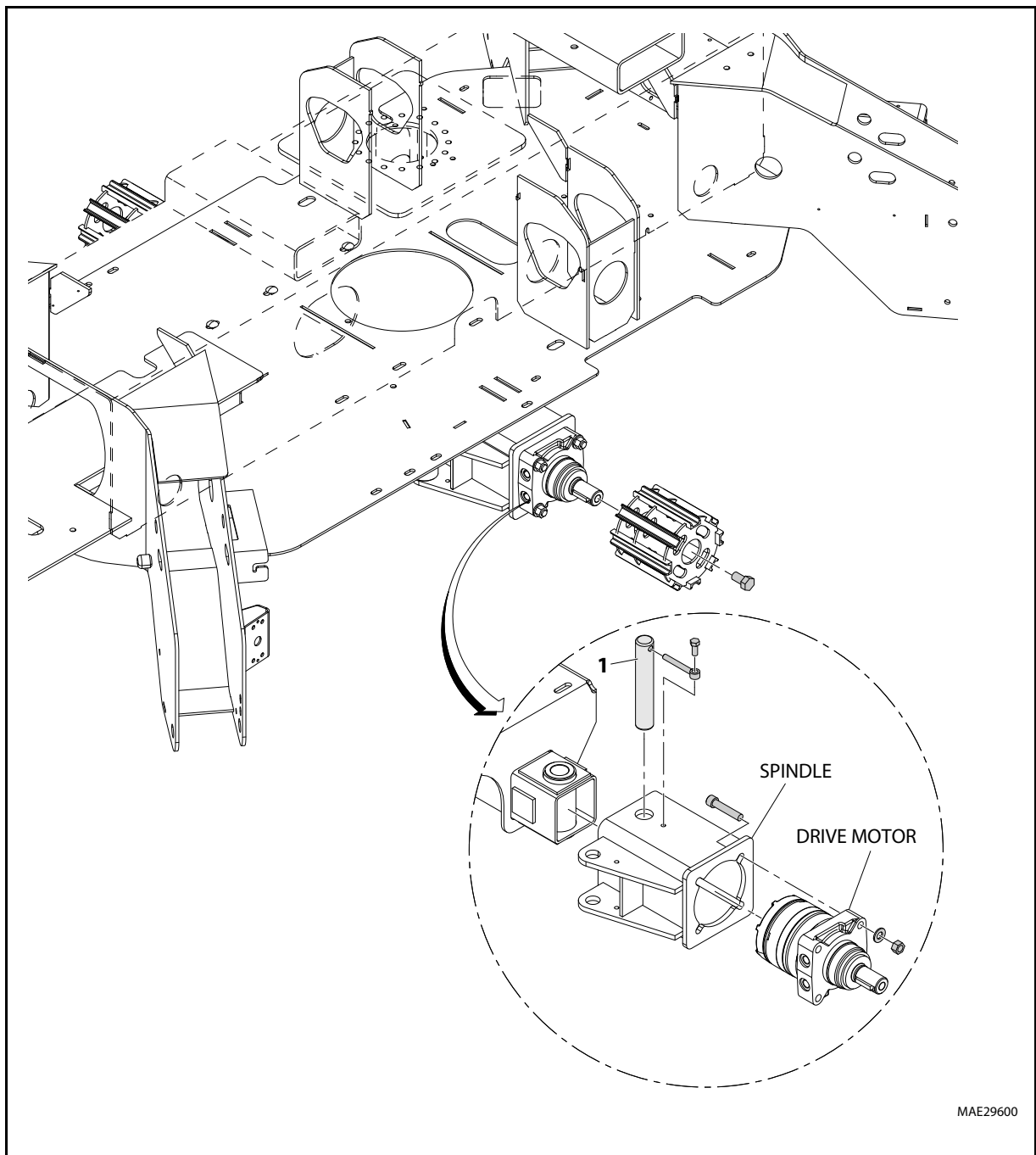
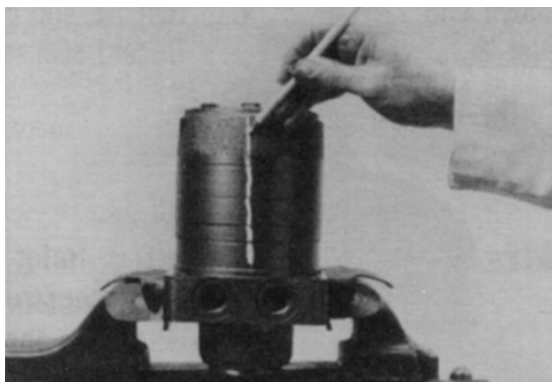


Figure 3-38. Wheel Drive - Removal and Installation

3.23 DRIVE MOTOR

Disassembly and Inspection

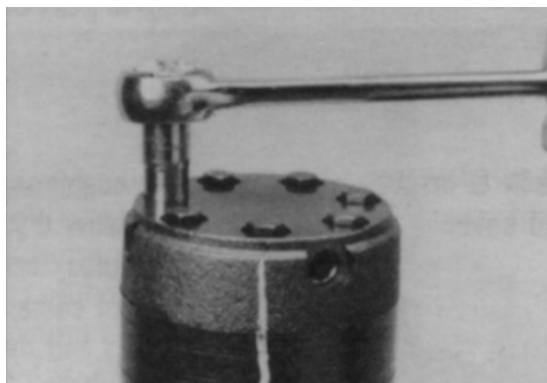
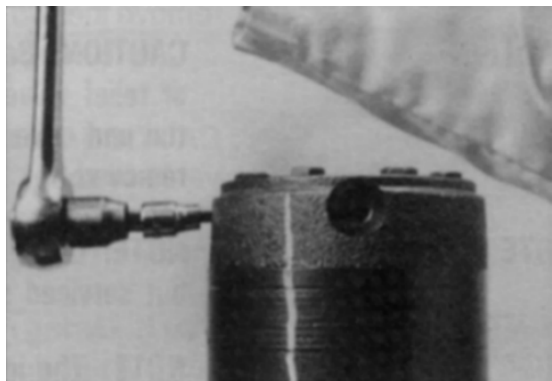
1. Place the Torqlink™ in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port o-rings if applicable.



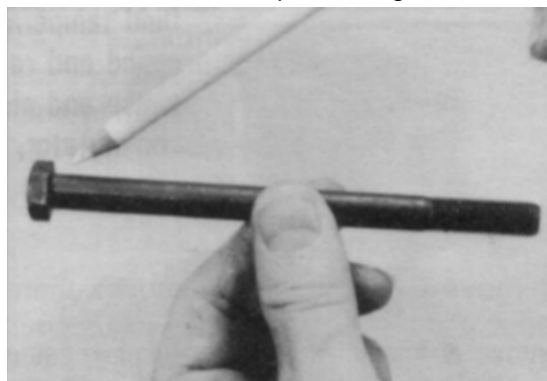
⚠ WARNING

IF THE TORQLINK™ 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 Torqlink™ components from end cover (2) to housing (18) to facilitate reassembly orientation where required. Loosen two shuttle or relief valve plugs for disassembly later if included in end cover. 3/16 or 3/8 inch Allen wrench or 1 inch hex socket required.



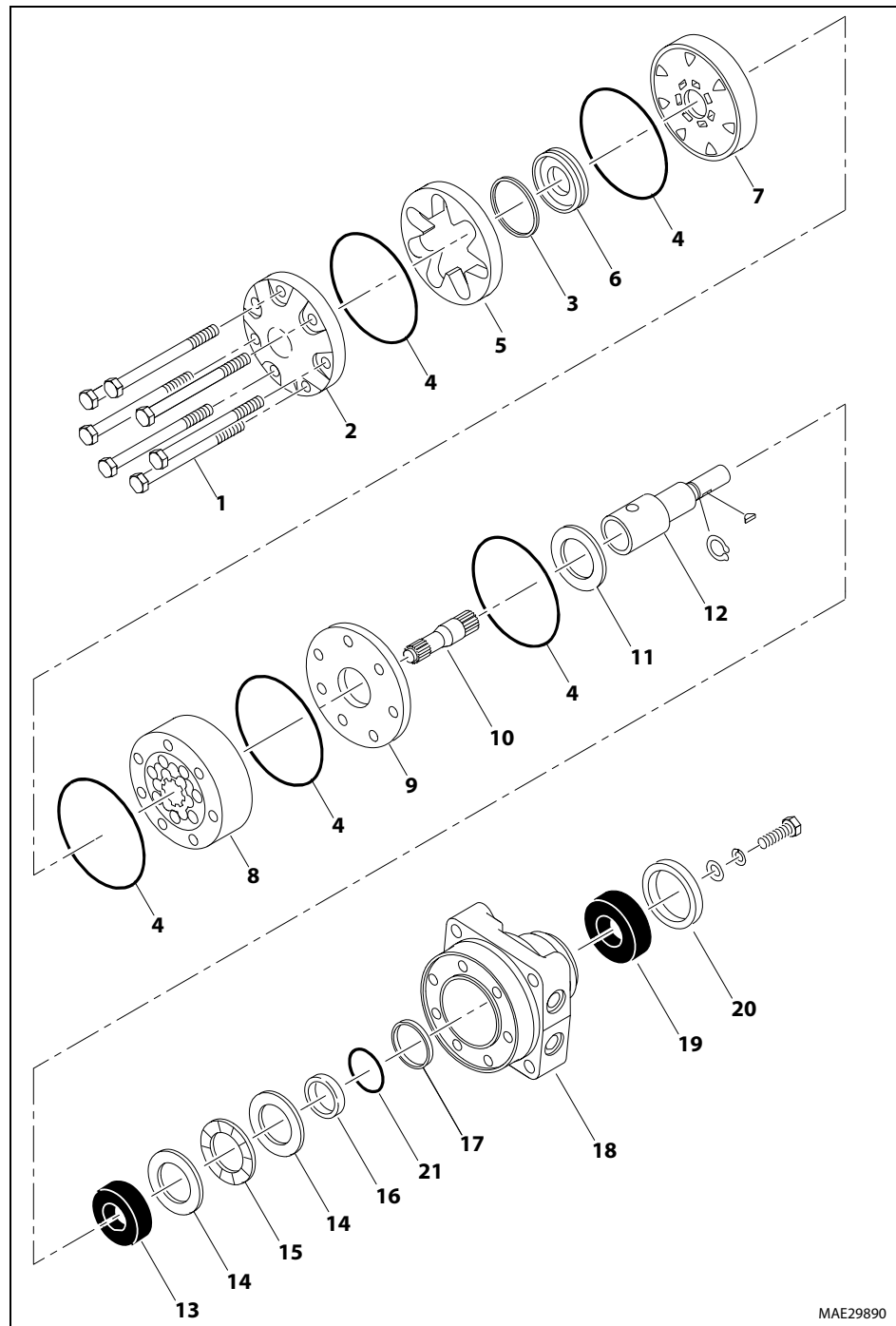
3. Remove the five, six, or seven special ring head bolts (1) using an appropriate 1/2 or 9/16 inch size socket. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts.



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



NOTE: Refer to the appropriate "alternate cover construction" on the exploded view to determine the end cover construction being serviced.

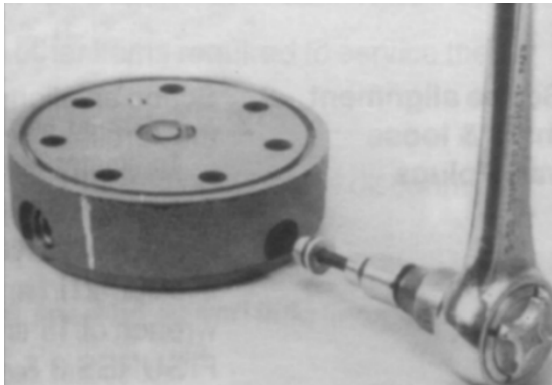


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- | | | | | |
|-------------------------|----------------|----------------------------|----------------------------|-------------------|
| 1. Special Bolts | 6. Commutator | 11. Thrust Bearing | 16. Seal | 21. Backup Washer |
| 2. End Cover | 7. Manifold | 12. Coupling Shaft | 17. Back-up Washer | |
| 3. Seal Ring-Commutator | 8. Rotor Set | 13. Bearing/Bushing, Inner | 18. Housing | |
| 4. Seal Ring | 9. Wear Plate | 14. Thrust Washer | 19. Bearing/Bushing, Outer | |
| 5. Commutator Ring | 10. Drive Link | 15. Thrust Bearing | 20. Dirt & Water Seal | |

Figure 3-39. Wheel Drive Motor

5. If the end cover (2) is equipped with shuttle valve components, remove the two previously loosened plugs.

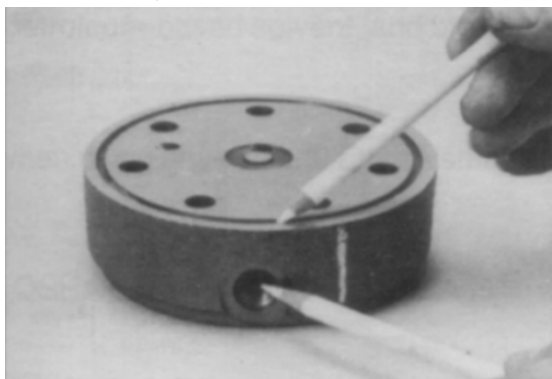


NOTICE

BE READY TO CATCH THE SHUTTLE VALVE OR RELIEF VALVE COMPONENTS THAT WILL FALL OUT OF THE END COVER VALVE CAVITY WHEN THE PLUGS ARE REMOVED.

NOTE: The insert and if included the orifice plug in the end cover (2) must not be removed as they are serviced as an integral part of the end cover.

6. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures, including the internal orifice plug, 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.

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



8. 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.



9. 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 them an if old to ensure that same surface is reassembled against the rotor set.

10. Remove rotor set (8) and wear plate (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 wear plate. You may have to shift the rotor set on the wear plate to work the drive link out of the rotor and wear plate. 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 wear plate for cracks, brinelling, or scoring. Discard seal ring (4) that is between the rotor set and wear plate.



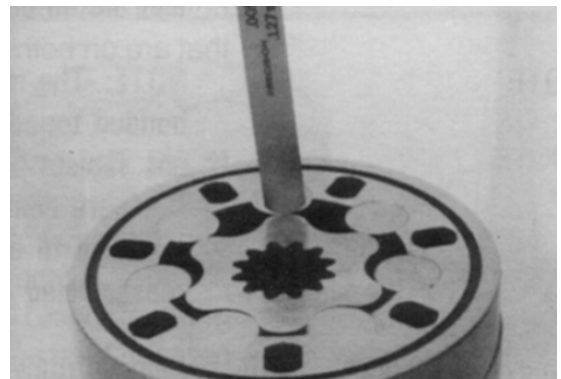
NOTE: The rotor set (8) components may become disassembled during service procedures. Marking the surface of the rotor and stator that is facing UP, with etching ink or grease pencil before removal from Torqlink™ will ensure correct reassembly of rotor into stator and rotor set into Torqlink™. Marking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



NOTE: Series TG Torqlinks™ may have a rotor set with two stator halves with a seal ring (4) between them and two sets of seven vanes. Discard seal ring only if stator halves become disassembled during the service procedures.

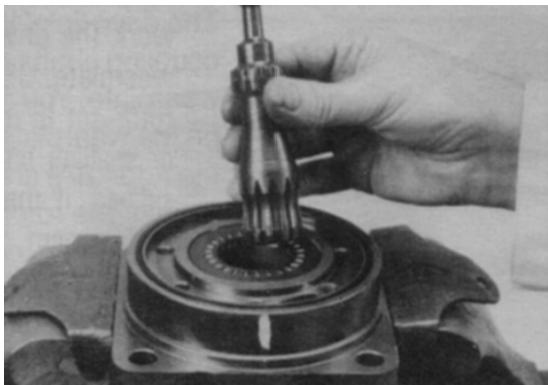
NOTE: A polished pattern on the wear plate from rotor rotation is normal.

11. 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 gauge 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 in the alternate construction TG rotor set assembly view, check the rotor lobe to roller vane clearance at both ends of rotor.

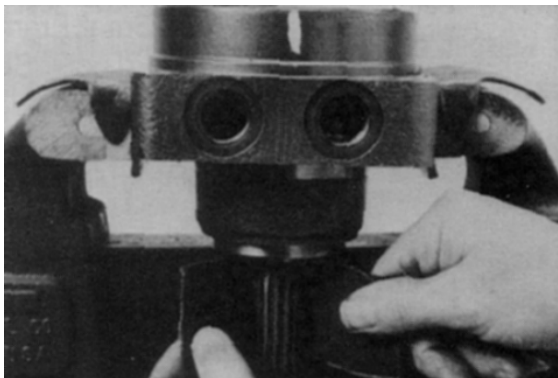
12. Remove drive link (10) from coupling shaft (12) if it was not removed with rotor set and wear plate. Inspect drive link for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. Remove and discard seal ring (4) from housing (18).



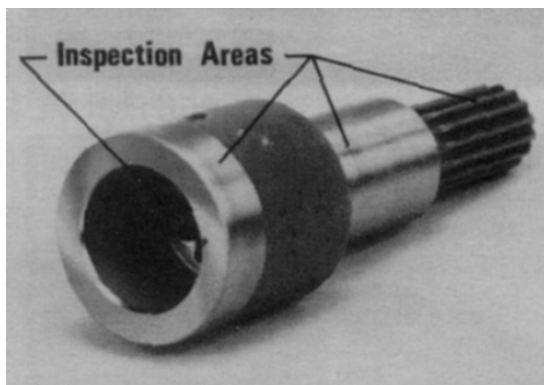
13. Remove thrust bearing (11) from top of coupling shaft (12). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.



14. 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.



15. 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.

16. Remove and discard seal ring (4) from housing (18).
17. Remove thrust bearing (15) and thrust washer (14). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.



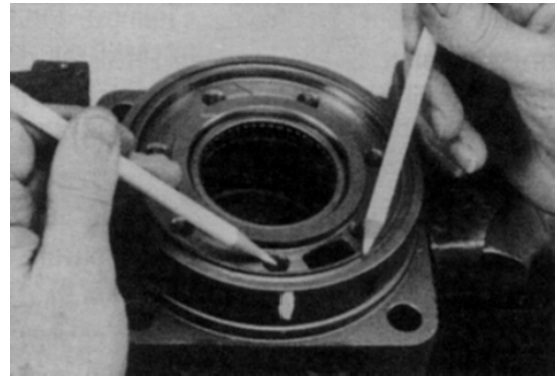
18. Remove and Discard seal (16) and backup washer (17) from small frame, housing (18).



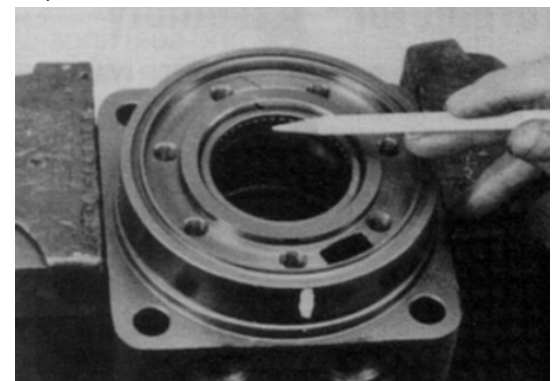
19. Remove housing (18) from vise, invert it and remove and discard seal (20). A blind hole bearing or seal puller is required.

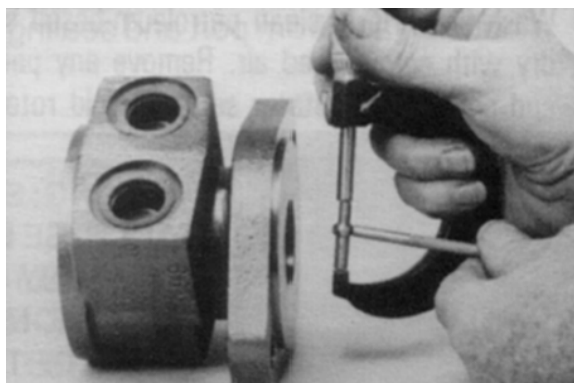


20. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly.

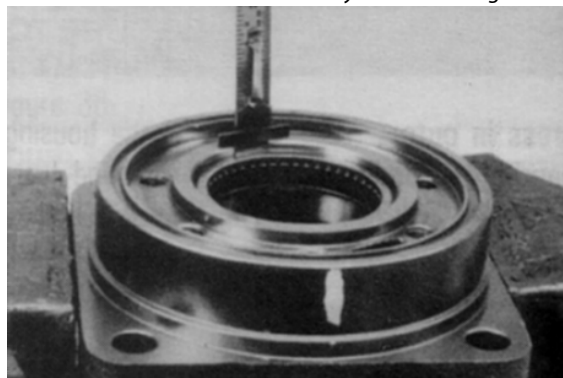


21. If the housing (18) assembly has passed inspection to this point, inspect the housing bearings/bushings (19) and (13) and if they are captured in the housing cavity the two thrust washers (14) and thrust bearing (15). The bearing rollers must be firmly retained in the bearing cages, but must rotate 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 Torqlink™ is completed.

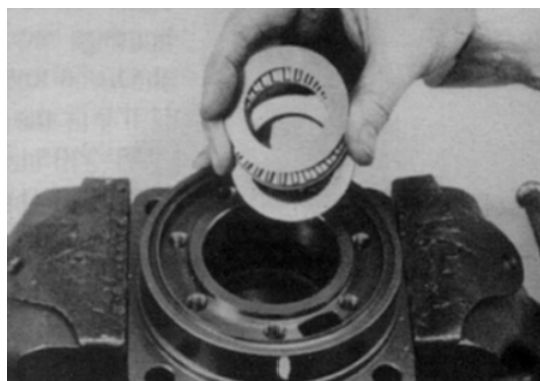
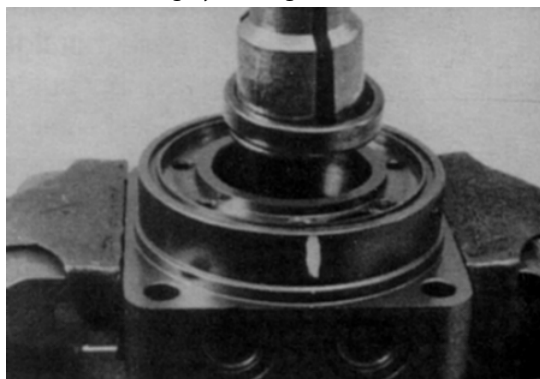




NOTE: The depth or location of bearing/bushing (13) in relation to the housing wear plate surface and the depth or location of bearing/bushing (19) in relation to the beginning of bearing/bushing counter bore should be measured and noted before removing the bearings/ bushings. This will facilitate the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



22. 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 Torqlink™ unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.

NOTE: Individual seals and seal rings as well as a complete seal kit are available. The parts should be available through most OEM parts distributors or Parker approved Torqlink™ distributors. (Contact your local dealer for availability).

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, which will control the bearing/ bushing depth.

Torqlink™ housings require 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.



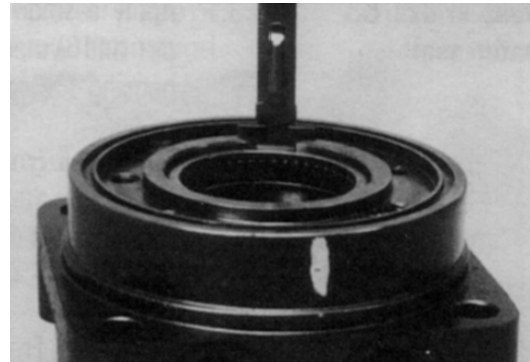
NOTE: Bearing mandrel must be pressed against the lettered end of bearing shell. Take care that the housing bore is square with the press base and the bearing/bushing is not cocked when pressing a bearing/bushing into the housing.

NOTICE

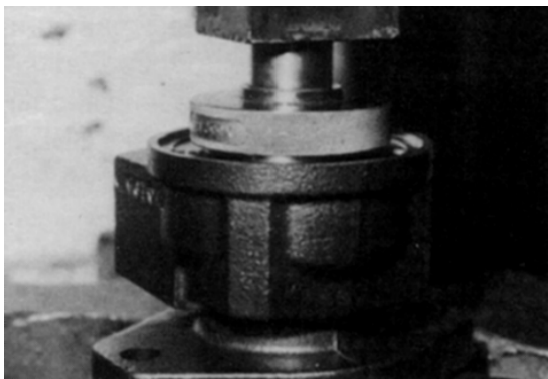
IF THE BEARING MANDREL SPECIFIED IN THE "TOOLS AND MATERIALS REQUIRED FOR SERVICING" SECTION IS NOT AVAILABLE AND ALTERNATE METHODS ARE USED TO PRESS IN BEARING/BUSHING (13) AND (19) THE BEARING/BUSHING DEPTHS SPECIFIED MUST BE ACHIEVED TO INSURE ADEQUATE BEARING SUPPORT AND CORRECT RELATIONSHIP TO ADJACENT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

NOTICE

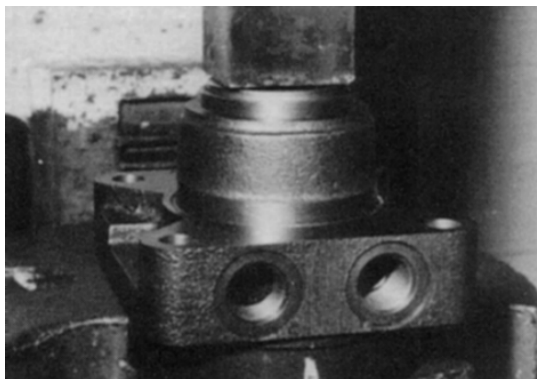
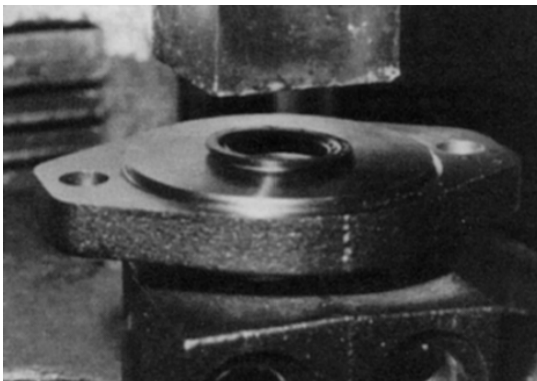
BECAUSE THE BEARING/BUSHINGS (13) AND (19) HAVE A PRESS FIT INTO THE HOUSING THEY MUST BE DISCARDED WHEN REMOVED. THEY MUST NOT BE REUSED.



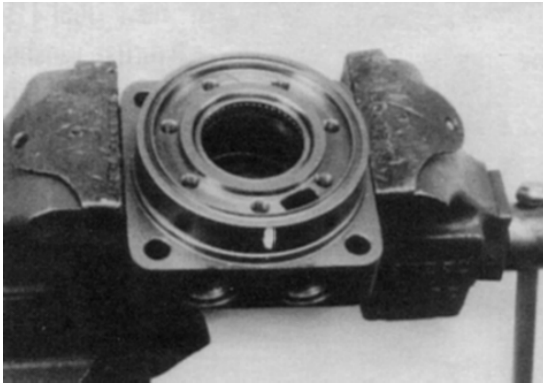
2. The Torqlink™ inner housing bearing/bushing (13) can now be pressed into its counterbore in housing (18) flush to 0.03 inch (0.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19).



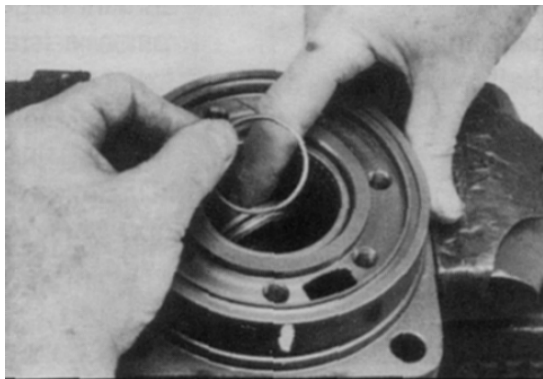
3. Press a **new** dirt and water seal (20) into the housing (18) outer bearing counterbore.
The Torqlink™ dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



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



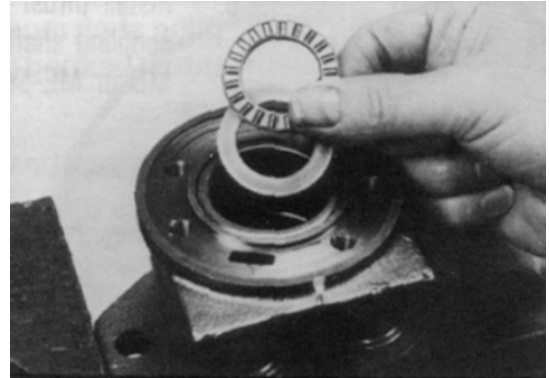
5. On the Torqlinks™ assemble a **new** backup washer (17) and **new** seal (16) with the seal lip facing toward the inside of Torqlink™, into their respective counterbores in housing (18) if they were not assembled in procedure 2.



NOTICE

ORIGINAL DESIGN LARGE FRAME, TF & TG TORQLINKS™ THAT DO NOT HAVE BACKUP WASHER (21) WHEN DISASSEMBLED MUST BE ASSEMBLED WITH A NEW BACKUP WASHER (17), NEW BACKUP WASHER (21), AND NEW SEAL (16).

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

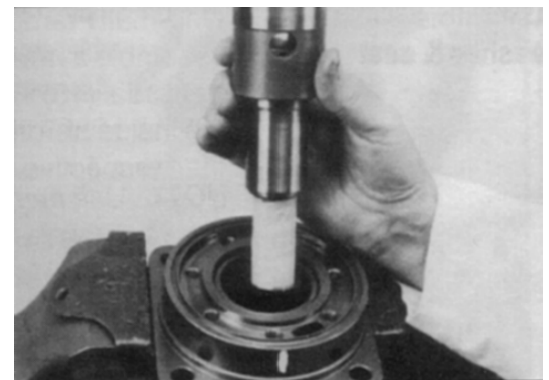


NOTE: Torqlinks™ require one thrust washer (14) with thrust bearing (15). The coupling shaft will be seated directly against the thrust

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) in the housings.



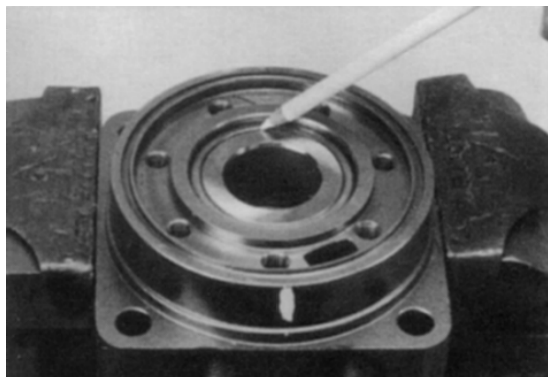
NOTICE

THE OUTER BEARING (19) IS NOT LUBRICATED BY THE SYSTEM'S HYDRAULIC FLUID. BE SURE IT IS THOROUGHLY PACKED WITH THE RECOMMENDED GREASE, PARKER GEAR GREASE SPECIFICATION #045236, E/M LUBRICANT #K-70M.

NOTE: Mobil Mobilith SHC® 460

NOTE: A 102Tube (P/N 406010) is included in each seal kit.

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



9. Install thrust bearing (11) onto the end of coupling shaft (12).

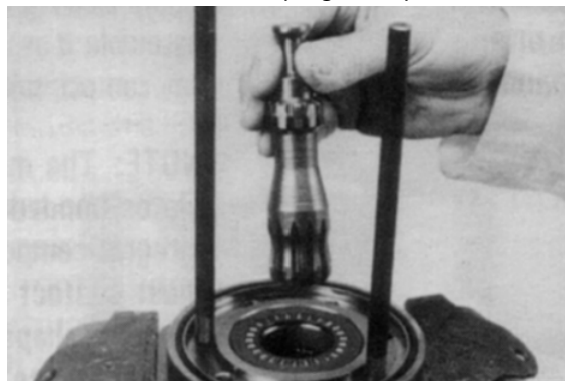


10. Apply a small amount of clean grease to a **new** seal ring (4) and insert it into the housing (18) seal ring groove.



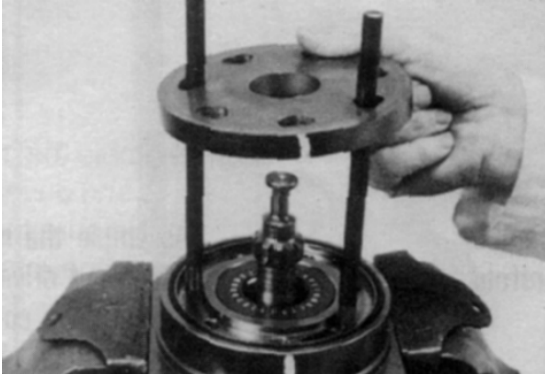
NOTE: One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF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

11. 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.

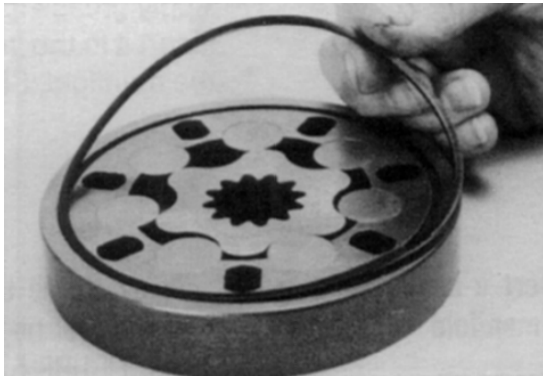


NOTE: Use any alignment marks put on the coupling shaft and drive link before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

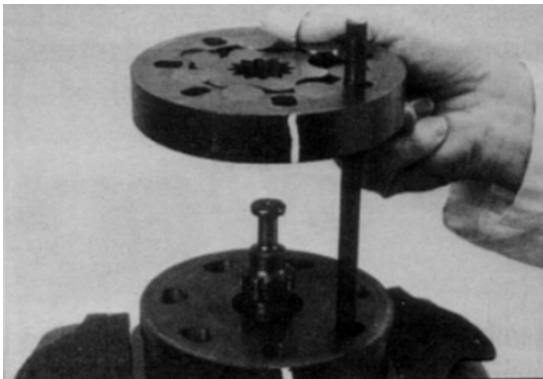
12. Assemble wear plate (9) over the drive link (10) and alignment studs onto the housing (18).



13. 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.



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

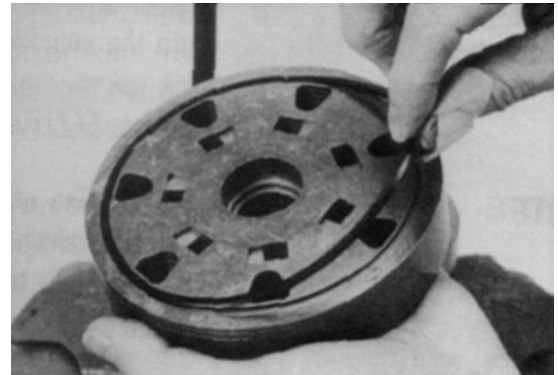


NOTE: It may be necessary to turn one alignment stud out of the housing (18) temporarily to assemble rotor set (8) or manifold (7) over the drive link.

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

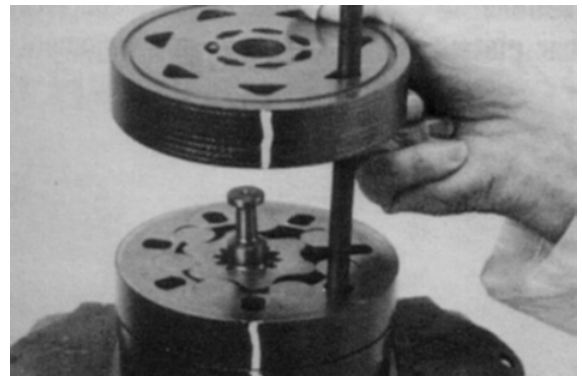
NOTE: The rotor set rotor counter bore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counter bore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the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

15. 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).

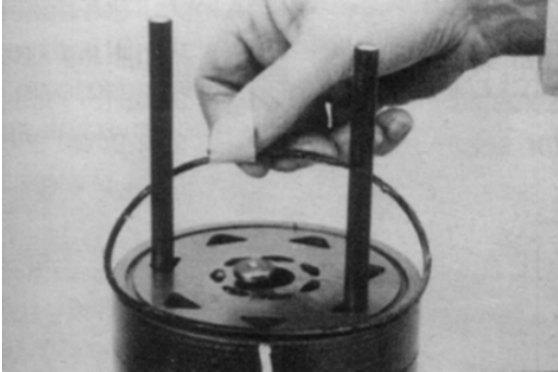


NOTE: The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left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

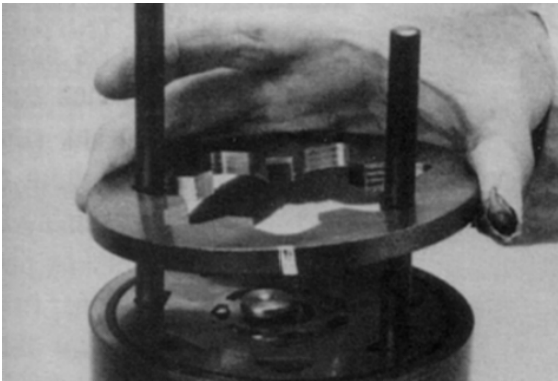
16. Assemble the manifold (7) over the alignment studs and drive link (10) and onto the rotor set. Be sure the correct manifold surface is against the rotor set.



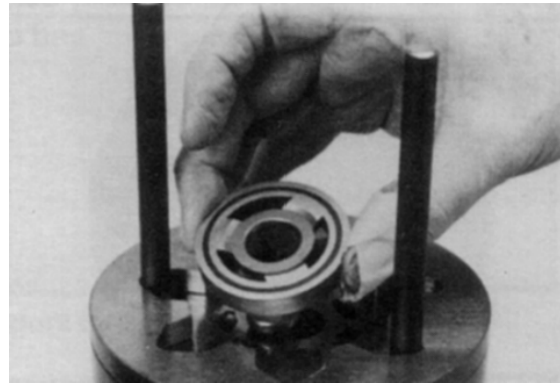
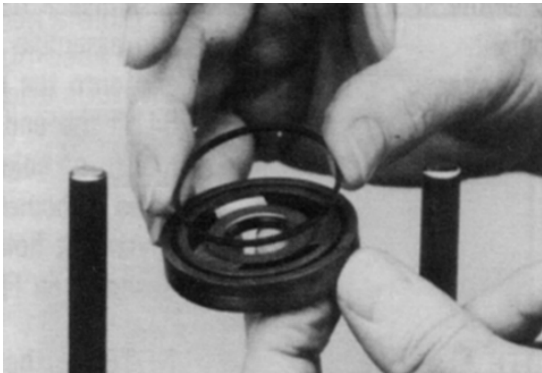
17. Apply grease to a **new** seal ring (4) and insert it in the seal ring groove exposed on the manifold.



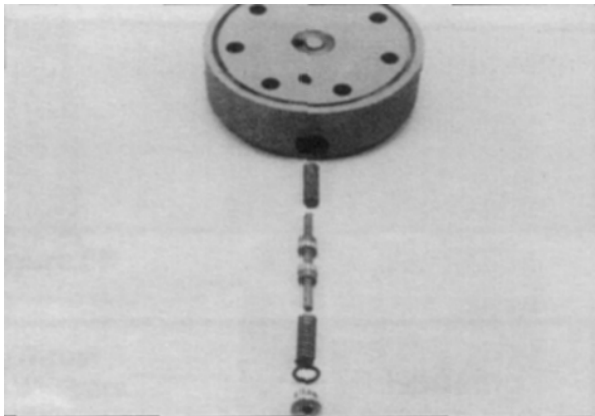
18. Assemble the commutator ring (6) over alignment studs onto the manifold.



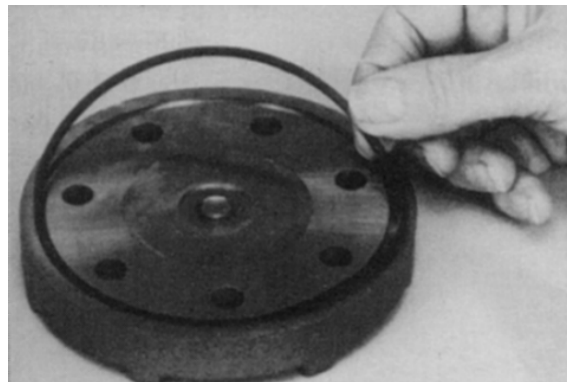
19. Assemble a **new** seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.

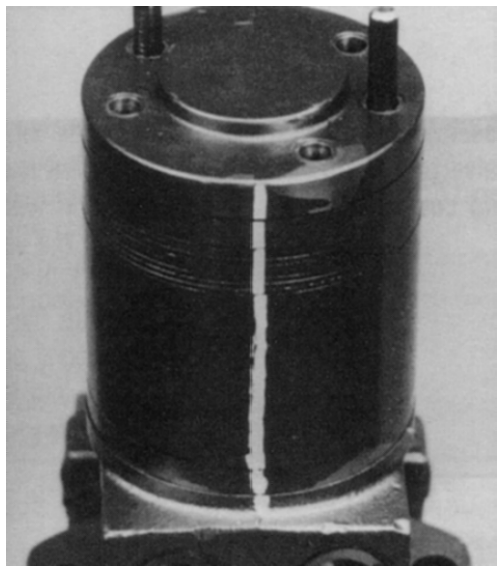
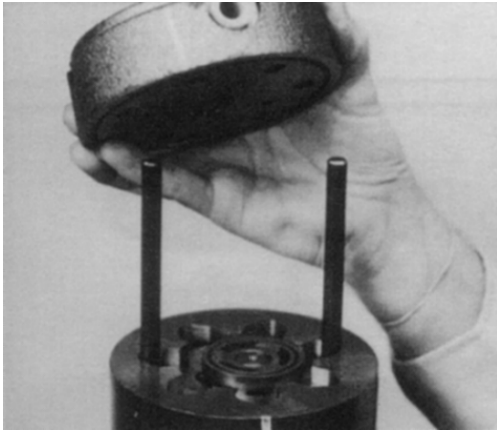


20. If shuttle valve components items #21, were removed from the end cover (2) turn a plug, loosely into one end of the valve cavity in the end cover. A 3/16 inch Allen wrench is required.



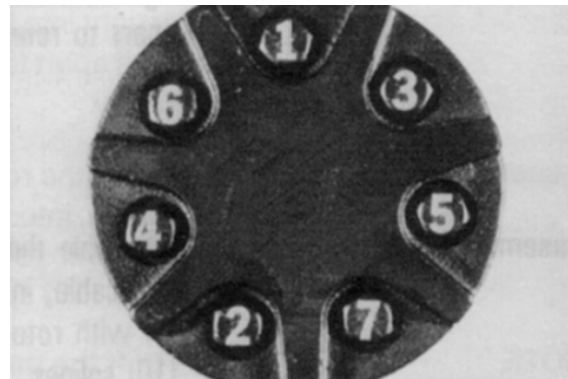
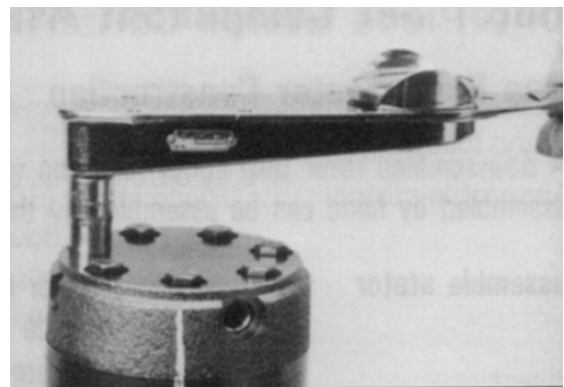
21. Assemble a **new** seal ring (4) into end cover (2) and assemble end cover over the alignment studs and onto the commutator set. If the end cover has only 5 bolt holes be sure the cover holes are aligned with the 5 threaded holes in housing (18). The correct 5 bolt end cover bolt hole relationship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





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

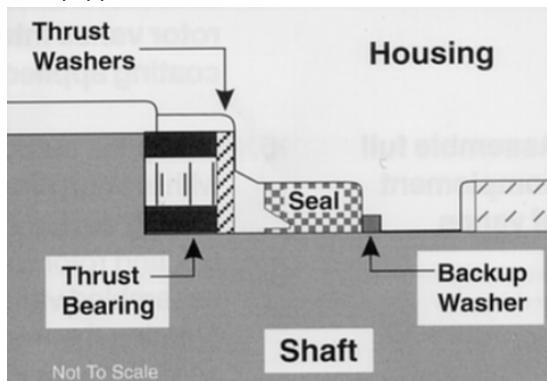
22. Assemble the 5 or 7 special bolts (1) and screw in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 22-26 ft. lbs. 45-55 ft. lbs. (61-75 Nm) for the seven 3/8-24 threaded bolts.



NOTE: The special bolts required for use with the relief or shuttle valve end cover assembly (2) are longer than the bolts required with standard and cover assembly. Refer to the individual service parts lists or parts list charts for correct service part number if replacement is required.

23. Torque the two shuttle valve plug assemblies in end cover assembly to 9-12 ft. lbs. (12-16 Nm) if cover is so equipped.

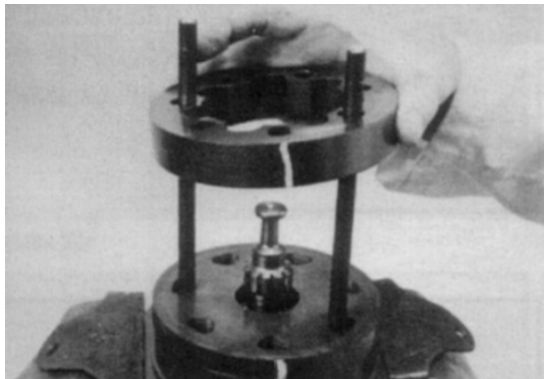
Torque the two relief valve plug assemblies in end cover assembly to 45-55 ft. lbs. (61-75 Nm) if cover is so equipped.



One Piece Stator Construction

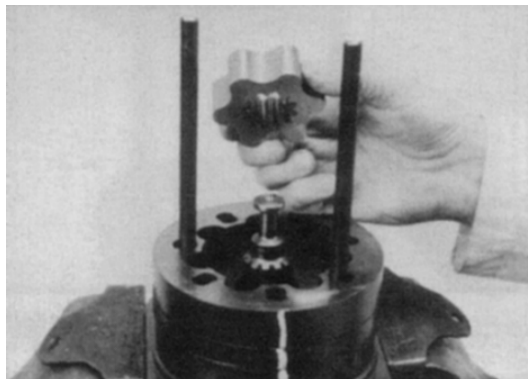
A disassembled rotor stator and vanes that cannot be readily assembled by hand can be assembled by the following procedures.

1. Place stator onto wear plate (9) with seal ring (4) side down, after following Torqlink™ 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.



NOTE: If the manifold side of the rotor was etched during Torqlink disassembly, this side should be up. If the rotor is not etched and does not have a counterbore, use the drive link spline contact pattern apparent on the rotor splines to determine the rotor side that must be against the wear plate.

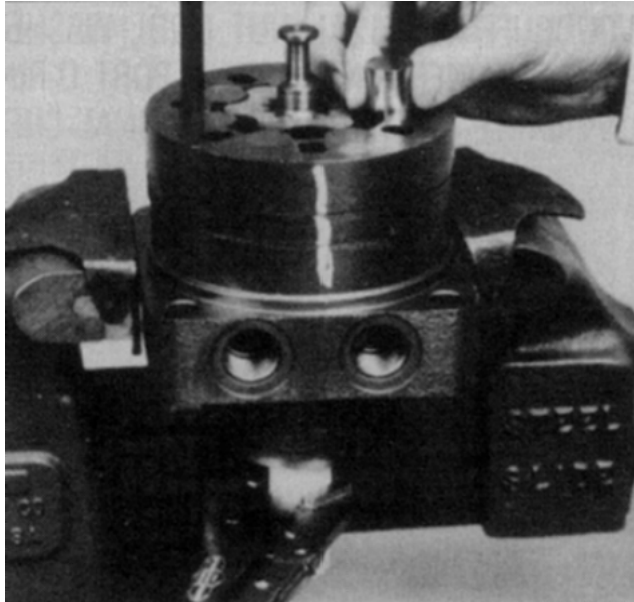
4. Assemble six vanes, or as many vanes that will readily assemble into the stator vane pockets.



NOTICE

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.

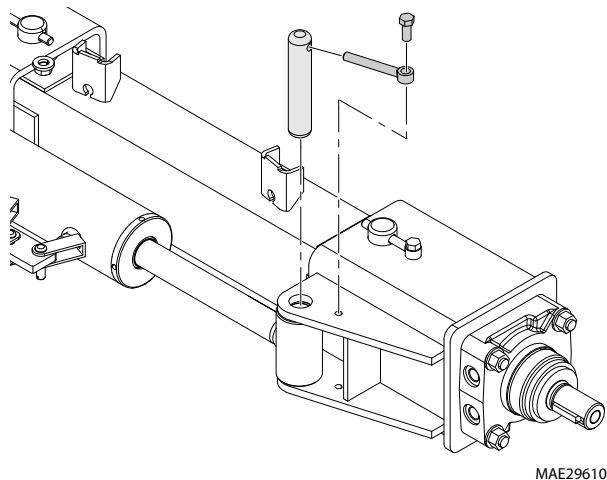
3.24 DRIVE ENGAGE CYLINDER

Removal

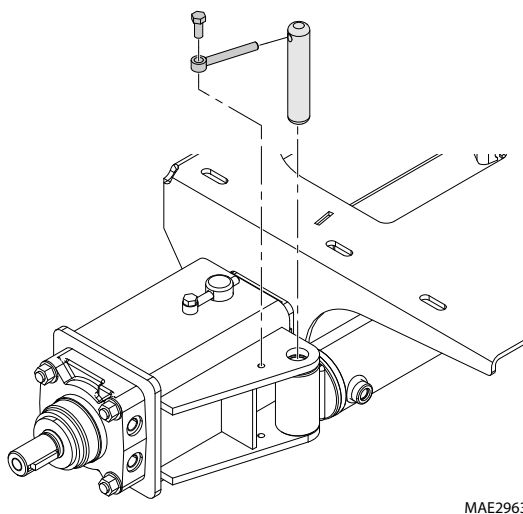
1. Tag and disconnect the hoses running to the drive engage cylinder. Cap or plug all openings.
2. Using an adequate supporting device, support the drive engage cylinder so it doesn't fall when the pin is removed.

NOTE: The drive engage cylinder weighs approximately 26 lbs. (12 kg).

3. Remove the retaining pins and pivot pin from the rod end of the cylinder.

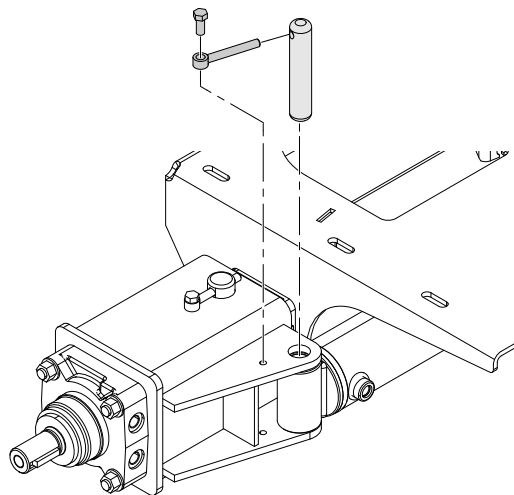


4. Remove the retaining pins and pivot pin from the barrel end of the cylinder and remove the cylinder from the machine.



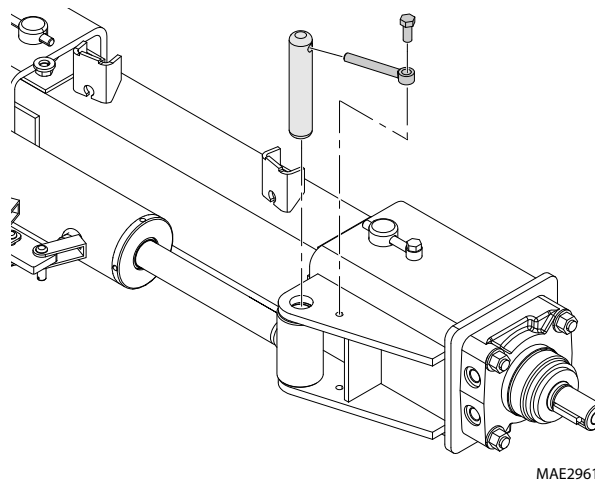
Installation

1. Using suitable lifting device, lift the drive engage cylinder into position and install the pivot pin and retaining pin into the barrel end of the cylinder.



NOTE: The drive engage cylinder weighs approximately 26 lbs. (12 kg).

2. Install the pivot pin and retaining pin into the rod end of the cylinder.



3. Connect the hydraulic hoses to the drive engage cylinder as tagged during removal.
4. Cycle the drive engage cylinder several times to check for proper operation and any leakage.

3.25 BATTERIES (ELECTRIC MACHINES)

The electrical system is a 24 volt system, supplied by four, six volt, 220 amp-hour batteries. Two batteries are located on the right side of the frame and two are located on the left side. A gray quick disconnect is used to disconnect electrical power between the batteries and the machine if needed.

NOTE: Battery weight is important for stability. Each battery weighs 59 lbs. (26.8 kg). Do not use batteries that are not approved by JLG.

WARNING

IF REPLACING A BATTERY, EACH NEW BATTERY MUST WEIGH AT LEAST 59 LBS (26.8 KG). FAILURE TO REPLACE THE BATTERY WITH ONE OF THE CORRECT WEIGHT WILL RESULT IN A TIPOVER HAZARD WHICH COULD RESULT IN SERIOUS INJURY OR DEATH.

Quarterly Battery Maintenance

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

NOTICE

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.

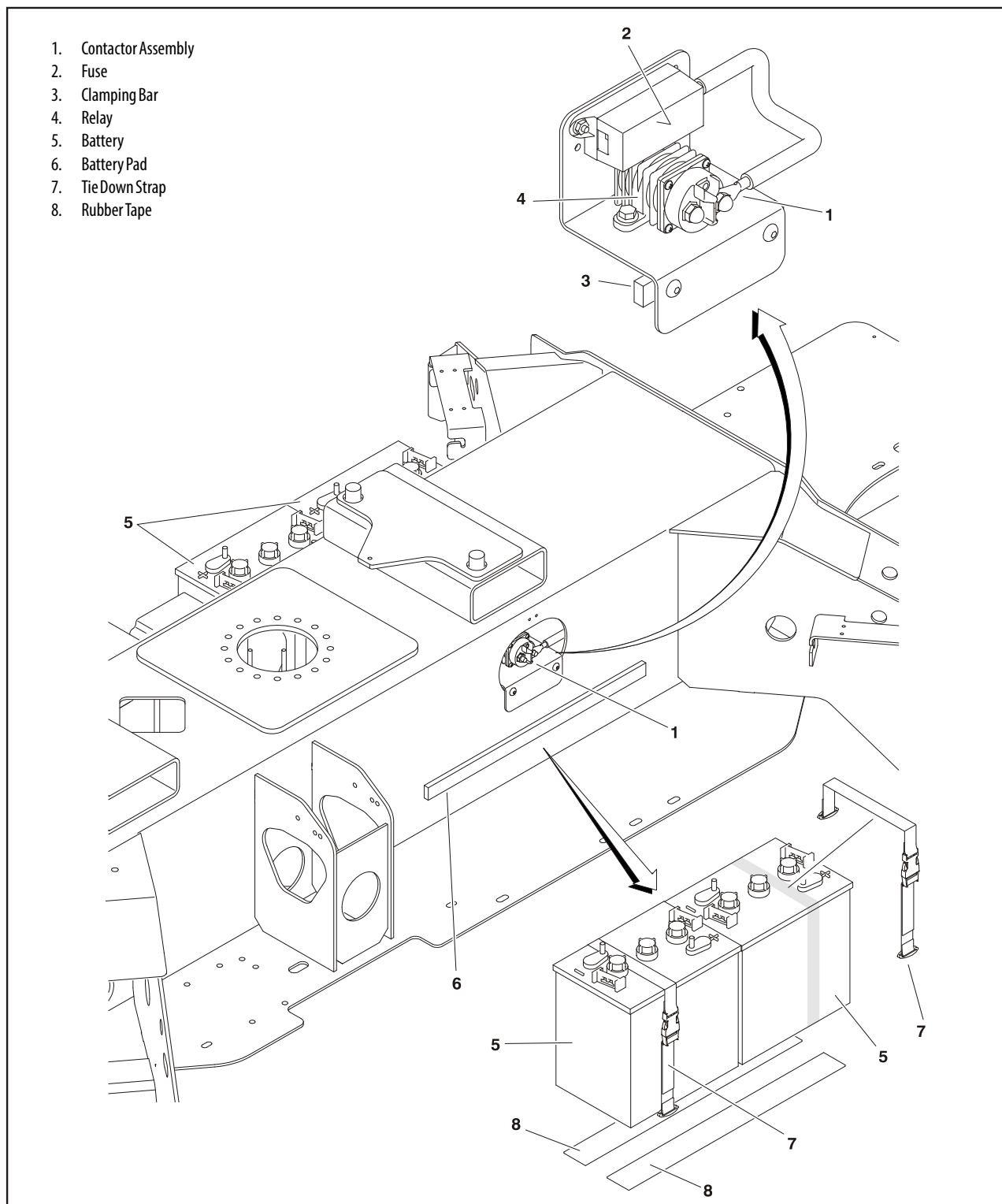


Figure 3-40. Battery and Contactor Installation (Prior to SN 0030001804) - Sheet 1 of 2

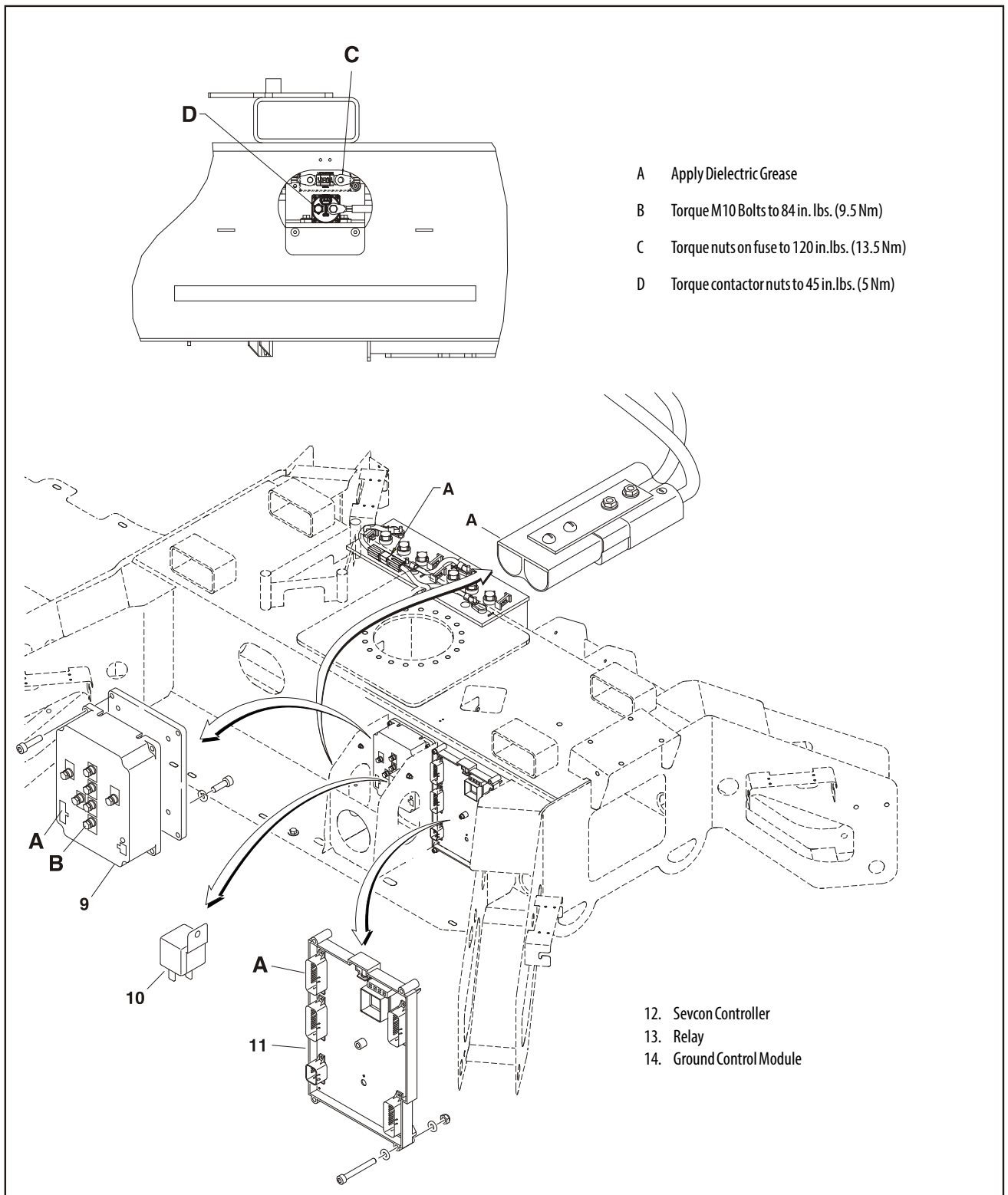


Figure 3-41. Battery and Contactor Installation (Prior to SN 0030001804)- Sheet 2 of 2

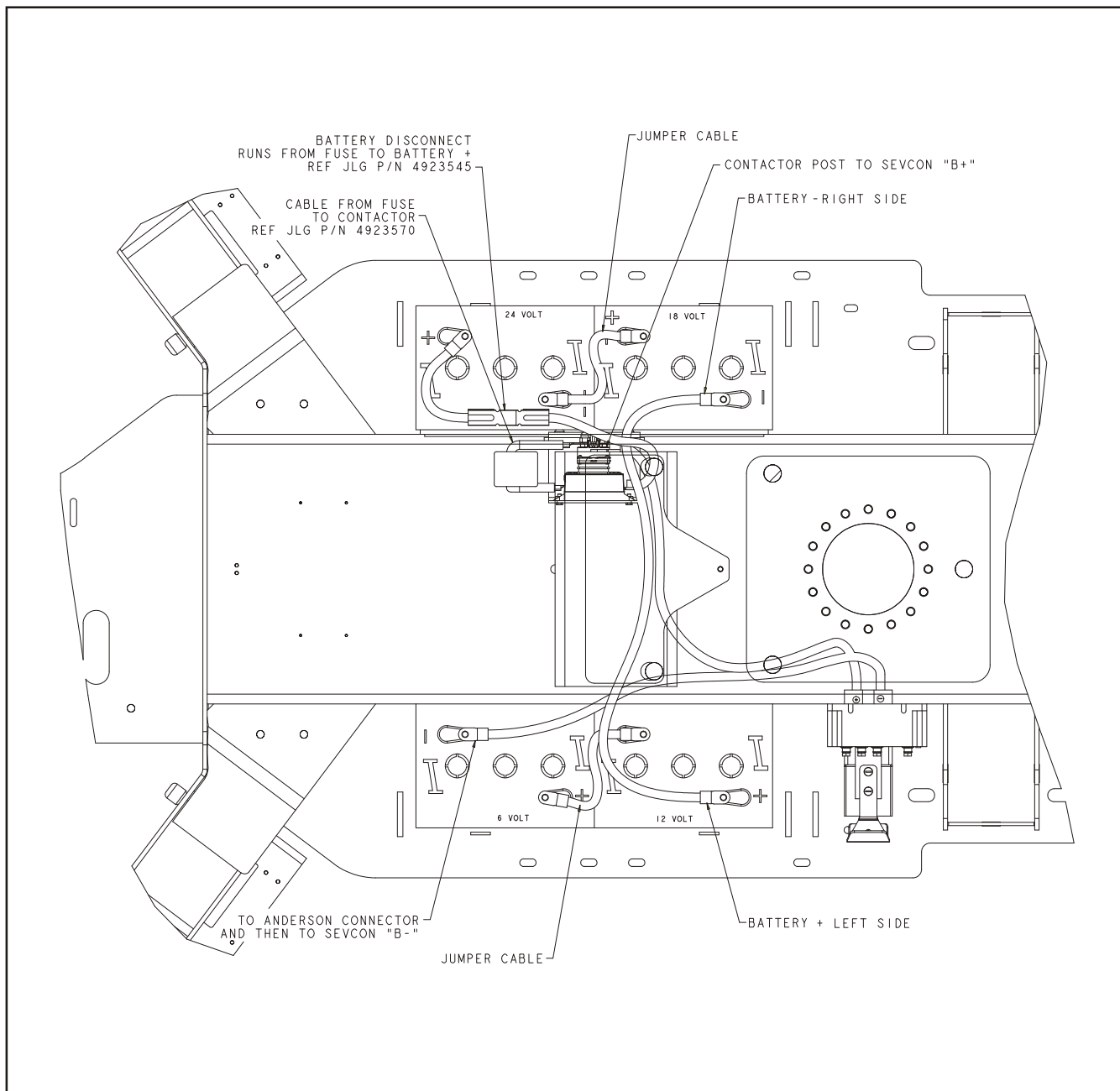
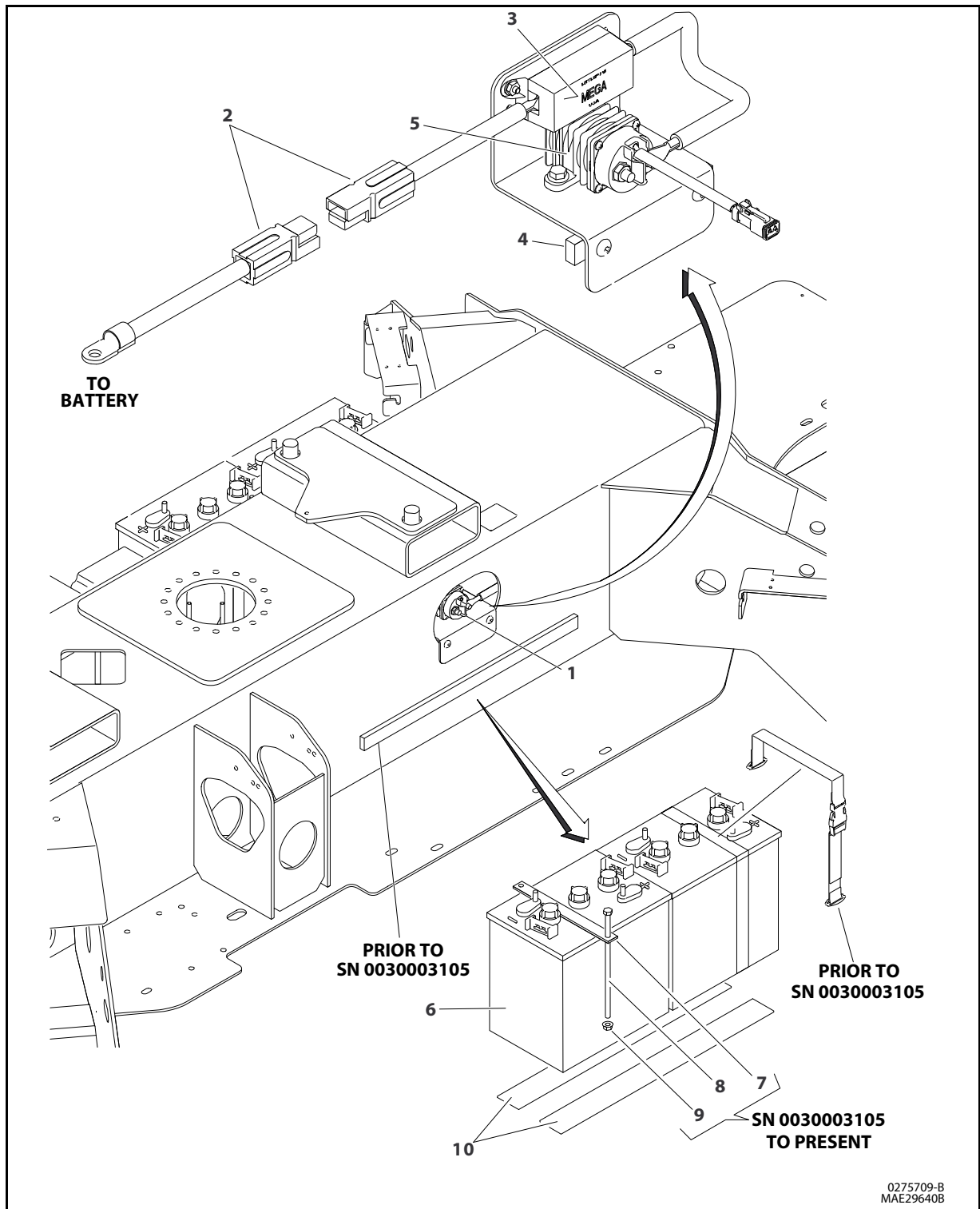
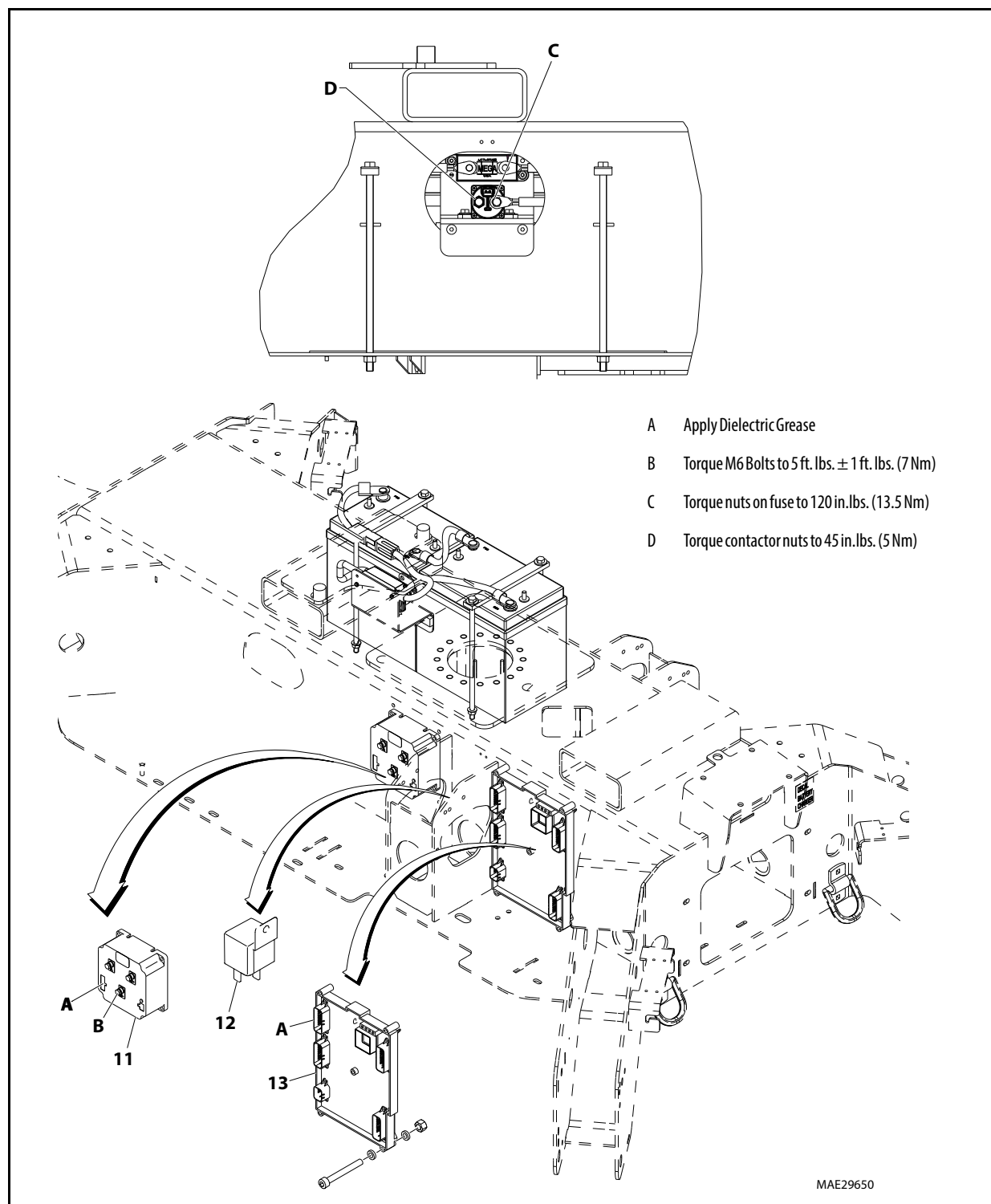


Figure 3-42. Battery Cable Routing (Prior to SN 0030001804)



- | | | | | |
|--------------------------|-----------------|------------|----------|-----------------|
| 1. Contactor | 3. Fuse | 5. Relay | 7. Plate | 9. Nut |
| 2. Fuse to Battery Cable | 4. Clamping Bar | 6. Battery | 8. Bolt | 10. Rubber Tape |

Figure 3-43. Battery and Contactor Installation (SN 0030001804 to Present) - Sheet 1 of 2



11. Sevcon Controller

12. Relay

13. Ground Control Module

Figure 3-44. Battery and Contactor Installation (SN 0030001804 to Present) - Sheet 2 of 2

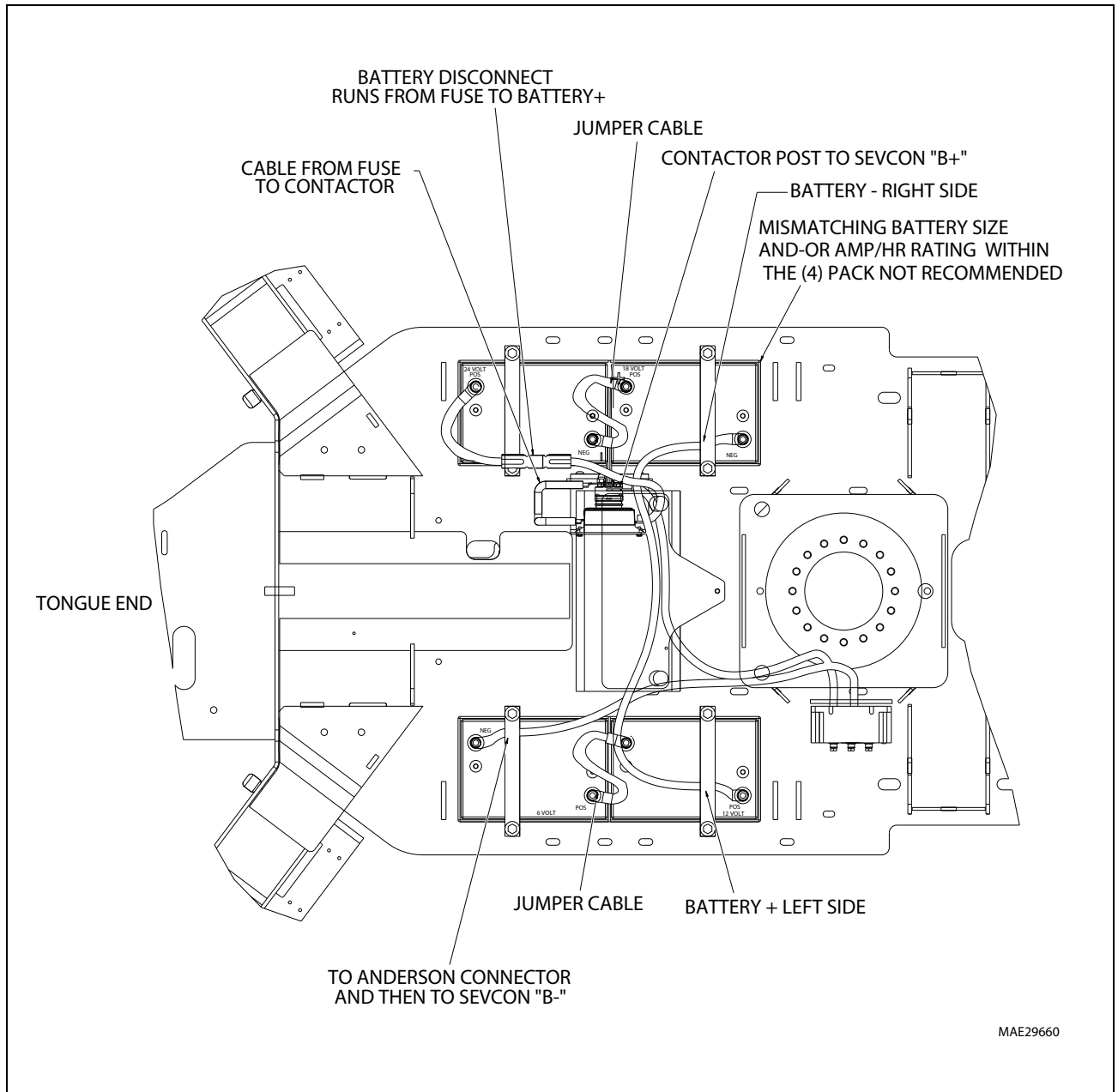


Figure 3-45. Battery Cable Routing (SN 0030001804 to Present)

3.26 BATTERY CHARGER (PRIOR TO SN 030000236)

NOTICE

OPENING THE BATTERY CHARGER WHILE THE MACHINE IS UNDER WARRANTY WILL VOID THE CHARGER WARRANTY. IF UNDER WARRANTY REQUEST A REPLACEMENT CHARGER.

BEFORE REPLACING ANY COMPONENT, USE THE CHARGER MANUFACTURERS TROUBLESHOOTING GUIDE FOR CHECKING THE INTERNAL AC AND DC CIRCUITS TO DETERMINE WHICH COMPONENT HAS FAILED. COMPLETE WIRING DIAGRAMS PERTAINING TO YOUR MODEL CHARGER ARE ALSO INCLUDED IN THE MANUFACTURERS CHARGER MANUAL.

The VP Series battery charger allows for replacement of the following internal components. Consult your Illustrated Parts Manual for part numbers of these components which are available from the JLG Parts Department:

- Transformer
- Printed Circuit Board
- Shunt Assembly
- Interlock Relay
- SCR Rectifier
- AC Circuit Breaker
- DC Circuit Breaker

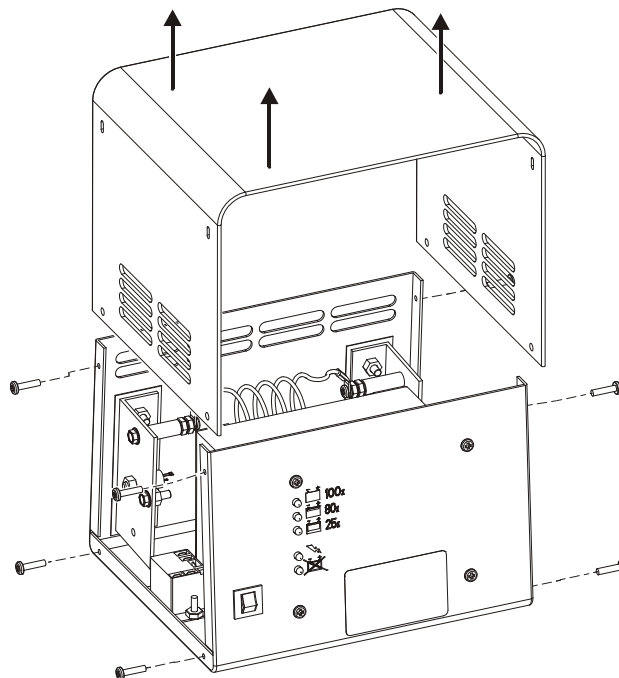
Replacement and troubleshooting of these components requires removal of the battery charger from the machine.

Removal

1. Remove the rear cover from the machine.
2. Unbolt and lower the MC-1 Controller Box.
3. Remove the four (4) capscrews securing the charger to it's mounting plate.
4. Disconnect the DC wiring from the positive/negative battery terminals and interlock connector from the wiring harness.
5. Remove the charger from the machine.

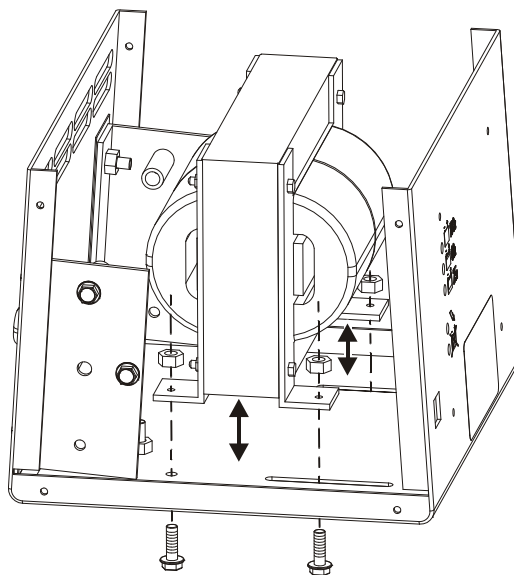
Cover Removal

1. Remove the eight (8) screws on the sides of the charger cover and remove cover.



Transformer Replacement

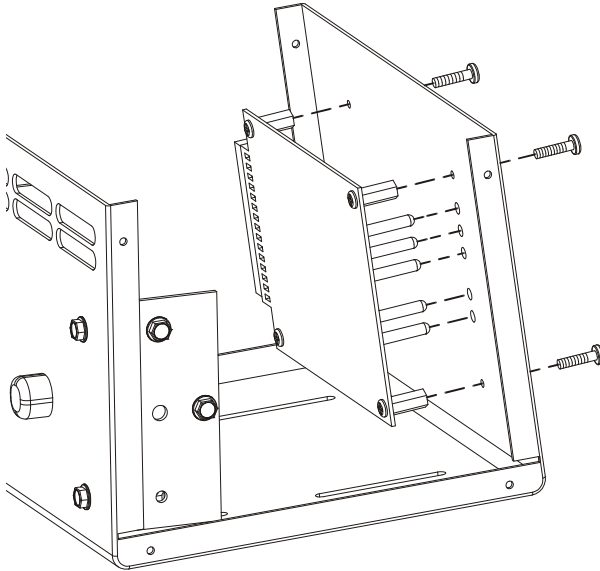
1. Disconnect the wiring connecting the transformer to other components within the charger assembly.
2. Remove the four nuts from the cap screws securing the transformer brackets to the base of the charger chassis.



3. Remove transformer.

Printed Circuit Board Replacement

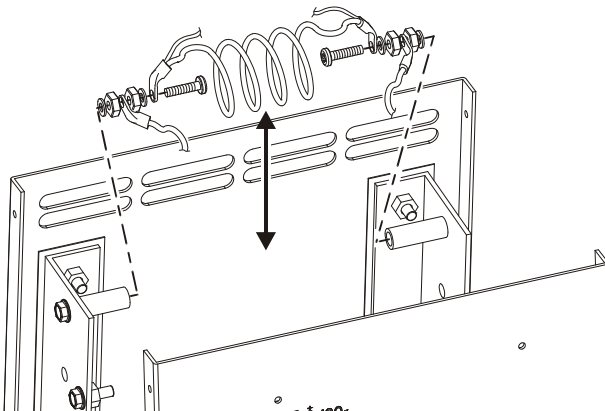
1. Disconnect the wide wiring connector from the end of the circuit board.
2. Remove the four (4) screw attaching the card to the front face of the charger chassis.



3. Remove the circuit board.

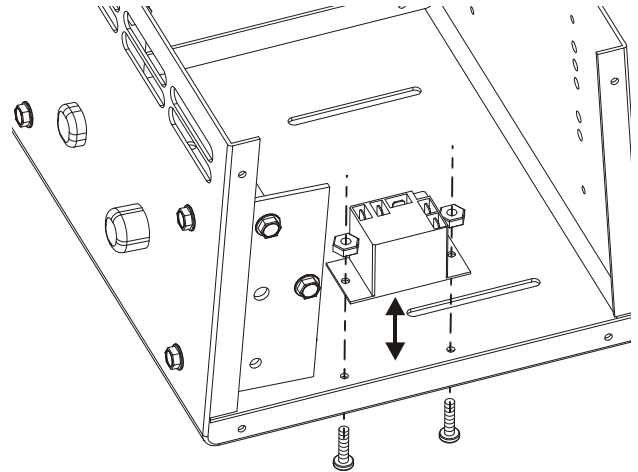
Shunt Assembly Replacement

1. Carefully remove the screw from each end of the shunt assembly. The white insulator may need to be restrained to keep it from turning while removing the shunt assembly fasteners. Also make note of the position of each washer, nut and wire connector when removing for later assembly.



Interlock Relay Replacement

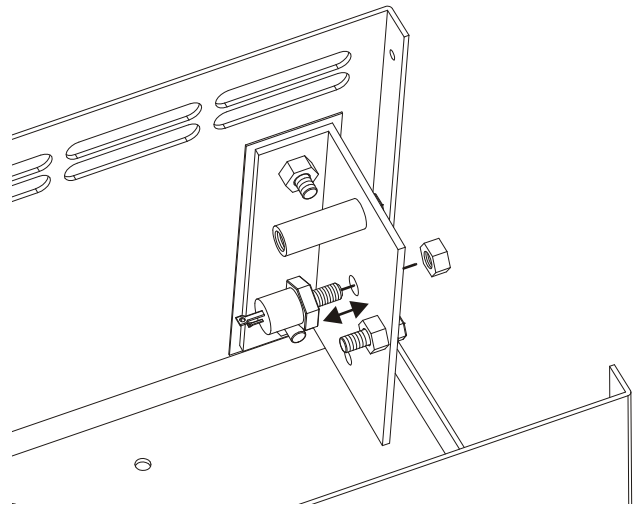
1. Disconnect the wiring connected to the relay.
2. Remove the two (2) nuts securing the interlock relay to the chassis base.



3. Remove the relay.

SCR Rectifier Replacement (Either Side)

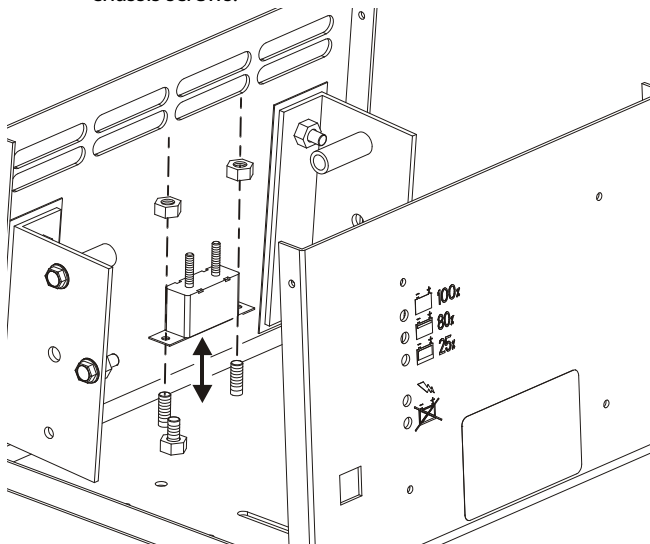
1. Remove the wiring from the SCR Rectifier.
2. Remove the nut securing the rectifier to the insulated aluminum chassis bracket.



3. Remove the SCR Rectifier.

AC Circuit Breaker Replacement

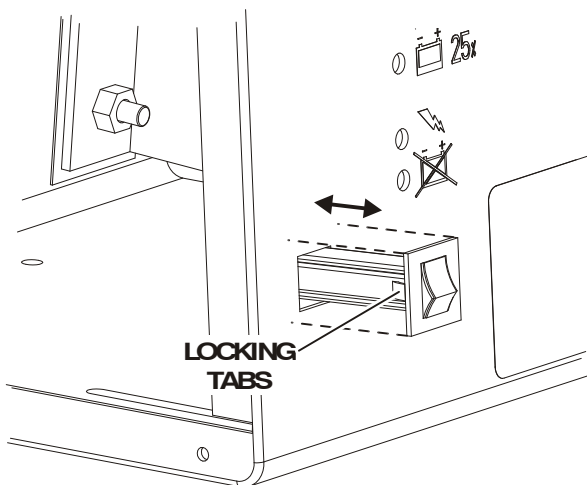
1. Disconnect wiring connected to the breaker poles.
2. Remove the two (2) nuts securing the AC breaker to the chassis screws.



3. Remove the breaker from the chassis.

DC Circuit Breaker Replacement

1. Remove the wiring from the DC breaker terminals.
2. To remove the breaker from the front face of the charger, on the inside of the charger front face, push in on the tabs located on the sides of the breaker assembly and remove the breaker out the front of the charger.



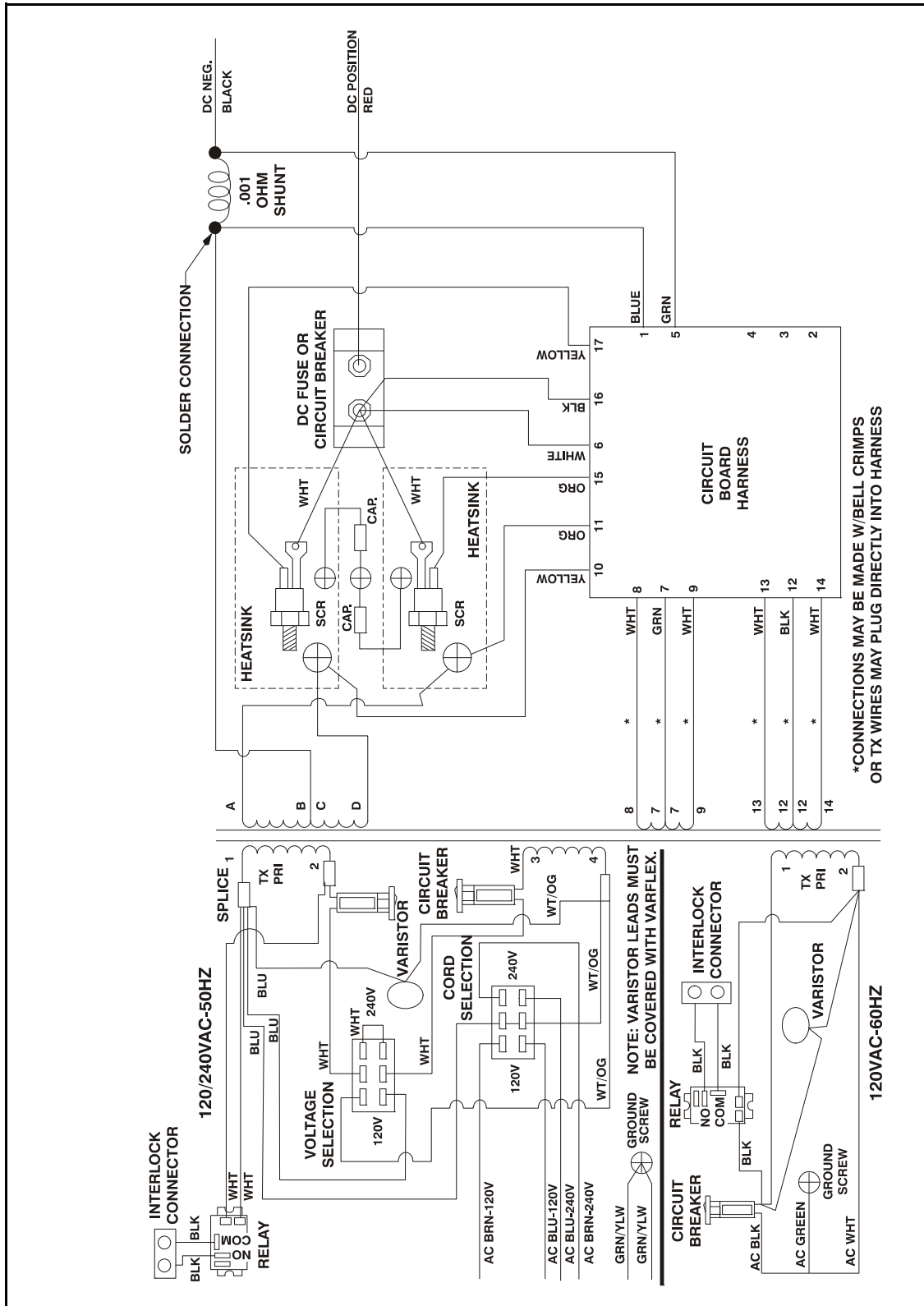
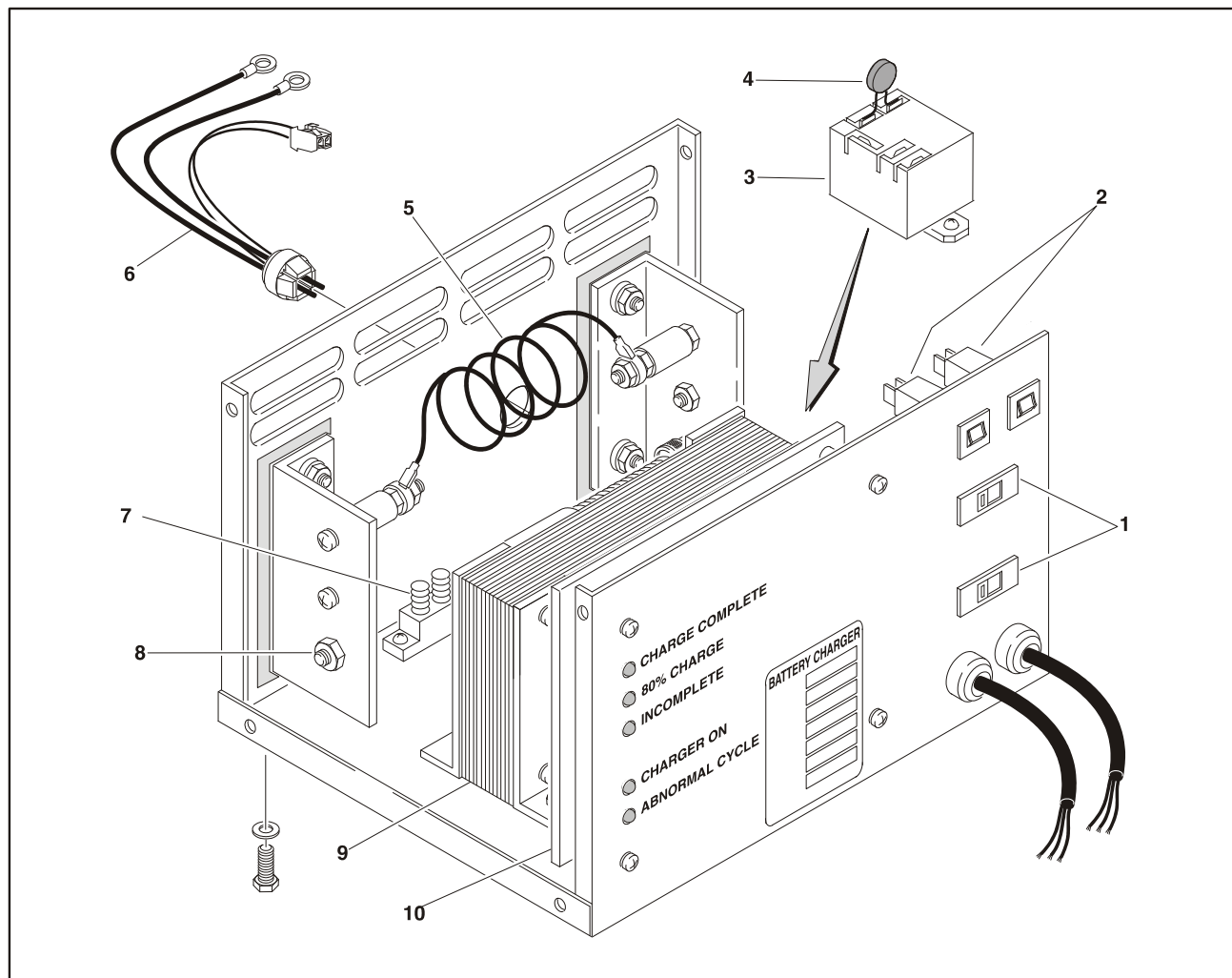


Figure 3-46. Battery Charger Schematic



- | | |
|-----------------------|-----------------------|
| 1. Selector Switch | 6. DC Harness |
| 2. AC Circuit Breaker | 7. DC Circuit Breaker |
| 3. Interlock Relay | 8. SCR Rectifier |
| 4. Varistor | 9. Transformer |
| 5. Shunt Assembly | 10. Circuit Card |

Figure 3-47. Battery Charger

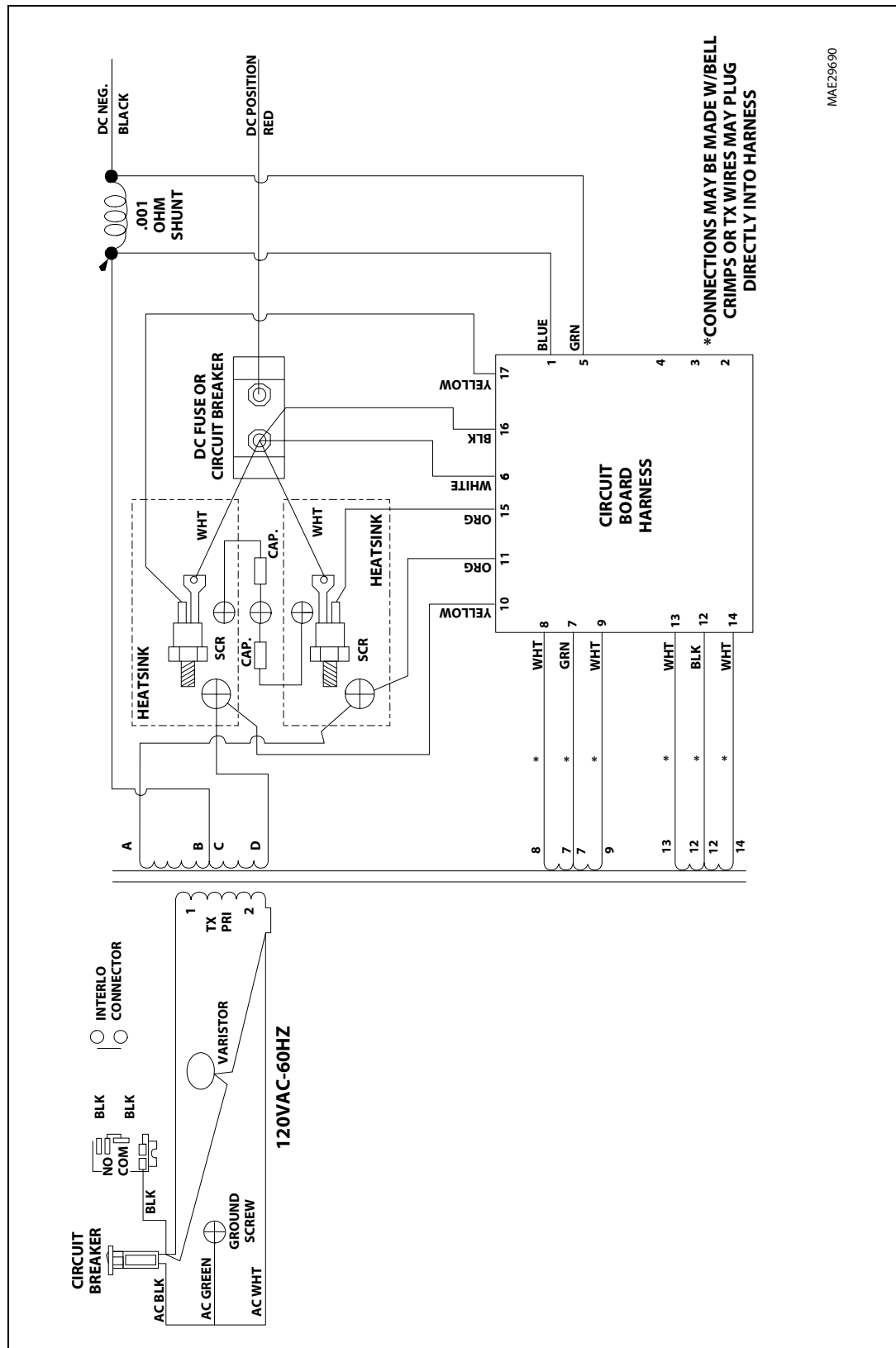
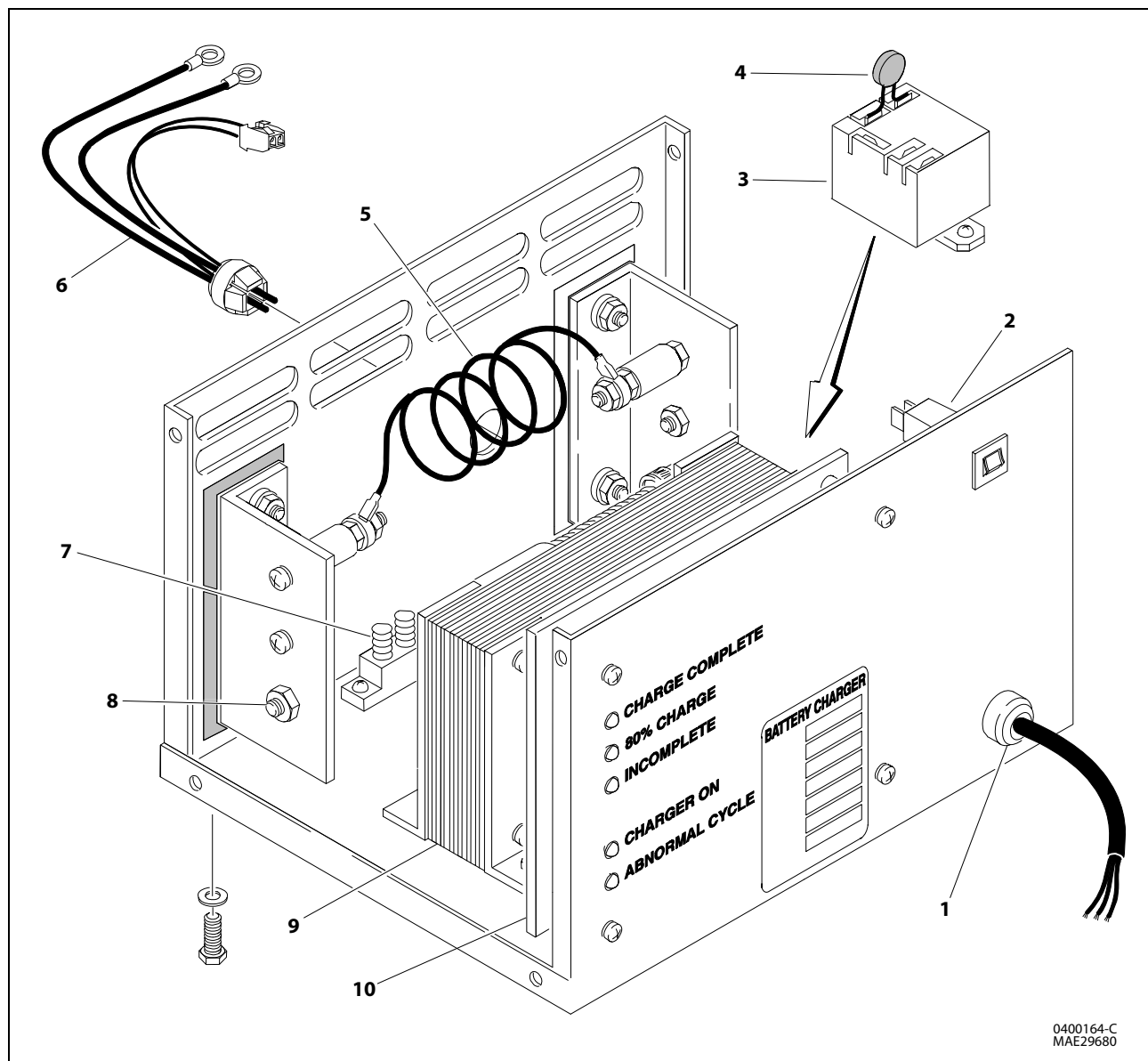


Figure 3-48. Battery Charger Schematic



0400164-C
MAE29680

- | | |
|-----------------------|-----------------------|
| 1. AC Cord Assembly | 6. DC Harness |
| 2. AC Circuit Breaker | 7. DC Circuit Breaker |
| 3. Interlock Relay | 8. SCR Rectifier |
| 4. Varistor | 9. Transformer |
| 5. Shunt Assembly | 10. Circuit Card |

Figure 3-49. Battery Charger

3.27 BATTERY CHARGER (SN 030000199 TO 030000225 & SN 030000236 TO PRESENT)

⚠ 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

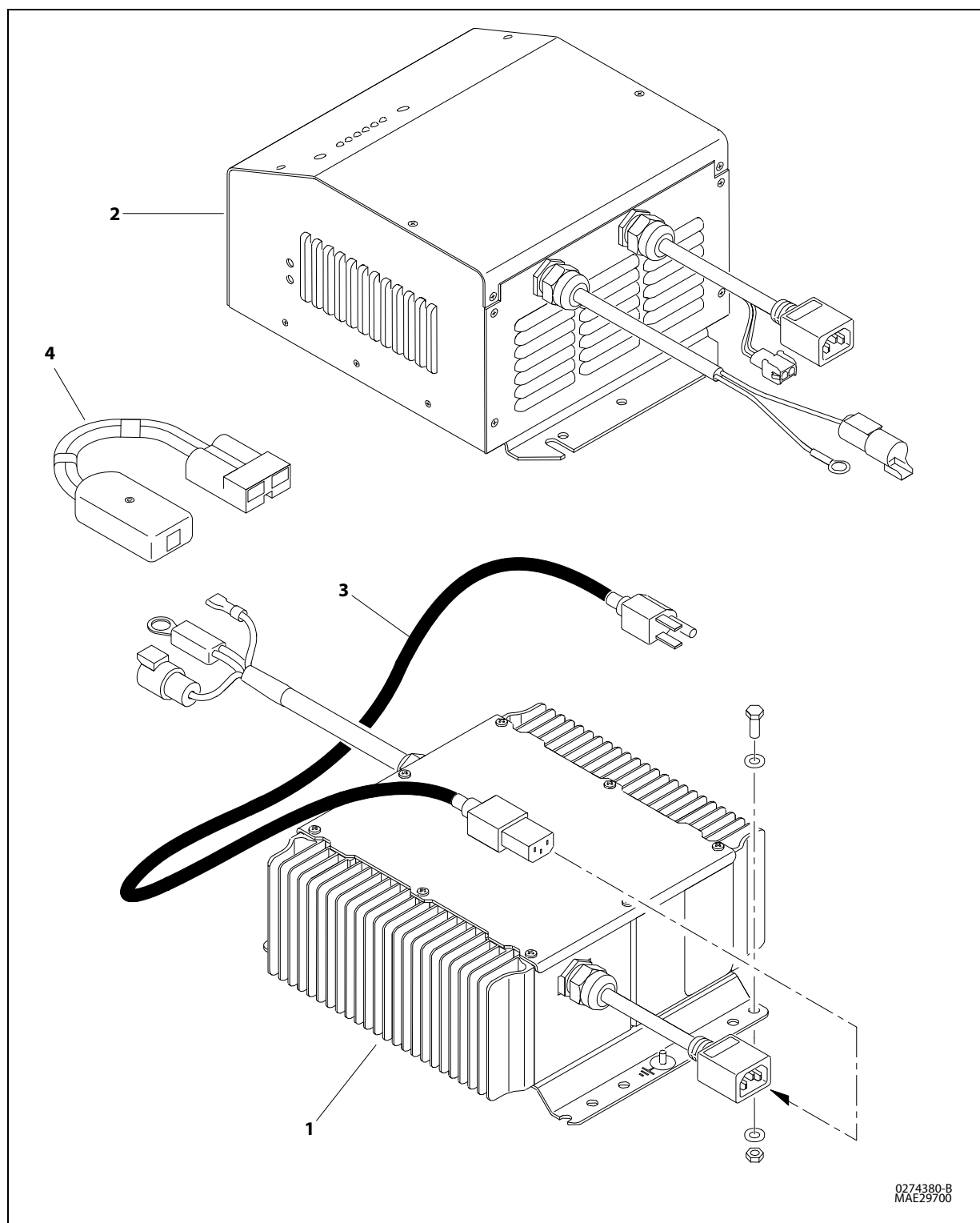
1. For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to level specified by battery manufacturer. Follow the safety instructions recommended by the battery manufacturer.
2. Make sure charger connections to battery terminals 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 3-6. 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.



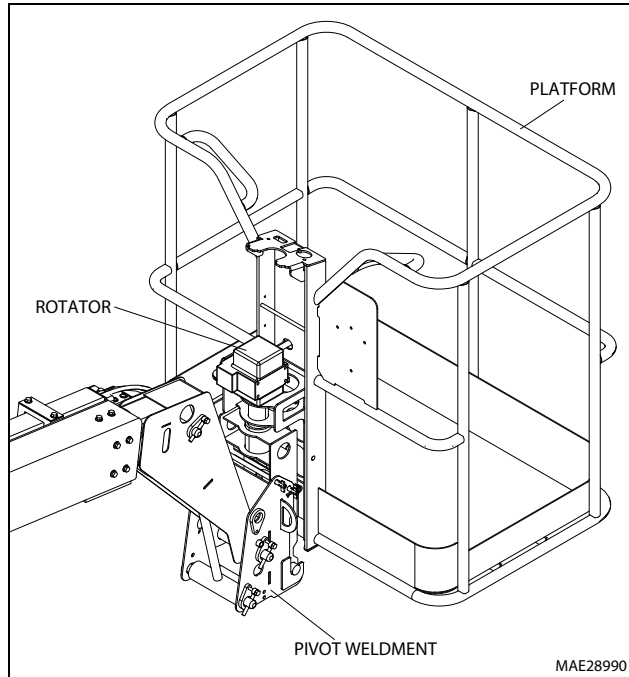
- | | |
|--|-------------------------|
| 1. Battery Charger with Optional Generator | 3. AC Extension Cord |
| 2. Battery Charger | 4. Reprogram Controller |

Figure 3-50. Battery Charger Installation - Delta-Q

SECTION 4. BOOM & PLATFORM

4.1 PLATFORM AND ROTATOR

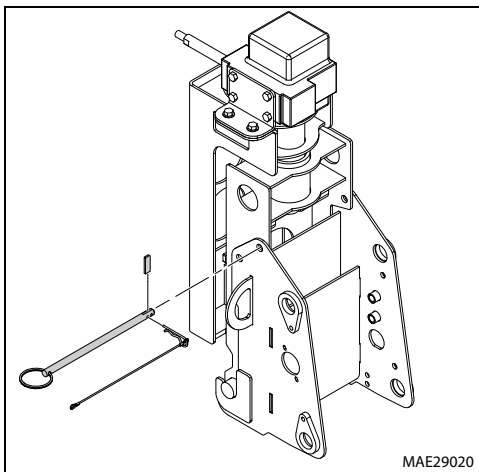
Removal



1. Using a suitable lifting device, support the rotator and platform.

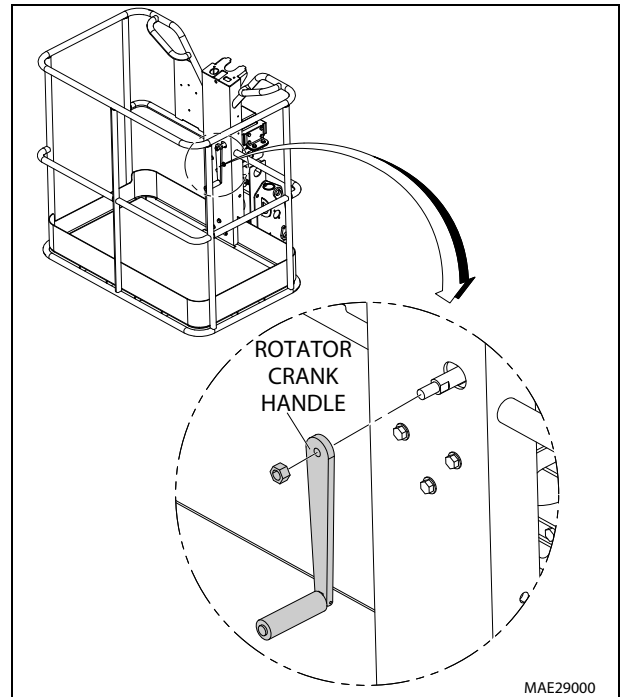
NOTE: The platform with console and rotator weighs approximately 150 lbs. (68 kg).

2. Remove hair pin, lanyard cable and gravity lock pin securing the platform assembly to boom assembly and then remove the platform assembly.

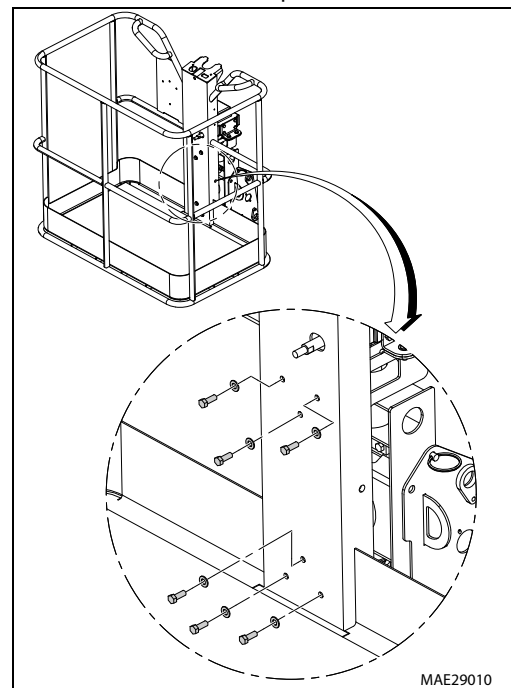


NOTE: The platform rotator weighs approximately 69 lbs. (32 kg).

3. Remove hardware securing rotator crank handle to the platform rotator, then remove rotator crank handle.



4. Using a suitable lifting device, support the platform.
5. Remove the hardware securing the platform to the platform rotator. Remove the platform.

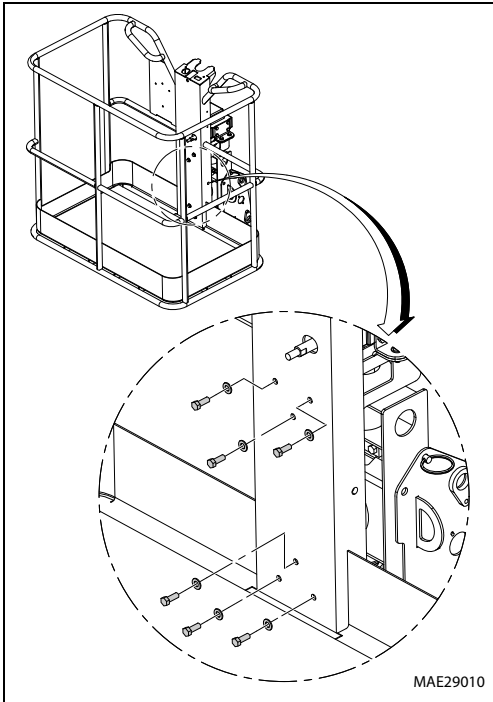


Installation

1. Using a suitable lifting device, support the platform rotator to platform.

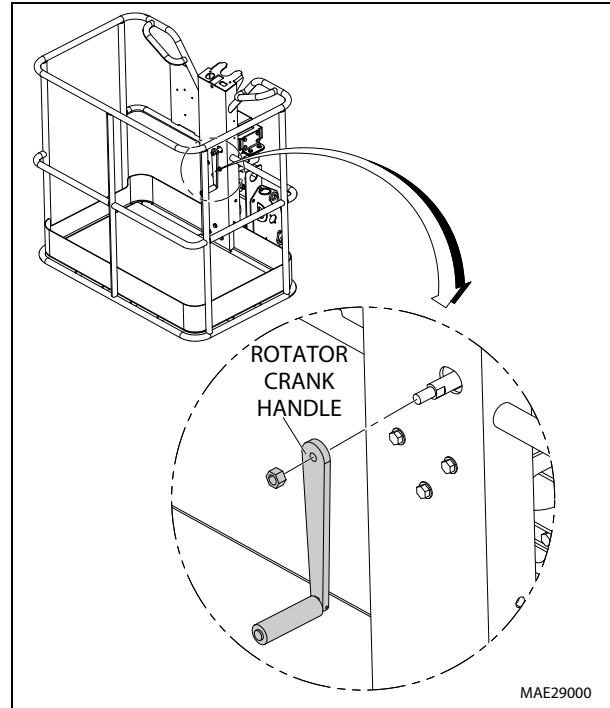
NOTE: The platform rotator weighs approximately 69 lbs. (32 kg).

2. Align and install platform rotator to the platform and secure with hardware.

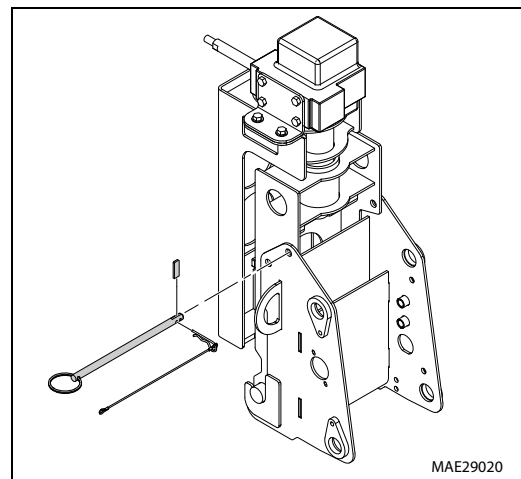


NOTE: The platform with console and rotator weighs approximately 150 lbs. (68 kg).

3. Align and install rotator crank handle to platform rotator and secure with hardware.



4. Using a suitable lifting device, support the platform assembly and position on the boom assembly.
5. Align and install platform assembly to platform support and secure with gravity lock pin, lanyard cable and hair pin.



4.2 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness from ground control box.

NOTICE

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

2. Tag and disconnect hydraulic lines at boom assembly. Use a suitable container for residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove hydraulic lines and electrical cables from the powertrack.
4. Using a suitable lifting equipment, adequately support powertrack weight along entire length.
5. Remove hardware (1) securing push tube on fly boom section.

6. Remove hardware (2) securing push tube on base boom section.
7. With powertrack support and using all applicable safety precautions, remove bolts (3) securing rail to the base boom section. Remove powertrack from boom section.

Installation

1. With powertrack supported and using all applicable safety precautions, install hardware (3) securing rail to the base boom.
2. With adequate support and lifting device align, push tube on the boom section to get access to install hardware (2).
3. Install the hardware (1) securing push tube to fly boom section.
4. Connect all hydraulic lines and electrical cables to powertrack as tagged during removal.
5. Connect wiring harness to ground control box.

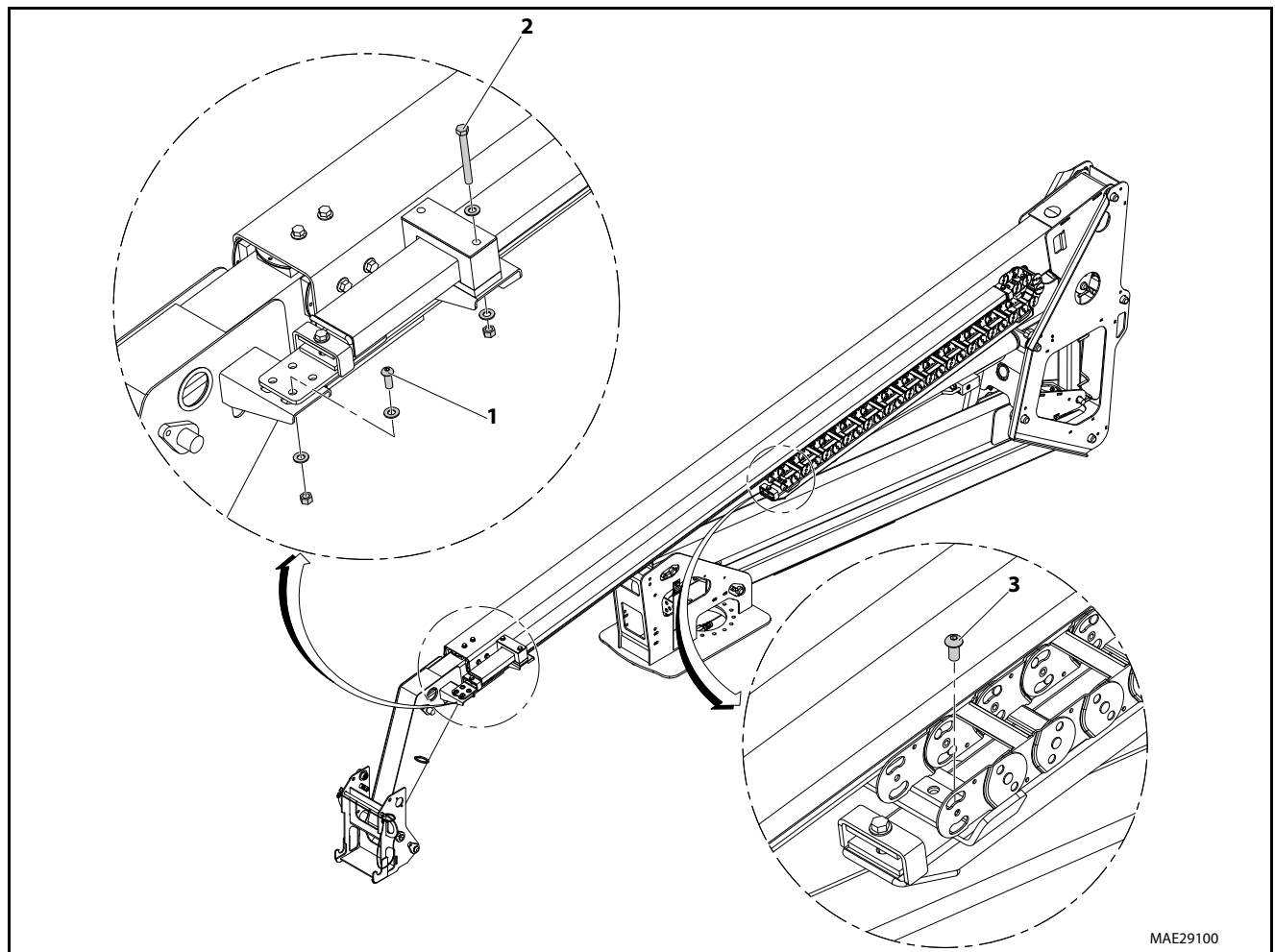


Figure 4-1. Powertrack Removal and Installation

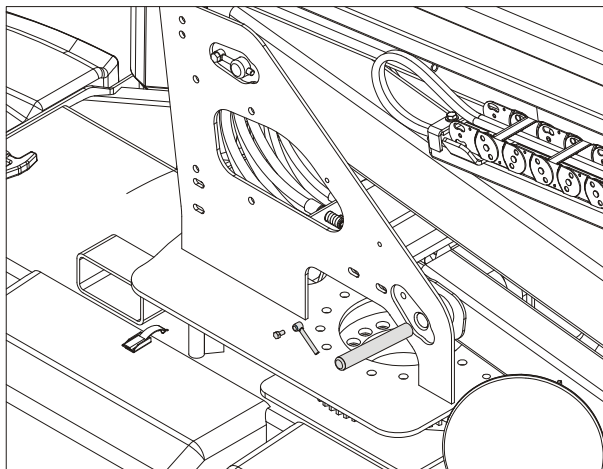
4.3 BOOM AND CYLINDER ASSEMBLY

Removal

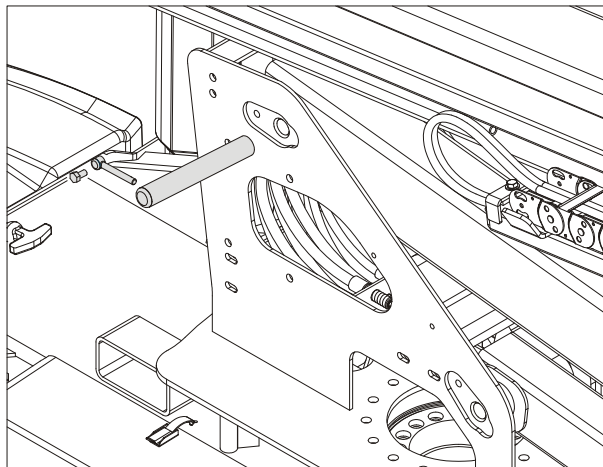
1. Using an adequate supporting device, support the weight of the boom and cylinders assembly.

NOTE: The boom and cylinder assemblies weigh approximately 1150 lbs. (522 kg).

2. Tag and disconnect all hoses and wiring in the turntable that runs to the boom.
3. Remove the bolt, keeper pin, and pivot pin that secures the tower boom link to the turntable.



4. Remove the bolt, keeper pin, and pivot pin that secures the tower boom link to the turntable.



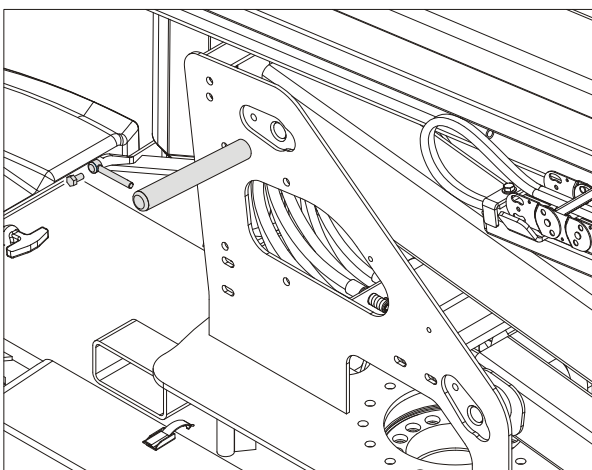
5. Using an adequate lifting device, position straps around the boom and cylinders assembly, taking care to ensure the weight of the assembly is evenly distributed.
6. Lift the assembly away from the machine and lower it onto proper supporting devices.

Installation

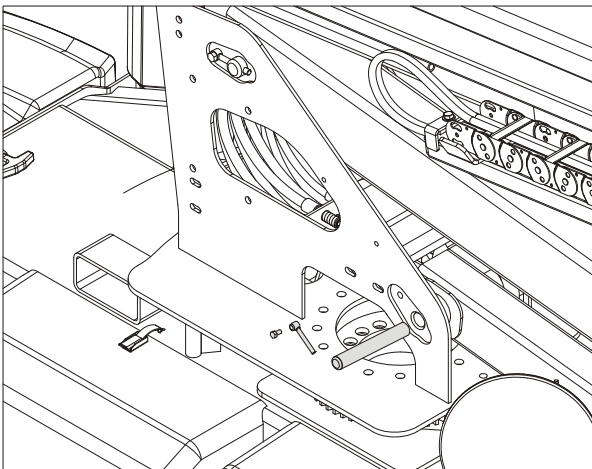
1. Using an adequate lifting device, position straps around the boom and cylinders assembly, taking care to ensure the weight of the assembly is evenly distributed.

NOTE: The boom and cylinder assemblies weigh approximately 1150 lbs. (522 kg).

2. Lower the boom and cylinder assembly into position on the machine.
3. Install the pivot pin, keeper pin, and bolt that secures the tower boom to the turntable.



4. Install the pivot pin, keeper pin, and bolt that secures the tower boom link to the turntable.



5. Connect all hoses and wiring in the turntable that runs to the boom as tagged during removal.
6. Operate all boom functions and check for proper operation or any leakage.

4.4 MAIN BOOM ASSEMBLY

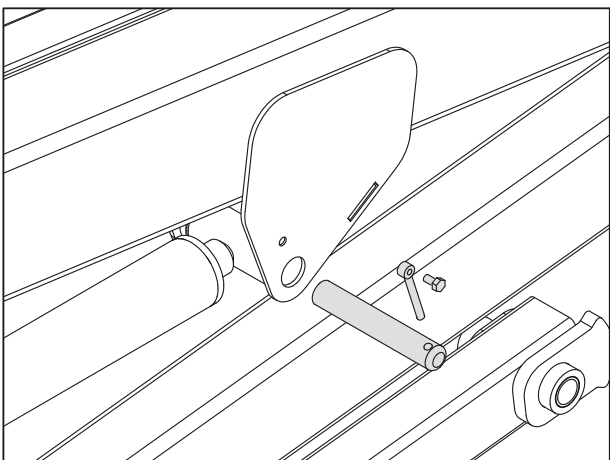
Removal

NOTE: Prior to removing the boom, it will be helpful to extend the boom fly section out far enough to access the telescope cylinder retaining pin if the boom is to be disassembled.

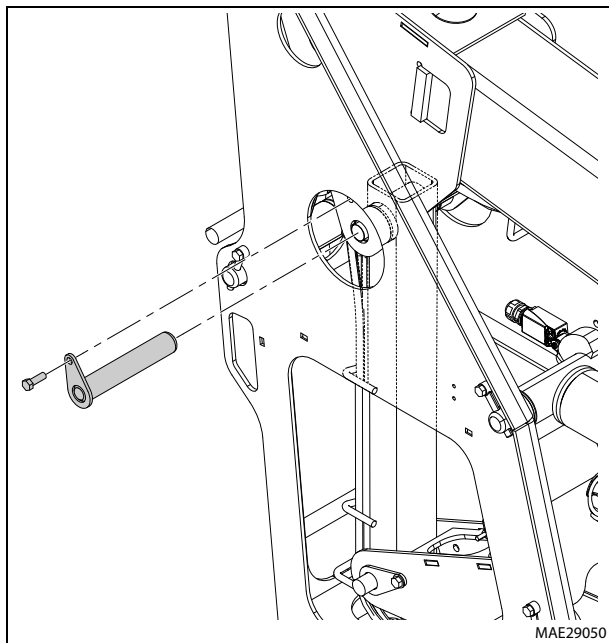
1. Using an adequate lifting device, support the weight of the main boom.

NOTE: The main boom weighs approximately 626 lbs. (284 kg).

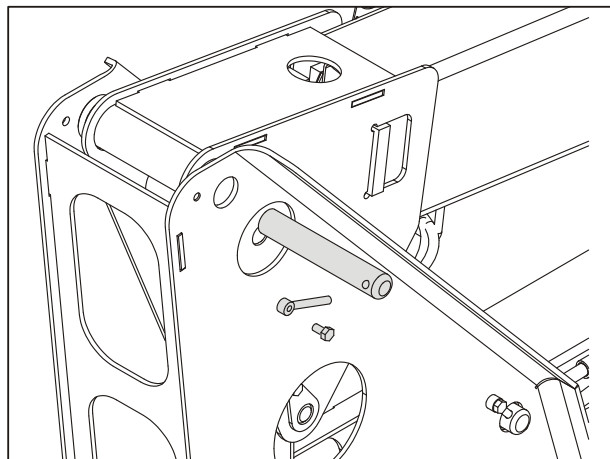
2. To gain access to the tele cylinder, remove the master cylinder. Refer to Section 4.6, Master Cylinder.
3. Tag and disconnect the hydraulic hoses at the rear of the telescope cylinder.
4. Place blocking under the lift cylinder to prevent it from dropping. Remove the bolt, keeper pin, and pivot pin securing the rod end of the lift cylinder to the boom.



5. Remove the bolt, nut, and pivot pin securing the top of the timing link to the boom.

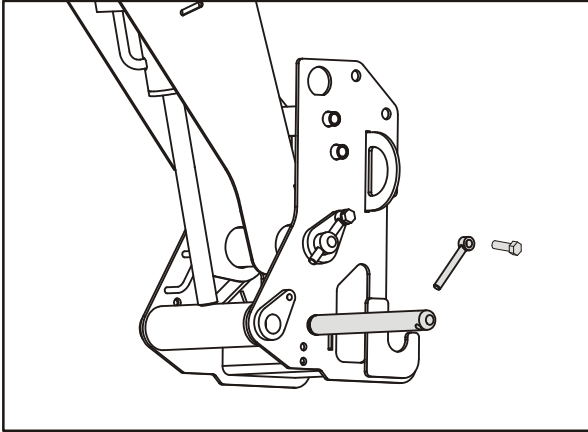


6. Remove the bolt, keeper pin, and pivot pin securing the boom to the turntable. Lift the boom away from the machine and place it on proper supports for servicing.



Disassembly

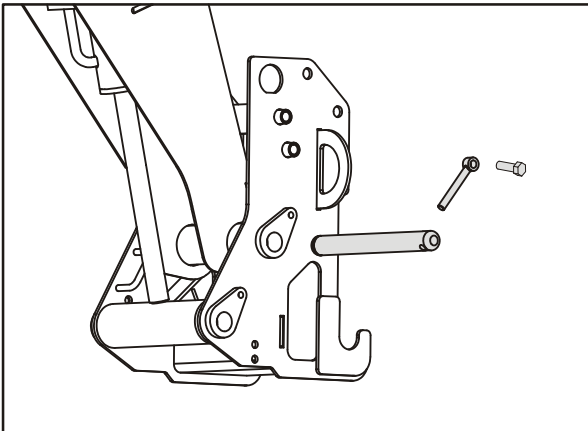
1. Using an adequate supporting device, support the platform level cylinder so it doesn't fall when the pivot pin is removed.
2. Remove the bolt, keeper pin, and lower pivot pin securing the platform pivot.



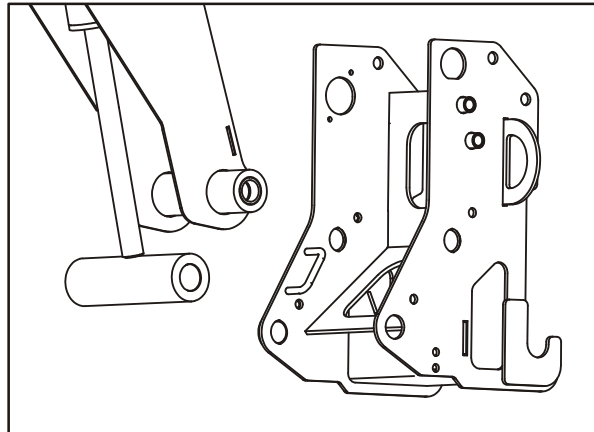
3. Using an adequate lifting device, support the weight of the platform pivot.

NOTE: The pivot weighs approximately 19.5 lbs. (9 kg).

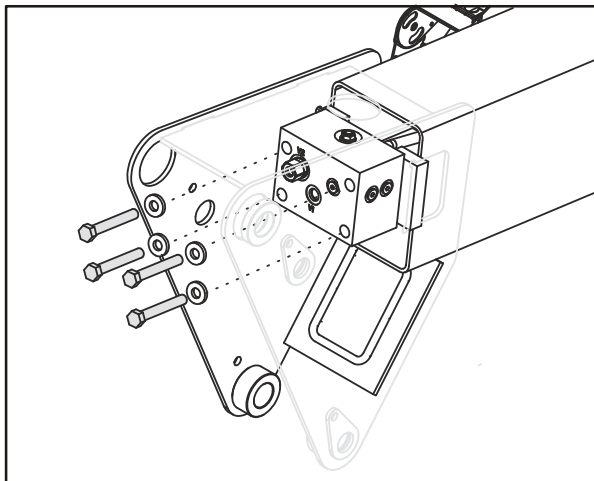
4. Remove the bolt, keeper pin, and upper pivot pin securing the platform pivot.



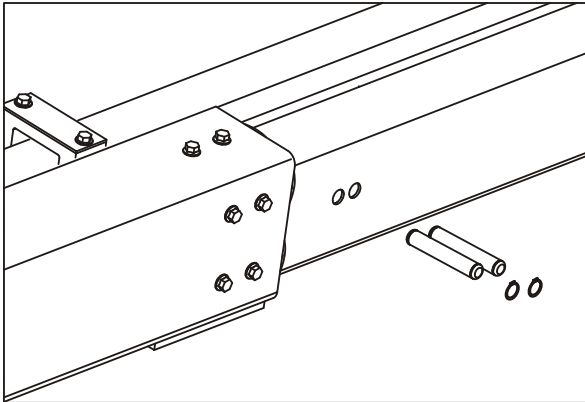
5. Remove the pivot from the boom assembly.



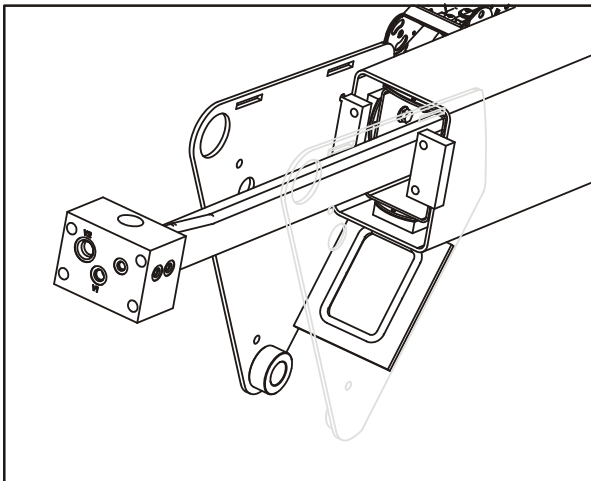
6. Remove the Platform level cylinder. Refer to Section 4.7, Platform Level Cylinder.
7. Remove the bolts securing the telescope cylinder to the boom base section.



8. Remove the retaining rings and attach pins securing the telescope cylinder to the boom fly section.

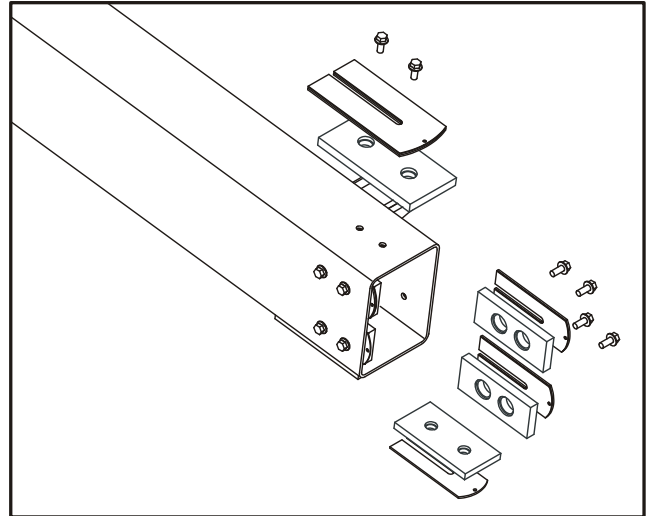


9. Pull the telescope cylinder out from the rear of the boom.



NOTE: The telescope cylinder weighs approximately 110 lbs. (50 kg).

10. Remove the wear pads from the front of the boom base section.

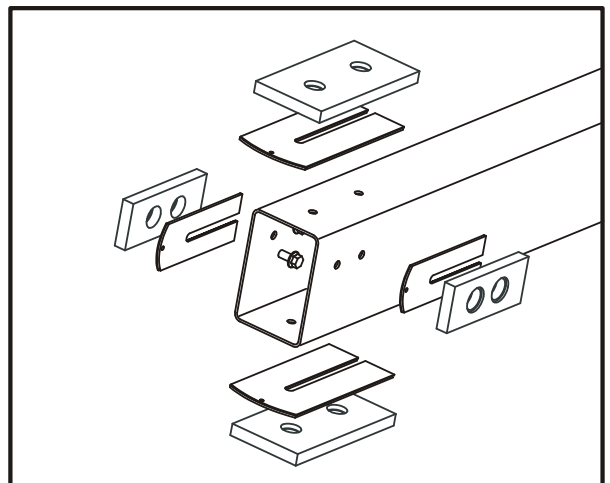


11. Using an adequate lifting device, support the weight of the fly boom section.

12. Pull the fly section out of the base section.

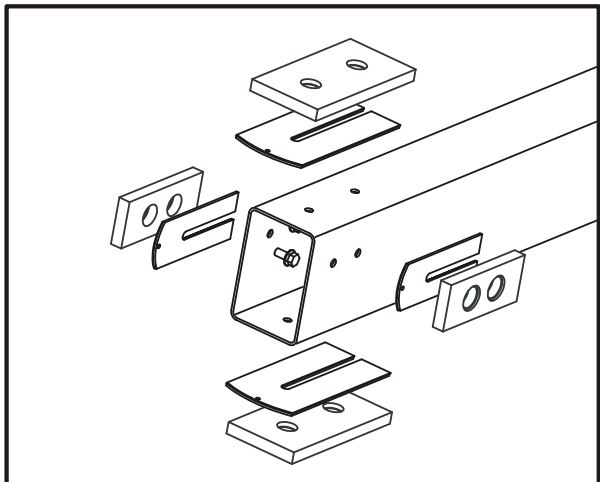
NOTE: The boom fly section weighs approximately 125 lbs. (57 kg.).

13. If necessary, remove the wear pads from the rear of the fly section.



Assembly

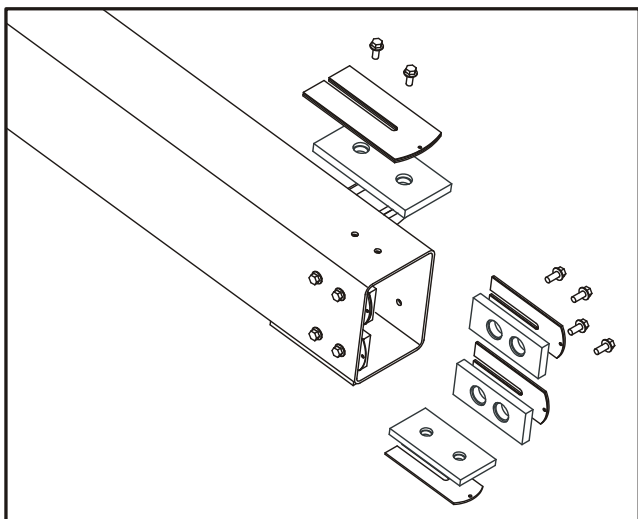
1. If removed, install the wear pads and shims onto the rear of the fly section. Apply JLG threadlocker 0100011 to the bolts and torque to 40 ft.lbs. (55 Nm).



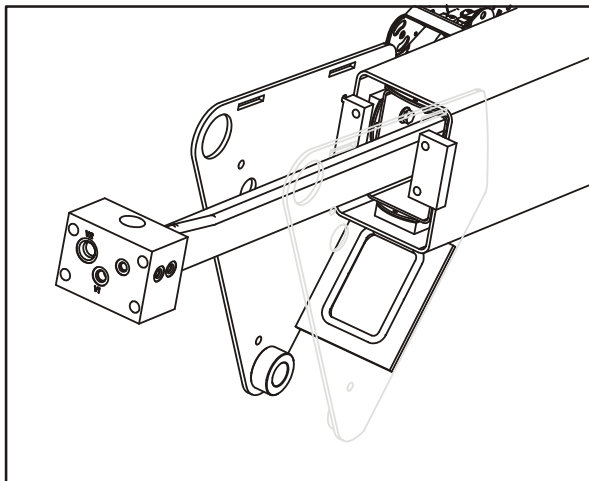
2. Using an adequate lifting device, support the weight of the fly boom section.
3. Align and install the fly section into the base section.

NOTE: The boom fly section weighs approximately 125 lbs. (57 kg.).

4. If removed, install the wear pads into the front of the boom base section. Apply JLG threadlocker 0100011 to the bolts and torque to 35 ft.lbs. (47 Nm).

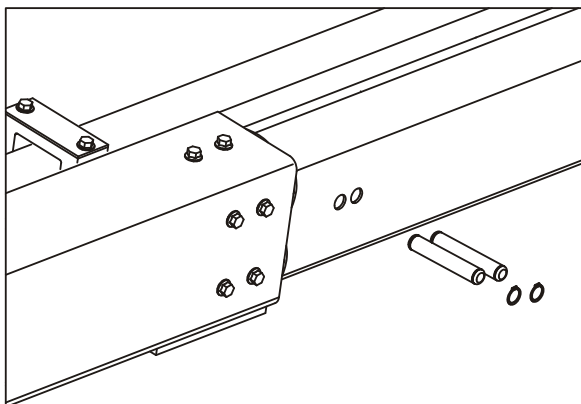


5. Push the telescope cylinder into the rear of the boom.

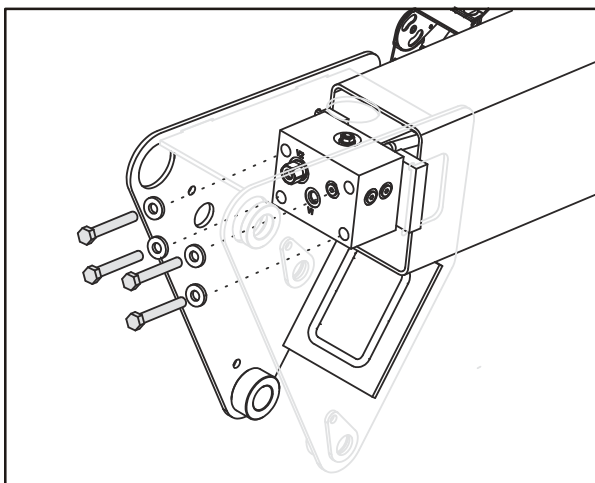


NOTE: The telescope cylinder weighs approximately 110 lbs. (50 kg.).

6. Align and install the retaining rings and attach pins securing the telescope cylinder to the boom fly section.

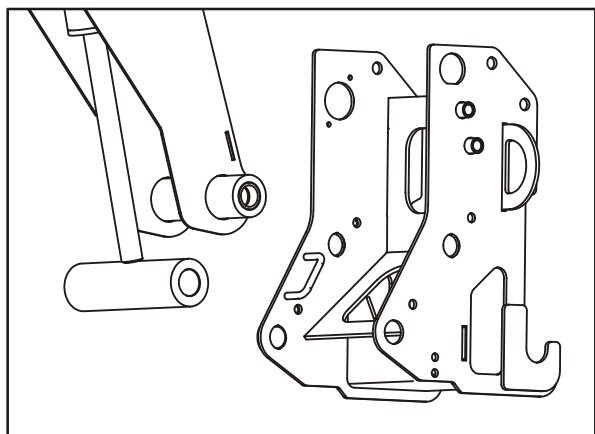


7. Apply JLG threadlocker 0100011 to the bolts and secure the telescope cylinder to the boom base section. Torque the bolts to 85 ft. lbs. (115 Nm).

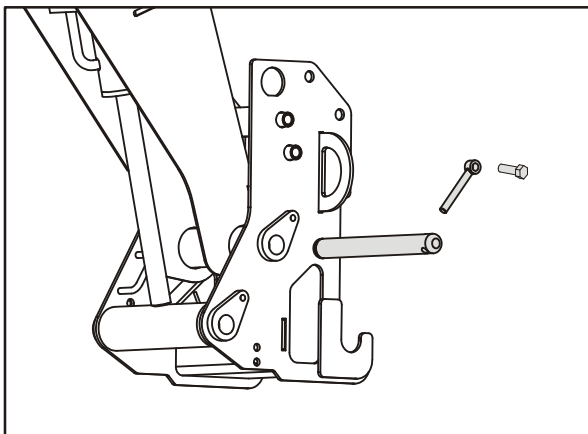


8. Install the slave cylinder. Refer to Section 4.7, Platform Level Cylinder.
9. With adequate support, position the pivot onto the boom assembly.

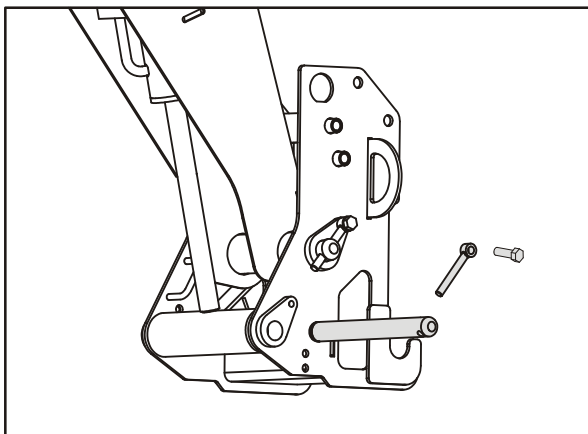
NOTE: The pivot weighs approximately 19.5 lbs. (9 kg).



10. Install the bolt, keeper pin, and upper pivot pin securing the platform pivot to the boom.



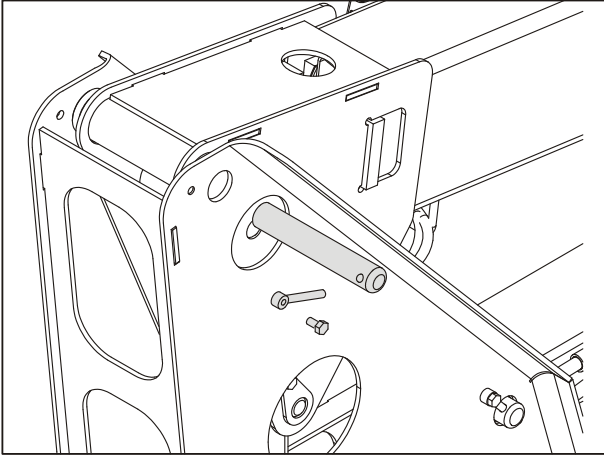
11. Install the bolt, keeper pin, and lower pivot pin securing the platform pivot to the Platform level cylinder.



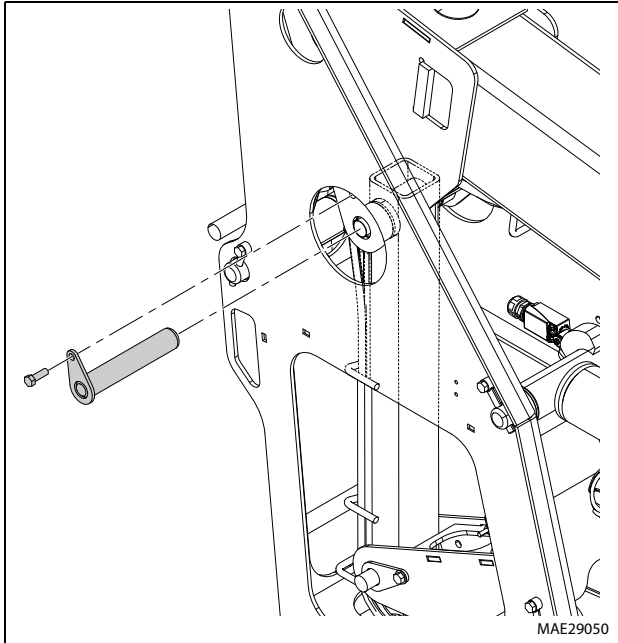
Installation

1. Using adequate lifting support, lift the boom into position on the machine. Install the pivot pin, keeper pin, and bolt securing the boom to the upright.

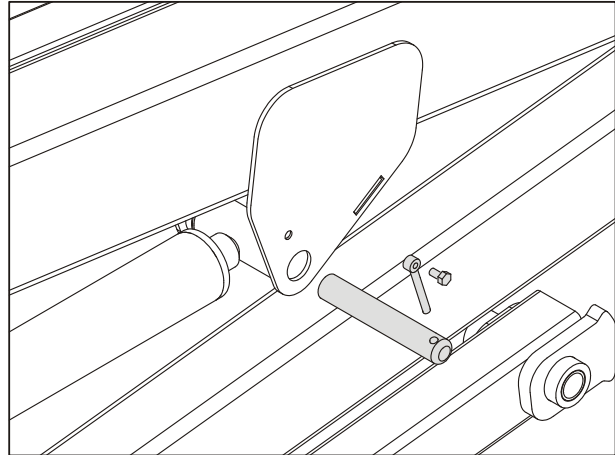
NOTE: The main boom weighs approximately 628 lbs. (285 kg).



2. Install the pivot pin, nut, and bolt securing the top of the timing link to the boom.



3. Install the pivot pin, keeper pin, and bolt securing the rod end of the lift cylinder to the boom.



4. Connect the hydraulic hoses at the rear of the telescope cylinder as tagged during removal.
5. Install the master cylinder. Refer to Section 4.3, Master Cylinder.
6. Operate the boom through all functions and check for proper operation or any leakage.

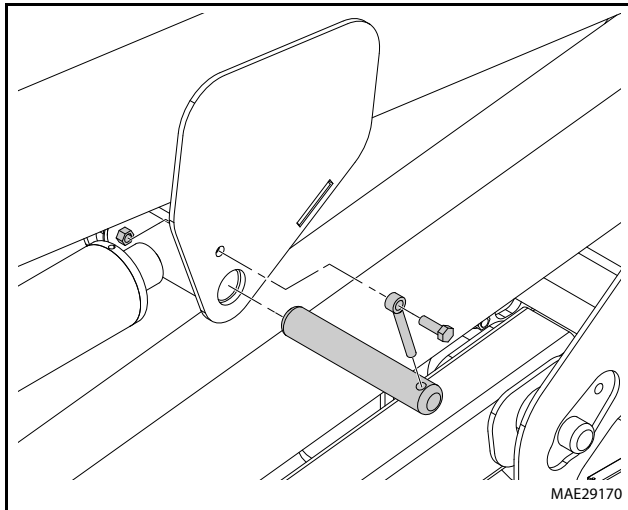
4.5 MAIN LIFT CYLINDER

Removal

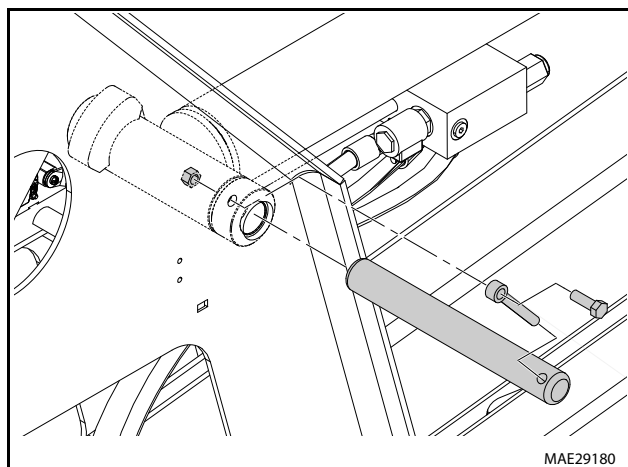
1. Swing the boom away from the tongue.
2. Place a suitable support or blocking under the boom.
3. Tag and disconnect the hoses running to the main lift cylinder. Cap or plug all openings.
4. Using an adequate supporting device, support the main lift cylinder so it doesn't fall when the pin is removed.

NOTE: The lift cylinder weighs approximately 90 lbs. (40 kg).

5. Remove the retaining pins and pivot pin from the rod end of the cylinder.

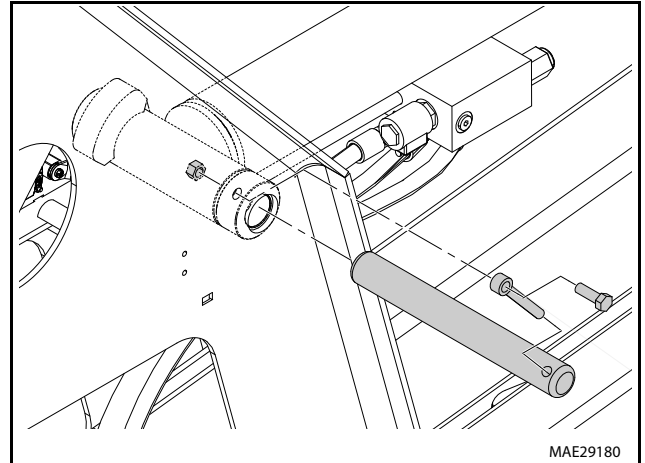


6. Remove the retaining pins and pivot pin from the barrel end of the cylinder and remove the cylinder from the machine.



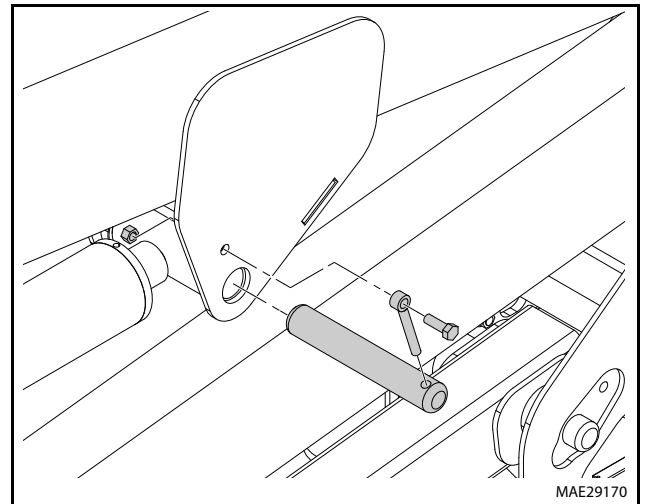
Installation

1. Using suitable lifting device, lift the main lift cylinder into position and install the pivot pin and retaining pin into the barrel end of the cylinder.



NOTE: The lift cylinder weighs approximately 90 lbs. (40 kg).

2. Install the pivot pin and retaining pin into the rod end of the cylinder.



3. Connect the hydraulic hoses to the lift cylinder as tagged during removal.
4. Cycle the lift cylinder several times to check for proper operation and any leakage.

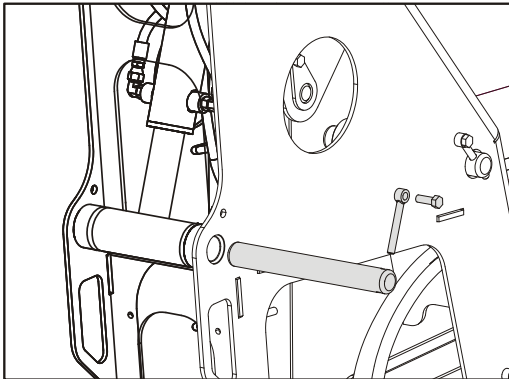
4.6 MASTER CYLINDER

Removal

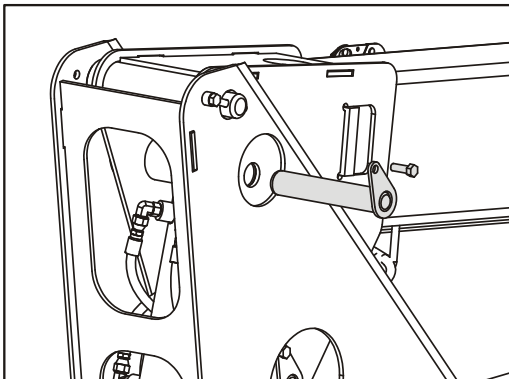
1. Swing the boom away from the tongue.
2. Place a suitable support or blocking under the platform pivot.
3. Tag and disconnect the hoses running to the master cylinder. Cap or plug all openings.
4. Using an adequate supporting device, support the master cylinder so it doesn't fall when the pin is removed.

NOTE: The master cylinder weighs approximately 65 lbs. (29.5 kg).

5. Remove the retaining pins and pivot pin from the rod end of the cylinder.

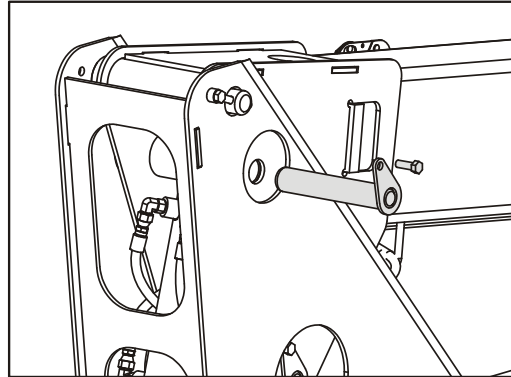


6. Remove the retaining pins and pivot pin from the barrel end of the cylinder and remove the cylinder from the machine.



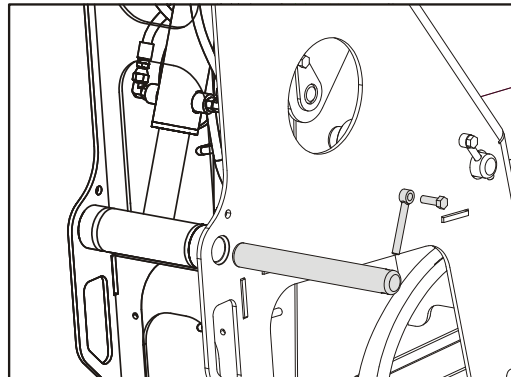
Installation

1. Using suitable lifting device, lift the master cylinder into position and install the pivot pin and retaining pin into the barrel end of the cylinder.



NOTE: The master cylinder weighs approximately 65 lbs. (29.5 kg).

2. Install the pivot pin and retaining pin into the rod end of the cylinder.



3. Connect the hydraulic hoses to the master cylinder as tagged during removal.
4. Cycle the master cylinder several times to check for proper operation and any leakage.

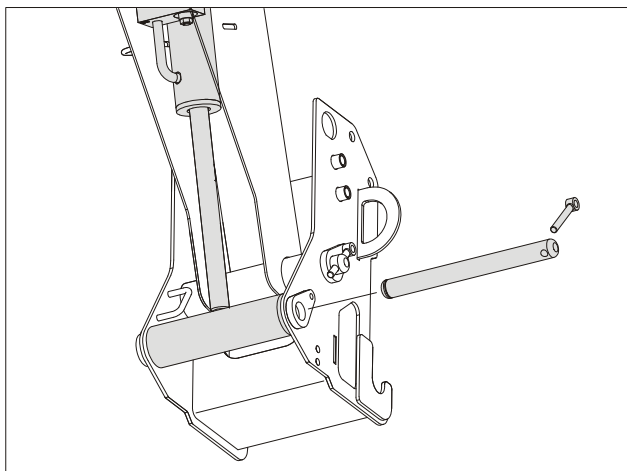
4.7 PLATFORM LEVEL CYLINDER

Removal

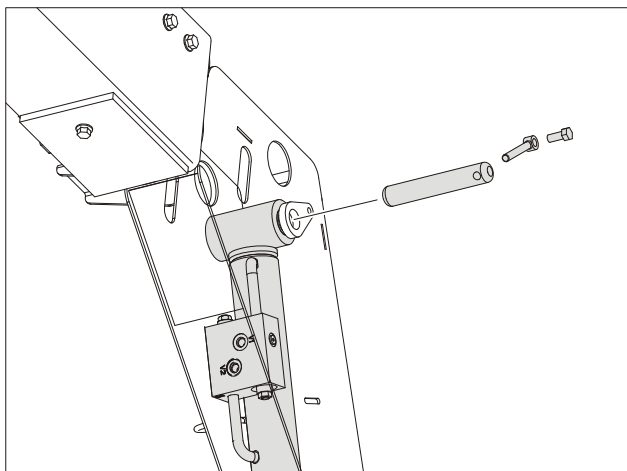
1. Swing the boom away from the tongue.
2. Place a suitable support or blocking under the platform pivot.
3. Tag and disconnect the hoses running to the platform level cylinder. Cap or plug all openings.
4. Using an adequate supporting device, support the platform level cylinder so it doesn't fall when the pin is removed.

NOTE: The slave cylinder weighs approximately 23 lbs. (10 kg).

5. Remove the retaining pins and pivot pin from the rod end of the cylinder.

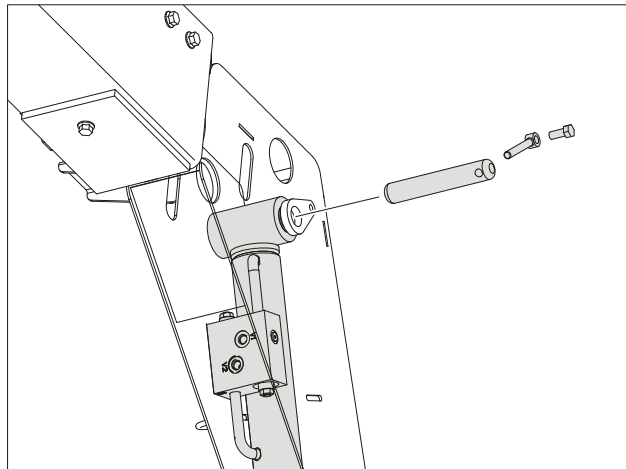


6. Remove the retaining pins and pivot pin from the barrel end of the cylinder and remove the cylinder from the machine.



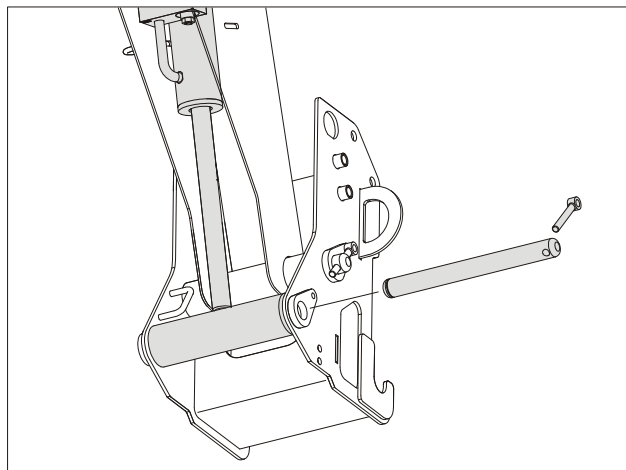
Installation

1. Using suitable lifting device, lift the platform level cylinder into position and install the pivot pin and retaining pin into the barrel end of the cylinder.



NOTE: The platform level cylinder weighs approximately 23 lbs. (10 kg).

2. Install the retaining pins and pivot pin into the rod end of the cylinder.



3. Connect the hoses running to the platform level cylinder as tagged during removal.
4. Function the platform level cylinder through several cycles and check for proper operation and any leakage.



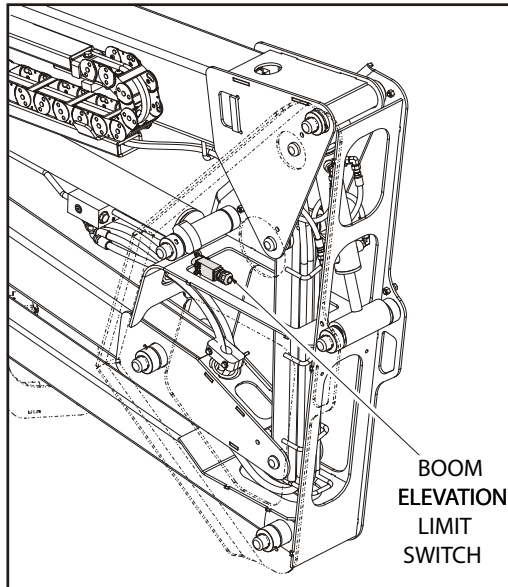
- | | | |
|------------------------------|---------------------|-----------------------------|
| 1. Boom & Cylinders Assembly | 6. Gravity Lock Pin | 11. Lift Cylinder |
| 2. Keeper Bolt | 7. Main Boom | 12. Upright |
| 3. Retaining Pin | 8. Tower Boom | 13. Timing Link |
| 4. Pivot Pin | 9. Tower Boom Link | 14. Powertrack |
| 5. Boom Rest | 10. Master Cylinder | 15. Platform level Cylinder |

Figure 4-2. Boom and Cylinders Assembly

4.8 BOOM SENSORS

There are two mechanical sensors that are standard on the machine which sense the boom state. One is located on the side of the base boom and senses when the boom is fully telescoped in. The other sensor, which is mounted to the side of the upright, senses whether the main boom is elevated and is activated by a cam on the lift cylinder bushing.

Boom Elevation Limit Switch



1. Set the limit switch to trip at 3.8° above horizontal (Main Boom Position).
2. Set the switch to reset at 1° below horizontal (Main Boom Position).
3. Route harness through center of turntable and chassis plug harness into connector labeled transport limit switch provided with frame harness.

4.9 BOOM CLEANLINESS GUIDELINES

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

1. JLG recommends use of JLG Hostile Environment Package to keep internal portions of a boom cleaner and 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 you follow all guidelines for servicing your equipment in accordance with instruction in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to proper operation of the machine. Frequency of service and maintenance must be increased as environment, severity, and frequency of usage requires.
3. Debris and contamination inside 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 debris, then water with mild solvents applied with a pressure washer can be used. Wash debris toward the nearest exiting point from the boom. Make sure all debris is removed, no "puddling" of water has occurred, and boom internal components are dry before operating machine. Make sure you comply with all federal and local laws for disposing of wash water and debris.
6. If pressurized air or washing boom does not dislodge and remove debris, disassemble boom following instructions outlined in the JLG Service & Maintenance Manual to remove debris.

4.10 PLATFORM CONTROL ENABLE SYSTEM (TRIGGER)

The platform controls make use of a time dependent enable circuit to limit the time availability of "live" or enabled controls. To operate any directional function, the trigger switch on the joystick must be depressed before activation of the function. When the switch is depressed, the controls are enabled and the operator has 7 seconds to operate any function. While the controls are "live", the enabled light will be illuminated in the platform display panel. When the time limit has been reached, the enabled light will turn off and the controls will be "dead" or disabled. To continue use of the machine the controls must be re-enabled to start the timer system over again. This is done by releasing all functions, then releasing and re-depressing the trigger switch.

4.11 SIDE ENTRY PLATFORM

The aluminum side entry platform is the common platform for all markets. It is 30" X 48" and has a drop bar gate.

4.12 HYDRAULIC MANUAL DESCENT SYSTEM

The manual descent allows retrieval of an elevated boom in the event of a power failure. The valves are manually operated and fluid is moved with a hand pump to charge the system to allow lift down and to operate telescope in or out. The swing motor can be actuated using a 1/2" drive ratchet.

4.13 POWERTRACK MAINTENANCE

Remove Link

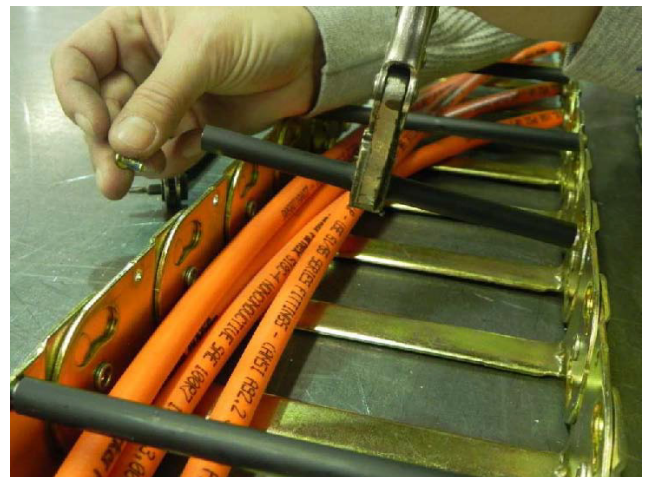
NOTE: Hoses shown in powertrack are for example only. Actual hose and cable arrangements are different.



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



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

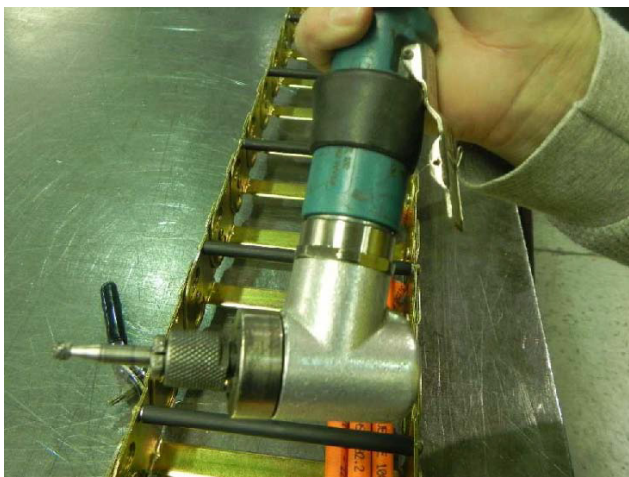


NOTICE

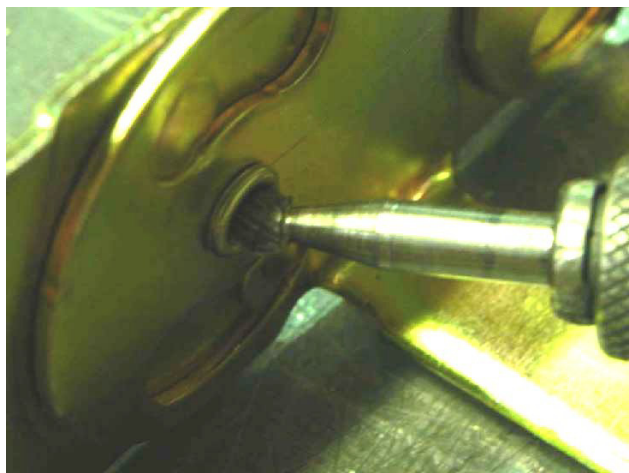
REPOSITION CABLES/HOSES. KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

SECTION 4 - BOOM & PLATFORM

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

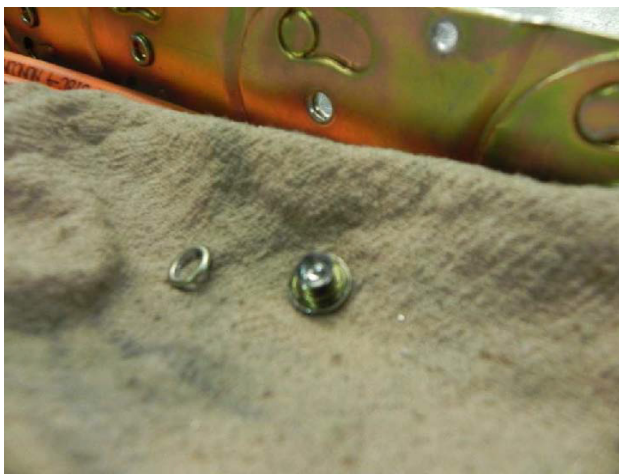
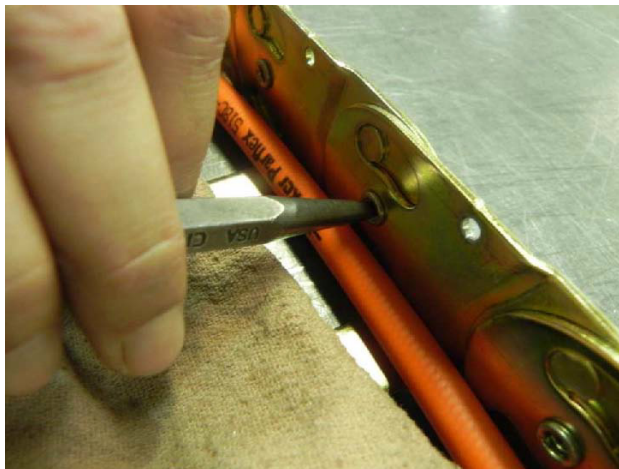


4. Insert tool into rolled over end of rivet. Grind out middle of rivet until rolled over part of rivet falls off. Repeat for all rivets to be removed.

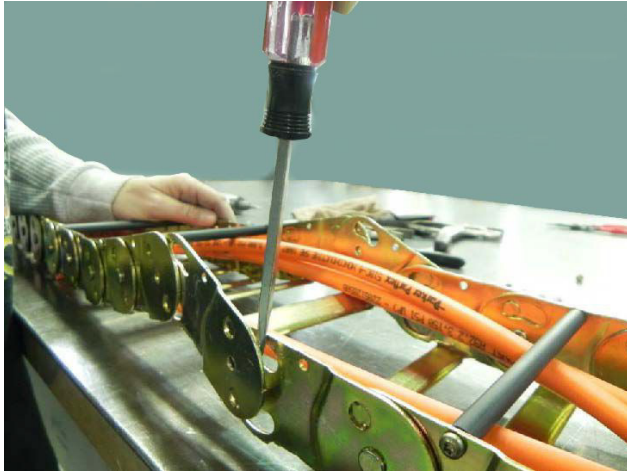


5. After grinding it may be necessary to use a center punch with a hammer to remove rivet.

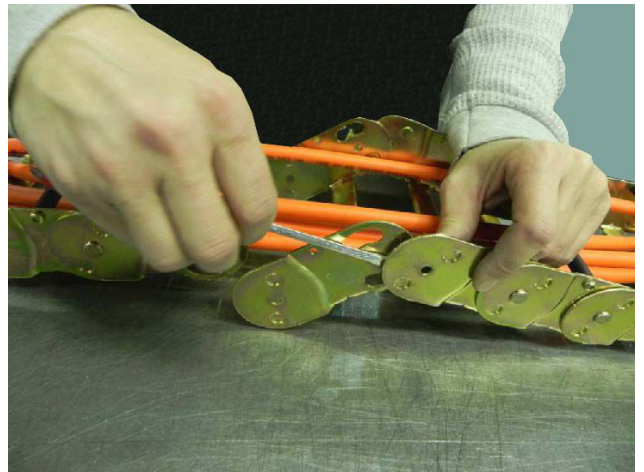
NOTE: It may be necessary to loosen fixed end brackets from machine to move track section enough to disconnect links.



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

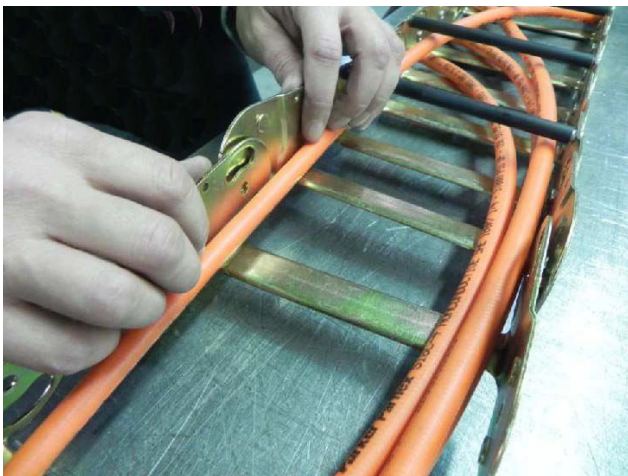


7. Remove link from other section of powertrack using screwdriver.

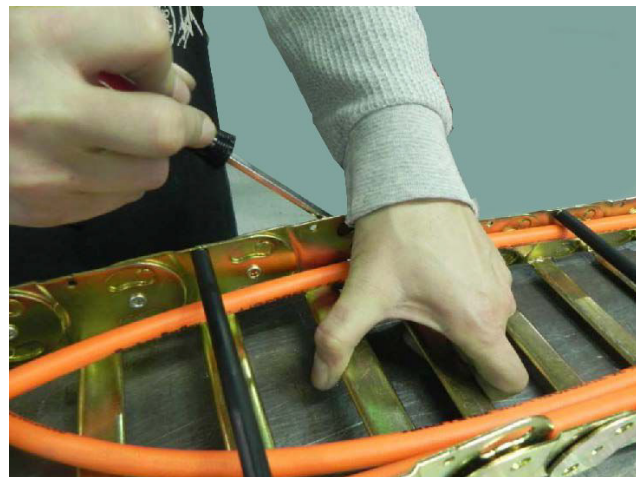
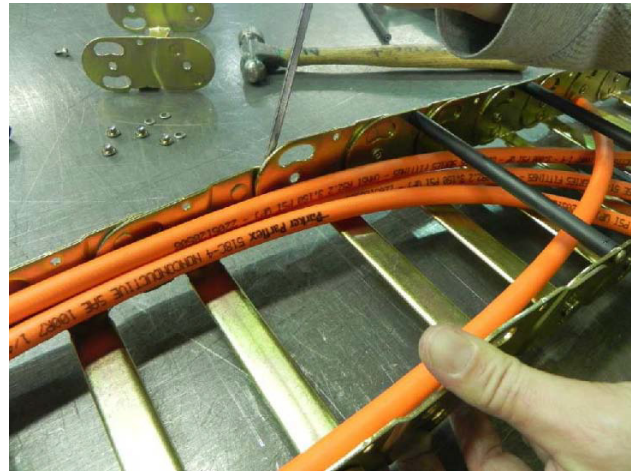


Install New Link

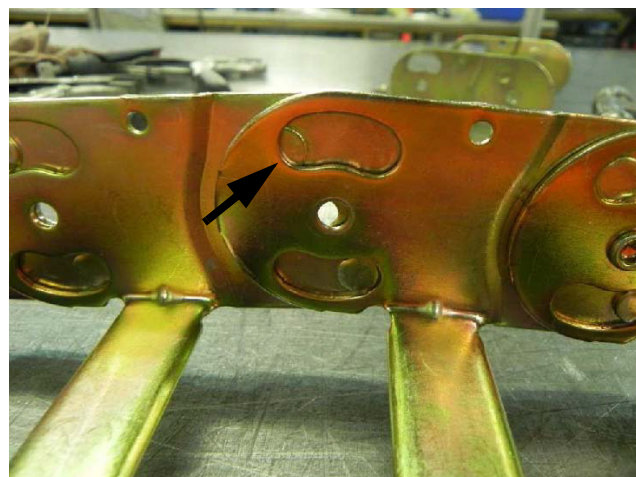
1. Squeeze cut-out end of new link into half-shear (female) end of track section.



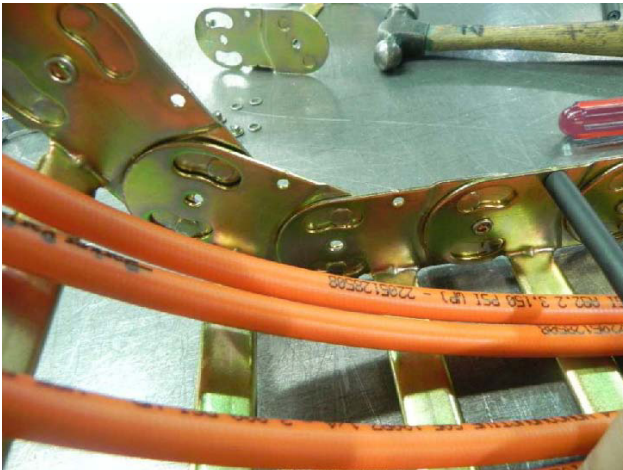
2. Spread half-shear (female) end of new link and slide cut-out end of track section into it. Use screwdriver if necessary.



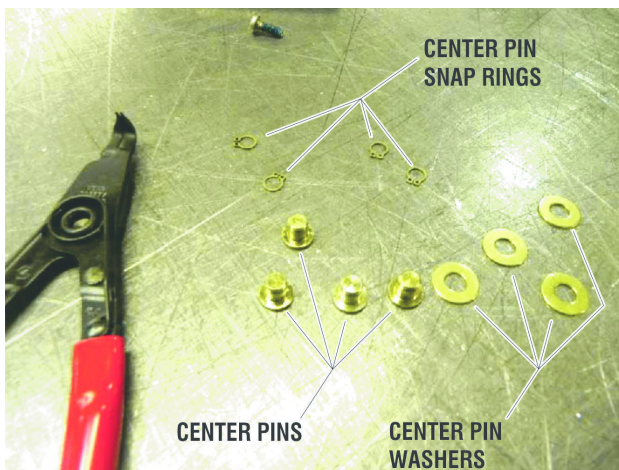
3. Round half-shears will not fit properly in cut-outs after new link is installed.



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



5. Parts shown below connect new link to powertrack.



6. Push pin through center hole. Slide washer on pin.

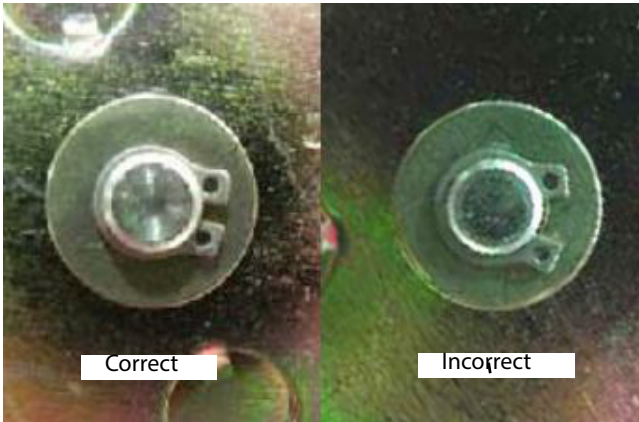


7. Install snap ring in groove on pin. Repeat pin installation steps for all center holes with rivets removed.

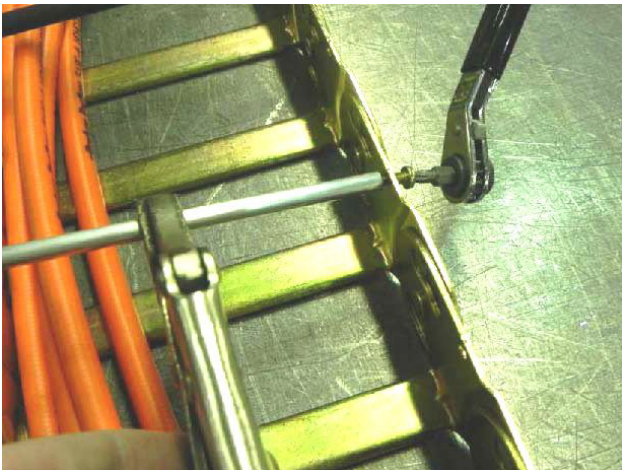


SECTION 4 - BOOM & PLATFORM

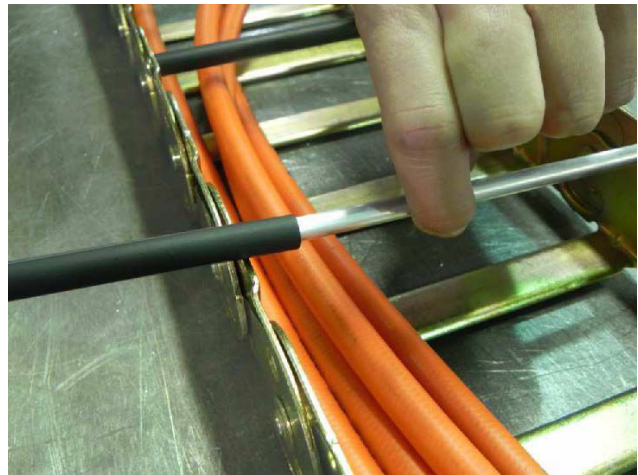
NOTE: Make sure snap rings are seated in pin groove and closed properly.



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



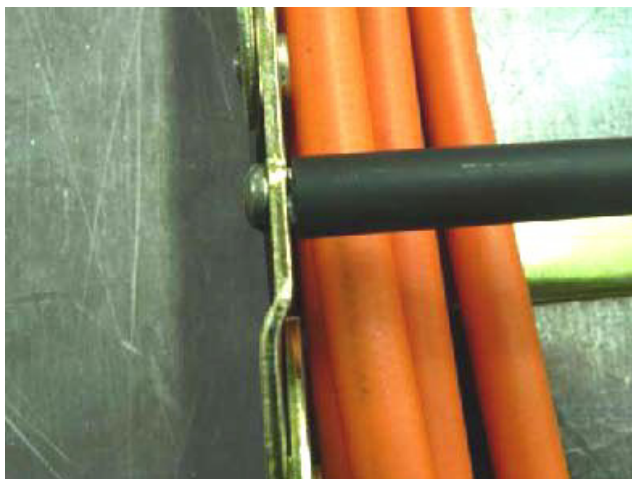
2. Pull up on other end of round bar. Slide new poly roller on bar.



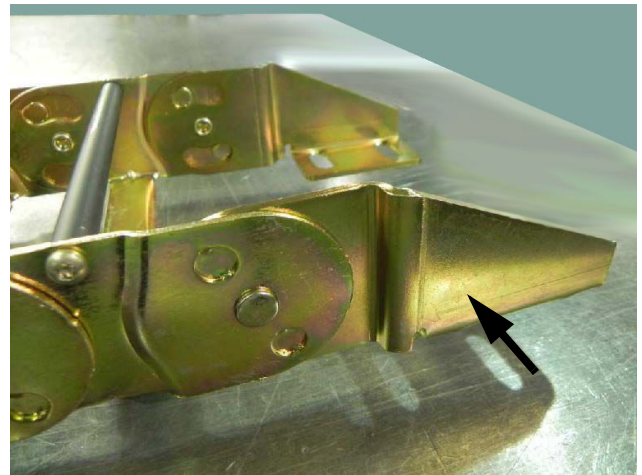
3. Install new 8-32 x 0.500 self threading screw on other side. Torque to 18-20 in-lb (2-2.25 Nm).



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



Replace Fixed End Brackets



NOTICE

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

1. Remove rivets as shown in link removal instructions.



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



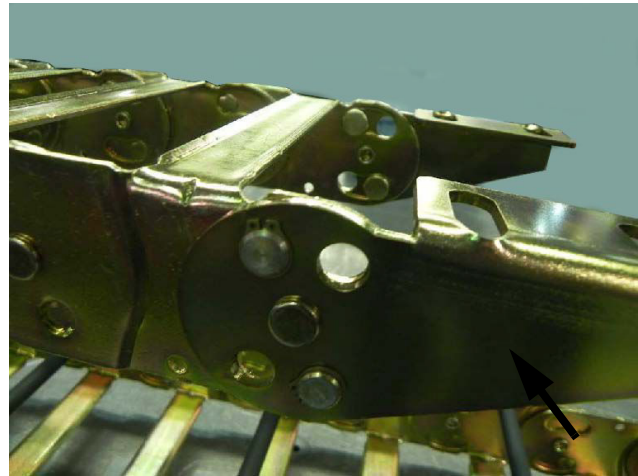
3. Take new bracket and install bracket center pin and snap ring. Repeat on other bracket if replacing it.



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



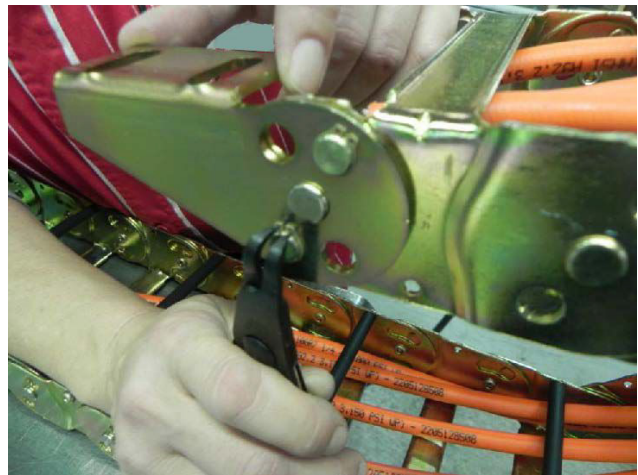
Replace Moving End Brackets



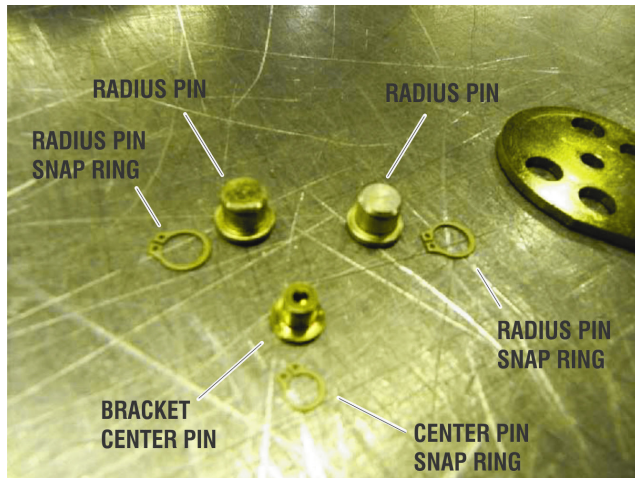
NOTICE

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

1. Remove existing pins and center rivet. Remove rivet as shown in link removal instructions on page 4-20. Repeat on other bracket if replaced.



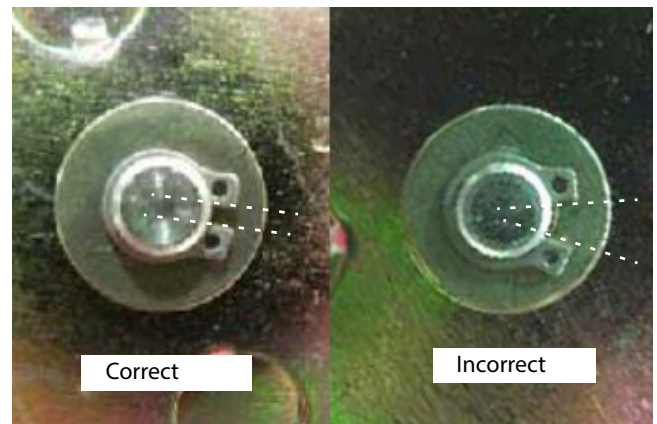
2. Install center pin with snap ring in new bracket.



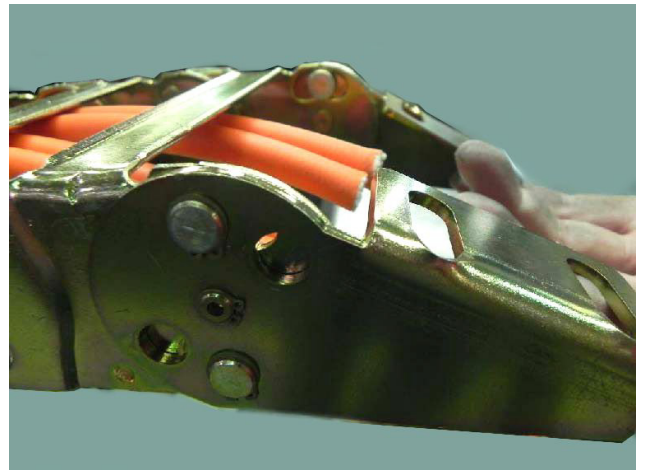
3. Install radius pins and snap rings in original locations. Repeat with other moving end if replaced.



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



4. Make sure both brackets rotate correctly.



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SECTION 5. BASIC HYDRAULIC INFORMATION & SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

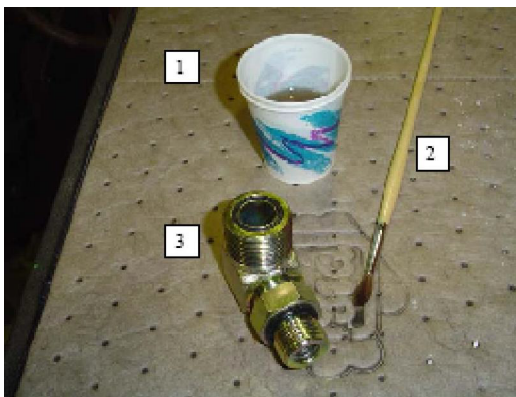
When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

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

Cup and Brush

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

- A small container for hydraulic oil
- Small paint brush



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



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



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



Dip Method

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

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

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



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



Spray Method

This method requires a pump or trigger spray bottle.

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



Brush-on Method

This method requires a sealed bottle brush.

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



5.2 HYDRAULIC CYLINDERS

Cylinder Locations

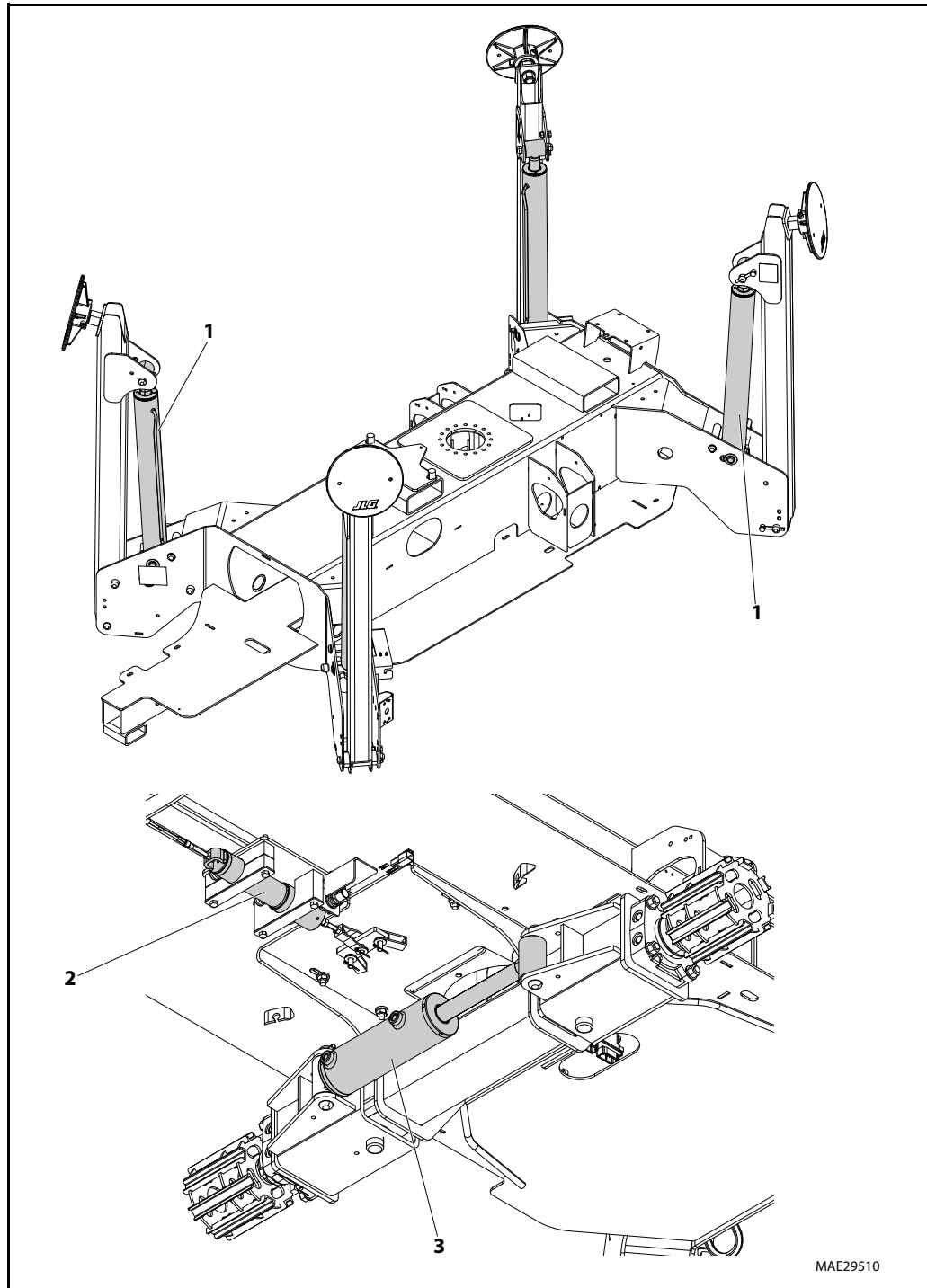
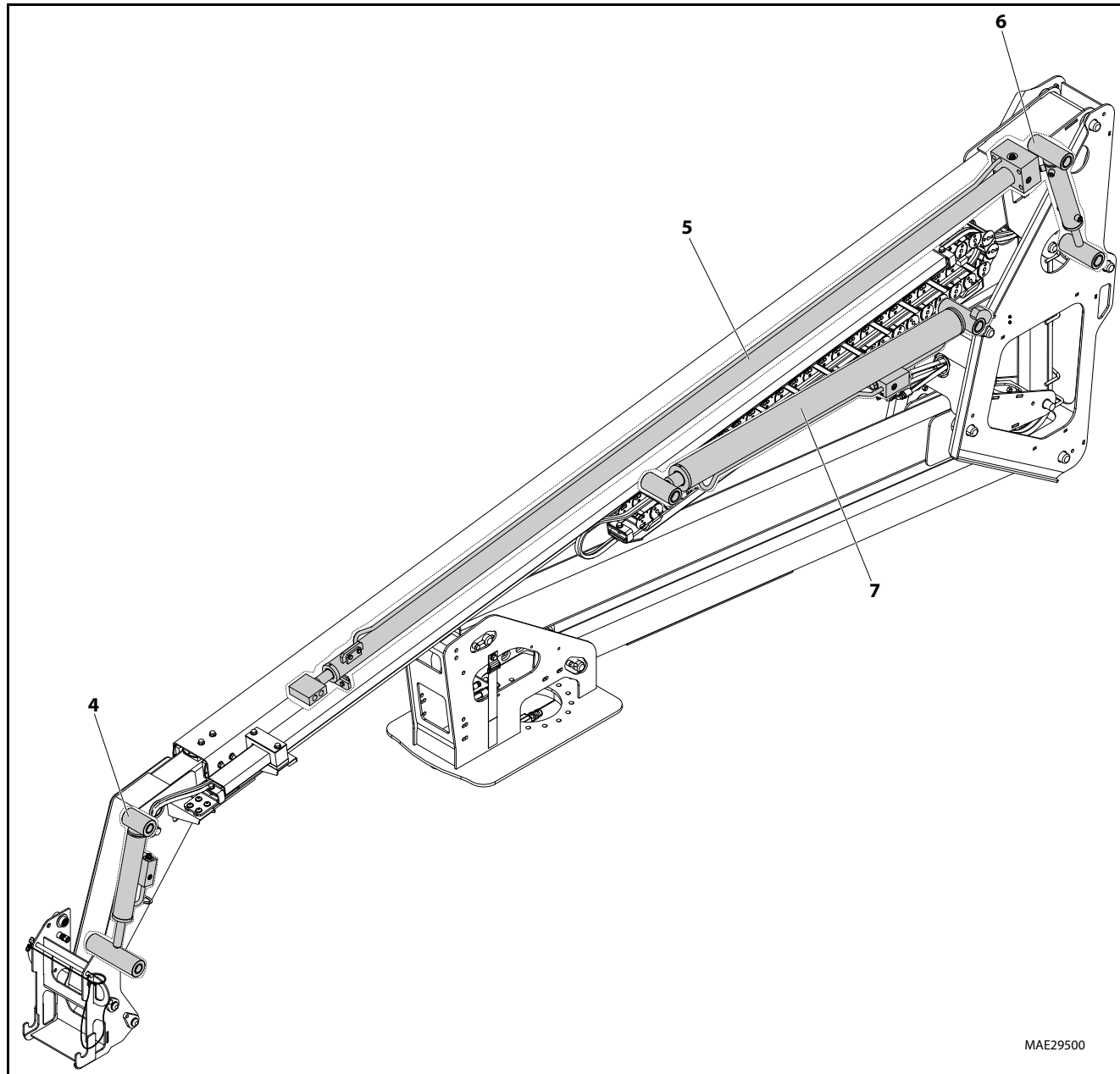


Figure 5-1. Cylinder Locations - Sheet 1 of 2



- | | | | |
|---------------------------|----------------------------|-----------------------|------------------|
| 1. Outrigger Cylinder | 3. Drive Engage Cylinder | 5. Telescope Cylinder | 7. Lift Cylinder |
| 2. Brake Release Cylinder | 4. Platform Level Cylinder | 6. Master Cylinder | |

Figure 5-2. Cylinder Locations - Sheet 2 of 2

Disassembly

CAUTION

DO NOT ATTEMPT TO SERVICE A HYDRAULIC CYLINDER WHILE IT IS INSTALLED. THE CYLINDER MUST BE REMOVED FROM THE MACHINE AND ALL PRESSURE MUST BE RELIEVED. AIR MUST NOT BE USED TO EXTEND OR RETRACT THE CYLINDER. SAFETY GLASSES MUST BE WORN AT ALL TIMES BY SERVICE PERSONNEL.

1. The cylinder should be secured in such a way as to prevent rotation of the barrel while unscrewing the head gland. Care should be taken to avoid damaging the rod surface and to avoid excessive deformation of the barrel, which could permanently damage the unit. Make sure to support the rod during removal.

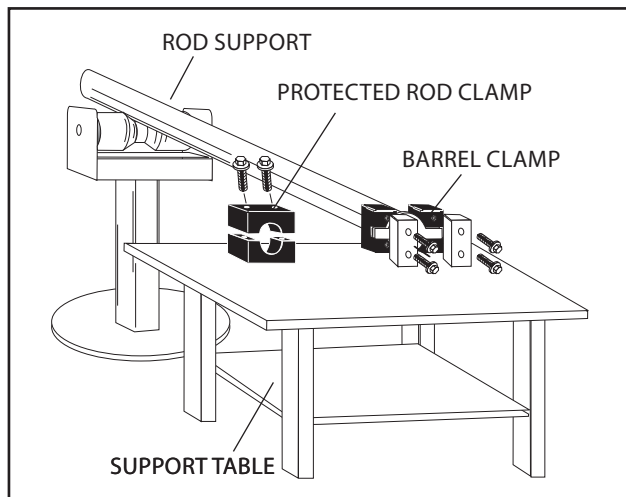


Figure 5-3. Cylinder Barrel Support

2. Remove all dirt, grease, and other contaminants from around the ports and the head gland. Drain all oil from the unit. Extending and retracting the rod manually can help purge the bulk of the remaining oil.

3. Mark the orientation of the rod, gland, and barrel with a permanent marker or paint pen. Do not apply any paint on the chromed surface of the rod. Unscrew the head gland from the cylinder assembly using a spanner wrench in the holes provided in the OD of the head gland.

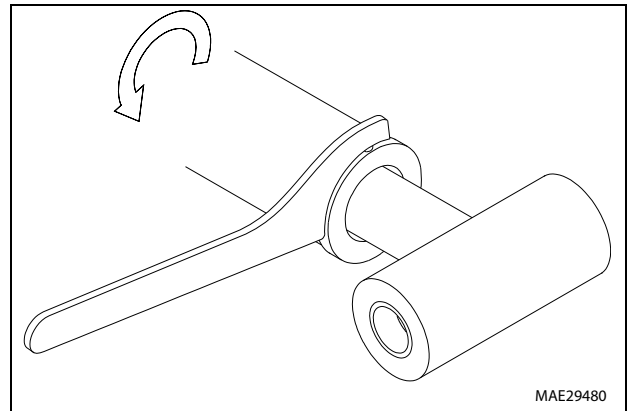


Figure 5-4. Cylinder Head Removal

NOTE: The threads are locked with a non-permanent thread adhesive during assembly. A quick tug on the wrench may be necessary to release the thread adhesive.

4. Remove the rod assembly from the barrel using care not to damage the threads or any other component surface.

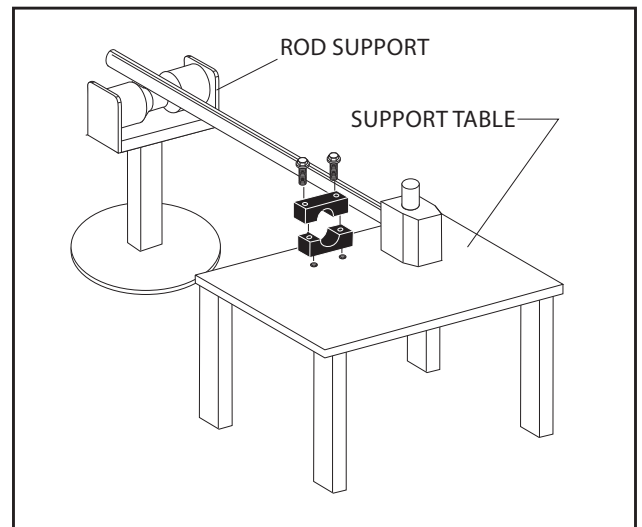
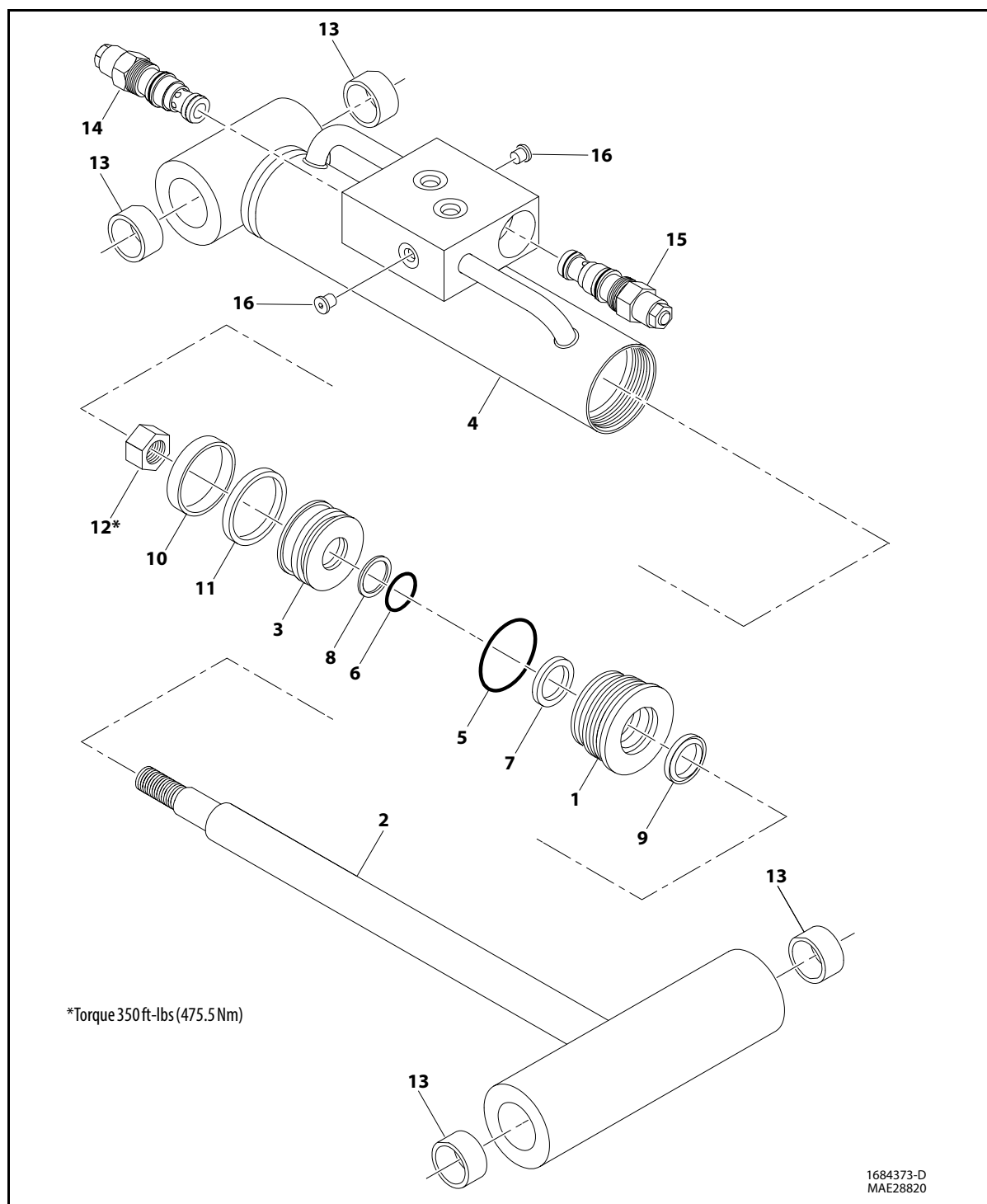


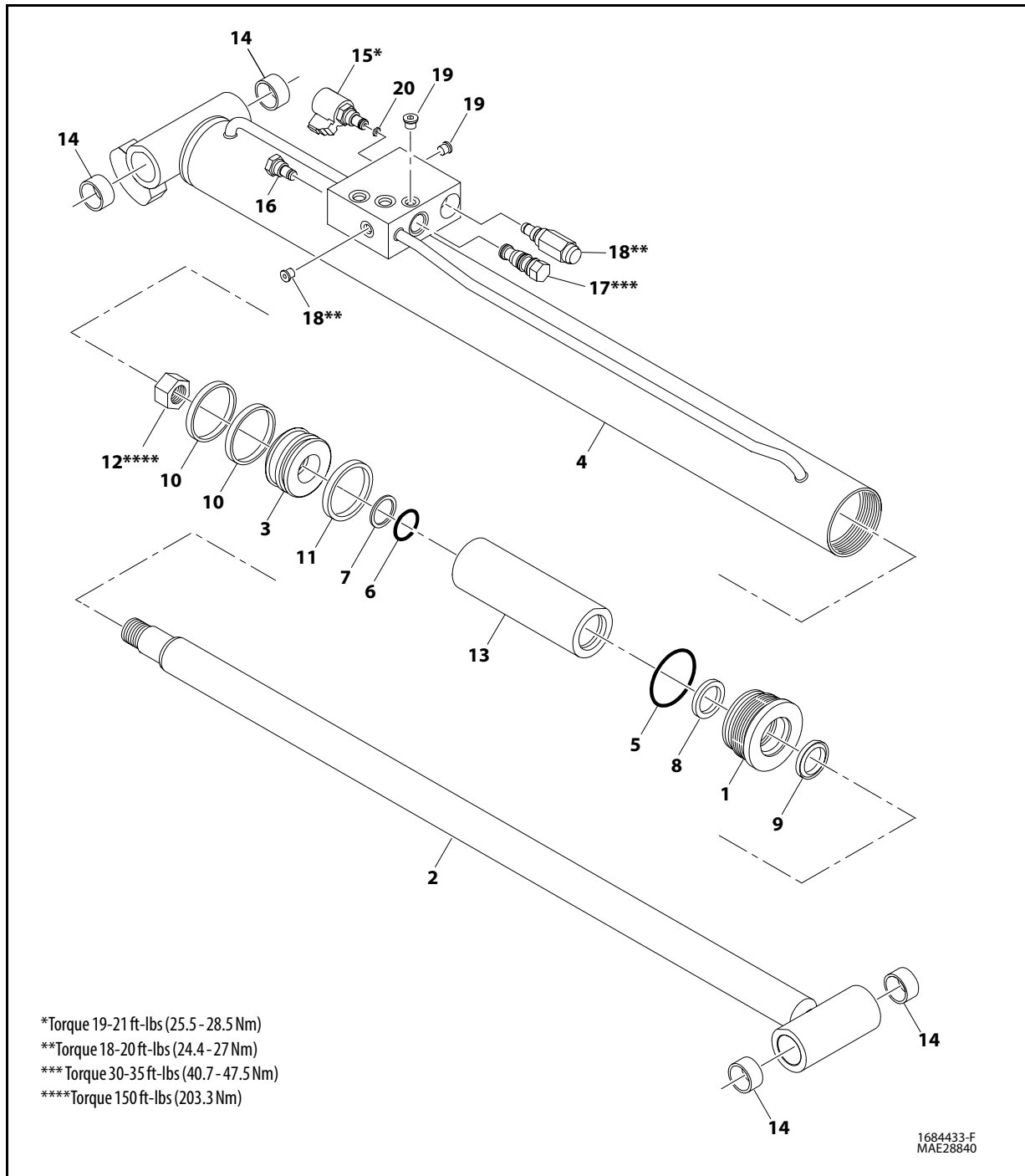
Figure 5-5. Cylinder Rod Support

5. Clamp the rod mount and support the rod assembly with the chrome surface protected. Remove the piston assembly either by unthreading the locknut with a socket wrench or the piston itself from the rod using a spanner wrench depending on the cylinder model.



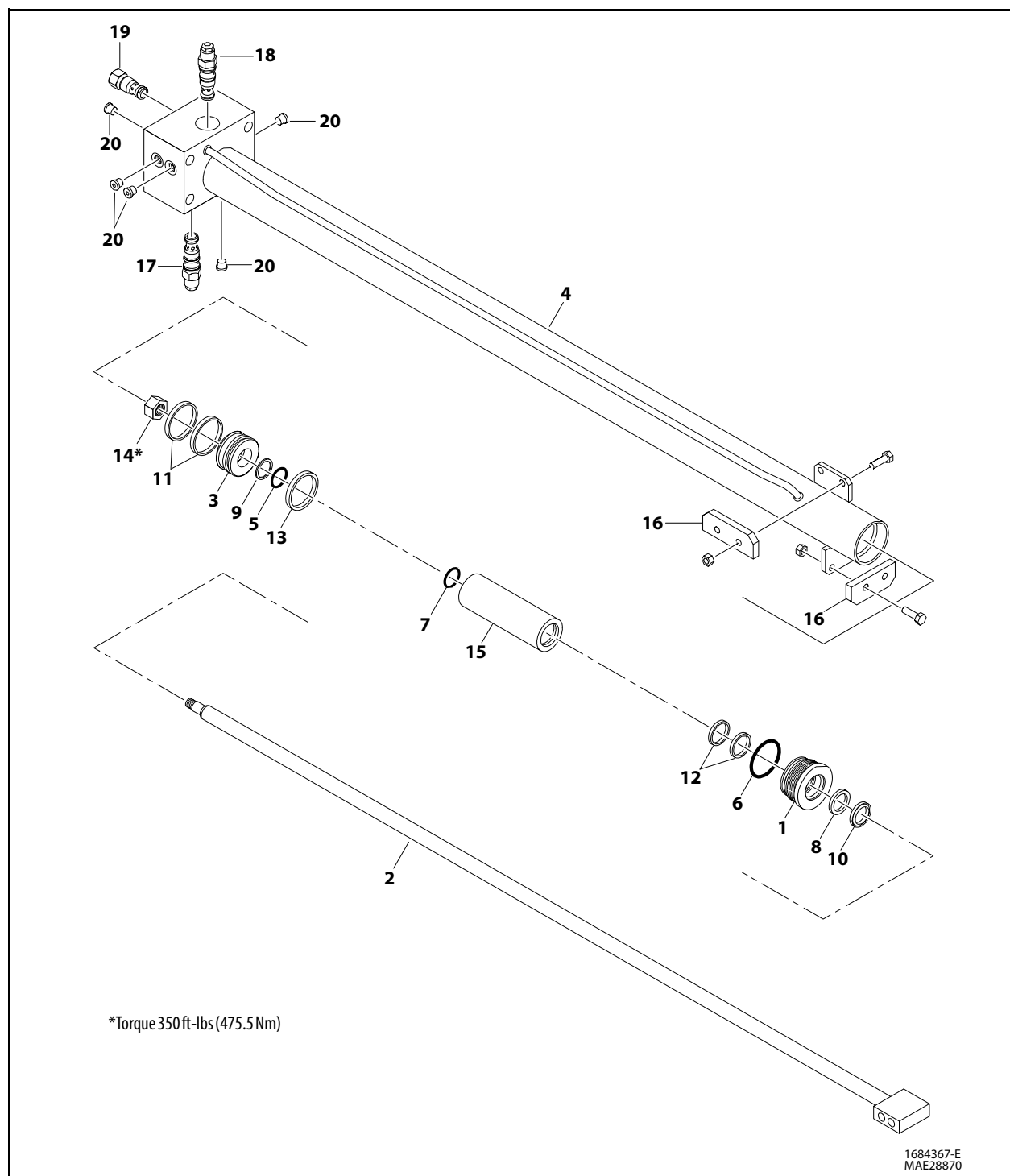
- | | | | |
|-----------|----------------|-----------------|--------------------------|
| 1. Head | 5. O-Ring | 9. Wiper Seal | 13. Bushing |
| 2. Rod | 6. O-Ring | 10. Wear Ring | 14. Counterbalance Valve |
| 3. Piston | 7. Rod Seal | 11. Piston Seal | 15. Counterbalance Valve |
| 4. Barrel | 8. Backup Ring | 12. Locknut | 16. Plug |

Figure 5-6. Platform Level Cylinder



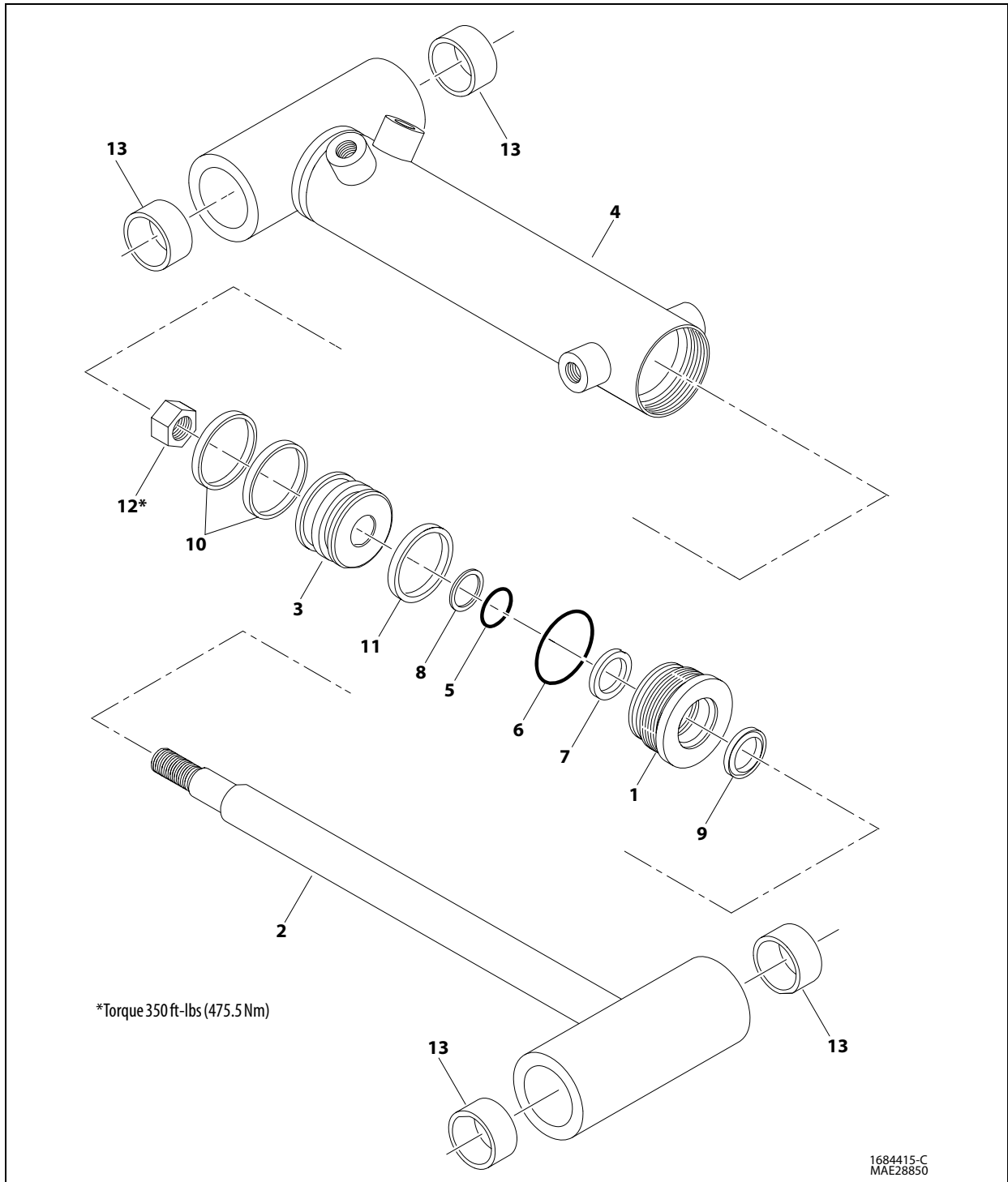
- | | | | |
|-----------|----------------|--------------------|-----------------------|
| 1. Head | 6. O-ring | 11. Piston Seal | 16. Check Valve |
| 2. Rod | 7. Backup Ring | 12. Locknut | 17. Pilot Check Valve |
| 3. Piston | 8. Rod Seal | 13. Spacer | 18. Relief Valve |
| 4. Barrel | 9. Wiper Seal | 14. Bushing | 19. Plug |
| 5. O-ring | 10. Wear Ring | 15. Solenoid Valve | 20. Orifice |

Figure 5-7. Lift Cylinder



- | | | | | |
|-----------|-------------|----------------|-----------------|--------------------------|
| 1. Head | 5. O-ring | 9. Backup Ring | 13. Piston Seal | 17. Counterbalance Valve |
| 2. Rod | 6. O-ring | 10. Wiper Seal | 14. Locknut | 18. Counterbalance Valve |
| 3. Piston | 7. O-ring | 11. Wear Ring | 15. Spacer | 19. Shuttle Valve |
| 4. Barrel | 8. Rod Seal | 12. Wear Ring | 16. Wear Pad | 20. Plug |

Figure 5-8. Telescope Cylinder



- | | | | | |
|-----------|-----------|----------------|-----------------|-------------|
| 1. Head | 4. Barrel | 7. Rod Seal | 10. Wear Ring | 13. Bushing |
| 2. Rod | 5. O-ring | 8. Backup Ring | 11. Piston Seal | |
| 3. Piston | 6. O-ring | 9. Wiper Seal | 12. Locknut | |

Figure 5-9. Master Cylinder

CLEANING AND INSPECTION

1. Inspect all seals, backup rings, wipers, and wear rings for tears, grooves, foreign matter, and excessive wear. Deep grooves may be an indication of damage to the barrel bore, rod chrome, or the presence of large particle contamination.
2. Remove the seals, backup rings, wipers, and wear rings using a soft metal tool (brass or aluminum) with rounded edges. Use care not to nick or score the surfaces of any component, especially the seal grooves.
3. Wipe all components with a lint-free cloth. Plug the barrel opening with a lint-free cloth. Remove any adhesive remnants from the head gland, barrel, rod, and piston threads (where applicable) using a soft wire brush. Use care not to scratch or otherwise damage the critical surfaces of any component including seal grooves, barrel bore, rod chrome, etc.
4. Inspect the piston and head gland for excessive wear, cracks, scoring, or any other damage. If wear is present on the OD of the piston or the ID of the head gland, check to ensure that the circularity of both dimensions is within 0.007" (0.177 mm). Beyond this limit the seal performance is compromised and the components must be replaced.
5. If equipped, the stop tube should be inspected for cracking and excessive flaring of the ends.
6. Closely inspect the chrome surface of the rod. Any nicks, gouges, or scratches that penetrate the chrome plating or result in a sharp edge, which may damage seals, are cause for rod assembly replacement.
7. Flush the barrel and fluid tube (if equipped), drain, and wipe dry with a lint-free cloth. Closely inspect bore for nicks, gouges, or scratches. Replace the barrel assembly if any of these are present.

Assembly

NOTICE

INSPECT ALL COMPONENTS AS DESCRIBED UNDER INSPECTION. CLEAN ALL COMPONENTS WITH A LINT-FREE CLOTH. THE BARREL SHOULD BE FLUSHED OUT AND DRAINED. COMPRESSED AIR MUST BE USED TO BLOW OUT THE BARREL BORE AND ALL PORTS. LUBRICATE ALL SEALS WITH HYDRAULIC FLUID PRIOR TO ASSEMBLY.

HEAD GLAND ASSEMBLY

1. Install rod seal. Check for proper orientation.
2. Install wear rings on gland ID if required.
3. Rod wipers are installed by snapping the wiper into the groove.
4. Install the backup ring and o-ring with the backup ring nearest the head gland threads.

PISTON ASSEMBLY

1. Install wear rings onto piston.
2. Install piston seal into central groove on piston OD. A clean, small cross-section o-ring or a thin elastic band may be wrapped around seal to help stretch it over the piston.
3. Install piston seal backup rings on both sides of seal. Make sure the backup rings are oriented so that lips on the side lock into grooves in the sides of the seal.

ROD, GLAND, PISTON ASSEMBLY

1. Lubricate ID of head gland assembly with hydraulic fluid, and slide onto rod (rod wiper end first) using caution not to damage rod wiper or seal on rod end.
2. Slide stop tube (if equipped) onto rod. Do not scratch rod chrome.
3. Apply Loctite #7471 (Primer-T) to piston and rod threads. Allow primer to evaporate then apply two beads of Loctite #222 Thread Adhesive axially across the threads of the piston ID.
4. Screw threaded piston onto rod end and torque to 100 ft.lbs. (136 Nm). An optional method for tightening the threaded piston is to turn until the piston bottoms out, then set in place by hitting the spanner wrench handle with a hammer; the piston should rotate slightly.
5. For all non-threaded pistons, install the piston assembly onto the threaded end of the rod. Torque the locknut to the following specification:

Table 5-1. Torques of Locknut

Cylinder	Torque
Telescope, Platform Level, Master	350 ft.lbs. (475 Nm)
Lift	150 ft.lbs. (203 nm)

FINAL ASSEMBLY

1. Ensure all rags, etc. are removed from the barrel bore. Apply Loctite #7471 (Primer-T) to the barrel bore and gland threads. Lubricate the barrel bore and piston assembly with hydraulic fluid. Avoid getting any oil on the barrel threads.
2. Align the rod with the barrel assembly. Insert the piston into the barrel opening. Use care to avoid damaging the wear rings, seals, and piston surface on the barrel.
3. Lubricate the o-ring and backup ring on the head gland using hydraulic fluid. Avoid getting oil on the threads. Apply two beads of Loctite #222 Thread Adhesive axially across the head gland threads. Screw the gland into the barrel and torque to 100 ft.lbs. (135 Nm). An optional method for tightening the head gland is to turn until the head gland bottoms out, then set in place by hitting the spanner wrench handle with a hammer, the head gland should rotate slightly.

TESTING

1. Set the test apparatus to test the pressures as listed below.

Cylinder	Working Pressure	
	PSI	Bar
Telescope	1000	69
Platform Level	1050	72
Master	1050	72
Lift	2500	172
Outtrigger	2400	165

2. Connect pressure lines to the proper ports.
3. Extend and retract the cylinder to full stroke position three times.
4. Check for leakage in each position at all weld joints, between the head gland and the barrel, and between the head gland and rod.
5. Drain all hydraulic fluid and cap or plug all ports.

Outrigger Cylinder

DISASSEMBLY

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to cylinder port block fitting.

NOTICE

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. If applicable, remove solenoid valve and fittings from cylinder port block. Discard o-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

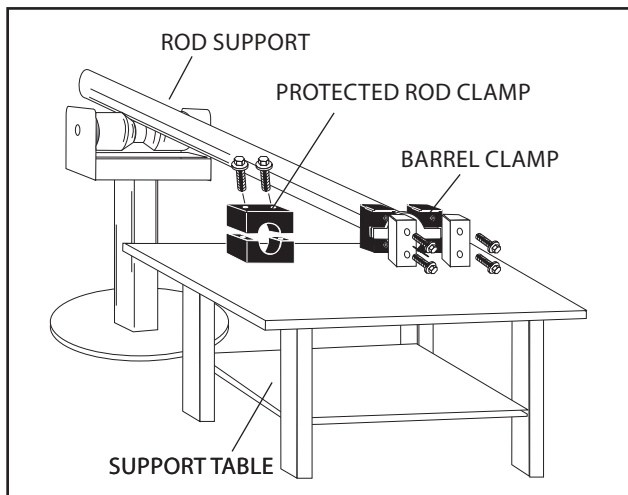


Figure 5-10. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew cylinder head (1) with Pin face spanner wrench.

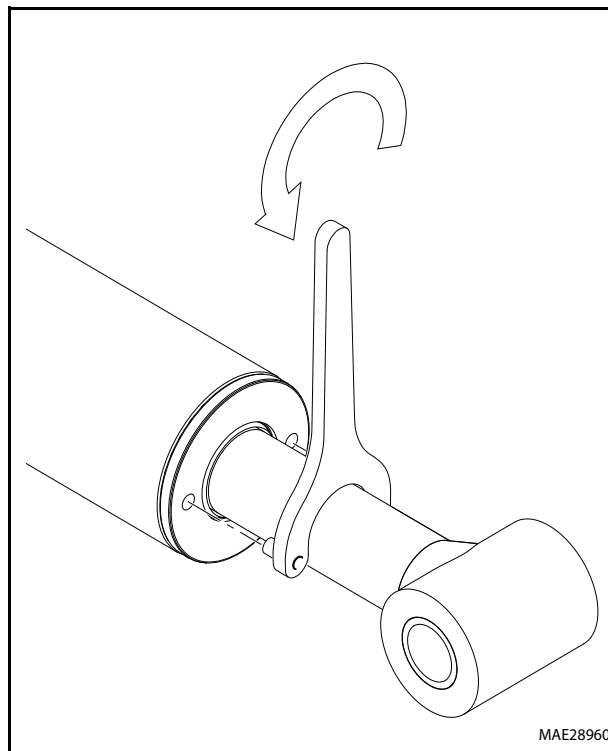


Figure 5-11. Cylinder Head Removal

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

6. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.
7. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

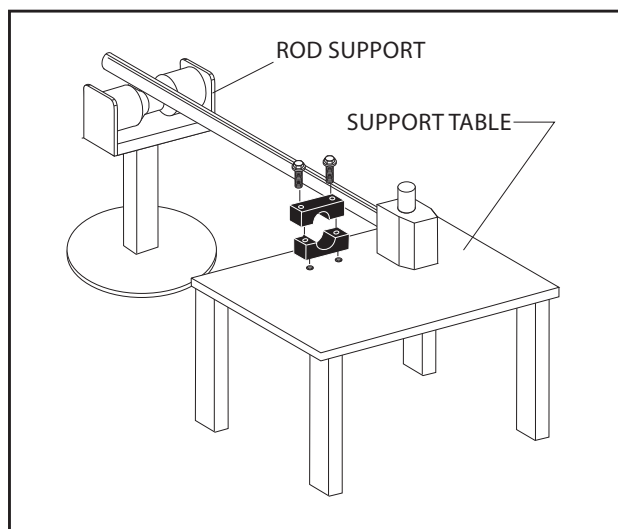
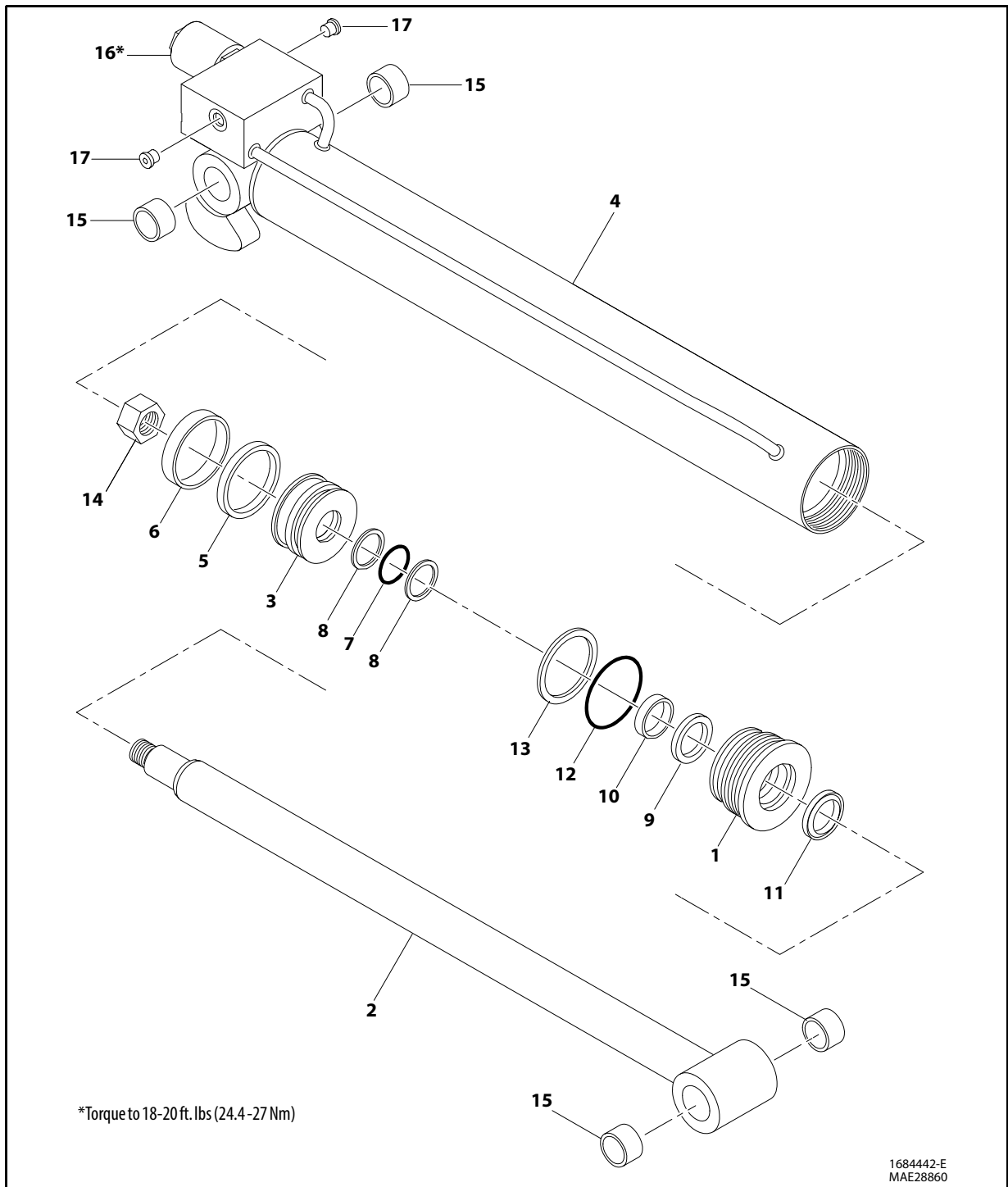


Figure 5-12. Cylinder Rod Support



- | | | | | | |
|-----------|--------------|----------------|----------------|-----------------|--------------------|
| 1. Head | 4. Barrel | 7. O-ring | 10. Wear Ring | 13. Backup Ring | 16. Solenoid Valve |
| 2. Rod | 5. T-Seal | 8. Backup Ring | 11. Wiper Seal | 14. Locknut | 17. Plug |
| 3. Piston | 6. Wear Ring | 9. Rod Seal | 12. O-ring | 15. Bushing | |

Figure 5-13. Outrigger Cylinder

NOTICE

REMOVE SEALS USING A BRASS OR PLASTIC PICK ONLY. DO NOT USE A KNIFE, SHARP OBJECT, OR SCREW DRIVER. NOTE SEAL ORIENTATION BEFORE REMOVING FOR PROPER INSTALLATION.

8. Remove Locknut (14) from the rod(2).
9. Screw piston counter-clockwise and remove from rod.
10. Remove and discard wear ring (6) and T-seal (5) from piston (3).
11. Remove and discard backup rings (8) and o-ring (7) from piston (3).

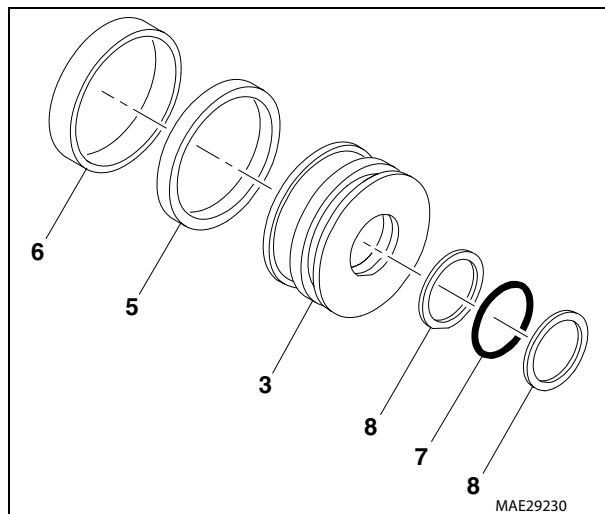


Figure 5-14. Piston Disassembly

12. Remove rod from holding fixture.
10. Remove cylinder head assembly (1) from rod (2).
10. Remove and discard backup ring (13), o-ring (12), wear ring (10) from cylinder head (1).
11. Remove and discard rod seal (9) and wiper seal (11) from cylinder head (1).

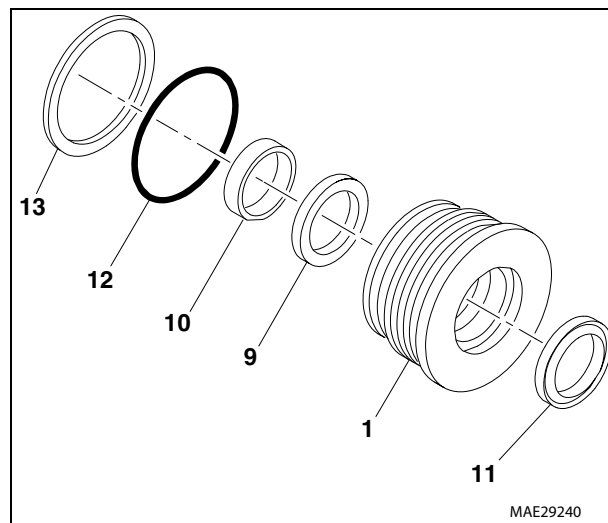


Figure 5-15. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring, or distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring, damage, ovality, and tapering. Replace as necessary.

13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inner side of the steel bushing prior to bearing installation.
 - d. Press composite bushing into barrel or rod bushing with correct size arbor.

NOTE: Lubrication is not required with nickel plated pins and bearings. Install pin in composite bushing dry.

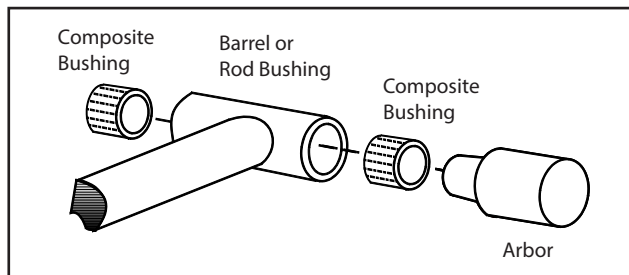


Figure 5-16. Composite Bushing Installation

14. If applicable, inspect port block fittings and holding valve. Replace as necessary.
15. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.
16. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: Use proper cylinder seal kit for cylinder assembly. See your JLG Parts Manual.

NOTE: Apply a light film of hydraulic oil to all components before assembly.

1. Install rod seal (9), wiper seal (11) and wear ring (10) inside the cylinder head.
2. Install o-ring (12) on cylinder head.

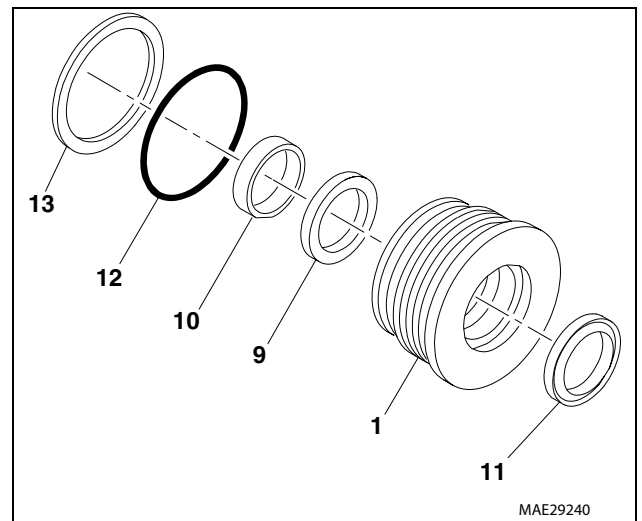


Figure 5-17. Cylinder Head Assembly

3. Install backup ring (13) on cylinder head.
4. Slide cylinder head assembly onto rod (2). Do not dislodge or damage seals.
5. Support rod in holding fixture.
6. Install backup rings (8) and o-ring (7) inside the piston assembly.

7. Install T-seal (5) and wear ring (6) on piston (3).

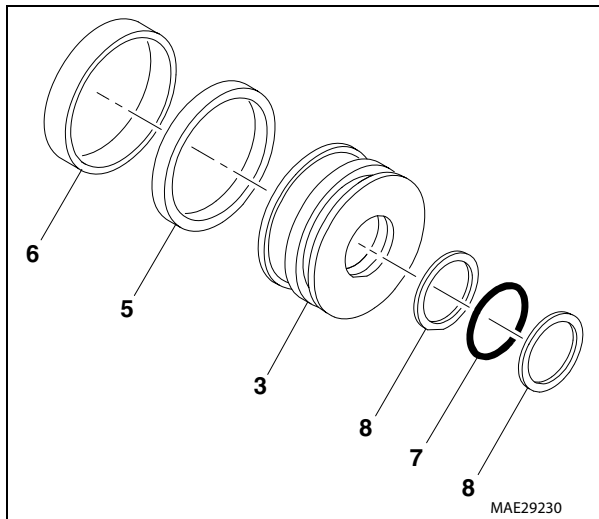


Figure 5-18. Piston Disassembly

8. Screw the piston (3) on to rod end. Do not dislodge or damage seals.
9. Install locknut (14) on the rod.
10. Remove cylinder rod from holding fixture.
11. Position cylinder barrel in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

12. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge seal.
13. Continue pushing rod into barrel until cylinder head gland can be inserted into barrel cylinder.
14. Screw the cylinder head gland into the barrel using a tool and tighten until punch mark matches.

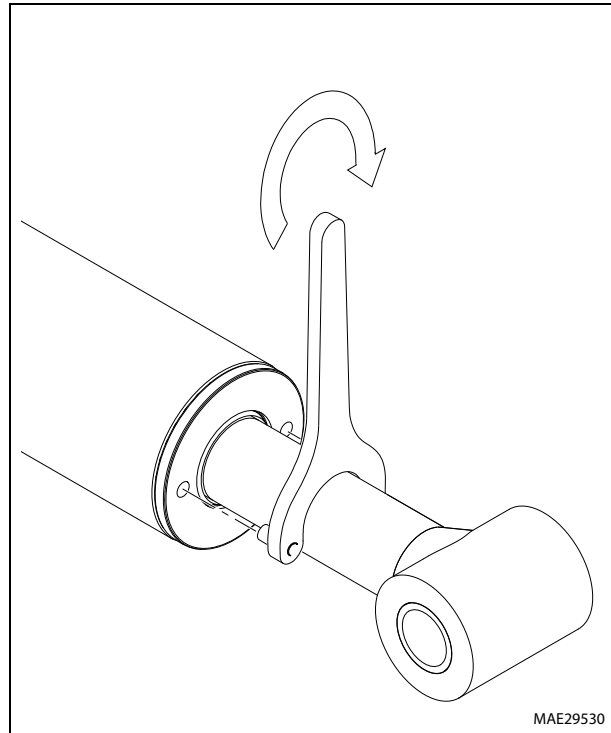


Figure 5-19. Cylinder Head Installation

15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
16. Install the solenoid valve and fittings in the rod port block, using new o-rings as applicable.

Brake Release Cylinder

DISASSEMBLY

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. If applicable, remove cartridge-type counterbalance valve and fittings from cylinder port block. Discard o-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

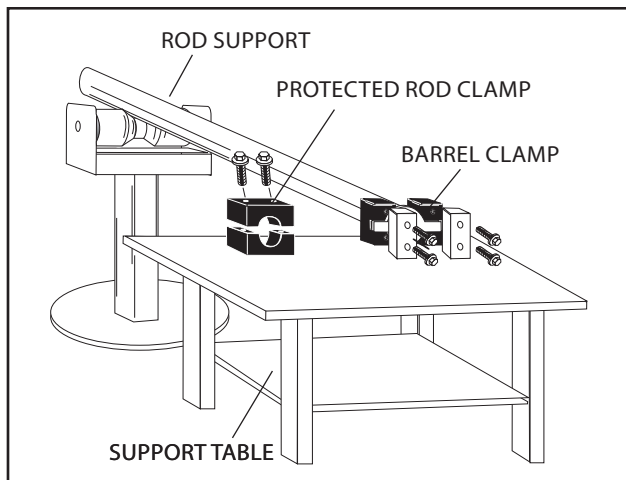


Figure 5-20. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew cylinder head (3) with spanner wrench.
6. Remove and discard o-ring (9) and backup ring (10) from barrel.

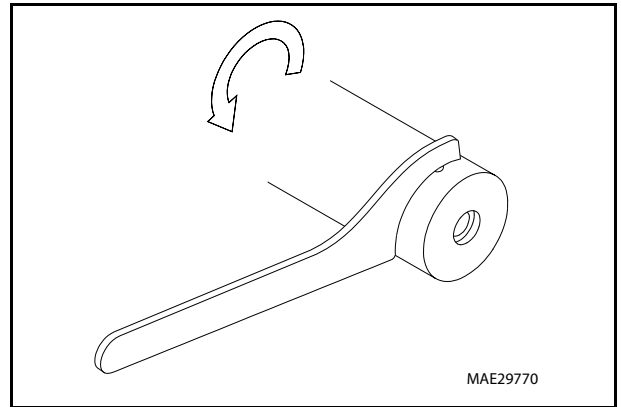


Figure 5-21. Cylinder Head Removal

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

7. Clamp barrel securely. Pull rod (2) assembly from barrel (1).
8. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

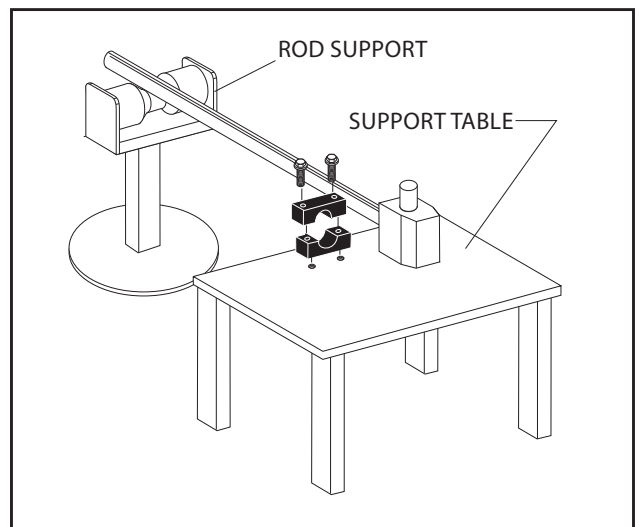
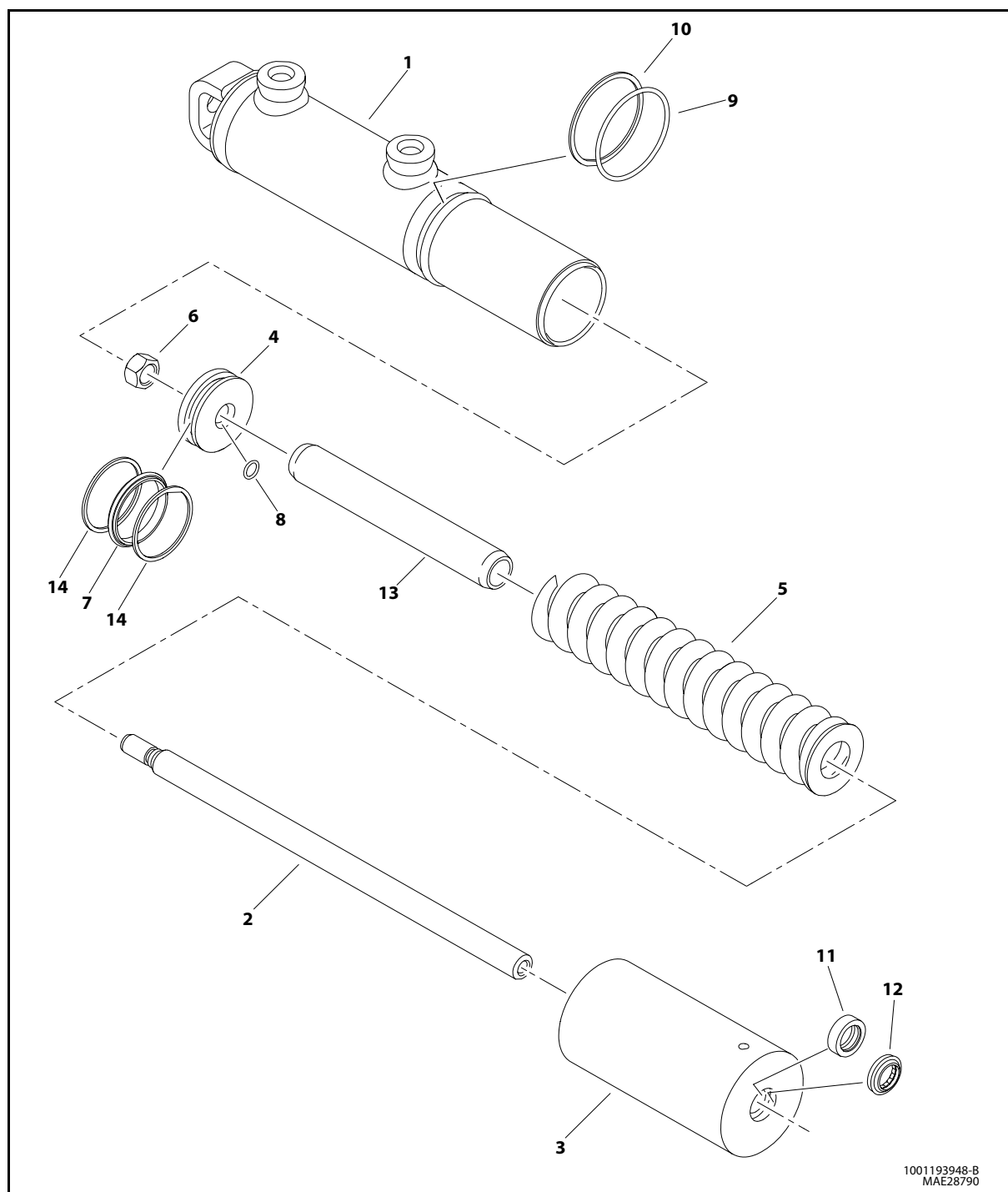


Figure 5-22. Cylinder Rod Support



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MAE28790

- | | | |
|-----------|-----------------|-----------------|
| 1. Barrel | 6. Nut | 11. Rod Seal |
| 2. Rod | 7. O-ring | 12. Wiper Seal |
| 3. Head | 8. O-ring | 13. Spacer |
| 4. Piston | 9. O-ring | 14. Backup Ring |
| 5. Spring | 10. Backup Ring | |

Figure 5-23. Brake Release Cylinder

NOTICE

REMOVE SEALS USING A BRASS OR PLASTIC PICK ONLY. DO NOT USE A KNIFE, SHARP OBJECT, OR SCREW DRIVER. NOTE SEAL ORIENTATION BEFORE REMOVING FOR PROPER INSTALLATION.

9. Remove locknut (6) from the rod (2).
10. Screw piston counter-clockwise and remove from rod.
11. Remove and discard o-ring (7), backup rings (14) and o-ring (8) from piston (4).

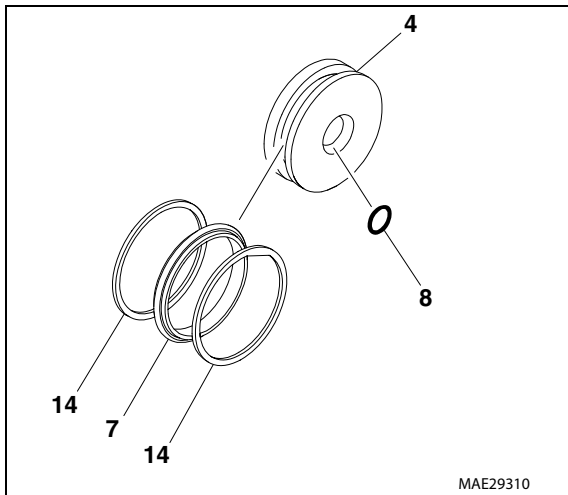


Figure 5-24. Piston Disassembly

12. Remove spring (5) and spacer (13) from rod (2).
13. Remove rod from holding fixture.
14. Remove and discard wiper seal (12), rod seal (11) from cylinder head (3).

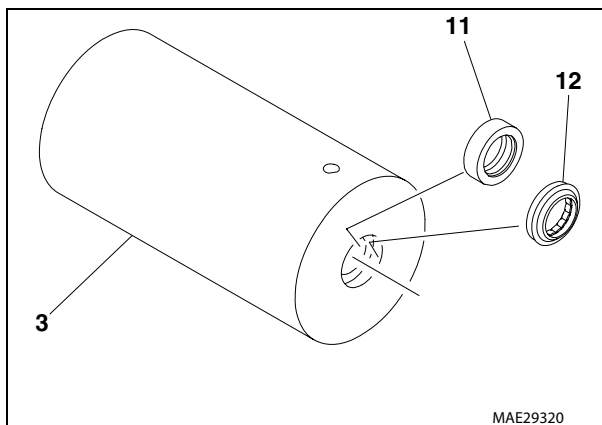


Figure 5-25. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring, or distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring, damage, ovality, and tapering. Replace as necessary.
13. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
14. If applicable, inspect port block fittings and holding valve. Replace as necessary.
15. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.
16. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: Use proper cylinder seal kit for cylinder assembly. See your JLG Parts Manual.

NOTE: Apply a light film of hydraulic oil to all components before assembly.

1. Support rod in holding fixture.
2. Slide spacer (13) on the rod (2).
3. Install spring (5) onto the spacer and rod.
4. Install o-ring (8) inside the piston (4).
5. Install o-ring (7) and backup ring (14) on the piston.

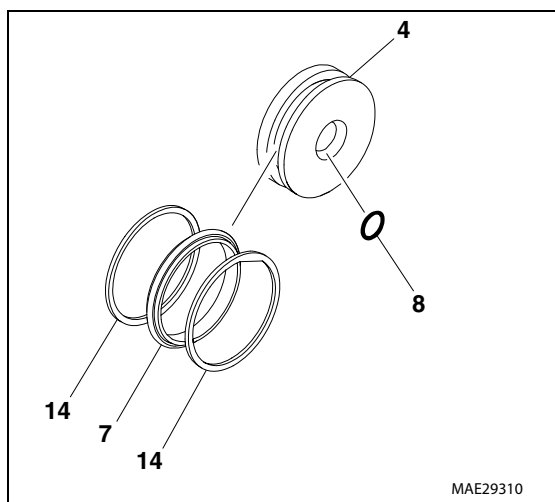


Figure 5-26. Piston Disassembly

6. Screw the piston (4) onto rod. Do not dislodge or damage seals.
7. Install locknut (6) on the rod.

8. Install rod seal (11) and wiper seal (12) inside the cylinder head.

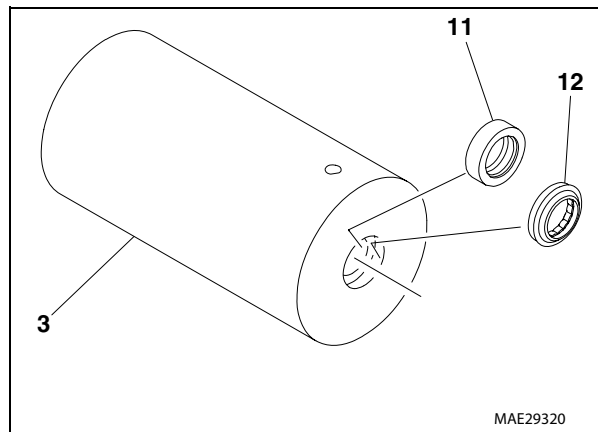


Figure 5-27. Cylinder Head Assembly

9. Remove cylinder rod from holding fixture.
10. Position cylinder barrel in suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

11. Clamp barrel securely and support rod. Insert piston end into barrel. Do not damage or dislodge piston loading o-ring and seal ring.
12. Screw the cylinder head gland into the barrel using a spanner wrench, and tighten until punch mark matches.

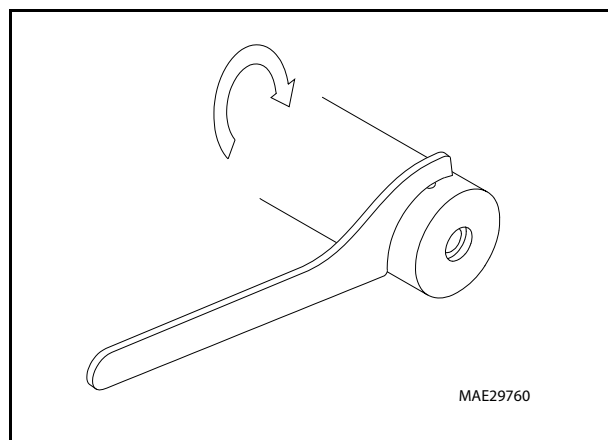


Figure 5-28. Cylinder Head Installation

13. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

Drive Engage Cylinder

DISASSEMBLY

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

1. Connect a suitable auxiliary hydraulic power source to cylinder port block fitting.
2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. If applicable, remove cartridge-type counterbalance valve and fittings from cylinder port block. Discard o-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

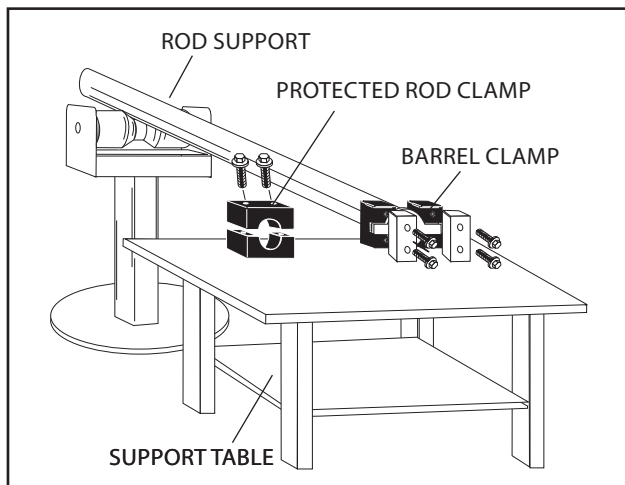


Figure 5-29. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew cylinder head (4) with spanner wrench.

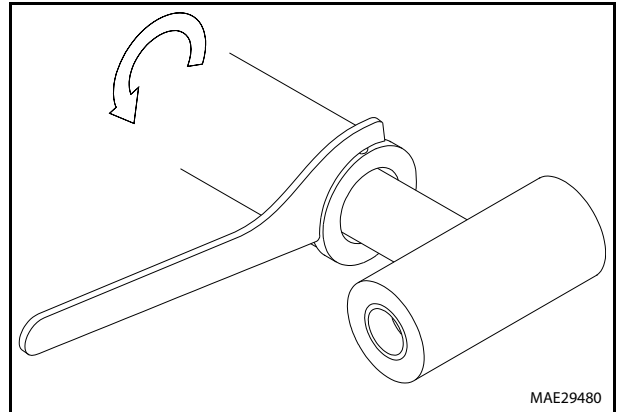


Figure 5-30. Cylinder Head Removal

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

6. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.
7. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

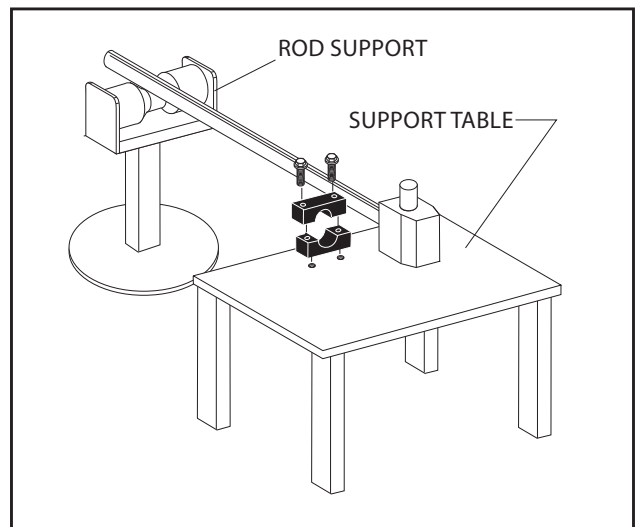
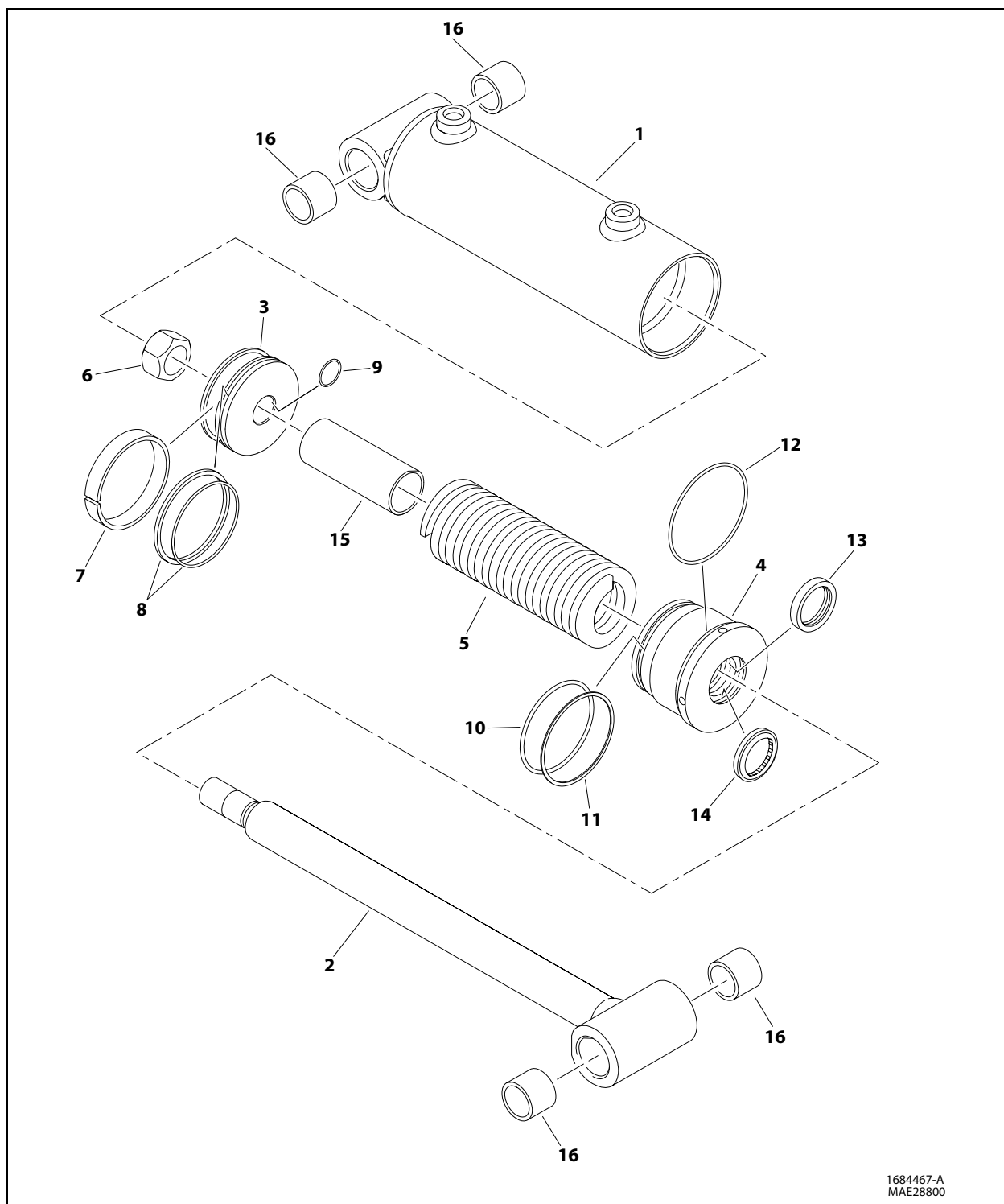


Figure 5-31. Cylinder Rod Support



- | | | | |
|-----------|----------------|------------|----------------|
| 1. Barrel | 5. Spring | 9. O-ring | 13. Rod Seal |
| 2. Rod | 6. Locknut | 10. O-ring | 14. Wiper Seal |
| 3. piston | 7. Wear Ring | 11. Seal | 15. Spacer |
| 4. Head | 8. Piston Seal | 12. O-ring | 16. Bushing |

Figure 5-32. Drive Engage Cylinder

NOTICE

REMOVE SEALS USING A BRASS OR PLASTIC PICK ONLY. DO NOT USE A KNIFE, SHARP OBJECT, OR SCREW DRIVER. NOTE SEAL ORIENTATION BEFORE REMOVING FOR PROPER INSTALLATION.

8. Remove locknut (6) from rod(2).
9. Screw piston counter-clockwise and remove from rod.
10. Remove and discard piston seal (8) and wear ring (7) from piston (3).
11. Remove and discard o-ring (9) from piston.

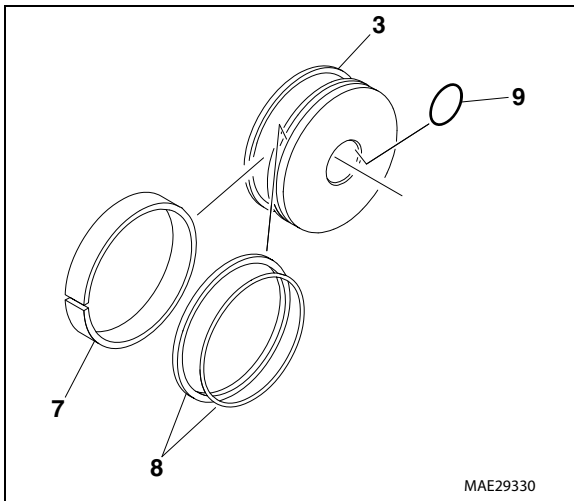


Figure 5-33. Piston Disassembly

12. Remove spring (5) and spacer (15) from rod.
13. Remove rod from holding fixture.
14. Remove cylinder head assembly (4) from rod (2).
15. Remove and discard o-rings (10 and 12) and seal (11) from cylinder head (4).

16. Remove and discard rod seal (13) and wiper seal (14) from head assembly.

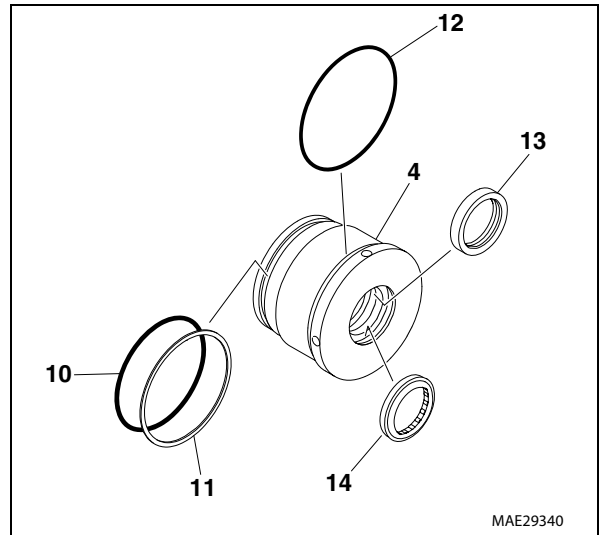


Figure 5-34. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring, or distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring, damage, ovality, and tapering. Replace as necessary.

13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inner side of the steel bushing prior to bearing installation.
 - d. Press composite bushing into barrel or rod bushing with correct size arbor.

NOTE: Lubrication is not required with nickel plated pins and bearings. Install pin in composite bushing dry.

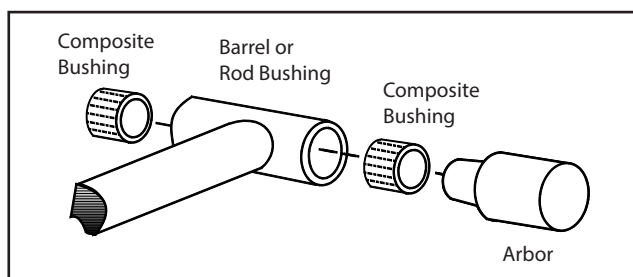


Figure 5-35. Composite Bushing Installation

14. If applicable, inspect port block fittings and holding valve. Replace as necessary.
15. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.
16. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: Use proper cylinder seal kit for cylinder assembly. See your JLG Parts Manual.

NOTE: Apply a light film of hydraulic oil to all components before assembly.

1. Install rod seal (13) and wiper seal (14) inside the cylinder head.
2. Install o-rings (10 and 12) and seal (11) on cylinder head.
3. Slide cylinder head assembly onto rod (2). Do not dislodge or damage seals.

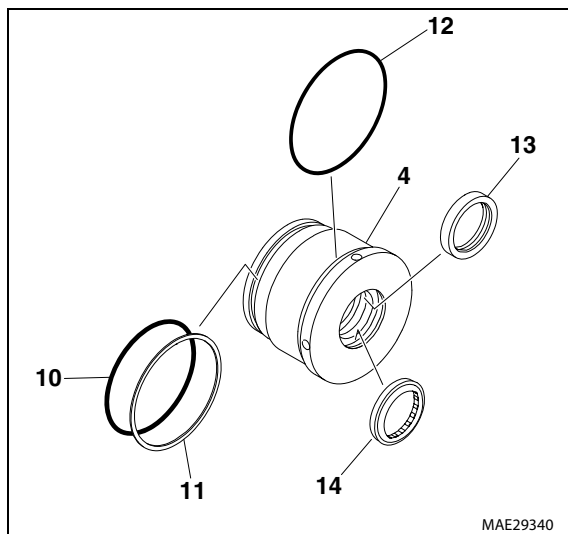


Figure 5-36. Cylinder Head Assembly

4. Support rod in holding fixture.
5. Carefully slide the spacer (15) onto the rod.
6. Insert spring (5) onto the rod.
7. Install o-ring (9) inside piston (3).

8. Install piston seal (8) and wear ring (7) onto piston (3).

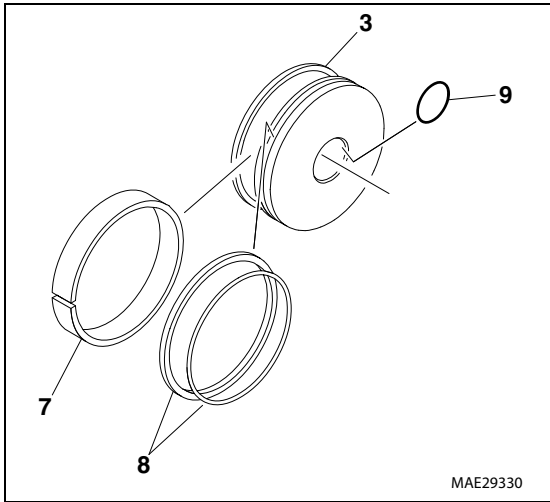


Figure 5-37. Piston Disassembly

9. Carefully install piston on cylinder rod. Do not damage or dislodge o-ring and backup rings.
10. Install locknut (6) onto the rod.
11. Remove cylinder rod from holding fixture.
12. Position cylinder barrel in suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

13. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston loading o-ring and seal ring.
14. Screw the cylinder head gland into the barrel using a tool and tighten until punch mark matches.

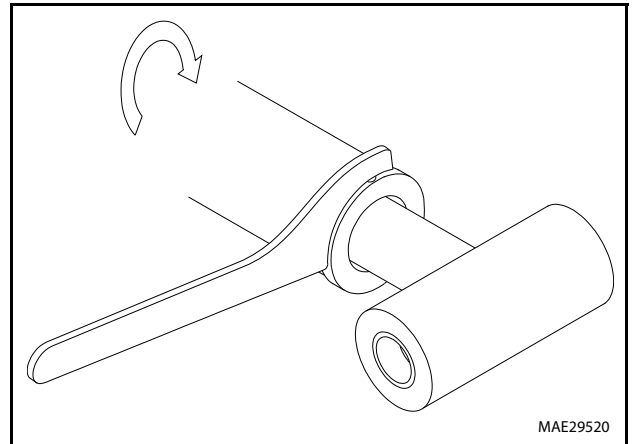


Figure 5-38. Cylinder Head Installation

15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

5.3 HYDRAULIC PUMP (GEAR)

Removal

⚠ WARNING

ENSURE THE PRESSURE IS PROPERLY RELIEVED FROM THE HYDRAULIC SYSTEM BEFORE PROCEEDING TO REMOVAL OF THE PUMP MOTOR.

1. Disconnect the hydraulic hoses from inlet and outlet ports of the gear pump.

NOTICE

CAP OR PLUG ALL THE HYDRAULIC HOSES TO PREVENT ENTRAPPING OF THE DUST AND DIRT INTO IT.

2. Remove bolts and washers secured on the gear pump.
3. Carefully remove gear pump shaft from the rear piston pump assembly.

4. Carefully place the gear pump on the clean working surface.

Installation

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Apply thin film of spline grease on the gear shaft.
2. Carefully insert the shaft into the piston pump and secure the gear pump using two bolts and washers. Apply JLG Threadlocker P/N 0100011 to end of bolts. Torque bolts to 20-24 ft.lbs (27-33 Nm).
3. Remove cap from the hydraulic hoses and re-connect to their original locations.

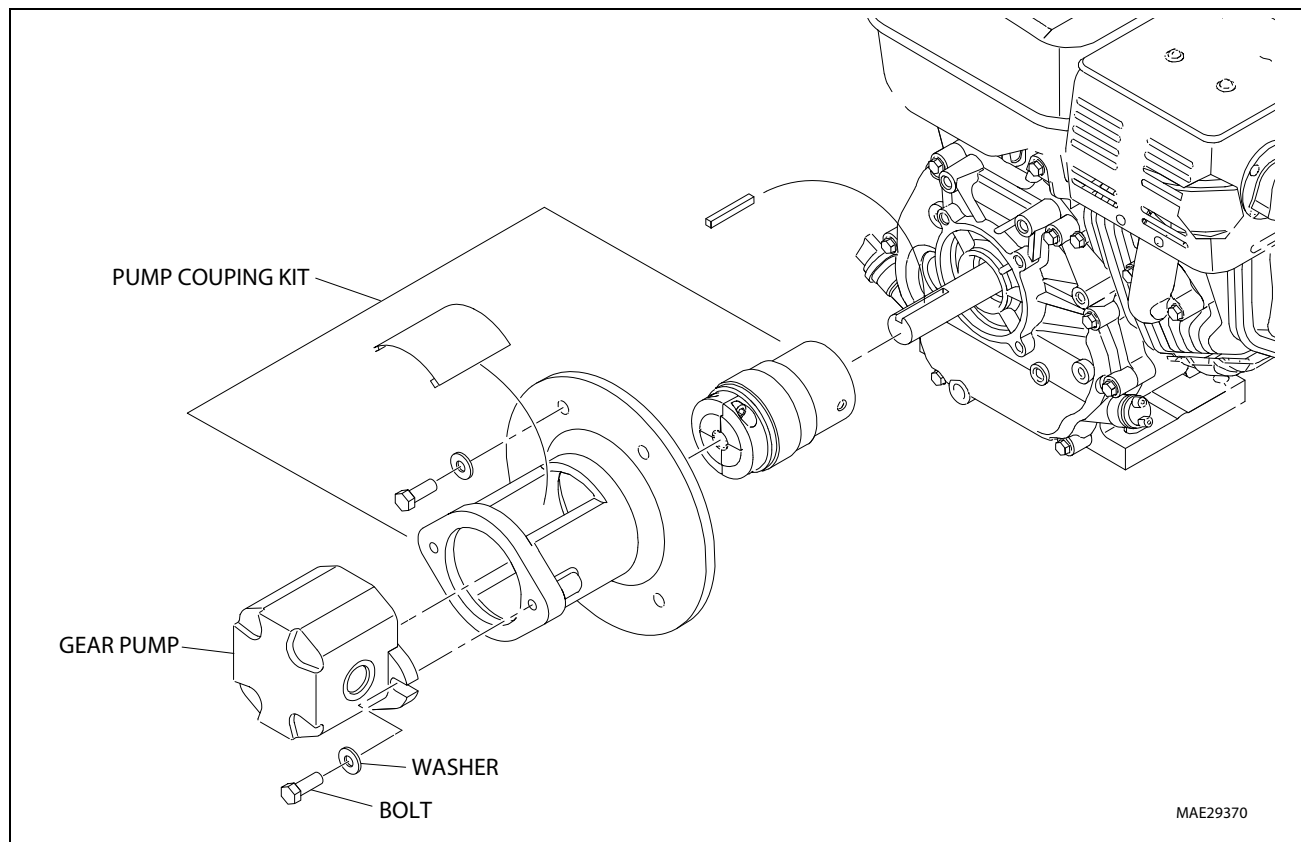


Figure 5-39. Hydraulic Pump Installation

5.4 PRESSURE SETTING PROCEDURE

Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until the hydraulic system has warmed to normal operating temperatures prior to checking pressures. JLG Industries Inc. also recommends the use of a calibrated gauge. Pressure readings are acceptable if they are within $\pm 5\%$ of specified pressures.

Main Relief

1. Install a pressure gauge at the port marker "G" located on top of the valve block.
2. The telescope "In" relief valve is located below the hand pump. Screw this in (clockwise) 2 turns.
3. Telescope out about 5 feet. Then telescope in until it bottoms out. The gauge should read 2700 psi. (186 bar).
4. If adjustment is needed, the main relief adjustment is located below the "TA" and "TB" ports. To increase, screw clockwise, to decrease screw counterclockwise.

Telescope In

1. Install a pressure gauge at the port marked "G" located on top of the valve block.
2. Locate the telescope "In" relief valve below the hand pump.
3. Telescope out about 5 feet. Then telescope in until it bottoms out. The gauge should read 2200 psi. (152 bar).
4. To increase, screw clockwise, to decrease screw counterclockwise.

Telescope Out

1. Install a pressure gauge at the port marked "G" located on top of the valve block.
2. Locate the telescope "Out" relief valve located below the "GA" gauge port.
3. Telescope out until it bottoms out. The gauge should read 2400 psi. (166 bar).
4. To increase, screw clockwise, to decrease screw counterclockwise.

Platform Level Up

1. Install a pressure gauge at the port marked "GA" located on the left side of the block right next to the telescope directional valve.
2. Both level relief valves are located on top of the valve block. The one toward the center is level up.
3. Level up until it bottoms out. The gauge should read 2200 psi (152 Bar).

4. To increase, screw clockwise, to decrease screw counterclockwise.

Platform Level Down

1. Install a pressure gauge at the port marked "GB" located on the front side of the block right below the hand pump.
2. Both level relief valves are located on top of the valve block. The one toward the out side is level down.
3. Level down until it bottoms out. The gauge should read 2000 psi. (138 bar).
4. To increase, screw clockwise, to decrease screw counterclockwise.

Swing Right

1. Install a pressure gauge at the port marked "G" located on top of the block.
2. Lower the boom down into the boom rest to lock the boom.
3. Activate swing right. The gauge should read 600 - 800 psi. (41 - 55 bar).
4. The swing right relief valve is located on the left face next to the swing directional valve. To increase, screw clockwise, to decrease screw counterclockwise.

Swing Left

1. Install a pressure gauge at the port marked "G" located on top of the block.
2. Lower the boom down into the boom rest to lock the boom.
3. Activate swing left. The gauge should read 600 - 800 psi. (41 - 55 bar).
4. The swing left relief valve is located on the front face next to the suction port. To increase, screw clockwise, to decrease screw counterclockwise.

Outrigger Up

1. Install a pressure gauge at the port marked "G" located on top of the block.
2. Activate jacks up until the cylinders are all bottomed out. The gauge should read 2500 psi. (172.5 bar).
3. The outrigger relief valve is located on the front face below the lift push button manual descent valve. To increase, screw clockwise, to decrease screw counterclockwise.

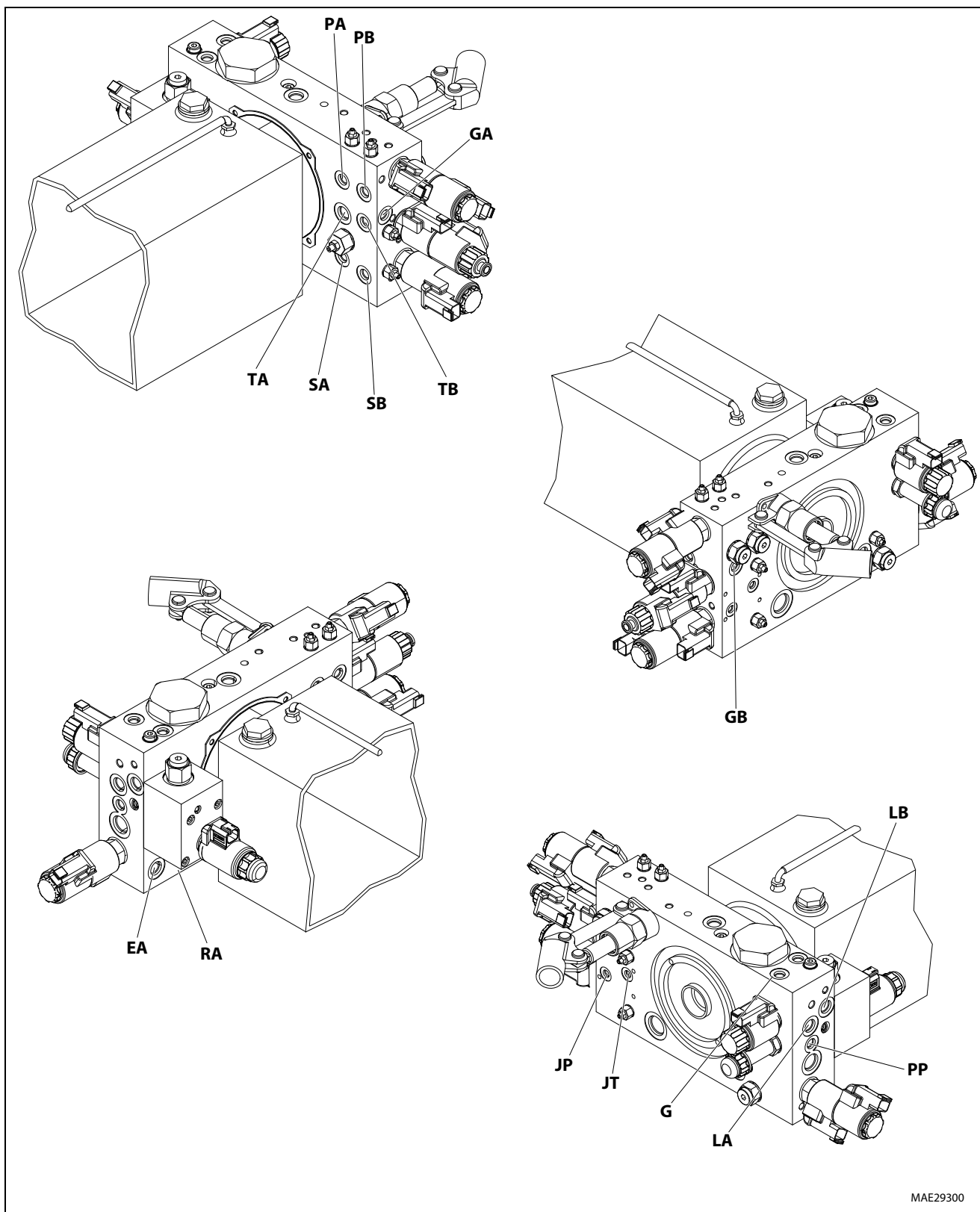


Figure 5-40. Hydraulic Test Ports

5.5 HYDRAULIC OIL FILL AT STARTUP

1. Fill the tank.

NOTE: Step 2 applies to Gas Engine equipped models only.

2. Loosen the outlet port hose of the pump until oil is seen. This ensures that air has been bled from the suction line. Without doing this step, there could be an air lock up on start-up, which can damage the pump.
3. Manually lay the outriggers out so the pads are on the ground.
4. Retract the outriggers.
5. Extend the outriggers.
6. Refill the hydraulic tank.
7. Raise the boom up to horizontal.
8. Raise the Jib (if applicable) to full stroke. Lower the Jib with manual descent. (Needle valve at the Jib cylinder). Close the needle valve when the Jib is fully retracted.
9. Extend and retract platform level to full stroke in both directions. Level the platform.
10. Lift up the boom to full stroke (or as high as the boom will go).
11. Extend and retract platform level, then back to level.
12. Lift down the boom using manual descent. Bring the boom down to the boom rest.
13. Repeat the lift up and down function using the switch, not manual descent.
14. Telescope the boom out to full stroke.
15. Telescope the boom in to the end of stroke.
16. Swing the turn-table 1/8th turn in both directions.
17. Retract the outriggers.
18. Refill the tank to the full mark on the dipstick.

5.6 HYDRAULIC HOSES

When replacing any of the hoses that run through the center of the turntable, make sure the boom is positioned 180° opposite from the tongue and not over the tongue. Failure to have the boom properly positioned will cause the hoses to experience excessive twisting during swing operations and will cause premature failure of the hose.

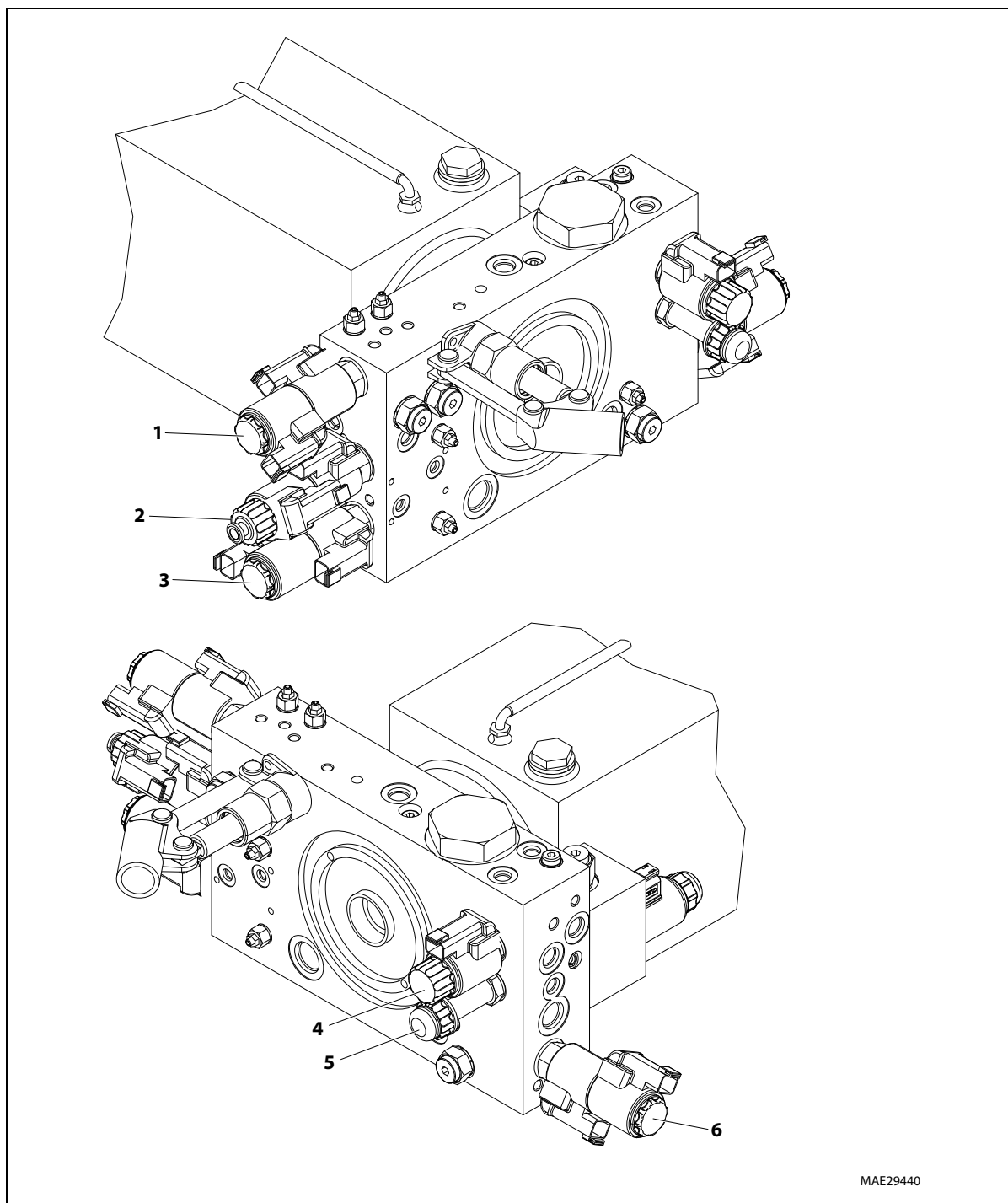
5.7 HYDRAULIC FILTER AND BREATHER

When changing the hydraulic filter, inspect the o-ring on the cap for any nicks or tears. Replace the o-ring if there is any damage. Check the breather line (clear line) that runs from the hydraulic tank to the breather to ensure it is free from oil and not pinched or damaged. If oil has ever entered the breather, it must be changed. This can happen if the hydraulic tank is overfilled or the breather line gets pinched.



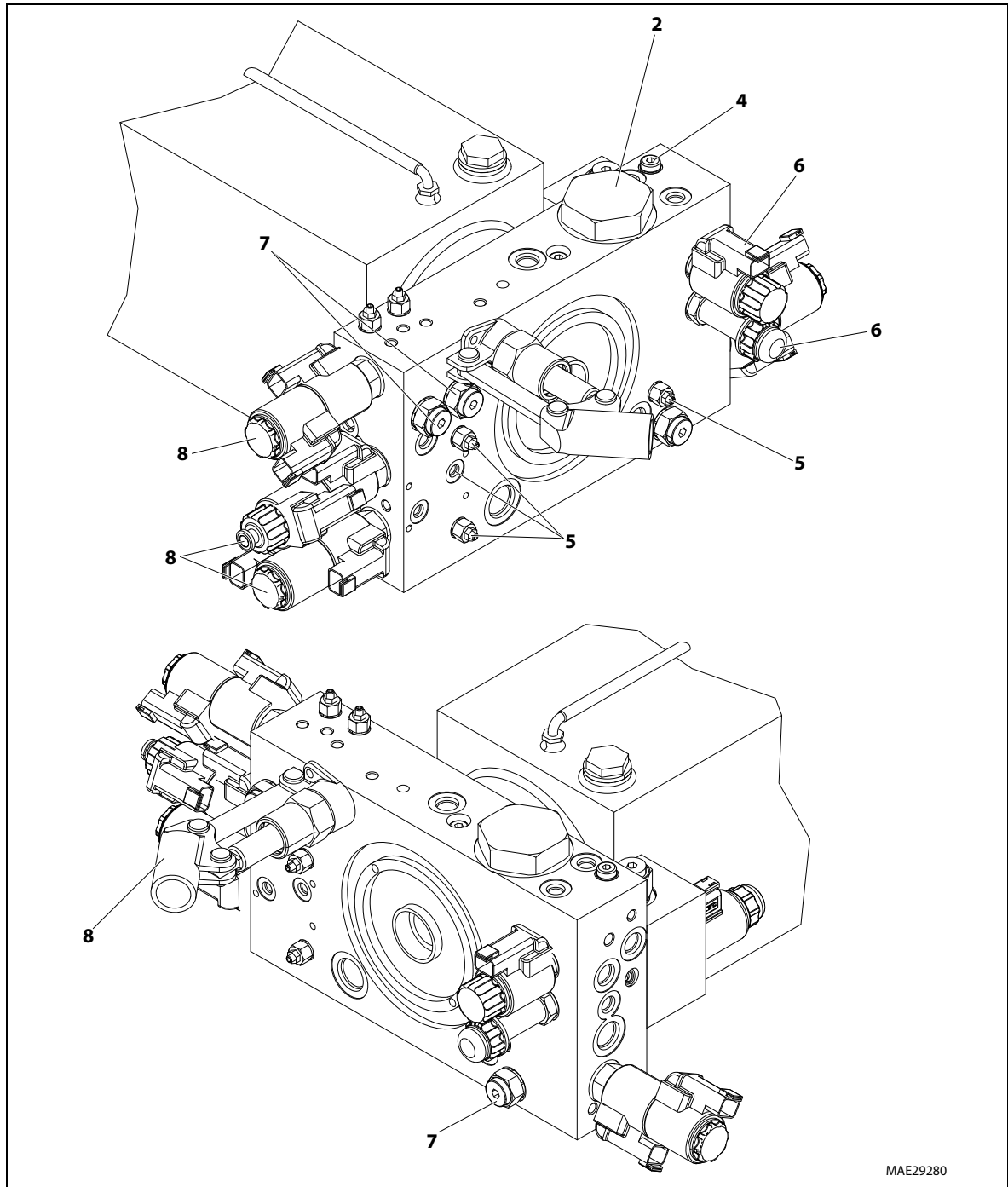
NOTE: The cap securing the filter must be torqued 154 to 170 ft.lbs. (209 to 230.5 Nm).





- | | | |
|-----------------------------------|--------------------------|-----------------------------------|
| 1. Platform Level Cartridge Valve | 3. Swing Cartridge Valve | 5. Manual Descent Cartridge Valve |
| 2. Telescope Cartridge Valve | 4. Lift Cartridge Valve | 6. Outrigger Cartridge Valve |

Figure 5-41. Control Valve Identification



MAE29280

Table 5-2. Control Valve Torque Values

	Ft-Lbs.	Nm		Ft-Lbs.	Nm		Ft-Lbs.	Nm
1	11-14	15-20	4	13-15	17.5-20	7	25-28	34-38
2	154-170	209-230.5	5	17-19	23-26	8	28-33	38-45
3	15-18.5	20-25	6	18.5-22	25-30			

Figure 5-42. Control Valve Torque Values (Engine Powered Machines) - Sheet 1 of 2

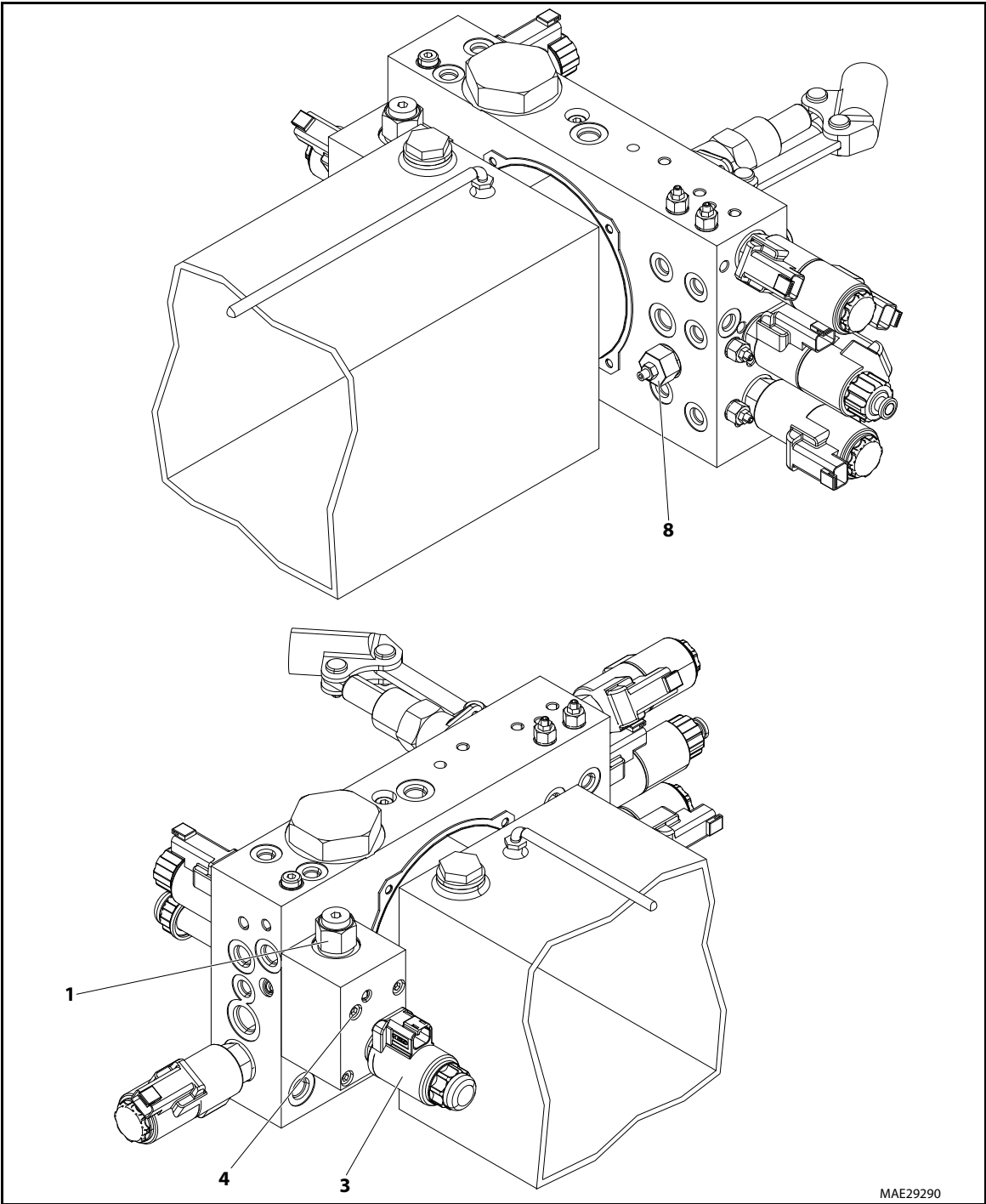


Table 5-3. Control Valve Torque Values

	Ft-Lbs.	Nm		Ft-Lbs.	Nm		Ft-Lbs.	Nm
1	11-14	15-20	4	13-15	17.5-20	7	25-28	34-38
2	154-170	209-230.5	5	17-19	23-26	8	28-33	38-45
3	15-18.5	20-25	6	18.5-22	25-30			

Figure 5-43. Control Valve Torque Values (Engine Powered Machines) - Sheet 2 of 2

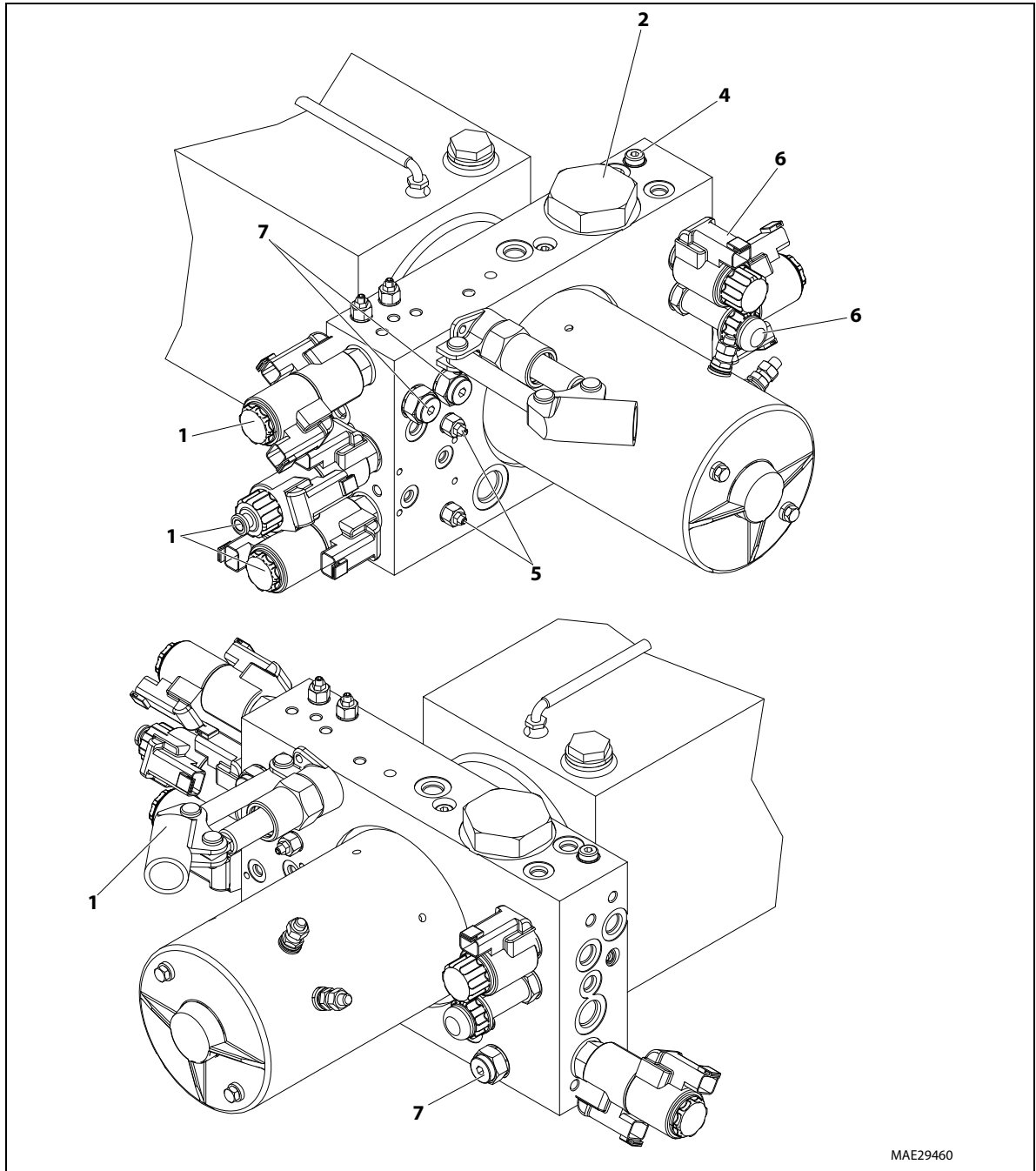
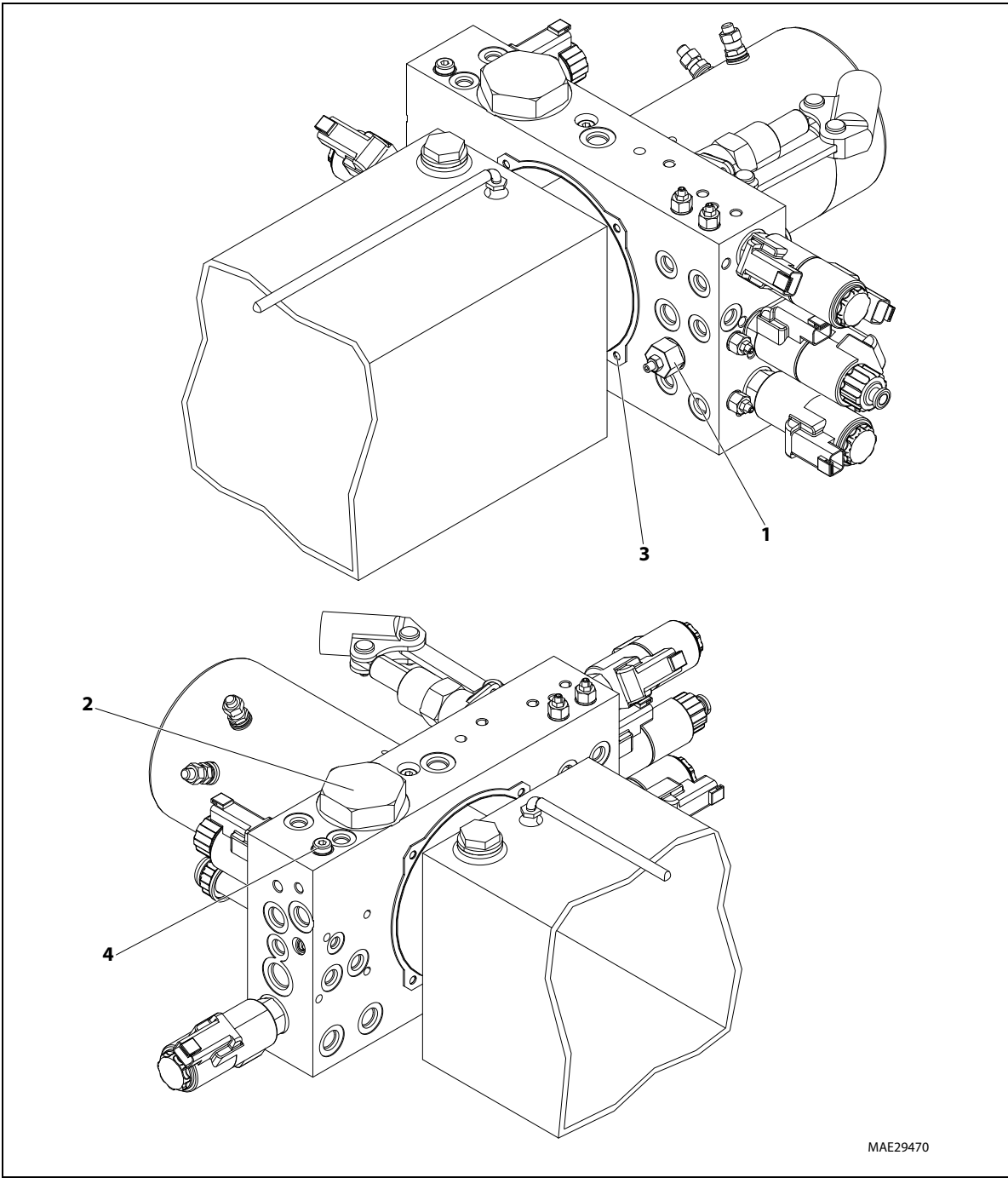


Table 5-4. Control Valve Torque Values

	Ft-Lbs.	Nm		Ft-Lbs.	Nm		Ft-Lbs.	Nm
1	28-33	38-45	4	13-15	17.5-20	7	25-28	34-38
2	154-170	209-230.5	5	17-19	23-26			
3	9	12	6	18.5-22	25-30			

Figure 5-44. Control Valve Torque Values (Electric Powered Machines) - Sheet 1 of 2

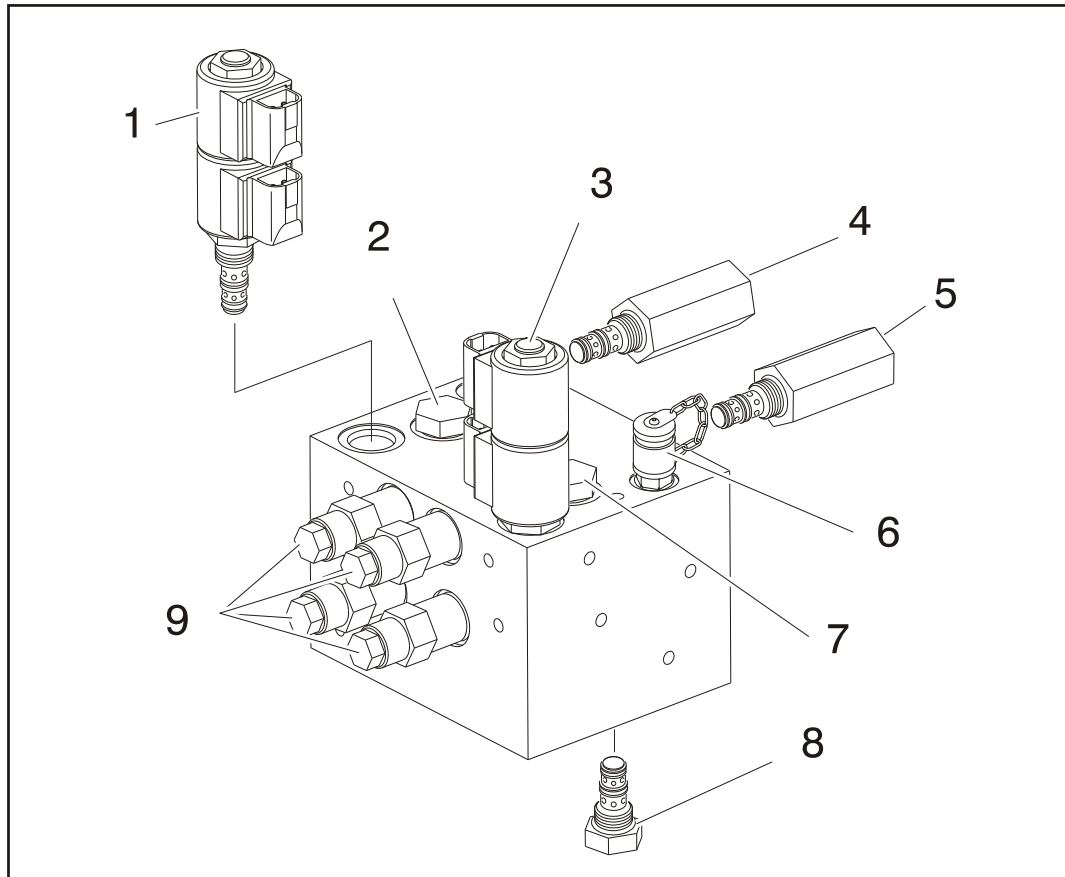


MAE29470

Table 5-5. Control Valve Torque Values

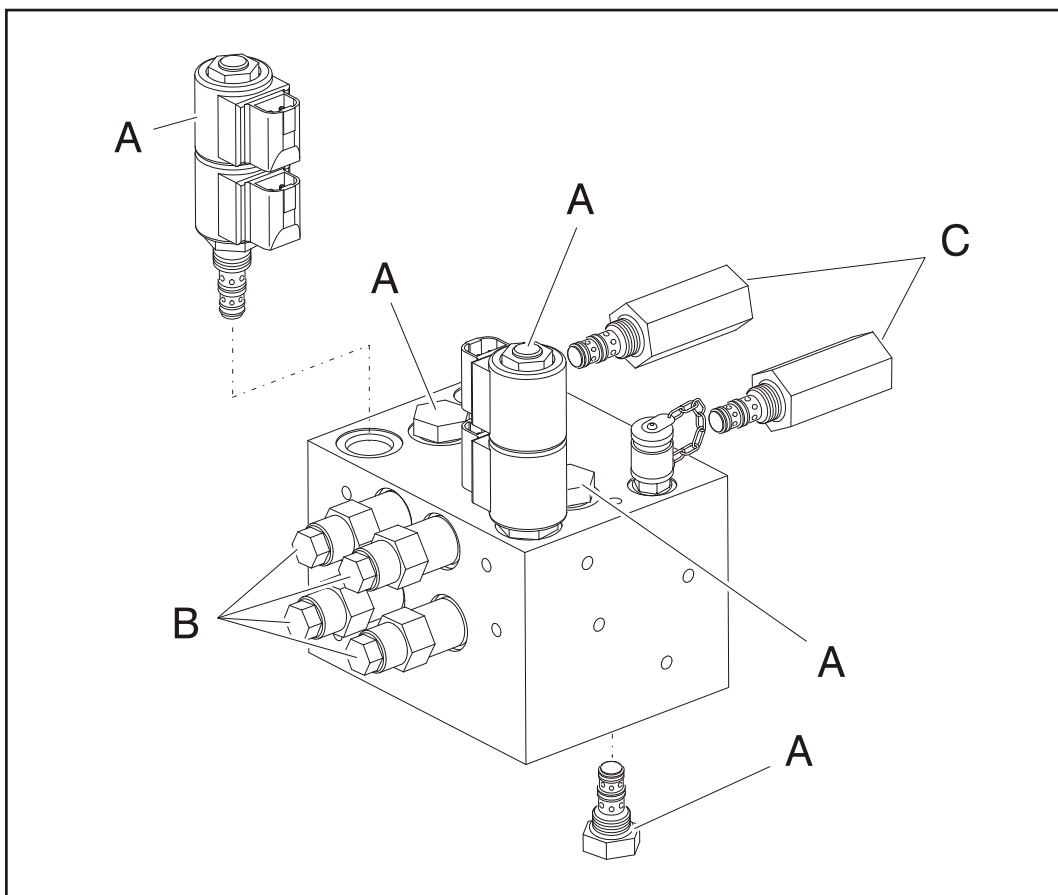
	Ft-Lbs.	Nm		Ft-Lbs.	Nm		Ft-Lbs.	Nm
1	28-33	38-45	4	13-15	17.5-20	7	25-28	34-38
2	154-170	209-230.5	5	17-19	23-26			
3	9	12	6	18.5-22	25-30			

Figure 5-45. Control Valve Torque Values (Electric Powered Machines) - Sheet 2 of 2



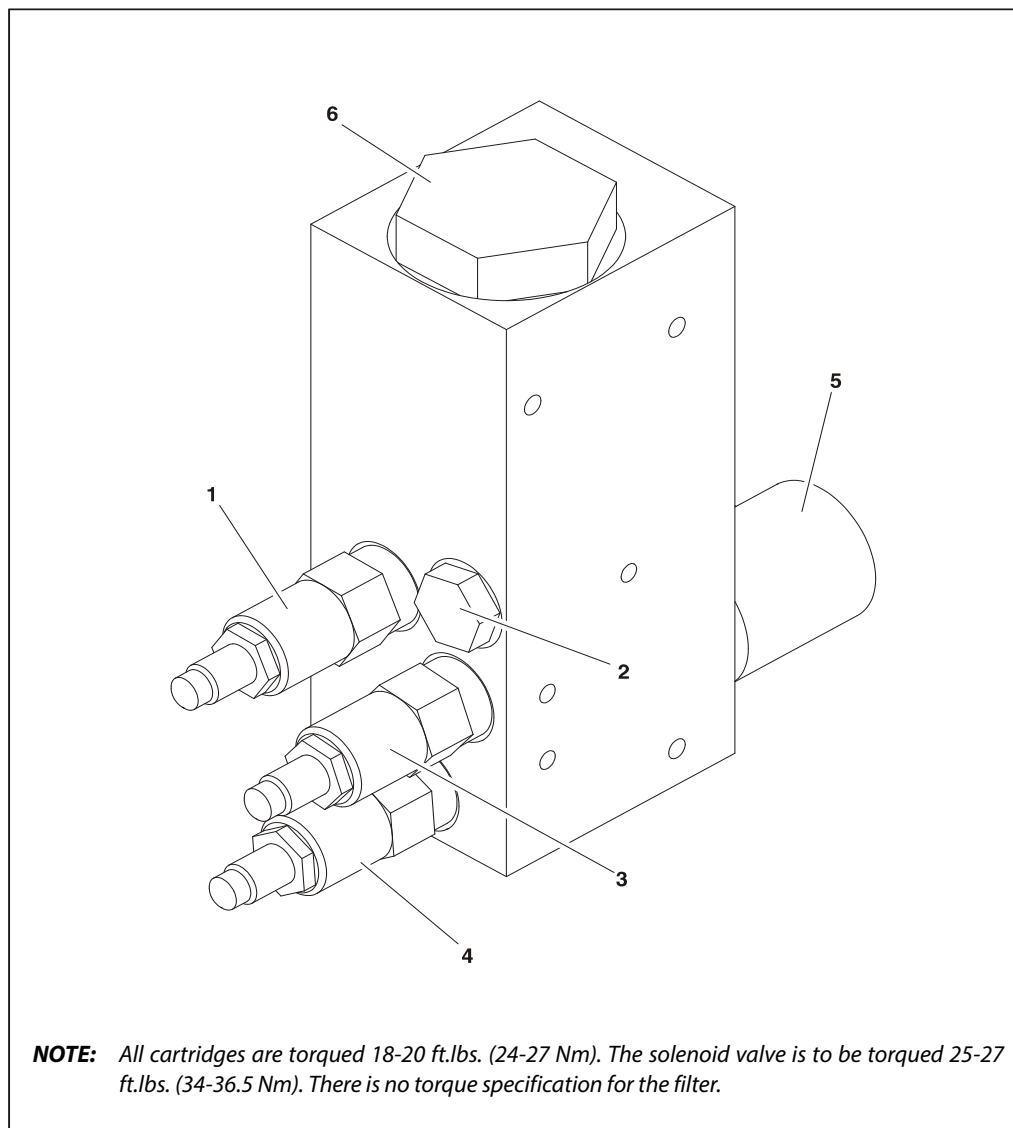
- | | |
|------------------------|--------------------------|
| 1. Left Drive Valve | 6. Pressure Check |
| 2. Shuttle Valve (LS2) | 7. Shuttle Valve (LS1) |
| 3. Right Drive Valve | 8. Shuttle Valve (LS3) |
| 4. EP2 | 9. Counterbalance Valves |
| 5. EP1 | |

Figure 5-46. Drive Directional Valve Identification - Drive & Set Option



	Ft-Lbs.	Nm
A	18-20	24-27
B	30-35	41-47
C	35-40	47-54

Figure 5-47. Drive Directional Valve Torque Values - Drive & Set Option



- 1. Pressure Regulator (PR1)
- 2. Check Valve (CV1)
- 3. Relief Valve (RV1)
- 4. Relief Valve (RV2)
- 5. Solenoid Valve (SV1)
- 6. Filter (F1)

Figure 5-48. Drive Enable Valve Identification - Drive & Set Option

5.8 HYDRAULIC SCHEMATICS

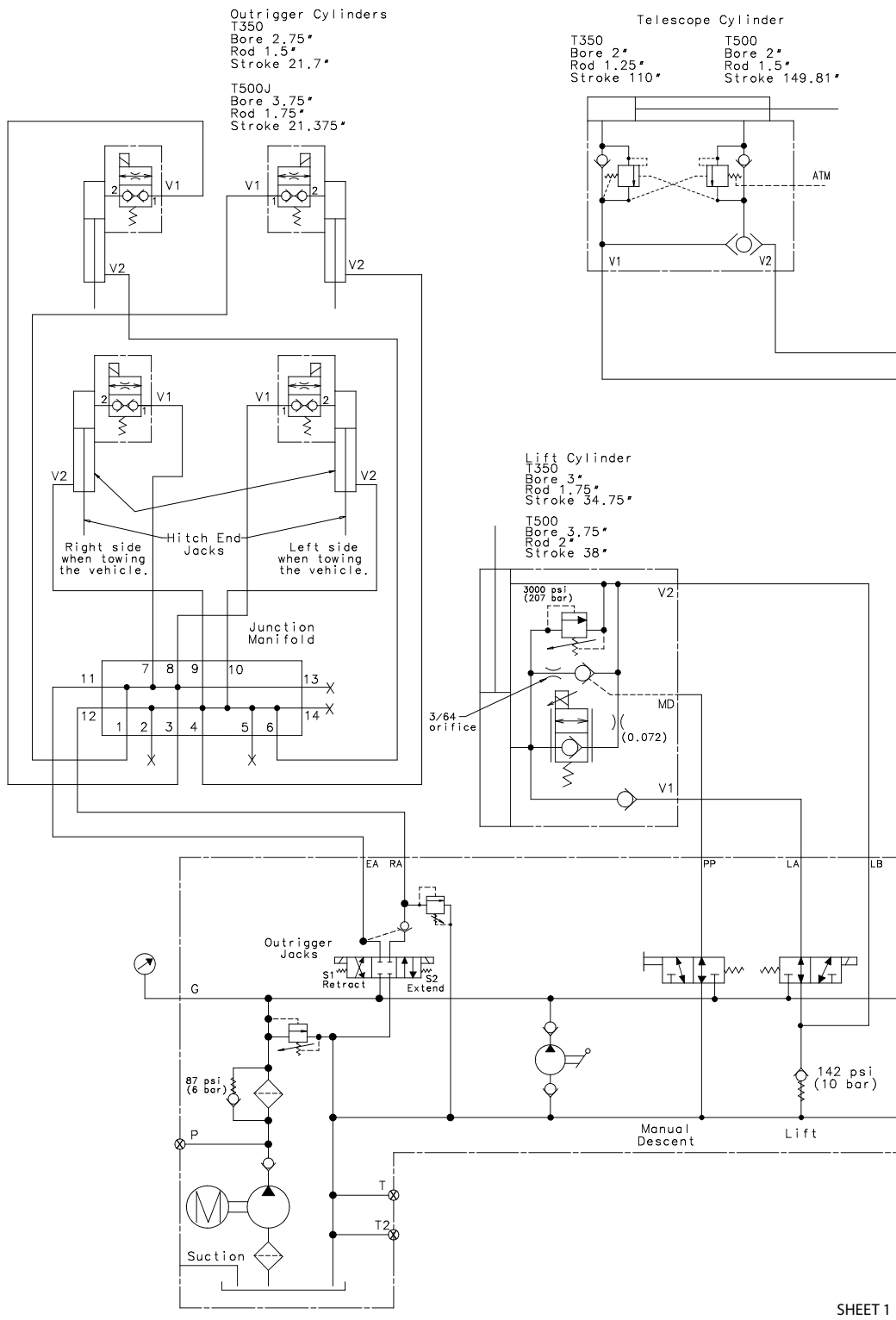
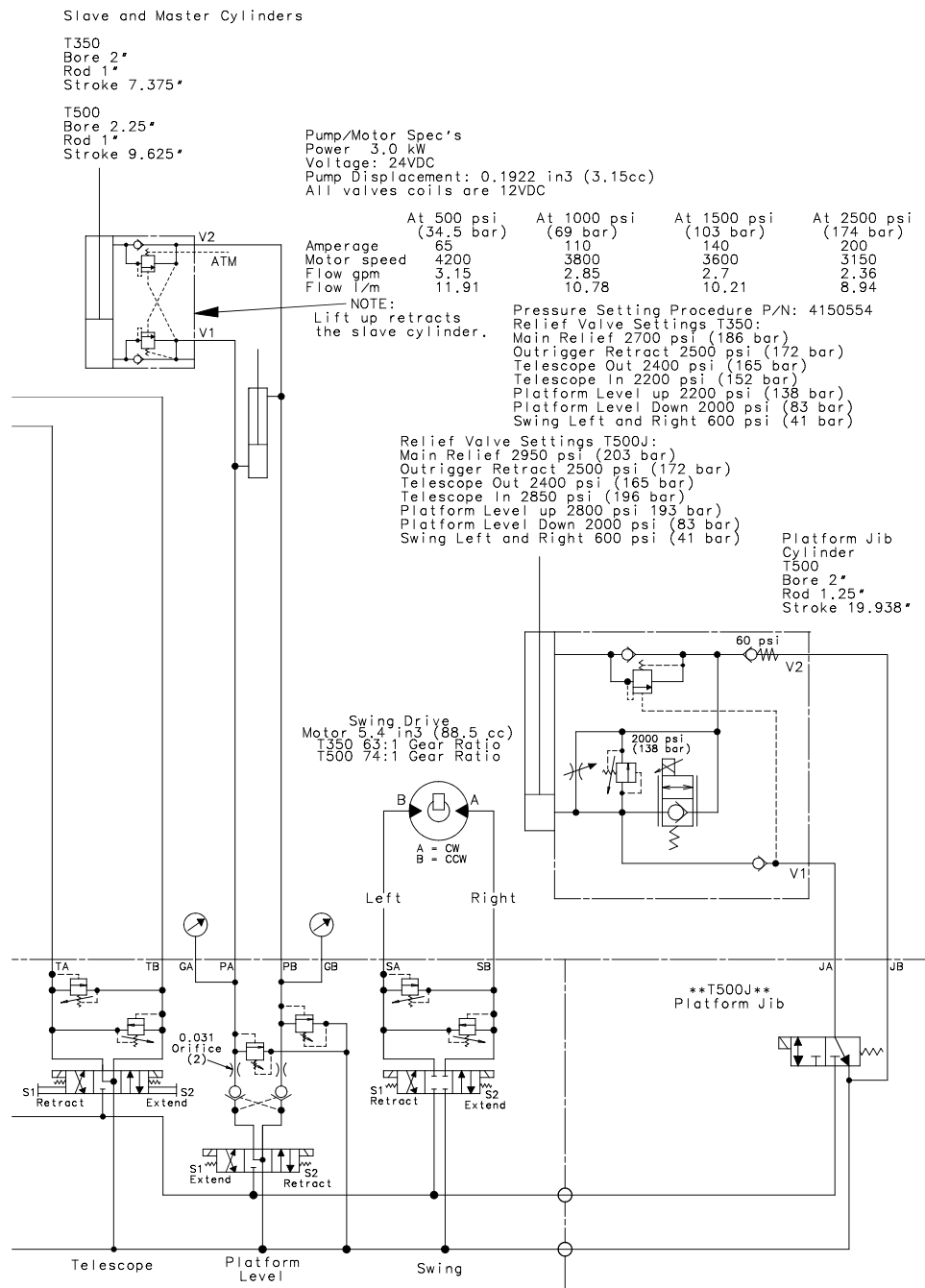


Figure 5-49. Hydraulic Schematic - Electric Machines - Sheet 1 of 2



SHEET 1

2792642-G

Figure 5-50. Hydraulic Schematic - Electric Machines - Sheet 2 of 2

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

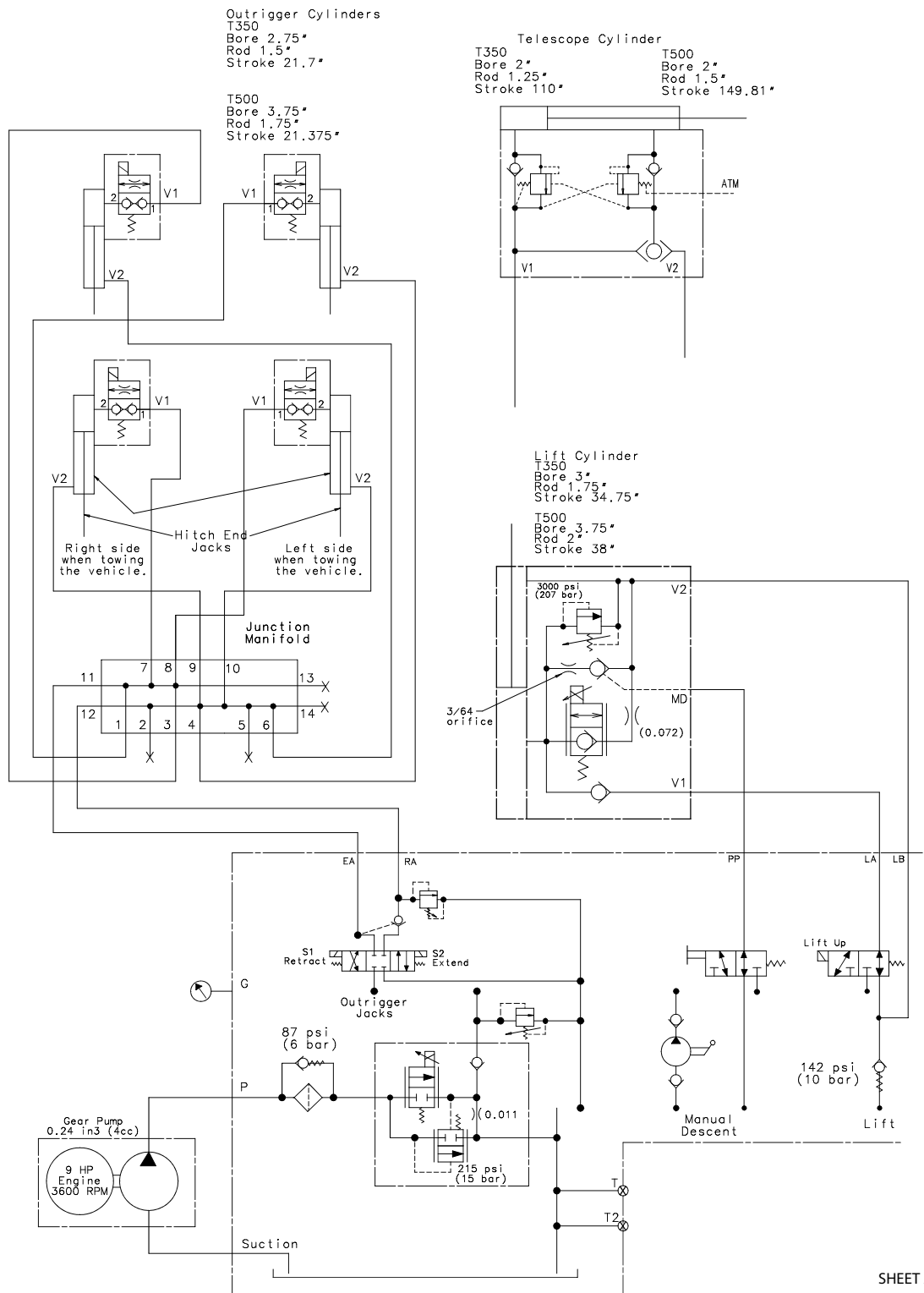
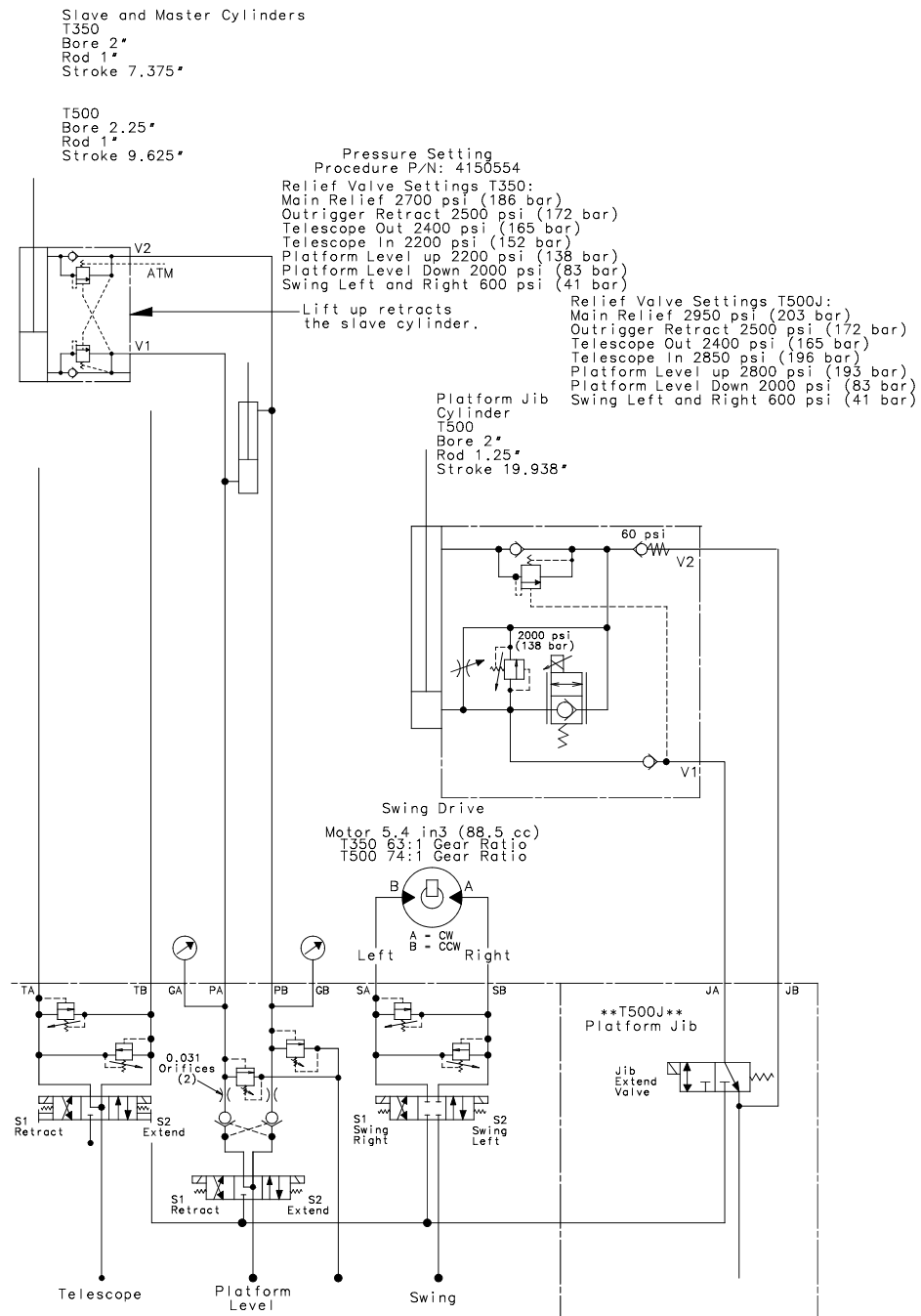


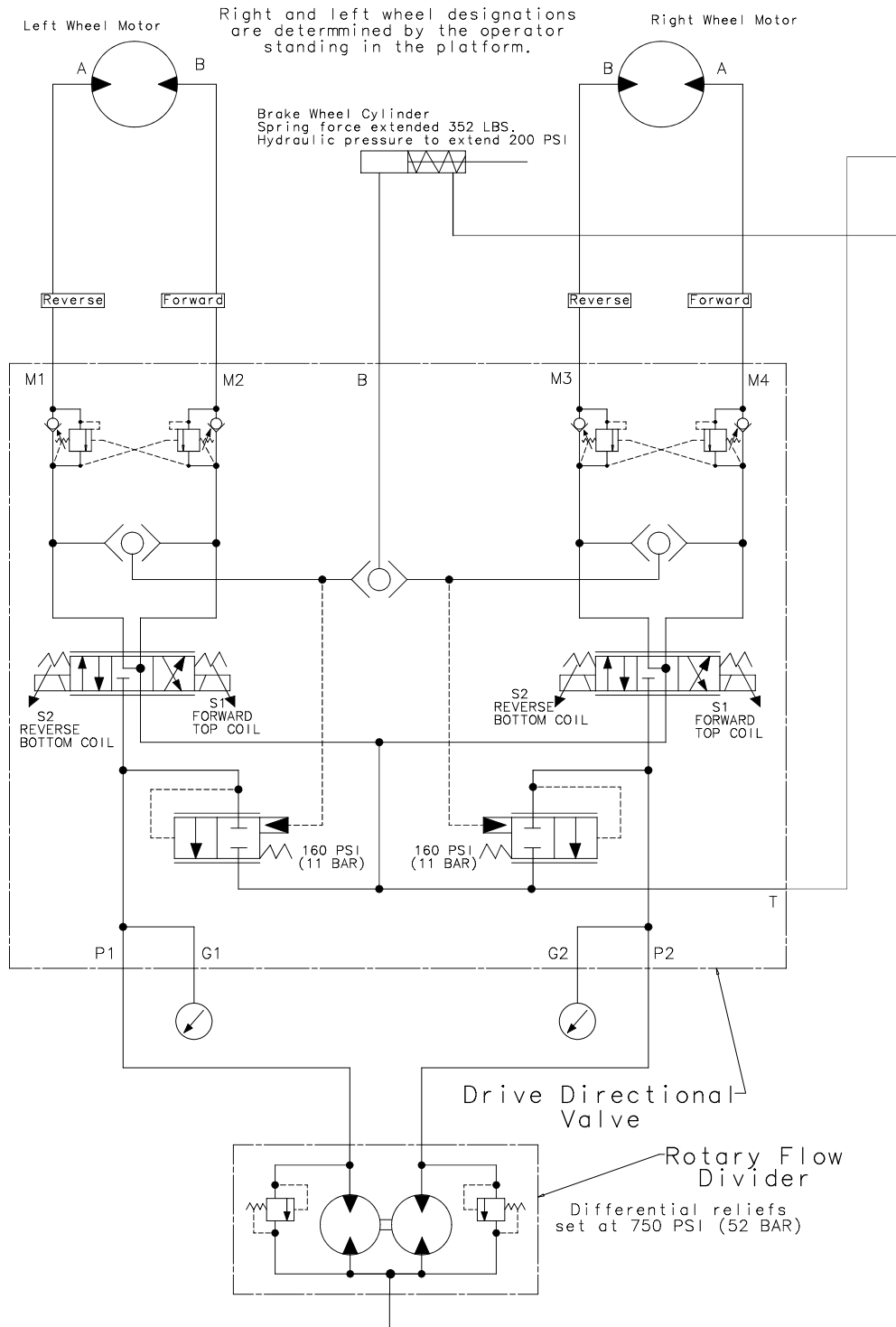
Figure 5-51. Hydraulic Schematic - Gas Machines - Sheet 1 of 2



SHEET 2

2792642-G

Figure 5-52. Hydraulic Schematic - Gas Machines - Sheet 2 of 2



SHEET 3

Figure 5-53. Hydraulic Schematic - Drive Option (Gas) - Sheet 1 of 2

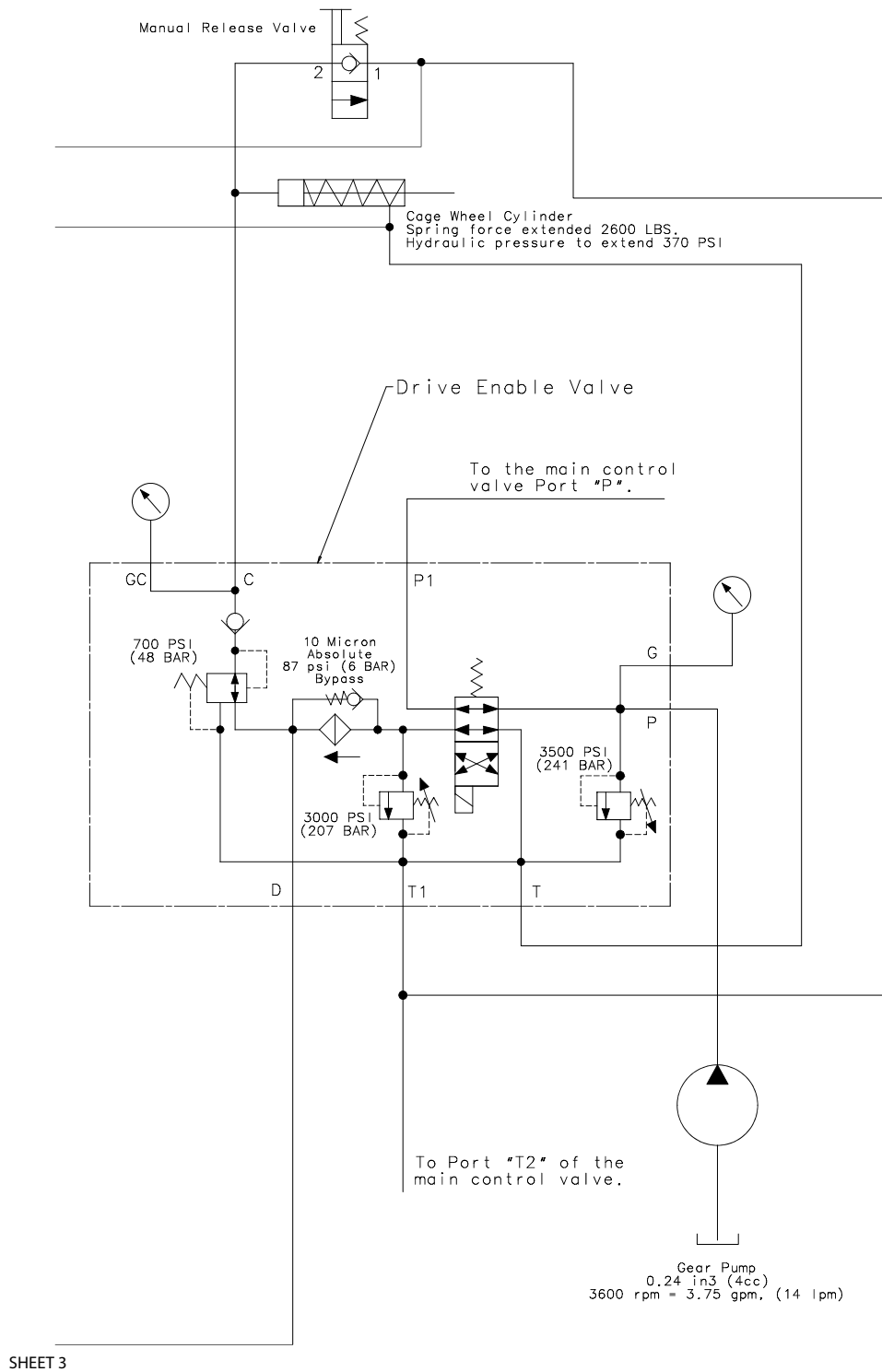
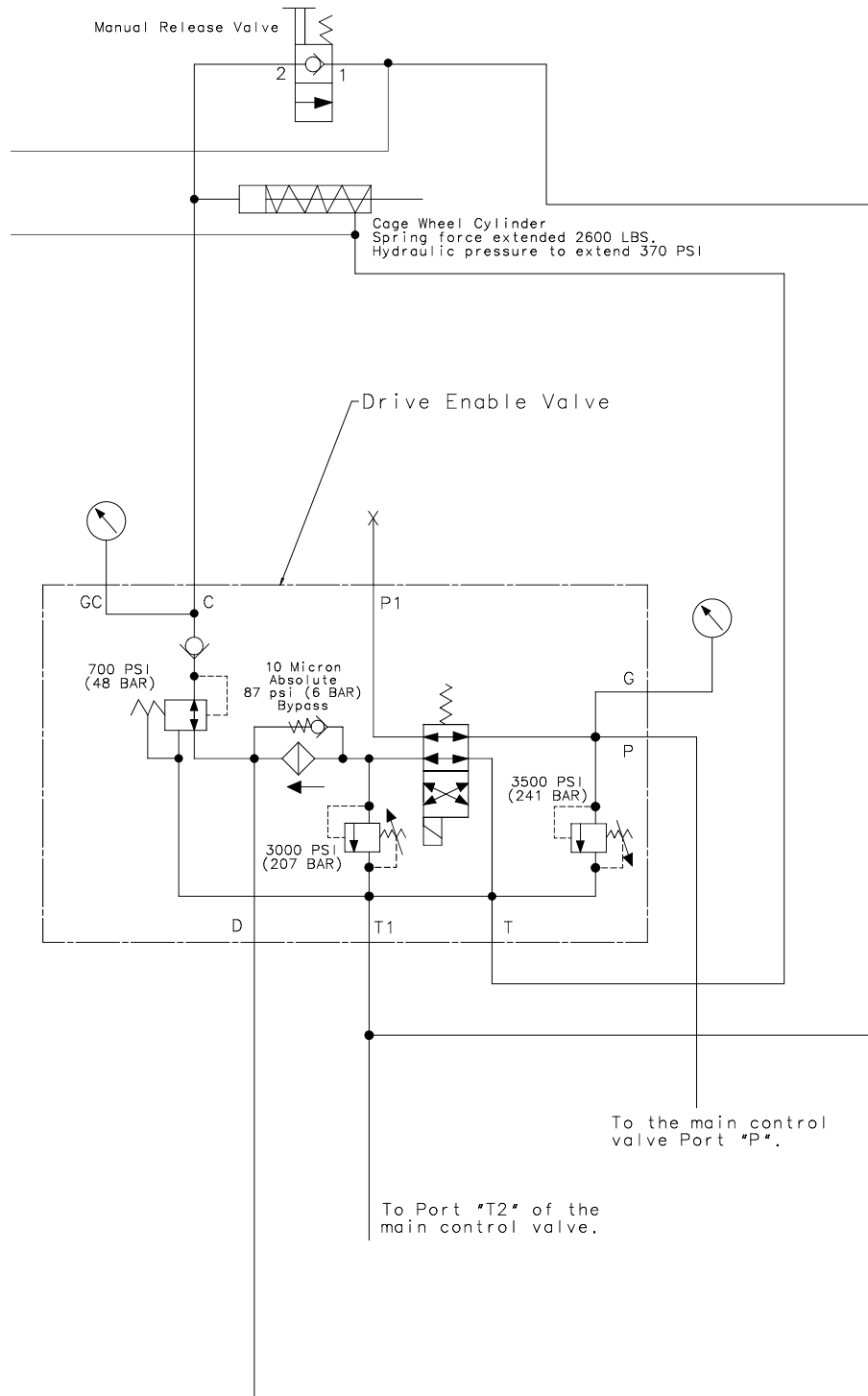


Figure 5-54. Hydraulic Schematic - Drive Option (Gas) - Sheet 2 of 2



3121198



SHEET 4

2792642-G

Figure 5-56. Hydraulic Schematic - Drive Option Electric Motor - Sheet 2 of 2

5.9 HYDRAULIC DIAGRAM

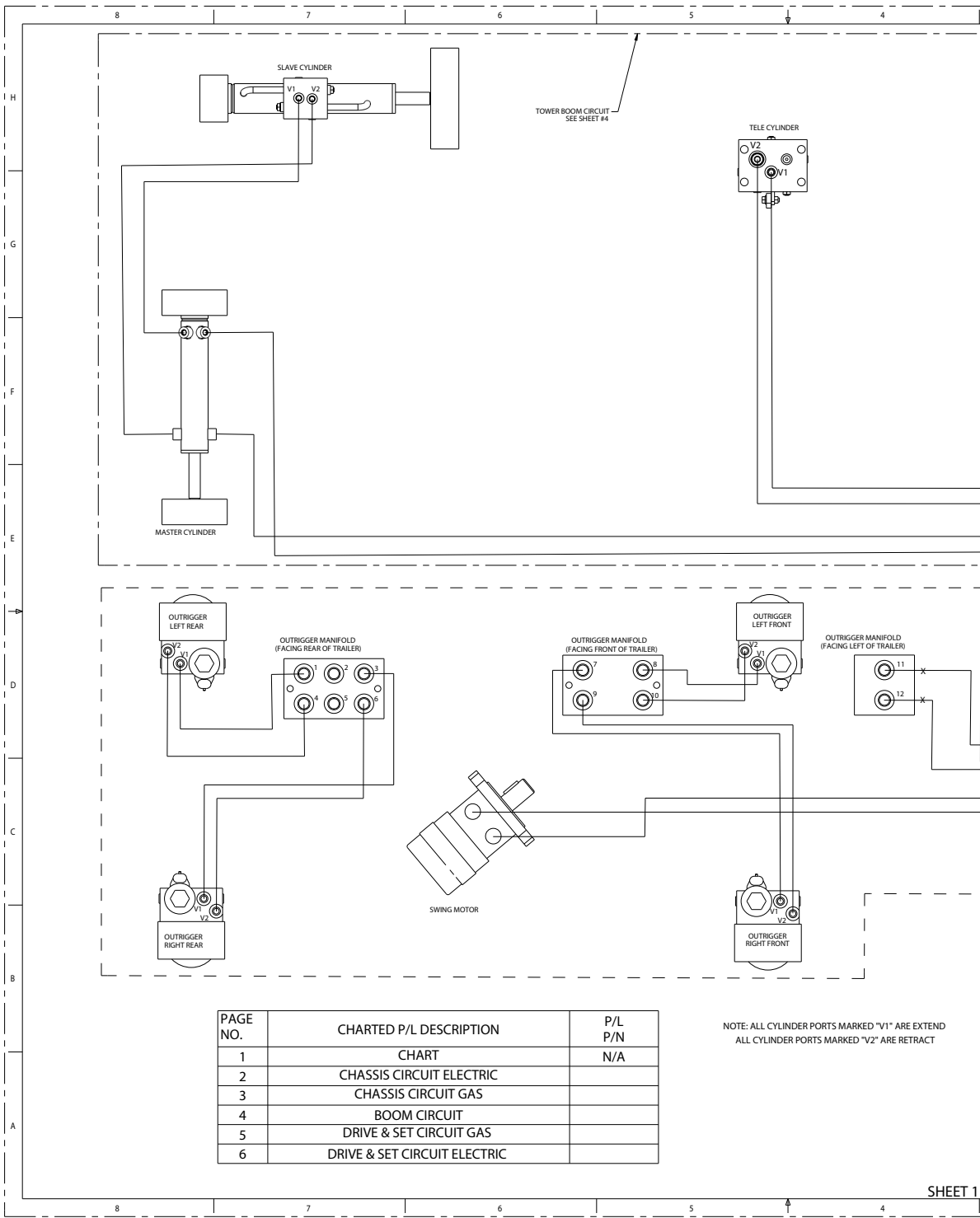


Figure 5-57. Machine - Sheet 1 of 12

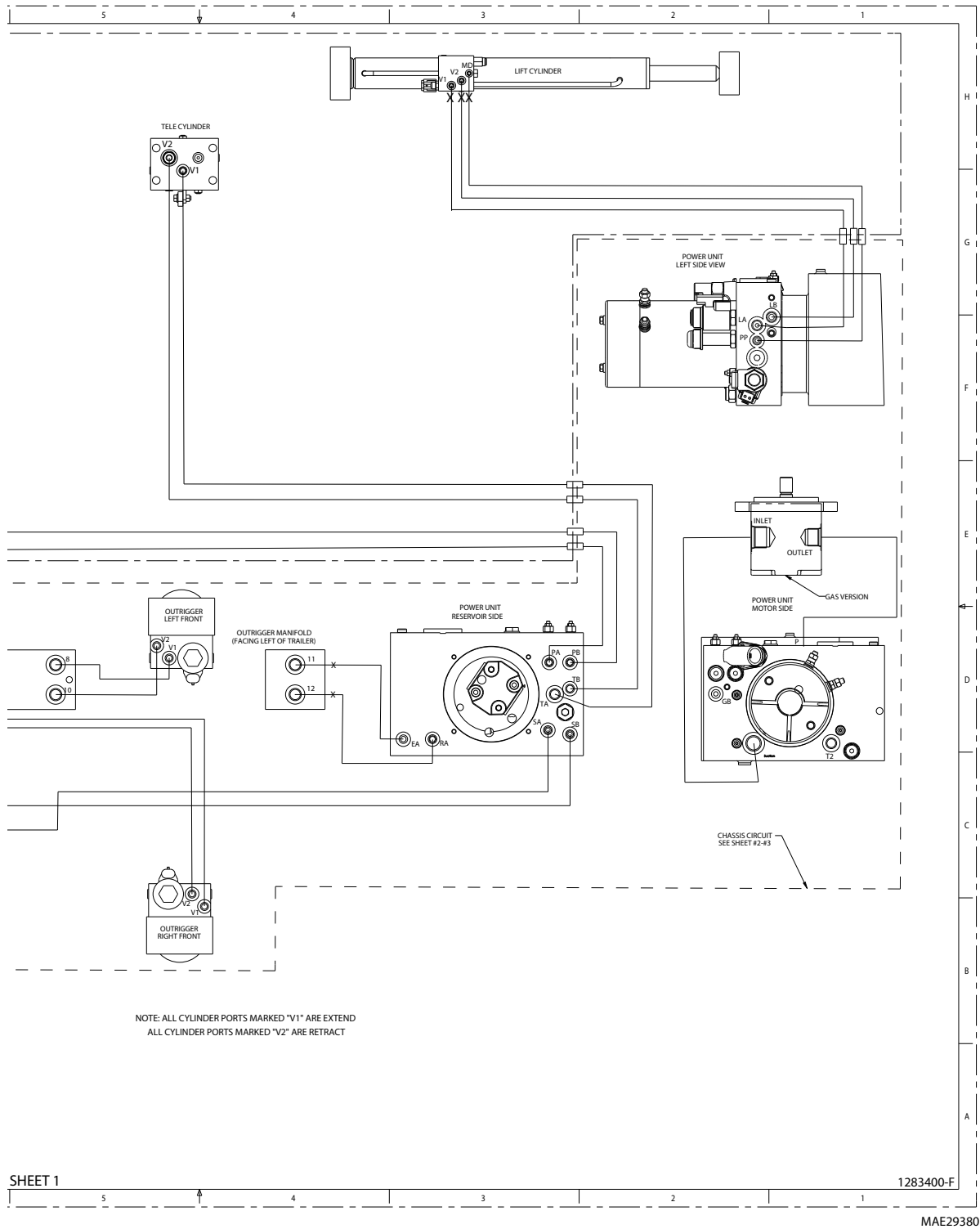


Figure 5-58. Machine - Sheet 2 of 12

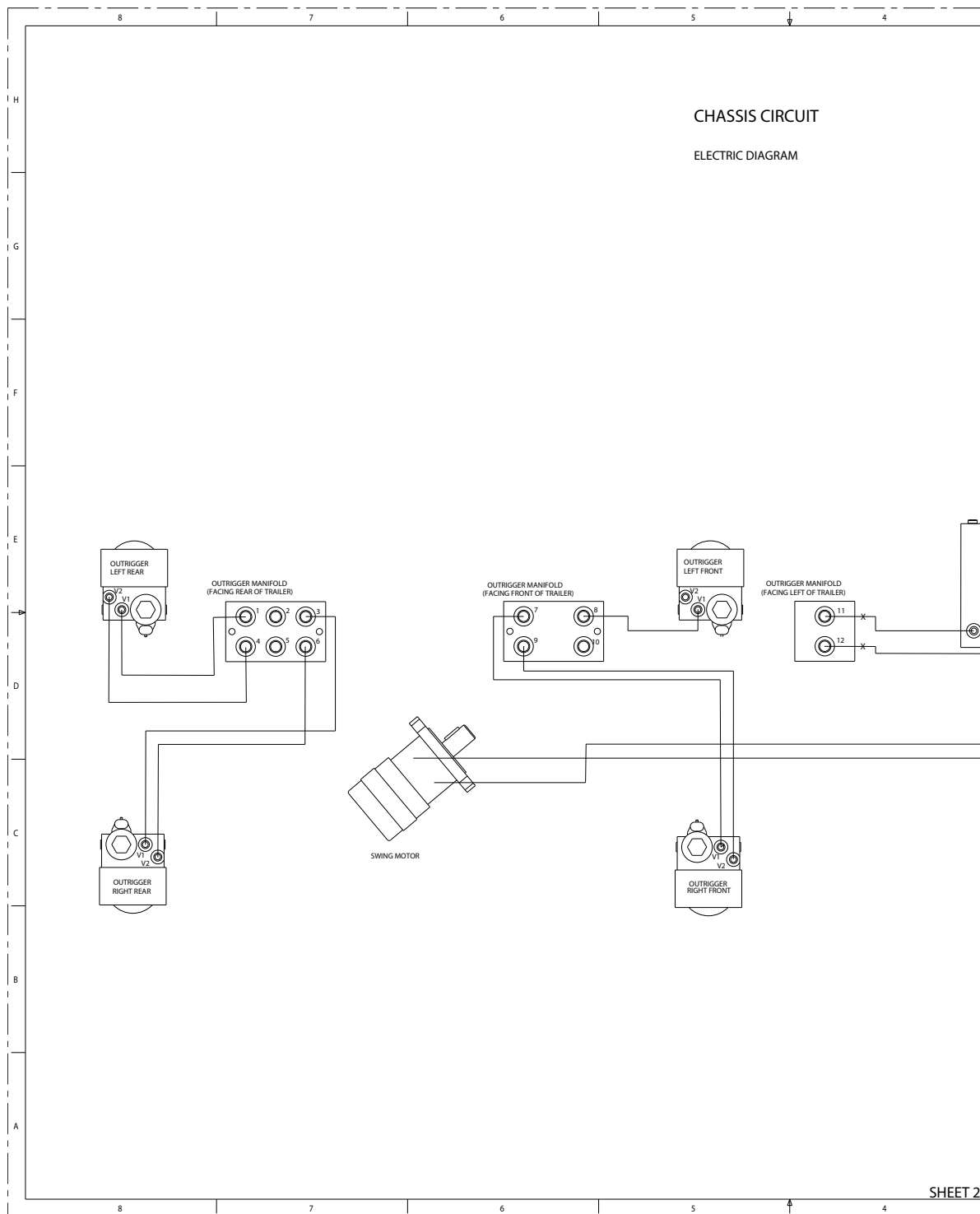


Figure 5-59. Chassis Circuit (Electric) - Sheet 3 of 12

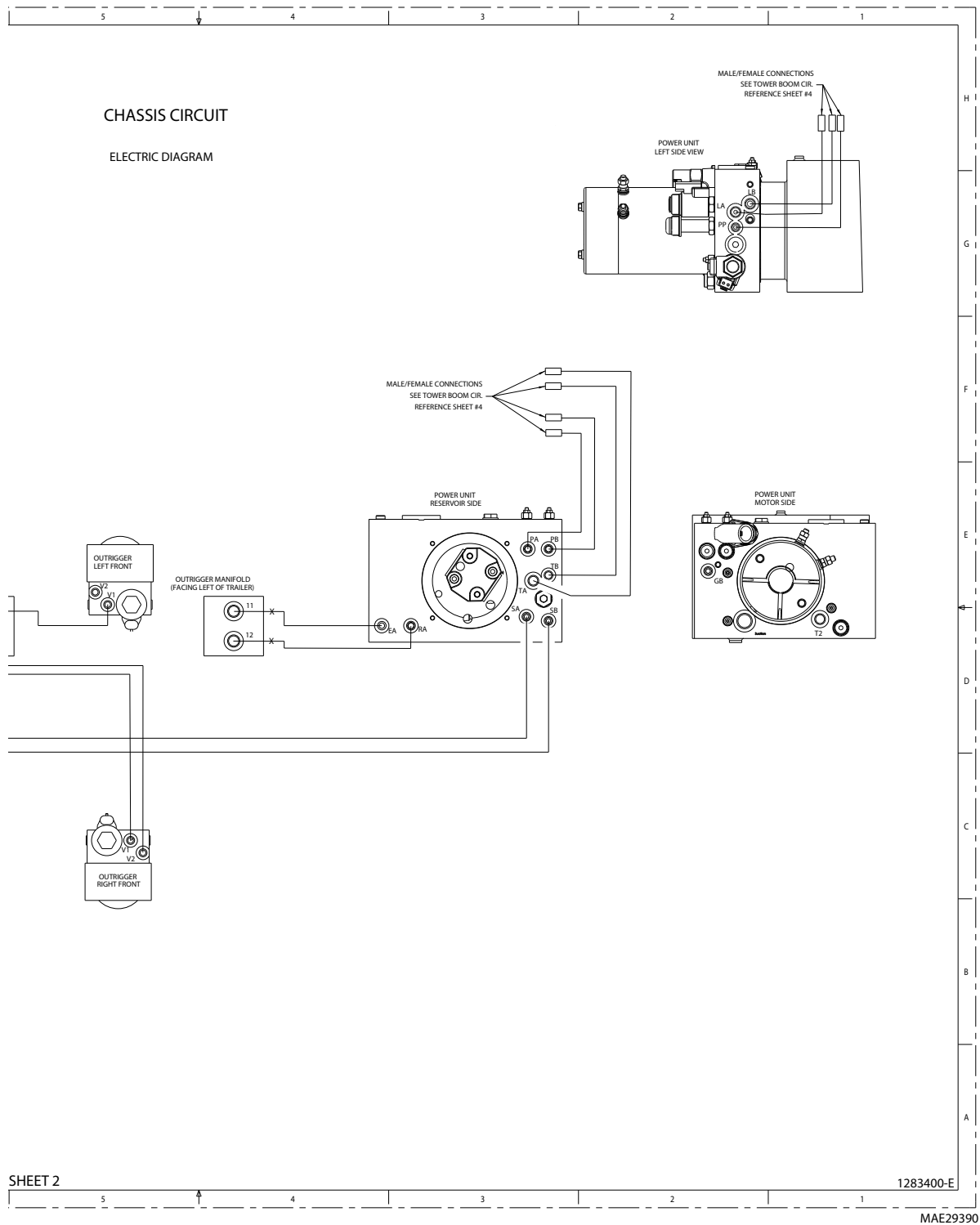


Figure 5-60. Chassis Circuit (Electric) - Sheet 4 of 12

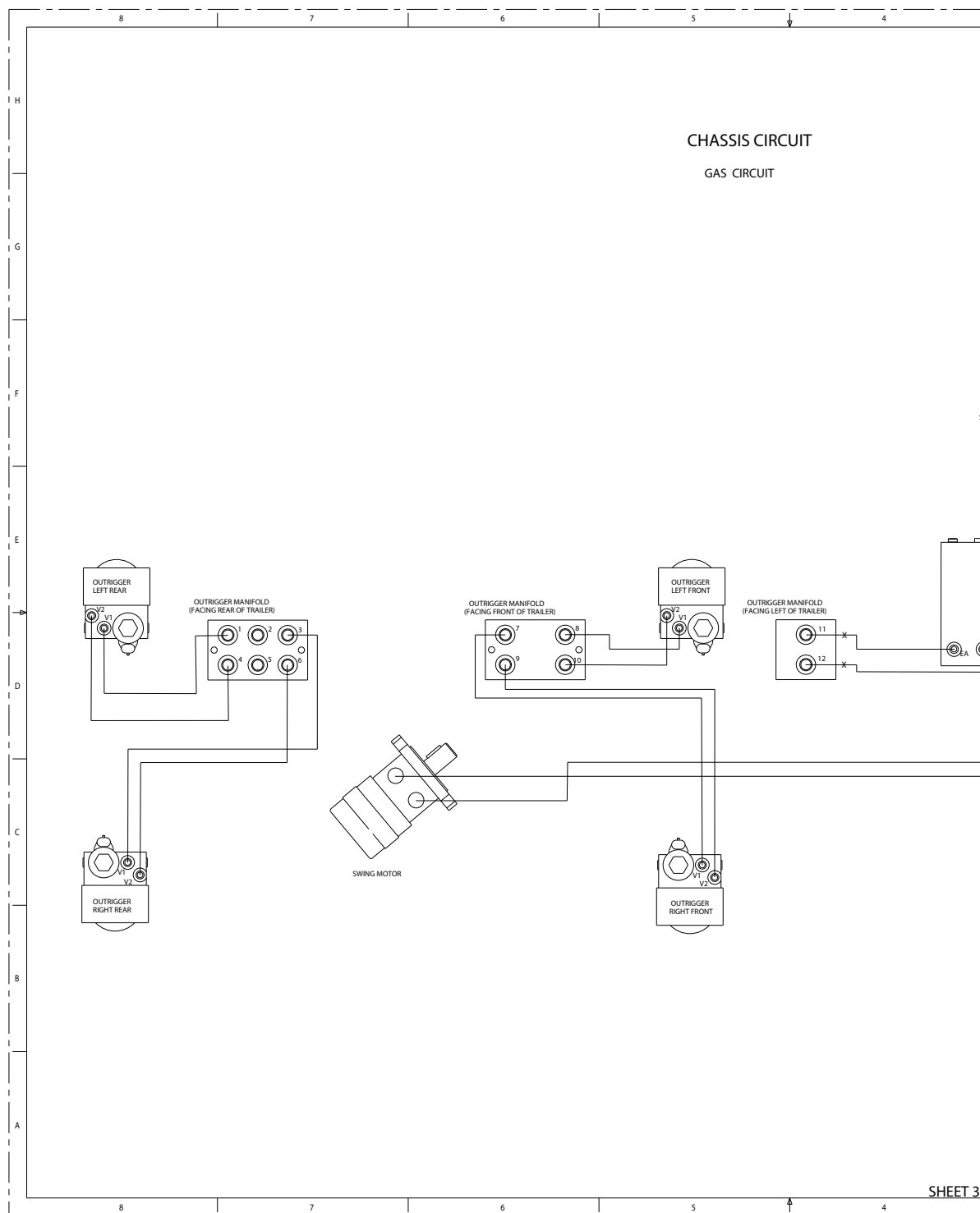


Figure 5-61. Chassis Circuit (Gas) - Sheet 5 of 12

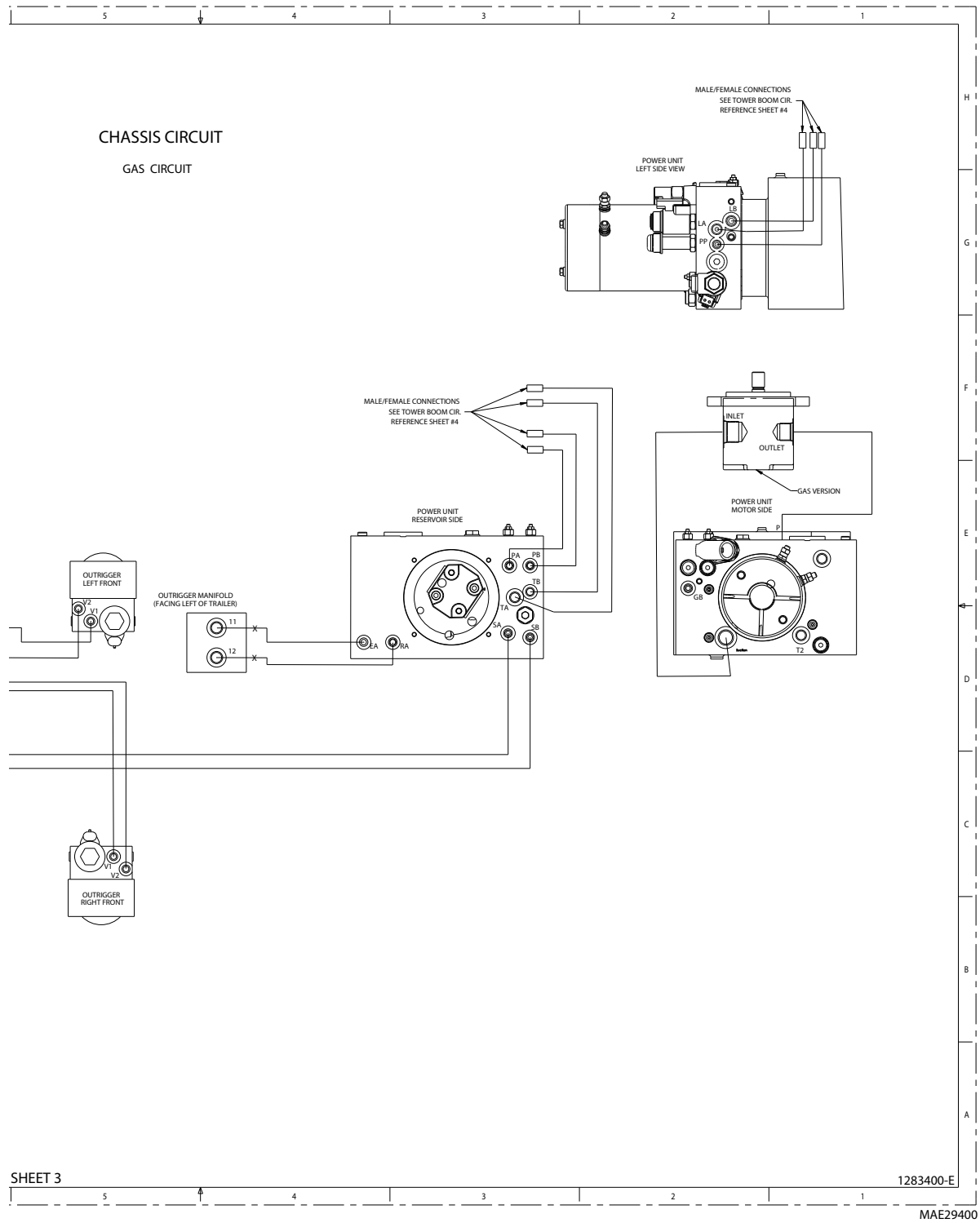


Figure 5-62. Chassis Circuit (Gas) - Sheet 6 of 12

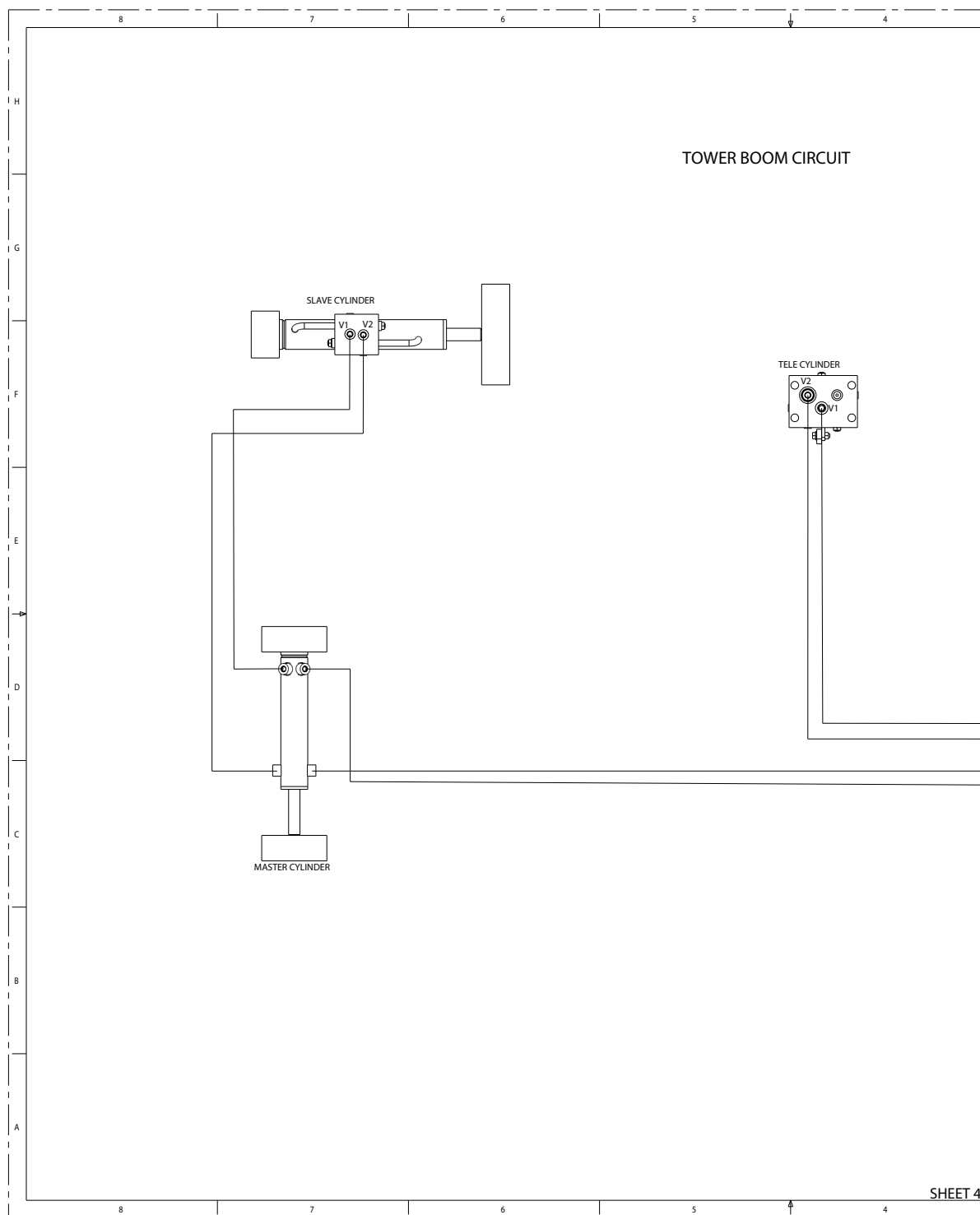


Figure 5-63. Boom Circuit - Sheet 7 of 12

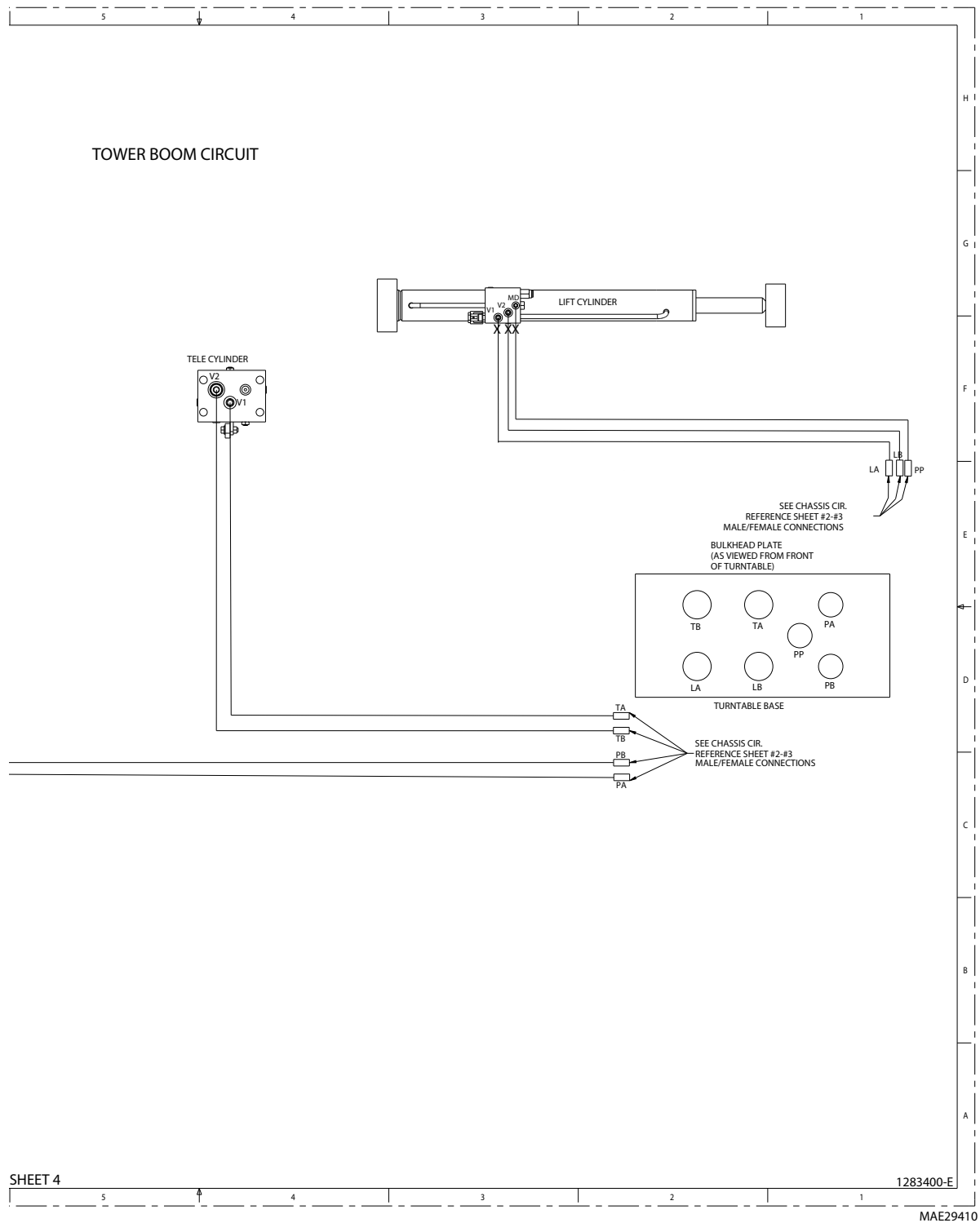


Figure 5-64. Boom Circuit - Sheet 8 of 12

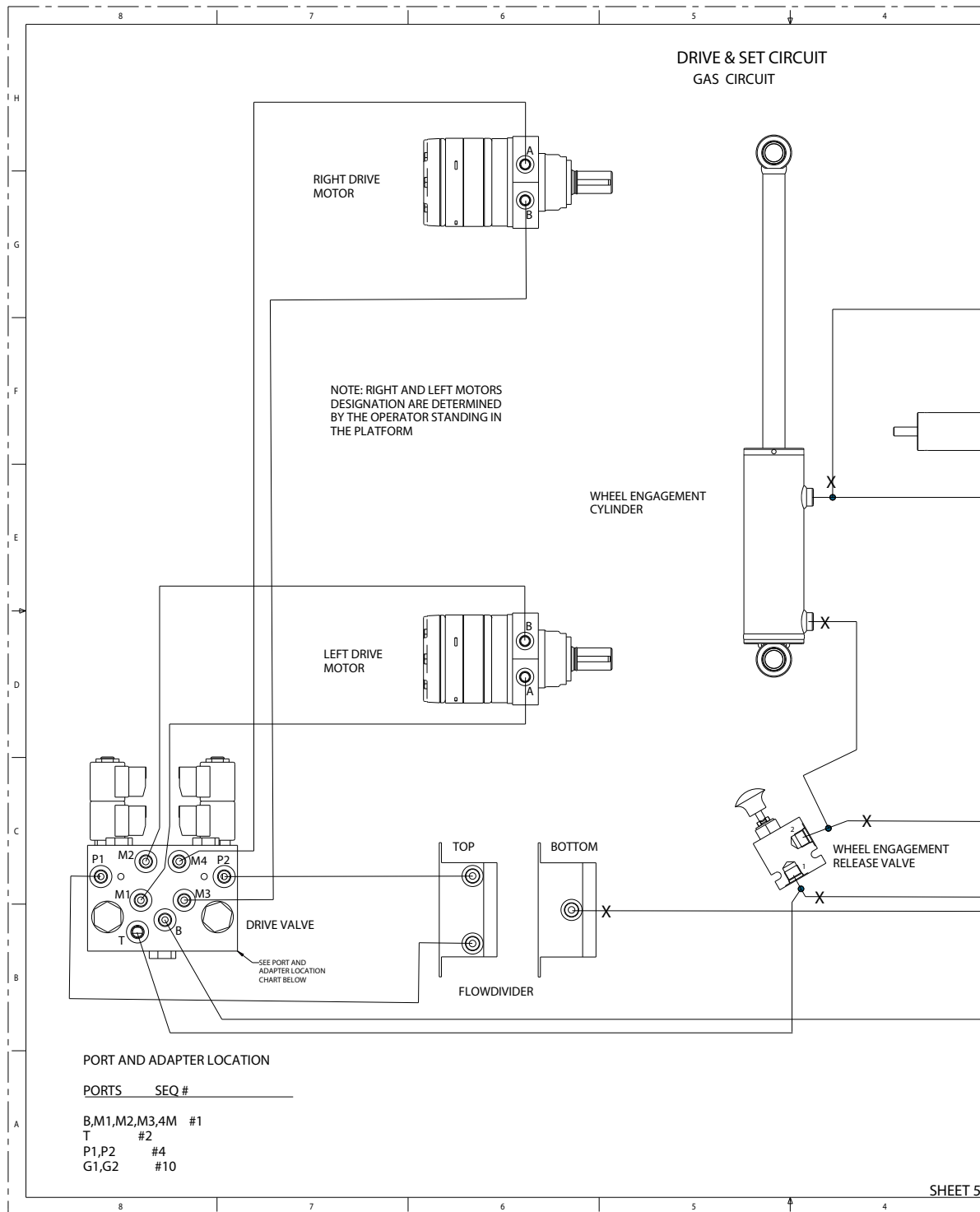


Figure 5-65. Drive and Set Circuit (Gas) - Sheet 9 of 12

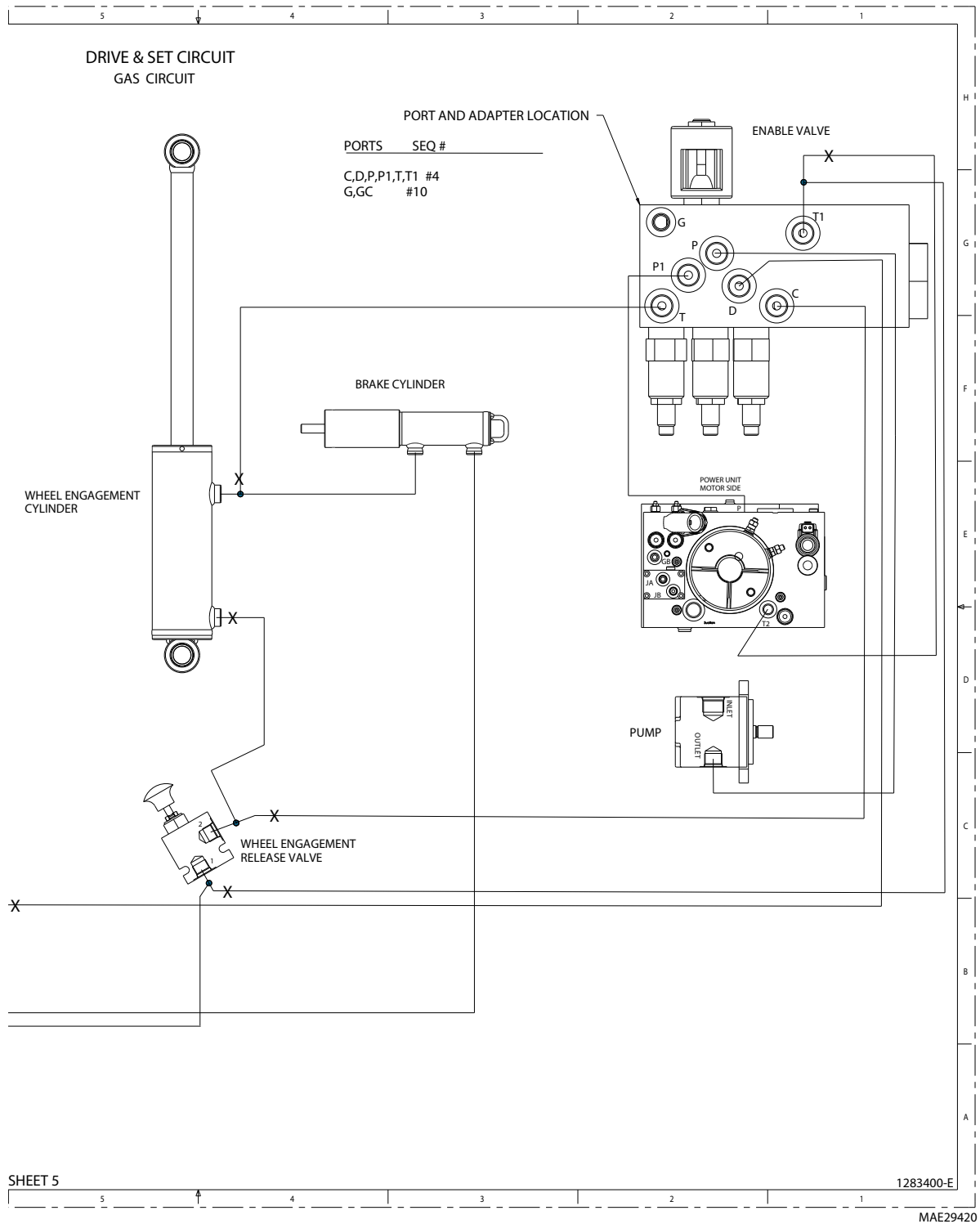


Figure 5-66. Drive and Set Circuit (Gas) - Sheet 10 of 12

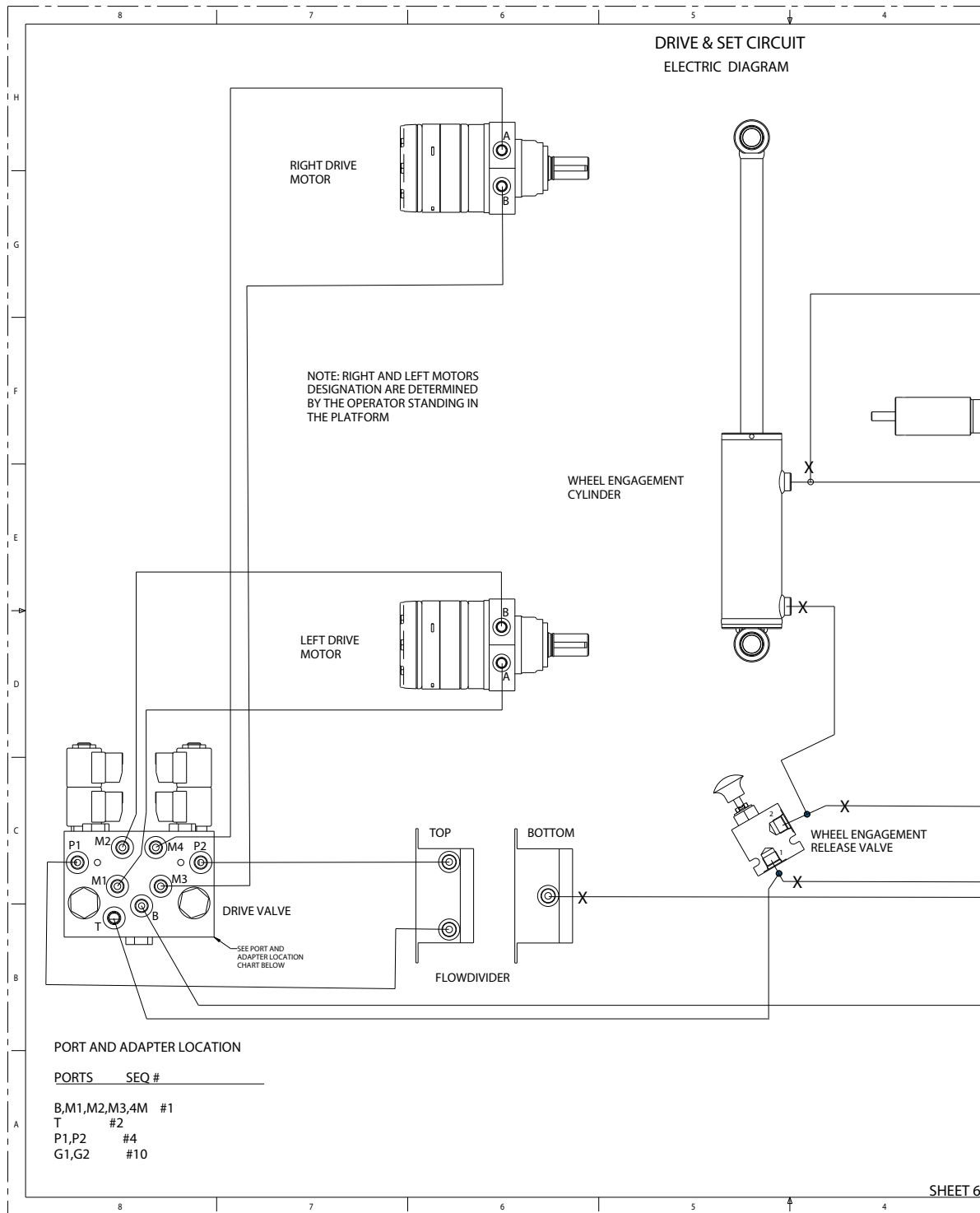


Figure 5-67. Drive and Set Circuit (Electric) - Sheet 11 of 12

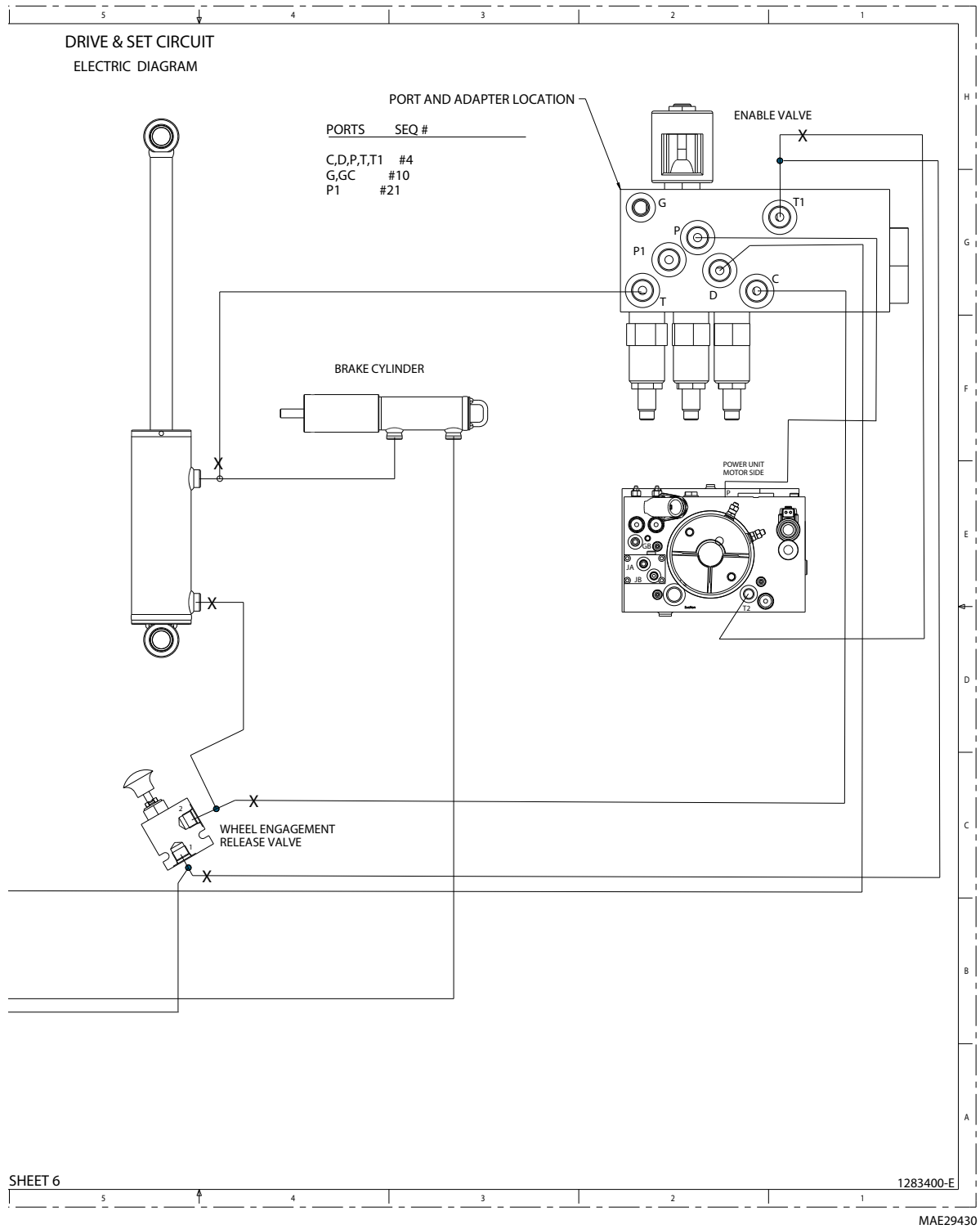


Figure 5-68. Drive and Set Circuit (Electric) - Sheet 12 of 12

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

SECTION 6. JLG CONTROL SYSTEM

6.1 INTRODUCTION

NOTICE

WHEN INSTALLING A NEW GROUND MODULE CONTROLLER IT IS NECESSARY TO PROGRAM THE CONTROLLER FOR PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS.

NOTICE

AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. IF PRESSURE-WASHING IS USED 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) FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

The JLG designed Control System is a 12 volt based 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, minimum speed, and maximum speed for all boom, drive, and steering functions.

The control system provides voltage output to the valves and pump, as programmed for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed into the control system.

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.

The Control System may be accessed with a custom designed, direct connect hand held analyzer or wireless adapter using an app on your Android or iPhone/iPad device. The analyzer or wireless output displays two lines of information at a time, by scrolling through the program.

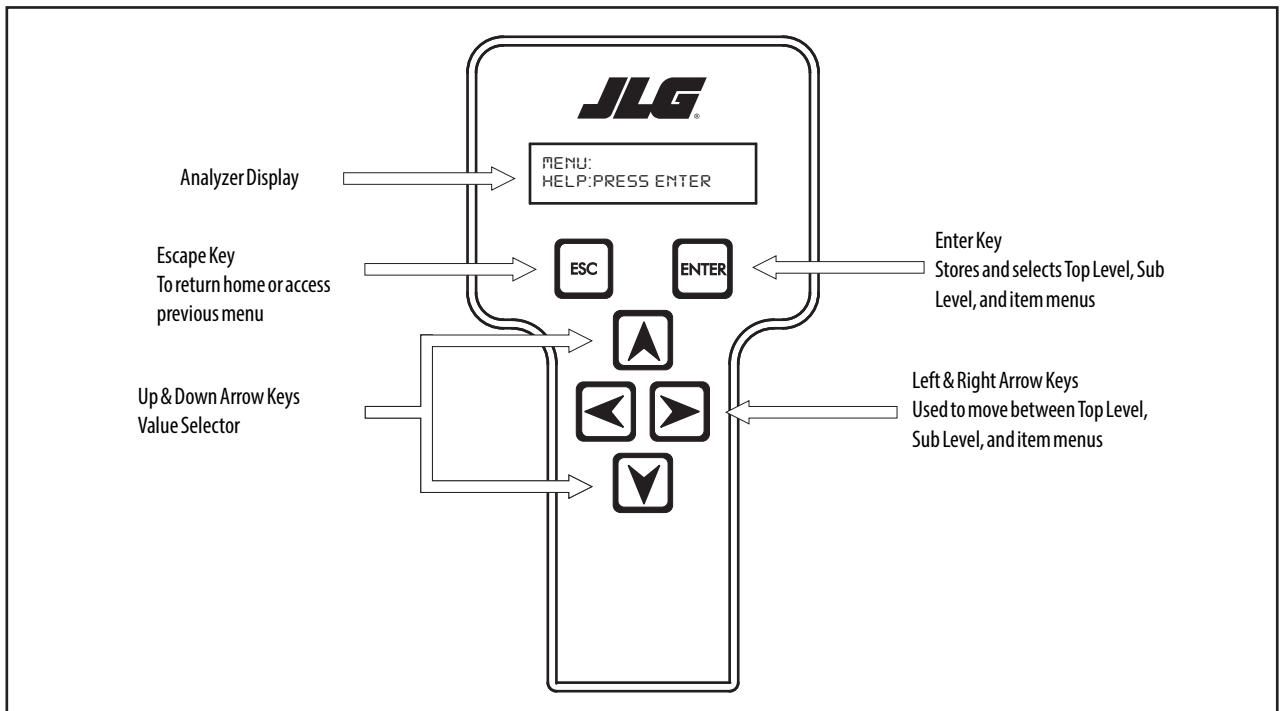


Figure 6-1. Hand Held Analyzer

6.2 TO CONNECT THE JLG CONTROL SYSTEM ANALYZER

1. Connect the cable supplied with the analyzer, to the controller module in the ground control box and connect the remaining end of the cable to the analyzer.

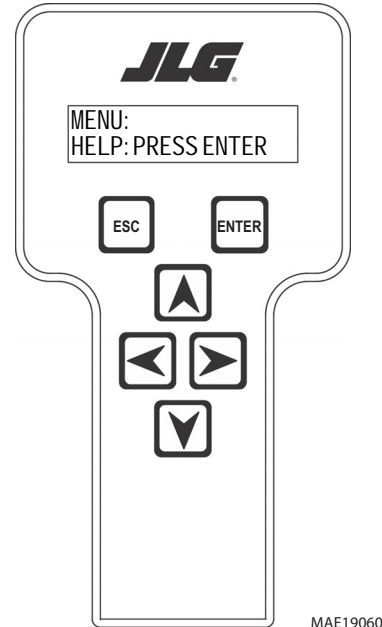


NOTE: The cable has a four pin connector at each end of the cable; the cable cannot be connected backwards.

2. Power up the Control System by turning the key to the ground position and pulling the emergency stop button on.

Using the Analyzer

With the machine power on and the analyzer connected properly, the analyzer will display the following:




MENU:

HELP:PRESS ENTER


Move between top level menu items using


RIGHT  and **LEFT**  arrow keys. To select a displayed menu item, press **ENTER** . To cancel a selected

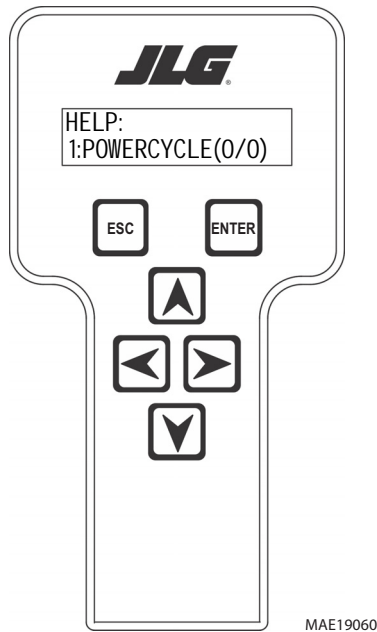
menu item, press **ESC**  then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

HELP
DIAGNOSTICS
SYSTEM TEST
ACCESS LEVEL
PERSONALITIES
MACHINE SETUP
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: POWER CYCLE (0/0)

At this point, the analyzer will display the last fault the system has seen, if any are present. You may scroll through the fault logs to view what the last 25 faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the

beginning, press **ESC**  two times. **POWER CYCLE (0/0)** indicates a power up.

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

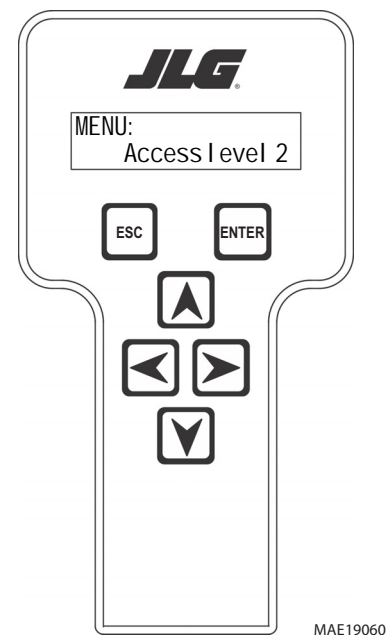
PLATFORM
GROUND
PUMP
ENGINE
SYSTEM
VALVES
DATALOG
VERSIONS

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.

6.3 CHANGING ACCESS LEVEL

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:



MENU: ACCESS LEVEL 2


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

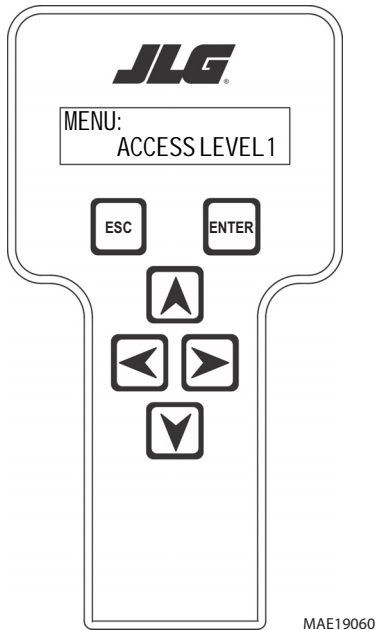
Using the **UP**  or **DOWN**  arrow keys, enter the first digit of the password, 3.

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.

Continue using the arrow keys until all the remaining digits of the password is shown.

Once the correct password is displayed, press **ENTER** . The access level should display the following, if the password was entered correctly:



MAE19060

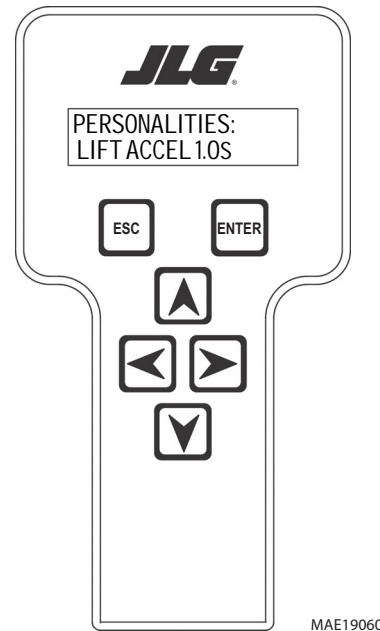
MENU: ACCESS LEVEL 1

Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings.

6.4 ADJUST PARAMETERS

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:




MAE19060



PERSONALITIES: LIFT ACCEL 1.0s

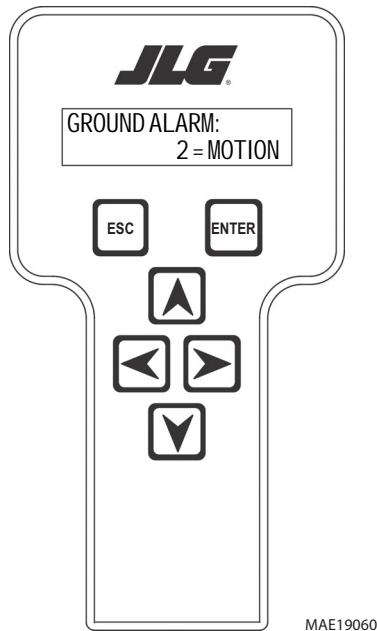
There will be a minimum and maximum for the value to ensure efficient operation. The Value will not increase if the

UP  arrow is pressed when at the maximum value nor

will the value decrease if the **DOWN**  arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at access level 1.

6.5 MACHINE SETUP

When a machine digit item is selected, press **UP**  or **DOWN**  arrow keys to adjust its value, for example:



GROUND ALARM: 2 = MOTION

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 lifting down. 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.

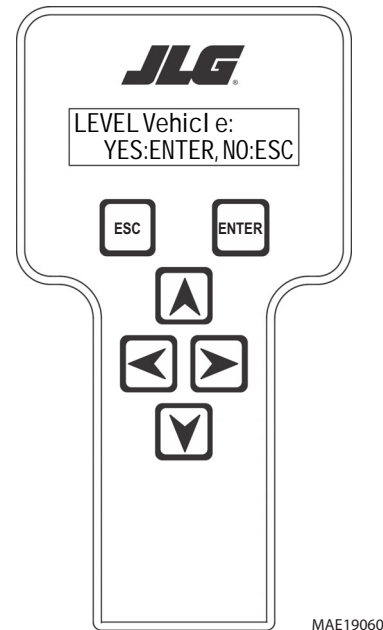
NOTE: Refer to Table 6-3, Machine Model Adjustments and Speeds - ANSI & CSA and Table 6-4, Machine Model Adjustments and Speeds - CE Only for the recommended factory settings.

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

Level Vehicle Description

WARNING


DO NOT LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.



MAE19060

LEVEL VEHICLE

YES:ENTER, NO:ESC

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

SECTION 6 - JLG CONTROL SYSTEM

Table 6-1. Analyzer Abbreviations

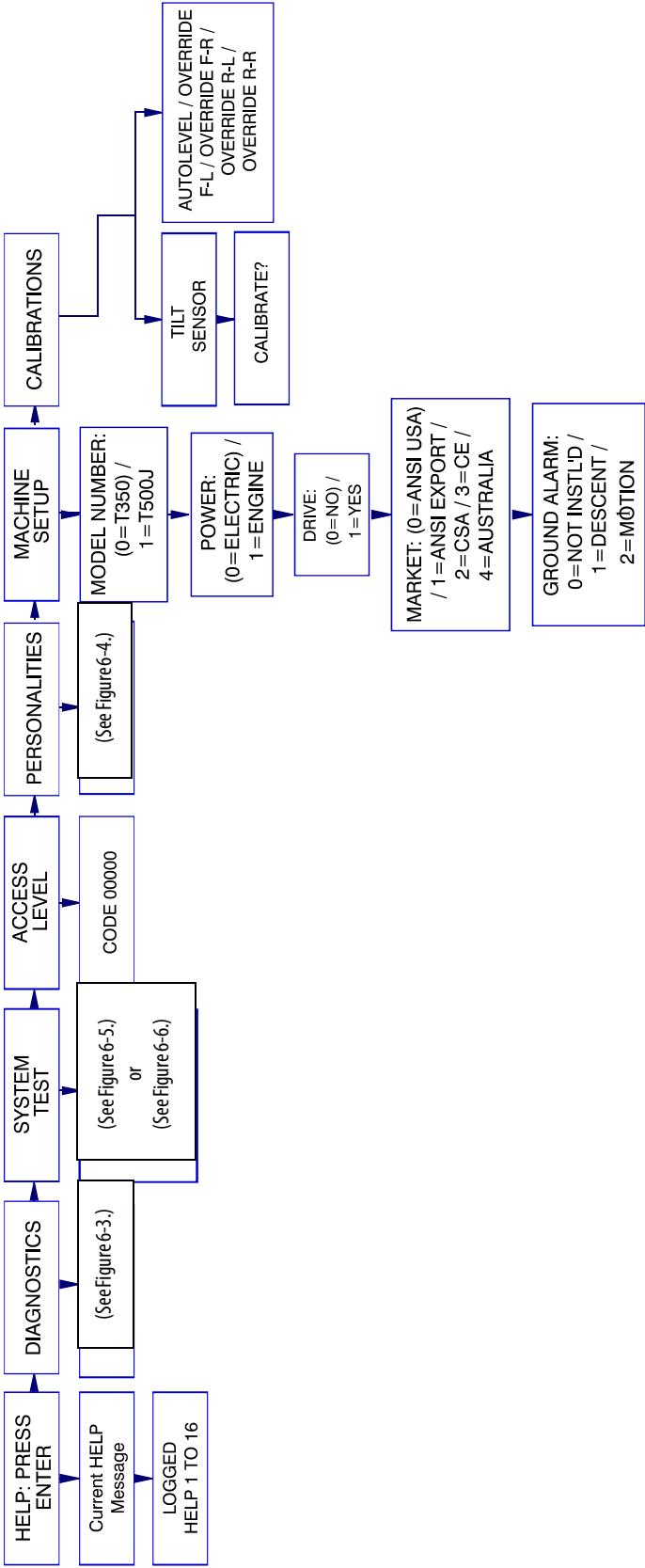
ABBREVIATION	MEANING
ACCEL	ACCELERATE
ACT	ACTIVE
A/D	ANALOG DIGITAL CONVERTER COUNT
AMB.	AMBIENT
ANG	ANGLE
AUX	AUXILIARY
BCS	BOOM CONTROL SYSTEM
BM	BOOM LENGTH ANGLE MODULE
BLAM	BOOM LENGTH ANGLE MODULE
BR	BROKEN
BSK	BASKET
CAL	CALIBRATION
CL	CLOSED
CM	CHASSIS MODULE
CNTL	CONTROL
CNTRL	CONTROL
C/O	CUT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

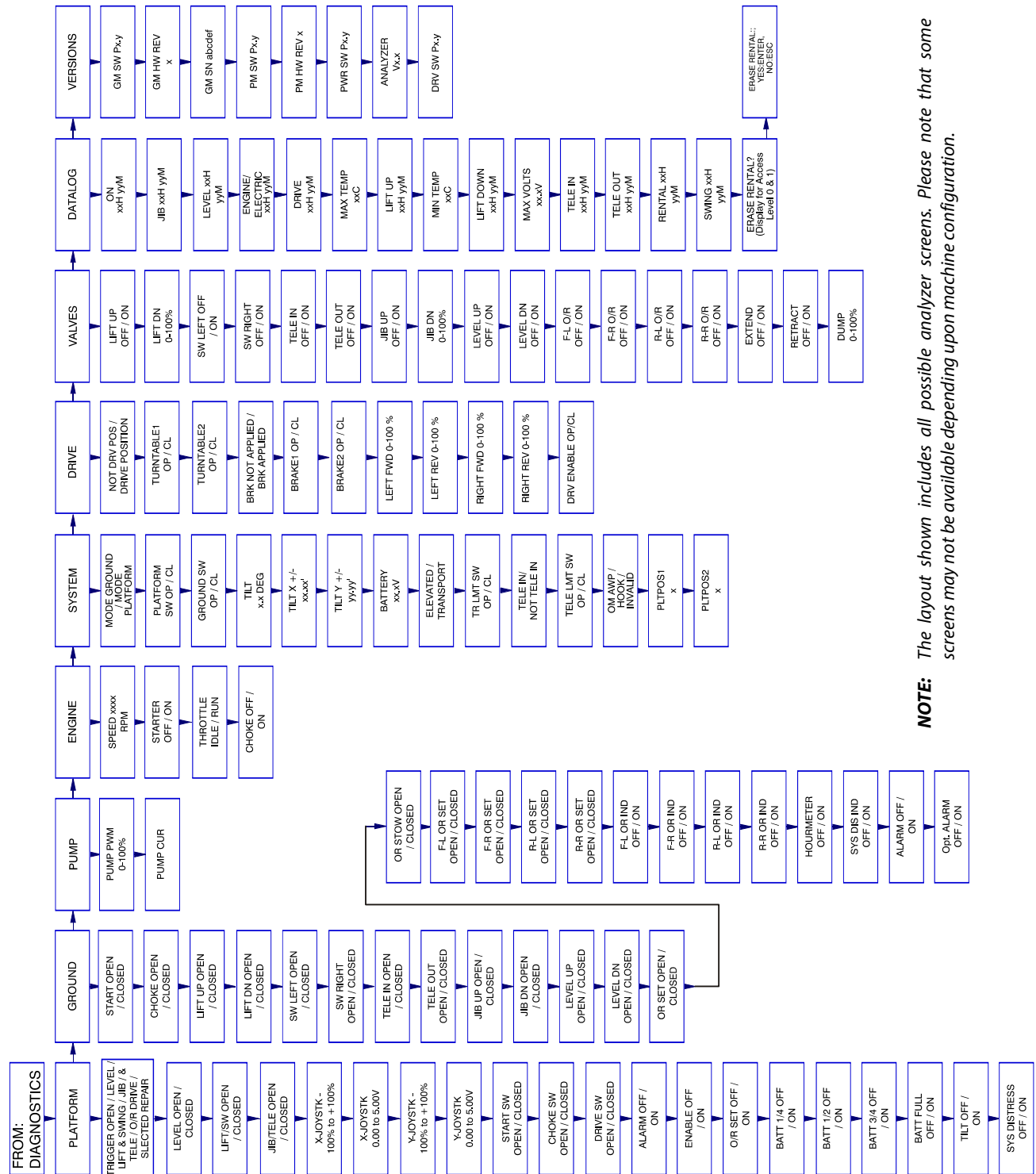
Table 6-1. Analyzer Abbreviations

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



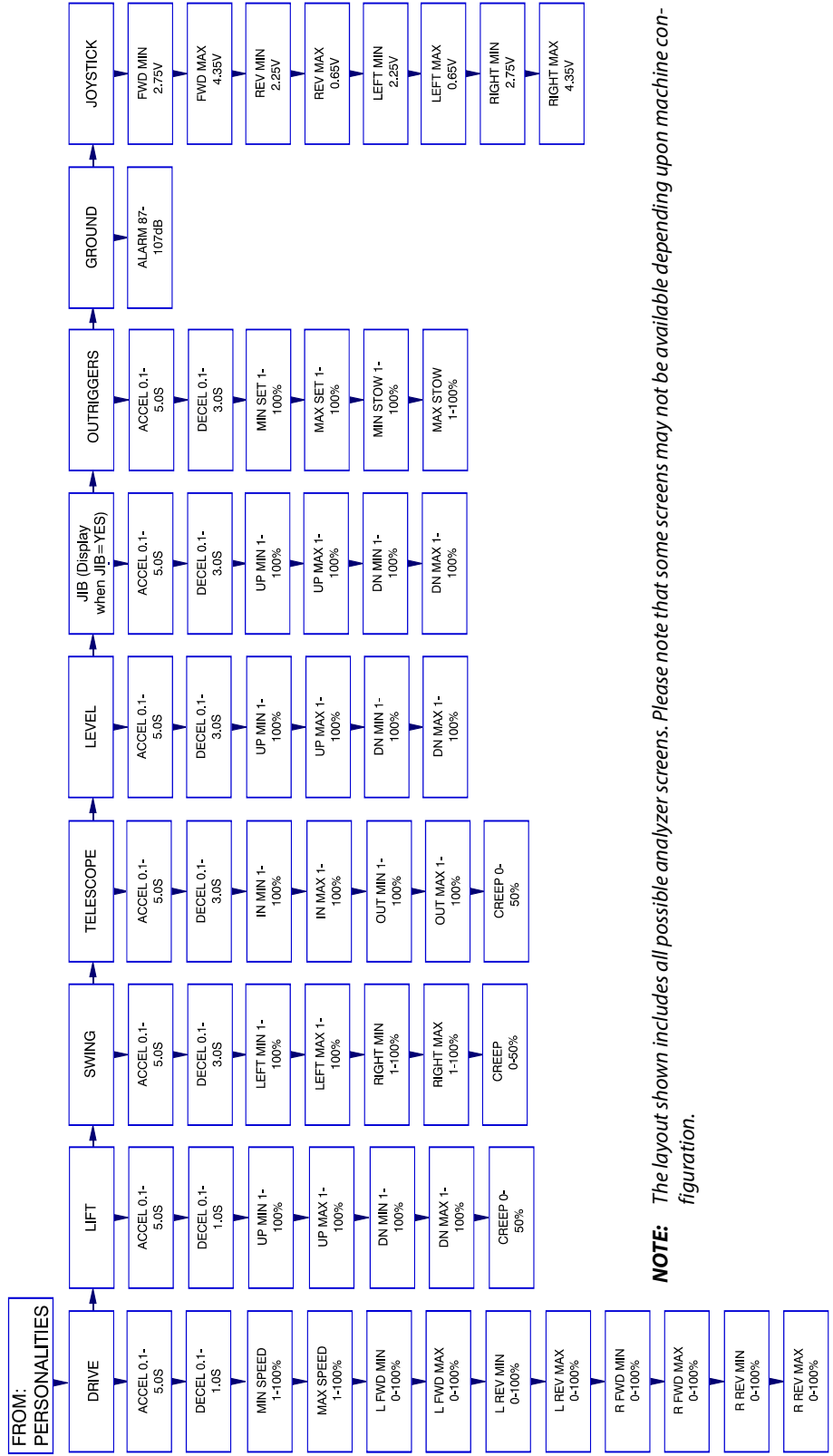
NOTE: The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.

Figure 6-2. Analyzer Flow Chart P1.7



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

Figure 6-3. Analyzer Flow Chart P1.7 - Diagnostics



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

Figure 6-4. Analyzer Flow Chart P1.7 - Personalities

6.6 SYSTEM TEST

The Control System Incorporates a built-in system test to check the system components and functions. To use this function, use the following procedures.

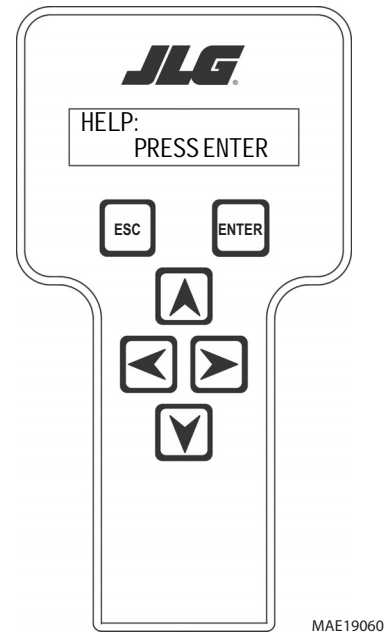
Platform Test

1. Position the Platform/Ground select switch to the Platform position.
2. Plug the analyzer into the connector at the base of the platform control box.



3. Pull out the Emergency Stop switch.

4. The analyzer screen should read.



5. Use the arrow button to reach SYSTEM TEST. Hit Enter. The analyzer will prompt you asking if you want to activate the system test; hit Enter again to activate.
6. Follow the flow path in Figure 6-5., System Test Flow Chart - Platform Tests and go through the component tests. Hit the ESC key during any part of the test to return to the main menu without completing all tests or wait until all tests are complete. During the TEST ALL INPUTS sequence, the analyzer allows control switches to be operated and shows if they are closed (CL) or open (OP).

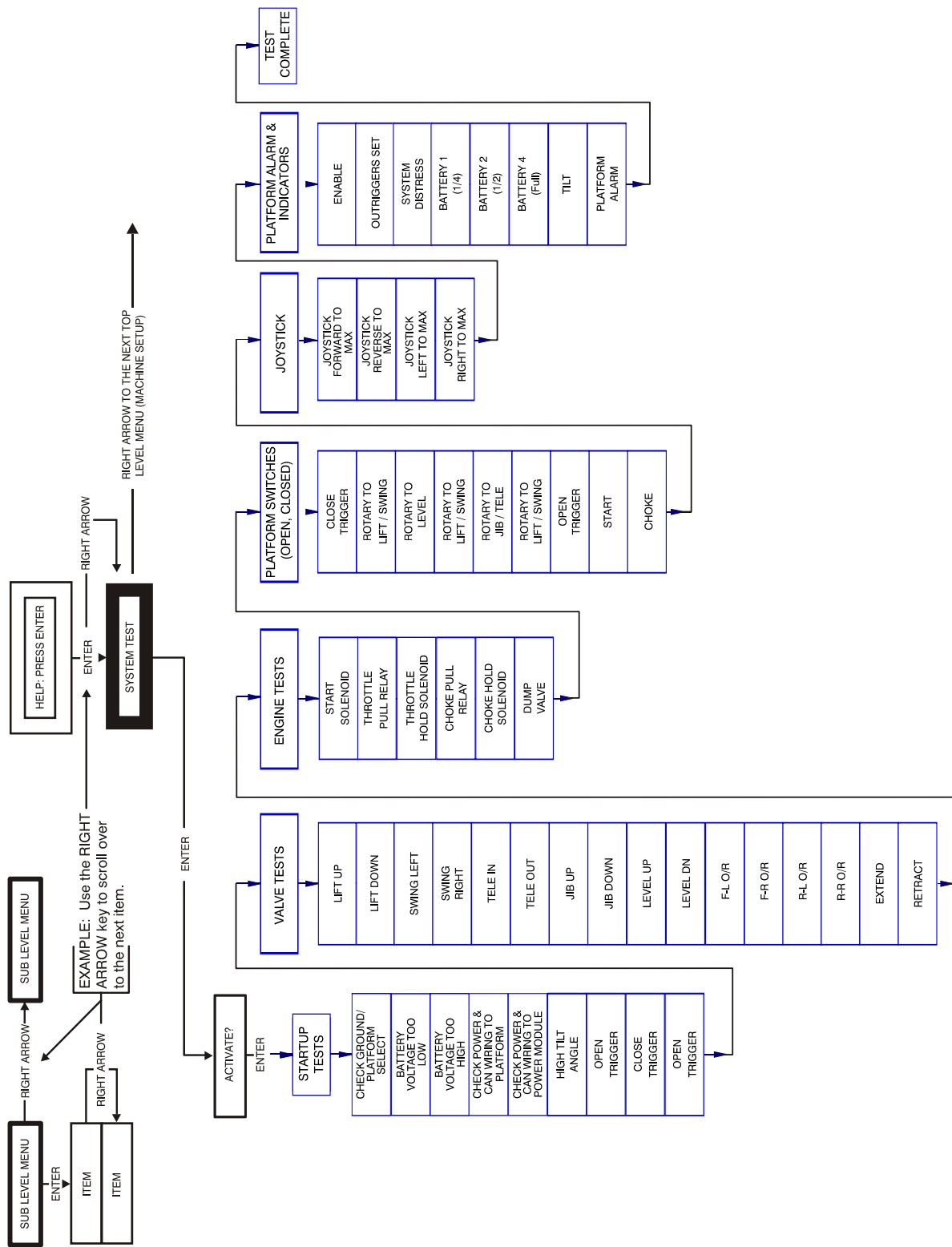


Figure 6-5. System Test Flow Chart - Platform Tests

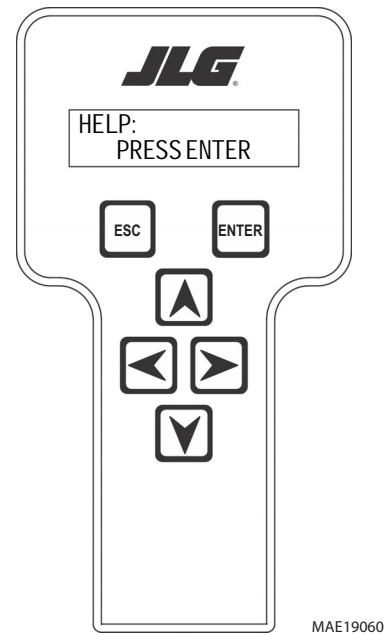
Ground Test

1. Position the Platform/Ground select switch to the Ground position.
2. Plug the analyzer into the connector inside the Ground control box.



3. Pull out the Emergency Stop switch.

4. The analyzer screen should read:



5. Use the arrow button to reach SYSTEM TEST. Hit Enter. The analyzer will prompt you asking if you want to activate the system test; hit Enter again to activate.
6. Follow the flow path in Figure 6-6., System Test Flow Chart - Ground Station Tests and go through the component tests. Hit the ESC key during any part of the test to return to the main menu without completing all tests or wait until all tests are complete. During the TEST ALL INPUTS sequence, the analyzer allows control switches to be operated and shows if they are closed (CL) or open (OP).

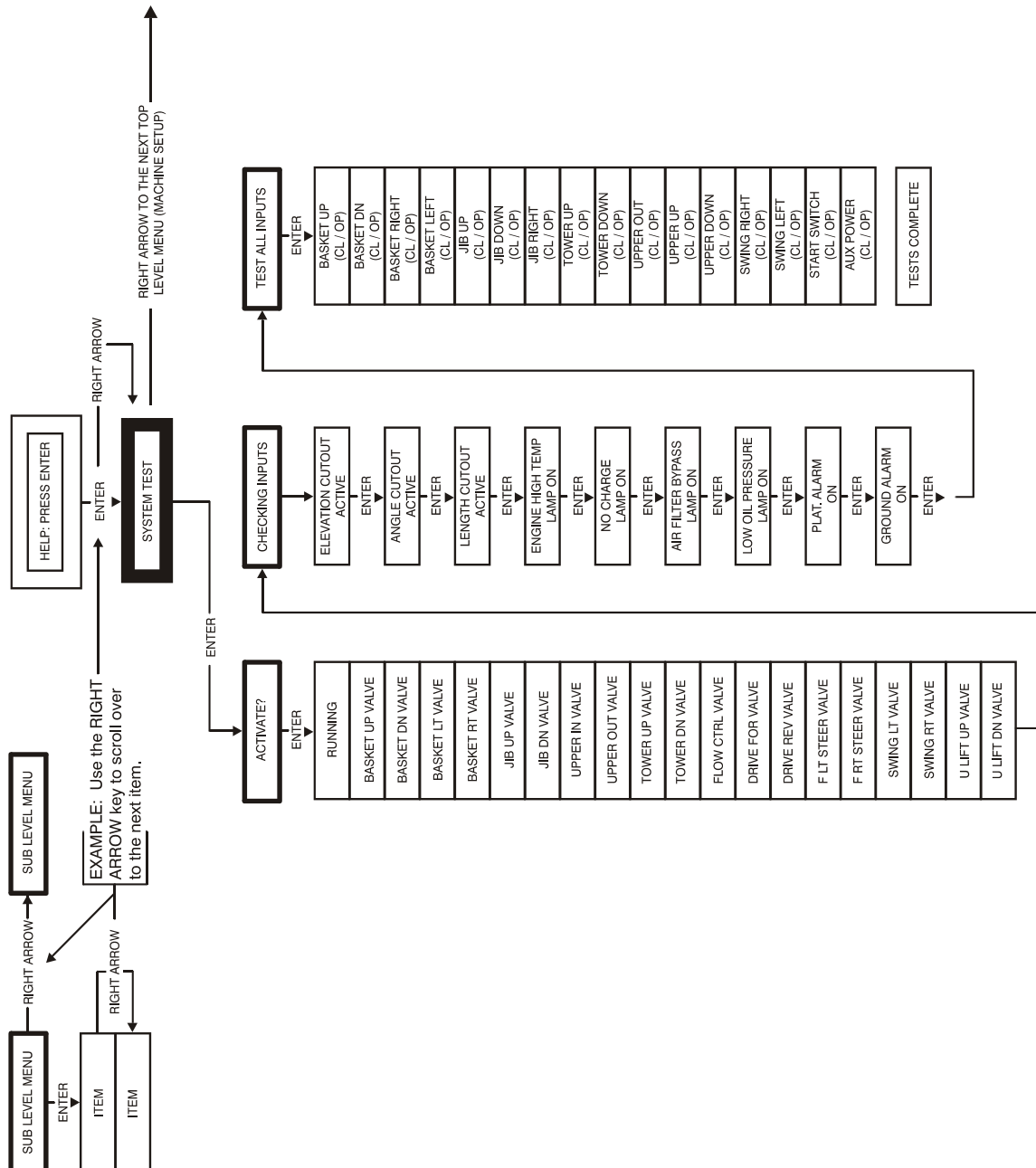


Figure 6-6. System Test Flow Chart - Ground Station Tests

6.7 LEVELING, TILT SENSOR CALIBRATION




When all outriggers are set, the leveling system looks at the angle reported by the bi-directional tilt sensor mounted on the ground board. The system automatically adjusts the outriggers until the chassis is level within 1.0° compound angle before allowing operation of the boom above elevation.

When Machine Is on a Firm Level Surface

1. Place the empty, stowed machine on a firm level surface.
2. Place a digital level on the frame as shown and level as well as possible in both x (left Wheel to right wheel) and y (tongue to tail lights) direction by adjusting tongue jack, being careful not to set the level on welds or adjacent plates (On later frames the fork pocket will be forward of the level).







3. If the board has been replaced or the tilt sensor is not calibrated, connect an analyzer to the machine at the ground control console and calibrate tilt sensor. Enter

Level 2 in Analyzer and use the right arrow key  to scroll to Calibrations. Next use the down arrow  to reach TILT SENSOR. Then press the ENTER key .











4. Deploy the outriggers until the machine auto levels. The machine will indicate it has leveled by beeping three times and flashing the outrigger indicator lights on the ground control box.
5. Verify the machine is level using a digital level as shown in step 1. If not level within 0.5° in each direction, continue to Setup When Machine Is Not on Firm Level Surface and Adjustment Procedure.

NOTE: The tilt sensor reading may be accessed through the ana-

lyzer: Use the right arrow key  to reach DIAGNOSTICS
down arrow key once , right arrow key  to
scroll over to SYSTEM, then the down arrow key  to reach Tilt.

Setup When Machine Is Not on Firm Level Surface and Adjustment Procedure:

1. Connect an analyzer to the machine at the ground control console. Turn the machine power on and select the ground control mode. Go to service mode and adjust outriggers individually to level the machine:
 - a. On the analyzer, select "ACCESS LEVEL 2" and enter 33271. Use the right arrow key  to scroll to CALIBRATIONS. Press the ENTER key . Press the right arrow key  once to reach AUTOLEVEL, then the down arrow key  once to reach OVERRIDE F-L.
 - b. Arrow down  until you reach the desired outrigger. Use the outrigger deploy switch on the Ground control to raise or lower the outrigger.
2. Verify the reading from digital level. Must not exceed 0.2° in both the X- direction (left Wheel to right wheel) and Y-direction (tongue to tail lights).
3. Calibrate tilt sensor. Enter Level 2 in Analyzer and use the right arrow key  to scroll to CALIBRATIONS. Press the down arrow key  once to reach TILT SENSOR. Then hit ENTER .
4. Recycle emergency stop switch. Retract leveling jacks until the set lights go out. Set leveling jacks and wait until the machine signals it is level. Verify machine auto levels within 1.0°.

6.8 USER FAULT CODES

A single digit fault code blinks on the Platform and the Ground control panel to signal the operator of a procedure fault. Refer to Table 6-2, User Fault Codes.

Table 6-2. User Fault Codes

Code	Message
0	Chassis Tilt Sensor Out Of Range Running At Creep - Material Hook Mode
1	Function Locked Out - Joystick Not Centered At Startup Function Locked Out - Trigger Permanently Closed Function Problem - Engine Choke Permanently Selected Function Problem - Engine Start Permanently Selected Function Problem - Jib Down Permanently Selected Function Problem - Jib Up Permanently Selected Function Problem - Level Down Permanently Selected Function Problem - Level Up Permanently Selected Function Problem - Lift Down Permanently Selected Function Problem - Lift Up Permanently Selected Function Problem - Outrigger Set Permanently Selected Function Problem - Outrigger Stow Permanently Selected Function Problem - Swing Left Permanently Selected Function Problem - Swing Right Permanently Selected Function Problem - Telescope In Permanently Selected Function Problem - Telescope Out Permanently Selected Joystick Moved But Trigger Switch Open Trigger Closed Too Long While In Neutral
2*	Drive & O/R Prevented - Operate From Platform Drive & O/R Prevented - Place Boom On Rest Drive & O/R Prevented - Set Hand Brake Drive Prevented - Lift Down Drive Prevented - Stow Outriggers Drive Prevented - Telescope In Lift Down Prevented - Tele In First Lift Up & Tele Out Prevented - Tilted & Above Elevation "Lift Up & Tele Out Prevented - Tilted, Unset, & Above Elevation" Lift Up & Tele Out Prevented - Unset & Above Elevation Lift Up Prevented - Check Outriggers Lift Up Prevented - Lift Down Then Set Outriggers Lift Up Prevented - Tilted Model Changed - Hydraulics Suspended - Cycle EMS Outrigger Stow Prevented - Tele In First Outriggers Prevented - Elevated Running At Creep - Tilted & Above Elevation Running At Creep - Unset & Above Elevation Tele Out Prevented - Set Outriggers Tele Out Prevented - Tilted

Table 6-2. User Fault Codes

Code	Message
<p>* A 2 user flash code indicates a problem with the machine set up, such as an outrigger not properly set. If this occurs while the boom is elevated, all functions will operate at a reduced speed. Immediately return the platform to the stowed position and reposition the machine or reset the outriggers, as required. If the problem still exists, troubleshoot with a JLG analyzer.</p> <p>A 2 user flash code and tilt alarm warning indicator activated at the same time indicates a potential tipping condition. If this occurs while boom is elevated, the lift up and telescope out functions will not operate. Telescope in, lift down and swing functions will operate at reduced speed. THE BOOM MUST BE FULLY RETRACTED BEFORE LOWERING. Immediately return the platform to the stowed position and reposition the machine or reset the outriggers, as required. If the problem still exists, troubleshoot with a JLG analyzer.</p>	
3	Battery Voltage Too High - System Shutdown Battery Voltage Too Low - System Shutdown No Charge System Output
4	Functions At Cutback - Power Module Current Limit Power Module Too Hot - Please Wait
5	Battery Voltage Too High - System Shutdown Battery Voltage Too Low - System Shutdown Engine Not Running
9	Vehicle Requires Service

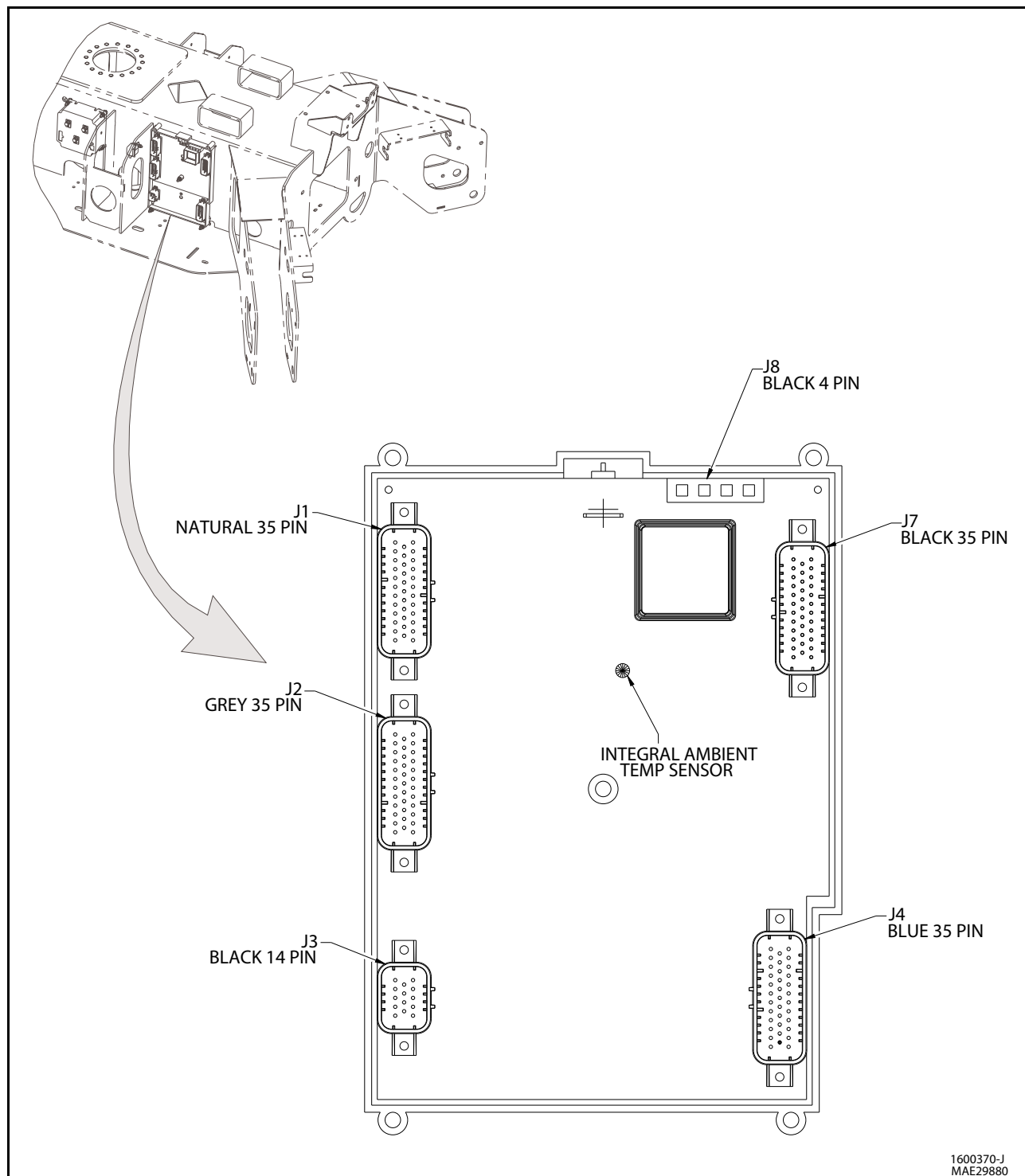


Figure 6-7. Ground Module

Connector	Pin	Tagname	Function	Type	
J1 (Natural)	1	N/C	NOT CONNECTED		
	2	N/C	NOT CONNECTED		
	3	N/C	NOT CONNECTED		
	4	GND	GROUND	Power	Output
	5	GND	GROUND	Power	Output
	6	N/C	NOT CONNECTED		
	7	N/C	NOT CONNECTED		
	8	GND	GROUND	Power	Output
	9	GND	GROUND	Power	Input
	10	N/C	NOT CONNECTED		
	11	N/C	NOT CONNECTED		
	12	N/C	NOT CONNECTED		
	13	N/C	NOT CONNECTED		
	14	AI0	ANALOG INPUT 0 (0-10V; 10 Bit; 200K pull-down)	Analog	Input
	15	AI1	ANALOG INPUT 1 (0-10V; 10 Bit; 200K pull-down)	Analog	Input
	16	ENG5	ENGINE MAGNETO (SPEED PICKUP)	Analog	Input
	17	GND	GROUND	Power	Output
	18	GND	GROUND	Power	Output
	19	GND	GROUND	Power	Output
	20	N/C	NOT CONNECTED		
	21	DIO	DIGITAL INPUT 0 (Low-Sensing)	Digital	Input
	22	DO0	DIGITAL OUTPUT 0 (High-Side; 4A; PWM; Exclusive with J4-12 & J2-27)	Digital	Output
	23	N/C	NOT CONNECTED		
	24	CBAT	CONSTANT BATTERY	Power	Input
	25	N/C	NOT CONNECTED		
	26	N/C	NOT CONNECTED		
	27	GND	GROUND	Power	Output
	28	APWR	ANALYZER POWER (+9.5V)	Power	Output
	29	RX	RS-232 RECEIVE	Serial	Input
	30	TX	RS-232 TRANSMIT	Serial	Output
	31	AGND	ANALYZER RETURN	Power	Output
	32	N/C	NOT CONNECTED	Power	Output
	33	GND	GROUND	Power	Output
	34	DI1	DIGITAL INPUT 1 (Low-Sensing)	Digital	Input
	35	DI2	DIGITAL INPUT 2 (Low-Sensing)	Digital	Input

Connector	Pin	Tagname	Function	Type	
J2 (Grey)	1	N/C	NOT CONNECTED		
	2	N/C	NOT CONNECTED		
	3	PWRS	POWER MODULE LOGIC & LINE CONTACTOR COIL SUPPLY	Digital	Output
	4	TELEIN	TELESCOPE IN VALVE	Digital	Output
	5	LVLUP	LEVEL UP VALVE	Digital	Output
	6	GND	GROUND	Power	Output
	7	LVLDN	LEVEL DOWN VALVE	Digital	Output
	8	OGALR	OPTIONAL GROUND ALARM (PWM)	Digital	Output
	9	DUMP	DUMP VALVE (PWM)	Digital	Output
	10	DO7	DIGITAL OUTPUT 7 (High-Side; 4A; Exclusive with J2-21)	Digital	Output
	11	LFTUP	LIFT UP VALVE	Digital	Output
	12	JIBU	JIB UP VALVE	Digital	Output
	13	N/C	NOT CONNECTED		
	14	GND	GROUND	Power	Output
	15	DO10	DIGITAL OUTPUT 10 (High-Side; 4A; Exclusive with J2-3)	Digital	Output
	16	TELEOUT	TELESCOPE OUT VALVE	Digital	Output
	17	GND	GROUND	Power	Output
	18	GND	GROUND	Power	Output
	19	GALR	GROUND ALARM	Digital	Output
	20	JIBD	JIB DOWN VALVE (PWM)	Digital	Output
	21	DO14	DIGITAL OUTPUT 14 (High-Side; 4A; Exclusive with J2-10)	Digital	Output
	22	LFTDN	LIFT DOWN VALVE (PWM)	Digital	Output
	23	STRO	ENGINE START	Digital	Output
	24	DI3	DIGITAL INPUT 3 (Low-Sensing)	Digital	Input
	25	AI3	ANALOG INPUT 3 (0-10V; 10 Bit; 200K pull-down)	Analog	Input
	26	OVLDI	PLATFORM OVERLOAD INDICATOR	Digital	Output
	27	SYSOI	SYSTEM DISTRESS INDICATOR	Digital	Output
	28	GND	GROUND	Power	Output
	29	GND	GROUND	Power	Output
	30	GND	GROUND	Power	Output
	31	N/C	NOT CONNECTED		
	32	HMTR	HOURLMETER	Digital	Output
	33	DO19	DIGITAL OUTPUT 19 (High-Side; 4A; Exclusive with J2-32)	Digital	Output
	34	SWGL	SWING LEFT VALVE	Digital	Output
	35	SWGR	SWING RIGHT VALVE	Digital	Output

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Connector	Pin	Tagname	Function	Type
J3 (Black)	1	N/C	NOT CONNECTED	
	2	FLLJ	FRONT-LEFT L/J VALVE	Digital Output
	3	GND	GROUND	Power Output
	4	CHKR	CHOKE PULL RELAY	Digital Output
	5	N/C	NOT CONNECTED	Digital Output
	6	FRLJ	FRONT-LEFT L/J VALVE	Digital Output
	7	CHKS	CHOKE HOLD SOLENOID	Digital Output
	8	RLLJ	REAR-LEFT L/J VALVE	Digital Output
	9	THTR	THROTTLE PULL RELAY	Digital Output
	10	RRLJ	REAR-RIGHT L/J VALVE	Digital Output
	11	THRH	THROTTLE HOLD SOLENOID	Digital Output
	12	GND	GROUND	Power Output
	13	EXTLJ	EXTEND L/J VALVE	Digital Output
	14	RETLJ	RETRACT L/J VALVE	Power Output

Connector	Pin	Tagname	Function	Type
J4 (Blue)	1	D032	DIGITAL OUTPUT 32 (High-Side; 4A; Exclusive with J4-2 & J4-14)	Digital Output
	2	D033	DIGITAL OUTPUT 33 (High-Side; 4A; Exclusive with J4-1 & J4-13)	Digital Output
	3	N/C	NOT CONNECTED	
	4	STRS	ENGINE START SWITCH	Digital Input
	5	LVLDS	LEVEL DOWN SWITCH	Digital Input
	6	DI6	DIGITAL INPUT 6 (High-Sensing)	Digital Input
	7	TELEINS	TELESCOPE IN SWITCH	Digital Input
	8	JIBDS	JIB DOWN SWITCH	Digital Input
	9	LJSTW	LEVELING JACK STOW SWITCH	Digital Input
	10	DI10	DIGITAL INPUT 10 (High-Sensing)	Digital Input
	11	TRANS	TRANSPORT LIMIT SWITCH	Digital Input
	12	D017	DIGITAL OUTPUT 17 (High-Side; 4A; PWM; Exclusive with J1-22&J2-26)	Digital Output
	13	RLLJI	REAR-LEFT L/J INDICATOR	Digital Output
	14	RRLJI	REAR-RIGHT L/J INDICATOR	Digital Output
	15	N/C	NOT CONNECTED	
	16	CHKSW	ENGINE CHOKE SWITCH	Digital Input
	17	LVLUPS	LEVEL UP SWITCH	Digital Input
	18	DI14	DIGITAL INPUT 14 (High-Sensing)	Digital Input
	19	JIBUS	JIB UP SWITCH	Digital Input
	20	LJSET	LEVELING JACK SET SWITCH	Digital Input
	21	TELELMT	TELESCOPE IN LIMIT SWITCH	Digital Input
	22	DI18	DIGITAL INPUT 18 (High-Sensing)	Digital Input
	23	LFTUPS	LIFT UP SWITCH	Digital Input
	24	IGN	IGNITION	Power Output
	25	IGN	IGNITION	Power Output
	26	FRLJI	FRONT-RIGHT L/J INDICATOR	Digital Output
	27	D034	DIGITAL OUTPUT 34 (High-Side; 4A; Exclusive with J4-28 & J4-29)	Digital Output
	28	D035	DIGITAL OUTPUT 35 (High-Side; 4A; Exclusive with J4-26 & J4-27)	Digital Output
	29	FLLJI	FRONT-LEFT L/J INDICATOR	Digital Output
	30	TELOUTS	TELESCOPE OUT SWITCH	Digital Input
	31	GND	GROUND	Power Output
	32	GND	GROUND	Power Output
	33	LFTDNS	LIFT DOWN SWITCH	Digital Input
	34	SWLS	SWING LEFT SWITCH	Digital Input
	35	SWRS	SWING RIGHT SWITCH	Digital Input

Connector	Pin	Tagname	Function	Type
J7 (Black)	1	PLTE	PLATFORM EMS	Power Input
	2	PLTM	PLATFORM MODE	Power Input
	3	GNDE	GROUND MODE (Connect to J7-14)	Power Input
	4	AI4	ANALOG INPUT 4 (0-10V; 10 Bit; 200K pull-down)	Analog Input
	5	7EXC	+7V ANALOG EXCITATION VOLTAGE	Power Output
	6	CANT	CANBUS TERMINATOR (Connect to J7-17 to engage)	Serial I/O
	7	PLTP1	PLATFORM POSITION 1	Analog Input
	8	PLTP2	PLATFORM POSITION 2	Analog Input
	9	GND	GROUND	Power Output
	10	GND	GROUND	Power Output
	11	FLSET	FRONT-LEFT L/J SET LIMIT SWITCH	Digital Input
	12	RRSET	REAR-RIGHT L/J SET LIMIT SWITCH	Digital Input
	13	CANH	CANBUS HIGH	Serial I/O
	14	GNDE	GROUND MODE (Connects to J7-3)	Power Output
	15	DI26	DIGITAL INPUT 26 (High-Sensing)	Digital Input
	16	7EXC	+7V ANALOG EXCITATION VOLTAGE	Power Output
	17	CANT	CANBUS TERMINATOR	Serial I/O
	18	CANS	CANBUS SHIELD	Power Input
	19	GND	GROUND	Power Input
	20	AI7	ANALOG INPUT 7 (0-10V; 10 Bit; 200K pull-down)	Analog Input
	21	DI27	DIGITAL INPUT 27 (High-Sensing)	Digital Input
	22	DI28	DIGITAL INPUT 28 (High-Sensing)	Digital Input
	23	FRSET	FRONT-RIGHT L/J SET LIMIT SWITCH	Digital Input
	24	CANL	CANBUS LOW	Serial I/O
	25	GND	GROUND	Power Output
	26	7EXC	+7V ANALOG EXCITATION VOLTAGE	Power Output
	27	7EXC	+7V ANALOG EXCITATION VOLTAGE	Power Output
	28	GND	GROUND	Power Output
	29	IGN	IGNITION	Power Output
	30	IGN	IGNITION	Power Output
	31	IGN	IGNITION	Power Output
	32	IGN	IGNITION	Power Output
	33	IGN	IGNITION	Power Output
	34	IGN	IGNITION	Power Output
	35	RLSET	REAR-LEFT L/J SET LIMIT SWITCH	Digital Input

Connector	Pin	Tagname	Function	Type
J8 (Black)	1	MGND	MASTER GROUND CONNECTION (Connect to J8-3)	Power Input
	2	MIGN	MASTER IGNITION CONNECTION (Connect to J8-4)	Power Input
	3	PGND	PASSTHROUGH GROUND CONNECTION (Connect to J8-1)	Power Output
	4	PIGN	PASSTHROUGH IGNITION CONNECTION (Connect to J8-2)	Power Output

Table 6-3. Machine Model Adjustments and Speeds - ANSI & CSA

FUNCTION	ADJUSTMENT ^{1,4}	MODEL DEFAULTS		MODEL TIME RANGE (SECONDS) ^{2,3}	
	RANGES ⁵	Electric	Gas	Electric	Gas
DRIVE					
FORWARD (25' COURSE)				20-28	19-22
REVERSE (25' COURSE)				20-28	19-22
ACCEL	0.1 to 5.0 sec	1.0	1.0		
DECEL	0.1 to 3.0 sec	0.5	0.5		
L FWD MIN	0 to 100%	15	15		
L FWD MAX	0 to 100%	50	50		
L REV MIN	0 to 100%	15	15		
L REV MAX	0 to 100%	50	50		
R FWD MIN	0 to 100%	15	15		
R FWD MAX	0 to 100%	50	50		
R REV MIN	0 to 100%	15	15		
R REV MAX	0 to 100%	50	50		
LIFT					
ACCEL	0.1 to 5.0 sec	1.5	1.5		
DECEL	0.1 to 3.0 sec	0.8	0.8		
MIN UP	0 to 25% (75%)	6	56		
MAX UP	0 to 100% (85%)	80	72	24-34	24-34
MIN DOWN	0 to 25% (50%)	11	25		
MAX DOWN	0 to 35% (65%)	27	46	26-36	26-36
CREEP	0 to 50%	50	50		
SWING					
ACCEL	0.1 to 5.0 sec	2.7	2.7		
DECEL	0.1 to 3.0 sec	1.0	1.0		
MIN LEFT	0 to 25% (75%)	4	58		
MAX LEFT	0 to 50% (85%)	35	63	55-85	55-85
MIN RIGHT	0 to 25% (75%)	4	58		
MAX RIGHT	0 to 50% (85%)	35	63	55-85	55-85
CREEP	0 to 35%	30	30		
TELESCOPE					
ACCEL	0.1 to 5.0 sec	1.5	1.5		
DECEL	0.1 to 3.0 sec	0.8	0.8		
MIN IN	0 to 25% (75%)	5	57		
MAX IN	0 to 100% (85%)	100	80	17-23	15-21
MIN OUT	0 to 25% (75%)	10	60		
MAX OUT	0 to 100% (85%)	60	80	17-23	13-19

Table 6-3. Machine Model Adjustments and Speeds - ANSI & CSA

FUNCTION	ADJUSTMENT ^{1,4}	MODEL DEFAULTS		MODEL TIME RANGE (SECONDS) ^{2,3}	
	RANGES ⁵	Electric	Gas	Electric	Gas
CREEP	0 to 35%	30	30		
PLATFORM LEVEL					
ACCEL	0.1 to 5.0sec	0.1	0.1		
DECEL	0.1 to 3.0sec	0.1	0.1		
MIN UP	0 to 25% (75%)	12	53		
MAX UP	0 to 50% (85%)	27	72		
MIN DOWN	0 to 25% (75%)	12	53		
MAX DOWN	0 to 50% (85%)	27	72		
JIB LIFT					
ACCEL	0.1 to 5.0sec	N/A	N/A		
DECEL	0.1 to 3.0sec	N/A	N/A		
MIN UP	0 to 25% (75%)	N/A	N/A		
MAX UP	0 to 50% (85%)	N/A	N/A	N/A	N/A
MIN DOWN	0 to 25% (75%)	N/A	N/A		
MAX DOWN	0 to 50% (85%)	N/A	N/A	N/A	N/A
OUTRIGGERS					
ACCEL	0.1 to 5.0sec	0.5	0.5		
DECEL	0.1 to 3.0sec	0.5	0.5		
MIN SET	0 to 25% (75%)	10	65		
MAX SET	0 to 100% (85%)	100	85		
MIN STOW	0 to 25% (75%)	10	65		
MAX STOW	0 to 100% (85%)	100	85		
JOYSTICK					
FWD IN	0.50-4.50V	2.75	2.75		
FWD MAX	0.50-4.50V	4.35	4.35		
REV IN	0.50-4.50V	2.25	2.25		
REV MAX	0.50-4.50V	0.65	0.65		
LEFT IN	0.50-4.50V	2.25	2.25		
LEFT MAX	0.50-4.50V	0.65	0.65		
RIGHT IN	0.50-4.50V	2.75	2.75		
RIGHT MAX	0.50-4.50V	4.35	4.35		
GROUND					
ALARM	87 to 107dB	87	107		

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Table 6-4. Machine Model Adjustments and Speeds - CE Only

FUNCTION	ADJUSTMENT ^{1,4}	MODEL DEFAULTS		MODEL TIME RANGE (SECONDS) ^{2,3}	
	RANGES ⁵	Electric	Gas	Electric	Gas
DRIVE					
FORWARD (25' COURSE)				20-28	19-22
REVERSE (25' COURSE)				20-28	19-22
ACCEL	0.1 to 5.0 sec	1.0	1.0		
DECEL	0.1 to 3.0 sec	0.5	0.5		
L FWD MIN	0 to 100%	15	15		
L FWD MAX	0 to 100%	50	50		
L REV MIN	0 to 100%	15	15		
L REV MAX	0 to 100%	50	50		
R FWD MIN	0 to 100%	15	15		
R FWD MAX	0 to 100%	50	50		
R REV MIN	0 to 100%	15	15		
R REV MAX	0 to 100%	50	50		
LIFT					
ACCEL	0.1 to 5.0 sec	1.5	1.5		
DECEL	0.1 to 3.0 sec	1.3	1.3		
MIN UP	0 to 25% (75%)	6	56		
MAX UP	0 to 100% (85%)	73	66	25-35	25-35
MIN DOWN	0 to 25% (50%)	11	25		
MAX DOWN	0 to 35% (65%)	25	40	35-45	35-45
CREEP	0 to 50%	50	50		
SWING					
ACCEL	0.1 to 5.0 sec	2.7	2.7		
DECEL	0.1 to 3.0 sec	1.0	1.0		
MIN LEFT	0 to 25% (75%)	4	58		
MAX LEFT	0 to 50% (85%)	35	63	55-85	55-85
MIN RIGHT	0 to 25% (75%)	4	58		
MAX RIGHT	0 to 50% (85%)	35	63	55-85	55-85
CREEP	0 to 35%	30	30		
TELESCOPE					
ACCEL	0.1 to 5.0 sec	1.5	1.5		
DECEL	0.1 to 3.0 sec	0.8	0.8		
MIN IN	0 to 25% (75%)	5	57		
MAX IN	0 to 100% (85%)	100	80	17-23	15-21
MIN OUT	0 to 25% (75%)	10	60		
MAX OUT	0 to 100% (85%)	60	80	17-23	13-19
CREEP	0 to 35%	30	30		

Table 6-4. Machine Model Adjustments and Speeds - CE Only

FUNCTION	ADJUSTMENT ^{1,4}	MODEL DEFAULTS		MODEL TIME RANGE (SECONDS) ^{2,3}	
	RANGES ⁵	Electric	Gas	Electric	Gas
PLATFORM LEVEL					
ACCEL	0.1 to 5.0 sec	0.1	0.1		
DECEL	0.1 to 3.0 sec	0.1	0.1		
MIN UP	0 to 25% (75%)	12	53		
MAX UP	0 to 50% (85%)	27	72		
MIN DOWN	0 to 25% (75%)	12	53		
MAX DOWN	0 to 50% (85%)	27	72		
JIB LIFT					
ACCEL	0.1 to 5.0 sec	N/A	N/A		
DECEL	0.1 to 3.0 sec	N/A	N/A		
MIN UP	0 to 25% (75%)	N/A	N/A		
MAX UP	0 to 50% (85%)	N/A	N/A	N/A	N/A
MIN DOWN	0 to 25% (75%)	N/A	N/A		
MAX DOWN	0 to 50% (85%)	N/A	N/A	N/A	N/A
OUTRIGGERS					
ACCEL	0.1 to 5.0 sec	0.5	0.5		
DECEL	0.1 to 3.0 sec	0.5	0.5		
MIN SET	0 to 25% (75%)	10	65		
MAX SET	0 to 100% (85%)	100	85		
MIN STOW	0 to 25% (75%)	10	65		
MAX STOW	0 to 100% (85%)	100	85		
JOYSTICK					
FWD IN	0.50-4.50V	2.75	2.75		
FWD MAX	0.50-4.50V	4.35	4.35		
REV MIN	0.50-4.50V	2.25	2.25		
REV MAX	0.50-4.50V	0.65	0.65		
LEFT MIN	0.50-4.50V	2.25	2.25		
LEFT MAX	0.50-4.50V	0.65	0.65		
RIGHT MIN	0.50-4.50V	2.75	2.75		
RIGHT MAX	0.50-4.50V	4.35	4.35		
GROUND					
ALARM	87 to 107dB	87	107		
* See Section 6.9 for orientation when setting speeds.					

Table 6-4. Machine Model Adjustments and Speeds - CE Only

FUNCTION	ADJUSTMENT ^{1,4}	MODEL DEFAULTS		MODEL TIME RANGE (SECONDS) ^{2,3}	
	RANGES ⁵	Electric	Gas	Electric	Gas
<p>Note 1: Personality settings can be adjusted anywhere within the adjustment range in order to achieve optimum machine performance.</p> <p>Note 2: Stop watch should be start when function starts. The exception is the drive function. The machine should have a running start. Stop watch as you cross the start line. The drive distance is 25 feet.</p> <p>Note 3: Unless noted, function speeds should be measured from the platform with one operator.</p> <p>Note 4: All test should be done with the oil temp above 65°F (15.5°C).</p> <p>Note 5: Ranges shown in "()" are exceptions for Gas-powered machines.</p> <p>Note 3: With swing motor P/N 3160182 optimum performance is achieved with these settings: SWING, MAX (RT OR LT): Electric = 21 - 25%, Gas = 66%, time = 65-80 seconds With swing motor P/N 3160331 optimum performance is achieved with these settings: SWING, MAX (RT OR LT): Electric = 30%, Gas = 60%, time = 65-85 seconds</p>					

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6.9 MACHINE ORIENTATION WHEN SETTING SPEEDS

LIFT: Telescope retracted, lift up, and record time. Lift down and record time.

SWING: Boom lift at full elevation, telescope retracted, swing 360 degrees and record time. Swing opposite 360 degrees and record time.

TELESCOPE: Boom lift at full elevation, telescope out and record time. Tele in and record time.

DRIVE: The machine should be in the stowed position.

Test Notes

1. Personality settings can be adjusted anywhere within the adjustment range in order to achieve optimum machine performance.
2. Stop watch should be start when function starts.
3. Unless noted, function speeds should be measured from the platform with one operator.
4. All test should be done with the oil temp above 65°F (15.5°C).

Table 6-5. Machine Configuration Programming Information

Configuration Digit	Setting	Description	Market Default				
			0	1	2	3	4
1 (MODEL#)	0 1	T350 - 35ft. T500 - 50ft.	0				
2 (POWER)	0 1	Electric - 24V Battery Engine - Honda Gasoline	0				
3 (DRIVE) ³	0 1	NO - Drive option not installed. YES - Drive option is installed.	0				
4 (MARKET)	0 1 2 3 4	ANSI USA ANSI EXPORT CSA CE AUSTRALIA	0				
5 (GROUND ALARM)	0 1 2	Not installed - Optional Ground Alarm shall not sound Descent - Optional Ground Alarm shall sound for 1000mS On, 1000mS Off during lift down operations. MOTION - Optional Ground Alarm shall sound for 1000mS On, 1000mS Off during drive, lift, swing, telescope, level jib and L/J operations.	1		1	1	1
NOTE: <ol style="list-style-type: none"> 1. When configuring a T-Series vehicle, the Machine Configuration must be completed before any Personality settings can be changed. Changing the Personality settings first and then changing the Model of the Machine Configuration will cause the Personality settings to return to default value. 2. Shaded entries are not available (adjustable) for the selected Market. 3. DRIVE Machine Configuration Setting only available when POWER is set to 1= ENGINE (Ground Module Version P1.3). 							

4150562-B

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
RUNNING AT CREEP – TILTED & ABOVE ELEVATION	1	None	2	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out
RUNNING AT CREEP – UNSET & ABOVE ELEVATION	2	None	2	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out
ENGINE NOT RUNNING	3	None	5		Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
JOYSTICK MOVED BUT TRIGGER SWITCH OPEN	4	None	1			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
CHASSIS TILT SENSOR OUT OF RANGE	5	None	None			
RUNNING AT CREEP – MATERIAL HOOK MODE	6	None	None	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out		
POWER CYCLE	7	2-1	None			
KEYSWITCH FAULTY	8	2-1	9			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold
PLATFORM POSITION DETECTION FAULTY	9	2-1	9	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out		
FUNCTION PROBLEM – ROTARY SELECTOR SWITCH	10	2-2	9			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
JOYSTICK FAULTY -- X-AXIS WIPER OUT OF RANGE	11	2-2	9			Swing Left, Swing Right, Telescope In, Telescope Out, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
JOYSTICK FAULTY -- Y-AXIS WIPER OUT OF RANGE	12	2-2	9			Lift Up, Lift Down, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
FUNCTION LOCKED OUT – JOYSTICK NOT CENTERED AT STARTUP	13	2-2	1			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
FUNCTION LOCKED OUT – TRIGGER PERMANENTLY CLOSED	14	2-2	1			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
TRIGGER CLOSED TOO LONG WHILE IN NEUTRAL	15	2-2	1			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
FUNCTION PROBLEM – ENGINE CHOKE PERMANENTLY SELECTED	16	2-2	1			Engine Choke Pull, Engine Choke Hold
FUNCTION PROBLEM – ENGINE START PERMANENTLY SELECTED	17	2-2	1			Engine Start, Engine Throttle Pull, Engine Throttle Hold
FUNCTION PROBLEM – LEVEL UP AND DOWN BOTH SELECTED	18	2-3	9		Level Up, Level Down	
FUNCTION PROBLEM – TELESCOPE IN AND OUT BOTH SELECTED	19	2-3	9		Telescope In, Telescope Out	
FUNCTION PROBLEM – JIB UP AND DOWN BOTH SELECTED	20	2-3	9		Jib Up, Jib Down	
FUNCTION PROBLEM – LEVELING JACK SET AND STOW BOTH SELECTED	21	2-3	9			
FUNCTION PROBLEM – LIFT UP AND DOWN BOTH SELECTED	22	2-3	9		Lift Up, Lift Down	
FUNCTION PROBLEM – SWING LEFT AND RIGHT BOTH SELECTED	23	2-3	9		Swing Left, Swing Right	
FUNCTION PROBLEM – ENGINE CHOKE PERMANENTLY SELECTED	24	2-3	1		Engine Choke Pull, Engine Choke Hold	Engine Choke Pull, Engine Choke Hold

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
FUNCTION PROBLEM – ENGINE START PERMANENTLY SELECTED	25	2-3	1		Engine Start, Engine Throttle Pull, Engine Throttle Hold	Engine Start, Engine Throttle Pull, Engine Throttle Hold
FUNCTION PROBLEM – LEVEL UP PERMANENTLY SELECTED	26	2-3	1		Level Up	
FUNCTION PROBLEM – LEVEL DOWN PERMANENTLY SELECTED	27	2-3	1		Level Down	
FUNCTION PROBLEM – TELESCOPE IN PERMANENTLY SELECTED	28	2-3	1		Telescope In	
FUNCTION PROBLEM – TELESCOPE OUT PERMANENTLY SELECTED	29	2-3	1		Telescope Out	
FUNCTION PROBLEM – JIB UP PERMANENTLY SELECTED	30	2-3	1		Jib Up	
FUNCTION PROBLEM – JIB DOWN PERMANENTLY SELECTED	31	2-3	1		Jib Down	
FUNCTION PROBLEM – LEVELING JACK SET PERMANENTLY SELECTED	32	2-3	1		Set (Extend L/J)	
FUNCTION PROBLEM – LEVELING JACK STOW PERMANENTLY SELECTED	33	2-3	1		Stow (Retract L/J)	
FUNCTION PROBLEM – LIFT UP PERMANENTLY SELECTED	34	2-3	1		Lift Up	
FUNCTION PROBLEM – LIFT DOWN PERMANENTLY SELECTED	35	2-3	1		Lift Down	
FUNCTION PROBLEM – SWING LEFT PERMANENTLY SELECTED	36	2-3	1		Swing Left	
FUNCTION PROBLEM – SWING RIGHT PERMANENTLY SELECTED	37	2-3	1		Swing Right	
LIFT DOWN PREVENTED – TELE IN FIRST	38	2-5	2		Lift Down	Lift Down
TELE OUT PREVENTED – SET LEVELING JACKS	39	2-5	2		Telescope Out	Telescope Out
TELE OUT PREVENTED – TILTED	40	2-5	2		Telescope Out	Telescope Out

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
LIFT UP & TELE OUT PREVENTED – TILTED & ABOVE ELEVATION	41	2-5	2		Lift Up, Telescope Out	Lift Up, Telescope Out
LIFT UP & TELE OUT PREVENTED – UNSET & ABOVE ELEVATION	42	2-5	2		Lift Up, Telescope Out	Lift Up, Telescope Out
LIFT UP & TELE OUT PREVENTED – TILTED, UNSET & ABOVE ELEVATION	43	2-5	2		Lift Up, Telescope Out	Lift Up, Telescope Out
LIFT UP PREVENTED – LIFT DOWN THEN SET LEVELING JACKS	44	2-5	2		Lift Up	Lift Up
LIFT UP PREVENTED – STOW LEVELING JACKS	45	2-5	2		Lift Up	Lift Up
LIFT UP PREVENTED – TILTED	46	2-5	2		Lift Up	Lift Up
LEVELING JACKS PREVENTED – ELEVATED	47	2-5	2		Set (Extend L/J)	Set (Extend L/J)
LEVELING JACK STOW PREVENTED – TELE IN FIRST	48	2-5	2		Stow (Retract L/J)	Stow (Retract L/J)
MODEL CHANGED – HYDRAULICS SUSPENDED – CYCLE EMS	49	2-5	2		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
LIFT UP SOLENOID - SHORT TO BATTERY	50	3-3	9		Lift Up	Lift Up
LIFT UP SOLENOID - SHORT TO GROUND	51	3-3	9		Lift Up	Lift Up
LIFT UP SOLENOID - OPEN CIRCUIT	52	3-3	9		Lift Up	Lift Up
LIFT DOWN SOLENOID - SHORT TO BATTERY	53	3-3	9		Lift Down	Lift Down
LIFT DOWN SOLENOID - OPEN CIRCUIT	54	3-3	9		Lift Down	Lift Down
TELESCOPE IN SOLENOID - SHORT TO BATTERY	55	3-3	9		Telescope In	Telescope In

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
TELESCOPE IN SOLENOID - SHORT TO GROUND	56	3-3	9		Telescope In	Telescope In
TELESCOPE IN SOLENOID - OPEN CIRCUIT	57	3-3	9		Telescope In	Telescope In
TELESCOPE OUT SOLENOID - SHORT TO BATTERY	58	3-3	9		Telescope Out	Telescope Out
TELESCOPE OUT SOLENOID - SHORT TO GROUND	59	3-3	9		Telescope Out	Telescope Out
TELESCOPE OUT SOLENOID - OPEN CIRCUIT	60	3-3	9		Telescope Out	Telescope Out
SWING LEFT SOLENOID - SHORT TO BATTERY	61	3-3	9		Swing Left	Swing Left
SWING LEFT SOLENOID - SHORT TO GROUND	62	3-3	9		Swing Left	Swing Left
SWING LEFT SOLENOID - OPEN CIRCUIT	63	3-3	9		Swing Left	Swing Left
SWING RIGHT SOLENOID - SHORT TO BATTERY	64	3-3	9		Swing Right	Swing Right
SWING RIGHT SOLENOID - SHORT TO GROUND	65	3-3	9		Swing Right	Swing Right
SWING RIGHT SOLENOID - OPEN CIRCUIT	66	3-3	9		Swing Right	Swing Right
LEVEL UP SOLENOID - SHORT TO BATTERY	67	3-3	9		Level Up	Level Up
LEVEL UP SOLENOID - SHORT TO GROUND	68	3-3	9		Level Up	Level Up
LEVEL UP SOLENOID - OPEN CIRCUIT	69	3-3	9		Level Up	Level Up
LEVEL DOWN SOLENOID - SHORT TO BATTERY	70	3-3	9		Level Down	Level Down
LEVEL DOWN SOLENOID - SHORT TO GROUND	71	3-3	9		Level Down	Level Down

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
LEVEL DOWN SOLENOID - OPEN CIRCUIT	72	3-3	9		Level Down	Level Down
JIB UP SOLENOID - SHORT TO BATTERY	73	3-3	9		Jib Up	Jib Up
JIB UP SOLENOID - SHORT TO GROUND	74	3-3	9		Jib Up	Jib Up
JIB UP SOLENOID - OPEN CIRCUIT	75	3-3	9		Jib Up	Jib Up
JIB DOWN SOLENOID - SHORT TO BATTERY	76	3-3	9		Jib Down	Jib Down
JIB DOWN SOLENOID - OPEN CIRCUIT	77	3-3	9		Jib Down	Jib Down
F-LL/J SOLENOID - SHORT TO BATTERY	78	3-3	9		Front Left L/J	Front Left L/J
F-LL/J SOLENOID - SHORT TO GROUND	79	3-3	9		Front Left L/J	Front Left L/J
F-LL/J SOLENOID - OPEN CIRCUIT	80	3-3	9		Front Left L/J	Front Left L/J
F-RL/J SOLENOID - SHORT TO BATTERY	81	3-3	9		Front Right L/J	Front Right L/J
F-RL/J SOLENOID - SHORT TO GROUND	82	3-3	9		Front Right L/J	Front Right L/J
F-RL/J SOLENOID - OPEN CIRCUIT	83	3-3	9		Front Right L/J	Front Right L/J
R-LL/J SOLENOID - SHORT TO BATTERY	84	3-3	9		Rear Left L/J	Rear Left L/J
R-LL/J SOLENOID - SHORT TO GROUND	85	3-3	9		Rear Left L/J	Rear Left L/J
R-LL/J SOLENOID - OPEN CIRCUIT	86	3-3	9		Rear Left L/J	Rear Left L/J
R-RL/J SOLENOID - SHORT TO BATTERY	87	3-3	9		Rear Right L/J	Rear Right L/J

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
R-RL/J SOLENOID - SHORT TO GROUND	88	3-3	9		Rear Right L/J	Rear Right L/J
R-RL/J SOLENOID - OPEN CIRCUIT	89	3-3	9		Rear Right L/J	Rear Right L/J
EXTEND L/J SOLENOID - SHORT TO BATTERY	90	3-3	9		Set (Extend L/J)	Set (Extend L/J)
EXTEND L/J SOLENOID - SHORT TO GROUND	91	3-3	9		Set (Extend L/J)	Set (Extend L/J)
EXTEND L/J SOLENOID - OPEN CIRCUIT	92	3-3	9		Set (Extend L/J)	Set (Extend L/J)
RETRACT L/J SOLENOID - SHORT TO BATTERY	93	3-3	9		Stow (Retract L/J)	Stow (Retract L/J)
RETRACT L/J SOLENOID - SHORT TO GROUND	94	3-3	9		Stow (Retract L/J)	Stow (Retract L/J)
RETRACT L/J SOLENOID - OPEN CIRCUIT	95	3-3	9		Stow (Retract L/J)	Stow (Retract L/J)
GROUND ALARM - SHORT TO BATTERY	96	3-3	9			
GROUND ALARM - SHORT TO GROUND	97	3-3	9			
OPTIONAL GROUND ALARM - SHORT TO BATTERY	98	3-3	9			
OPTIONAL GROUND ALARM - SHORT TO GROUND	99	3-3	9			
HOURLMETER - SHORT TO BATTERY	100	3-3	9			
HOURLMETER - SHORT TO GROUND	101	3-3	9			
START SOLENOID - SHORT TO BATTERY	102	3-3	9		Engine Start	Engine Start
START SOLENOID - SHORT TO GROUND	103	3-3	9		Engine Start	Engine Start

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
START SOLENOID - OPEN CIRCUIT	104	3-3	9		Engine Start	Engine Start
THROTTLE PULL RELAY - SHORT TO BATTERY	105	3-3	9		Engine Throttle Pull	Engine Throttle Pull
THROTTLE PULL RELAY - SHORT TO GROUND	106	3-3	9		Engine Throttle Pull	Engine Throttle Pull
THROTTLE PULL RELAY - OPEN CIRCUIT	107	3-3	9		Engine Throttle Pull	Engine Throttle Pull
THROTTLE HOLD SOLENOID - SHORT TO BATTERY	108	3-3	9		Engine Throttle Hold	Engine Throttle Hold
THROTTLE HOLD SOLENOID - SHORT TO GROUND	109	3-3	9		Engine Throttle Hold	Engine Throttle Hold
THROTTLE HOLD SOLENOID - OPEN CIRCUIT	110	3-3	9		Engine Throttle Hold	Engine Throttle Hold
CHOKE PULL RELAY - SHORT TO BATTERY	111	3-3	9		Engine Choke Pull	Engine Choke Pull
CHOKE PULL RELAY - SHORT TO GROUND	112	3-3	9		Engine Choke Pull	Engine Choke Pull
CHOKE PULL RELAY - OPEN CIRCUIT	113	3-3	9		Engine Choke Pull	Engine Choke Pull
CHOKE HOLD SOLENOID - SHORT TO BATTERY	114	3-3	9		Engine Choke Hold	Engine Choke Hold
CHOKE HOLD SOLENOID - SHORT TO GROUND	115	3-3	9		Engine Choke Hold	Engine Choke Hold
CHOKE HOLD SOLENOID - OPEN CIRCUIT	116	3-3	9		Engine Choke Hold	Engine Choke Hold
DUMP SOLENOID - SHORT TO BATTERY	117	3-3	9		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
DUMP SOLENOID - SHORT TO GROUND	118	3-3	9		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
DUMP SOLENOID - OPEN CIRCUIT	119	3-3	9		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
DRIVE LEFT FWD SOLENOID - SHORT TO BATTERY	120	3-3	9			
DRIVE LEFT FWD SOLENOID - SHORT TO GROUND	121	3-3	9			
DRIVE LEFT FWD SOLENOID - OPEN CIRCUIT	122	3-3	9			
DRIVE LEFT REV SOLENOID - SHORT TO BATTERY	123	3-3	9			
DRIVE LEFT REV SOLENOID - SHORT TO GROUND	124	3-3	9			
DRIVE LEFT REV SOLENOID - OPEN CIRCUIT	125	3-3	9			
DRIVE RIGHT FWD SOLENOID - SHORT TO BATTERY	126	3-3	9			
DRIVE RIGHT FWD SOLENOID - SHORT TO GROUND	127	3-3	9			
DRIVE RIGHT FWD SOLENOID - OPEN CIRCUIT	128	3-3	9			
DRIVE RIGHT REV SOLENOID - SHORT TO BATTERY	129	3-3	9			
DRIVE RIGHT REV SOLENOID - SHORT TO GROUND	130	3-3	9			
DRIVE RIGHT REV SOLENOID - OPEN CIRCUIT	131	3-3	9			

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
DRIVE ENABLE SOLENOID - SHORT TO BATTERY	132	3-3	9			
DRIVE ENABLE SOLENOID - SHORT TO GROUND	133	3-3	9			
DRIVE ENABLE SOLENOID - OPEN CIRCUIT	134	3-3	9			
POWER MODULE TOO HOT - PLEASE WAIT	135	4-2	4		Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
FUNCTIONS AT CUTBACK - POWER MODULE CURRENT LIMIT	136	4-2	4			
NO CHARGE SYSTEM OUTPUT	137	4-3	3		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
BATTERY VOLTAGE TOO LOW - SYSTEM SHUTDOWN	138	4-4	5		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold
BATTERY VOLTAGE TOO HIGH - SYSTEM SHUTDOWN	139	4-4	5		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold
CANBUS FAILURE: POWER MODULE	140	6-6	9		Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
CANBUS FAILURE: PLATFORM MODULE	141	6-6	9			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold
CANBUS FAILURE: DRIVE MODULE	142	6-6	9			
ACCESSORY CAN COMMUNICATION LOST	143	6-6	9			
ACCESSORY FAULT	144	6-7	9			
CHASSIS TILT SENSOR NOT CALIBRATED	145	8-1	9			
POWER MODULE FAILURE: PERSONALITY RANGE ERROR	146	9-9	9		Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
POWER MODULE FAILURE: INTERNAL ERROR	147	9-9	9		Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
POWER MODULE FAILURE: CHECK POWER CIRCUITS OR MOSFET SHORT CIRCUIT	148	9-9	9		Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
EEPROM FAILURE – CHECK ALL SETTINGS	149	9-9	9		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold

Table 6-6. Help Messages

Help Message	Index	Service Flash Code	User Flash Code	Function in Creep Mode	Function Locked Out from Ground Control	Function Locked Out from Platform Control
FUNCTIONS LOCKED OUT – PLATFORM MODULE SOFTWARE VERSION IMPROPER	150	9-9	9			Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold
FUNCTIONS LOCKED OUT – POWER MODULE SOFTWARE VERSION IMPROPER	151	9-9	9		Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)	Lift Up, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J)
FUNCTIONS LOCKED OUT – DRIVE MODULE SOFTWARE VERSION IMPROPER	152	9-9	9		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold
GROUND MODULE FAILURE: VLOW FET FAILURE	153	9-9	9		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold
GROUND MODULE FAILURE: REF VOLTAGE OUT OF RANGE	154	9-9	9			
CHASSIS TILT SENSOR GAIN OUT OF RANGE	155	9-9	9			
CHASSIS TILT SENSOR NOT GAIN CALIBRATED	156	9-9	9			
FUNCTIONS LOCKED OUT – CONSTANT DATA VERSION IMPROPER	157	9-9	9		Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold	Lift Up, Lift Down, Swing Left, Swing Right, Telescope In, Telescope Out, Jib Up, Jib Down, Level Up, Level Down, Front Left L/J, Front Right L/J, Rear Left L/J, Rear Right L/J, Set (Extend L/J), Stow (Retract L/J), Engine Start, Engine Throttle Pull, Engine Throttle Hold, Engine Choke Pull, Engine Choke Hold

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.

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 kW = 1200 W

Example: 50 mA = 0.05 A

Voltage Measurement

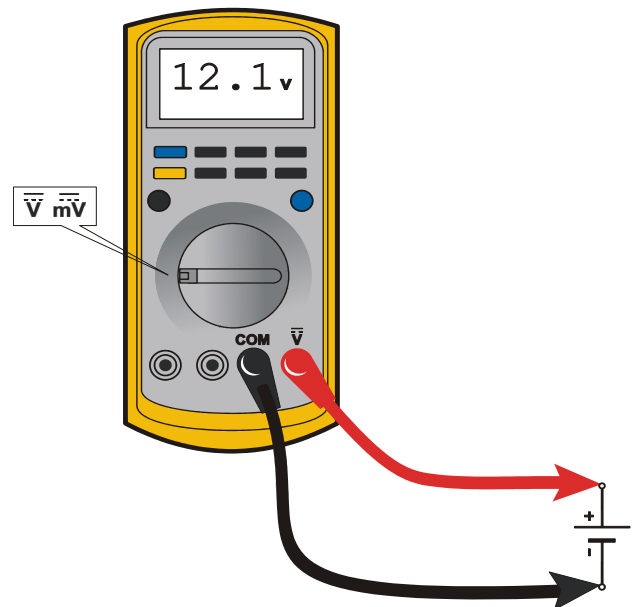


Figure 7-1. Voltage Measurement (DC)

- 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

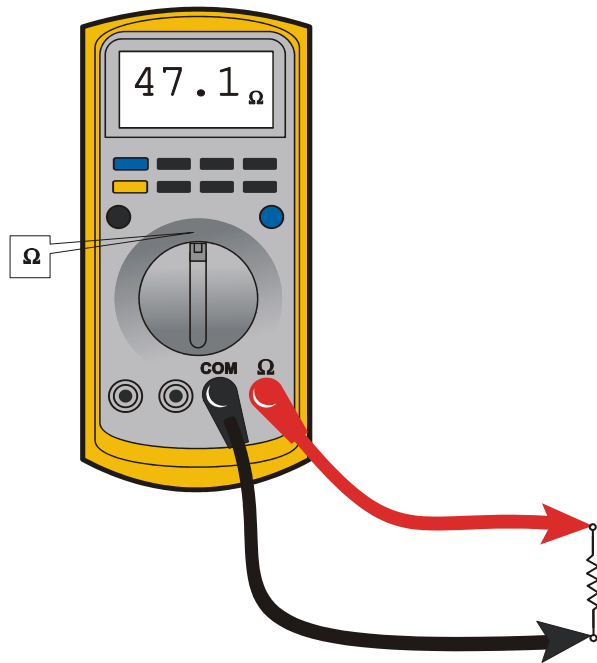


Figure 7-2. Resistance Measurement

- 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

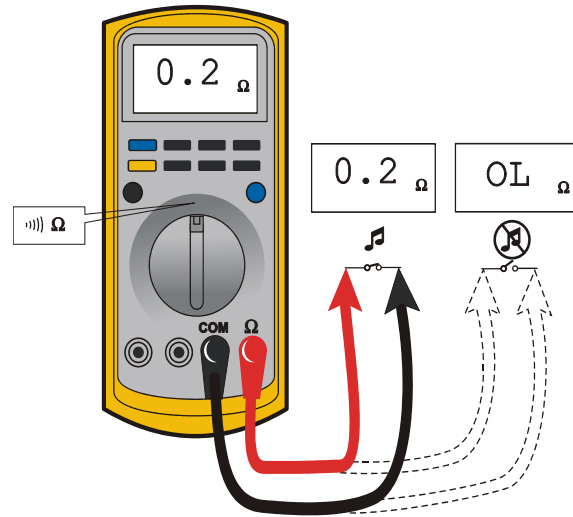


Figure 7-3. Continuity Measurement

- 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

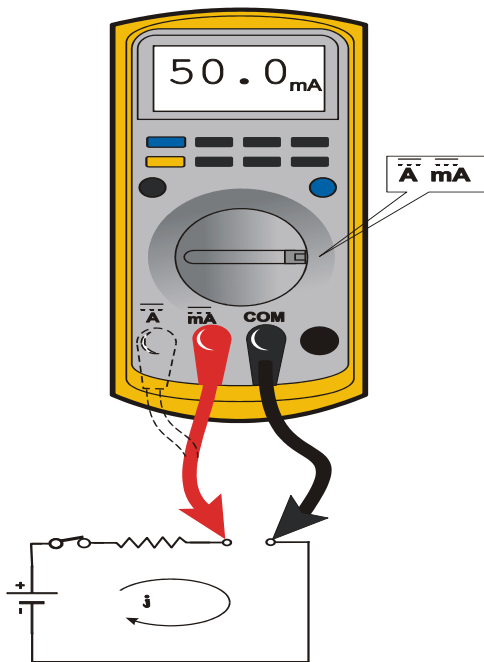


Figure 7-4. Current Measurement (DC)

- 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 CHECKING SWITCHES

Basic Check

The following check determines if the switch is functioning properly, not the circuit in which the switch is placed. A switch is functioning properly when there is continuity between the correct terminals or contacts only when selected.

1. De-energize the circuit.
2. Isolate the switch from the rest of the circuit if possible. If not possible, keep in mind it may affect readings.
3. Access the terminals to the switch.
4. If the switch has two terminals:
 - a. Measure resistance across the terminals.
 - b. Change the switch position.
 - c. Measure resistance again with the leads in the same positions. If the meter was reading short, it should read an open. If the meter was reading open it should read short.
5. If the switch has more than two terminals, consult the schematic or switch diagram to determine what terminals will be connected. The test is similar to testing a switch with two terminals.
 - a. Place one meter lead on the common contact and the other on a different contact in the same circuit.
 - b. Cycle through all positions of the switch. The meter should read short only when the switch connects the two terminals and open otherwise.
 - c. If the switch has more than one common contact repeat the process for that circuit.

Limit Switches

Limit switches are used to control movement or indicate position. Mechanical limit switches are just like manually operated switches except that the moving object operates the switch. These switches can be tested the same way as a standard switch by manually operating the sensing arm.

Another type of limit switch used by JLG is the inductive proximity switch, also referred to as a "prox switch". Inductive proximity switches are actuated only by ferrous metal (metal that contains Iron, such as steel) near the switch. They do not require contact, and must be energized to actuate. These types of switches can be used to detect boom or platform position, for example. These switches have a sensing face where the switch can detect ferrous metal close to it. To find the sensing face, take note how the switch is mounted and how the mechanisms meet the switch. Test this type of switch as follows:

1. Remove prox switch from its mount.
2. Reconnect harness if it was disconnected for step a, and turn on machine.
3. Hold switch away from metal and observe switch state in the control system diagnostics using the Analyzer. See vehicle or control system documentation on how to do this.
4. Place sensing face of switch on the object to be sensed by the switch. If that is not available, use a piece of ferrous metal physically similar to it. The switch state in the control system diagnostics should change.
5. When reinstalling or replacing switch be sure to follow mounting instructions and properly set the gap between the switch and object sensed.

Automatic Switches

If the switch is actuated automatically, by temperature or pressure for example, find a way to manually actuate the switch to test it. Do this either by applying heat or pressure, for example, to the switch. These switches may need to be energized to actuate.

1. Connect instrumentation to monitor and/or control the parameter the switch is measuring.
2. Observe switch state in control system with the Analyzer. See vehicle or control system documentation on how to do this.
3. Operate system such that the switch actuates. This could be going over a certain pressure or temperature, for example. The state indicated in the control system should change.

Switch Wiring - Low Side, High Side

When controlling a load, a switch can be wired between the positive side of the power source and the load. This switch is called a "high side" switch. The switch supplies the power to the load. When a switch is wired between the negative side of the power source and the load, it is a "low side" switch. The switch provides the ground to the load.

A low side switch will allow voltage to be present on the load. No power is applied because the switch is stopping current flow. This voltage can be seen if the measurement is taken with one test lead on the load and the other on the battery negative side or grounded to the vehicle. What is actually being measured is the voltage drop across the switch. This could mislead a technician into thinking the load is receiving power but not operating. To produce an accurate picture of power or voltage applied to the load, measure voltage across the load's power terminals. Also, the technician can measure the voltage at both power terminals with respect to battery ground. The difference between those two measurements is the voltage applied to the load.

7.4 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

Silicone Dielectric Compound must be used on all electrical connections for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors. 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 prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from 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 plug/male connector housing which typically contains sockets contact/female terminals.
3. Leave a thin layer of dielectric grease on the face of the connector.
4. Assemble connector system immediately to prevent moisture or dust contamination.
5. Pierce one of the unused wire seals before assembly if the connector system tends to trap air (i.e. AMP Seal) and then install a seal plug.

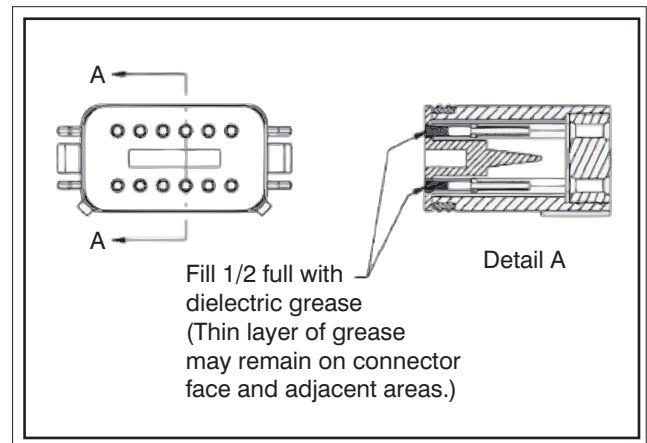


Figure 7-5. Applying Dielectric Grease

Deutsch HD, DT, DTM, DRC Series

The Deutsch connector system is commonly used for harsh environments. Follow installation instructions.



Figure 7-6. Deutsch Connector

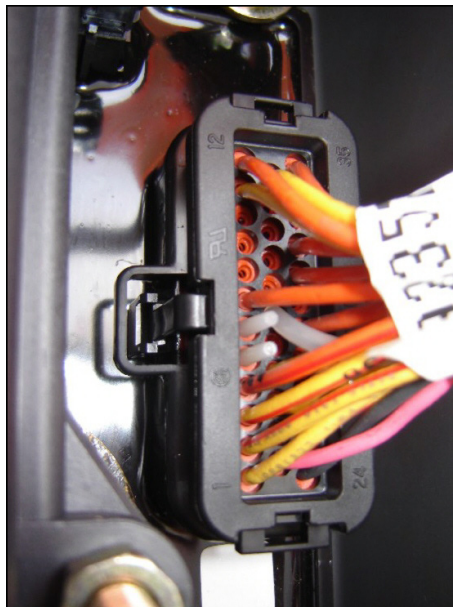


Figure 7-8. Use of Seal Plugs

AMP Seal

The AMP Seal connector system is used on Control ADE Platform and Ground Modules.

Apply dielectric grease to the plug/male connector housing which typically contains socket contacts/female terminals. 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 the corrected).



Figure 7-7. Application to plug/male connector housing

AMP Mate-N-Lok

Follow manufacturer installation instructions.

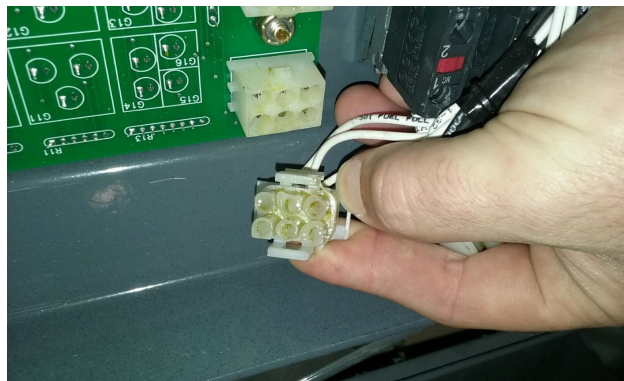


Figure 7-9. AMP Mate-N-Lok Connector

DIN Connectors

This connector is typically used on hydraulic valves. Follow manufacturer installation instructions.



Figure 7-10. DIN Connector

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).



Engine Control Unit Connectors

Many times, these types of connectors use back-seals for moisture integrity. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The EMR4 engine control module from Deutz employs this connector system (for example).



7.5 AMP CONNECTOR

Applying Silicone Dielectric Compound to AMP Connectors

Silicone Dielectric Compound must be used on the AMP connections for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors.

1. To prevent oxidation and low level conductivity, silicone dielectric grease must be packed completely around male and female pins on the inside of the connector after the mating of the housing to the header. This is easily achieved by using a syringe to fill the header with silicone dielectric compound, to a point just above the top of the male pins inside the header. When assembling the housing to the header, it is possible that the housing will become air locked, thus preventing the housing latch from engaging.
2. Pierce one of the unused wire seals to allow the trapped air inside the housing to escape.
3. Install a hole plug into this and/or any unused wire seal that has silicone dielectric compound escaping from it.

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-11.). Proceed as follows:

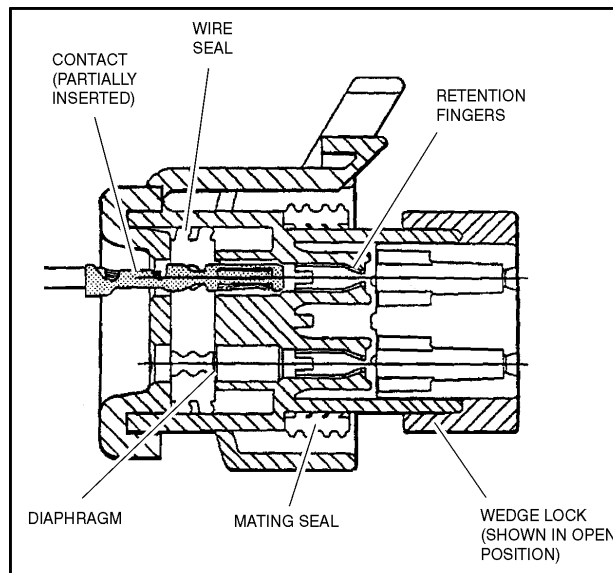


Figure 7-11. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-13.).
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 7-13.).

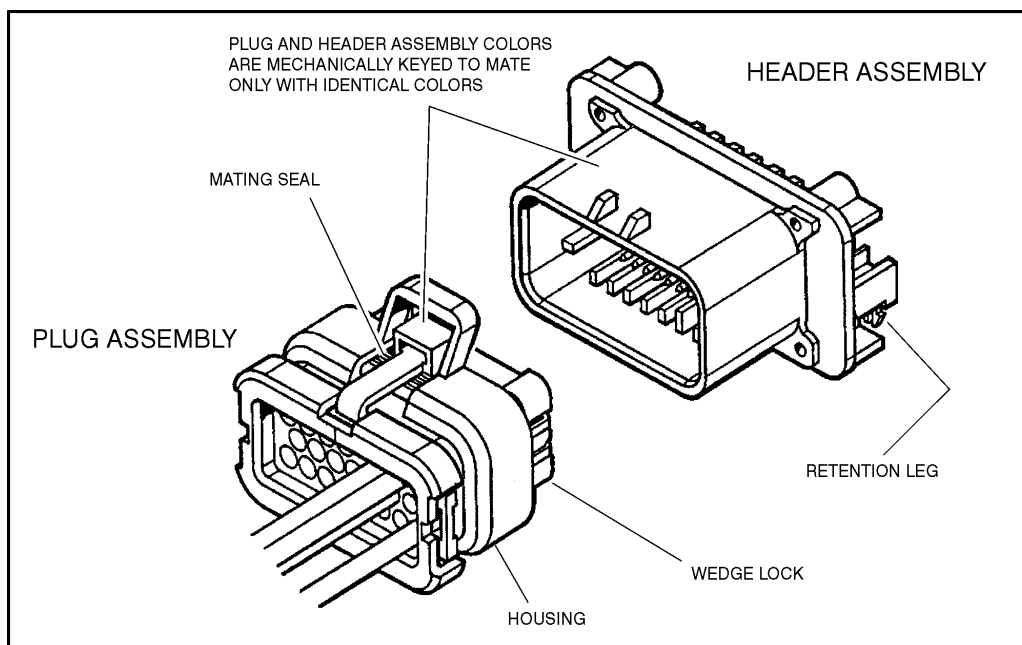


Figure 7-12. AMP Connector

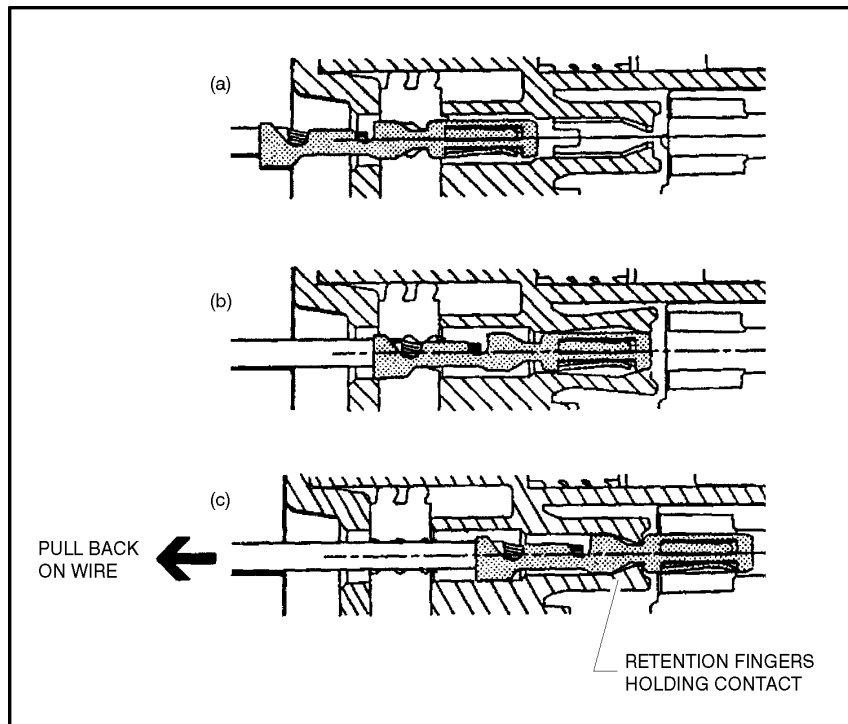


Figure 7-13. Connector Assembly Figure 2

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 7-14.).

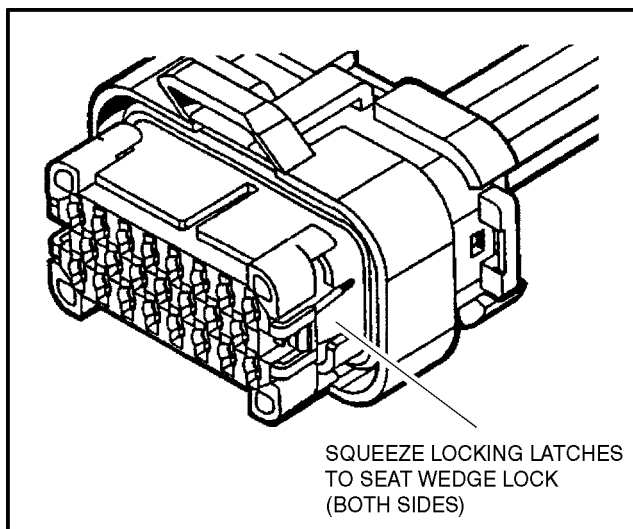


Figure 7-14. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-15.).

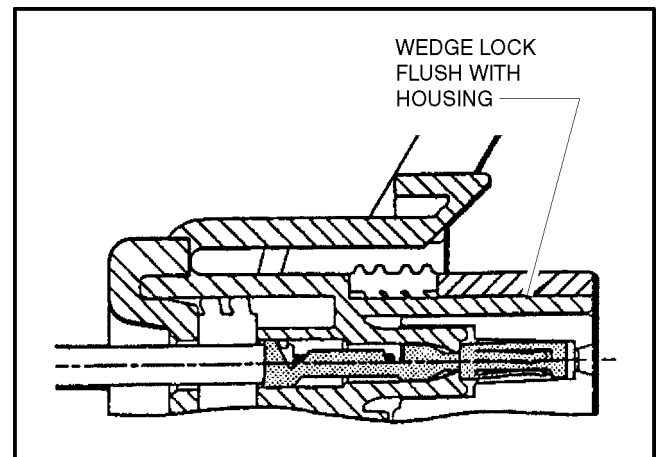


Figure 7-15. Connector Assembly Figure 4

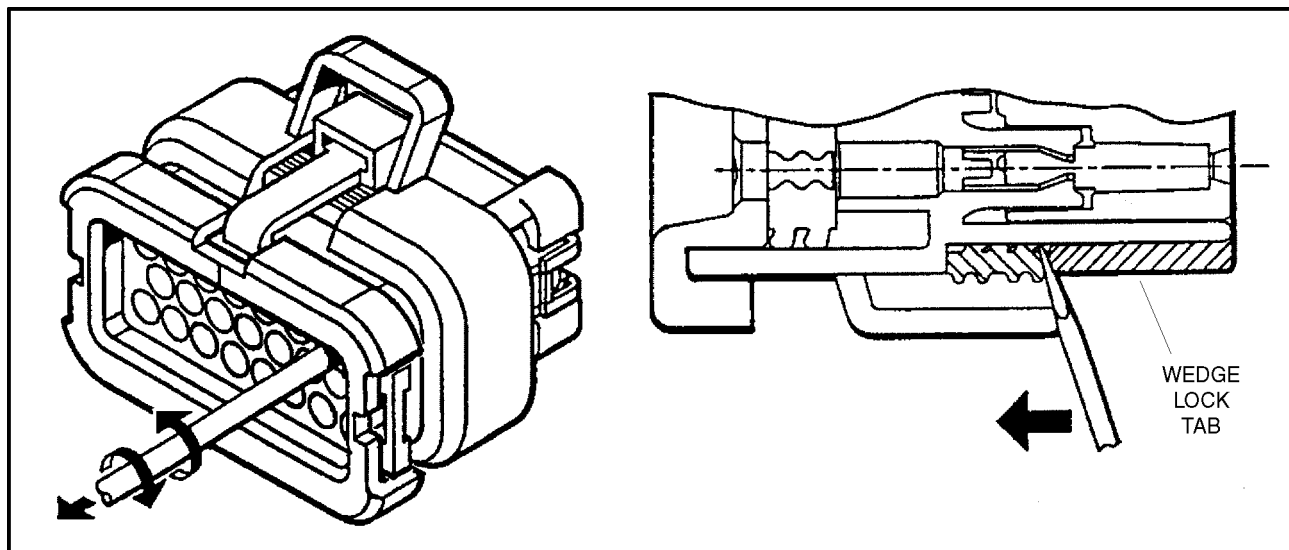


Figure 7-16. Connector Disassembly

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

⚠ CAUTION

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.

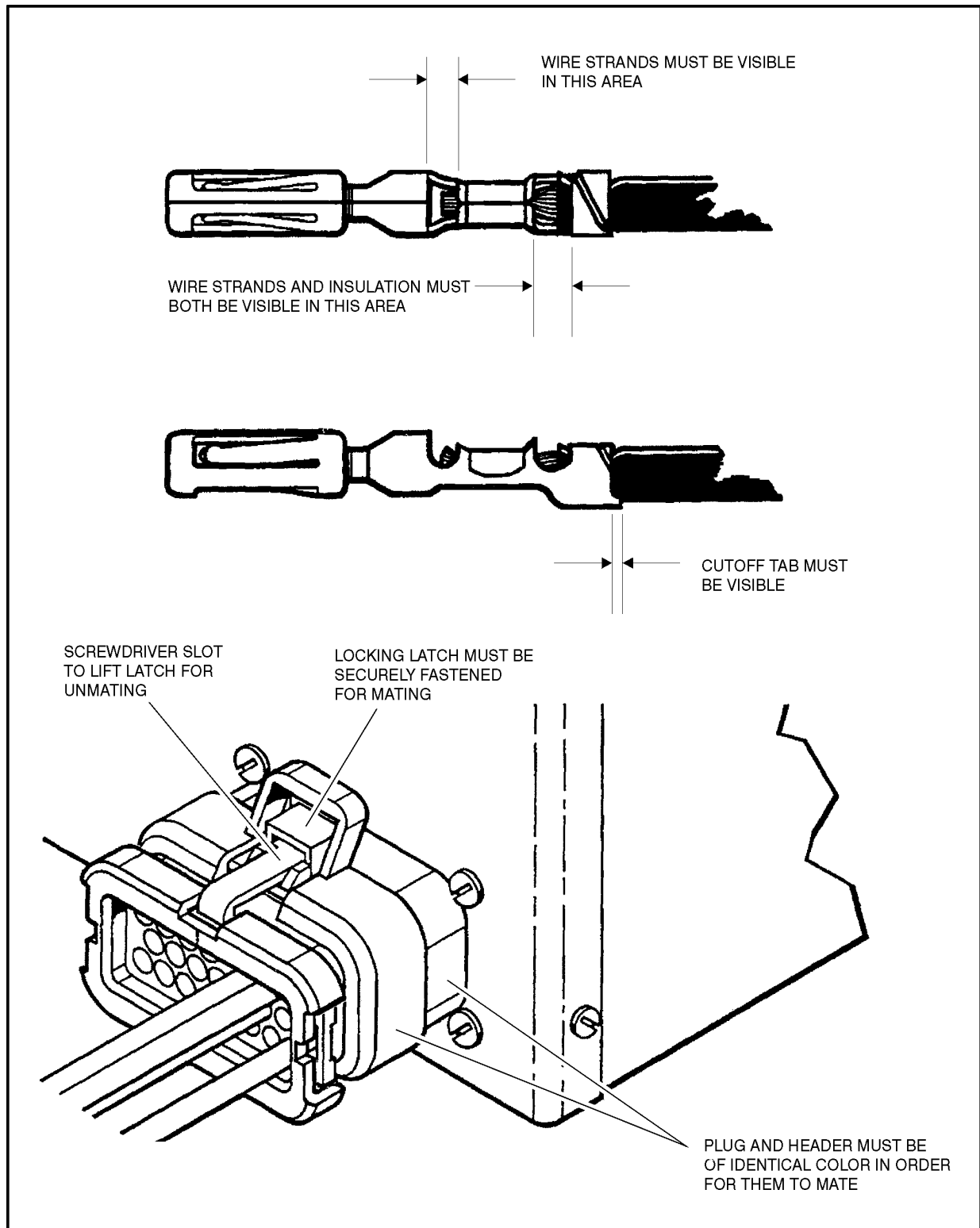


Figure 7-17. Connector Installation

7.6 DEUTSCH CONNECTORS

DT/DTP Series Assembly

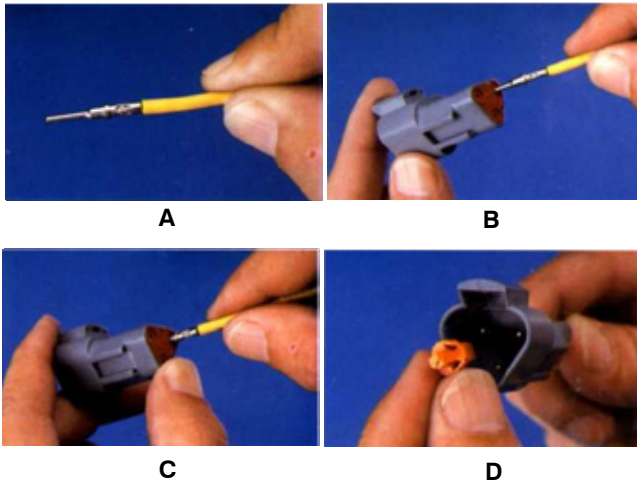


Figure 7-18. DT/DTP Contact Installation

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 wedge lock with arrow pointing toward exterior locking mechanism. The wedge lock will snap into place. Rectangular wedges are not oriented. They may go in either way.

NOTE: The receptacle is shown - use the same procedure for plug.

DT/DTP Series Disassembly

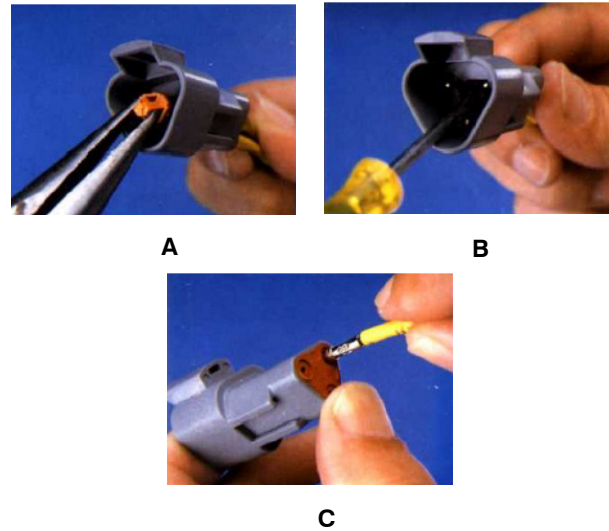


Figure 7-19. DT/DTP Contact Removal

5. Remove wedge lock using needle nose 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

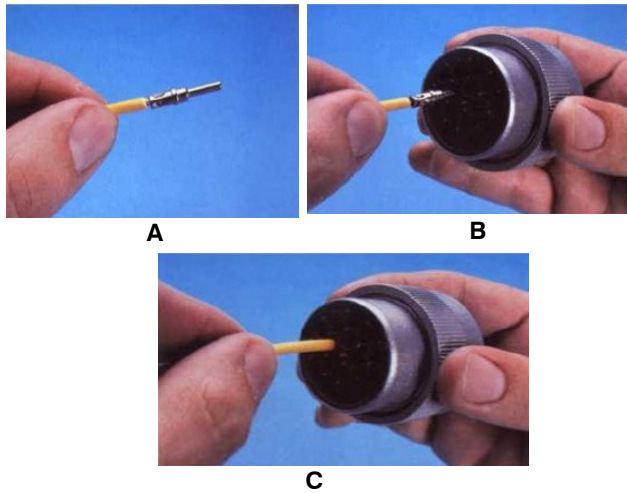


Figure 7-20. HD/HDP Contact Installation

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.

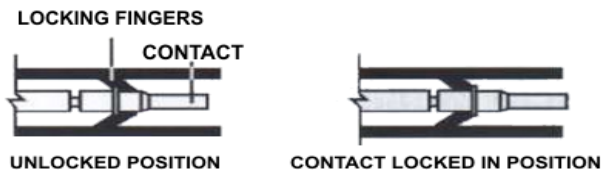


Figure 7-21. HD/HDP Locking Contacts Into Position

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

HD30/HDP20 Series Disassembly

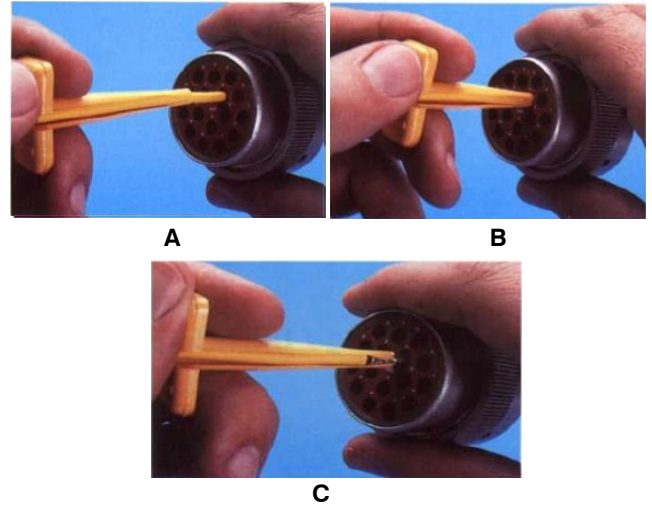


Figure 7-22. HD/HDP Contact Removal

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 7-23. HD/HDP Unlocking Contacts

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

7.7 ELECTRICAL COMPONENT

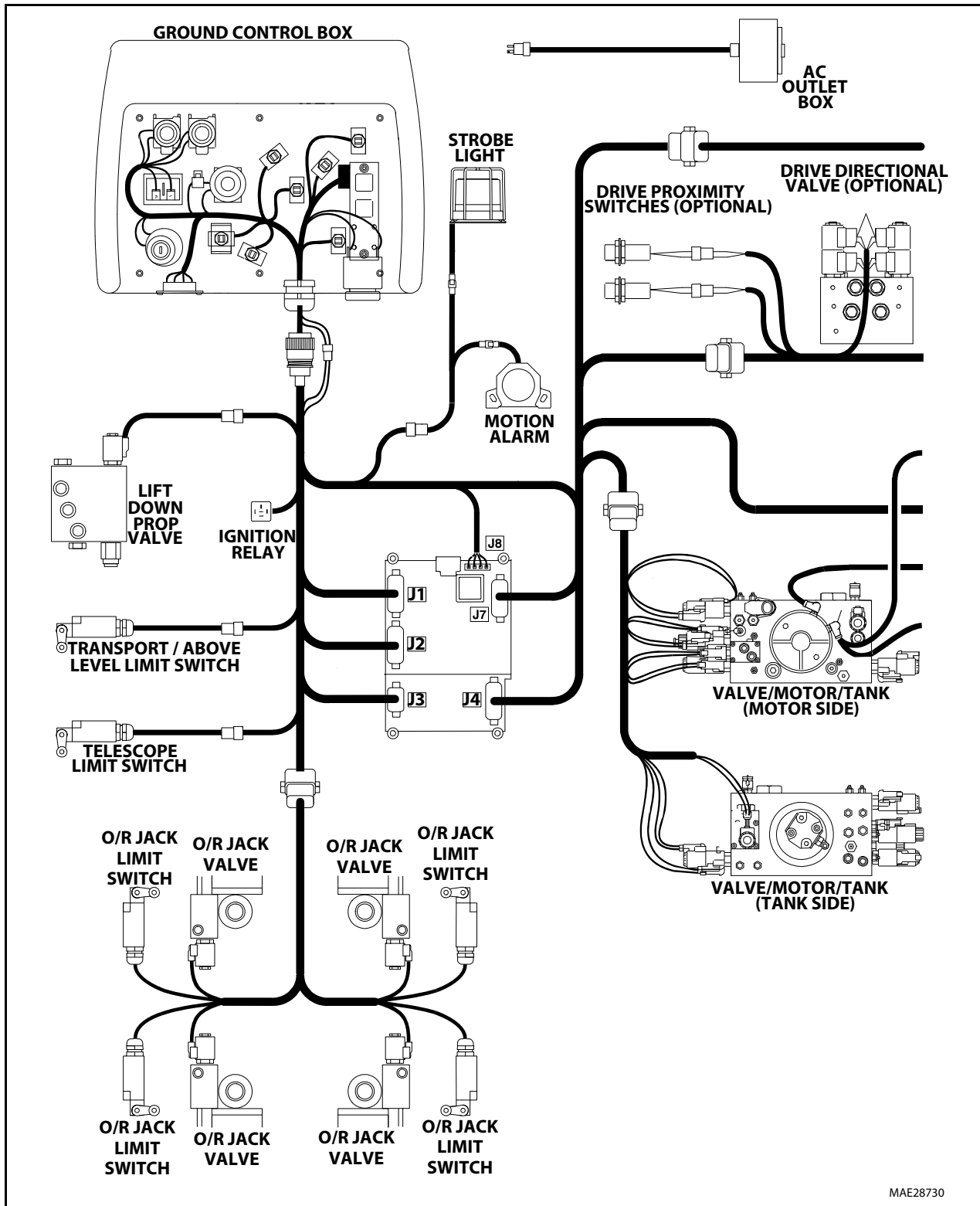


Figure 7-24. Electrical Components Installation - Electric Powered Machines (Prior to SN 00300001804) - Sheet 1 of 2

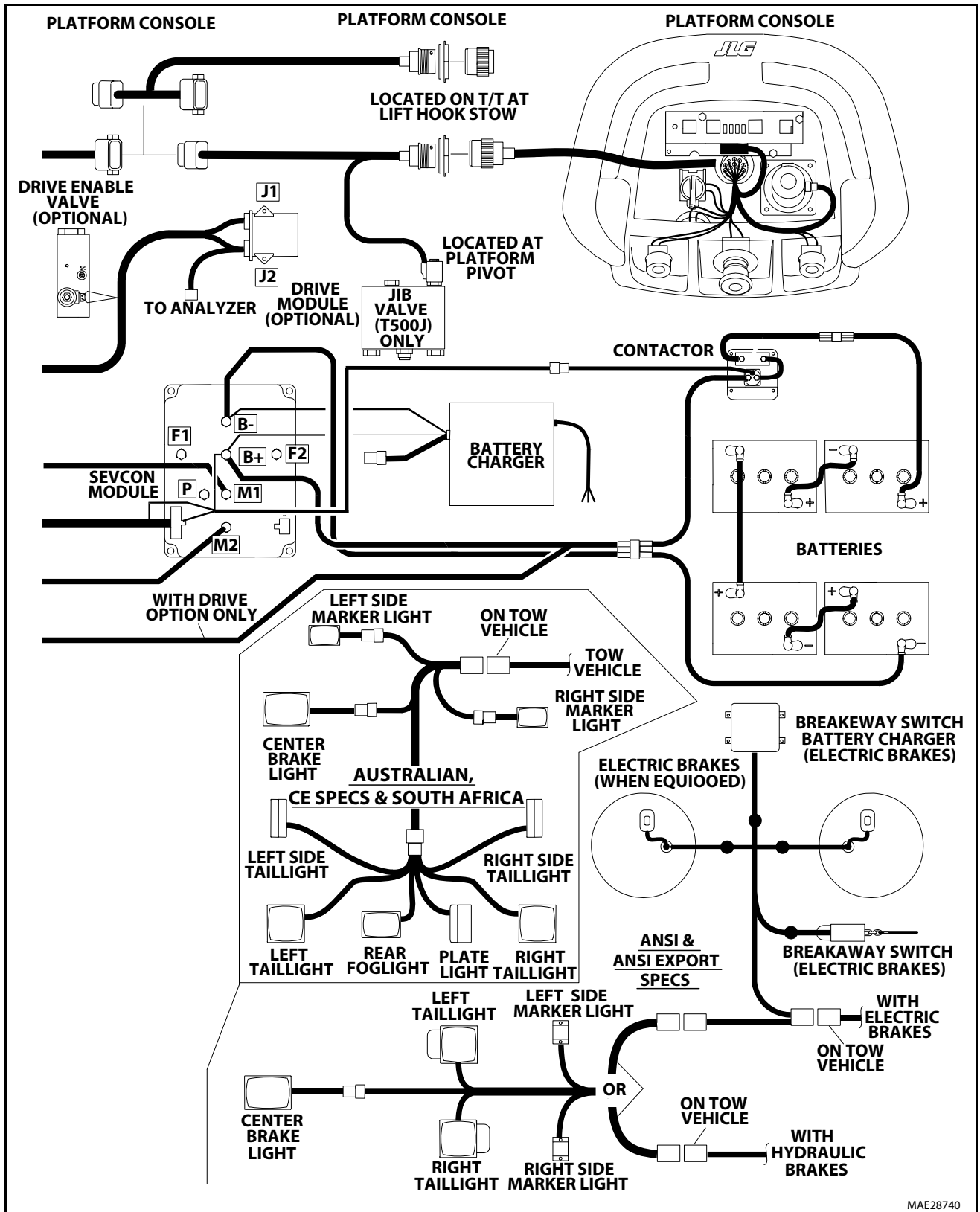


Figure 7-25. Electrical Components Installation - Electric Powered Machines (Prior to SN 00300001804) - Sheet 2 of 2

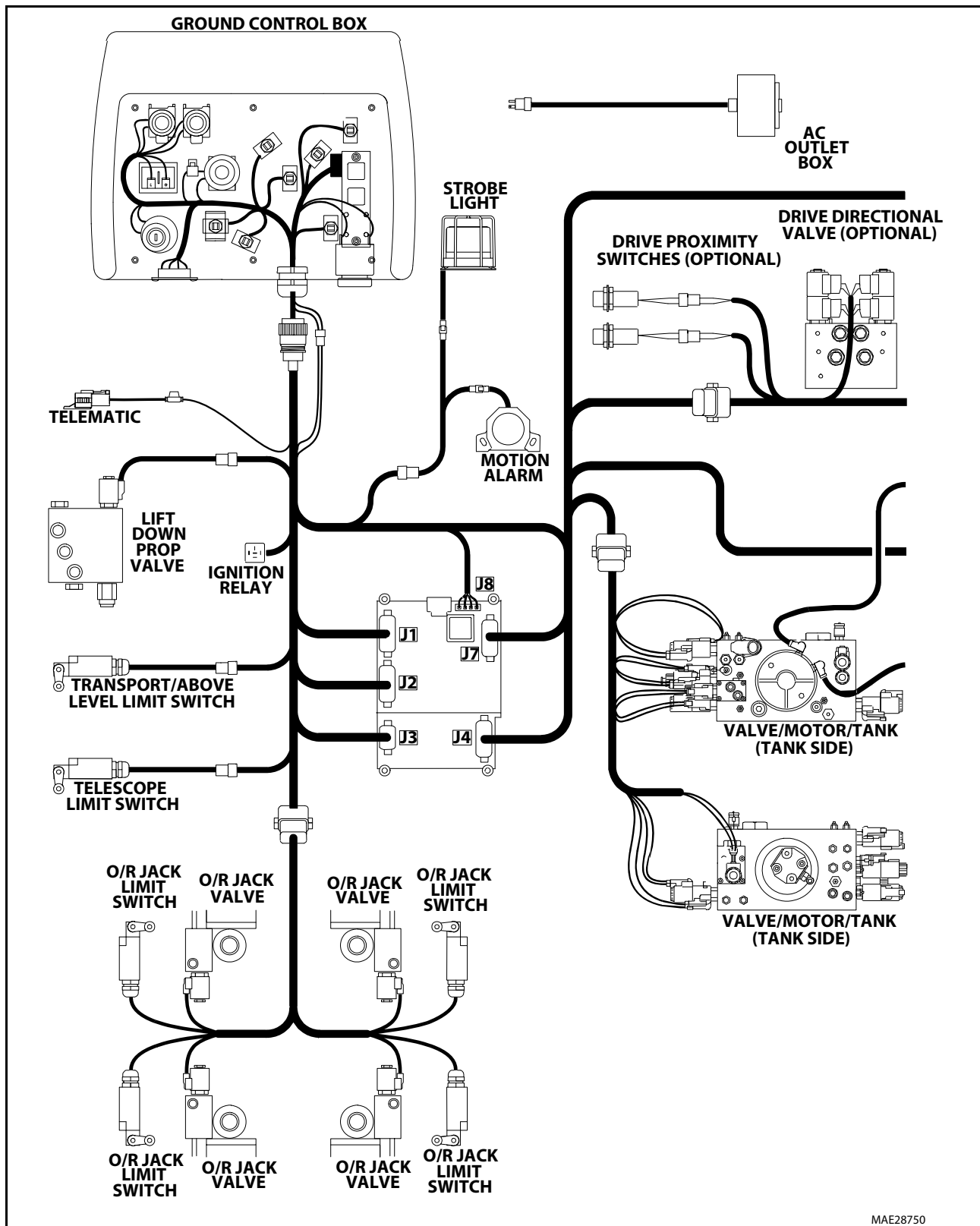


Figure 7-26. Electrical Components Installation - Electric Powered Machines (SN 00300001804 to Present) - Sheet 1 of 2

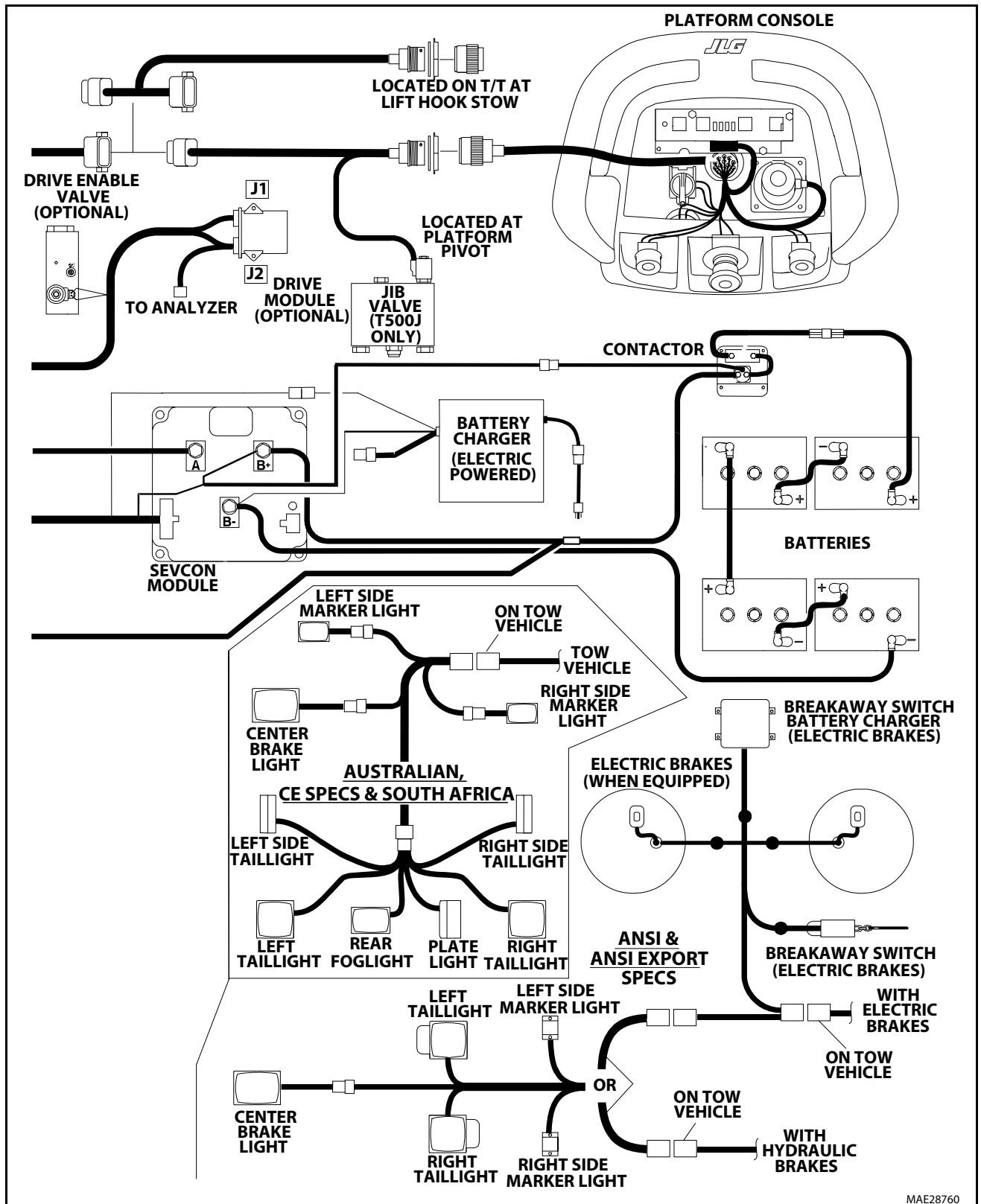


Figure 7-27. Electrical Components Installation - Electric Powered Machines (SN 00300001804 to Present) - Sheet 2 of 2

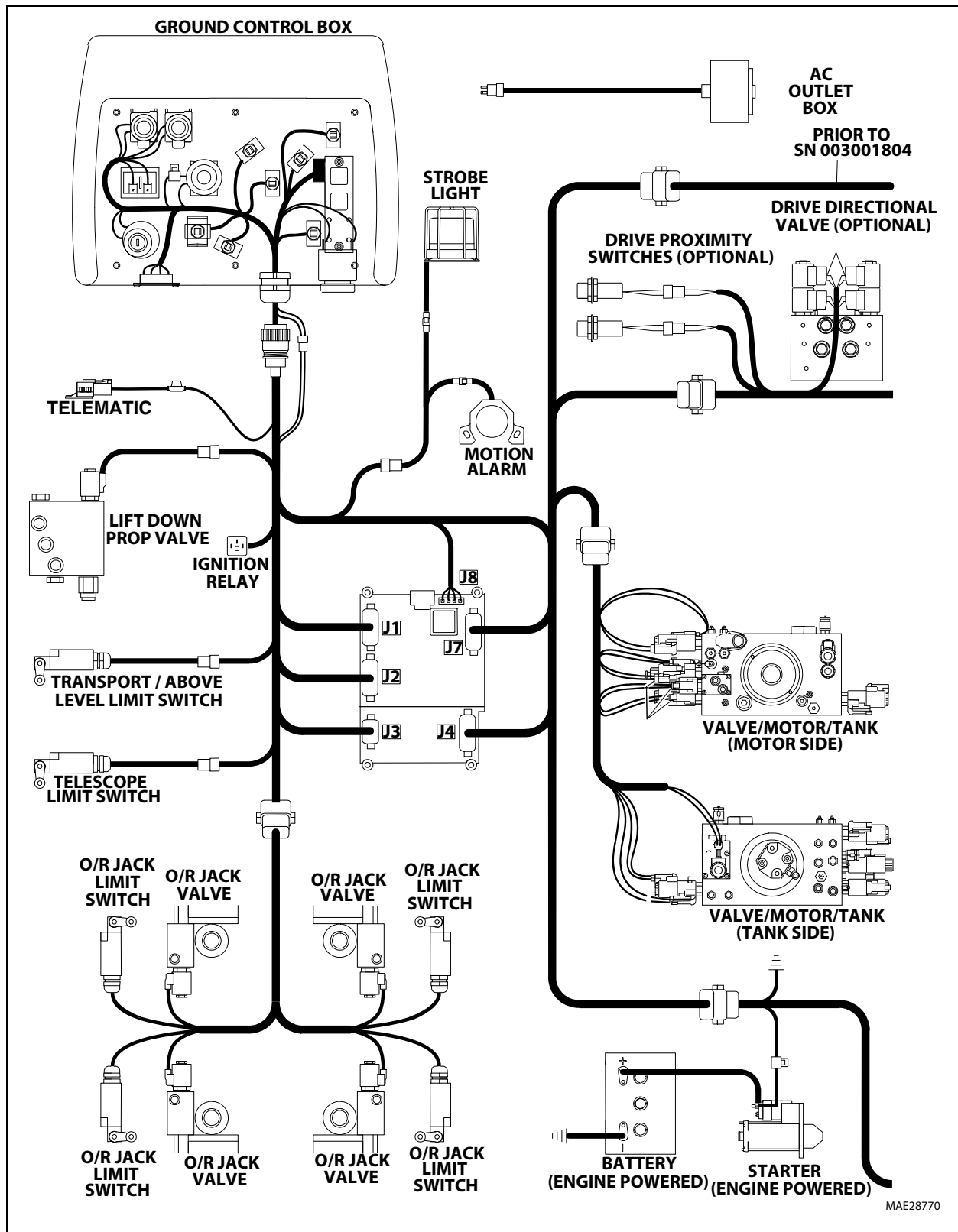


Figure 7-28. Electrical Components Installation - Engine Powered Machines - Sheet 1 of 2

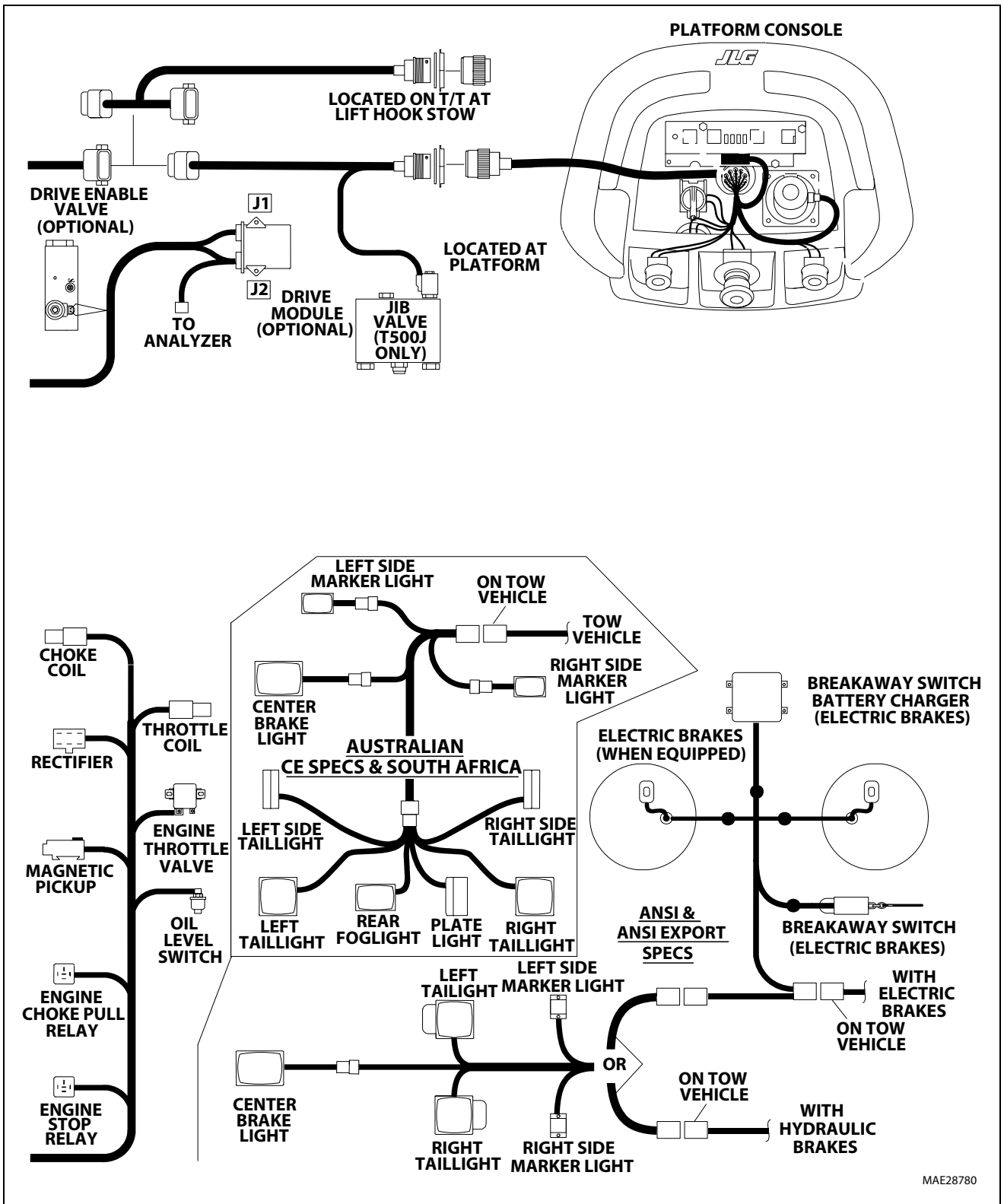


Figure 7-29. Electrical Components Installation - Engine Powered Machines - Sheet 2 of 2

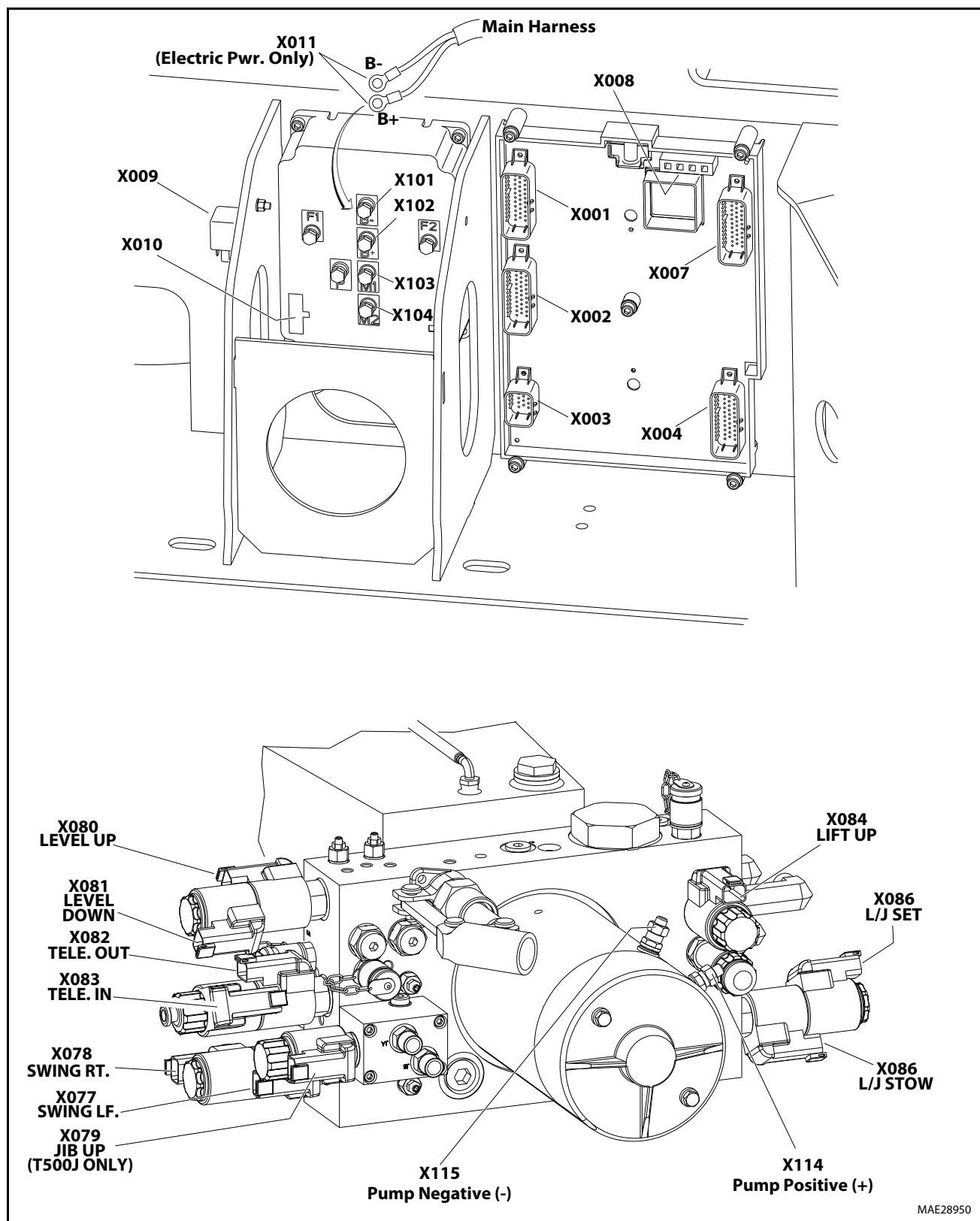


Figure 7-30. Controller and Valve Body Connector Locations - Electrical Machine without Drive (Prior to SN 0030001804)

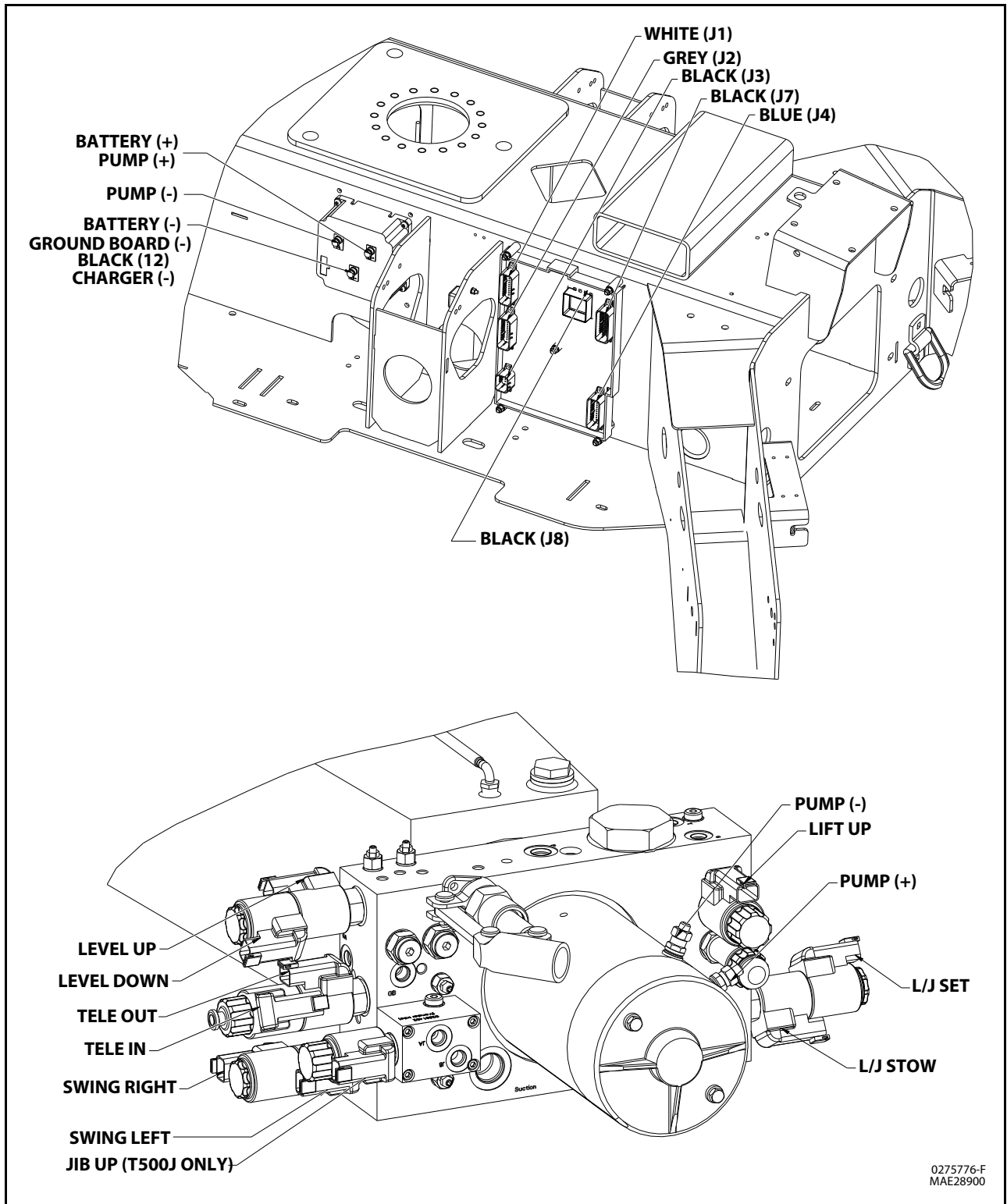


Figure 7-31. Controller and Valve Body Connector Locations - Electrical Machine without Drive (SN 0030001804 to Present)

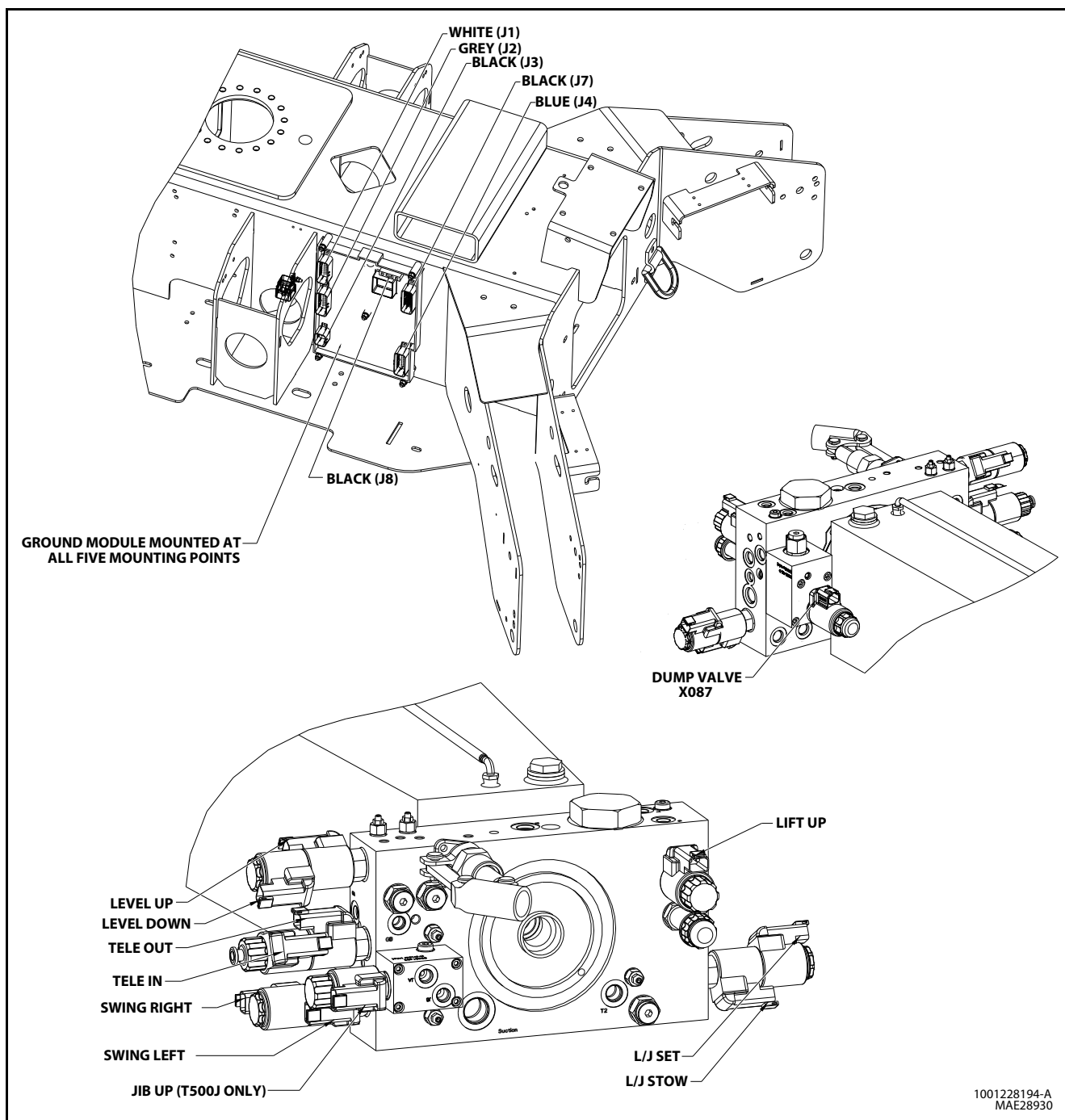


Figure 7-32. Controller and Valve Body Connector Locations - Engine Machine without Drive

Table 7-1. Connector Identification

CONNECTOR	DESCRIPTION
X001	Ground Module, J1
X002	Ground Module, J2
X003	Ground Module, J3
X004	Ground Module, J4
X007	Ground Module, J7
X008	Ground Module, J8
X009	IGN Relay
X010	Power Module (Sevcon), P
X011	Main Harness power
X012	Drive Module
X013	Ground Module Supply
X014	Ground Control Pass-thru
X015	Transport Limit Pass-thru
X016	Lift Down Pass-thru
X017	Strobe/Alarm Pass-thru
X018	Tele Limit Pass-thru
X019	Boom Cable
X020	Jack Switches Pass-thru
X021	Valves Pass-thru
X022	Engine Pass-thru
X023	Ground Outriggers Sw
X024	Ground Swing Sw
X025	Ground Enable Sw
X026	Ground Key Sw
X027	Ground Hour Meter
X028	Ground Alarm
X029	Ground Analyzer Port
X030	Ground LED Board
X031	Ground Lift Sw
X032	Ground Jib Sw
X033	Ground Tele Sw
X034	Ground Level Sw
X035	Ground Choke Sw
X036	Ground Start Sw
X037	Ground EMG Stop
X038	Strobe Light
X039	Lift Down Valve Coil
X040	Transport Limit Sw
X041	Tele Limit Sw
X042	F/L Jack Limit Sw
X043	F/R Jack Limit Sw
X044	R/L Jack Limit Sw
X045	R/R Jack Limit Sw
X046	F/L Jack Valve Coil
X047	F/R Jack Valve Coil
X048	R/L Jack Valve Coil

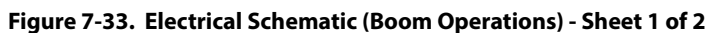
Table 7-1. Connector Identification

CONNECTOR	DESCRIPTION
X049	R/R Jack Valve Coil
X050	Motion Alarm
X051	Lift Hook Harness to X019
X052	Lift Hook Harness to X054
X053	Lift Hook Harness to Console X058
X054	Platform Harness to X019
X055	Platform Boom Connector
X056	Jib Down Valve Coil
X057	Platform Harness to console X058
X058	Platform Console Main
X059	Console Pass-Thru
X060	Platform Module
X061	Joystick
X062	EMG Stop
X063	Rotary Select Sw
X064	Choke Sw
X065	Start Sw
X066	Alarm
X067	Drive, L Forward
X068	Drive, R Forward
X069	Drive, L Reverse
X070	Drive, R Reverse
X071	Drive, Dump
X072	Drive, Left Prox Sw
X073	Drive, Right Prox Sw
X074	Drive Module, A
X075	Drive Module, B
X076	Drive Module, Analyzer
X077	Swing Left Coil
X078	Swing Right Coil
X079	Jib Up Coil
X080	Level Up Coil
X081	Level Down Coil
X082	Tele Out Coil
X083	Tele In Coil
X084	Lift Up Coil
X085	L/J Stow Coil
X086	L/J Set Coil
X087	Dump Valve Coil
X088	Starter Sol. Fuse
X089	Starter Sol.
X090	Engine Stop Relay
X091	Throttle Pull Relay
X092	Engine Oil Level Switch
X093	Engine Choke Pull Relay
X094	Engine Oil Pressure Switch
X095	Engine Mag Pickup

Table 7-1. Connector Identification

CONNECTOR	DESCRIPTION
X096	Engine Rectifier
X097	Engine Throttle Coil
X098	Engine Choke Coil
X099	Engine Powered, Battery Pos.
X100	Engine Powered, Battery Neg.
X101	Power Module (Sevcon), B-
X102	Power Module (Sevcon), B+
X103	Power Module (Sevcon), M1
X104	Power Module (Sevcon), M2
X105	Sevcon Power Cable In-line
X106	6V Batt 1, Pos.
X107	6V Batt 1, Neg.
X108	6V Batt 2, Pos.
X109	6V Batt 2, Neg.
X110	6V Batt 3, Pos.
X111	6V Batt 3, Neg.
X112	6V Batt 4, Pos.
X113	6V Batt 4, Neg.
X114	Electric Pump Pos.
X115	Electric Pump Neg.
X116	Battery Charger Power

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SECTION 7 - BASIC ELECTRICAL INFORMATION & SCHEMATICS

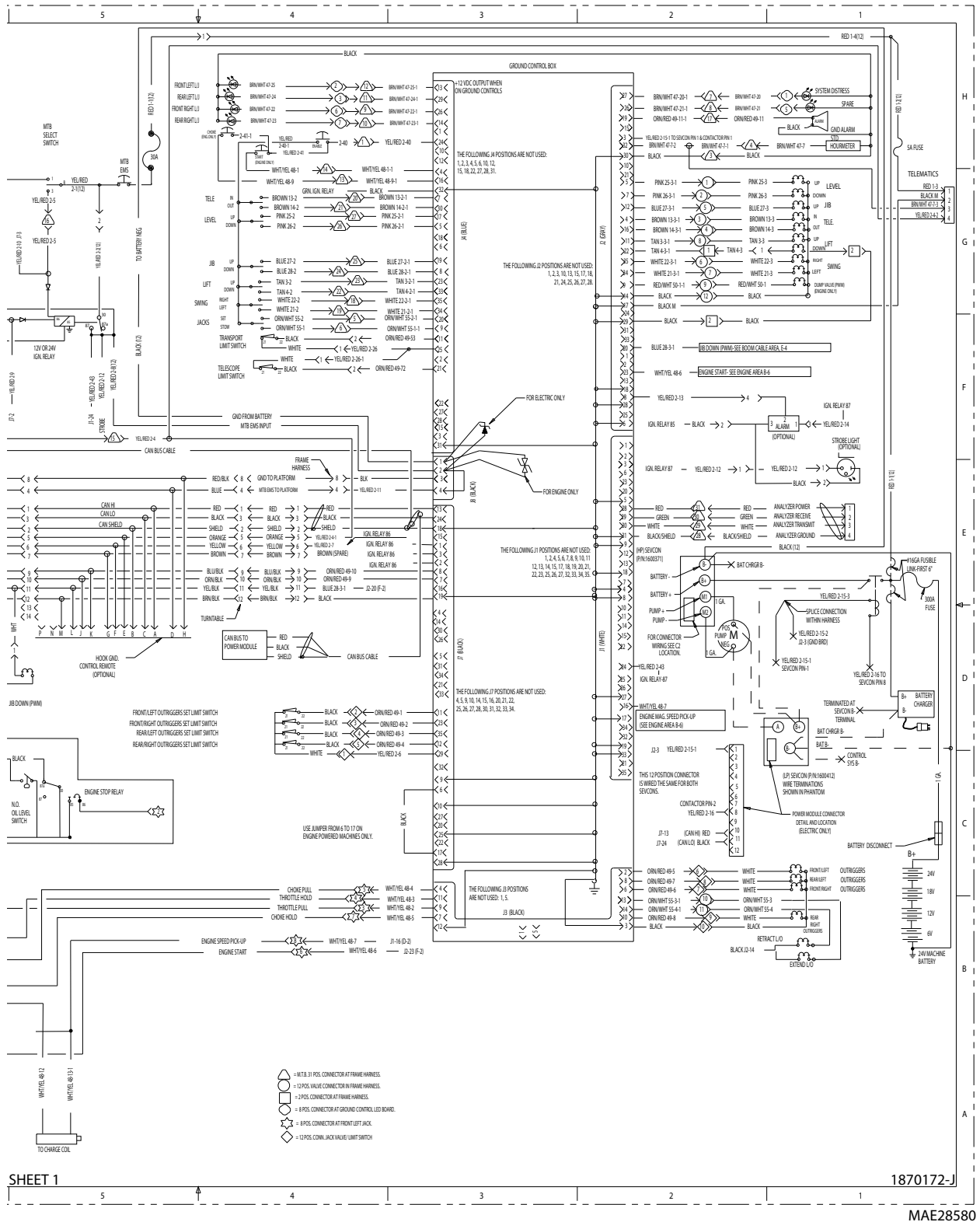


Figure 7-34. Electrical Schematic (Boom Operations) - Sheet 2 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & SCHEMATICS

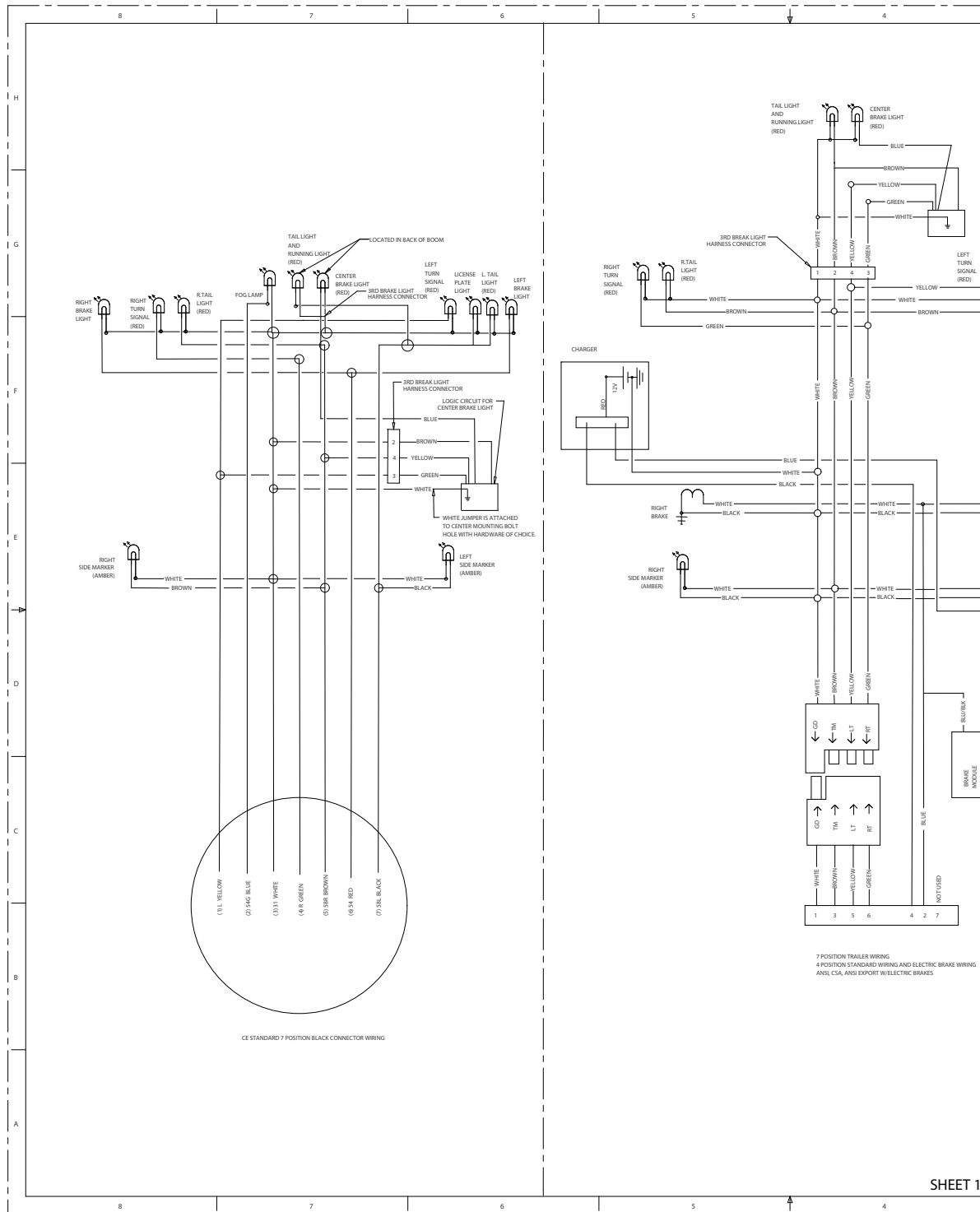


Figure 7-35. Electrical Schematic (Trailer) - Sheet 1 of 4

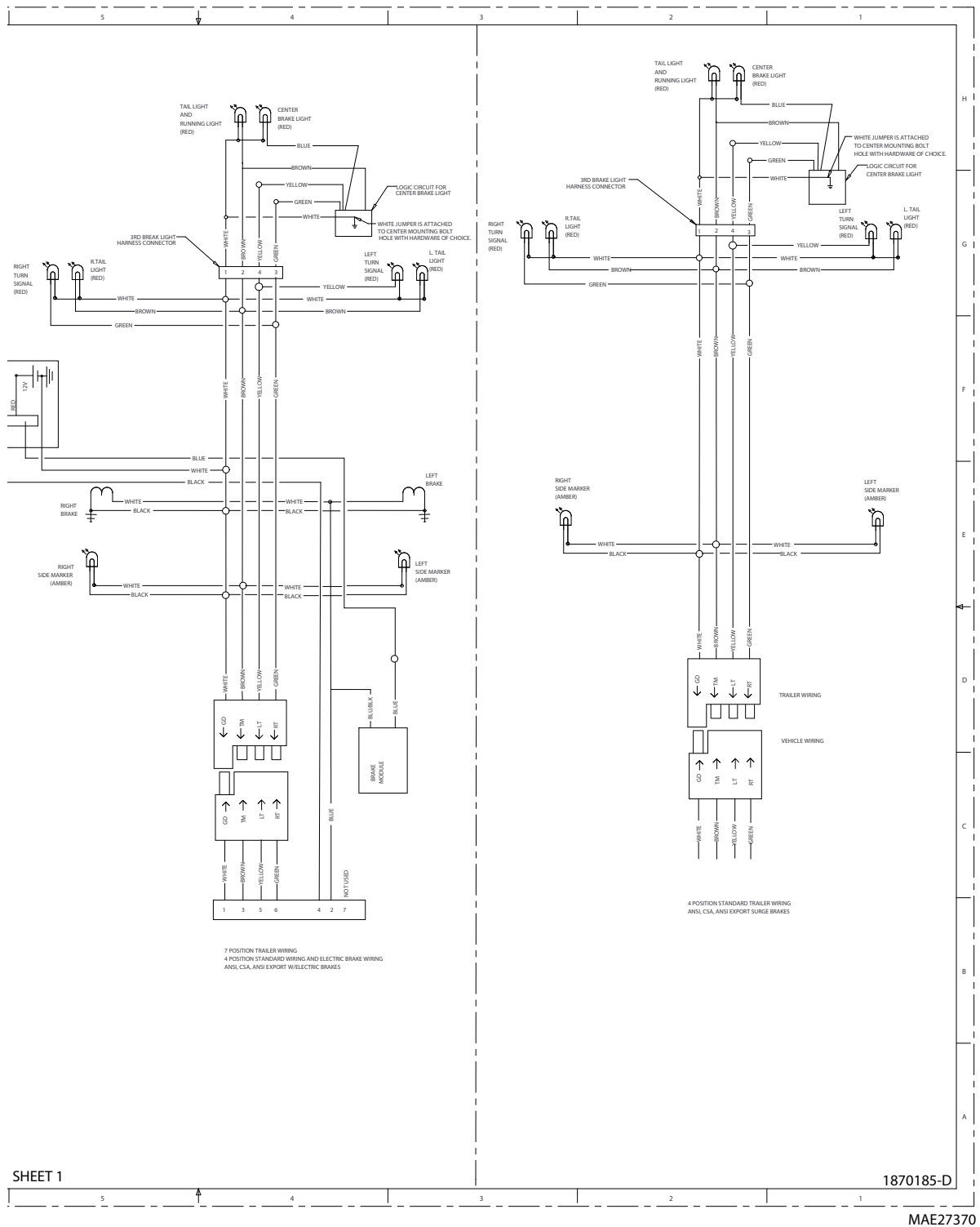


Figure 7-36. Electrical Schematic (Trailer) - Sheet 2 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & SCHEMATICS

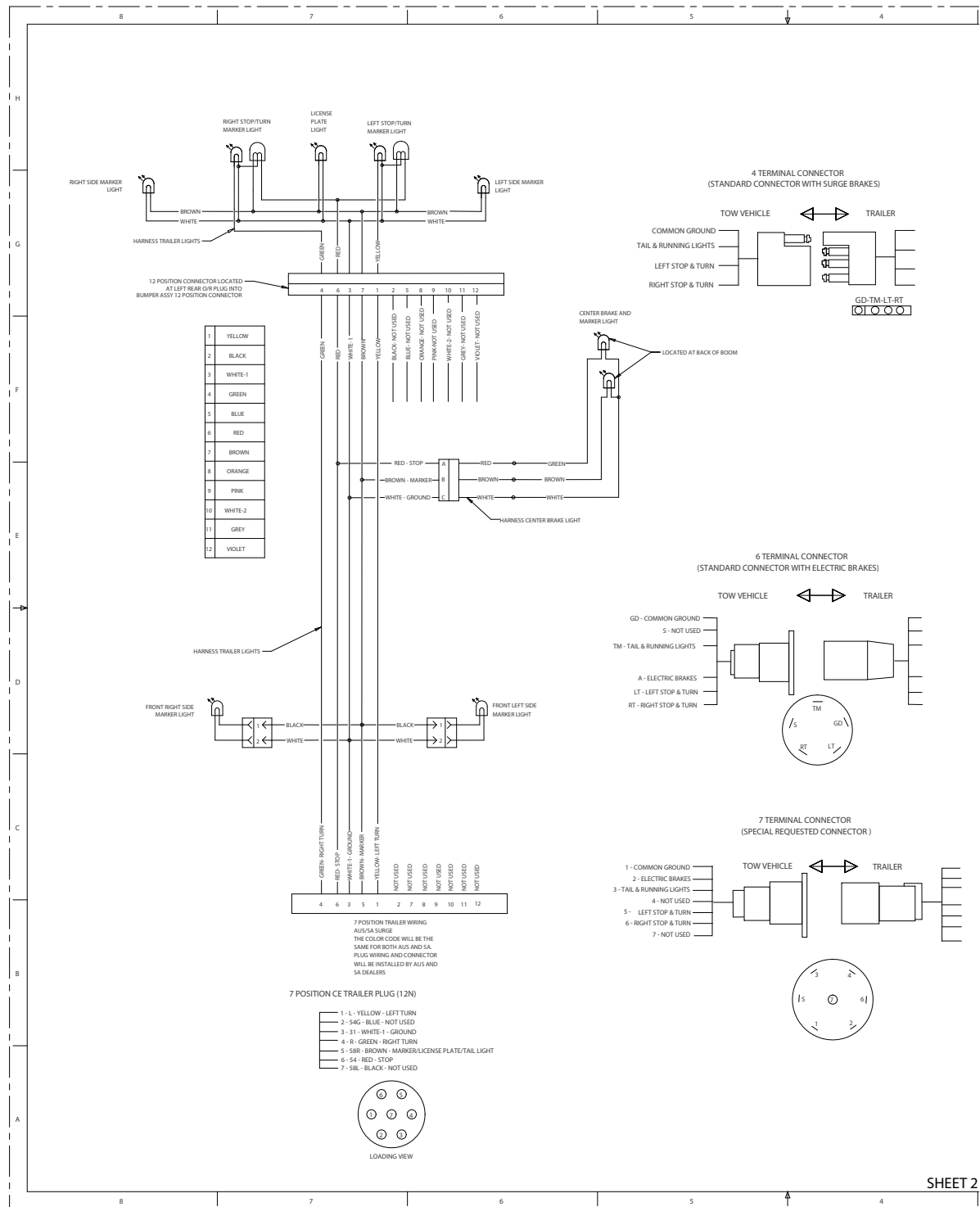


Figure 7-37. Electrical Schematic (Trailer) - Sheet 3 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & SCHEMATICS

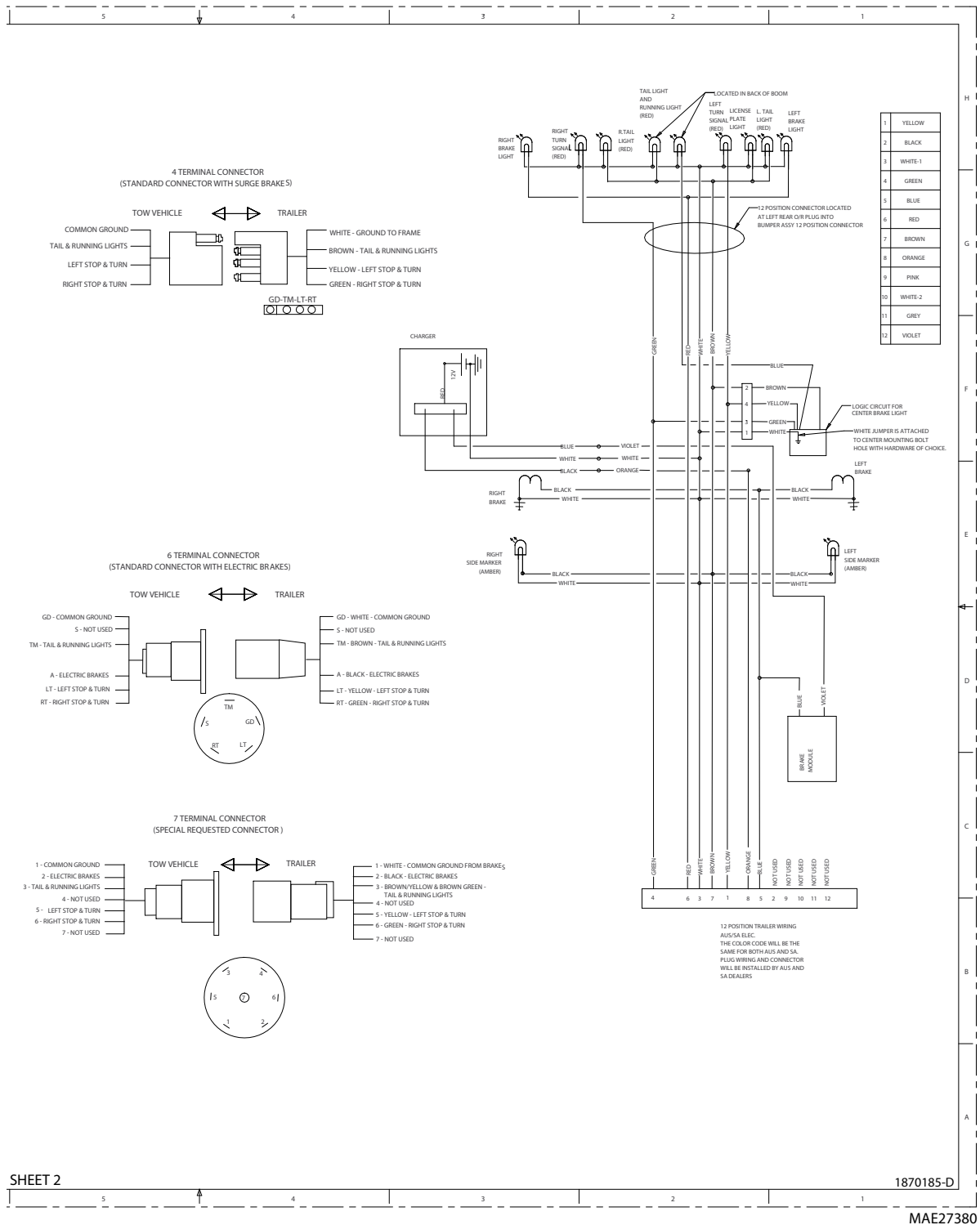
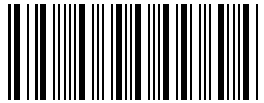


Figure 7-38. Electrical Schematic (Trailer) - Sheet 4 of 4

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