An Oshkosh Corporation Company

Service and Maintenance Manual

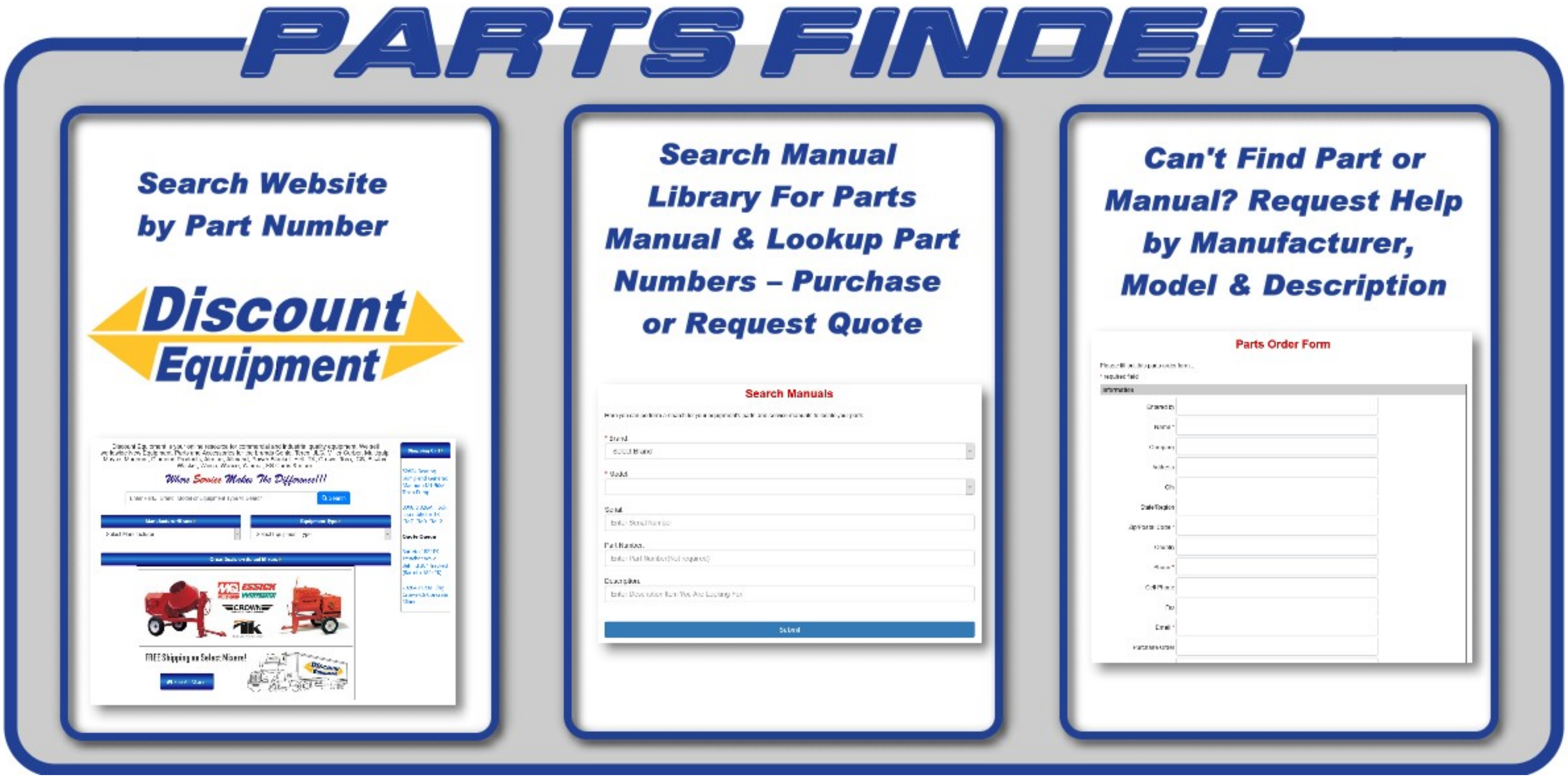
Model
H800AJ

PN - 3121770

February 27, 2019 - Rev C

ANSI

AS/NZS



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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

NOTICE

THIS MACHINE IS POWERED BY AN 84VDC (NOMINAL) ELECTRICAL SYSTEM THAT CAN RANGE UP TO 105VDC DURING NORMAL OPERATION, AND BY A 48VAC (NOMINAL) ELECTRICAL MOTOR SYSTEM THAT CAN RANGE UP TO 60VAC. BASED ON EMPLOYER, LOCAL, AND GOVERNMENTAL REGULATIONS AS THEY PERTAIN TO THIS MACHINE, SPECIFIC ELECTRICAL TRAINING AND CERTIFICATIONS MAY BE REQUIRED BEFORE SERVICING OR TROUBLESHOOTING.

A GENERAL

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

⚠ WARNING

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

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

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

⚠ WARNING

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

B HYDRAULIC SYSTEM SAFETY

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

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

C MAINTENANCE

⚠ WARNING

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

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

REVISON LOG

Original Issue	A - March 19, 2018
Revised	B - June 29, 2018 - Revised Covers
Revised	C - February 27, 2019

SECTION NO.	TITLE	PAGE NO.

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

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

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FIGURE NO.	TITLE	PAGE NO.

FIGURE NO.	TITLE	PAGE NO.

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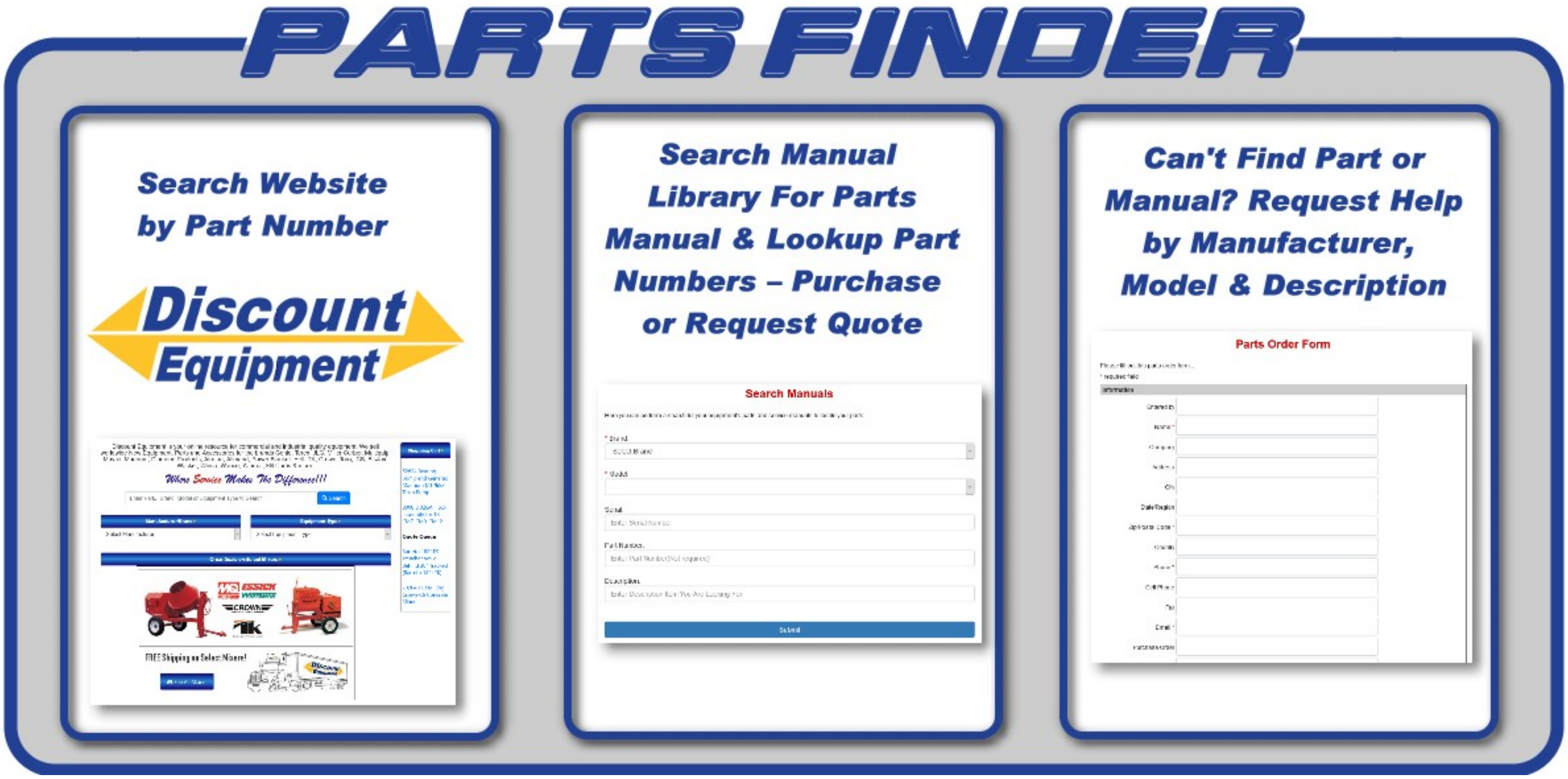

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating Specifications

Travel Speed	3.0 MPH (4.83 Km/hr.)
Gradeability 2WD 4WD	 30% 45%
Platform height	80 ft. (24.38 m)
Horizontal reach	51.8 ft. (15.8 m)
Turning Radius (Outside) 2WS	 19 ft. 8 in. (6.02 m)
Turning Radius (Inside) 2WS	 12 ft. 6 in. (3.8 m)
Overall Width	8 ft. 2 in. (2.48 m)
Tailswing	3 ft. 6 in. (1.06 m)
Ground Clearance	11 ft. (28 cm)
Machine Height Stowed	9 ft. 10 in. (3 m)
Machine Length (Stowed)	36 ft.-6 in. (11.13 m)
Wheel base	10 ft. (3.05 m)
Boom Elevation - 800AJ Above Grade Below Grade	 +80 ft. (24.38 m) -13 ft. - 1 in. (3.99 m)
Max. Ground Bearing Pressure	76 psi. (5.3 kg/cm^2)
Max. Tire Load	17,755 lbs. (8054 kg)
Machine Weight approximately*	35,500 lb. (16,103 kg)
* Certain options or country standards can increase weight.	

1.2 TIRES

Table 1-2. Tire Specifications

Size	Type	Ply Rating	Load Range	Pressure
15-625	foam-filled	16	H	6.5 bar (94 psi)
18-625	foam-filled	16	H	5.9 bar (86 psi)
18-625	foam-filled	16	H	5.9 bar (86 psi)

1.3 CAPACITIES

Table 1-3. Capacities

Fuel Tank	Approx. 25 gallons (94.6 liters)
Hydraulic Tank	Approx. 21 gallons (79.5 liters)
Hydraulic System (Including Tank)	65 gallons (246 liters)
Drive Hub	44 ounces (1.3 liters)
Drive Brake	2.7 ounces (80 ml)
Engine Crankcase	6 quarts (5.7 liters)

1.4 ENGINE DATA

Table 1-4. Kubota D1305

Fuel	Diesel
Fuel Consumption	1.2 GPH (4.54 LPH)
No. of Cylinders	3
Max Rated Gross Output	24.8 hp (18.5 kW) @ 2600 rpm
High RPM	2600
Low RPM	1800
Oil Capacity w/filter	6 qts. (5.7 L)
Coolant Capacity (Engine Only)	0.45 gallons (1.7 liters)
Engine Dry Weight	247 lbs. (112 kg)
Acceptable Fuel Grades	
Low Sulfur (<500 ppm) or Ultra Low Sulfur (15 ppm) strongly recommended	
Up to 5% BioDiesel	

1.5 HYDRAULIC OIL

Table 1-5. 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 must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service. JLG Industries recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity index of 152.*

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

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

Table 1-6. Mobilfluid 424 Specs

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

Table 1-7. Mobil DTE 10 Excel 32 Specs

ISO Viscosity Grade	#32
Pour Point, Max	-40°F (-54°C)
Flash Point, Min.	330°F (250°C)
Viscosity	
at 40° C	33cSt
at 100° C	6.6 cSt
at 100° F	190 SUS (32.7 cSt)
at 212° F	51.1 SUS (6.63 cSt)
cp at -30° F	6,200
Viscosity Index	164

Table 1-8. Mobil EAL H32 Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	32
Pour Point, Max	-38°F (-39°C)
Flash Point, Min.	514°F (268°C)
Operating Temp.	-20 to 200°F (-29 to 93°C)
Viscosity	
at 40° C	33.1 cSt
at 100° C	6.36 cSt
Viscosity Index	147

Table 1-9. Mobil EAL H46 Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	46
Pour Point, Max	-49°F (-45°C)
Flash Point, Min.	500°F (260°C)
Operating Temp.	-20 to 200°F (-29 to 93°C)
Viscosity	
at 40° C	48.8 cSt
at 100° C	7.8 cSt
Viscosity Index	145

Table 1-10. Quintolubric 888-46

Density	0.92 @ 15°C (59°F)
Pour Point	<-22°F (<-4°C)
Flash Point	572°F (300°C)
Fire Point	680°F (360°C)
Auto Ignition Temperature	>842°F (>450°C)
Viscosity	
at 0° C (32° F)	320 cSt
at 20° C (68° F)	109 cSt
at 40° C (104° F)	47.5 cSt
at 100° C (212° F)	9.5 cSt
Viscosity Index	190

1.6 CRITICAL STABILITY WEIGHTS

⚠ WARNING

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

Table 1-11. Critical Stability Weights

COMPONENTS		LBS.	KG.
Tire & Wheel Size (Foam Filled Only)	15-625	544	247
	18-625	601	273
Engine (No added components)		247	112
Wheel Hubs		218	99
Platform	6 ft. (1.83 m)	205	93
	8 ft. (2.44 m)	230	105
Battery	12 V	66	30
	84 V	138	63

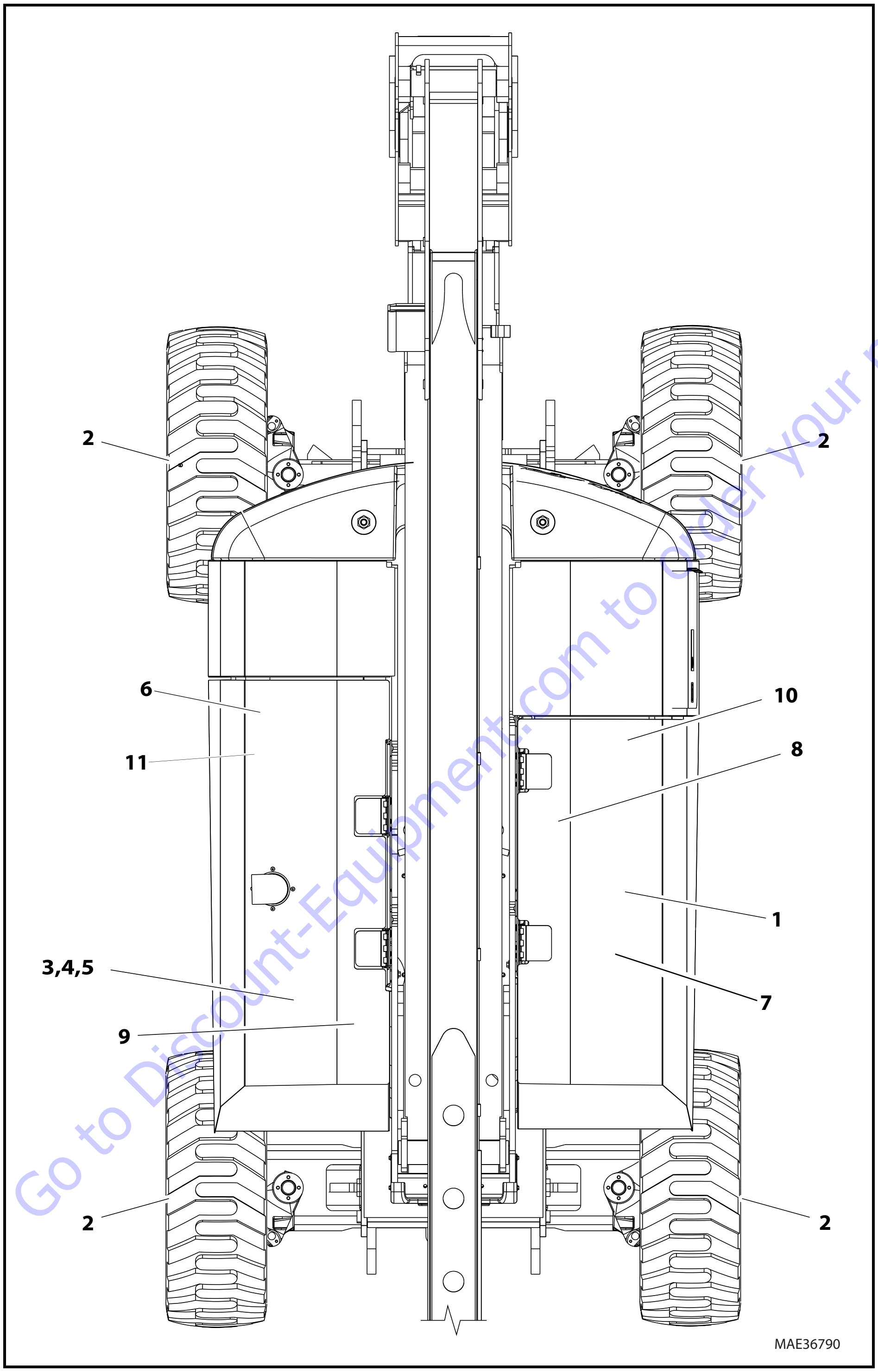


Figure 1-1. Maintenance and Lubrication Diagram

1.7 MAINTENANCE AND LUBRICATION

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

Table 1-12. Lubrication Specifications.

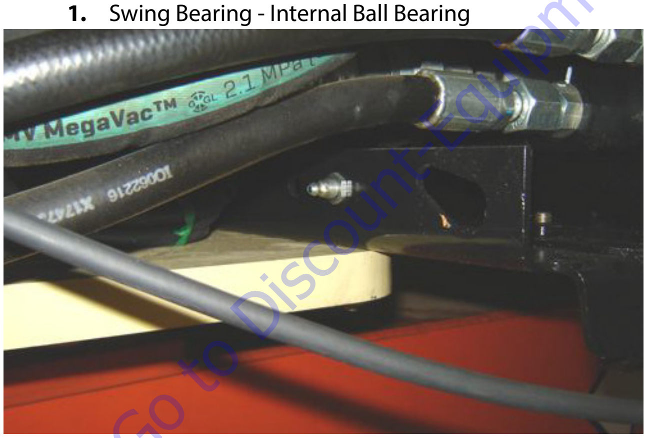
KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350° F (177° C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobilfluid 424
EO	Engine (crankcase) Oil. Gas - API SF, SH, SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C

NOTICE

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

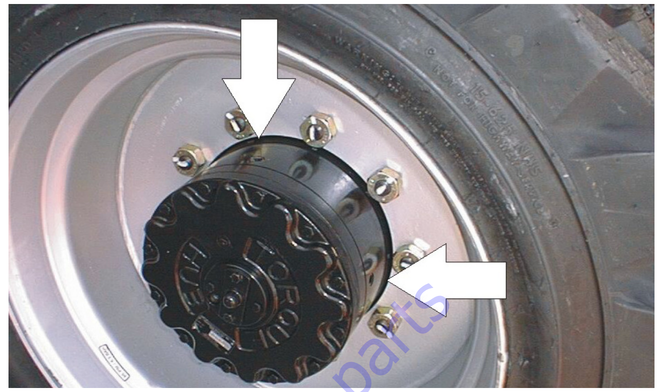
NOTE: *It is recommended as a good practice to replace all filters at the same time.*

1. Swing Bearing - Internal Ball Bearing



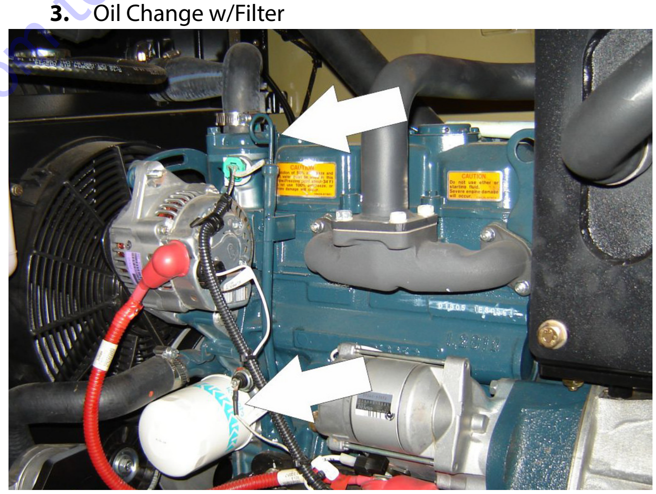
Lube Point(s) - 2 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Remote Access.

2. Wheel Drive Hub



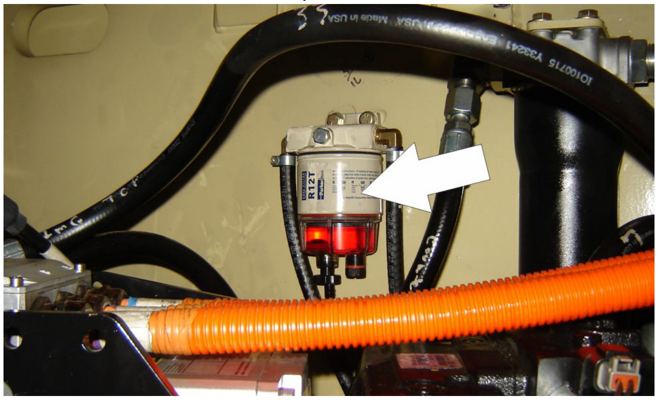
Lube Point(s) - Level/Fill Plug
Capacity - 17 oz. (0.5 L) - 1/2 Full
Lube - EPGL
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation
Comments - Place Fill port at 12 o'clock position and Check port at 3 o'clock position. Pour lubricant into fill port until it just starts to flow out of check port.

3. Oil Change w/Filter



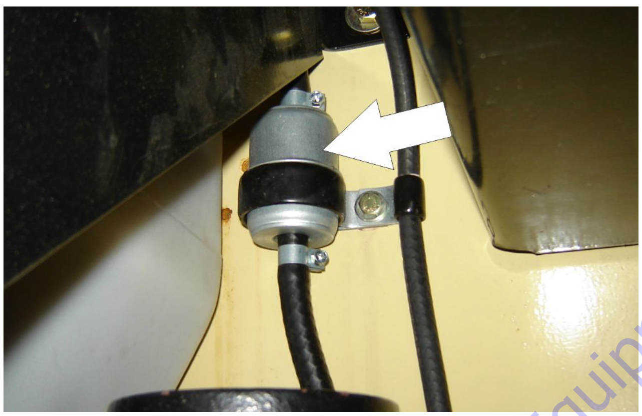
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 6 qt. (5.7 L) w/filter
Lube - EO
Interval - Change in accordance with engine manual
Comments - Check level daily/Adjust full level by mark on dipstick.

4. Fuel Filter/Water Separator



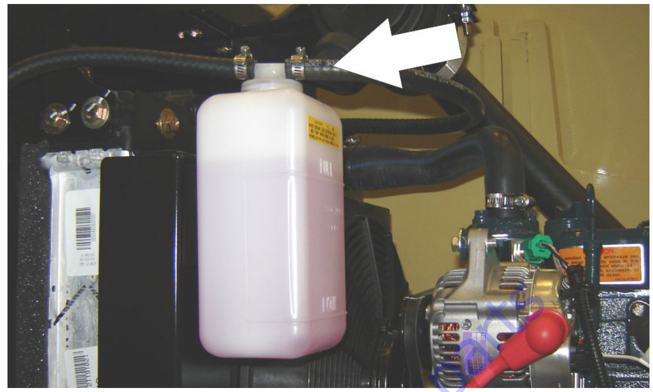
Lube Point(s) - Replaceable Element
Interval - Drain water daily; Change every year or 600hours of operation.

5. Fuel Strainer



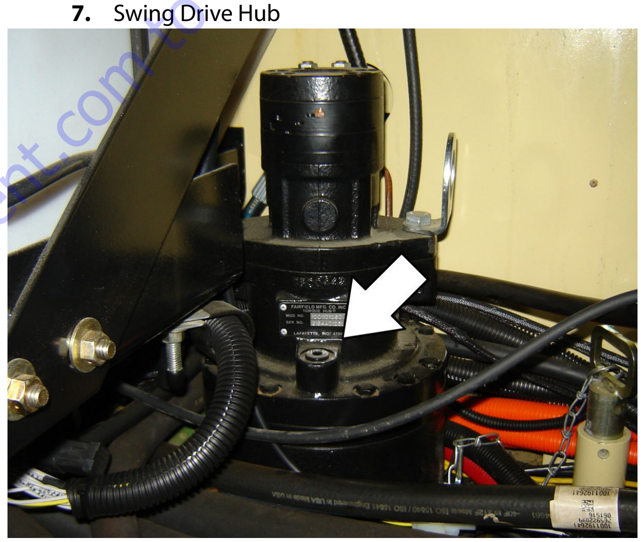
Lube Point(s) - Replaceable Element
Interval - Change every year or 600 hours of operation.

6. Radiator



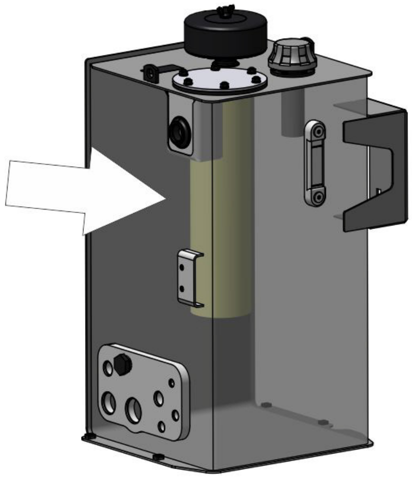
Lube Point(s) - Fill Cap
Lube - Anti-Freeze Coolant (Refer to Engine Manual for compatible coolants)
Capacity - 6 qt. (5.7 L)
Interval - Check coolant level daily. Ensure it is between the "FULL" and "LOW" lines. If coolant level is low, allow fluid to cool, then add as required.

7. Swing Drive Hub



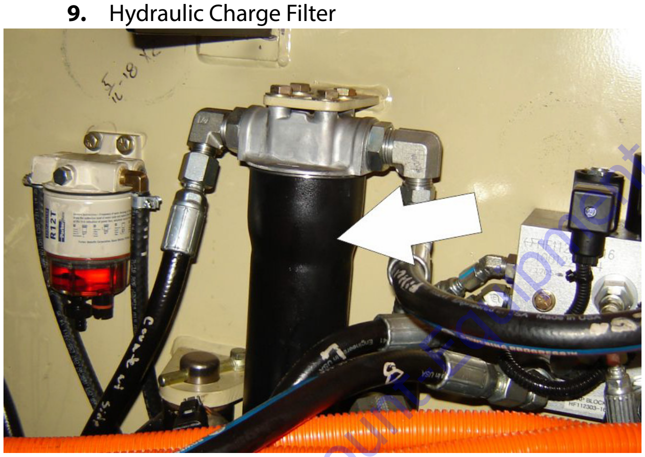
Lube Point(s) - Level/Fill Plug
Capacity - 43 oz. (1.3 L)
Lube - 90w80 Gear Oil
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation.

8. Hydraulic Return Filter



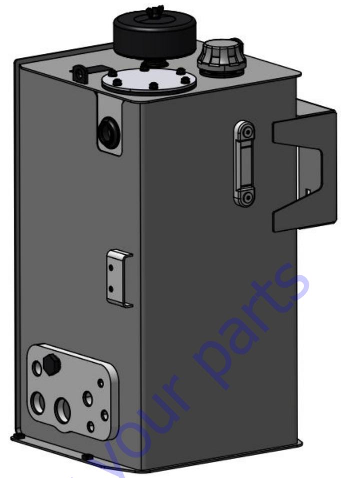
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter or as indicated by Condition Indicator.

9. Hydraulic Charge Filter



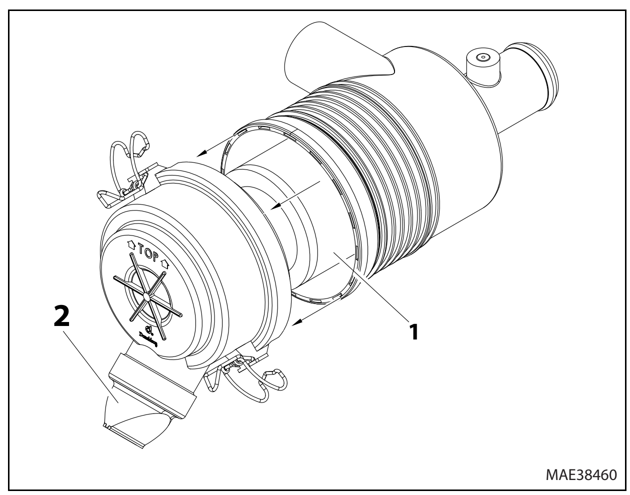
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter or as indicated by Condition Indicator.

10. Hydraulic Tank



Lube Point(s) - Fill Cap
Capacity - 25 gallons (94.5 L) total capacity, 21 gallons (79.5 L) to Full Mark on Sight Gauge; 59 gallons (223 L) System
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.

11. Air Filter



Lube Point(s) - Replaceable Primary Filter Element (1) (Dry Type)
Interval - Every 6 months or 300 hours of operation. Under severe operating conditions (such as a very dusty work area) check condition of filter more often.

Once a week, squeeze the evacuator valve (2) on bottom of air cleaner assembly to allow collected debris to fall out of the air cleaner.

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)																			
				SAE GRADE 5 BOLTS & GRADE 2 NUTS									SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)		Clamp Load	Torque (Dry or Loctite® 263) K= 0.20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7											
	48	0.1120	0.00661	420	9	1.0	7	0.8											
6	32	0.1380	0.00909	580	16	1.8	12	1.4											
	40	0.1380	0.01015	610	18	2.0	13	1.5											
8	32	0.1640	0.01400	900	30	3.4	22	2.5											
	36	0.1640	0.01474	940	31	3.5	23	2.6					1320	43	5				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5					1580	60	7				
	32	0.1900	0.02000	1285	49	5.5	36	4					1800	68	8				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12			2860	143	16	129	15		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22	4720	25	35	20	25	20	25
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38	7000	45	60	40	55	35	50
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61	9550	70	95	65	90	50	70
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92	12750	105	145	95	130	80	110
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133	16400	155	210	140	190	115	155
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183	20350	210	285	190	260	160	220
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	21300	260	353	200		285	388	240	325	30100	375	510	340	460	280	380
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523	41600	605	825	545	740	455	620
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676	142200	3555	4835	3200	4350	2665	3625

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

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

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

				Values for Magni Coating Fasteners (Ref 4150701)														
				SAE GRADE 5 BOLTS & GRADE 2 NUTS							SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*							
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15		Clamp Load	Torque (Dry or Loctite® 263) K= 0.17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8											
	48	0.1120	0.00661	420	8	0.9											
6	32	0.1380	0.00909	580	14	1.5											
	40	0.1380	0.01015	610	14	1.6											
8	32	0.1640	0.01400	900	25	2.8											
	36	0.1640	0.01474	940	26	2.9					1320	37	4				
10	24	0.1900	0.01750	1120	36	4.1					1580	51	6				
	32	0.1900	0.02000	1285	42	4.7					1800	58	7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9			2860	122	14	114	13		
	28	0.2500	0.0364	2320	99	11.1	95	11			3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20	4720	20	25	20	25	20	25
	24	0.3125	0.0580	3700	15	20	15	21	15	20	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34	7000	35	50	35	50	35	50
	24	0.3750	0.0878	5600	30	40	28	38	25	34	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48	9550	60	80	55	75	50	70
	20	0.4375	0.1187	7550	45	60	44	60	40	54	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75	12750	90	120	85	115	80	110
	20	0.5000	0.1599	10700	75	100	71	97	65	88	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109	16400	130	175	125	170	115	155
	18	0.5625	0.2030	12950	105	145	97	132	90	122	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156	20350	180	245	170	230	160	220
	18	0.6250	0.2560	16300	145	195	136	185	125	170	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272	30100	320	435	300	410	280	380
	16	0.7500	0.3730	23800	255	345	238	324	225	306	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435	41600	515	700	485	660	455	620
	14	0.8750	0.5090	32400	400	545	378	514	355	483	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	38600	545	740	515	700	480	653	51500	730	995	685	930	645	875
	12	1.0000	0.6630	42200	600	815	563	765	530	721	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	47500	755	1025	713	969	670	911	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237	142200	3020	4105	2845	3870	2665	3625

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

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

				SOCKET HEAD CAP SCREWS													
				Magni Coating (Ref 4150701)*							Zinc Yellow Chromate Fasteners (Ref 4150707)*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15		Clamp Load See Note 4	Torque (Dry) K = .20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604														
	48	0.1120	0.00661														
6	32	0.1380	0.00909														
	40	0.1380	0.01015														
8	32	0.1640	0.01400														
	36	0.1640	0.01474														
10	24	0.1900	0.01750														
	32	0.1900	0.02000														
1/4	20	0.2500	0.0318	2860	122	14	114	13			2860	143	16	129	15		
	28	0.2500	0.0364	3280	139	16	131	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	320	435	300		280	380	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875	51500	860	1170	775	1055	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625	142200	3555	4835	3200	4350	2665	3625

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

NO. 5000059 REV. K

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

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

NO. 5000059 REV. K

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

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

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

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

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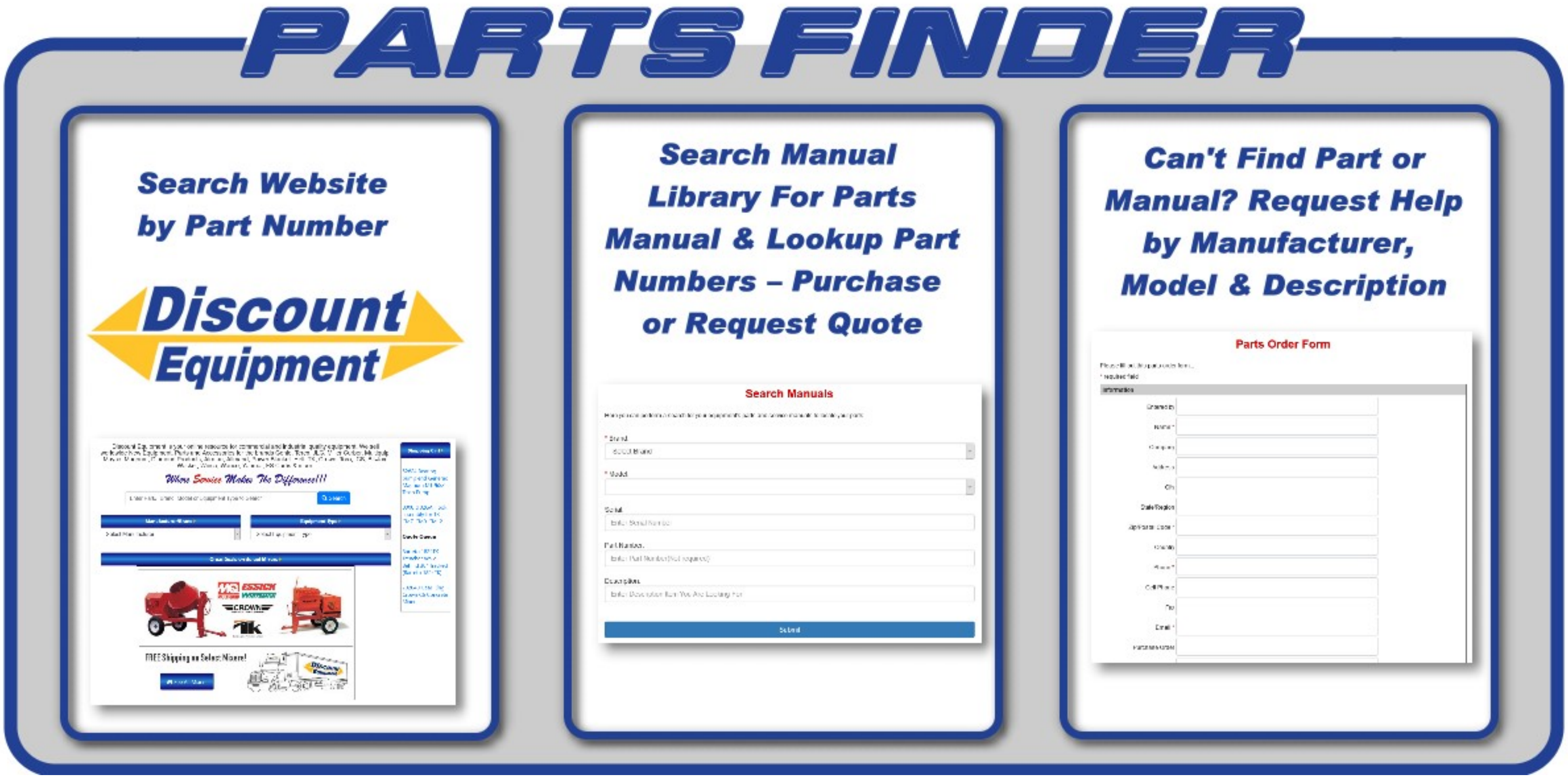
Figure 1-6. Torque Chart - Sheet 5 of 5 - (METRIC Fasteners)



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SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

It is the User's or Operator's primary responsibility to perform a Pre-Start Inspection of the machine prior to use daily or at each change of operator. Reference the 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 Preventive Maintenance Schedule for items requiring inspection during the performance of these inspections. Reference the appropriate areas of this manual for servicing and maintenance procedures.

Annual Machine Inspection

The Annual Machine Inspection must be performed 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-Trained Service Technician as a person who has successfully completed the JLG Service Training School for the subject JLG product model. Reference the machine Service and Maintenance Manual and appropriate JLG inspection form for performance of this inspection.

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

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

Preventive Maintenance

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

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

Table 2-1. Inspection and Maintenance

Type	Frequency	Primary Responsibility	Service Qualification	Reference
Pre-Start Inspection	Prior to use each day; or At each Operator change.	User or Operator	User or Operator	Operation and Safety Manual
Pre-Delivery Inspection	Prior to each sale, lease, or rental delivery.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Frequent Inspection	In service for 3 months or 150 hours, whichever comes first; or Out of service for a period of more than 3 months; or purchased used.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Annual Machine Inspection	Annually, no later than 13 months from the date of the prior inspection.	Owner, Dealer, or User	Factory Trained Service Technician (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 and a viscosity index of 140.

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.

Cylinder Leakage Test

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

Measure drift at cylinder rod with a calibrated dial indicator.

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

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

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

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

Cylinder Thermal Drift

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:

    a. Excessive sloppiness in joints.

    b. Noise originating from the joint during operation.

2. Filament wound bearings should be replaced if any of the following is observed:

    a. Frayed or separated fibers on the liner surface.

    b. Cracked or damaged liner backing.

    c. Bearings that have moved or spun in their housing.

    d. Debris embedded in liner surface.

3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):

    a. Detectable wear in the bearing area.

    b. Flaking, pealing, scoring, or scratches on the pin surface.

    c. Rusting of the pin in the bearing area.

4. Re-assembly of pinned joints using filament wound bearings.

    a. Housing should be blown out to remove all dirt and debris bearings and bearing housings must be free of all contamination.

    b. Bearing / pins should be cleaned with a solvent to remove all grease and oil filament wound bearing are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).

    c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

- Disconnect the battery.
- 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. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL		
	Pre-Delivery[1] or Frequent[2] Inspection	Annual[3] (Yearly) Inspection	Every 2 Years
Boom Assembly			
Boom Weldments	1,2,4	1,2,4	
Hose/Cable Carrier Installations	1,2,9,12	1,2,9,12	
Pivot Pins and Pin Retainers	1,2	1,2	
Sheaves, Sheave Pins	1,2	1,2	
Bearings	1,2	1,2	
Wear Pads	1,2	1,2	
Covers or Shields	1,2	1,2	
Extend/Retract Chain or Cable Systems	1,2,3	1,2,3	
Platform Assembly			
Platform		1,2	
Railing	1	1,2	
Gate	1,5	1,5	
Floor	1	1,2	
Rotator	5,9,15		
Lanyard Anchorage Point	1,2,10	1,2,10	
Turntable Assembly			
Swing Bearing or Worm Gear	1,2,14	1,2,3,13,14	
Oil Coupling	9		
Swing Drive System	11	11	
Turntable Lock	1,2,5	1,2,5	
Hood, Hood Props, Hood Latches	5	1,2,5	
Chassis Assembly			
Tires	16,17,18	16,17,18	
Wheel Nuts/Bolts	15	15	
Wheel Bearings			14,24
Oscillating Axle/Lockout Cylinder Systems		5,8	
Outrigger or Extendable Axle Systems	5,8	5,8	
Steer Components			
Drive Motors			
Drive Hubs	11	11	
Functions/Controls			
Platform Controls	5,6	6	

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

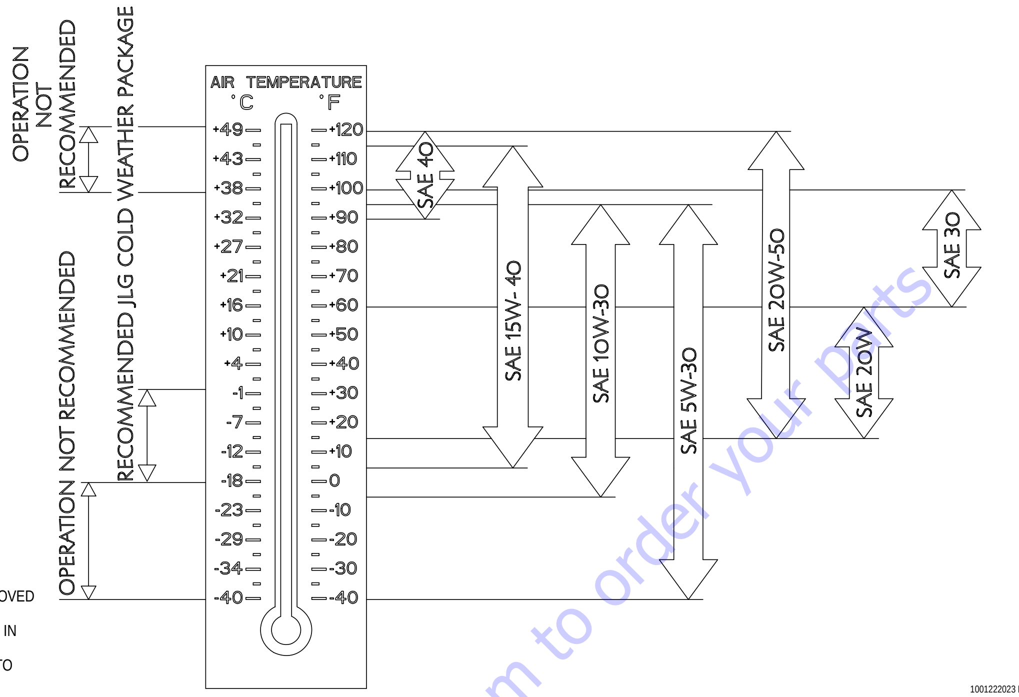
Footnotes:

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

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

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

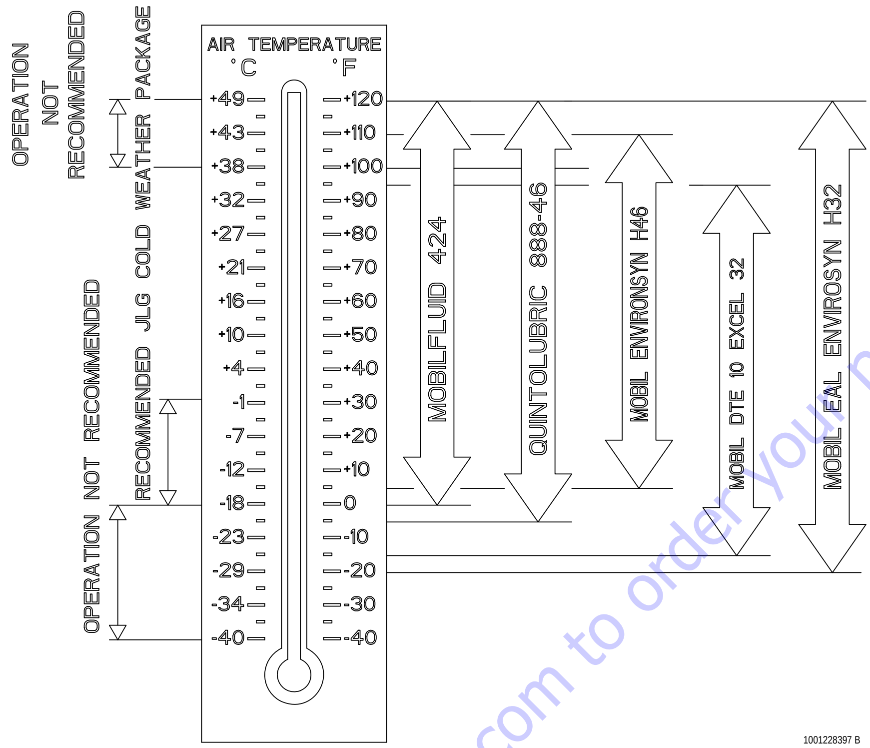
Performance Codes:
1 - Check for proper and secure installation
2 - Visual inspection for damage, cracks, distortion or excessive wear
3 - Check for proper adjustment
4 - Check for cracked or broken welds
5 - Operates Properly
6 - Returns to neutral or "off" position when released
7 - Clean and free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



NOTICE:

MACHINE OPERATION USING NON-JLG APPROVED ENGINE OIL OR OPERATION OUTSIDE OF THE TEMPERATURE BOUNDARIES OUTLINED IN THE "ENGINE OIL OPERATION CHART" MAY RESULT IN PREMATURE WEAR OR DAMAGE TO COMPONENTS OF THE ENGINE.

Figure 2-1. Engine Operating Temperature Specifications



Fluid	Properties		Base				Classification		
Description	Viscosity @ 40° C (CsT, Typical)	Visc Index	Mineral Oils	Vegetable Oils	Synthetic	Synthetic Polyol Esters	Readily Biodegradable*	Virtually Non-toxic**	Fire Resistant***
Mobilfluid 424	55	152	X						
Mobil DTE 10 Excel 32	32.7	164	X						
Mobil EAL Envirosyn H 32	33.1	147			X		X		
Mobil Envirosyn H 46	48.8	145			X		X	X	
Quintolubric 888-46	47.5	190				X	X	X	X

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

MACHINE OPERATION TEMPERATURE BOUNDARIES CONTAINED IN THIS DOCUMENT APPLY TO THE FOLLOWING MODELS:
H800AJ

* Readily biodegradable classification indicates one of the following:
CO2 Conversion>60% per EPA560/6-82-003
CO2 Conversion>80% per CEC-L-33-A-93

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

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

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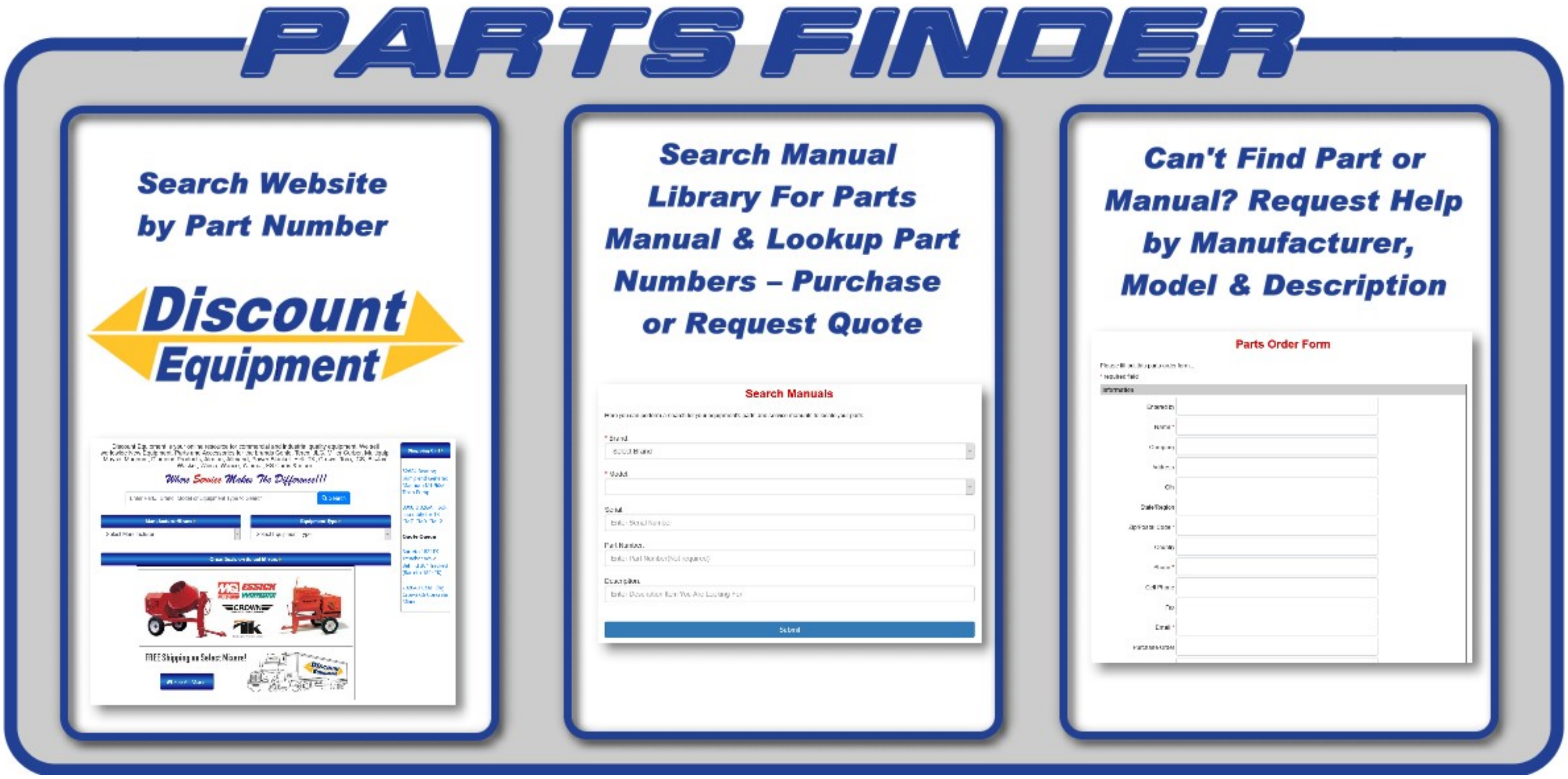
Figure 2-2. Hydraulic Oil Operating Temperature Specifications



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

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES & WHEELS

Tire Damage

For polyurethane foam filled tires, JLG Industries, Inc. recommends that when any of the following are discovered, measures must be taken to remove the JLG product from service immediately and arrangements must be made for replacement of the tire or tire assembly.

- a smooth, even cut through the cord plies which exceeds 3 inches (7.5 cm) in total length
- any tears or rips (ragged edges) in the cord plies which exceeds 1 inch (2.5 cm) in any direction
- any punctures which exceed 1 inch in diameter
- any damage to the bead area cords of the tire

If a tire is damaged but is within the above noted criteria, the tire must be inspected on a daily basis to insure the damage has not propagated beyond the allowable criteria.

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 fill media.

Wheel Replacement

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

Wheel Installation

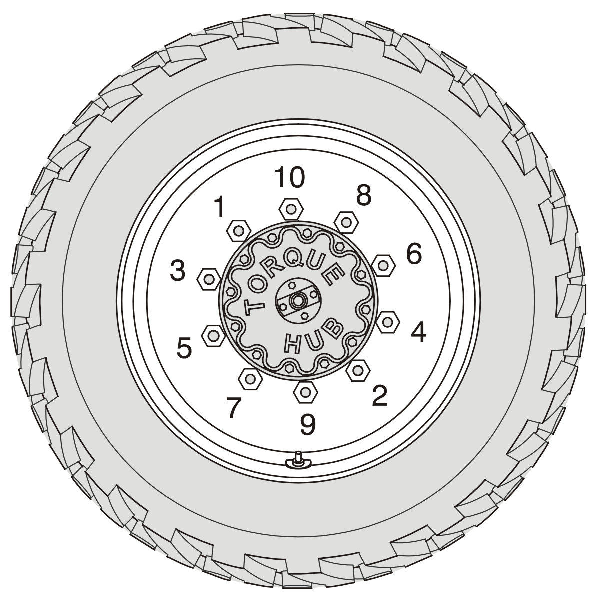
It is extremely important to apply and maintain proper wheel mounting torque.

WARNING

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

Tighten the lug nuts to the proper torque to prevent wheels from coming loose. Use a torque wrench to tighten the fasteners. If you do not have a torque wrench, tighten the fasteners with a lug wrench, then immediately have a service garage or dealer tighten the lug nuts to the proper torque. Over-tightening will result in breaking the studs or permanently deforming the mounting stud holes in the wheels. The proper procedure for attaching wheels is as follows:

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



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

Table 3-1. Wheel Torque Chart

TORQUE SEQUENCE		
1st Stage	2nd Stage	3rd Stage
70 ft. lbs. (95 Nm)	170 ft. lbs. (225 Nm)	300 ft. lbs. (405 Nm)

4. Wheel nuts should be torqued after first 50 hours of operation and after each wheel removal. Check torque every 3 months or 150 hours of operation.

3.2 POWERTRAIN OPERATING MODES

The powertrain system consists of diesel engine, automotive style friction clutch, IMG, and hydraulic pumps. When the clutch is engaged, the diesel engine power transmits through the clutch to the shaft of the IMG, then to the hydraulic pumps.

There are two operation modes for the powertrain system – HYBRID Mode and ELECTRIC Mode. These modes can be selected through the Engine Start/Mode Select switch on the platform console.

Hybrid Mode

Under this mode, the engine is started with engine start switch on the platform console. Once started, the engine runs continually until either the Power/Emergency Stop is pressed down, or the mode selection switch is flipped to ELECTRIC Mode position. The clutch is engaged under this mode so engine, clutch, IMG, hydraulic pump turn at the same RPM.

The clutch is always engaged under this mode. So engine, clutch, IMG, hydraulic pump normally turn at the same RPM.

The engine drives the IMG to generate electricity to charge the battery pack and also drive the hydraulic pumps to provide energy needed to operate boom functions and drive functions. The engine runs on either 1800 RPM or 2600 RPM, controlled by system to achieve optimal system efficiency.

While the engine is the primary power source of the vehicle, some vehicle functions need the augmentation of additional power provided by the IMG to achieve maximum performances. The Hybrid Electric Control system can sense if the engine power is enough to operate the commanded function. The IMG will then utilize stored energy from the batteries to provide the additional power required for that function.

When the hydraulic pumps' demand for power is less than the full power available from the engine or the system is idling, depending on the State Of Charge (SOC) of the battery, the IMG could utilize engine power to generate electricity to charge the battery. When the battery stack is lower than 75%(?) SOC, the IMG will charge the battery pack at a higher rate until the battery stack reaches 90%(?) SOC (values configurable via Analyzer), then IMG will charge with a lower current.

The engine will run continuously. If the engine is not required for operation or battery charging, it will stop and can be restarted via footswitch-enable or a request from the engine start switch.

Electric Mode

In Electric mode, the engine does not run and the clutch is disengaged. The machine operates all functions using battery power only to drive the IMG, which in turn drives the hydraulic pumps.

If operated in this mode until the battery stack SOC reaches a Discharged state (Approximately 20%(?) SOC), the Low Battery indicator will warn the operator that HYBRID mode must be reactivated or the battery charger plugged into an external AC source. If the operation of the machine continues, the machine will eventually reach a Deeply Discharged state (Approximately 5%(?) SOC). In this condition, the operator will be allowed to return to transport position but will not be allowed to elevate above transport position afterward. In the event the battery stack is not recharged after the warning indicators are illuminated and the machine is stored, the Low Battery warning indicator will resume flashing after the Emergency Stop is reset.

Switching Between Modes on the Fly

If the selection switch is changed from HYBRID Mode to ELECTRIC Mode position while the engine is running, the clutch will disengage and the engine will stop automatically. The operator can continue operation under ELECTRIC Mode.

If the selection switch is changed from ELECTRIC Mode to HYBRID Mode position, the machine will engage the clutch. The operator must release the foot switch and press the HYBRID/ELECTRIC Mode Switch into the Engine Start position to start the engine. If the switch is in the HYBRID mode position and the engine is not running, the machine will not operate and will notify the operator with a flashing light.

Idle Reduction Stop Start

Idle Reduction Stop Start (IRSS) allows for the engine to shutdown when the machine does not need to high charge the 84V battery stack and the operator is not commanding machine functions. IRSS will shut down the engine once the machine has not been enabled for the amount of time defined in the HEC analyzer parameter (IRSS TIMER). The machine will then restart the engine when the operator steps back into the foot switch, or the coolant temperature drops below an acceptable threshold which would affect the engine ability to restart with no glow plugs or other cold weather assistance.

The machine permits IRSS when [PERSONALITIES - ENGINE - IRSS = ENABLED (Production Default = DISABLED)], when the machine is in Platform Mode of operation and when SkyPower is not active.

When IRSS is enabled, the engine will shut down once all the following conditions are met:

- The machine has not been enabled for the IRSS TIMER, which can be set by the operator from 10 to 1800 seconds (10 seconds to 30 minutes), in increments of 10 seconds. [PERSONALITIES - ENGINE - IRSS TIMER = 20s (Default)]
- High battery charging of the 84V stack is not required.
- The engine must be running and warmed up, which is defined when engine coolant temperature is above 70°C.

After the IRSS shuts down the engine the IRSS will restart the engine if any of the following conditions are true.

- The machine is enabled by the operator stepping into the foot switch, in anticipation of commanding a function.
- The coolant temperature drops below 60. When this threshold is met, a 3 second ground alarm warning is commanded and an additional 3 second delay must expire after the ground alarm has expired before the engine is automatically started.

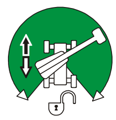
There is an IRSS suspend override that can be triggered if the engine is starting after either of two progressive SOC% thresholds are met. The first temporary IRSS suspend will occur if operator starts the engine after IRSS has been activated by reaching the 80% High to Low Charge threshold. When the 90% Charging Stop threshold has been met, the engine will again be stopped due to IRSS. If the operator again starts the engine while above the 90% threshold, IRSS will be disabled and the engine will continue to run, indefinitely, until the operator turns the engine off, either by changing to Electric Mode, or powering down the machine with the ESTOP button.

IRSS will be cancelled if the SOC drops below the 80% threshold (-5% hysteresis, 75-80% reading), if the machine is powered down or if the machine is switched to Electric Mode. DTC008 (FUNCTIONS LOCKED OUT- SYSTEM POWERED DOWN) also cancels IRSS.

IRSS will be cancelled if:

- The SOC drops below the 80% threshold (-5% hysteresis, essentially 75-80% SOC reading), if the machine is powered down or if the machine is switched to Electric Mode.
- DTC008 (FUNCTIONS LOCKED OUT- SYSTEM POWERED DOWN) is triggered after the 15 minute unattended alarm is issued. This DTC is not triggered when machine is in Platform Mode and Above Elevation, so IRSS will not time out if the operator is working above elevation.
- The machine transitions through a power cycle.

3.3 DRIVE ORIENTATION SYSTEM



The Drive Orientation System (DOS) is intended to indicate to the operator conditions that could make the direction of movement of the chassis different than the direction of movement of the drive/steer control handle. The system indicates to the operator the need to match the black and white directional arrows on the platform control panel to the arrows on the chassis. The system uses a limit switch mounted on the underside of the turntable, an indicator light and an override switch on the platform display panel. The limit switch trips when the turntable is swung +/- 42 degrees off center of the normal driving position.

This occurs roughly when the boom is swung past a rear tire. When the turntable is in the normal drive position with the boom between the rear tires, no indications or interlocks are made. When the machine is actively driving when the turntable is swung past the switch point, the system is ignored until drive/steer is released. When drive is initiated with the boom swung past the switch point, the DOS indicator will flash and the drive/steer functions will be disabled. The operator must engage the DOS override switch to enable drive/steer (High Speed drive will remain disabled). When the DOS is enabled, the DOS indicator will be illuminated continuously and a 3-second enable timer will be started and will continue for 3 seconds after the end the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

3.4 OSCILLATING AXLE SYSTEM

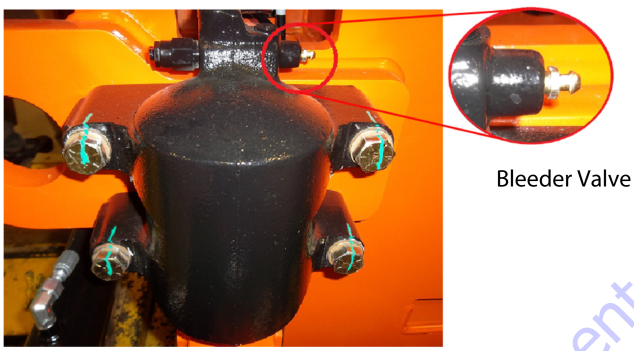
The oscillating front axle is attached to the frame by a pivot pin, which allows all four wheels to remain on the ground when traveling on rough terrain. The oscillating axle also incorporates two lockout cylinders connected between the frame and the axle. The lockout cylinders permit axle oscillation when the main boom is in Transport Position as described in the Above Elevation Cutout System (the tower boom position is not considered) and when the boom is oriented between the rear tires as described in the Drive Orientation System. In this system, both of these boom positions (swing and main boom elevate) are sensed by two switches set up in redundancy. One switch in each position is normally closed and opens when out of Transport Position (these are the same switches described in the Above Elevation Cutout System and in the Drive Orientation System. The other switch for each position is normally open and closes in the when in Transport Position.

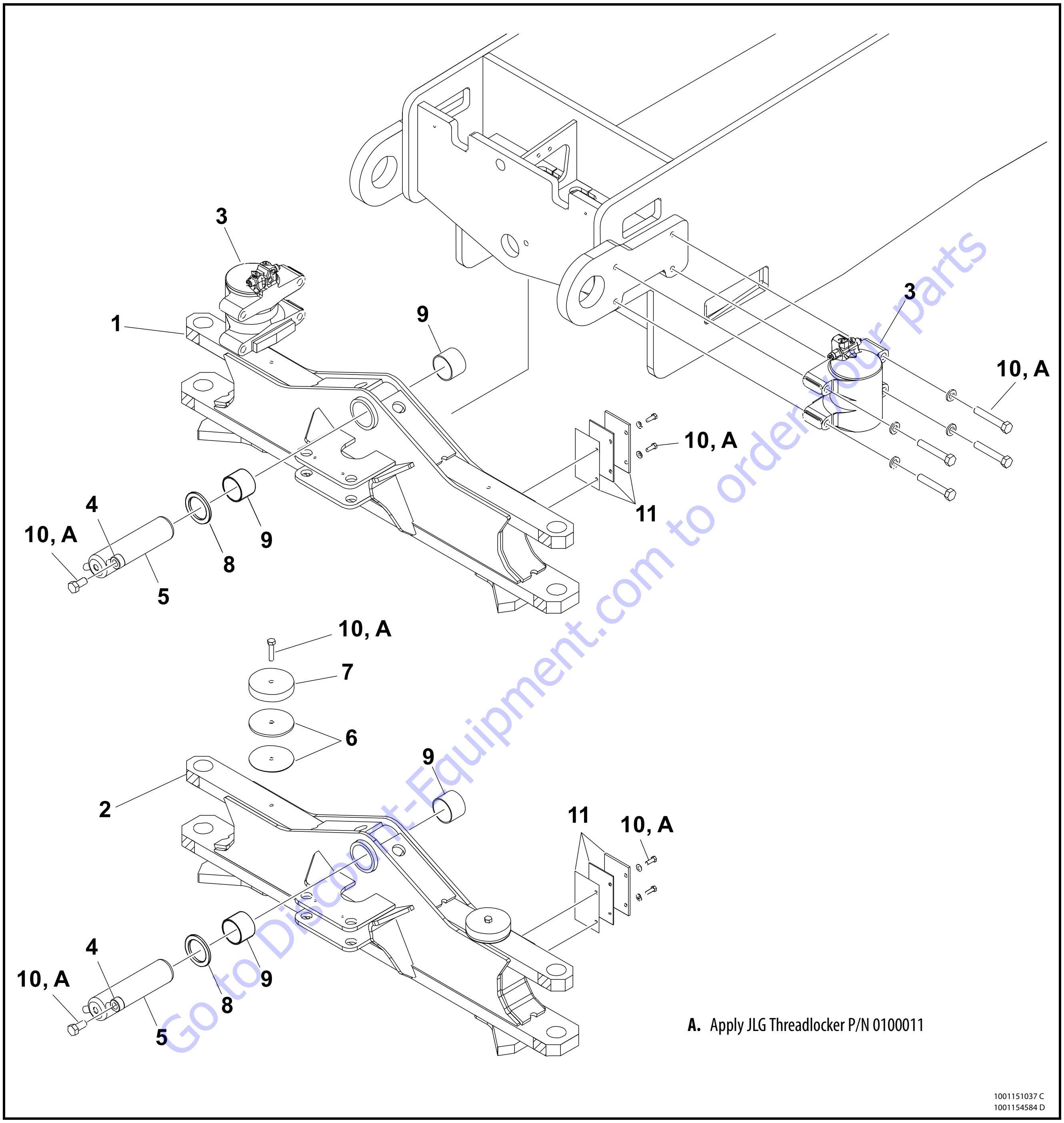
The lockout cylinders will lock and hold the axle when the boom is in a position as described above (Main boom above horizontal or swung beyond the rear tires). The cylinders unlock when pilot pressure is applied to the holding valves mounted on the cylinders and lock when pilot pressure is removed.

Pilot pressure is supplied via Drive Pump charge pressure. When the Main Boom is below horizontal and swung between the rear tires, the switches described above provide power to actuate the two control valves to supply charge pressure to the lock-out cylinder holding valves. This allows the cylinders to unlock which allows the axle to float. The first valve is normally closed and opens when actuated to allow flow to the lock-out cylinder circuit. The second valve (located between the first valve and the lock-out cylinders) is normally open to tank. This valve closes when actuated to block the tank path and force the flow to the lock-out cylinders. If either of these valves is in its normal state, the axle will be locked. The Ground Control Module supplies power to and monitors the state of the boom elevation and oscillating axle switches. If the switch states are not congruent, the Ground Control Module will remove power, thereby causing the oscillating axle to lock in the fail-safe position until power is cycled.

3.5 LOCKOUT CYLINDER BLEEDING

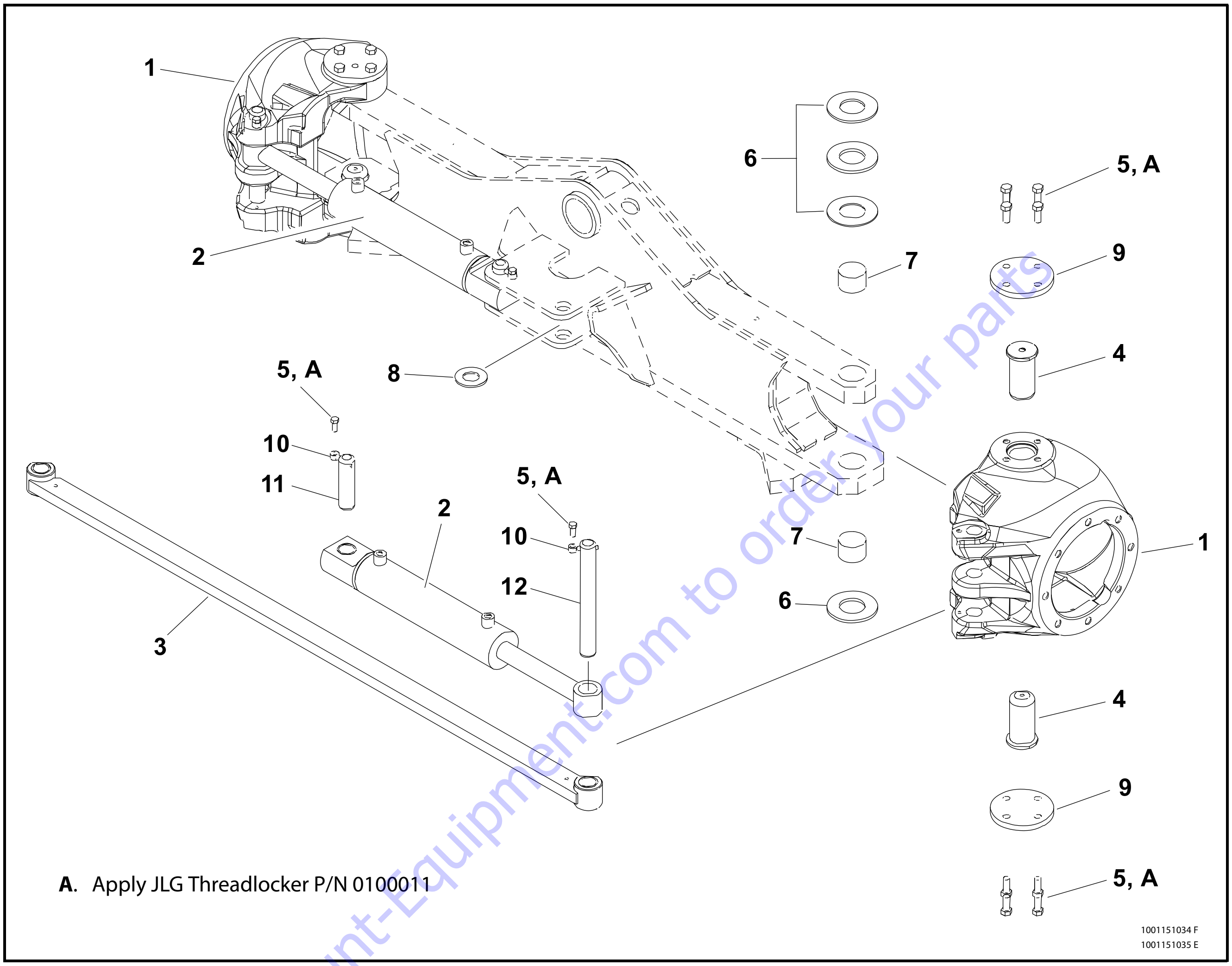
1. Start the engine.
2. Position the turntable to the normal stowed position.
3. Attach clear tubing to bleeder valve nipple.
4. Position a small bucket/bottle in front of the lockout cylinder bleeder valve and insert clear tubing.
5. Using a 3/8" wrench, loosen the bleeder valve, turning counterclockwise slowly. Bleed air from the top of lockout cylinder. Capture hydraulic oil until a steady unbroken stream of hydraulic oil is viewed. Tighten/close the bleeder valve while stream of hydraulic oil is running.
6. Locate the bleeder valve on the opposite side lockout cylinder. Repeat the process.





1. Oscillating Axle
2. Fixed Axle
3. Axle Lockout Cylinder
4. Keeper Pin
5. Axle Pivot Pin
6. Shim
7. Stop Plate
8. Washer
9. Bushing
10. Bolt
11. Shim

Figure 3-1. Axle Installation



1. Drive Spindle
2. Steer Cylinder
3. Tie Rod
4. Kingpin
5. Bolt
6. Thrust Washer
7. Composite Bearing
8. Thrust Washer
9. Retaining Plate
10. Keeper PIN
11. Cylinder Pivot Pin
12. Cylinder Pivot Pin

Figure 3-2. Steering Installation

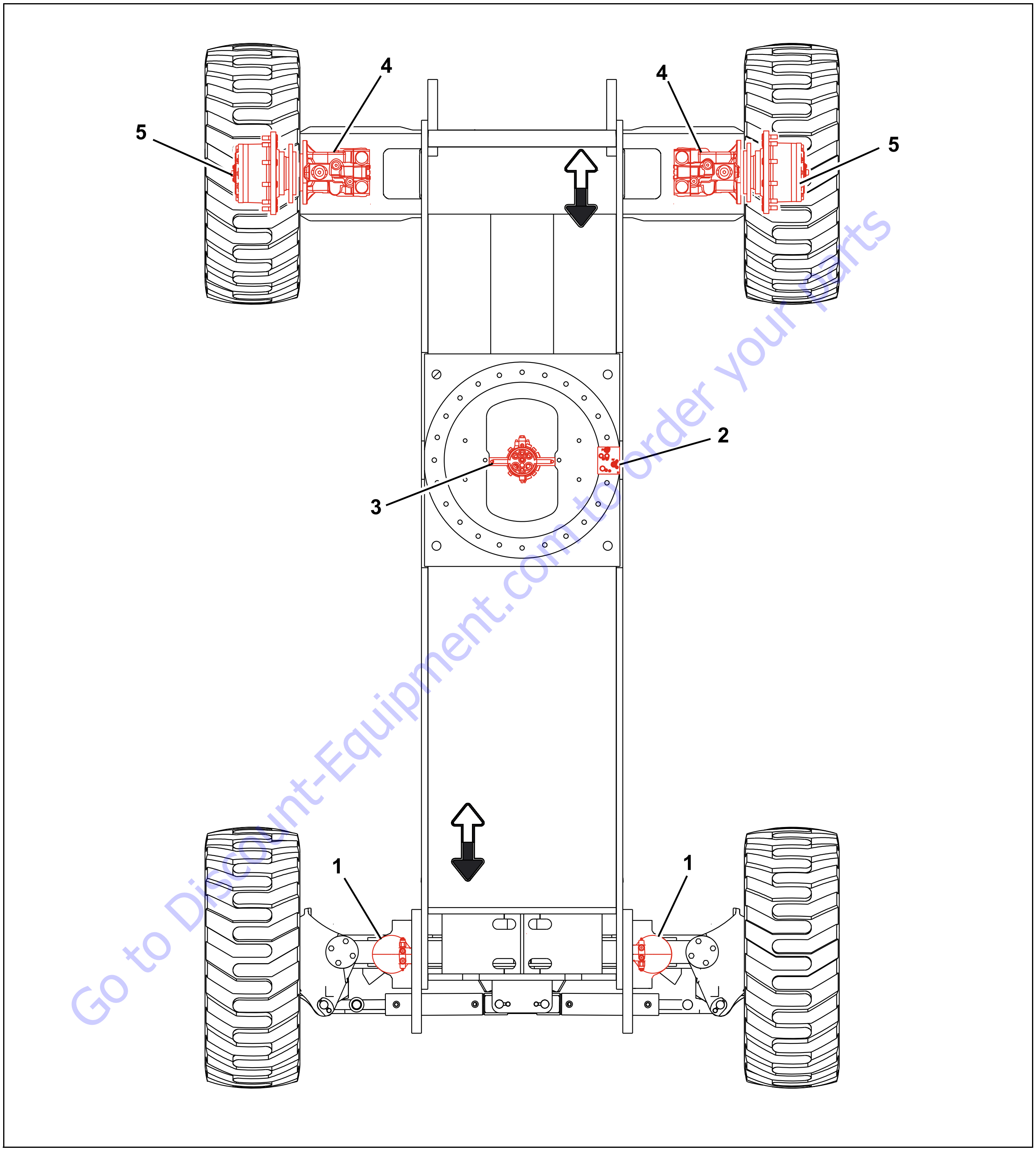
3.6 OSCILLATING AXLE LOCKOUT TEST

NOTICE

LOCKOUT SYSTEM TEST MUST BE PERFORMED QUARTERLY, ANY TIME A SYSTEM COMPONENT IS REPLACED, OR WHEN IMPROPER SYSTEM OPERATION IS SUSPECTED.

NOTE: *Ensure boom is fully retracted, lowered, and centered between drive wheels prior to beginning lockout cylinder test.*

1. Place a 6 inch (15.2 cm) high block with ascension ramp in front of left front wheel.
2. From platform control station, activate machine hydraulic system.
3. Place FUNCTION SPEED CONTROL and DRIVE SPEED/TORQUE SELECT control switches to their respective LOW positions.
4. Place DRIVE control lever to FORWARD position and carefully drive machine up ascension ramp until left front wheel is on top of block.
5. Carefully activate SWING control lever and position boom over right side of machine.
6. With boom over right side of machine, place DRIVE control lever to REVERSE and drive machine off of block and ramp.
7. Have an assistant check to see that left front wheel remains locked in position off of ground.
8. Carefully activate SWING control lever and return boom to stowed position (centered between drive wheels). When boom reaches center, stowed position, lockout cylinders should release and allow wheel to rest on ground, it may be necessary activate DRIVE to release cylinders.
9. Place the 6 inch (15.2 cm) high block with ascension ramp in front of right front wheel.
10. Place DRIVE control lever to FORWARD and carefully drive machine up ascension ramp until right front wheel is on top of block.
11. Carefully activate SWING control lever and position boom over left side of machine.
12. With boom over left side of machine, place DRIVE control lever to REVERSE and drive machine off of block and ramp.
13. Have an assistant check to see that right front wheel remains locked in position off of ground.
14. Carefully activate SWING control lever and return boom to stowed position (centered between drive wheels). When boom reaches center, stowed position, lockout cylinders should release and allow wheel to rest on ground, it may be necessary activate DRIVE to release cylinders.
15. If lockout cylinders do not function properly, have trained personnel correct the malfunction prior to any further operation



1. Axle Lockout Cylinder
2. Flow Drive Valve
3. Swivel
4. Drive Motor
5. Drive Hub

Figure 3-3. Chassis Component Location

3.7 DRIVE SYSTEM

The drive system consists of one variable displacement closed loop pump, four variable displacement piston motors, gear reduction hubs, and a traction control manifold that includes three flow dividers/combiners.

Drive speed is varied by a combination of drive pump displacement, engine & integrated motor/generator speed, and motor displacement. Traction control is full-time and is present in all drive modes. There are three drive modes that can be selected at the platform console. The functionality of the drive system is dependent on the position of the boom (In Transport or Out of Transport, refer to Section 4 for a detailed description of Beyond Transport Position - Drive Cut-back System). The following table describes how the system works in each drive mode.

Table 3-2. Drive Mode Speeds

Boom Position	Drive Selection	Engine Speed when Drive Control is Activated	Approx. Hybrid Mode Max Speed (MPH)	Approx. Electric Mode Max Speed (MPH)
In Transport	Max Speed	High – 2600 RPM	3.45	2.5
	Mid-Engine	Mid – 1800 RPM	0.8	0.5
	Max Torque	High – 2600 RPM	1.1	0.8
Out of Transport	Max Speed	High – 2600 RPM	0.2	0.2
	Mid-Engine	Mid – 1800 RPM	0.2	0.2
	Max Torque	High – 2600 RPM	0.2	0.2

3.8 DRIVE HUB (TORQUE)

Removal

NOTE: *Refer Figure 3-4., Drive Hub Removal and Installation.*

1. Place machine on the firm level surface.
2. Remove and cap all hydraulic hoses from the drive motor assembly.
3. Disconnect the electrical connections from the drive motor assembly.
4. Use suitable lifting device to support the drive hub assembly.

NOTE: *The drive hub assembly weighs approximately 135 lbs. (61 kg).*

5. Remove bolts attached drive hub to the frame.
6. Remove the drive hub assembly from machine and place in a clean work area.

Installation

1. Use suitable lifting device to support the drive hub assembly.

NOTE: *The drive hub assembly motor weighs approximately 135 lbs. (61 kg).*

2. Install the drive hub to the machine.
3. Use the eight bolts and attach the drive hub to the machine. Tighten the bolts to torque 300 ft.lbs. (406 Nm).
4. Reconnect electrical connections to the drive motor.
5. Install previously removed hydraulic hoses to drive motor.

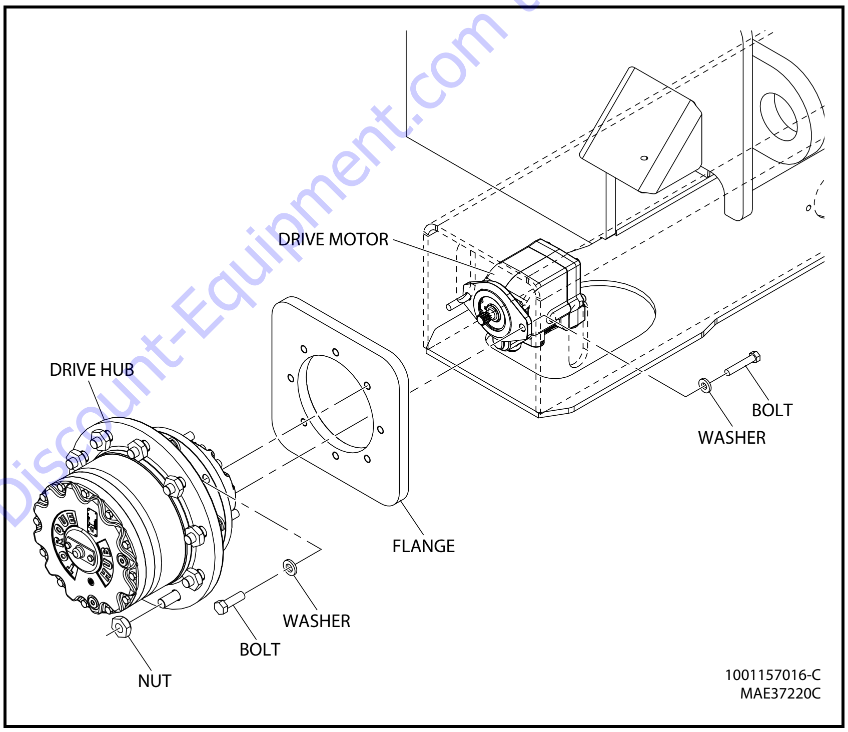


Figure 3-4. Drive Hub Removal and Installation

3.9 DRIVE HUB (PRIOR TO SN 0300247156)

Disassembly

1. Position hub over suitable container and remove drain plugs (10) from unit. Allow oil to completely drain, then replace drain plugs.
2. Remove bolts (41) securing cover assembly to hub (7). Remove cover assembly (23) and discard o-ring seal (22).
3. Lift carrier assembly and top thrust washer and thrust bearing(39, 40) from hub. Thrust washer may stick inside cover.
4. Pry ring gear (21) loose from hub and remove it. Remove o-ring seal (22) from hub counterbore and discard it.
5. Remove input gear (37) and thrust spacer (36) from input shaft assembly and remove input shaft assembly from hub.
6. Lift internal gear (12) and thrust washer and thrust bearing (39, 40) from hub. Thrust washer may stick to bottom of carrier.
7. Remove retaining ring (9) from spindle (1) and discard; lift hub from spindle.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

8. Remove inside bearing cone (6) and bearing shim (8).
9. If necessary, pry seal (2) out of hub using screwdriver or pry bar. With seal removed, outside bearing cone (4) can be removed.
10. If necessary, remove inner and outer bearing cups (3, 5) using a suitable slide hammer puller or driven out with a punch.
11. To remove the cluster gears from the carrier, drive the anti-roll pin into the planet shaft of the cluster gear. After the planet shaft is removed, the roll pin should be driven out of the planet shaft.

NOTICE

WHEN REBUILDING TORQUE HUB, REMOVE AND REPLACE ALL O-RINGS AND RETAINING RINGS.

Cleaning and Inspection

1. Thoroughly clean all parts in an approved cleaning solvent.
2. Inspect bearing cups and cones for damage, pitting, corrosion, or excessive wear. If necessary, replace bearings as a complete set ensuring that they remain covered until use.
3. Inspect bearing mounting surfaces on spindle, hub, input shaft and carrier. Replace components as necessary.
4. Inspect all geared components for chipped or broken teeth and for excessive or uneven wear patterns.
5. Inspect carrier for damage, especially in anti-roll pin and planet shaft hole areas.
6. Inspect all planet shafts for scoring or other damage.
7. Inspect all threaded components for damage including stretching, thread deformation, or twisting.
8. Inspect seal mounting area in hub for burrs or sharp edges. Dress applicable surfaces or replace components as necessary.
9. Inspect cover for cracks or other damage, and o-ring sealing area for burrs or sharp edges. Dress applicable surfaces or replace cover as necessary.

Repair

1. Cover Assembly.
   - **a.** Remove two bolts (25) securing disconnect cap (26) to cover (23) and remove cap.
   - **b.** Remove two bolts (25) securing cover cap (24) to cover and remove cap.
   - **c.** Remove disconnect rod (27) from cap and remove o-rings (28, 29) from cover cap. Discard o-rings.
   - **d.** If necessary, remove pipe plug (30) from cover.
   - **e.** Clean and inspect parts in accordance with Cleaning and Inspection procedures. Replace parts as necessary.
   - **f.** If removed, screw pipe plug into cover.
   - **g.** Slip o-ring (29) over cover cap and against face.
   - **h.** Place o-ring (28) into cover cap internal groove. Disconnect rod may be used to push o-ring into groove.
   - **i.** Place cover cap into cover with large hole located over pipe plug. Secure cover cap to cover with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 Nm).
   - **j.** Place disconnect cap over cover cap with nipple facing out and secure with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 Nm).
   - **k.** Turn cover over and push disconnect rod into cover cap. Rod will be held in place by friction from o-ring.

2. Carrier Assembly.

a. Drive anti-roll pin (19) into planet shaft (17) using a suitable punch.

b. Using a suitable press, press planet shaft from carrier (13). After planet shaft is removed, drive anti-roll pin from shaft.

c. Remove cluster gear (18) and thrust washers (14) from carriers.

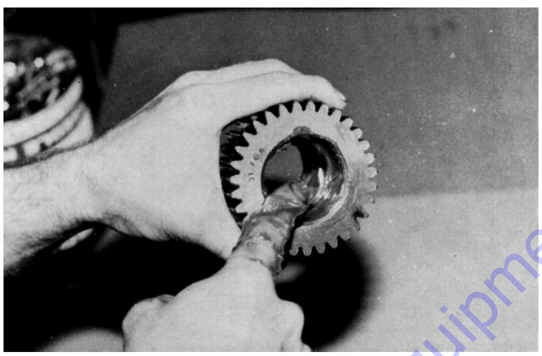
d. Remove needle rollers (15) from cluster gear bore.

e. Remove spacer (16) from cluster gear bore and remove second set of needle rollers (15).

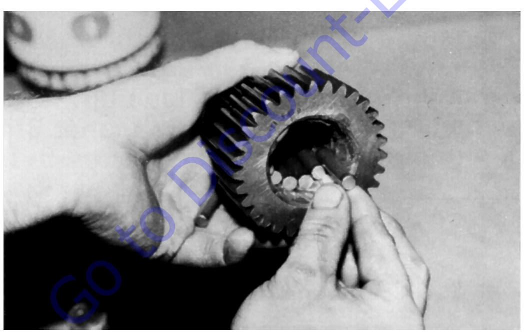
f. Repeat steps (a) through (e) for remaining two cluster gears.

g. Clean and inspect all parts in accordance with Cleaning and Inspection procedures. Replace parts as necessary.

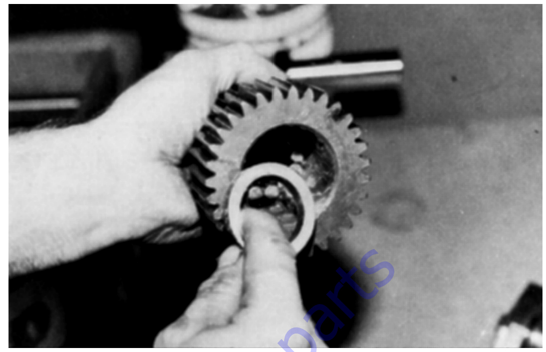
h. Apply a coat of grease or petroleum jelly to cluster gear bore.



i. Place needle rollers into cluster gear bore.

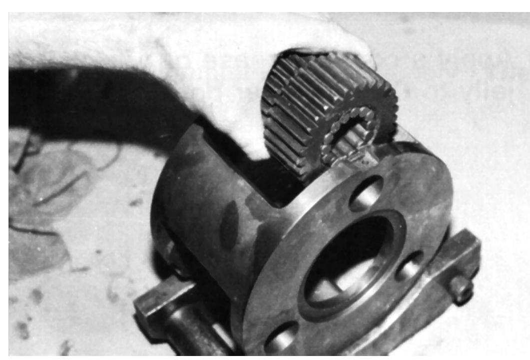


j. Place spacer into opposite side of cluster gear and against needle rollers.Place second set of needle rollers into cluster gear.

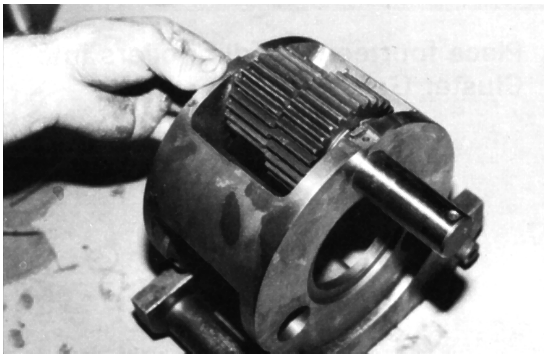


k. Apply grease or petroleum jelly to tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.

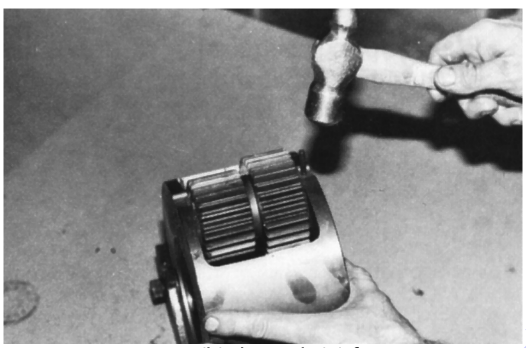
l. While keeping thrust washers in place, slide cluster gear into carrier with larger gear on side with small pin hole.



m. Line up cluster gear and thrust washers with hole in carrier and slide planet shaft through. Ensure chamfered side of hole in planet shaft is lined up with pin hole in carrier.



n. Drive anti-roll pin flush into carrier hole, locking planet shaft into place.



o. Repeat steps (h) through (o) for remaining two cluster gears.

3. Input Shaft Assembly.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL AND INSTALLATION

a. Carefully remove retaining ring (33) from counterbore in the spindle (1) and discard retaining ring.

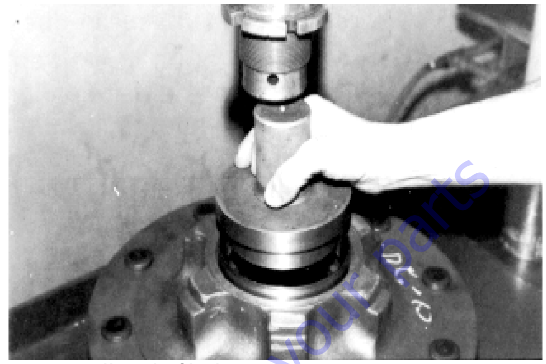
b. Remove two washers (31) and spring (32) from input shaft.

c. Clean and inspect all parts in accordance with Cleaning and Inspection procedures. Replace parts as necessary.

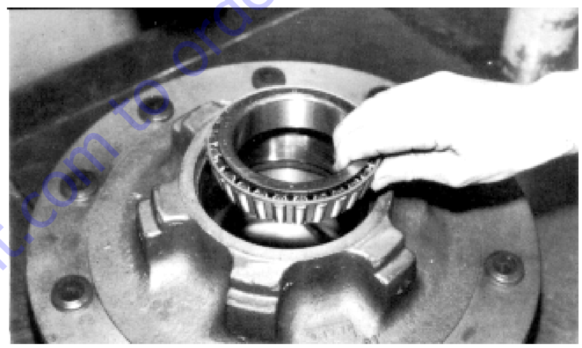
d. Place washer (31), spring (32), and washer (31), in that order, onto input shaft.

Assembly

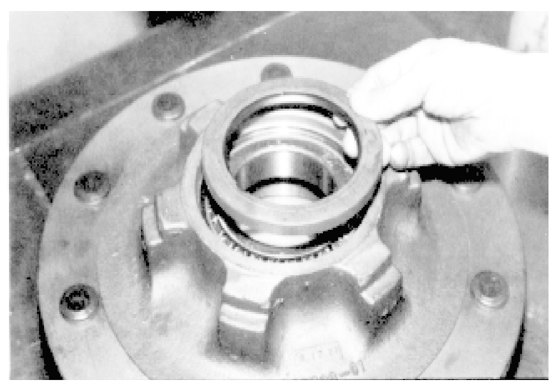
1. Using a suitable press, press new bearing cups (3, 5), with large inside diameters facing out, into hub (7) counterbores.Place bearing cone (4) into bearing cup (3)



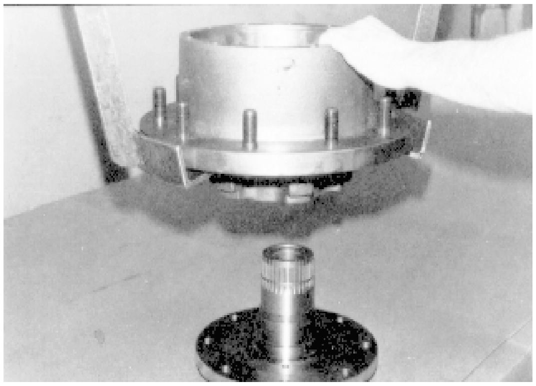
in small end of hub.



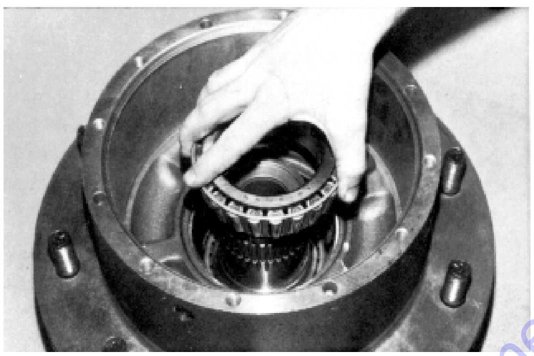
2. Press new seal (2) into hub counterbore with flat metal side facing in. Use a flat object to ensure that seal is pressed evenly and is flush with hub face.



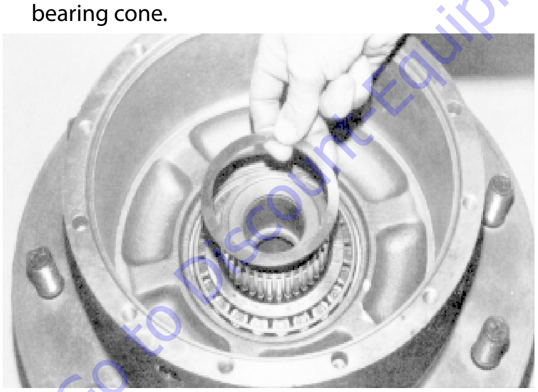
3. Lower hub onto spindle (1) with large open end up.



4. Place bearing cone (6) over end of spindle and into bearing cup.



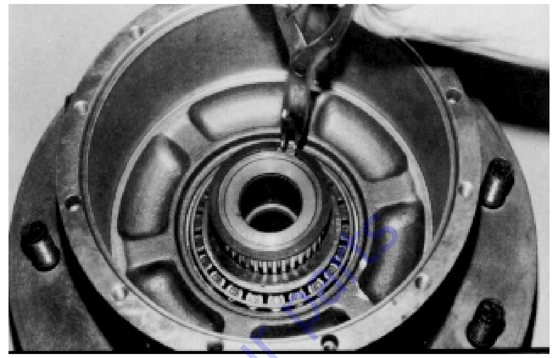
5. Place bearing shim (8) over end of spindle and against bearing cone.



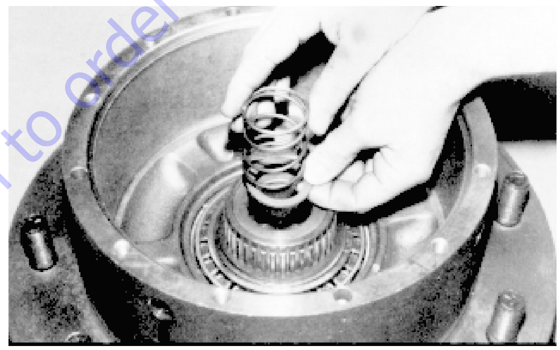
⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

6. Install retaining ring (9) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.

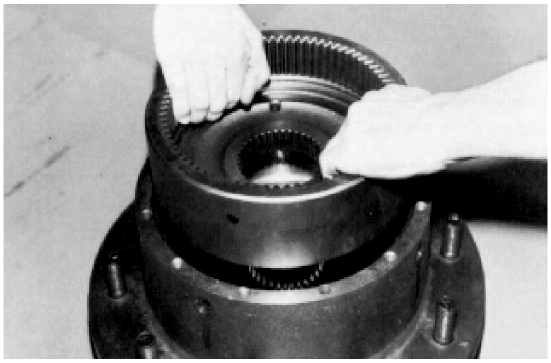


7. The disengage spacer and spring are installed into the counterbore of the spindle.

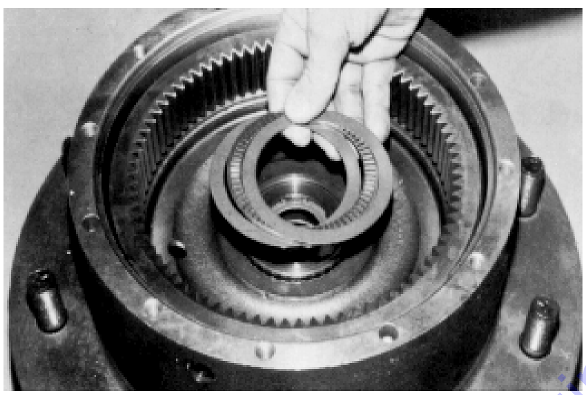


8. Install retaining ring into input shaft groove to secure spacers and spring to shaft.

9. Place the internal gear (12) onto end of spindle by matching the bore spline, the spindle spline.

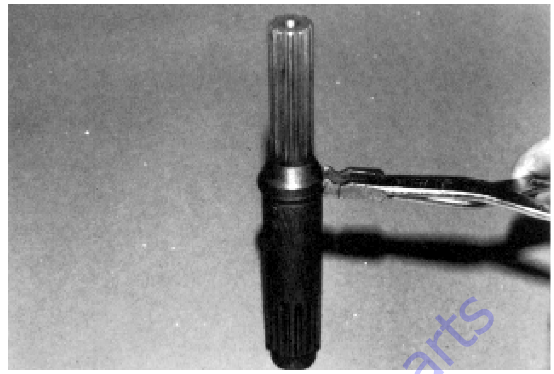


10. Install thrust washers and thrust bearing (39, 40) on the portion of the spindle which extends into the internal gear.

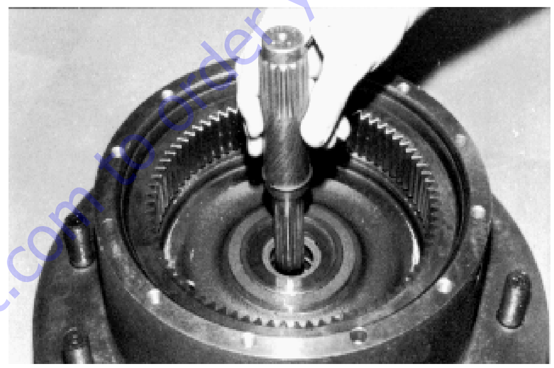


11. The o-ring is placed into the counterbore provided in the hub. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.

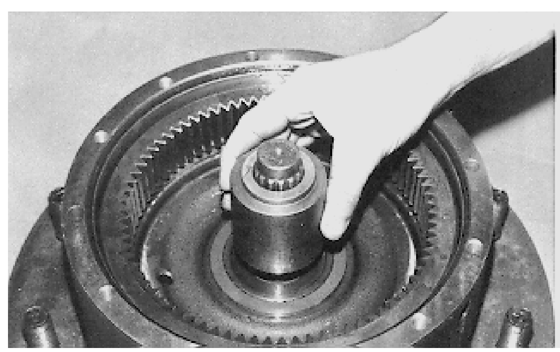
12. Install retaining ring (34) into input shaft retaining ring groove.



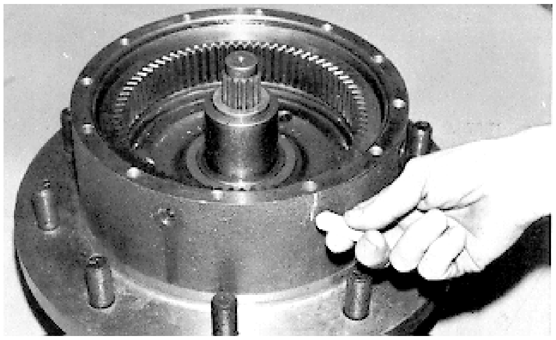
13. Place input shaft assembly (35) into spindle bore with unsplined end facing out.
The action of the spring should be checked at this point.



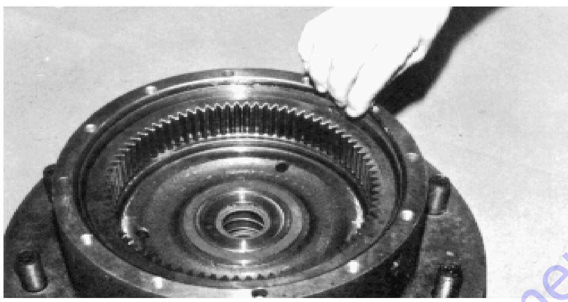
14. Place thrust spacer (36) over input shaft (35) with counterbore side facing spindle.



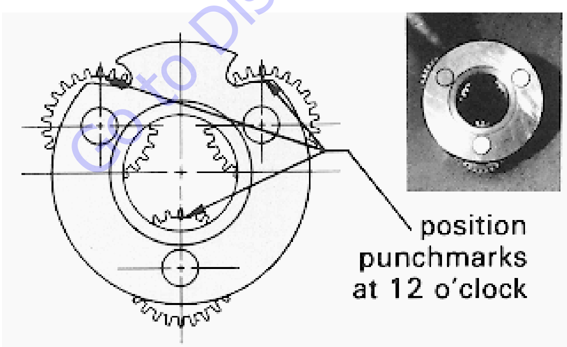
15. Locate the four counter reamed holes in the face of the hub, mark them for later identification.



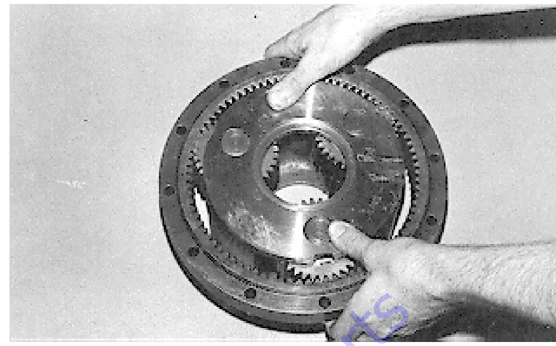
16. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place. Slight stretching of o-ring may be necessary to insure proper seating.



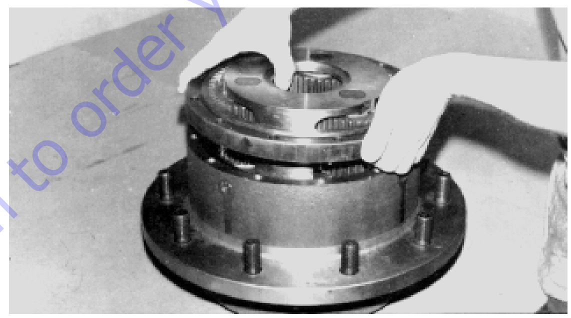
17. Place carrier assembly on a flat surface with large gears up and positioned as shown. Find punch marked tooth on each large gear and locate at 12 o'clock (straight up) from each planet pin. Marked tooth will be located just under carrier on upper two gears.



18. With shoulder side of ring gear (21) facing down, place ring gear over (into mesh with) large gears. Ensure punch marks remain in correct location during ring gear installation. The side of the ring gear with 'X' stamped on it should be up.

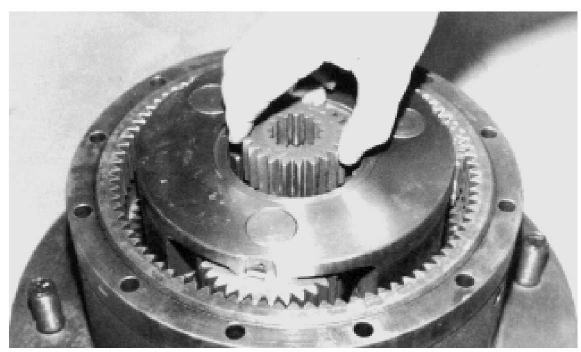


19. While holding ring gear, and cluster gears in mesh, place small side of cluster gears into mesh with internal gear. On ring gear, locate hole marked 'X' over one of the marked counterbored holes in hub.

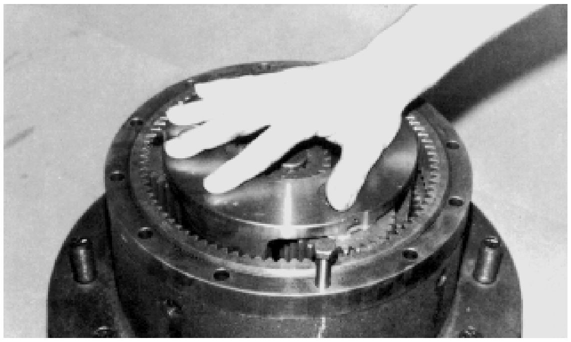


NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove carrier and ring gear and check cluster gear timing.*

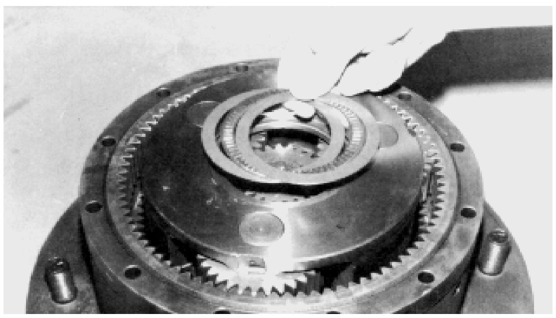
20. Install input gear (37) into the carrier assembly, meshing with large diameter cluster gears (18). Counterbore in bore of input gear must be to outside of carrier assembly.



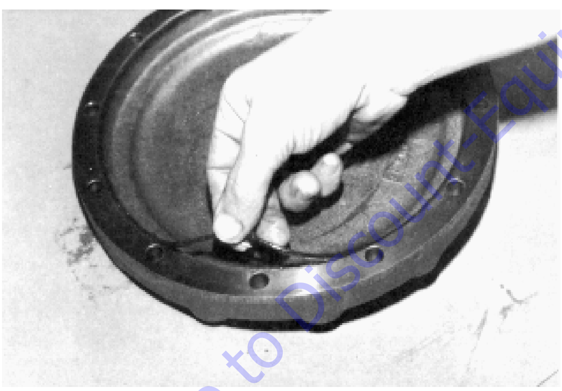
21. After inserting at least one bolt in the proper location, rotate the carrier. Check freedom of rotation and timing.



22. Install thrust washers and thrust bearing (39, 40) into carrier counterbore.



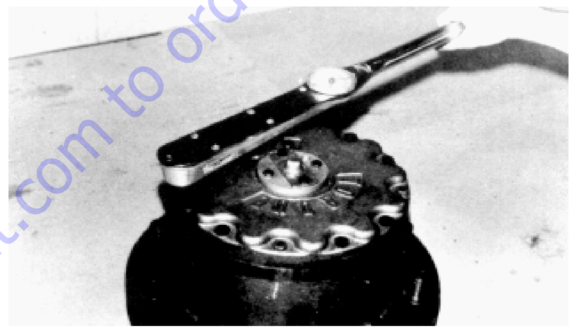
23. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place.



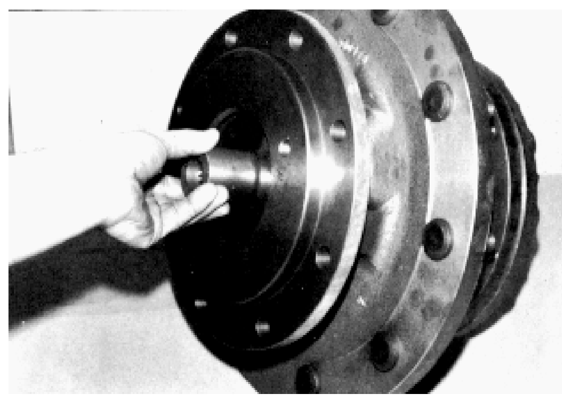
24. Place cover assembly over ring gear with oil level check plug in cover located approximately 90 degrees from oil fill plug in hub.

25. Locate four bolts (42), 90 degrees apart into counter-bored holes in hub marked in step (16). Torque bolts to 47 ft. lbs. (64 Nm).

26. Install bolts (41) in remaining holes. Torque bolts to 47 ft. lbs. (64 Nm).



27. Place coupling (1) into spindle and onto input shaft.



28. Fill hub one-half full of EPGL 90 lubricant before operation.

1. Spindle
2. Seal
3. Bearing Cup
4. Bearing Cone
5. Bearing Cup
6. Bearing Cone
7. Hub
8. Thrust Washer
9. Retaining Ring
10. Plug
11. Wheel Bolt
12. Internal Gear
13. Carrier
14. Thrust Washer
15. Needle Roller
16. Spacer
17. Planet Shaft
18. Cluster Gear
19. Roll Pin
20. Not Used
21. Cluster Gear
22. O-ring
23. Cover
24. Cover Cap
25. Bolt
26. Disconnect Cap
27. Disconnect Rod
28. O-ring
29. O-ring
30. Pipe Plug
31. Washer
32. Spring
33. Retaining Ring
34. Retaining Ring
35. Input Shaft
36. Thrust Spacer
37. Input Gear
38. Not Used
39. Thrust Washer
40. Thrust Bearing
41. Bolt
42. Coupling

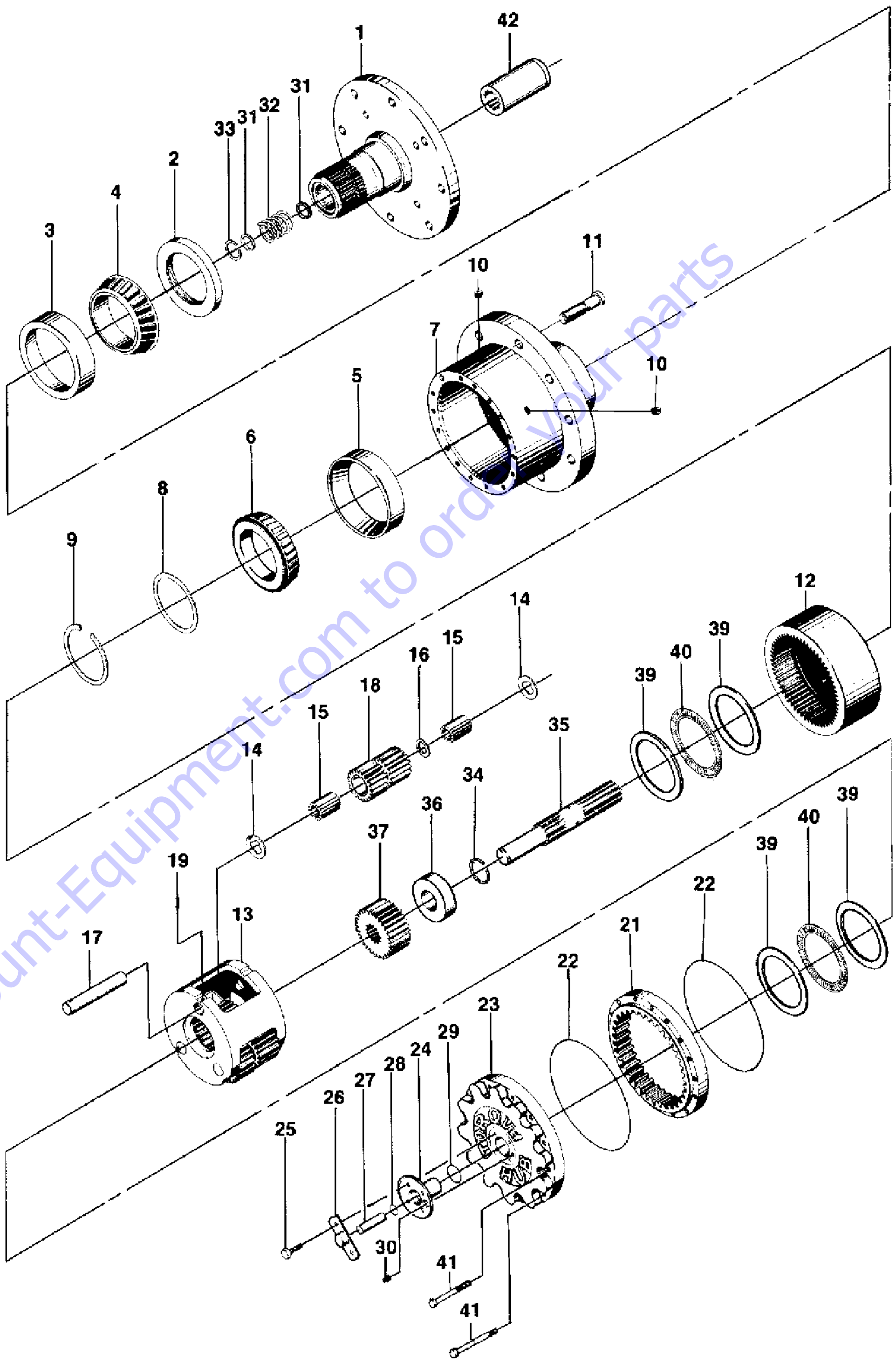


Figure 3-5. Drive Hub (Torque)

3.10 DRIVE HUB (SN 0300247156 TO PRESENT)

Assembly/Disassembly

For detail assembly/disassembly instruction, Refer to appropriate Drive Hub Manual.

3.11 DRIVE BRAKE (PRIOR TO SN 0300247156)

Disassembly

1. Supporting brake:, remove the six socket head capscrews and washers (13 & 14) in equal increments to ensure the spring pressure within the brake is reduced gradually and evenly.

   If a press is available, the cylinder housing (8) can be restrained while removing the six capscrews and washers (13 & 14).

   The brake assembly can now be fully dismantled and the parts examined.

2. Remove cylinder housing (8) and piston (9) subassembly and dismantle if required, removing O-ring seals (15 & 17) and backing rings (16 & 18) as necessary.
3. Remove gasket (7) from housing (2).
4. Remove friction plates (3 & 6) and pressure plate (4).
5. Remove two dowel pins (19).
6. Remove springs (22 & 23).
7. Should it be necessary to replace ball bearing (10) or shaft seal (12), reverse remainder of brake subassembly, supporting on face C of housing (2).
8. Remove internal retaining ring (11).
9. Using arbor press or similar to break Loctite seal, remove brake shaft (1) from housing (2) and lay aside.
10. Reverse housing (2) and press out ball bearing (10). Shaft seal (12) can also be removed if necessary.

Inspection

1. Inspect friction plates (3 & 6) and friction surface on pressure plate (4) for wear or damage.
2. Examine friction plates (3) and brake shaft (1) for wear or damage to the splines.
3. Examine input and output splines of brake shaft (1) for wear or damage.
4. Examine compression springs (22 & 23) for damage or fatigue.
5. Check ball bearing (10) for axial float or wear.
6. Examine O-ring seals (15 & 17) and backing rings (16 & 18) for damage.

Assembly

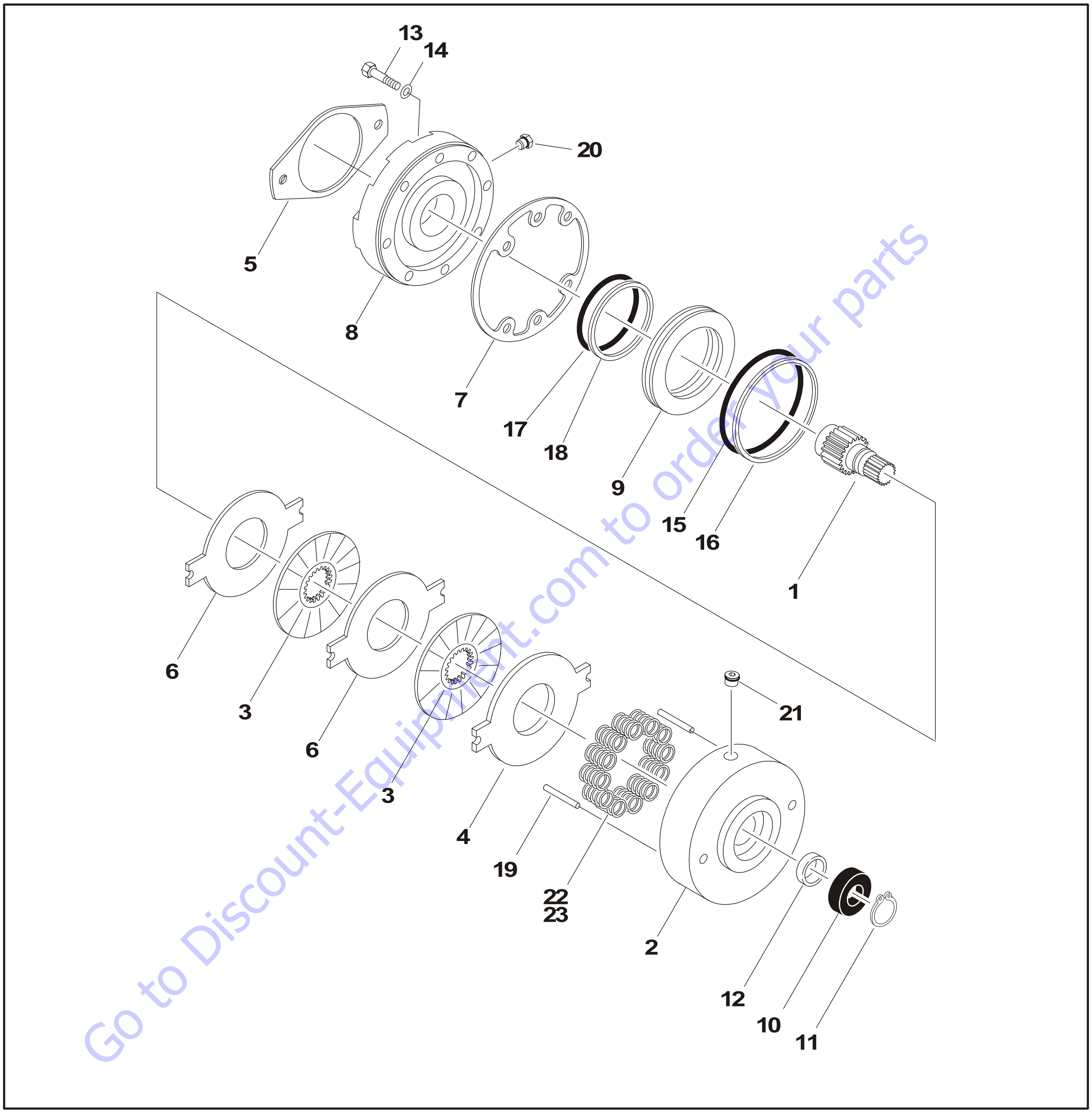
1. Lightly lubricate rotary shaft seal (12) and assemble to housing (2) taking care not to damage seal lip.
2. Apply ring of Loctite 641 or equivalent adhesive to full circumference of housing (2) bearing recess adjacent to shoulder.

   Apply complete coverage of Loctite 641 to outside diameter of bearing (10) and assemble fully In housing (2), retaining with internal retaining ring (11). Remove excess adhesive with a clean cloth.

   Press shaft (1) through bearing (10), ensuring bearing inner ring Is adequately supported.

3. Assemble correct quantity of springs (22 & 23) in orientation required.
4. Lubricate O-ring seals (15 & 17) with Molykote 55M (or equivalent) silicon grease and assemble together with backing rings (16 & 18) to piston (9). To ensure correct brake operation. It is important that the backing rings are assembled opposite to the pressurized side of piston.
5. Correctly orientate piston (9) aligning spaces with the two dowel pin holes and, assemble into cylinder housing (8) taking care not to damage seals and carefully lay aside.
6. Locate 2-off pins (19) in housing (2) followed by pressure plate (4) and friction plates i.e. an inner (3) followed by an outer (6) in correct sequence.
7. Position gasket (7) in correct orientation.
8. Align two holes in cylinder with dowel pins (19) and assemble piston & cylinder sub-assembly to remainder of brake securing with 6 capscrews and washers (13 & 14). Torque to 55 ft.lbs. (75 Nm).

NOTE: *The use of a suitable press (hydraulic or arbor) pressing down on cylinder end face B will ease assembly of the capscrews (13).*



1. Shaft	6. Outer Plate	11. Retaining Ring	16. Backup Ring	21. Plug
2. Housing	7. Gasket	12. Shaft Seal	17. O-ring	22. Spring (Natural)
3. Friction Plate	8. Cylinder	13. Capscrew	18. Backup Ring	23. Spring (Blue)
4. Pressure Plate	9. Piston	14. Lockwasher	19. Dowel Pin	
5. Gasket	10. Ball Bearing	15. O-ring	20. Plug	

Figure 3-6. Drive Brake

3.12 DRIVE BRAKE (SN 0300247156 TO PRESENT)

For detail assembly/disassembly instruction, refer to appropriate Drive Brake Manual.

3.13 DRIVE MOTOR

Removal

NOTE: *Refer Figure 3-7., Drive Motor Removal and Installation.*

1. Place machine on the firm level surface.
2. Disconnect the battery power and all electrical connections from the drive motor.
3. Use suitable lifting device to support the drive motor.

NOTE: *The drive motor weighs approximately 34 lbs. (15 kg).*

4. Remove two bolts attached drive motor to the drive hub.
5. Remove the motor from machine and place in a clean work area.
6. Clean the motor for dirt. Remove rust or corrosion from coupling shaft.

Installation

1. Use suitable lifting device to support the drive motor.

NOTE: *The drive motor weighs approximately 34 lbs. (15 kg).*

2. Install the drive motor to the machine.

CAUTION

INCORRECT SHAFT ALIGNMENT MAY RESULT IN DAMAGE TO DRIVE SHAFT, BEARINGS, OR SEAL WHICH CAN CAUSE EXTERNAL OIL LEAKAGE.

3. Make sure that the pump shaft is properly aligned.
4. Use the two bolts and attach the drive motor to the drive hub.
5. Reconnect all electrical connections to the drive motor.
6. Start the machine and check the motor for proper functioning.

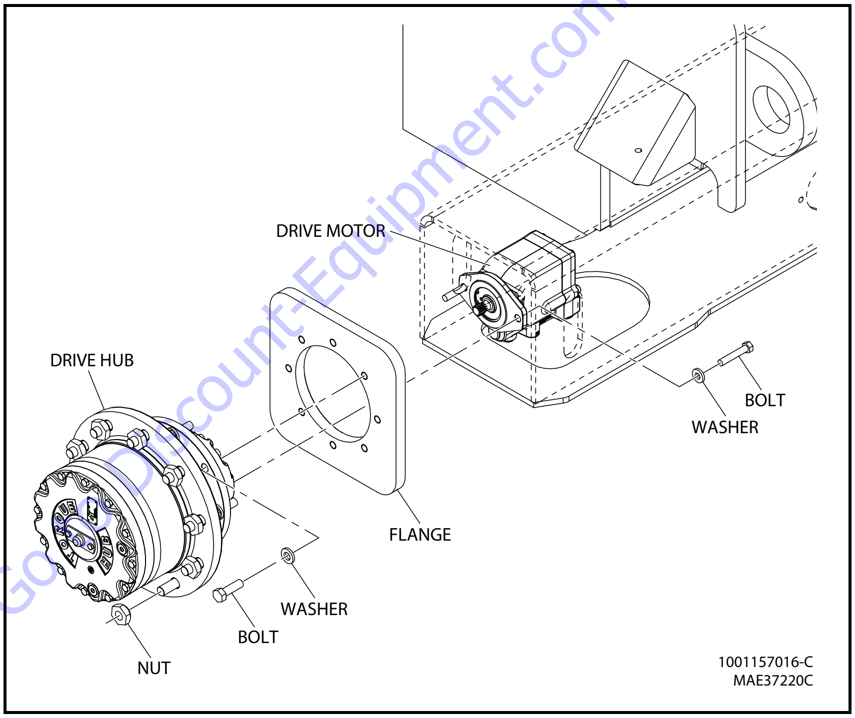


Figure 3-7. Drive Motor Removal and Installation

Description

The drive motors are low to medium power, two-position axial piston motors incorporating an integral servo piston. They are designed for operation in both open and closed circuit applications. The standard control is a direct acting single line hydraulic control. The integral servo piston controls motor displacement.

The motors are spring biased to maximum displacement and hydraulically shifted to minimum displacement. Minimum and maximum displacement can be set with fixed internal stops. The large diameter servo piston allows smooth acceleration and deceleration with relatively large circuit orificing.

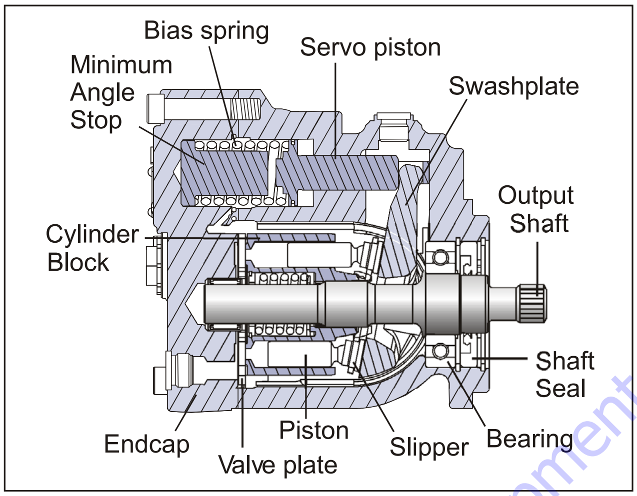
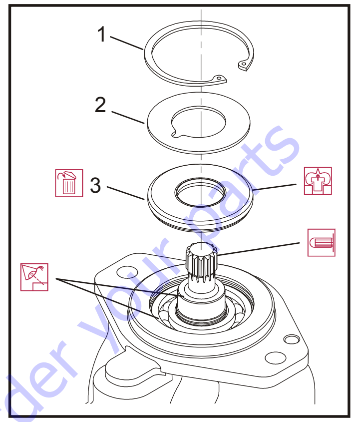


Figure 3-8. Drive Motor Cross Section

Shaft Seal Replacement

REMOVAL

1. Remove the snap ring (1) retaining the shaft seal and support washer.



1. Snap Ring
2. Support Washer
3. Shaft Seal

Figure 3-9. Removing the Shaft Seal

2. Remove the support washer (2).
3. Carefully pry out the shaft seal (3).

   To avoid damaging the shaft during removal, install a large sheet metal screw into the chuck of a slide hammer. Drive the screw into the seal surface and use the slide hammer to pull the seal.

4. Discard the seal.

INSPECT THE COMPONENTS

Inspect the new seal, the motor housing seal bore, and the sealing area on the shaft for rust, wear, and contamination. Polish the shaft and clean the housing if necessary.

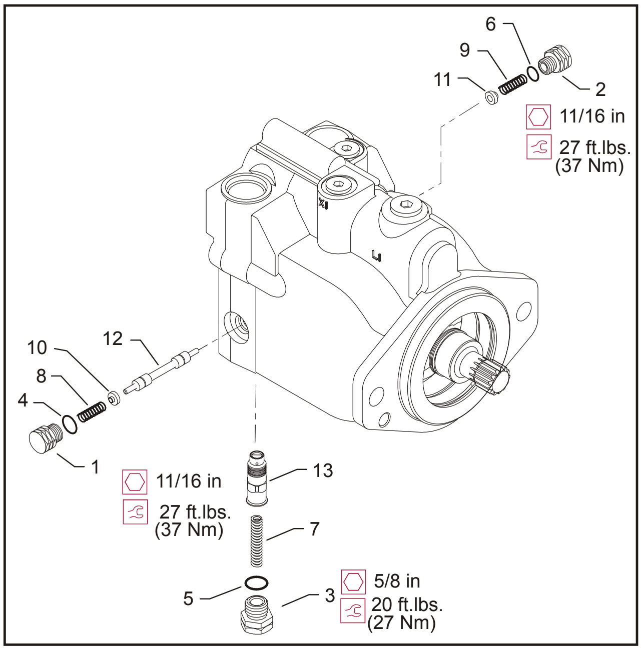
INSTALLATION

1. Cover the shaft splines with an installation sleeve to protect the shaft seal during installation.
2. Install a new shaft seal with the cupped side facing the motor. Press seal into housing until it bottoms out. Press evenly to avoid binding and damaging the seal.
3. Install seal support washer.
4. Install snap ring.
5. Remove the installation sleeve.

Loop Flushing Valve

REMOVAL

1. Using a 11/16 in internal hex wrench remove plug (1) and (2).



1. Plug	6. O-ring	11. Washer
2. Plug	7. Spring	12. Shift Spool
3. Plug	8. Spring	13. Orifice Poppet
4. O-ring	9. Spring	
5. O-ring	10. Washer	

Figure 3-10. Loop Flushing Spool

2. Using a 1/4 in hex wrench remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Using pliers, remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).

INSPECT THE COMPONENTS

Inspect new O-rings and the sealing area for rust, wear, or contamination. Also check springs and poppet for wear.

INSTALLATION

1. Install orifice poppet (13).
2. Install shift spool (12).
3. Install spring retaining washers onto springs (10 and 11).
4. Carefully install centering springs (7, 8, and 9).
5. Install new O-rings (6, 4, and 5).
6. Using a 1/4 in hex wrench torque plug (3) to 20 ft. lbs. (27 Nm).
7. Using a 11/16 in internal hex, torque plugs (2 and 1) to 27 ft.lbs. (37 Nm).

Troubleshooting

Table 3-3. Excessive Noise and/or Vibration

Item	Description	Action
Check oil level in reservoir and oil supply to the motor.	Insufficient hydraulic fluid could lead to cavitation that would cause system noise.	Fill the reservoir to the proper level and ensure that oil supply to the motor is adequate and the lines are unobstructed.
Check for air in the system.	Air trapped within the system lines, or the motor itself, could result in cavitation that would cause system noise.	Ensure that all of the system lines and components are purged of air.
Inspect the output shaft couplings.	A loose or incorrect shaft coupling will produce vibrations that could result in system noise.	Ensure that the correct coupling is used and that it fits properly onto the shaft.
Inspect the output shaft alignment.	Misaligned shafts create excessive frictional vibration that could result in system noise.	Ensure that the shafts are properly aligned.
Hydraulic oil viscosity above limits.	Viscosity above acceptable limits will result in cavitation that would lead to system noise.	Replace hydraulic oil with appropriate fluid for operating conditions.

Table 3-4. System Operating Hot

Item	Description	Action
Check oil level in reservoir and oil supply to the pump.	Insufficient amount of hydraulic fluid will not meet the cooling demands of the system.	Fill the reservoir to the proper level.
Inspect the heat exchanger, (if so equipped).	If the heat exchanger fails, or becomes obstructed, it may not meet the cooling demands of the system.	Ensure that heat exchanger is receiving adequate air flow and that the heat exchanger is in good operating condition. Repair or replace as necessary.
Check the system relief valves.	If a system relief valve becomes unseated for an extended period of time or fails for any other reason, the system could become overheated.	Repair or replace any malfunctioning relief valves as applicable and verify that the loads on the machine are not excessive.

Table 3-5. Won't Shift or Slow to Start

Item	Description	Action
Check the signal line to the servo control port.	Obstructed or restricted flow through the servo control signal lines could result in slow shift or no shift conditions within the motor.	Ensure that the signal lines are not obstructed or restricted and that signal pressure is adequate to shift the motor.
Check that the correct supply and drain orifices are properly installed, and are not obstructed.	Supply and drain orifices determine the shift rate of the motor. The smaller the orifice, the longer the time it takes to shift the motor. Obstruction will also increase shift times.	Ensure that the proper control orifices are installed in the motor and verify that they are not obstructed. Clean or replace as necessary.

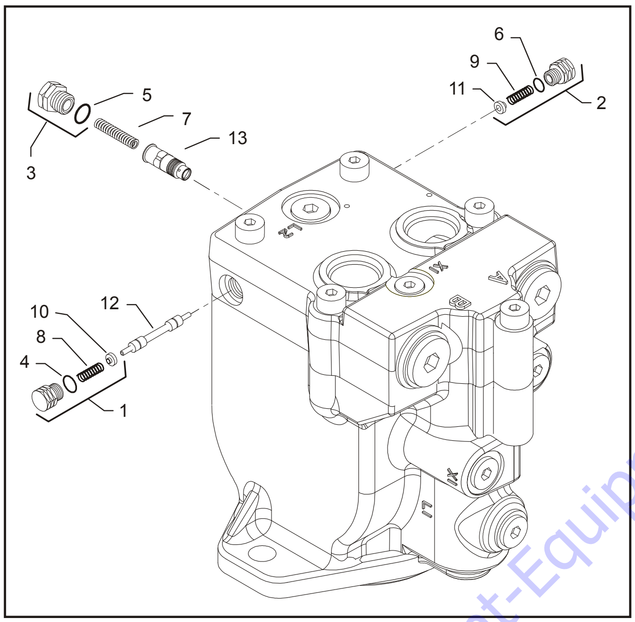
Disassembly

NOTE: *Removal of the endcap voids warranty.*

During assembly, coat all moving parts with a film of clean hydraulic oil. This assures that these parts will be lubricated during start-up.

Replace all O-Rings and gaskets.

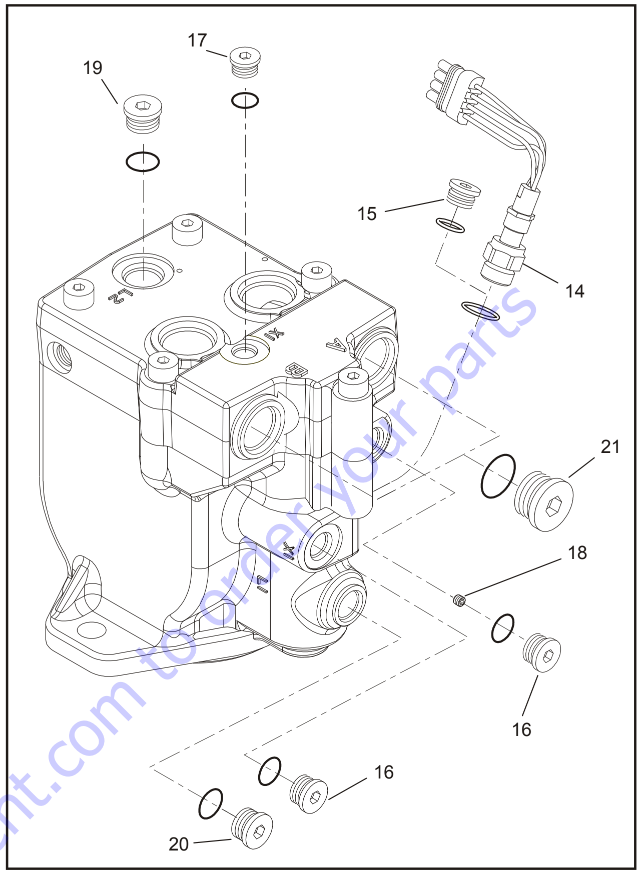
It is recommended that all O-rings be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.



1. Plug
2. Plug
3. Plug
4. O-ring
5. O-ring
6. O-ring
7. Spring
8. Spring
9. Spring
10. Washer
11. Washer
12. Shift Spool
13. Orifice Poppet

Figure 3-11. Loop Flushing Spool

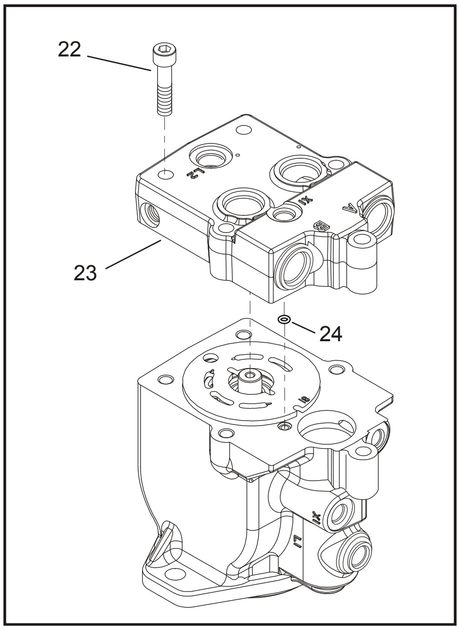
1. Using a 11/16 in wrench remove plug (1) and (2).
2. Using a 5/8 in hex wrench remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Using pliers, remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).



14. Lock Nut
15. O-ring Plug
16. Control Line Plug
17. Control Line Plug
18. Cavity Plug
19. Drain Plug
20. Drain Plug
21. Work Port Plug

Figure 3-12. Plugs, Fittings, and Speed Sensor

8. Remove all fittings from the unit. Discard any O-rings on the fittings.
9. Using an 11/16 inch hex wrench, loosen the speed sensor lock nut (14) if equipped. Then remove the speed sensor using a Vi inch hex wrench. Units without speed sensor have an O-ring plug (15) installed in that location; remove it with a Va inch internal hex wrench.
10. Using a 1/4 inch internal hex wrench, remove control line plugs (16, 17). Discard O-rings. Using a 3 mm hex wrench, remove cavity plug (18, if equipped with two-line control) from X2 cavity.
11. Using a 5/16 inch internal hex wrench, remove drain plugs (19, 20). Discard O-rings.
12. Using a 9/16 inch internal hex wrench, remove work port plugs (21, if equipped with axial ports). Discard O-rings.



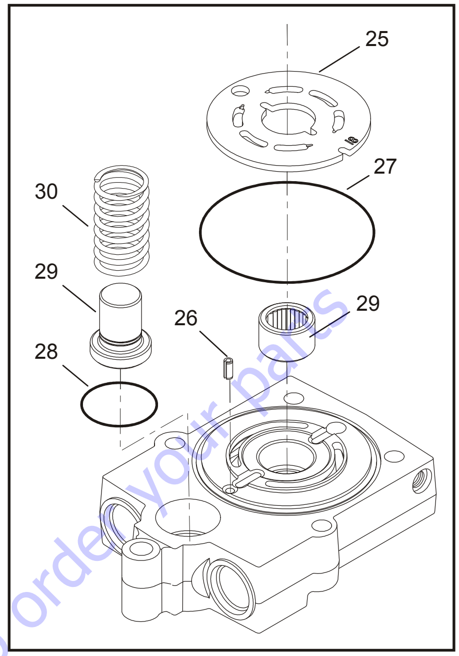
22. Screw
23. End Cap
24. O-ring

Figure 3-13. End Cap

13. Using an 8 mm internal hex wrench, remove the end-Capscrews (22).

14. Remove the endcap (23). Remove O-ring (24) from the housing or endcap.

When the end Capscrews are removed, pressure from the servo spring will cause the endcap to bind on the shaft. Press down on the portion of the endcap covering the servo piston and hold the endcap level while removing.



25. Valve Plate
26. End Cap
27. O-ring
28. O-ring
29. Angle Stop
30. Servo Spring

Figure 3-14. Valve Plate & Rear Shaft Bearing

NOTICE

TAKE CARE NOT TO SCRATCH THE SURFACE OF THE VALVE PLATE.

15. Remove the valve plate (25) and timing pin (26) from the endcap.

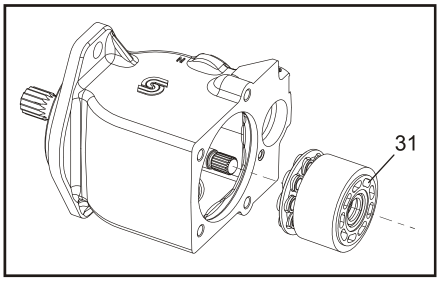
Each displacement has a unique valve plate. For identification, the last two digits of the valve plate part number are stamped on its surface.

16. Remove and discard the O-rings (27 and 28).

17. Remove the rear shaft bearing (29) from the endcap with a bearing puller.

The bearing may be difficult to remove with a puller. Try this as an alternative: Pack the bearing cavity with heavy grease. After the shaft is removed, insert it into the bearing cavity and tap lightly with a soft mallet on the splined end. The grease will force the bearing out. Use caution not to drive the bearing past the rear shaft journal as the bearing may become trapped on the shaft and damaged.

18. Remove minimum angle stop (29) and servo spring (30) from the housing.



31. Cylinder Kit Assembly

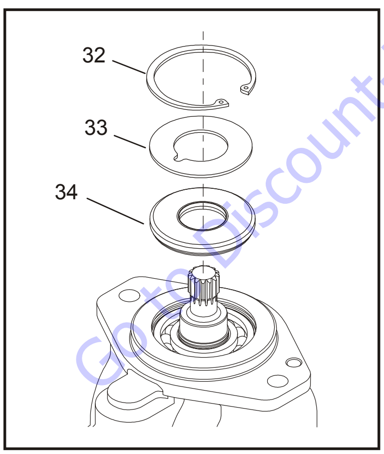
Figure 3-15. Cylinder Kit

19. Turn the housing on its side and remove the cylinder kit assembly (31). Set the assembly aside, being careful not to scratch the running surface.

NOTE: *Grooves on the surface of the cylinder kit identify its displacement:*

Table 3-6. Displacement Identifiers

# of Grooves	Frame L	Frame K
1	25	38
2	30	45
3	35	--

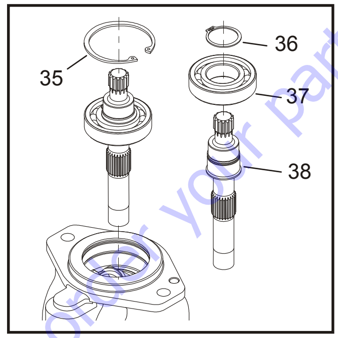


32. Snap Ring
33. Support Washer
34. Shaft Seal

Figure 3-16. Shaft Seal

20. Turn the housing over and remove the snap ring (32) retaining the shaft seal and support washer. Remove the support washer (33) and carefully pry out the shaft seal (34). Discard the seal.

To avoid damaging the shaft during seal removal. Install a large sheet metal screw into the chuck of a slide hammer. Drive the screw into the seal surface and use the slide hammer to pull the seal.

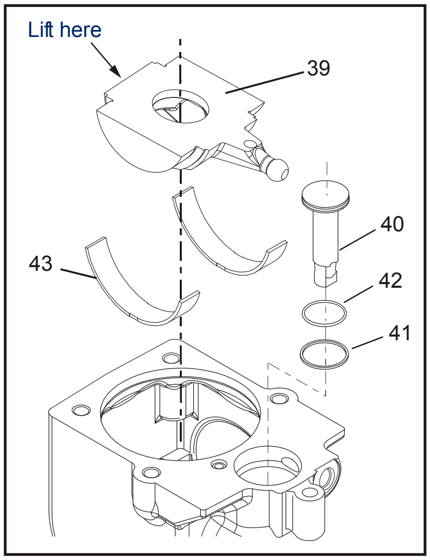


35. Inner Snap Ring
36. Snap Ring
37. Bearing
38. Shaft

Figure 3-17. Shaft & Front Bearing

21. Remove the inner snap ring (35) and the shaft / bearing assembly.

22. Remove the snap-ring (36) retaining the shaft front bearing. Pull the bearing (37) off of the shaft (38).



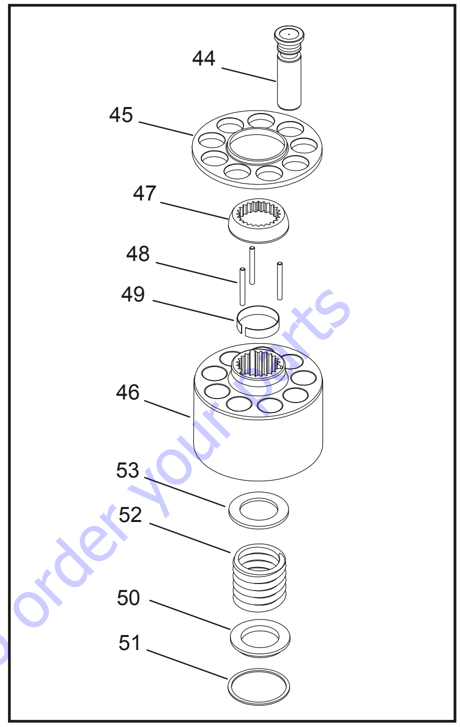
39. Swashplate
40. Servo Piston
41. Piston Seal
42. O-ring
43. Journal Bearings

Figure 3-18. Swash Plate & Servo Piston

23. Turn housing over and remove the swashplate (39) by lifting on the end opposite the servo lever.

24. Remove the servo piston (40). Remove the piston seal (41) and O-ring (42) from the servo piston. Discard the seal and O-ring.

25. Remove the journal bearings (43) from the housing. If the bearings are to be reused, note the location and orientation of each bearing for reassembly.



44. Piston	49. Retaining Ring
45. Slipper Retainer	50. Block Spring Washer
46. Cylinder Block	51. Spiral Retaining Ring
47. Ball Guide	52. Block Spring
48. Holddown Pins	53. Inner Block Spring Washer

Figure 3-19. Cylinder Kit Disassembly

26. Remove pistons (44) and slipper retainer (45) from the cylinder block (46).

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

27. Remove the ball guide (47), hold-down pins (48), and retaining ring (49) from the cylinder block.

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

⚠ WARNING

RISK OF PERSONAL INJURY: COMPRESSING THE BLOCK SPRING REQUIRES FORCE OF ABOUT 80 TO 90 LBF (350 TO 400 N). USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO REMOVE THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING RING IS REMOVED.

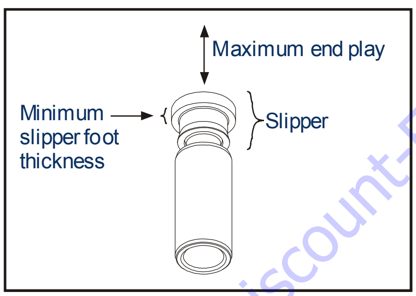
28. Turn the block over. Using a press, apply pressure on the block spring washer (50) to compress the block spring. Compress the spring enough to safely remove the spiral retaining ring (51). While maintaining pressure, unwind the spiral retaining ring (51). Carefully release the pressure and remove the outer block spring washer (50), block spring (52), and inner block spring washer (53) from the cylinder block.

Inspection

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

PISTON

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



SLIPPERS

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

Minimum slipper foot thickness and maximum axial end-play are given in the table below.

Table 3-7. Slipper Foot Thickness & End Play

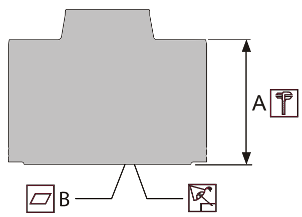
Measurement	L Frame mm (in.)	K Frame mm (in.)
Slipper Foot Thickness	2.71 (0.11)	4.07 (0.16)
Piston/Slipper End Play	0.15 (0.006)	

CYLINDER BLOCK

Measure the cylinder block height. Replace blocks worn beyond the minimum height specification. Inspect the running surface of the cylinder block. Replace or resurface worn or scratched blocks. Blocks may be resurfaced to the specifications shown in the drawing, provided resurfacing will not reduce the block height below the minimum specification. Table 3-8, Cylinder Block Measurements.

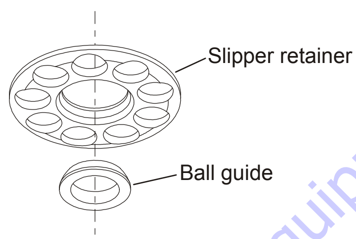
Table 3-8. Cylinder Block Measurements

Measurement	L25 mm (in.)	L30 mm (in.)	L35 mm (in.)	K38 mm (in.)	K45 mm (in.)
Minimum Cylinder Block Height (A)	50.8 (2.00)	50.8 (2.00)	50.8 (2.00)	54.4 (2.14)	54.4 (2.14)
Cylinder Block Surface Flatness	0.002 (0.0000079)	0.002 (0.0000079)	0.002 (0.0000079)	0.002 (0.0000079)	0.002 (0.0000079)



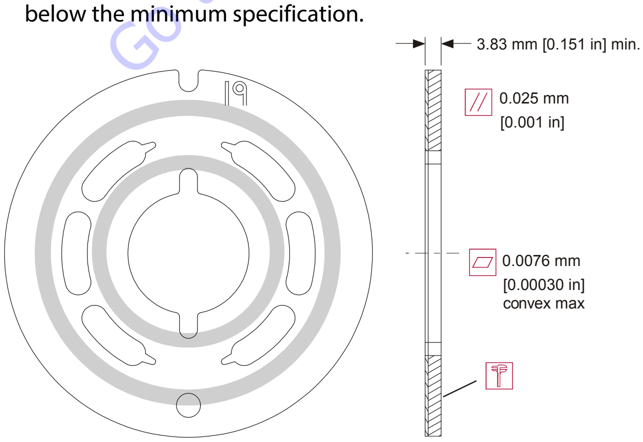
BALL GUIDE AND SLIPPER RETAINER

Inspect the ball guide and slipper retainer for damage, discoloration, or excessive wear. A discolored ball guide or slipper retainer indicates excessive heat. Do not reuse.



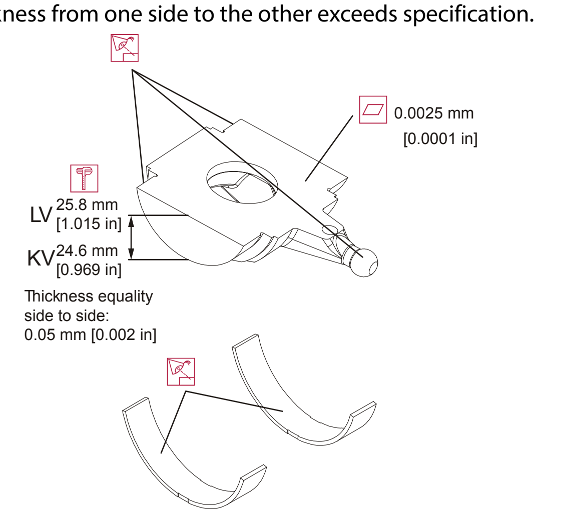
VALVE PLATE

The condition of the valve plate is critical to the efficiency of the motor. Inspect the valve plate surfaces carefully for excessive wear, grooves, or scratches. Replace or resurface grooved or scratched valve plates. Measure the valve plate thickness and replace if worn beyond the minimum specification. Valve plates may be resurfaced to the specifications shown in the drawing, provided resurfacing will not reduce the thickness below the minimum specification.



SWASHPLATE AND JOURNAL BEARINGS

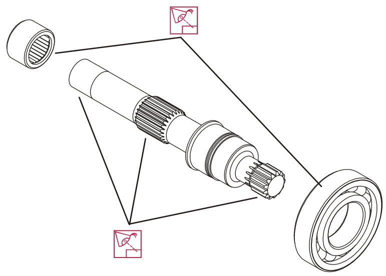
Inspect the running face, servo ball-joint, and swashplate journal surfaces for damage or excessive wear. Some material transfer may appear on these surfaces and is acceptable providing the surface condition meets specifications shown. Measure the swashplate thickness from the journals to the running face. Replace swashplate if damaged or worn beyond minimum specification. Replace swashplate if the difference in thickness from one side to the other exceeds specification.



Inspect the journal bearings for damage or excessive wear. Replace journal bearings if scratched, warped, or excessively worn. The polymer wear layer must be smooth and intact.

SHAFT BEARINGS

Inspect bearings for excessive wear or contamination. Rotate the bearings while feeling for uneven movement. Bearings should spin smoothly and freely. Replace bearings that appear worn or do not rotate smoothly.

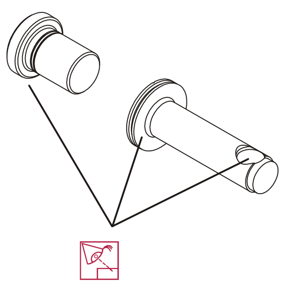


SHAFT

Inspect the motor shaft. Look for damage or excessive wear on the output and block splines. Inspect the bearing surfaces and sealing surface. Replace shafts with damaged or excessively worn splines, bearing surfaces, or sealing surfaces.

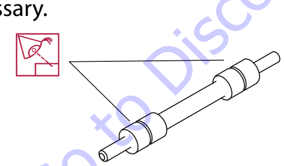
SERVO PISTON AND MINIMUM ANGLE STOP

Inspect the minimum angle stop, servo piston head, and servo piston ball-socket for damage or excessive wear. Replace if necessary.



LOOP FLUSHING SPOOL

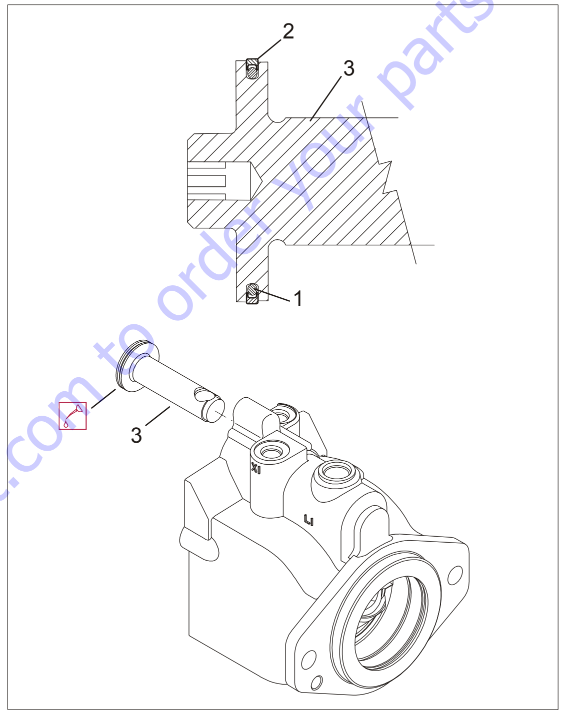
Inspect the loop flushing spool. Check for cracks or damage. Replace if necessary.



Assembly

1. Install new O-ring (1) and piston seal (2) to the servo piston (3). Install the piston seal over the O-ring.

   Installing the piston seal stretches it, making it difficult to install the servo piston in its bore. Allow 30 minutes for the seal to relax after installation. To speed up seal relaxation, compress the seal by installing the piston head into the servo cavity in the end-cap and let it stand for at least five minutes.



1. O-ring
2. Piston Seal
3. Servo Piston

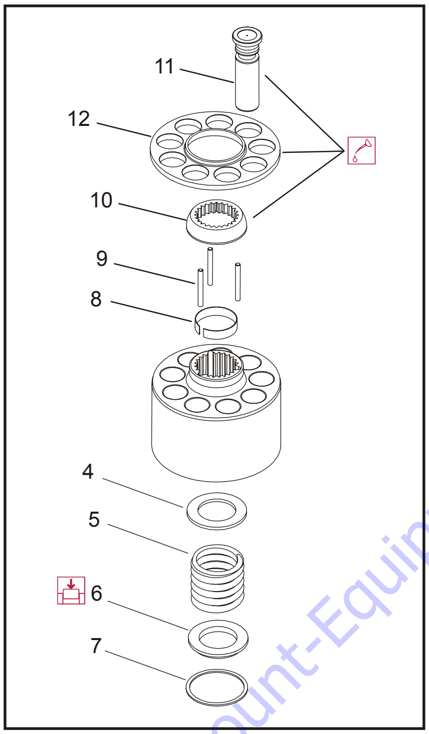
Figure 3-20. Servo Piston

2. After piston seal has relaxed, lubricate and install servo piston into the housing bore. Align the piston with the ball socket facing the inside of the housing.

⚠ WARNING

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

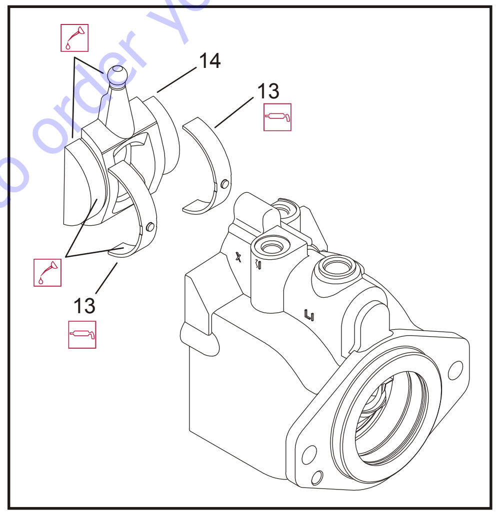
3. Install the inner block spring washer (4), block spring (5), and outer washer (6) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (7) into the groove in the cylinder block.



4. Block Spring Washer
5. Block Spring
6. Outer Washer
7. Spiral Retaining Ring
8. Retaining Ring
9. Holddown Pins
10. Ball Guide
11. Piston
12. Slipper Retainer

Figure 3-21. Cylinder Kit Assembly

4. Turn the block over and install the retaining ring (8), hold-down pins (9), and ball guide (10) to the cylinder block.
5. Install the pistons (11) to the slipper retainer (12). Install the piston/retainer assembly into the cylinder block. Ensure the concave surface of the retainer seats on the ball guide. If you're reusing the pistons, install them to the original block bores. Lubricate the pistons, slippers, retainer, and ball guide before assembly. Set the cylinder kit aside on a clean surface until needed.
6. Install the journal bearings (13) into the housing seats. Use assembly grease to keep the bearings seated during assembly. Ensure the locating nubs drop into the cavities in the seats. If you're reusing the bearings, install them in the original location and orientation. Lubricate the journal bearings.

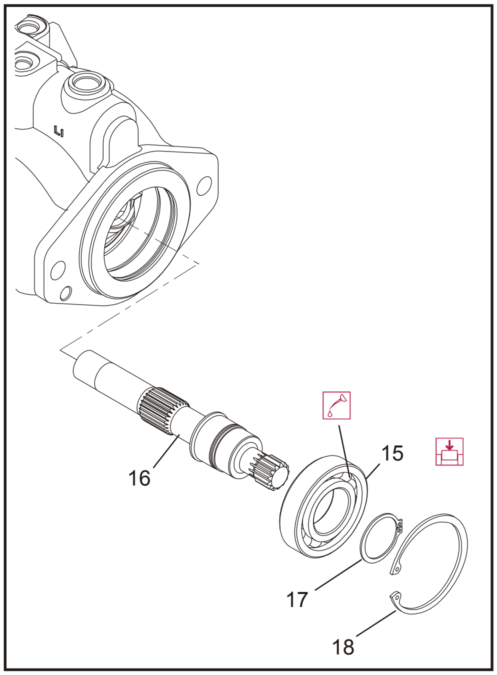


13. Journal Bearings
14. Swashplate

Figure 3-22. Swashplate and Journal Bearing

7. Install the swashplate (14) into the housing. Tilt the swashplate and guide the servo lever ball into its socket in the servo piston rod. Ensure the swashplate seats into the journal bearings and moves freely. Lubricate the running surface of the swashplate.

8. Press front shaft bearing (15) onto shaft (16). Press bearing onto shaft with lettering facing out. Lubricate bearing rollers. Install snap-ring (17) onto shaft.

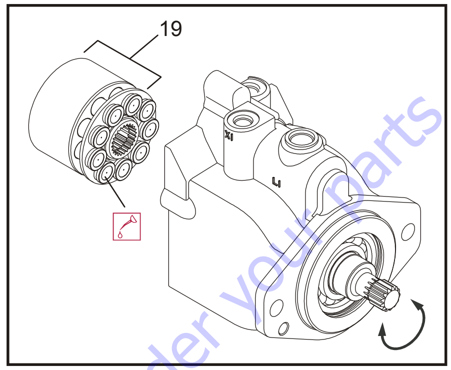


15. Front Shaft Bearing
16. Shaft
17. Snap Ring
18. Snap Ring

Figure 3-23. Shaft and Front Bearing

9. While holding the swashplate in place, turn the housing on its side. Install the install shaft/bearing assembly into housing from the flange end. Install the snap-ring (18).

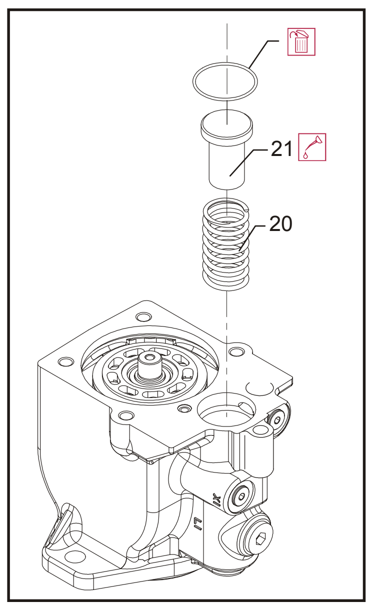
10. Verify swashplate and bearings are properly seated. Install the cylinder kit (19) onto the shaft. Install with the slippers facing the swashplate. Rock the shaft to align the block splines and slide the cylinder kit into place. Orient the motor with the shaft pointing downward and verify the cylinder kit, swashplate, journal bearings, and servo piston are all secure and properly installed.



19. Cylinder Kit

Figure 3-24. Cylinder Kit Installation

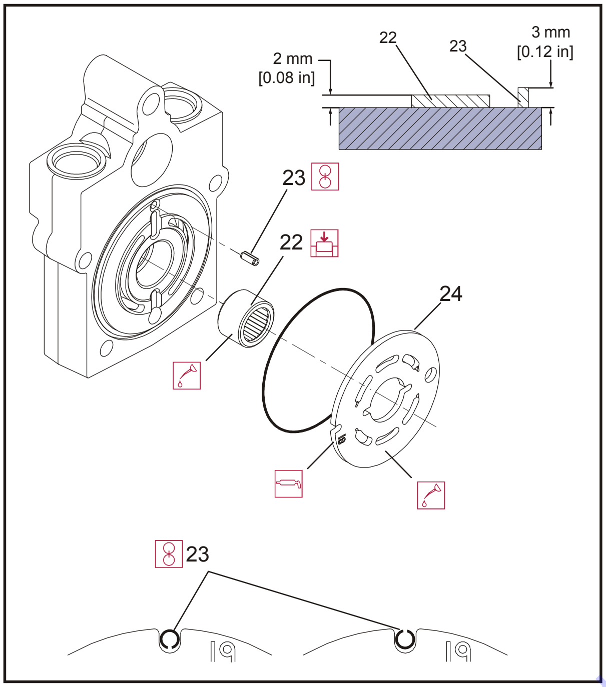
11. Lubricate and install the servo spring (20), and minimum angle stop (21) into the housing bore.



20. Servo Spring
21. Minimum Angle Stop

Figure 3-25. Servo Spring and Minimum Angle Stop

12. Press the rear shaft bearing (22) into the endcap. Install the bearing with letters facing out. Press until bearing surface is 0.08 ±0.01 in (2 ±0.25 mm) above endcap surface.



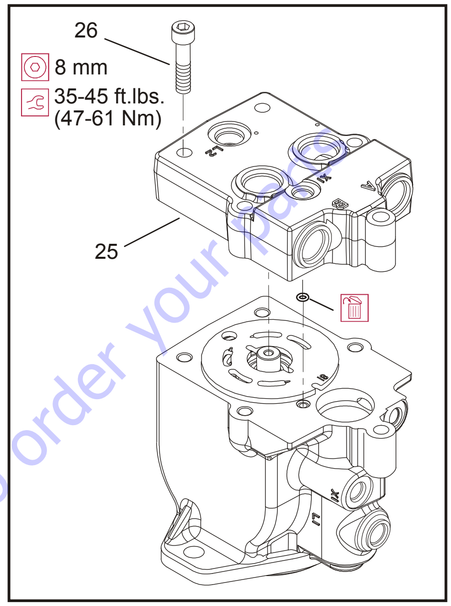
22. Rear Shaft Bearing
23. Timing Pin
24. Valve Plate

Figure 3-26. Valve Plate and Rear Bearing

13. Install timing pin (23) into its bore in the endcap. Install the pin with its groove facing toward or away from the shaft. Press the pin until the end protrudes 0.12 ±0.01 in (3 ±0.25 mm) above endcap surface.

14. Install the valve plate (24) onto the endcap. Install the valve plate with the yellow surface toward the cylinder block. Align the slot in the valve plate with the timing pin. Apply a liberal coat of assembly grease to the endcap side of the valve plate to keep it in place during installation.

15. Install the endcap (25) onto the housing with the end-Capscrews (26). Check to ensure the endcap will properly seat onto the housing without interference. Improper assembly of the internal components may prevent the endcap from seating properly. Ensure the O-rings seat properly when installing the endcap.



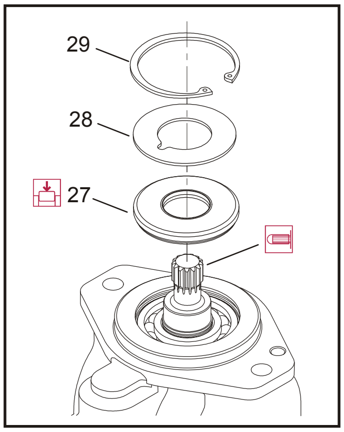
25. End Cap
26. Screw

Figure 3-27. End Cap

16. Using an 8 mm internal hex wrench, tighten the end-Capscrews. Tighten the screws in opposite corners slowly and evenly to compress the servo spring and properly seat the endcap. Torque end Capscrews 35-45 ft.lbs. (47-61 Nm).

17. Before installing the shaft seal, ensure the shaft turns smoothly with less than 120 in.lbs. (13.5 Nm) of force. If the shaft does not turn smoothly within the specified maximum force, disassemble and check the unit.

18. Cover shaft splines with an installation sleeve. Install a new shaft seal (27) with the cup side facing the motor. Press seal into housing until it bottoms out. Press evenly to avoid binding and damaging the seal. Install seal support washer (28) and snap ring (29).



27. Shaft Seal
28. Seal Support Washer
29. Snap Ring

Figure 3-28. Shaft Seal

19. Install remaining plugs and fittings to the housing. Refer to the drawing below for wrench sizes and installation torques.

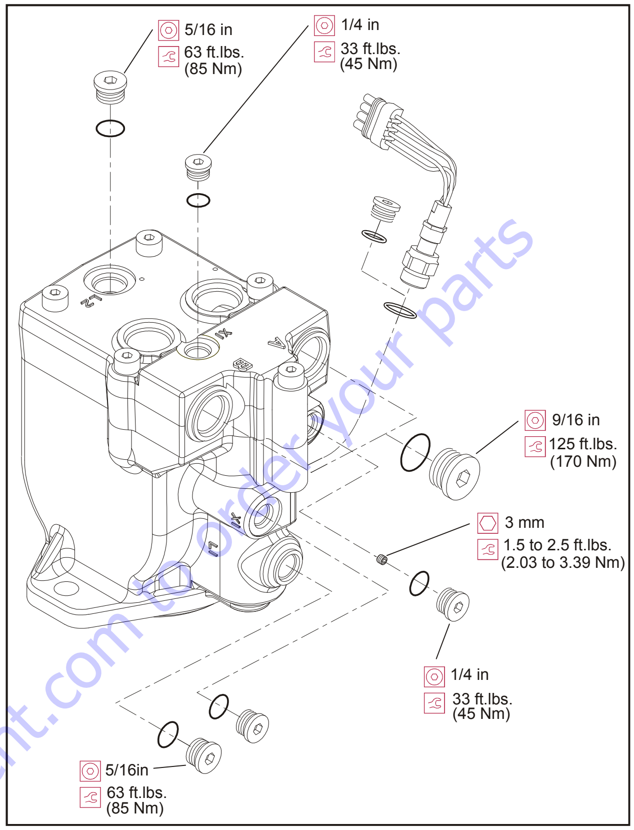
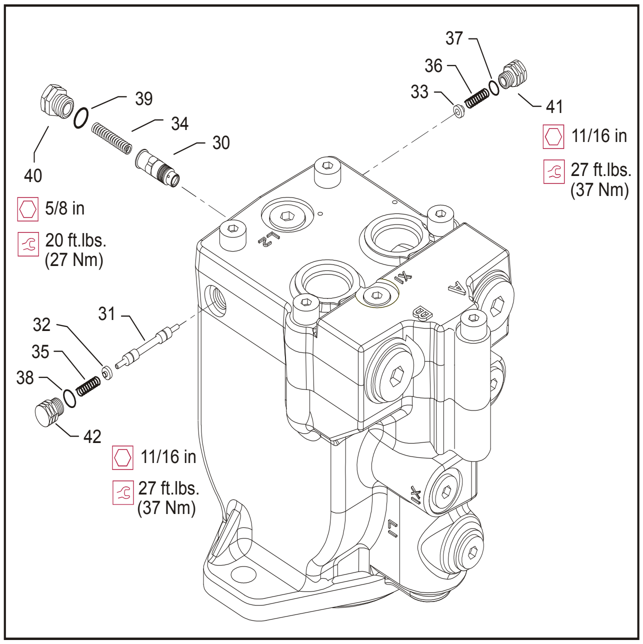


Figure 3-29. Plugs and Fittings Installation

20. Install orifice poppet (30).



30. Orifice Poppet	34. Spring	37. O-ring	40. Plug
31. Shift Spool	35. Spring	38. O-ring	41. Plug
32. Spring	36. Spring	39. O-ring	42. Plug
33. Spring			

Figure 3-30. Loop Flushing Spool

21. Install shift spool (31).

22. Install spring retaining washers onto springs (32 and 33).

23. Carefully install centering springs (34, 35, and 36).

24. Install new O-rings (37, 38, and 39).

25. Using a 5/8 in wrench torque plug (40) to 20 ft.lbs. (27 Nm).

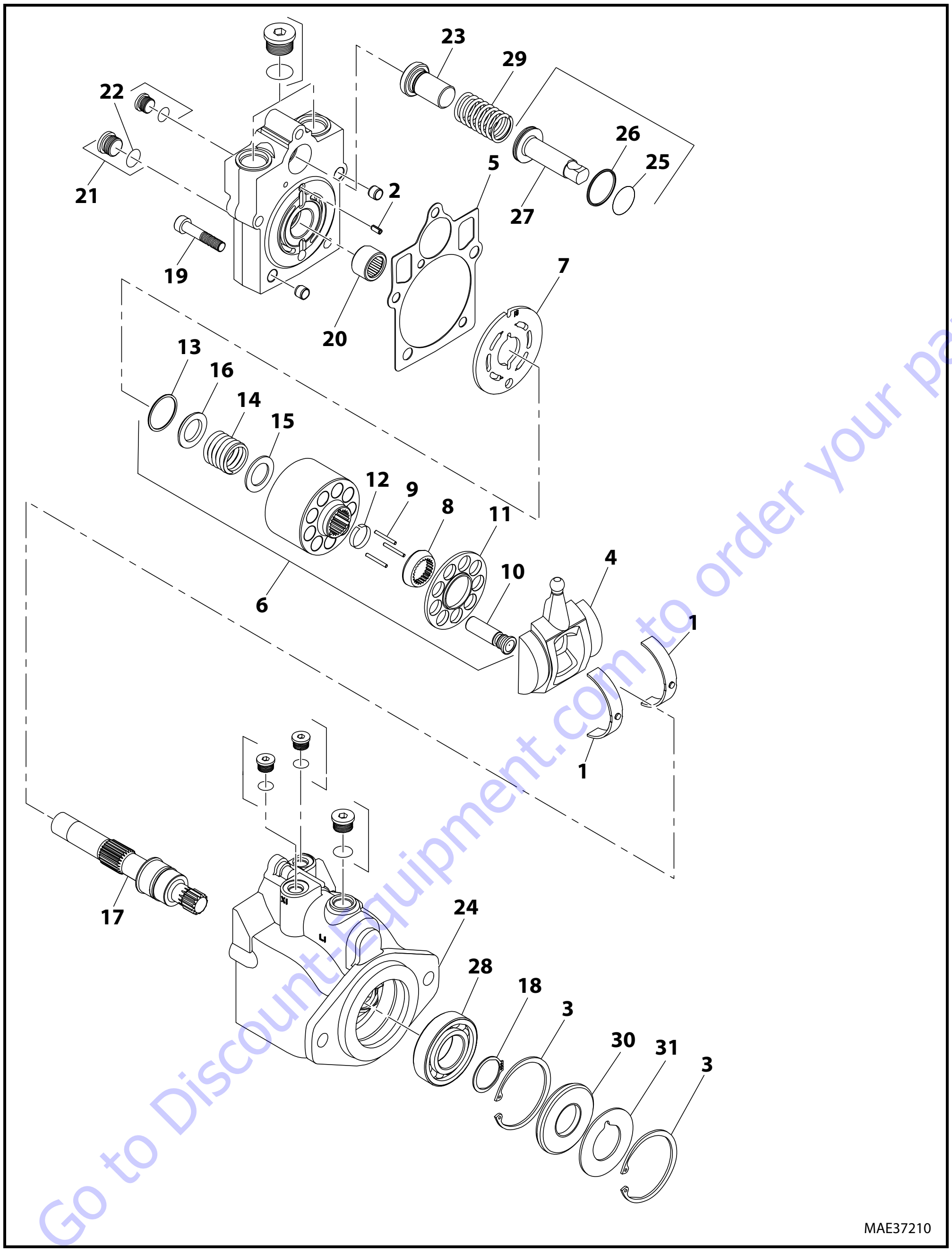
26. Using a 11/16 in wrench, torque plugs (41 and 42) to 27 ft.lbs. (37 Nm).

Initial Start-up Procedures

Follow this procedure when starting-up a new motor or when installing a motor that has been removed.

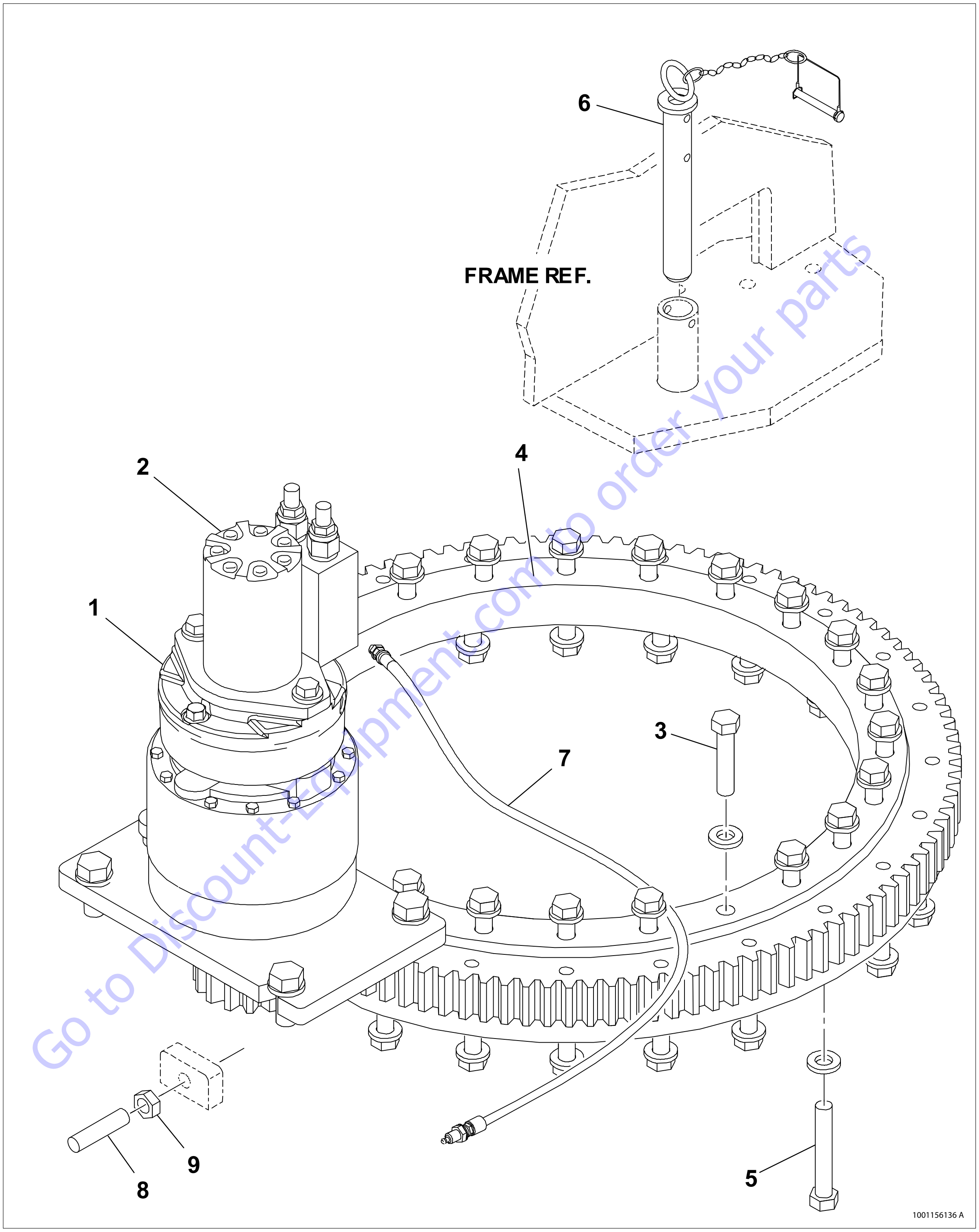
Prior to installing the motor, inspect for damage incurred during shipping. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

1. Fill the reservoir with recommended hydraulic fluid. Always filter fluid through a 10 micron filter when pouring into the reservoir. Never reuse hydraulic fluid.
2. Fill the inlet line leading from the pump to the reservoir. Check the inlet line for properly tightened fittings and be certain it is free of restrictions and air leaks.
3. Fill the pump and motor housing with clean hydraulic fluid. Pour filtered oil directly into the upper most case drain port.
4. To ensure the pump and motor stay filled with oil, install case drain lines into the upper most case drain ports.
5. Install a 0 to 500 psi (0 to 35 bar) gauge in the charge pressure gauge port of the pump to monitor system pressure during start up.
6. While watching the pressure gauge, run the engine at the lowest possible speed until system pressure builds to normal levels (minimum 160 psi [11 bar]). Once system pressure is established, increase to full operating speed. If system pressure is not maintained, shut down the prime mover, determine cause, and take corrective action.
7. Operate the hydraulic system for at least fifteen minutes under light load conditions.
8. Check and adjust control settings as necessary after installation.
9. Shut down the prime mover and remove the pressure gauge. Replace plug at the charge pressure gauge port.
10. Check the fluid level in the reservoir; add clean filtered fluid if necessary. The motor is now ready for operation.



1. Journal Bearing
2. Pin
3. Retaining Pin
4. Swash Plate
5. Gasket
6. Cylinder Block
7. Valve Plate
8. Slipper Retainer
9. Slipper Hold Pin
10. Piston Assembly
11. Retainer Slipper
12. Retainer Hold Down
13. Retaining Ring
14. Spring
15. Washer
16. Retainer
17. Shaft
18. Retaining Ring
19. Screw
20. Bearing Needle
21. Plug
22. O-Ring
23. Seat Spring
24. Housing
25. O-Ring
26. Ring Seal
27. Piston
28. Bearing
29. Spring
30. Seal Lip
31. Washer

Figure 3-31. Drive Motor



1. Swing Drive
2. Swing Motor
3. Inner Race Bearing Bolt
4. Swing Bearing
5. Outer Race Bearing Bolt
6. Turntable Lock Pin
7. Grease Line
8. Bolt
9. Jam Nut

Figure 3-32. Swing System

3.14 SWING DRIVE

Roll, Leak And Brake Testing

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

NOTE: *The brake must be released before performing the roll test. This can be accomplished by either pressure testing using the Brake Leak Test procedure below or by tightening the 12 bolts into the piston through the end plate (See Brake Disassembly Procedure).*

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

Roll Test

The purpose of the roll test is to determine if the unit's gears are rotating freely and properly. You should be able to rotate the gears in your unit by applying constant force to the roll checker. If you feel more drag in the gears only at certain points, then the gears are not rolling freely and should be examined for improper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if the gears in your unit seem to roll hard as long as they roll with consistency. Release the pressure at the Brake Housing (6) and remove the test fixtures.

Leak Test (Main Unit)

The purpose of a leak test is to make sure the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your air checker starts to fall after the unit has been pressurized and allowed to equalize. Leaks will most likely occur at the pipe plugs, the main seal or wherever o-rings or gaskets are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where the o-rings or gaskets meet on the exterior of the unit, then checking for air bubbles. If a leak is detected in a seal, o-ring or gasket, the part must be replaced, and the unit rechecked. Leak test at 10 psi (0.7 bar) for 20 minutes.

Brake Test

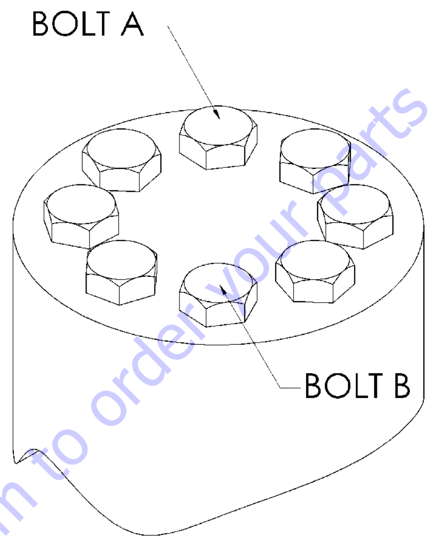
The brake test must be performed with the Motor removed and the Brake Test Plate (T-214404) installed. Install the Hex Bolts through Brake Test Plate and torque to 80 - 100 ft. lbs. (108-135 Nm). Install Roll Checking Tool (T-212731) and apply 210 psi (14 bar) to the o-ring port in the side of the Brake Housing. The roll checking fixture should roll freely. Increase the pressure to 3000 psi (207 bar) and perform the Roll Test.

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

Tightening and Torquing Bolts

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

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

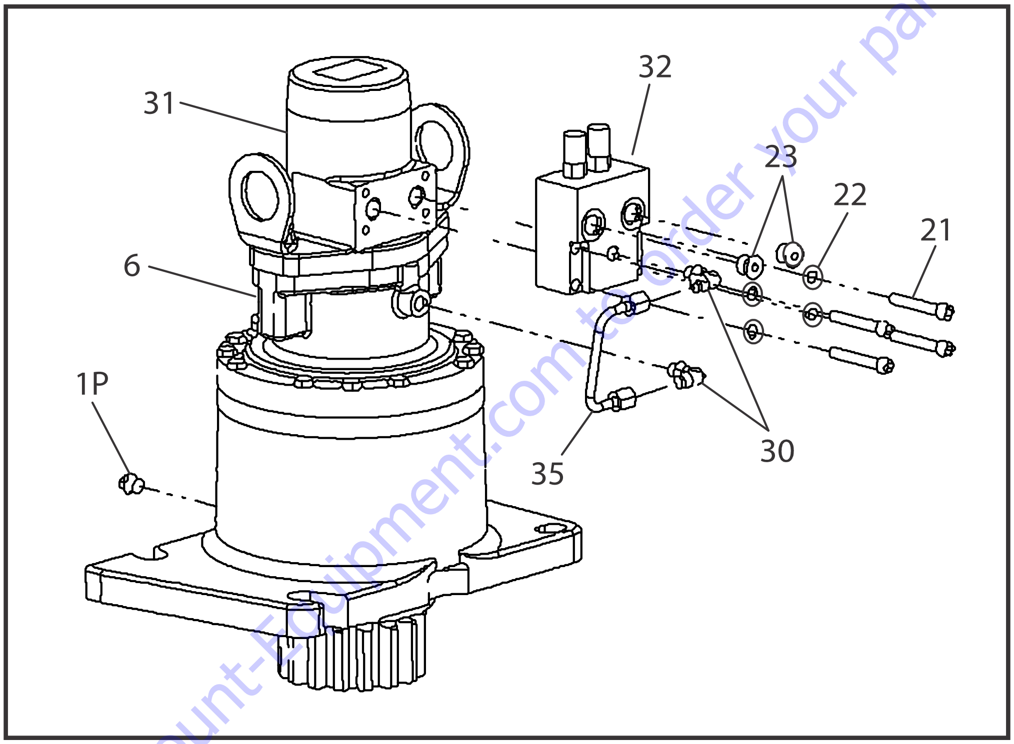


1. Tighten (but do not torque) bolt "A" until snug.
2. Go to the opposite side of the bolt circle and tighten bolt "B" until equally snug.
3. Crisscross around the bolt circle and tighten remaining bolts.
4. Now use a torque wrench to apply the specified torque to bolt "A".
5. Using the same sequence, crisscross around the bolt circle and apply an equal torque to the remaining bolts.

Motor Control Valve Disassembly

NOTE: *Refer to Figure 3-33.*

1. Place unit on bench with the motor end up.
2. Remove O-ring Plug (1P) and drain the oil from the gear-box.
3. Remove Hydraulic Tubing Assembly (35) by loosening fittings on both ends of tube with a wrench.
4. Using a wrench, loosen jam nuts on Elbow Fittings (30) and remove fittings from Brake (6) and Motor Control Valve (32).
5. Remove O-ring Plugs (23) from Motor Control Valve (32).
6. Remove Motor Control Valve (32) from Motor (31) by removing the four Bolts (21) and washers (22).



1P. O-ring Plug	30. Elbow Fitting
6. Hydraulic Brake	31. Hydraulic Motor
21. Hex Bolt	32. Motor Control Valve
22. Lockwasher	35. Hydraulic Tubing
23. Plug	

Figure 3-33. Motor Control Valve

Motor and Brake Disassembly

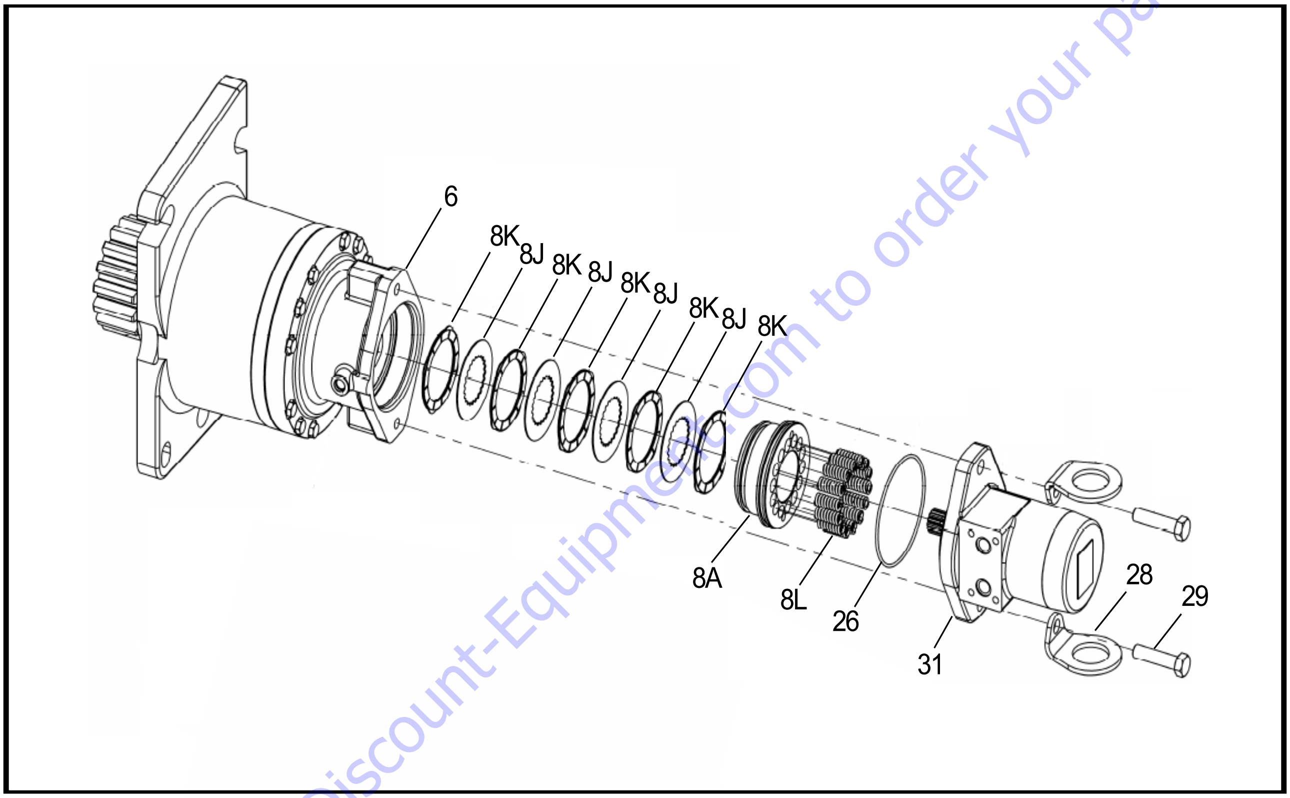
NOTE: *Refer to Figure 3-34., Motor and Brake*

1. With unit resting on bench with Motor (31) end up, loosen Hex Bolts (29) and remove Lift Lugs (28) from the Motor (31).
2. Pull Motor (31) straight up and remove Motor (31) from Brake Housing (6).
3. Remove O-ring (26) from between Motor (31) and Brake Housing (6).
4. Remove the Springs (8L) from the piston.
5. Apply less than 50 psi (3.45 bar) air to the "brake port" to remove Brake Piston (8A).

CAUTION

THE PISTON MAY MOVE QUICKLY. EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.

6. Remove Rotors (8J) and Stators (8K) from Brake Housing (6).



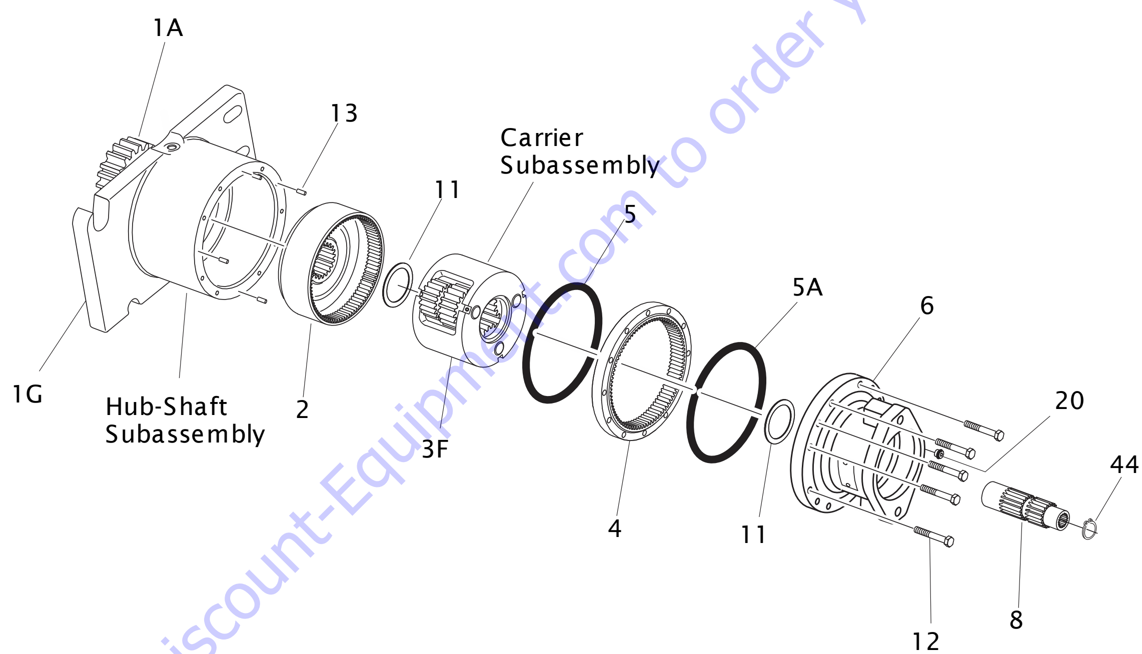
6. Brake Housing
8A. Brake Piston
8L. Spring
8J. Rotors
8K. Stator
26. O-ring
28. Lift Lug
29. Hex Bolt
31. Motor

Figure 3-34. Motor and Brake

Main Drive Disassembly

NOTE: *Refer to Figure 3-35., Main Drive Assembly*

1. Remove Sun Gear (8) with Retaining Ring (44) inside.
2. With the unit resting on the Output Shaft (Pinion) (1A), remove the Bolts (12) from the Brake Housing (6).
3. Remove the Brake Housing (6) from the main assembly.
4. Remove O-ring (5A) from between Brake Housing (6) and Ring Gear (4).
5. Remove Thrust Washer (11) from between Brake Housing (6) and Carrier Subassembly.
6. Remove Ring Gear (4) from Housing (1G).
7. Remove O-ring (5) from between Ring Gear (4) and Housing (1G).
8. Remove Carrier Sub-Assembly.
9. Remove Thrust Washer (11) from between Carrier Sub-Assembly and Internal Gear (2).
10. Remove Internal Gear (2).



1A. Output Shaft (Pinion)	5. O-ring	12. Bolt
1G. Housing	5A. O-ring	13. Dowel Pin
2. Internal Gear	6. Brake Housing	20. Pipe Plug
3F. Carrier subassembly	8. Sun Gear	44. Ring
4. Ring Gear	11. Thrust Washer	

Figure 3-35. Main Drive Assembly

Hub-Shaft Disassembly

NOTE: *Refer to Figure 3-36., Hub-Shaft*

1. Using retaining ring pliers remove Retaining Ring (1I) from groove in Output Shaft (1A) and discard.

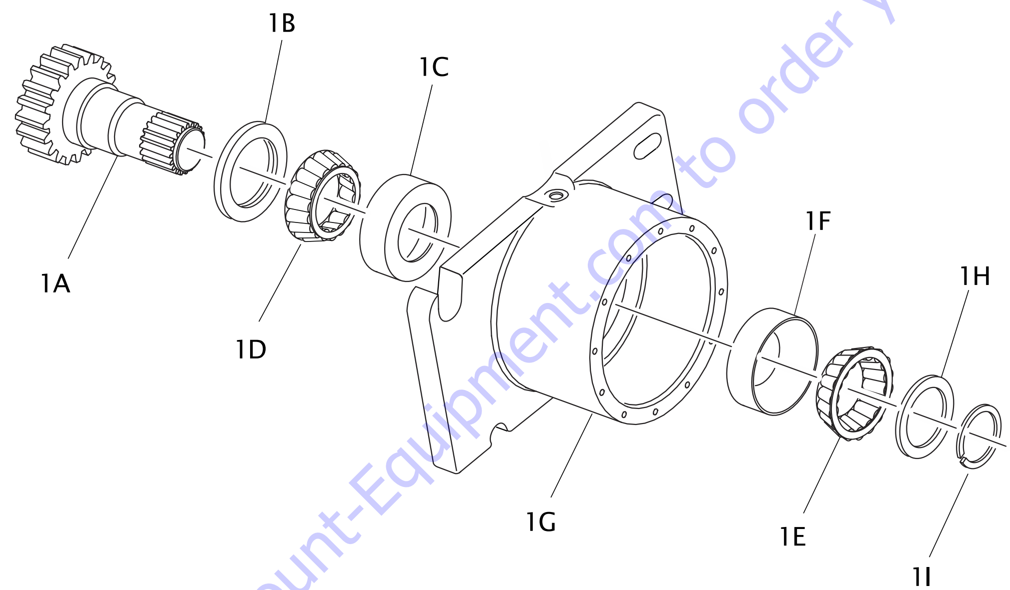
CAUTION

EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.

2. Remove Thrust Washer (1H).
3. While supporting the Housing (1G) on the Output Shaft (1A) end, press the Output Shaft (1A) out of the Housing (1G).

NOTE: *The Lip Seal (1B) will be pressed out of the Housing (1G) by the Bearing Cone (1D) during this step.*

4. Remove the Bearing Cone (1E) from the Housing (1G).
5. Use a bearing puller to remove the Bearing Cone (1D) from the Shaft (1A).
6. Bearing Cups (1C & 1F) will remain in Housing (1G).



1A. Output Shaft
1B. Lip Seal
1C. Bearing Cup
1D. Bearing Cone
1E. Bearing Cone
1F. Bearing Cup
1G. Housing
1H. Thrust Washer
1I. Retaining Ring

Figure 3-36. Hub-Shaft

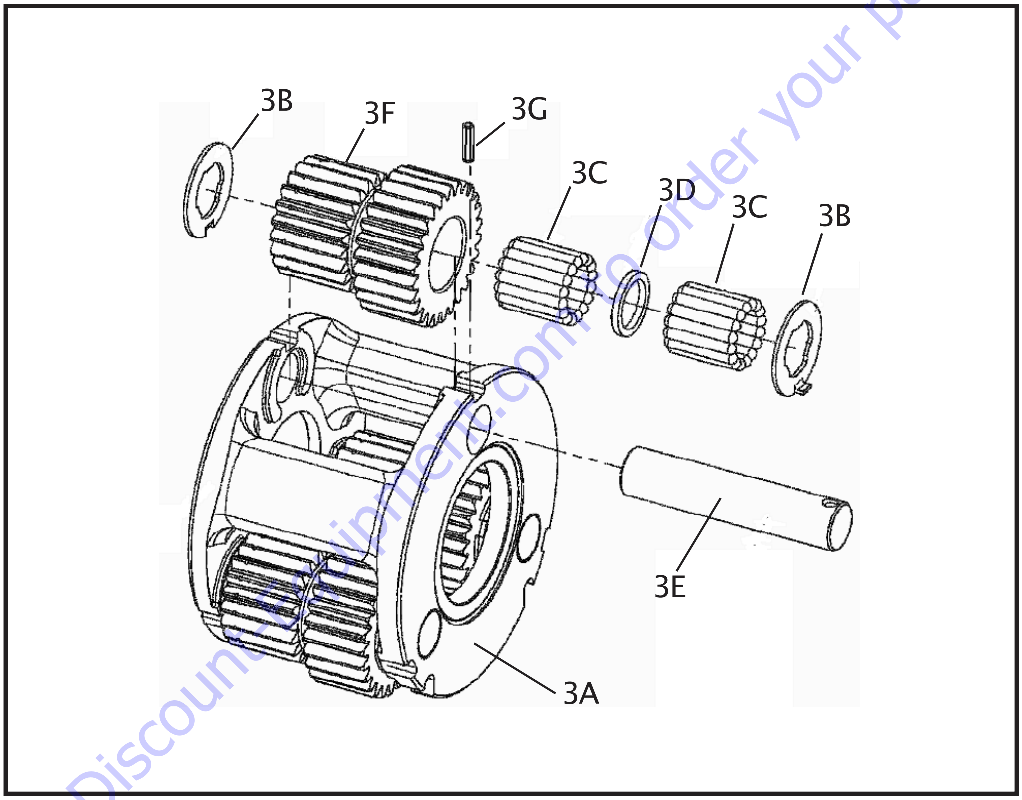
Carrier Disassembly

NOTE: *Refer to Figure 3-37., Carrier*

1. Using a 3/16” punch drive the Roll Pin (3G) which holds the Planet Shaft (3E) in the Carrier (3A) down into the Planet Shaft (3E) until it bottoms.

NOTE: *Make sure that the Roll Pin has bottomed. Otherwise, damage to the carrier could occur when the Planet Shaft is removed.*

2. Remove the Planet Shaft (3E) from the Carrier (3A). Use a small punch to remove the Roll Pin (3D) from the Planet Shaft (3E).
3. Slide the Planet Gear (3F), the two Thrust Washers (3B) out of the Carrier (3A).
4. Remove both rows of Needle Bearings (3C) and the Spacer (3D) from the bore of the Planet Gear (3F).
5. Repeat Steps 1 thru 4 for the remaining two Cluster Gears (3F).



3A. Carrier
3B. Thrust Washers
3C. Needle Bearing
3D. Spacer
3E. Planet Shaft
3F. Cluster Gear
3G. Roll Pin

Figure 3-37. Carrier

Hub-Shaft Assembly

NOTE: *Refer to Figure 3-36., Hub-Shaft*

1. Press Bearing Cup (1C) into Housing (1G) taking care to insure cup starts square with the bore of Hub (1G).
2. Place Bearing Cone (1D) in Bearing Cup (1C) in Housing (1G).
3. Press or tap Seal (1B) Into the counterbore of Housing (1G) to the point where it becomes flush with the Housing (1G) face. Care should be taken to insure Seal (1B) is being correctly installed (smooth face up). Apply grease to the rubber portion of the seal bore.
4. Invert Hub (1G) and press Bearing Cup (1E) into counterbore of Housing (1G).
5. Carefully lower Housing (1G) onto the Output Shaft (1A) until Bearing Cone (1D) contacts the Output Shaft (1A).
6. Press on the small end of the Bearing Cone (1D), being careful not to contact the bearing cage, until the Bearing Cone (1D) seats on the shoulder of the Output Shaft (1A).
7. Start the Bearing Cone (1F) onto the Output Shaft (1A).
8. Press or tap the Bearing Cone (1F) onto the Output Shaft (1A) until it is just seated in the Bearing Cup (1E). while rotating the Housing (G).
9. Install Bearing Spacer (1H) onto Output Shaft (1A) and against Bearing Cone (1F).
10. Install Retaining Ring (1I) into the groove in the Output Shaft (1A). This Retaining Ring (1I) should never be reused in a repair or rebuild.

⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.

11. Tap the Retaining Ring (1I) with a soft metal punch to ensure that the Retaining Ring (1I) is completely seated in the groove of the Output Shaft (IA).

⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.

12. Install O-ring Plug (1P) and torque to 23 to 24 ft.lbs. (31 to 32 Nm).

Carrier Assembly

NOTE: *Refer to Figure 3-37., Carrier*

1. Apply a liberal Coat of grease to the bore of Cluster Gear (3F). This will enable the Needle Rollers (3C) to be held in place during assembly.
2. Install the first row of Needle Rollers (3C) into the bore of Cluster Gear (3F).
3. Insert Spacer (3D) into bore of Cluster Gear (3F) on top of the Needle Rollers (3C).
4. Place second row of Needle Rollers (3C) into bore of Cluster Gear (3F) against Spacer (3D).
5. Place Carrier (3A) so that one of the roll pin holes is straight up.
6. Start Planet Shaft (3E) through the hole in Carrier (3A). Using ample grease to hold it in position, slide one Thrust Washer (3B) over the Planet Shaft (3E) with the tang resting in the cast slot of the Carrier (3A).
7. With large end of Cluster Gear (3F) facing the roll pin hole in the Carrier, place the Cluster Gear into position in carrier (3A) and push Planet Shaft (3E) through the Cluster Gear (3F) without going all the way through.
8. Slide the second Thrust Washer (3B) between the Cluster Gear (3F) and the Carrier (3A) with the tang of the washer located in the cast slot of the Carrier (3A). Finish sliding the Planet Shaft (3E) through the Thrust Washer (3B) and into the Carrier (3A).
9. Position the non-chamfered side on the Planet Shaft (3E) roll pin hole so that it is in line with the hole in the Carrier (3A) using a 1/8" (3 mm) diameter punch.
10. After using a 3/16" (5 mm) punch to align the two roll pin holes. Drive the Roll Pin (3G) through Carrier (3A) and into the Planet Shaft (3E) until the Roll Pin (3G) is flush with the bottom of the cast slot in the Carrier (3A) outside diameter at the thrust washer (3B) tang. Use a 1/4" (6 mm) pin punch to make sure the Roll Pin (3G) is flush in the slot.
11. Repeat Steps 1 thru 10 for the remaining two Cluster Gears(3F).

Main Drive Assembly

NOTE: *Refer to Figure 3-35., Main Drive Assembly*

1. With the Hub Shaft Sub-Assembly resting on the Shaft (1A) install Internal Gear (2). The spline of the Internal Gear (2) bore will mesh with the spline of the Output Shaft (1A). This will be a tight fit.
2. Inspect the location of the Internal Gear (2) on the Output Shaft (1A). The portion of the Output Shaft (1A) should protrude through the Internal Gear (2) bore.
3. Install 4 Dowel Pins (13) into counter bore holes in Hub (IG).
4. Install Thrust Washer (11) in counter bore of Carrier Sub-Assembly (Small Cluster-Gear end) Use grease to hold in place.
5. Place O-ring (5) into Hub counter-bore. Use grease to hold O-ring in place.

⚠ WARNING

BEWARE OF SHARP EDGES OF THE COUNTER BORE WHILE SEATING THIS ORING.

6. Place Carrier Sub-Assembly on bench with the large end of Cluster Gears (3F) facing up with one at the 12 o'clock position. Find the punch marked tooth on each gear at the large end and locate at 12 o'clock (straight up) from each planet pin. Marked tooth will be located just under the Carrier on upper two gears. Check the timing through the slots in the carrier (See Carrier Sub-Assembly).
7. With large shoulder side of Ring Gear (4) facing down, place Ring Gear (4) over (into mesh with) cluster gears (3F). Be sure that cluster gear timing marks (punch marks) remain in correct location during Ring Gear (4) installation. The side of the Ring Gear (4) with an "X" or punch mark stamped on it should be up.
8. While holding Ring Gear (4) and Cluster Gears (3F) in mesh, place small end of Cluster Gears (3F) into mesh with the Internal Gear (2). On the Ring Gear (4) locate the hole marked "X", or punch marked, over one of the marked counter-bored holes (Step 5) in Hub (1G). Check timing through the slots in the carrier. Rotate carrier in assembly to check for freedom of rotation.

NOTE: *If gears do not mesh easily or Carrier Assembly does not rotate freely, then remove the Carrier and Ring Gear and check the Cluster Gear timing.*

9. Install Thrust Washer (11) into the counter-bore on the face of the carrier. Use grease to hold in place.
10. Place O-ring (5A) into counter-bore or Brake Housing (6). Use grease to hold O-Ring in place.

⚠ CAUTION

BEWARE OF SHARP EDGES OF THE COUNTER-BORE WHILE SEATING THIS O-RING.

11. Install the Brake Housing (6), taking care to correctly align Pipe Plug (20) with those in the Hub (I G).
12. Install Bolts (12) through the Brake Housing (6) into the Hub (1G) and torque to 23-27 ft.lbs. (31-37 Nm).
13. With gearbox standing on the pinion end fill gearbox with 43 oz. of ISO VG150/VG220 gear Oil.
14. Install Retaining Ring (44) into the groove in the Sun Gear (8).
15. Install the Sun Gear (8) into mesh with the Planet Gears (3F).
16. Install Pipe Plug (20) into Cover (6) torque to 23 to 24 ft·lbs. (31-32 Nm).

Motor and Brake Assembly

NOTE: *Refer to Figure 3-34., Motor and Brake*

1. Alternate Stators (8K) (O.D. lobes) with Rotors (8J) (I.D. splines) into bore of Brake Housing (6). starting with a Stator (8K) and ending with a Stator (8K).
2. Grease the O-rings (8F) & (8D) and Backup rings (8H) & (8E). and place them in their respective grooves in the Brake Housing (6) and Piston (8A). Make sure the Backup rings are correctly positioned.
3. Apply grease sparingly to the Piston O.D. (8A) and the bore of the Brake Housing (6). Insert Piston (8A) into Brake Housing (6) be sure not to damage the O-rings.
4. Install Springs (8L) into the spring pockets of the Piston (8A).
5. Test the brake and perform the roll test. Remove the Brake Test Plate.
6. Install the O-ring (26) onto the pilot of the Motor (31), use grease to keep the O-ring in place.
7. Place Motor (31) into Brake pilot, and line up holes.
8. Assemble Lift Lugs (28) onto Hex Bolts (29). Assemble Hex Bolts (29) with Lift Lugs (28) through the Motor (31) and Brake (6) against Motor flange. Torque to 80-100 ft.lbs. (108-136 Nm).

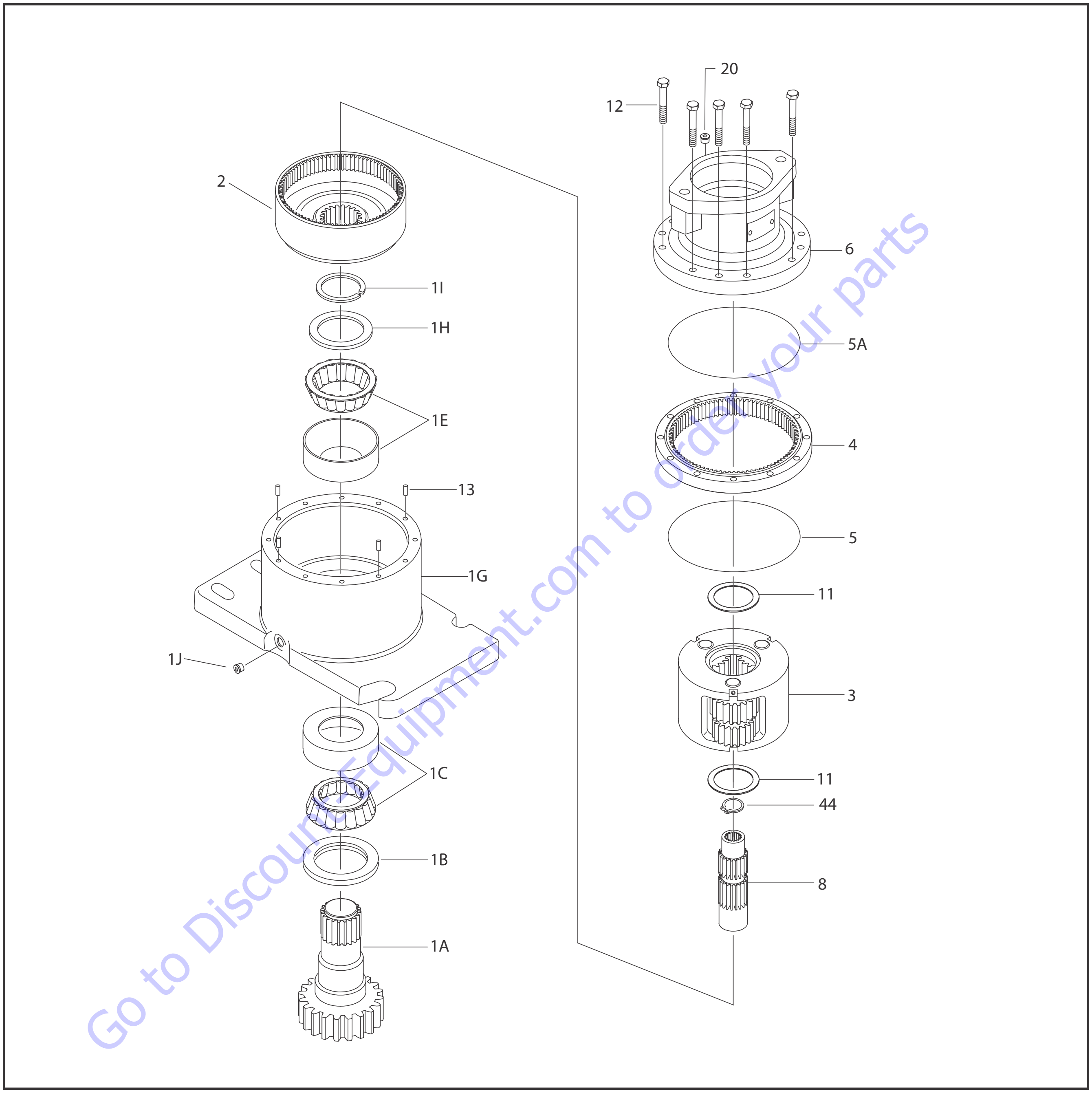
Motor Control Valve Assembly

NOTE: *Refer to Figure 3-33., Motor Control Valve*

1. Lay assembly down with motor ports facing up. Remove the two plastic plugs in the motor ports, being careful not to lose the O-ring in each port. Assemble the Motor control Valve (32) onto the Motor (31) with Bolt (21) and Lock Washers (22). Torque Bolts (21) to 23-27 ft.lbs. (31-37 Nm).

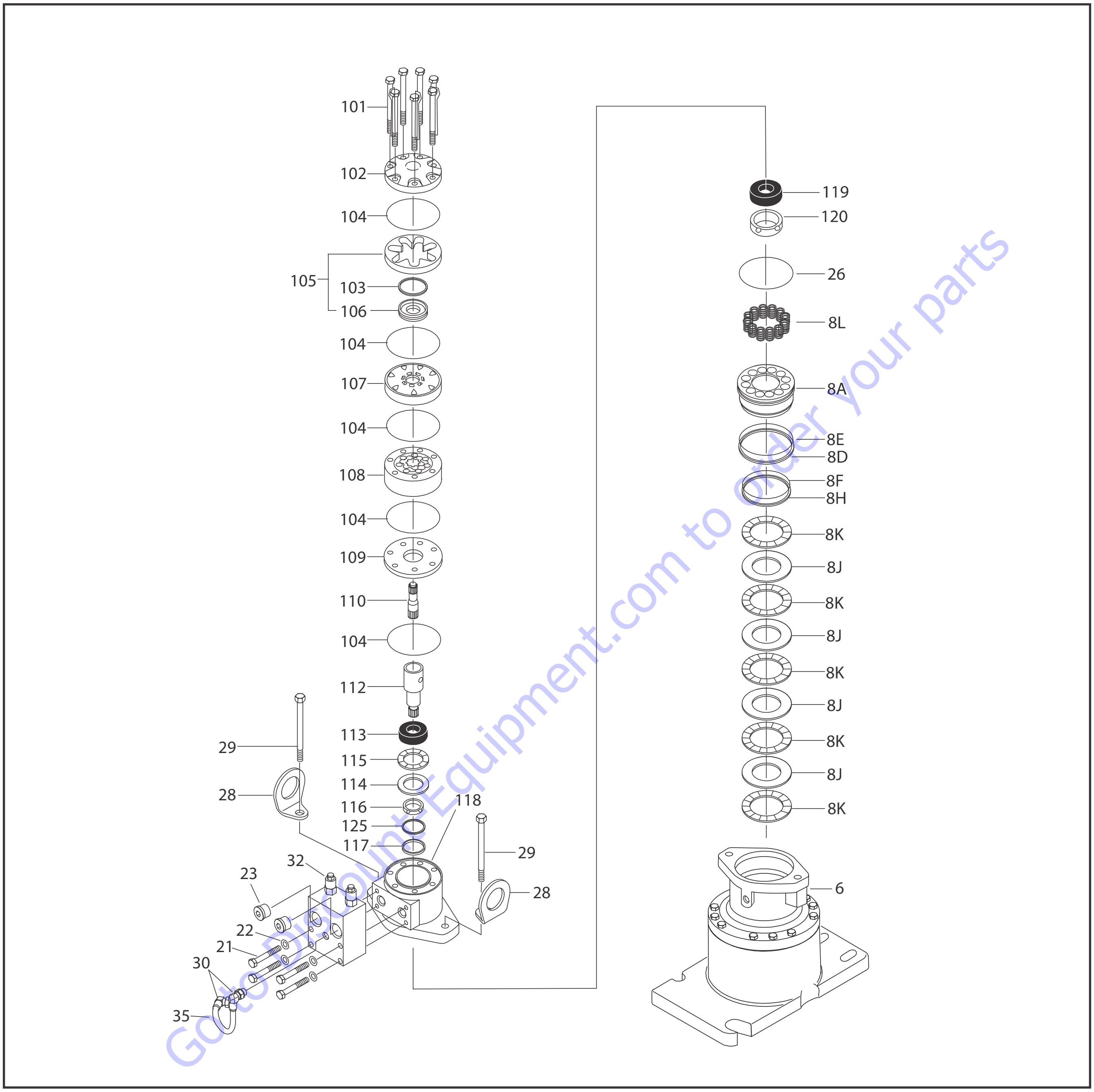
NOTE: *Be sure to align the holes in the control valve with the motor ports.*

2. Install Elbow Fittings (30) into Brake (6). Do not tighten jam nuts.
3. Install Elbow Fittings (30) into Motor Control Valve (32). Do not tighten jam nuts.
4. Assemble Tube (35) into Elbow Fittings (30) and torque to 13-15 ft.lbs (18-20 Nm). Tighten the jam nuts on the Elbow Fittings (30) and torque to 13-15 ft.lbs. (18-20 Nm).
5. Install one O-ring Plug (23) into Motor Control Valve (32) and torque to 30-31 fl.lbs. (41-42 Nm).
6. Pressure test brake, tube and control valve connections by applying 3000 psi (207 bar) pressure to the open port in the Motor Control Valve (32) and holding lor 1 minute. Check lor leaks al the control-valve-motor interface and the tube connections. Release pressure and install the remaining O-ring Plug (23) into Motor Control Valve (32) and torque to 30-31 ft.lbs. (41-42 Nm).



1A. Output Shaft	1G. Housing	2. Internal Gear	5A. O-Ring	12. Bolt
1B. Lip Seal	1H. Thrust Washer	3. Carrier Assembly	6. Brake Housing	13. Dowel Pin
1C. Bearing	1I. Retaining Ring	4. Ring Gear	8. Sun Gear	20. Pipe Plug
1D. Bearing	1J. Pipe Plug	5. O-Ring	11. Thrust washer	44. Internal Retaining Ring

Figure 3-38. Swing Drive Assembly



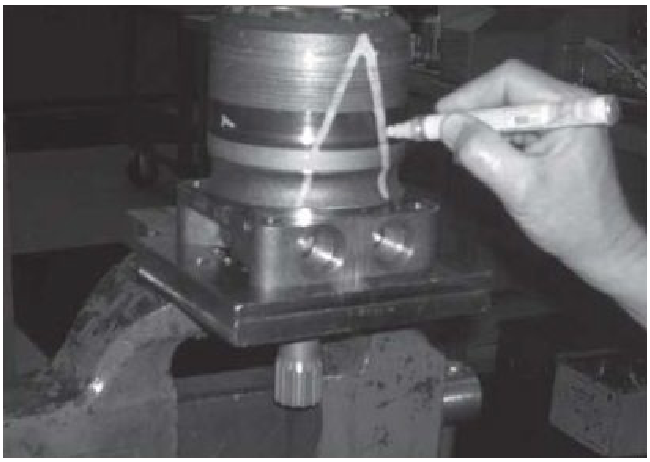
6. Brace Housing
8A. Piston
8D. 0-Ring
8E. BackUp Ring
8F. O-Ring
8H. Backup Ring
8J. Rotor Disc
8K. Stator Disc
8L. Spring
21. Thrust Washer
22. Lock washer
23. Pipe Plug
26. 0-Ring
28. Lifting lug
29. Bolt
30. Elbow
35. Tube
101. Bolt
102. End Cover
103. Commutator Seal
104. Ring Seal
105. Commutator and Ring Assy
106. Ring
107. Manifold
108. Rotor Set
109. Wear Plate
110. Drive Link
112. Coupling Shaft
113. Inner Bearing
114. Thrust Washer
115. Thrust Bearing
116. Inner Seal
117. Backup Washer
118. Housing
119. Outer Bearing
120. Seal
125. Backup Washer

Figure 3-39. Swing Motor and Brake Assembly

3.15 SWING MOTOR

Disassembly and inspection

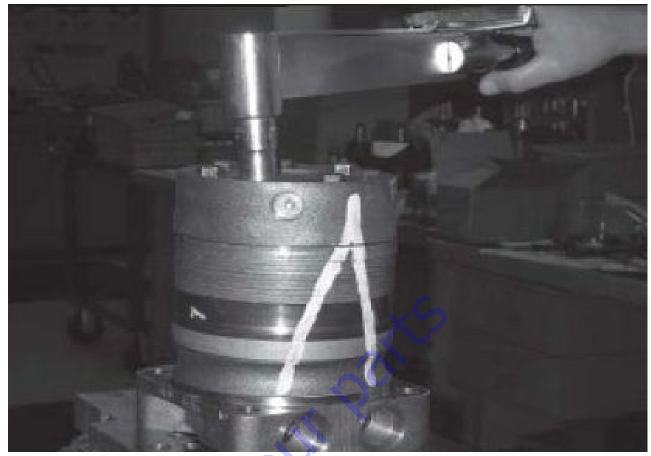
1. Place the Torqmotor™ in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings (18A) if applicable.



⚠ WARNING

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

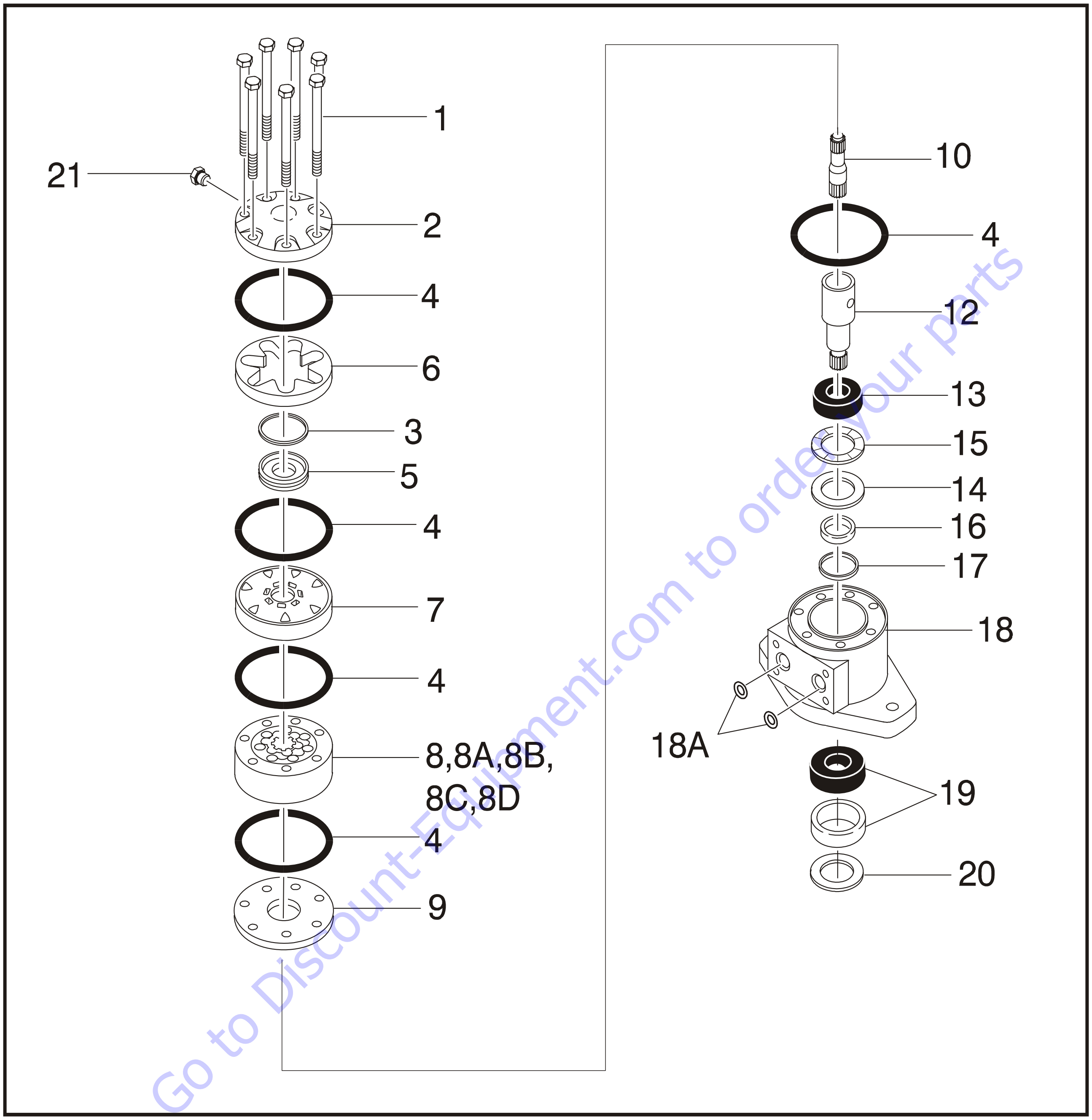
2. Scribe an alignment mark down and across the Torqmotor™ components from end cover (2) to housing (18) to facilitate reassembly orientation where required. Loosen two shuttle or relief valve plugs (21) for disassembly later if included in end cover. 3/16 or 3/8 inch Allen wrench or 1 inch hex socket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

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

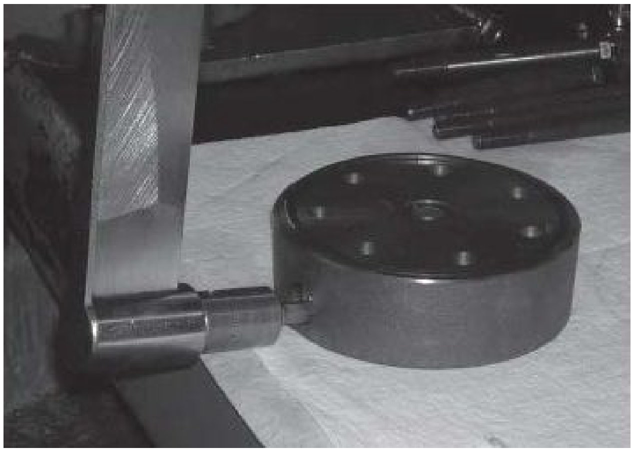
NOTE: *Refer to the appropriate "alternate cover construction" on the exploded view to determine the end cover construction being serviced.*



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

Figure 3-40. Swing Drive Motor

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: *O- ring is not included in seal kit but serviced separately, if required.*

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.*

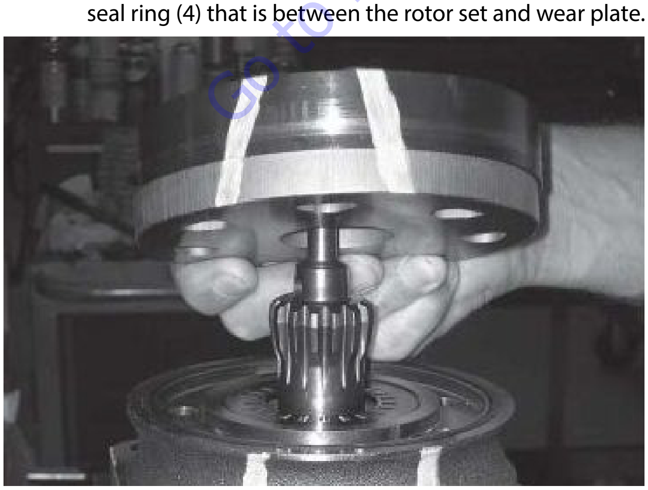
7. Remove commutator ring (6). Inspect commutator ring for cracks, or burrs.

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 oft hem an 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 wear plate.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.

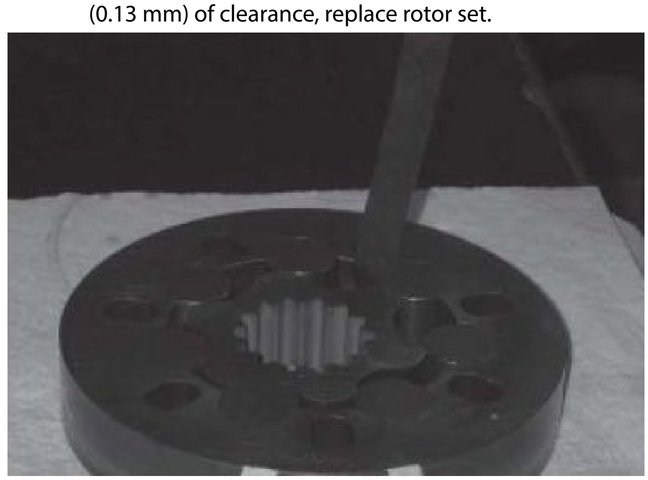


NOTE: *The rotor set (8) components may become disassembled during service procedures. Marking the surface of the rotor and stator that is facing UP, with etching ink or grease pencil before removal from Torqmotor™ will ensure correct reassembly of rotor into stator and rotor set intoTorqmotor™.Marking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

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

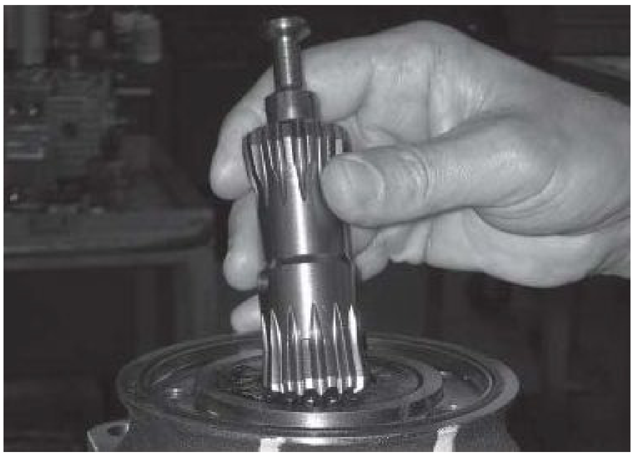
NOTE: *A polished pattern on the wear plate from rotor rotation is normal.*

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.

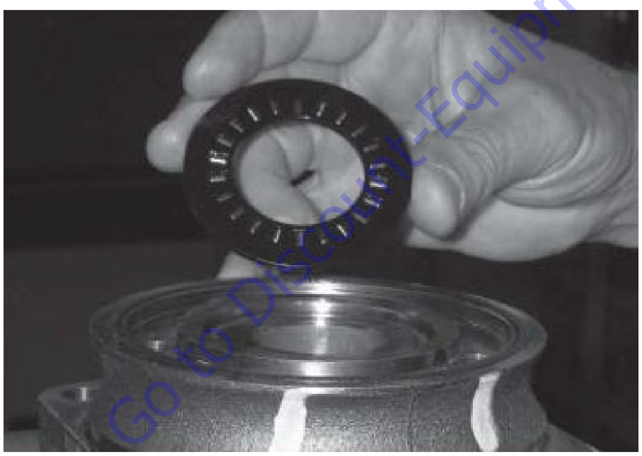


NOTE: *If rotor set (8) has two stator halves (8B & 8D) and two sets of seven vanes (8C & 8E) as shown in the alternate construction TG rotor set assembly view, check the rotor lobe to roller vane clearance at both ends of rotor.*

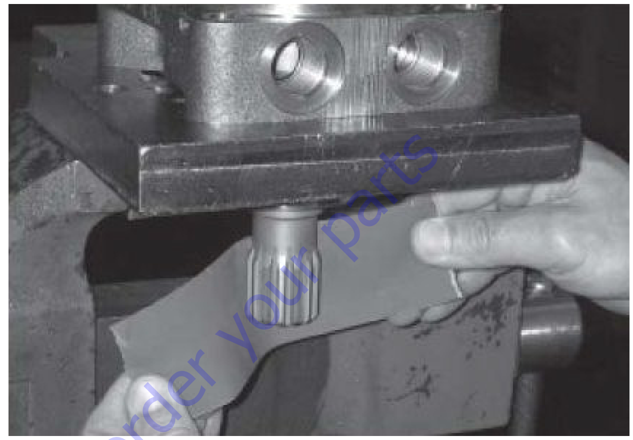
12. Remove drive link (10) from coupling shaft (12) if it was not removed with rotor set and wear plate. Inspect drive link for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. Remove and discard seal ring (4) from housing (18).



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. Remove any key (12A), nut (12B), washer (12C), bolt (12D), lock washer (12E), or retaining ring (12F).



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).

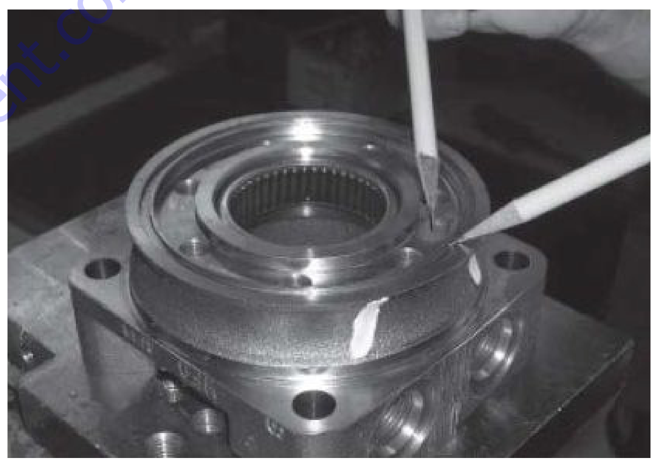
17. Remove thrust bearing (15) and thrust washer (14) Inspect for wear, brinelling, corrosion and a full complement of retained rollers.

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

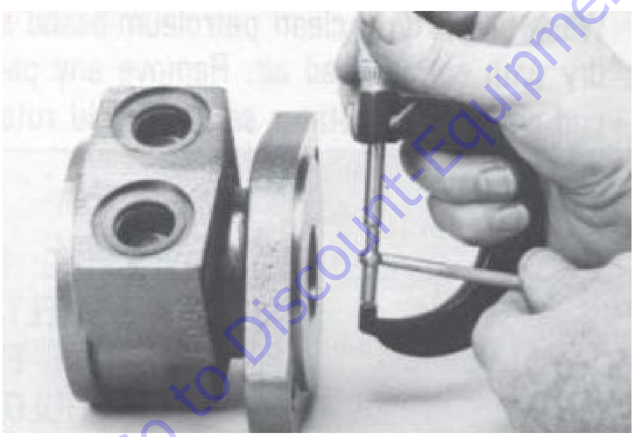
19. Remove housing (18) from vise, invert it and remove and discard seal

20. A blind hole bearing or seal puller is required.

21. 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.

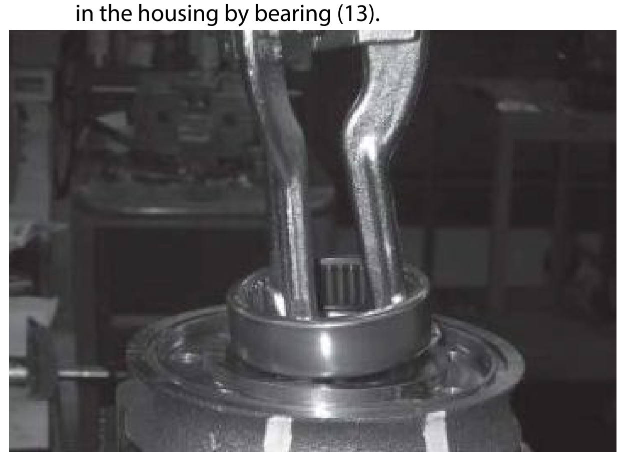


22. If the housing (18) assembly has passed inspection to this point, inspect the housing bearings/bushings (19) and (13) and if they are captured in the housing cavity the two thrust washers (14) and thrust bearing (15). The bearing rollers must be firmly retained in the bearing cages, but must rotate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

23. 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 Torqmotor™ 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 Torqmotor™ 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.

⚠ DANGER

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.

   Torqmotor™ 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

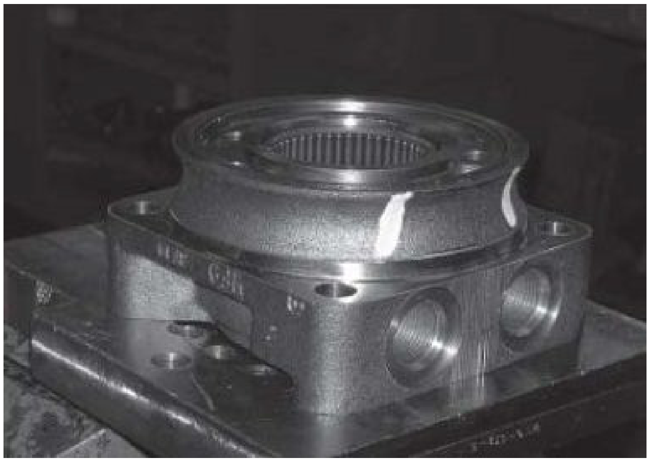
BECAUSE THE BEARING/BUSHINGS (13) AND (19) HAVE A PRESS FIT INTO THE HOUSING THEY MUST BE DISCARDED WHEN REMOVED. THEY MUST NOT BE REUSED.

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

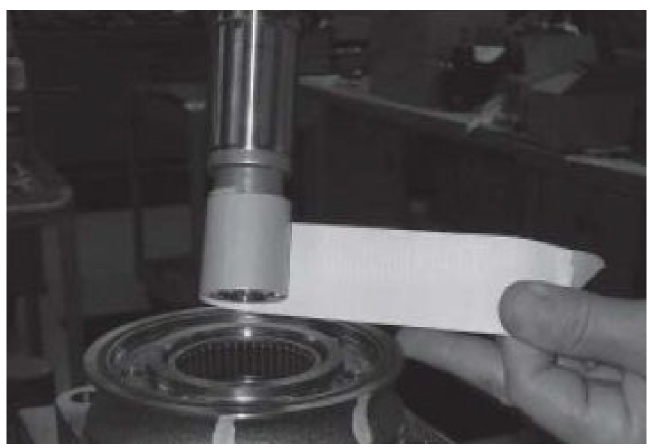
NOTICE

ORIGINAL DESIGN LARGE FRAME, TF & TG TORQMOTORS™ 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).

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

NOTE: *Torqmotors™ 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.

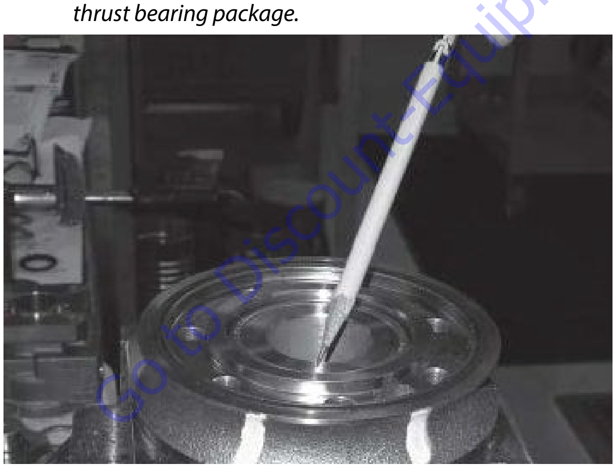


8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12) into housing (18), seating it against the thrust bearing (15) in the housings.

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 OR MOBIL MOBILITH SHC ® 460.

NOTE: *The coupling shaft (12) will be flush or just below the housing wear plate surface on Torqmotors™ 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.

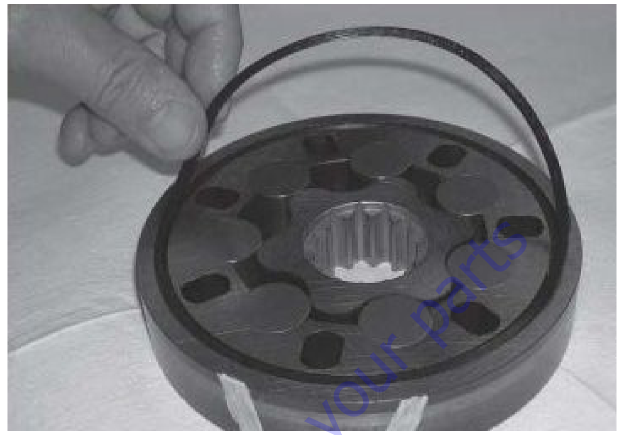
NOTE: *One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures.The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF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

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).

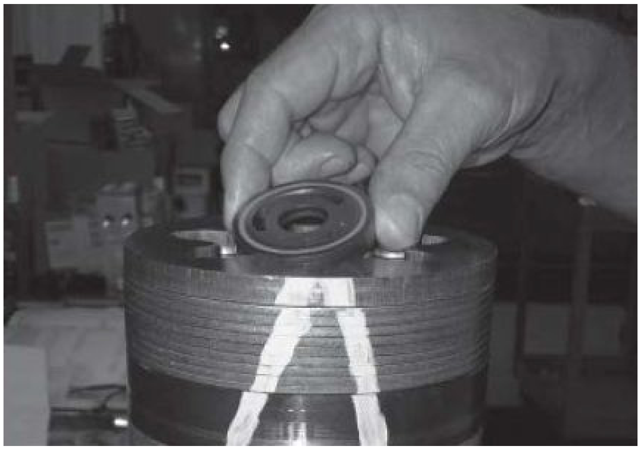
NOTE: *The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression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

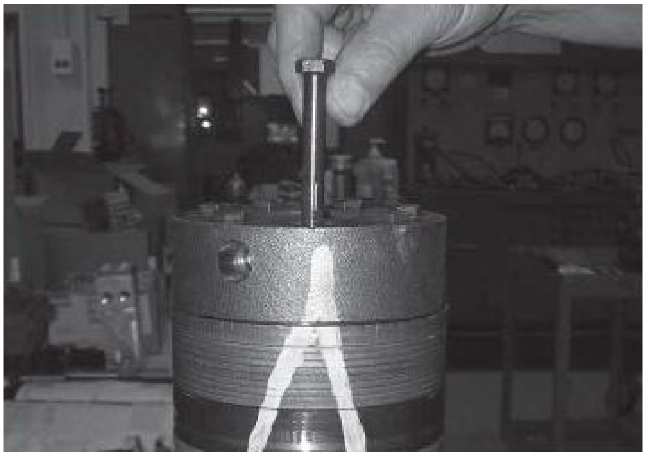
17. Assemble the commutator ring (6) over alignment studs onto the manifold.

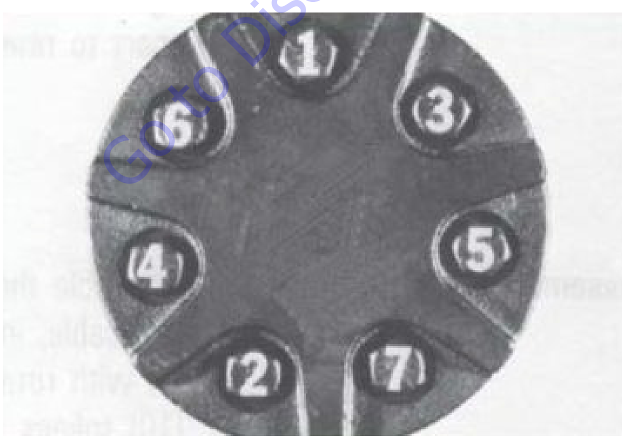
18. Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.



19. 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.

20. 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 50-55 ft. lbs.(68-75 N m) for the seven 3/8-24 threaded bolts.

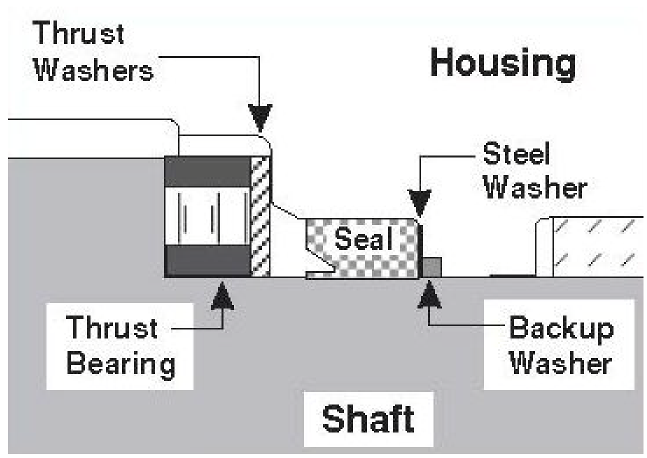




NOTE: *The special bolts required for use with the relief or shuttle valve (24) end cover assembly (2) are longer than the bolts required with standard and cover assembly. Refer to the individual service parts lists or parts list charts for correct service part number if replacement is required.*

21. 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.



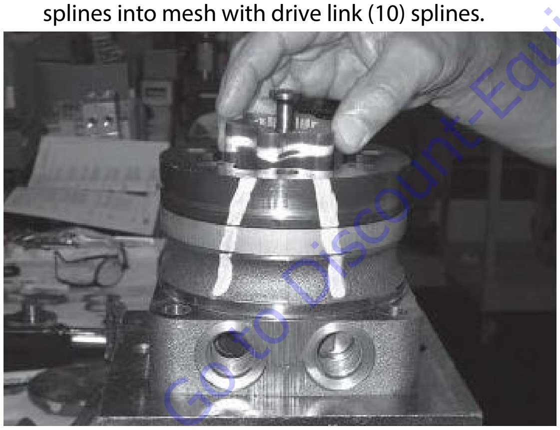
One Piece Stator Construction

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 Torqmotor™ 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 Torqmotor 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.

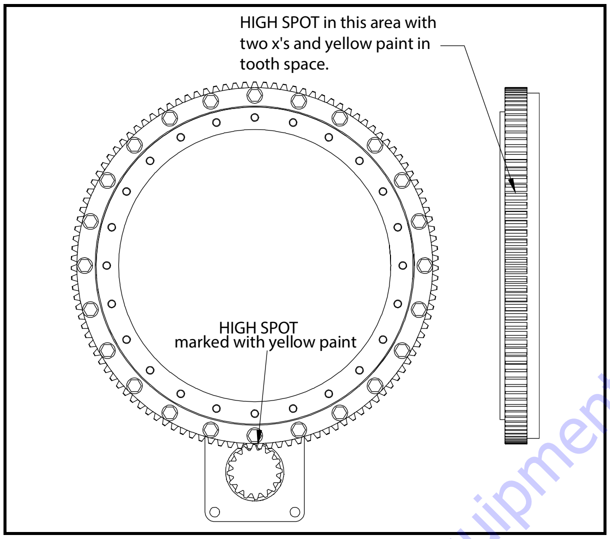
3.16 SWING HUB INSTALLATION

Ensure mounting plate and mounting location of the base plate are clean and painted with a uniform coating of minimum thickness (no runs, drips, etc.).

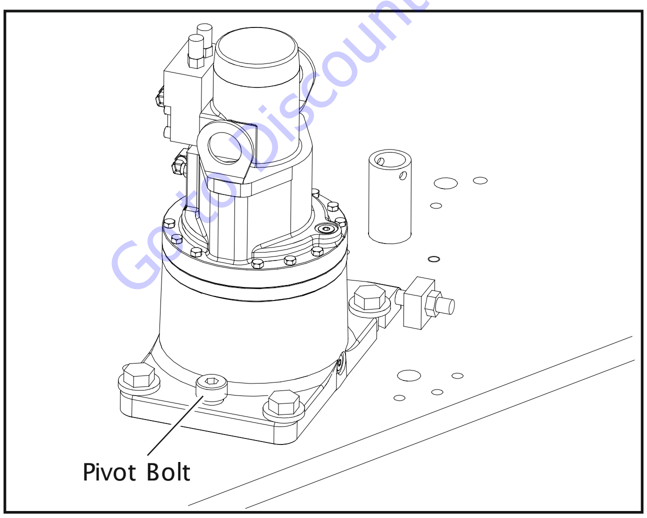
Procedure For Setting Swing Gear Backlash

Set backlash to 0.010 in. to 0.015 in. (0.254 mm - 0.381 mm) using the following procedure:

1. Place the machine on firm, level ground.
2. Place shim between pinion and bearing at bearing high spot (shown below).

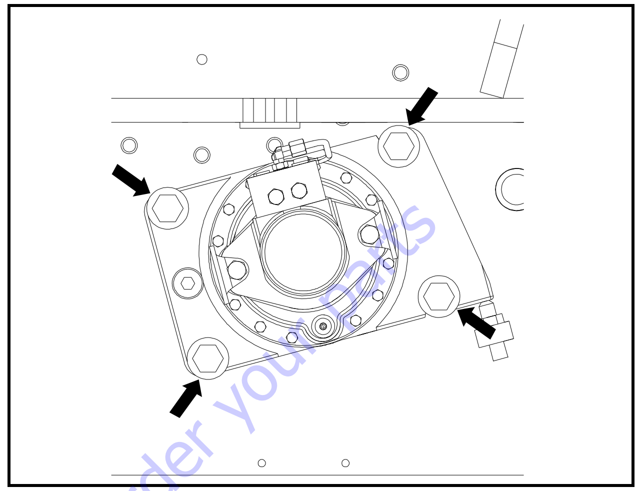


3. Apply JLG Threadlocker P/N 0100019 and torque pivot bolt to 205 ft. lbs. (280 Nm) (shown below).

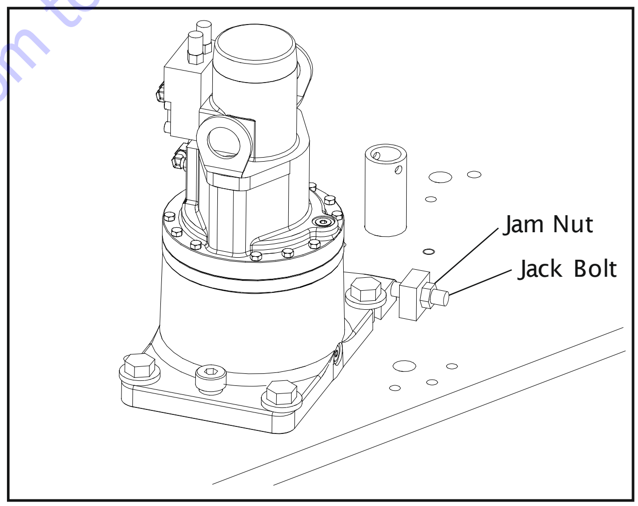


NOTE: *Make sure the turntable is properly supported during the following step. The turntable can swing a few degrees when the turntable lock is removed if the turntable is not balanced properly.*

4. Remove turntable lock pin.
5. Apply JLG Threadlocker P/N 0100019 and pre-torque swing drive mounting bolts to 30 ft. lbs. (40 Nm).

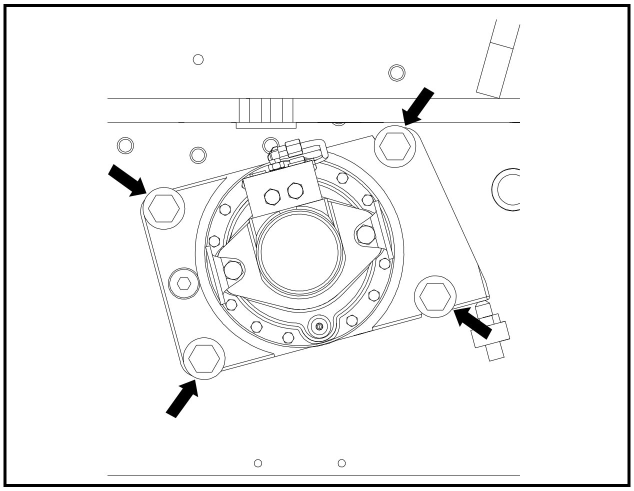


6. Tighten jack bolt until pinion is completely snug against shim and bearing then loosen jack bolt.

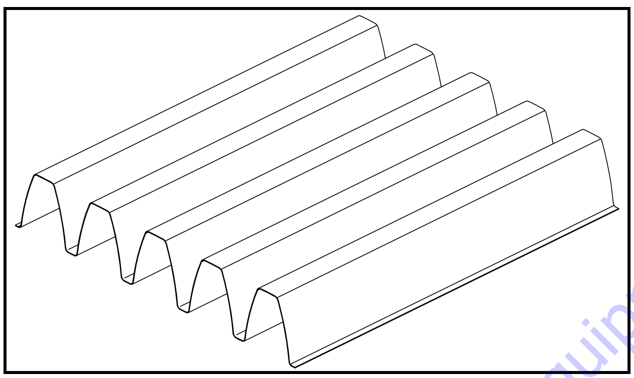


7. Apply JLG Threadlocker P/N 0100019 and torque jack bolt 50 ft. lbs. (68 Nm).
8. Apply JLG Threadlocker P/N 0100019 and tighten jam nut.

9. Torque mounting bolts to 340 ft. lbs. (Nm).

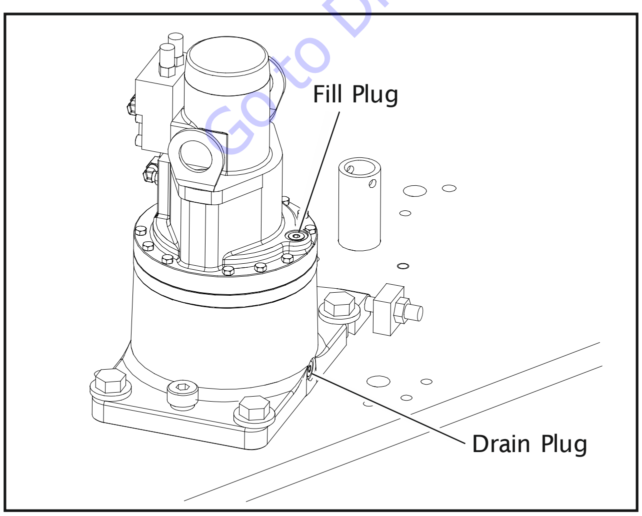


10. Remove shim and discard.



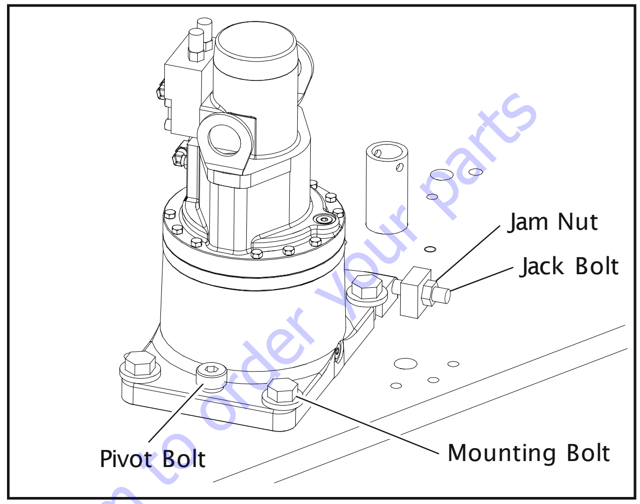
Swing Drive Lubrication

Fill Swing Drive Gearbox with 43 oz (1.27 L) 90w80gear oil with EP additives. Oil should cover the ring gear. Torque pipe plug to 23-25 ft.lbs (31- 33 Nm).



3.17 SWING HUB REMOVAL

1. Disconnect all wiring harness terminals connected to the swing motor.
2. Gently loosen the set screw. Do not remove.
3. Remove the pivot bolt using Allen Wrench.



4. Remove the mounting bolts securing swing drive hub to the turntable.
5. Using the suitable lifting device, remove the swing drive hub from mounting plate without damaging the swing gear.
6. Place swing drive hub in the clean area.
7. Refer to Section 3.14, Swing Drive for swing drive maintenance.

3.18 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

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.

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

1. Check the frame to bearing attach bolts as follows:
   - **a.** Elevate the fully extended main boom to horizontal. (See Figure 3-42.)
   - **b.** At the positions indicated on Figure 3-43. try to insert a.0015 feeler gauge between the bolt and hardened washer at the arrow indicated position.
   - **c.** Ensure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
   - **d.** Swing the turntable 90 degrees, and check some selected bolts at the new position.
   - **e.** Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.
2. Check the turntable to bearing Attach bolts as follows:
   - **a.** Elevate the fully retracted main boom to full elevation.
   - **b.** At the position indicated on Figure 3-41. try to insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   - **c.** Lower the boom to horizontal and fully extend the boom.
   - **d.** At the position indicated on Figure 3-43., try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

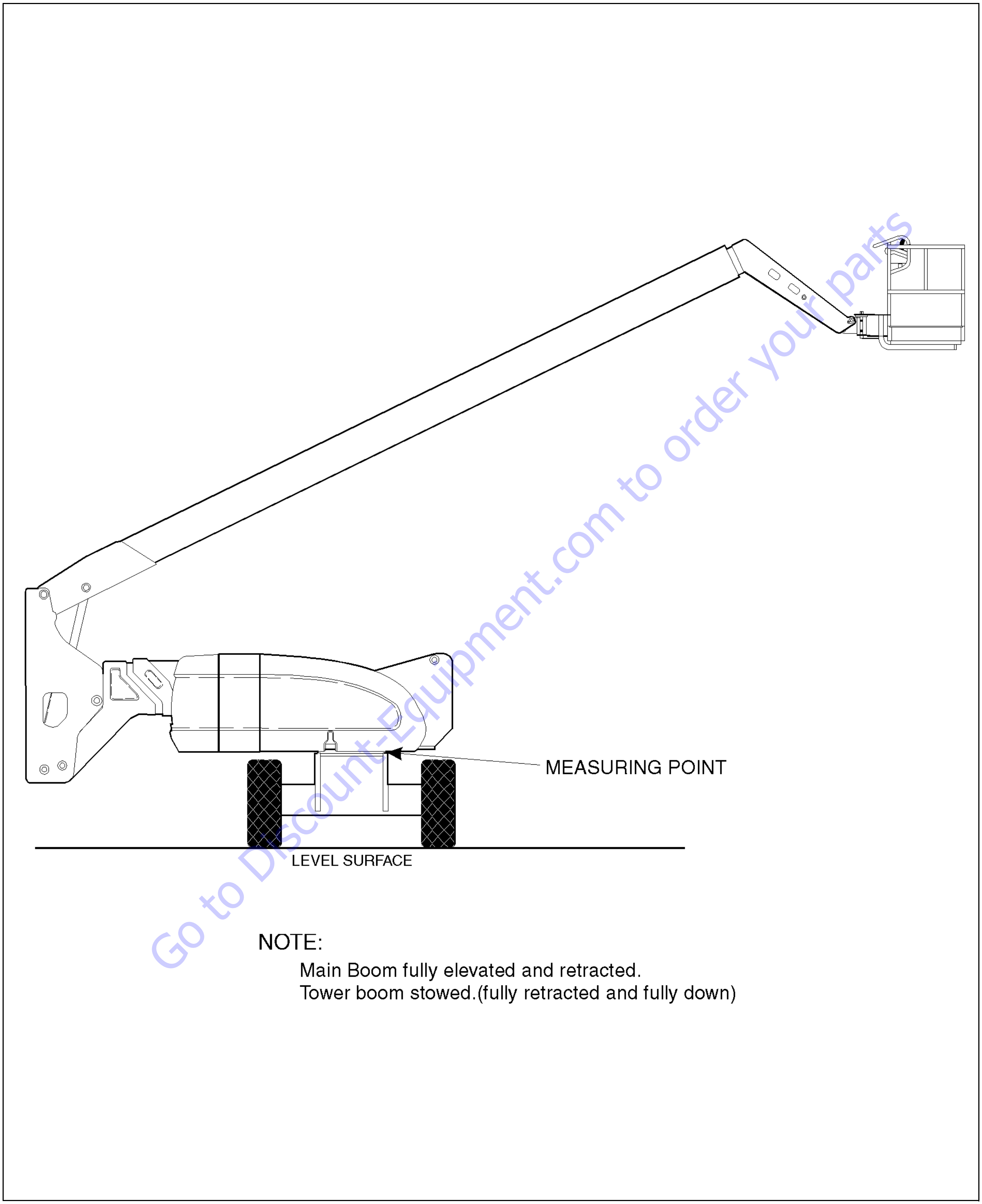


Figure 3-41. Swing Bearing Tolerance Boom Placement (Sheet 1 of 2)

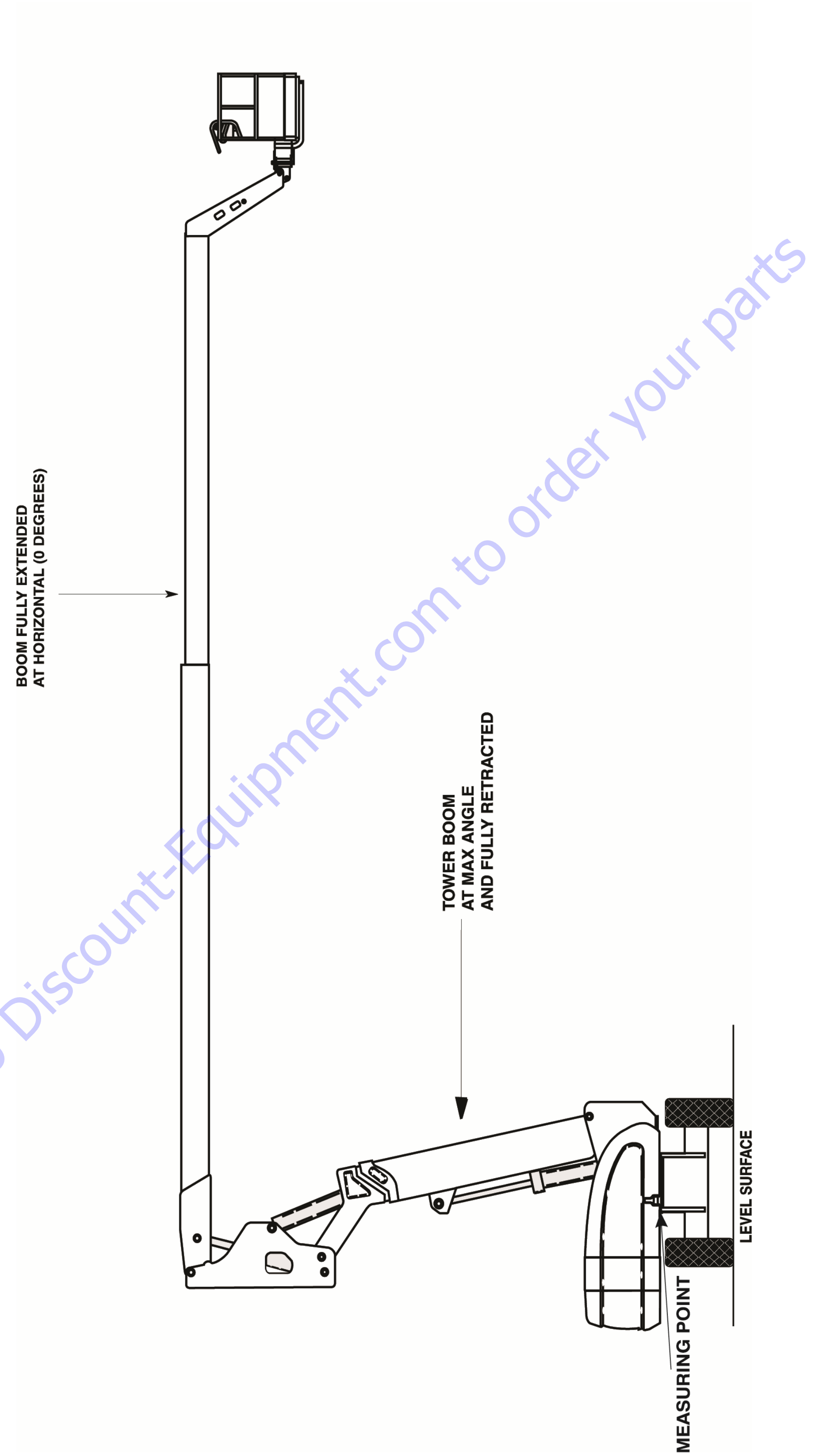


Figure 3-42. Swing Bearing Tolerance Boom Placement (Sheet 2 of 2)

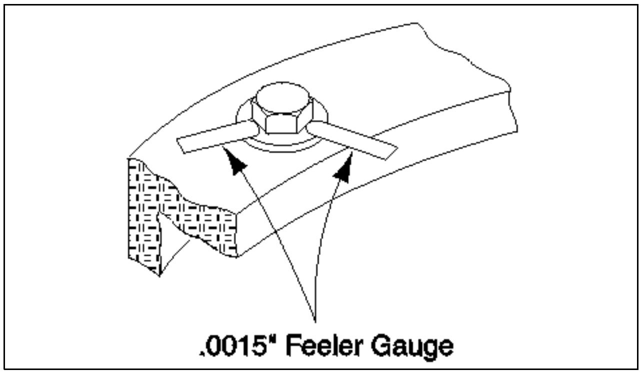


Figure 3-43. Swing Bolt Feeler Gauge Check

Wear Tolerance

1. From the underside of the machine, at rear center, with the main boom fully elevated and fully retracted, and tower boom stowed, as shown in Figure 3-41., Swing Bearing Tolerance Boom Placement (Sheet 1 of 2), using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. See Figure 3-44., Swing Bearing Tolerance Measuring Point
2. At the same point, with the main boom at horizontal and fully extended, and the tower boom fully elevated and fully retracted as shown in Figure 3-42., Swing Bearing Tolerance Boom Placement (Sheet 2 of 2). Using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. See Figure 3-44., Swing Bearing Tolerance Measuring Point
3. If a difference greater than 0.079 in. (2.00 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.079 in. (2.00 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.

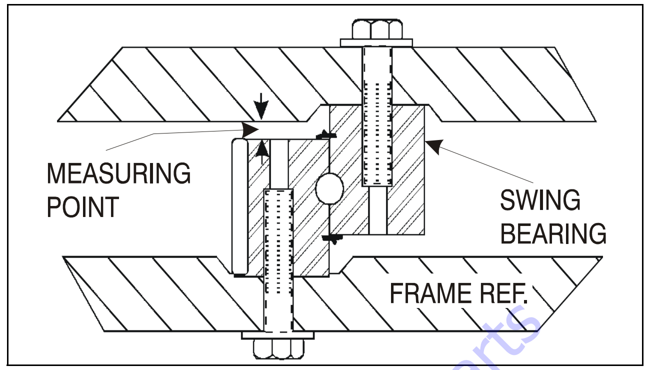


Figure 3-44. Swing Bearing Tolerance Measuring Point

Swing Bearing Replacement

REMOVAL

1. From Ground Control station, operate the boom adequately to provide access to frame opening to rotary coupling.

⚠ WARNING

NEVER WORK BENEATH THE BOOM WITHOUT FIRST ENGAGING BOOM SAFETY PROP OR PROVIDING ADEQUATE OVERHEAD SLING SUPPORT AND/OR BLOCKING.

2. Attach an adequate support sling to the boom and draw all slack from sling. Prop or block the boom if feasible.
3. From inside turntable, remove mounting hardware which attach rotary coupling retaining yoke brackets to turntable.

NOTICE

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

4. Tag and disconnect the hydraulic lines from the fittings on the top of the rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.
5. Attach suitable overhead lifting equipment to the base of the turntable weldment.
6. 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.
7. 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.

8. Carefully place the turntable on a suitably supported trestle.

9. 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.

INSTALLATION

1. 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 filler plug fitting is at 90 degrees from the fore and aft center line of the frame.

CAUTION

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.

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

NOTICE

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

3. Refer to the Torque Sequence diagram as shown in Figure 3-46., Swing Bearing Torque Sequence. Clean any residue off the new bearing bolts, then apply a light coating of JLG Threadlocker P/N 0100019 and install the bolts and washers through the frame and outer race of the bearing. Tighten the bolts to an initial torque of 190 Ft. lbs. (260 Nm) w/JLG Threadlocker P/N 0100019.

4. Remove the lifting equipment from the bearing.

5. Using suitable lifting equipment, carefully position the turntable assembly above the machine frame.

6. 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. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the turntable.

7. Clean any residue off the new bearing bolts, then apply a light coating of JLG Threadlocker P/N 0100019 and install the bolts and washers through the turntable and inner race of the bearing.

8. Following the Torque Sequence diagram shown in Figure 3-46., Swing Bearing Torque Sequence, tighten the bolts to a torque of 190 ft. lbs. (260 Nm) w/Loctite.

9. Remove the lifting equipment.

10. Install the rotary coupling retaining yoke brackets, apply a light coating of JLG Threadlocker P/N 0100011 to the attaching bolts and secure the yoke to the turntable with the mounting hardware.

11. Connect the hydraulic lines to the rotary coupling as tagged prior to removal.

12. At ground control station, use boom lift control to lower boom to stowed position.

13. 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 - 190 ft. lbs. (260 Nm) w/JLG Threadlocker P/N 0100019.

2. Inner Race - 190 ft. lbs. (260 Nm) w/JLG Threadlocker P/N 0100019.

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.

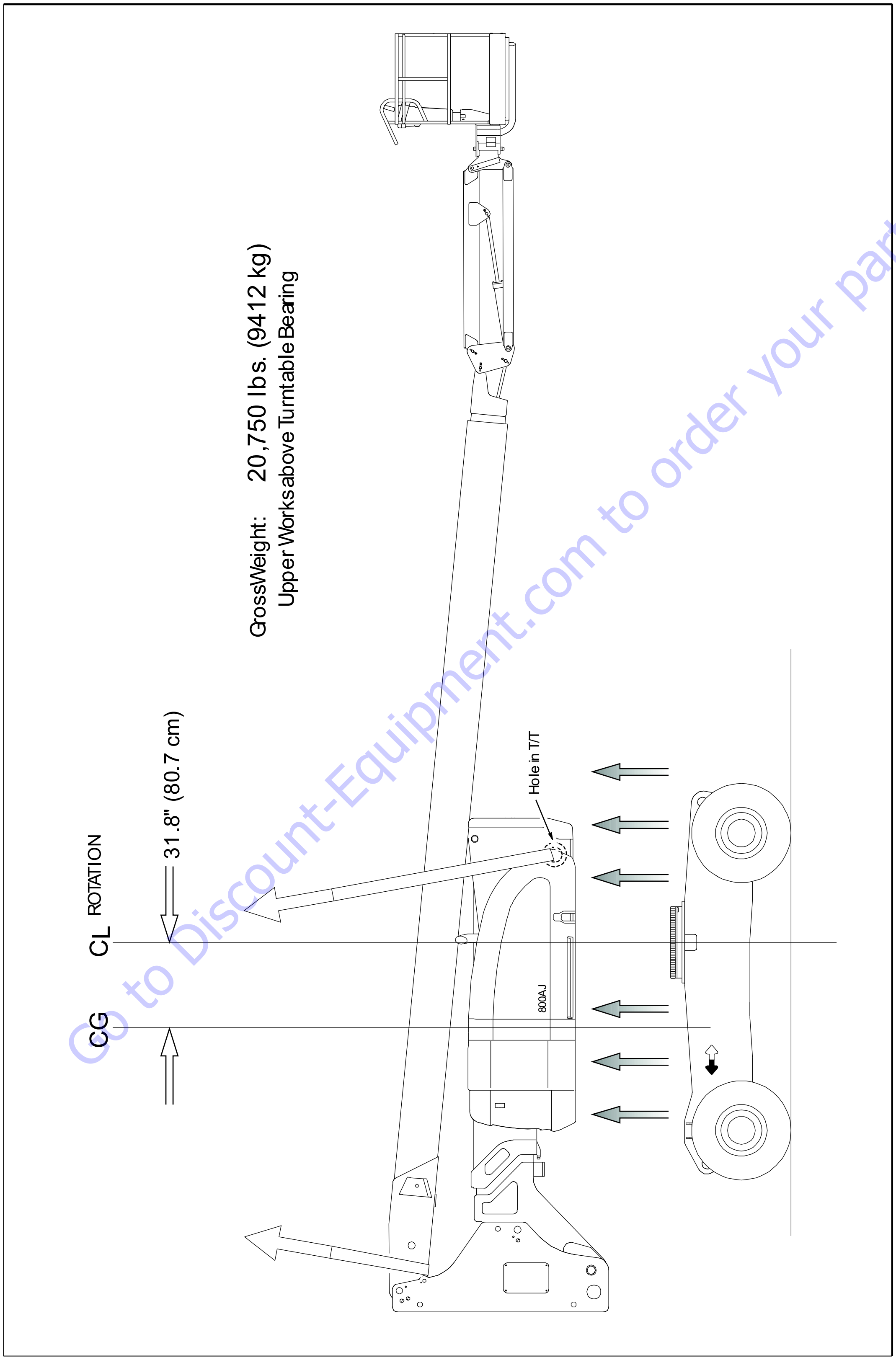
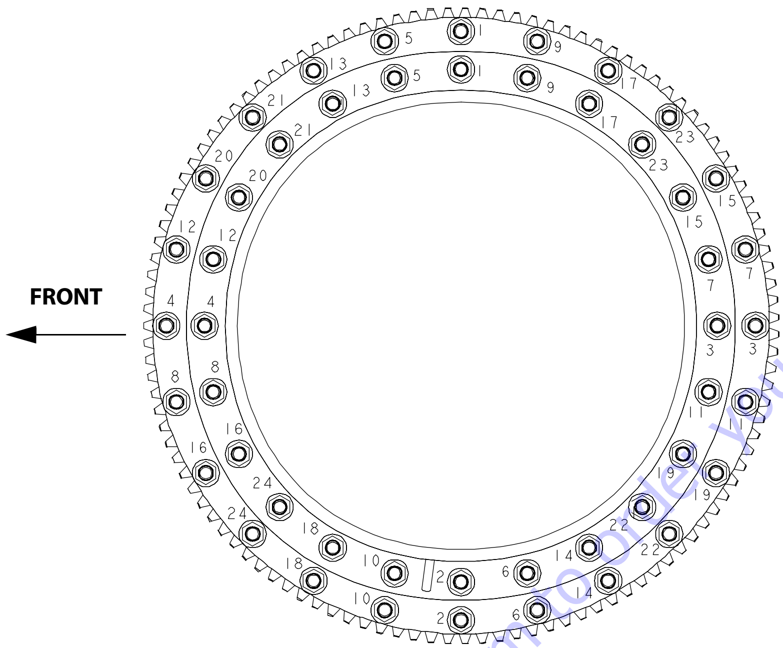


Figure 3-45. Swing Bearing Removal (800AJ)



NOTE: *Swing Bearing Torque Sequence is typical for both inner and outer races.*

Figure 3-46. Swing Bearing Torque Sequence

3.19 CHASSIS TILT INDICATOR SYSTEM

The Chassis Tilt Indicator System measures the turntable angle with respect to level ground. The tilt sensor has two settings: 5.0°/4.0° (depending on market) and 8.0° degrees.

The 5.0°/4.0° angle is used for the purpose of warning the operator by means of an audible alarm and the chassis tilt light in the platform display panel. This is a warning system only; the machine will continue to function. The operator is responsible for preventing the machine from attaining an unstable position.

The 8.0° angle is used exclusively for the purpose of automatically shifting the drive motors to the maximum displacement position (slow speed) when this angle is reached and the boom is in Transport position.

By default setting, when the boom is in Transport Position (refer to Section 4 - Boom for more information on Transport Position), and the chassis is at or above 8.0°, the drive and steer system will automatically switch into Max Torque mode that cuts back at speed. Other functions will automatically switch into creep mode.

The control system responds to indicated angle readings 0.25 degree smaller than the required angles to account for calibration and sensor variation.

3.20 ROTARY COUPLING

Use the following procedure to install the seal kit.

1. If not already removed, remove the axle oscillation valve from the cylinder barrel. The spool of the valve protrudes into the barrel and will damage the spool and seals if left in place.
2. Remove snap ring (7) from end.
3. Remove thrust ring (6) from the same end.
4. Remove center body (1) from housing (3).
5. Cut off old seals (2, 4, 5).
6. Remove proximity switch.
7. Assemble lip seals (2) in direction shown in Figure 3-47., Rotary Coupling Seal Installation.
8. Reassemble O-ring (4).
9. Heat cap seals (5) in hydraulic oil for 5 minutes at 300° F (149° C).
10. Assemble cap seals over O-rings.
11. Reinsert center body into housing (lube with hydraulic oil).
12. Replace thrust ring and snap ring.
13. Install proximity switch as shown in Figure 3-51.

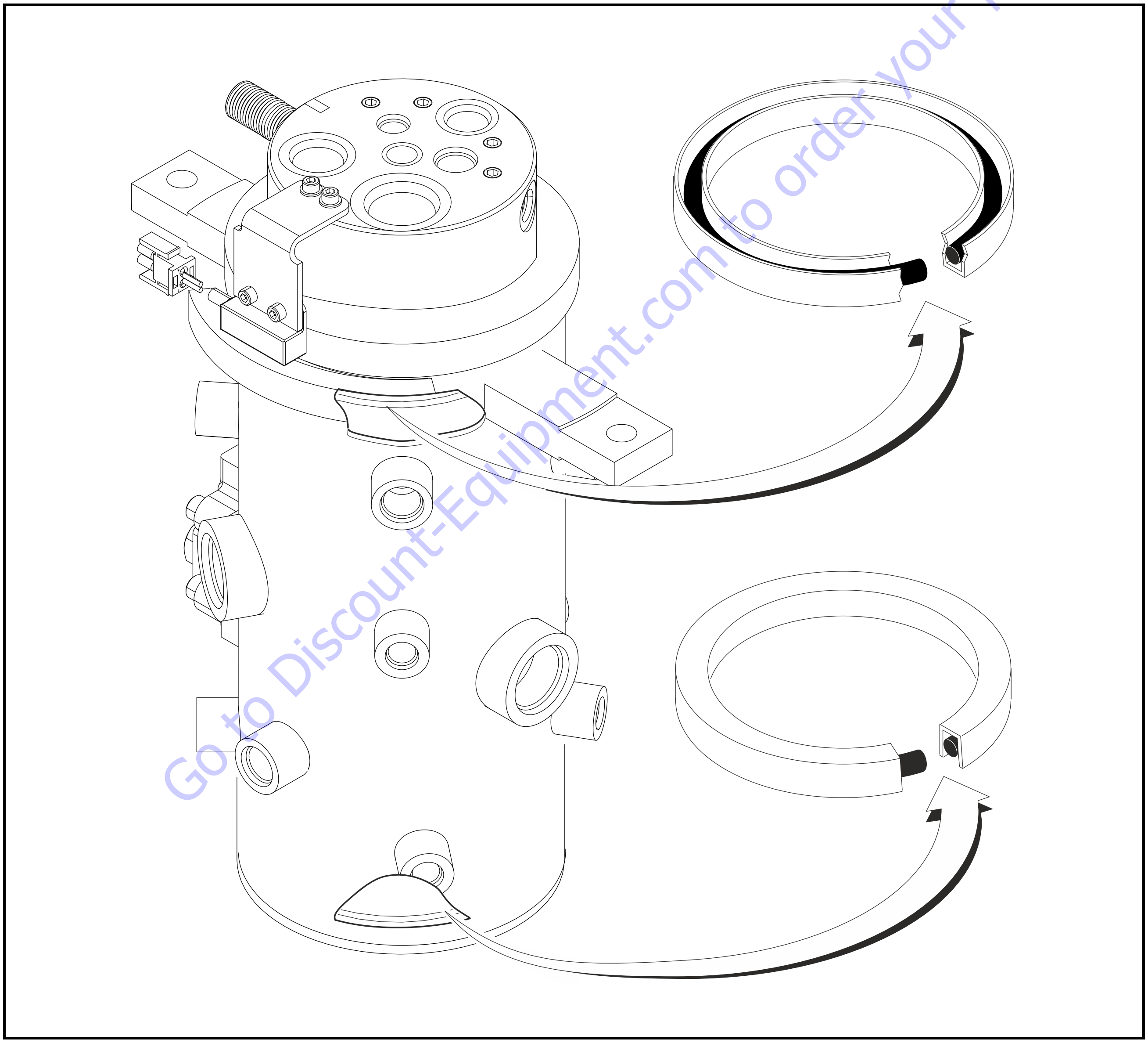
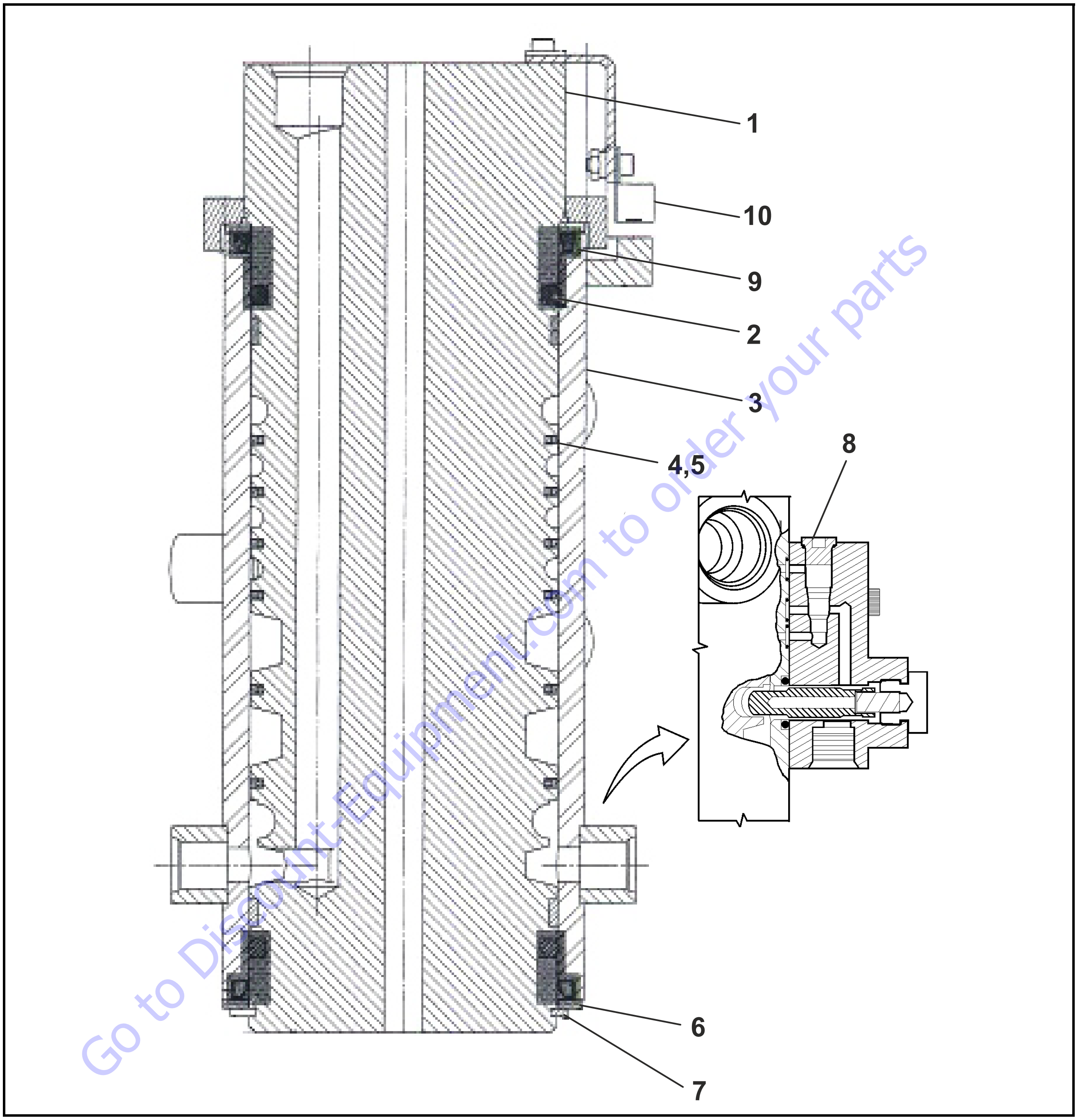


Figure 3-47. Rotary Coupling Seal Installation



1. Center Body
2. Seal
3. Housing
4. O-ring
5. Seal
6. Thrust Ring
7. Snap Ring
8. Valve Block (Axle Oscillation)
9. O-ring
10. Proximity Switch

Figure 3-48. Rotary Coupling Cutaway

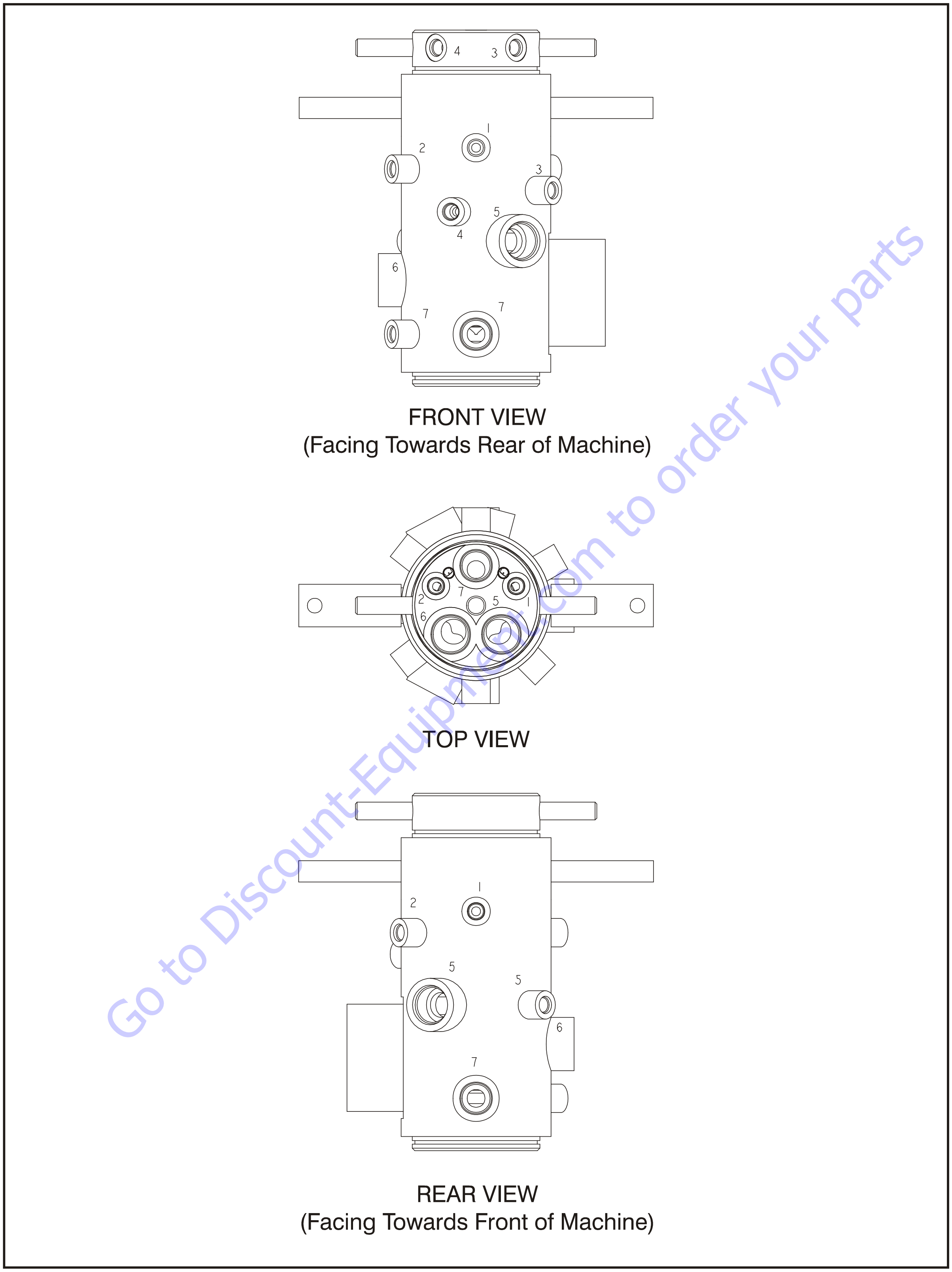


Figure 3-49. Rotary Coupling Port Location (7 Port)

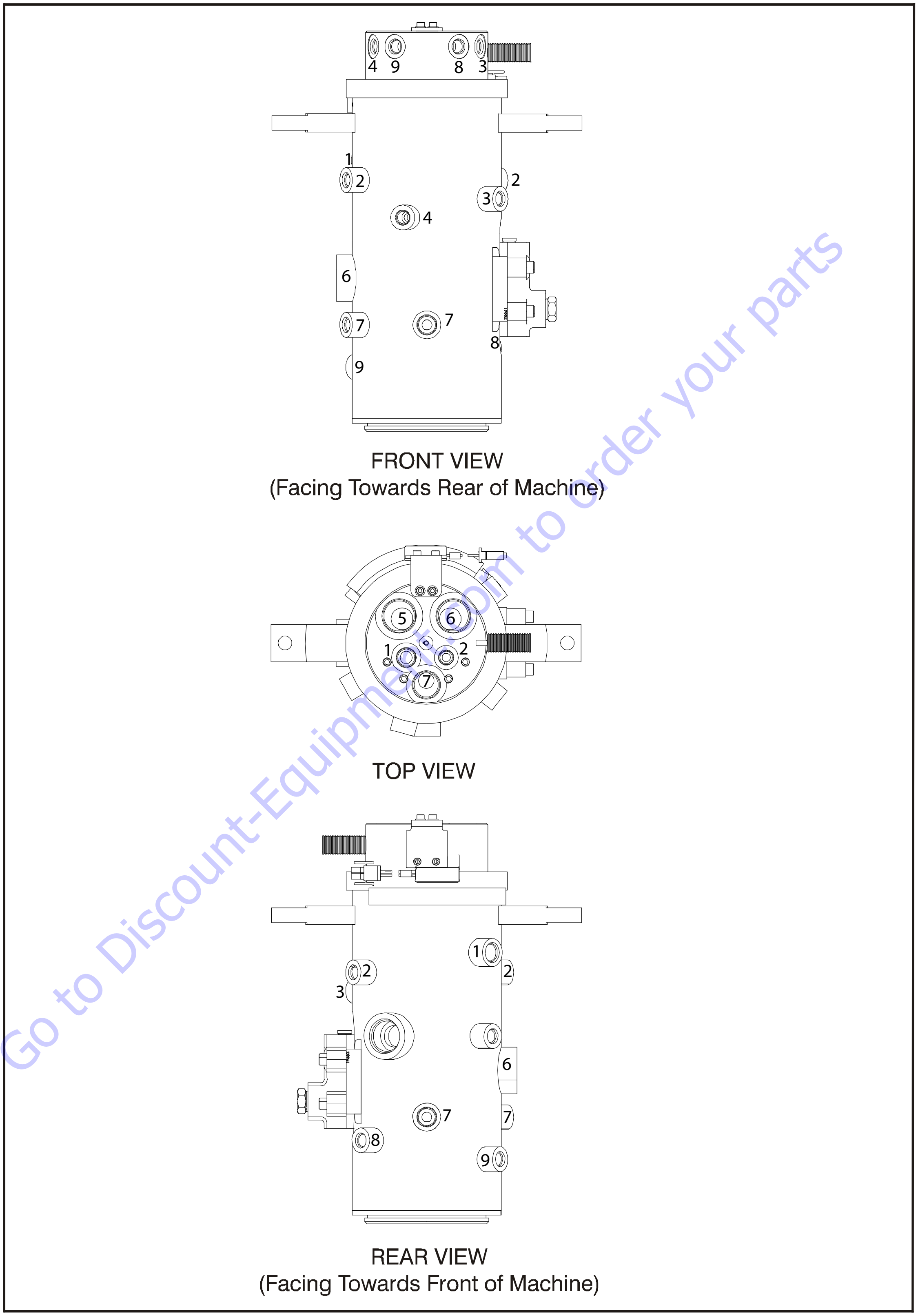
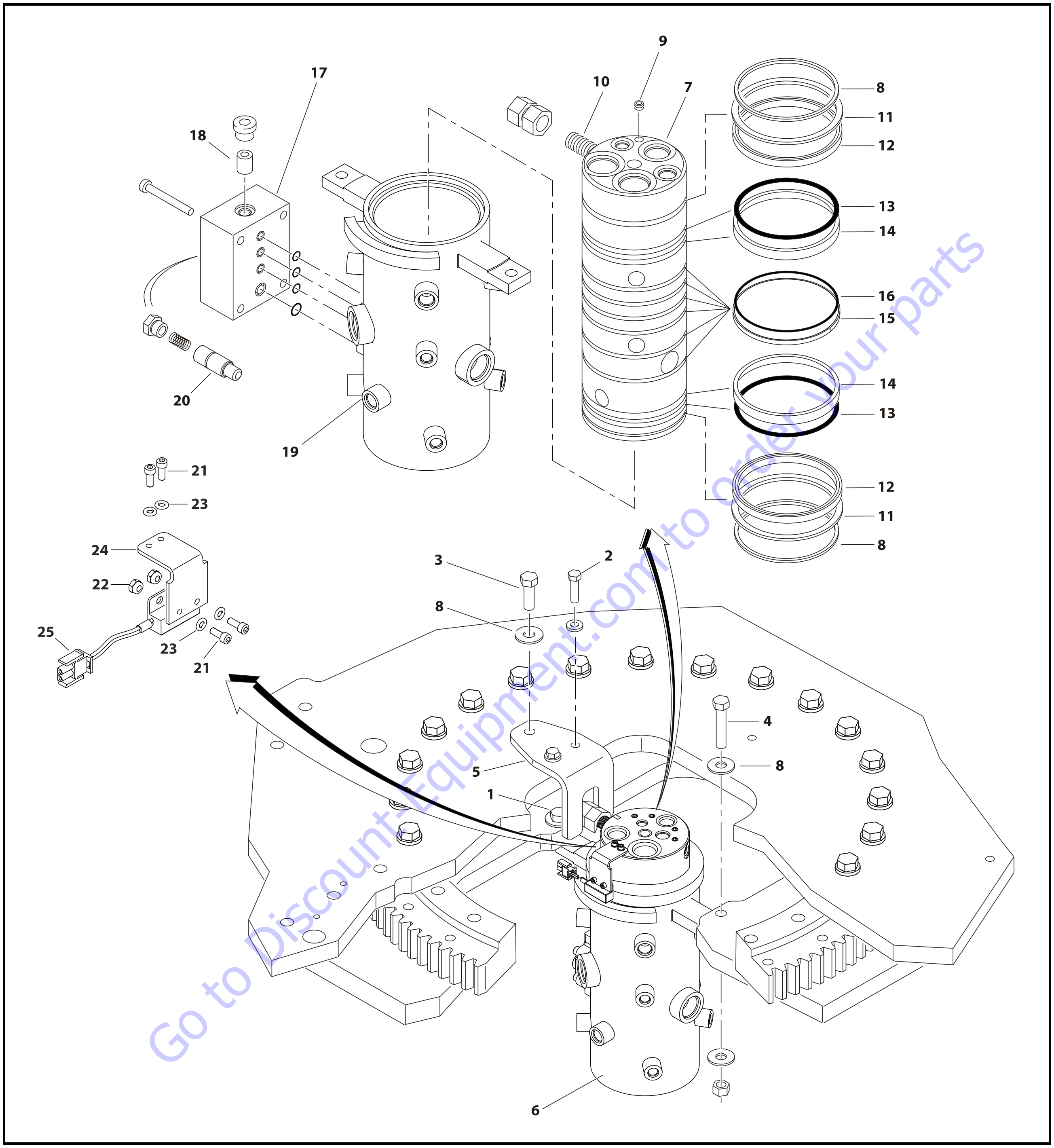


Figure 3-50. Rotary Coupling Port Location (9 Port)



1. JLG Threadlocker	6. Rotary Coupling	11. Ring	16. O-ring	21. Bolt
2. Bolt	7. Spool	12. Seal	17. Valve	22. Nut
3. Bolt	8. Retaining Ring	13. O-ring	18. Check Valve	23. Washer
4. Bolt	9. Plug	14. Bearing	19. Case	24. Bracket
5. Bracket	10. Torque Lug	15. Cap Seal	20. Plunger Valve	25. Proximity Switch

Figure 3-51. Rotary Coupling Installation

Table 3-9. Coupling Port Information Table (7 port)

Port No.	Outlets	Port Size	Description	Operating Pressure PSI (Bar)	Proof Pressure PSI (Bar)
1	1	-8	Brake	450 (31)	675 (46.5)
2	2	-6	2 Speed	4500 (310)	6750 (465)
3	1	-6	Steer	2500 (172)	3750 (258.5)
4	1	-6	Steer	2500 (172)	3750 (258.5)
5	2	1-6, 1-16	Drive Reverse	4500 (310)	6750 (465)
6	1	-16	Drive Forward	4500 (310)	6750 (465)
7	3	2-8, 1-6	Drain	250 (17)	375 (26)

Table 3-10. Coupling Port Information Table (9 port)

Port No.	Outlets	Port Size	Description	Operating Pressure PSI (Bar)	Proof Pressure PSI (Bar)
1	1	-8	Brake	450 (31)	675 (46.5)
2	2	-6	2 Speed	4500 (310)	6750 (465)
3	1	-6	Steer	2500 (172)	3750 (258.5)
4	1	-6	Steer	2500 (172)	3750 (258.5)
5	2	1-6, 1-16	Drive Reverse	4500(310)	6750(465)
6	1	-16	Drive Forward	4500 (310)	6750 (465)
7	3	2-8, 1-6	Drain	250 (17)	375 (26)
8	1	-6	Steer	2500 (172)	3750 (258.5)
9	1	-6	Steer	2500(172)	3750 (258.5)

3.21 GENERATOR

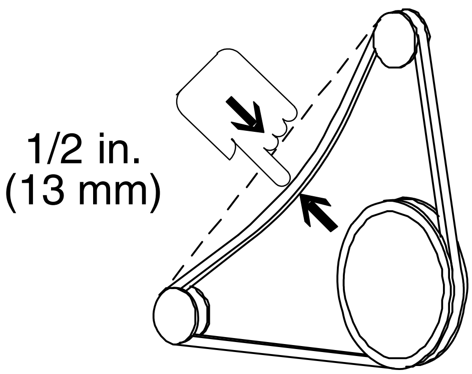
SkyPower

The optional 4kW and 7.5kW auxiliary generators can be powered by the engine only with the clutch engaged. When the aux generator is operational, excess power from the engine, coupled with power from the IMG can be used to drive the pumps to provide limited functionality. The performance of the drive and functions in this scenario will be less than in normal operation. In the event that the clutch is disengaged or the engine is reporting a code that could prevent it from providing full power, the SkyPower system will be disabled.

Maintenance Schedule

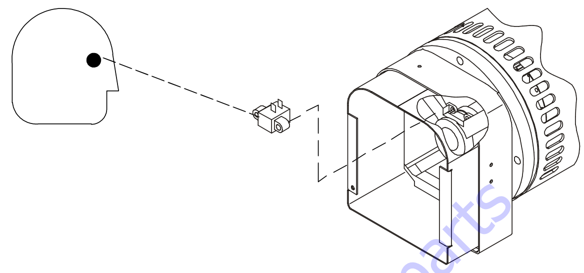
EVERY 250 HOURS

Every 250 hours of operation, check the drive belt for proper tension.

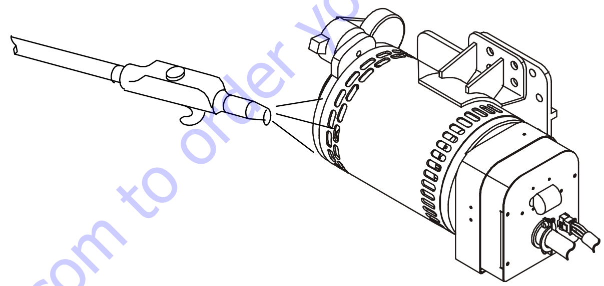


EVERY 500 HOURS

Every 500 hours of operation, service the generator brushes and slip rings. Hostile environments may require more frequent service.



Every 500 hours of service, blow out the inside of the generator. If operating in a hostile environment, clean monthly.

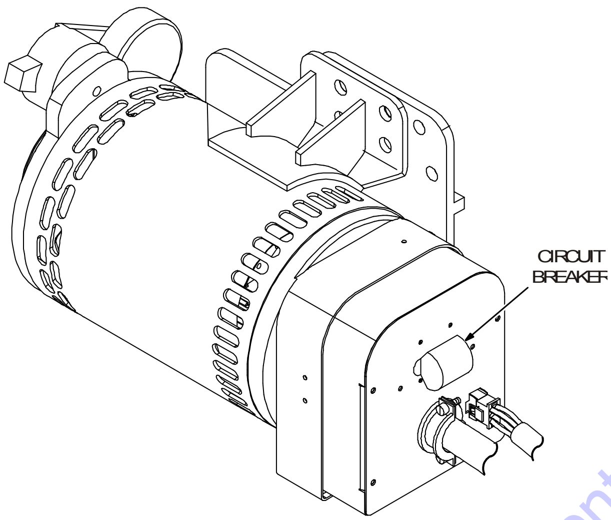


Overload Protection

⚠ CAUTION

STOP THE ENGINE WHENEVER CHECKING OR INSPECTING THE CIRCUIT BREAKER.

The circuit breaker protects the generator windings from overload. If the circuit breaker opens, generator output stops. If the circuit breaker continues to open, check for faulty equipment connected to the platform receptacles.



Inspecting Brushes, Replacing Brushes, and Cleaning Slip Rings

Refer to Figure 3-52., Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings.

INSPECTING BRUSH POSITION

Inspect brush alignment with slip rings. View alignment through the air vents in the stator barrel. The brushes must ride completely on the slip rings.

INSPECTING BRUSHES

Remove the end panel. Inspect the wires. Remove the brush holder assembly. Pull the brushes from the holders.

Replace the brushes if damaged, or if the brush is at or near minimum length.

CLEANING SLIP RINGS

Visually inspect the slip rings. Under normal use, the rings turn dark brown.
If the slip rings are corroded or their surface is uneven, remove the belt to turn the shaft by hand for cleaning.
Clean the rings with 220 grit emery paper. Remove as little material as possible. If the rings are deeply pitted and do not clean up, consult generator factory service.

Reinstall the belt, brush holder assembly, and end panel.

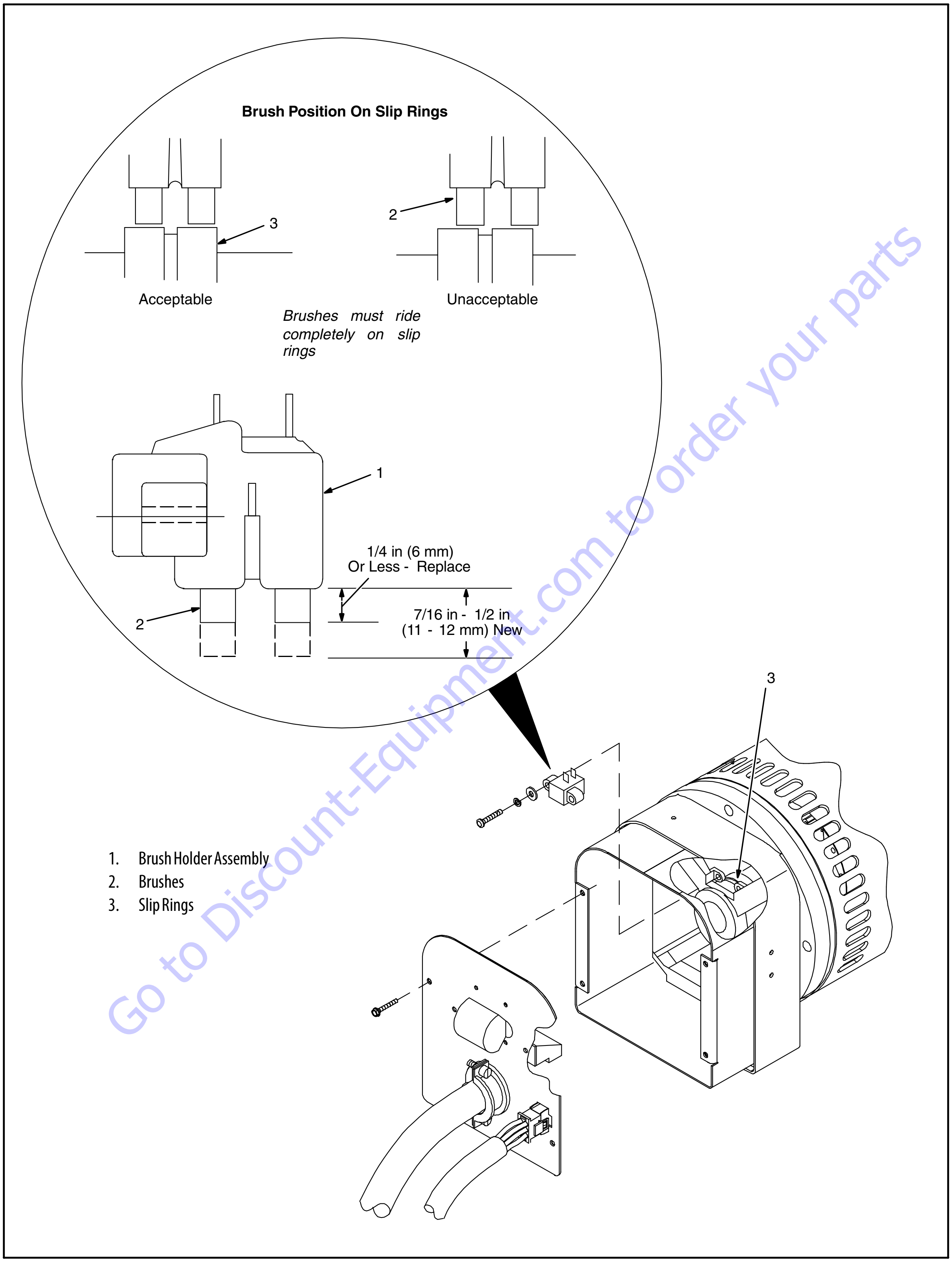


Figure 3-52. Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings

Troubleshooting

Table 3-11. Troubleshooting

Trouble	Remedy
No generator output at platform AC receptacles.	Be sure generator control switch is turned on at platform.
	Check and secure electrical connections at platform, generator, and control box.
	Be sure all equipment is turned off when starting unit.
	Reset circuit breaker CB1.
	Check plug PLG3 connection and/or connections at receptacles RC3 and RC5.
	Be sure + 12 volts DC input voltage is being supplied to control box.
	Check slip rings, wiring to brushes, and brush position on slip rings. Install new brushes if necessary.
	Disconnect leads 12 and 13 from brushes, and check continuity across slip rings (nominal reading is 26 ohms). Replace generator if rotor is open.
	Disconnect stator weld leads 1, 2, and 3 from circuit breaker CB1 , and check continuity between leads. Replace generator if necessary.
	Disconnect plug PLG4 and check continuity between exciter leads 5 and 6. Replace generator if necessary.
	Check power board PC1 and connections, and replace if necessary.
	Check control board PC2 and connections, and replace if necessary.
Low generator output at platform AC receptacles.	Verify generator is running at 3600 rpm (60 Hz) or 3000 rpm (50 Hz).
	Check slip rings, wiring to brushes, and brush position on slip rings. Install new brushes if necessary.
	Disconnect leads 12 and 13 from brushes, and check continuity across slip rings nominal reading is 26 ohms). Replace generator if rotor is open.
	Disconnect stator weld leads 1, 2, and 3 from circuit breaker CB1, and check continuity between leads. Replace generator if necessary.
	Disconnect plug PLG4 and check continuity between exciter leads 5 and 6. Replace generator if necessary.
	Check power board PC1 and connections, and replace if necessary.
	Check control board PC2 and connections, and replace if necessary.
High generator output at platform AC receptacles.	Verify generator is running at 3600 rpm (60 Hz) or 3000 rpm (50 Hz).
	Check slip rings, wiring to brushes, and brush position on slip rings. Install new brushes if necessary.
	Check power board PC1 and connections, and replace if necessary.
	Check control board PC2 and connections, and replace if necessary.
Erratic generator output at platform AC receptacles.	Check and secure electrical connections at platform, generator, and control box.
	Verify generator is running at 3600 rpm (60 Hz) or 3000 rpm (50 Hz).
	Check slip rings, wiring to brushes, and brush position on slip rings. Install new brushes n necessary.
	Disconnect leads 12 and 13 from brushes, and check continuity across slip rings nominal reading is 26 ohms). Replace generator if rotor is open.
	Check power board PC1 and connections, and replace if necessary
	Check control board PC2 and connections, and replace if necessary

Generator Disassembly and Assembly

Refer to Figure 3-54. and Figure 3-55. to determine if trouble is in stator, rotor, control box, or combination of these components.

1. Rotor
2. Stator Assembly

⚠ CAUTION

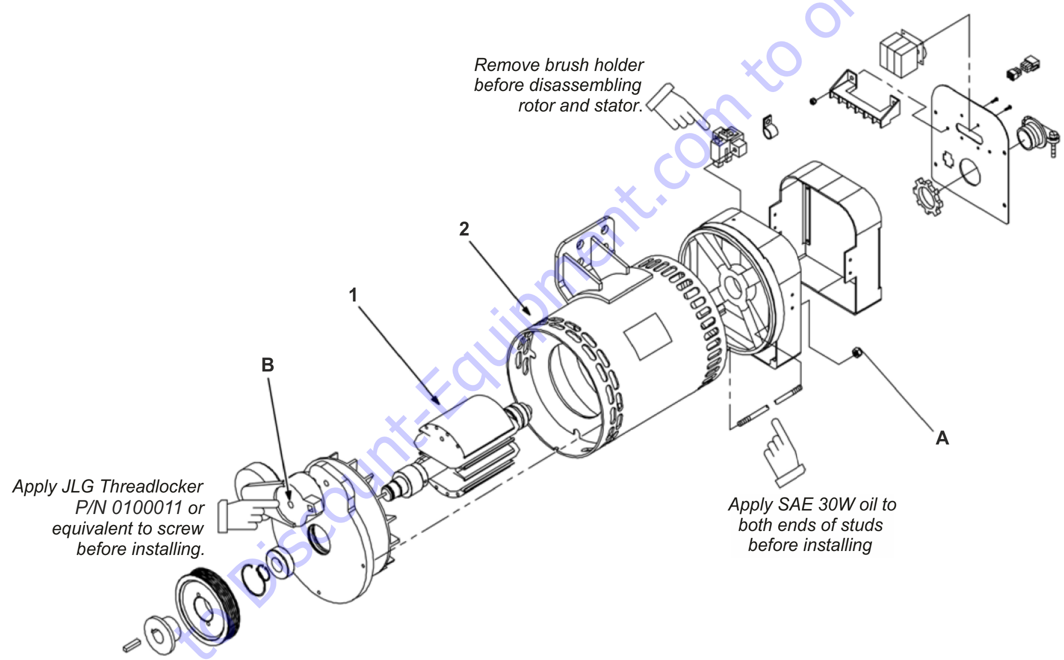
DO NOT DAMAGE ROTOR OR STATOR WINDINGS DURING DISASSEMBLY AND ASSEMBLY PROCEDURE.

DISASSEMBLY

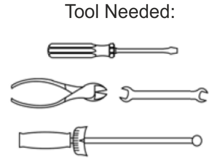
1. Mark and disconnect all electrical leads, secure using cable ties.
2. Remove brush holder assembly.
3. Disassemble generator parts shown in Figure 3-53.
4. Clean all parts with approved solvent and dry with compressed air, If applicable.
5. Inspect all part for damage. Replace if necessary.

ASSEMBLY

1. Assemble generator parts using torque values in table.
2. Reconnect all leads. Use cable ties to secure leads away from moving or hot parts.



Tool Needed:



Torques:	
A	95 in lb (10.7 Nm.)
B	38 ft.lbs (52 Nm.) (Belt Tensioner)

Figure 3-53. Generator Disassembly and Assembly

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Resistance Values	
a) Tolerance – ±10% unless specified	
b) Condition – 70°F (21°C); cold machine (no warm-up)	
c) Wiring Diagram	
d) Stop generator before checking resistance	
R1	26 ohms
R2	1 ohm
R3 thru R5	Less than 1 ohm

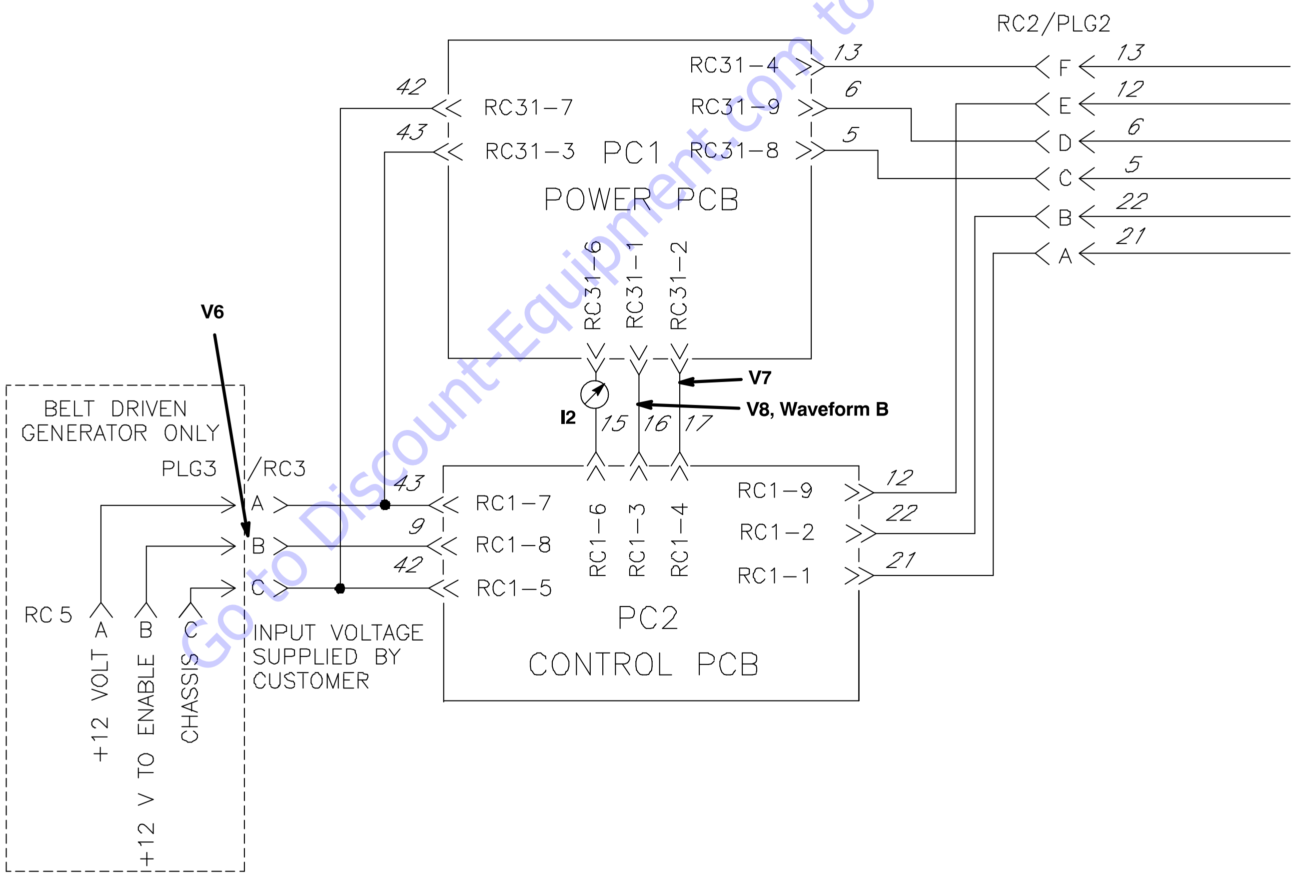
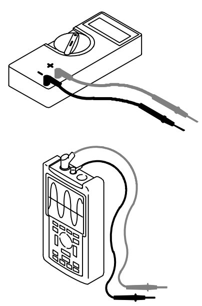


Figure 3-54. Generator Troubleshooting Circuit Diagram (Sheet 1 of 2)

Test Equipment Needed:



Amperage Readings	
a) Tolerance – ±5% unless specified	
b) Condition – 70°F (21°C); cold machine (no warm-up); no load	
I1	1 amps DC (60 Hz) No greater than 3.5 amps DC under load
I2	1 amps DC (60 Hz) No greater than 3.5 amps DC under load

Voltage Readings	
a) Tolerance – ±10% unless specified	
b) Condition – 70°F (21°C); cold machine (no warm-up); no load	
c) Weld/power rpm unless specified	
d) Reference – single arrow: reference to circuit common (lead 42); double arrow: reference to points indicated	
e) Wiring Diagram	
V1	Rotor: +25 volts DC at no load ±20%; +75 volts DC at full load ±10%
V2	Exciter: 150 volts AC
V3	Voltage Feedback: 240 volts AC
V4	Output (Odd Leg): 245 volts AC
V5	Output: 120 volts AC
V6	Generator Enable: +12 volts DC when generator is enabled (On); 0 volts DC when not enabled (Off)
V7	Shutdown Signal: +12 volts DC when shutdown is latched; 0 volts DC when not latched
V8	PWM Signal: 0 to +15 volts DC

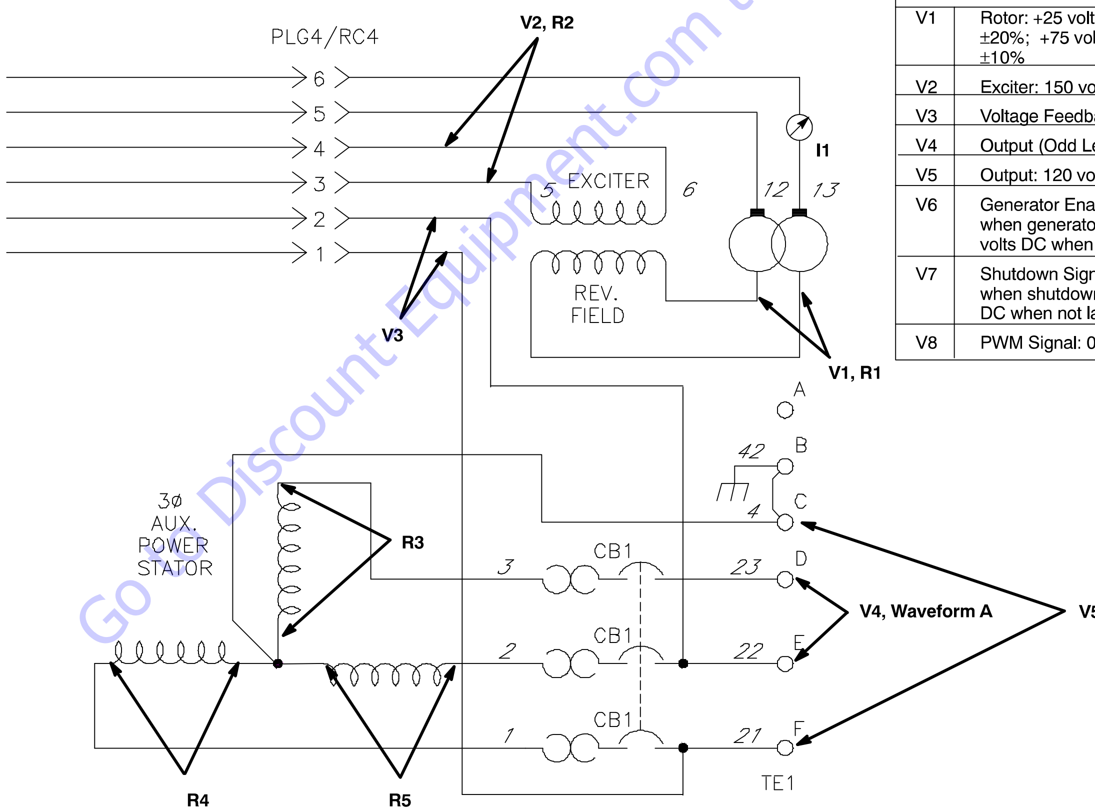


Figure 3-55. Generator Troubleshooting Circuit Diagram (Sheet 2 of 2)

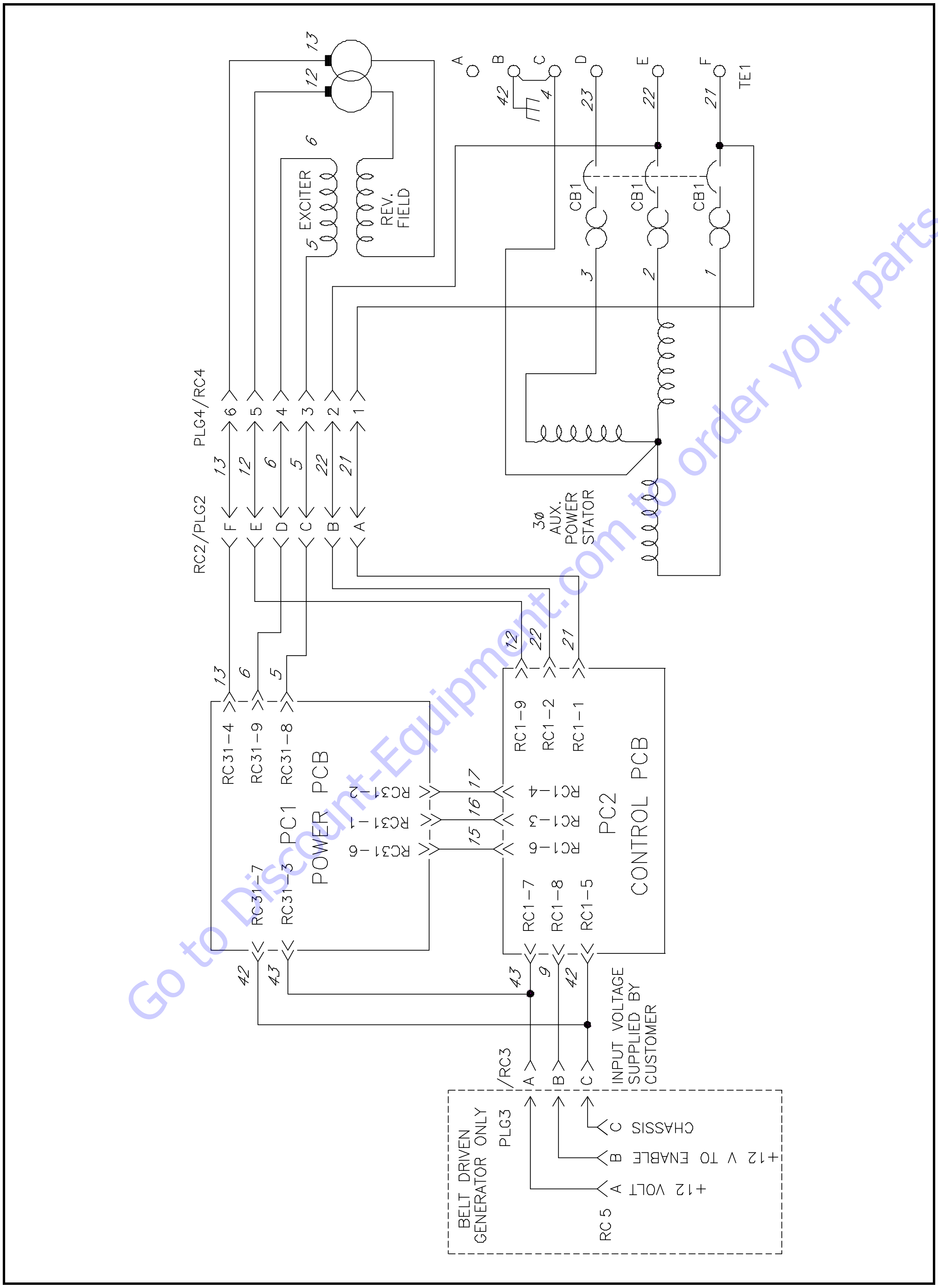


Figure 3-56. Generator Electrical Circuit Diagram

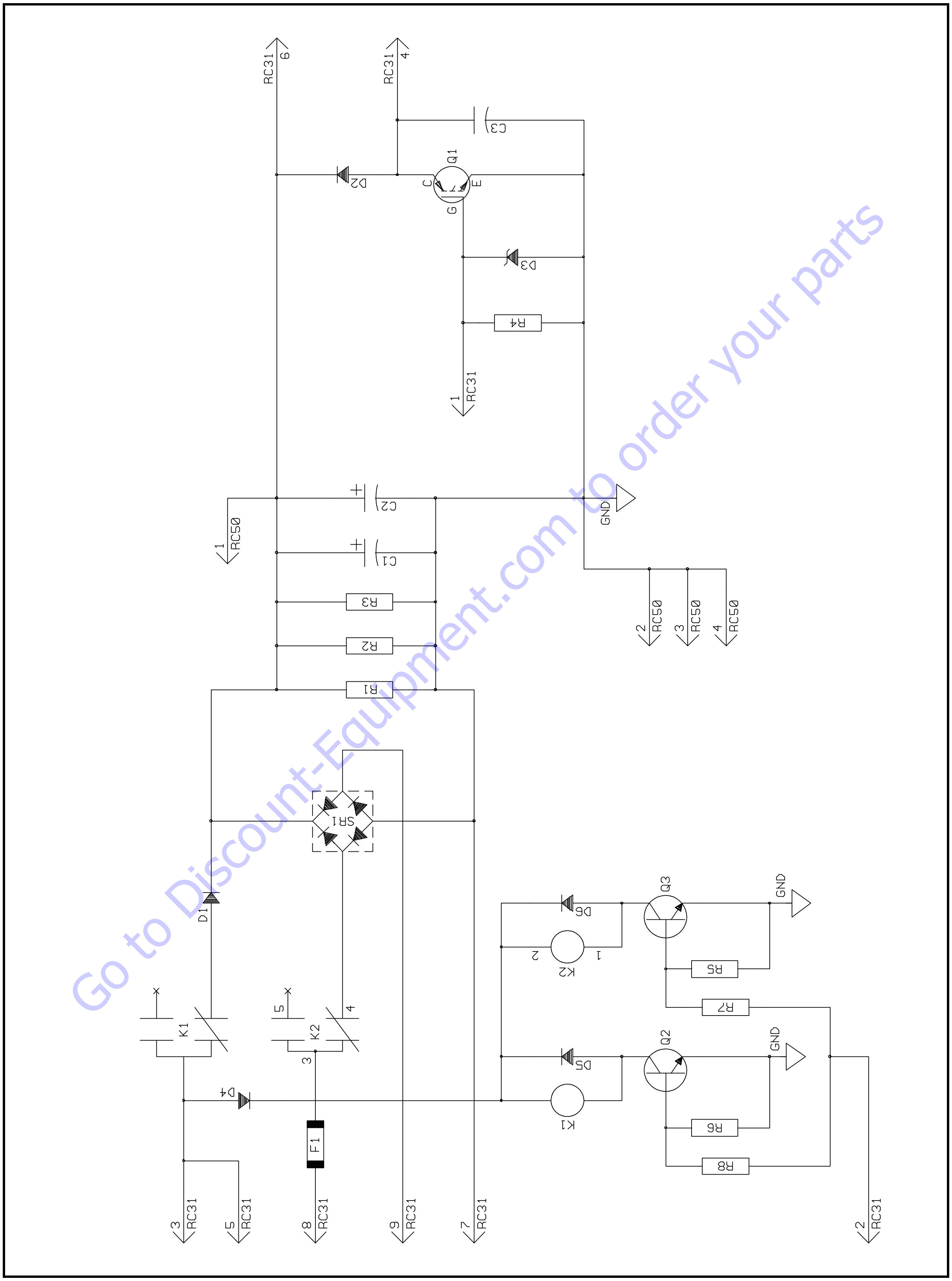


Figure 3-57. Power Board PC1 Electrical Circuit Diagram

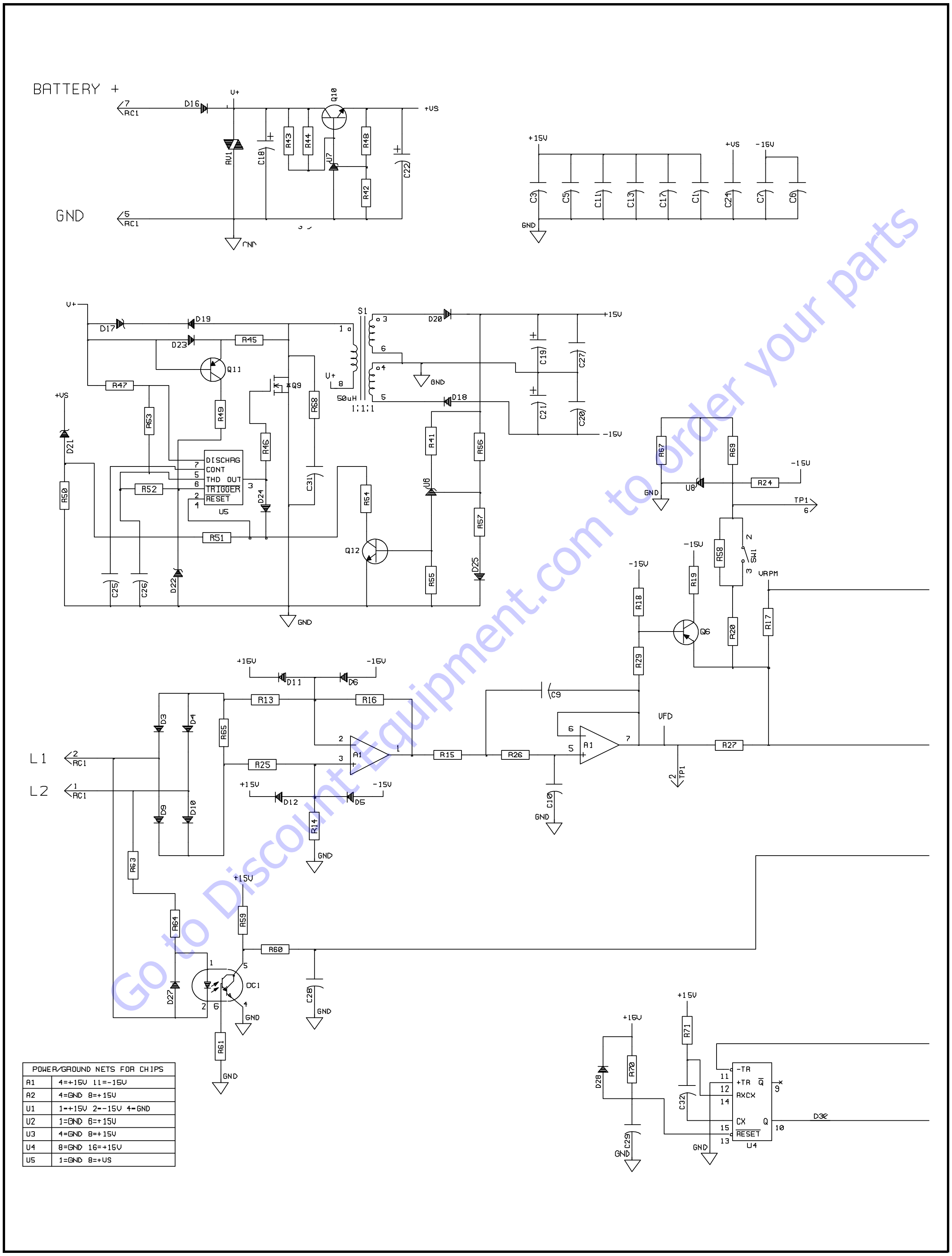


Figure 3-58. Power Board PC2 Electrical Circuit Diagram (Sheet 1 of 2)

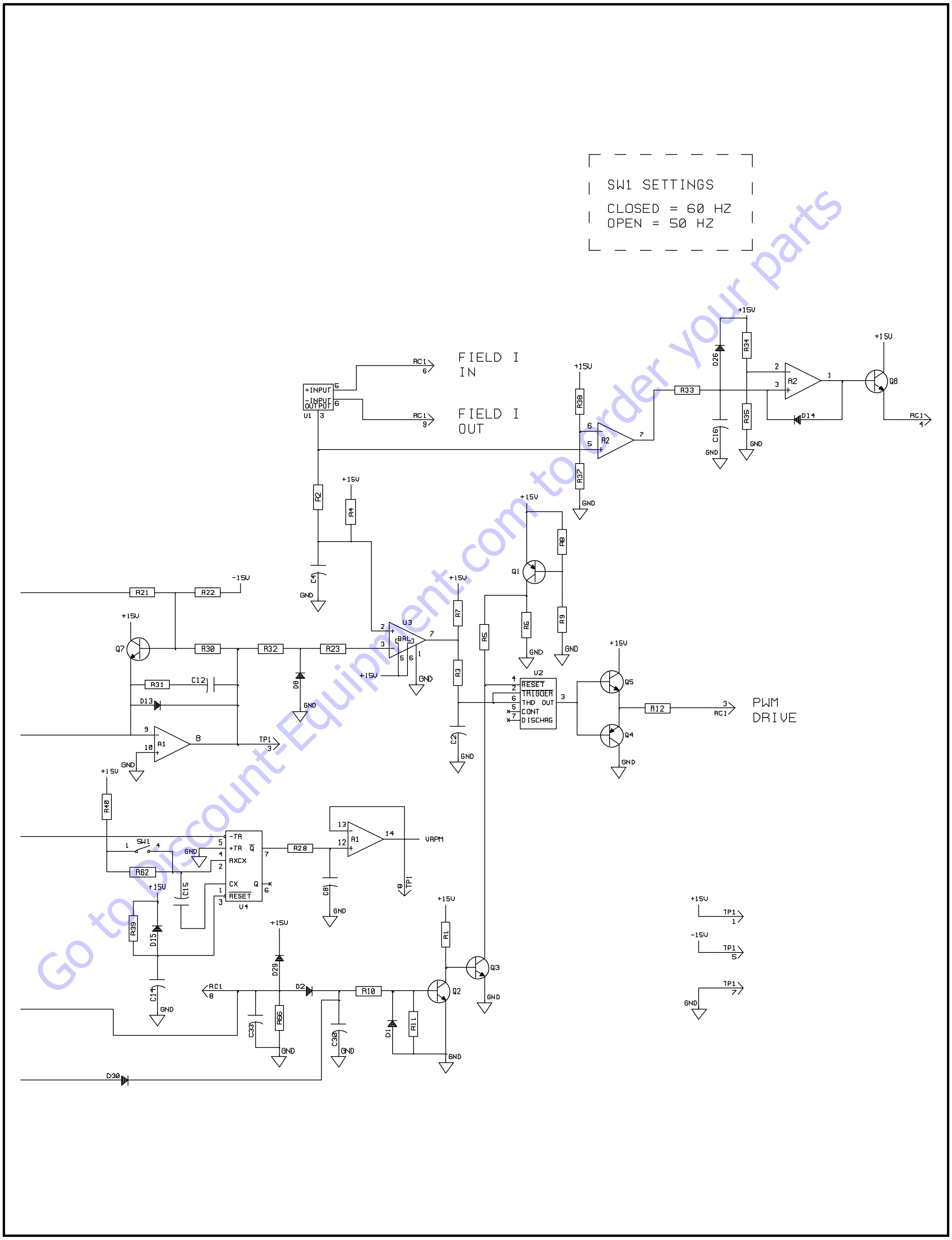


Figure 3-59. Power Board PC2 Electrical Circuit Diagram (Sheet 2 of 2)

Lead Connection List for Generator

NOTE: *Table shows physical lead connections and should be used with circuit diagram (table replaces wiring diagram).*

NOTE: *Apply small amount of dielectric grade, nonconductive electric grease to connectors where factory-applied grease had been present.*

Table 3-12. Lead Connection List for Generator

Leads	Connections
1A	STATOR TO CB1
2A	STATOR TO CB1
3A	STATOR TO CB1
4A	STATOR TO TE1 (C)
5A	STATOR TO RC4 (3)
5B	PLG2 (C) TO PLG4 (3)
5C	RC2 (C) PLG31 (8)
6A	STATOR TO RC4 (4)
6B	PLG2 (D) TO PLG4 (4)
6C	RC2 (D) PLG31 (9)
9A	RC5 (B) TO PLG3 (B) (Customer Supplied)
9B	RC3 (B) PLG1 (8)
12A	PLG2 (E) TO PLG4 (5)
12B	RC2 (E) PLG1 (9)
12C	RC4 (5) TO BRUSH
13A	PLG2 (F) TO PLG4 (6)
13B	RC2 (F) PLG31 (4)
13C	RC4 (6) TO BRUSH
15A	PLG1 (6) TO PLG31 (6)
16A	PLG1 (3) TO PLG31 (1)
17A	PLG1 (4) TO PLG31 (2)
21A	CB1 TO TE1 (F)
21B	PLG2 (A) TO PLG4 (1)
21C	PLG1 (1) TO RC2 (A)
21D	RC4 (1) TO CB1
22A	CB1 TO TE1 (E)
22B	PLG2 (B) TO PLG4 (2)
22C	PLG1 (2) TO RC2 (B)
22D	RC4 (2) TO CB1
23A	CB1 TO TE1 (D)
42A	RC5 (C) TO PLG3 (C) (Customer Supplied)
42B	RC3 (C) TO CONNECTION POINT 1
42C	PLG31 (7) TO CONNECTION POINT 1
42D	PLG1 (5) TO CONNECTION POINT 1
42F	END BELL SHROUD TO ENGINE MOUNT
42G	CHASSIS TO TE1 (B)
43A	RC5 (A) TO PLG3 (A) (Customer Supplied)
43B	RC3 (A) TO CONNECTION POINT 2
43C	PLG31 (3) TO CONNECTION POINT 2
43D	PLG1 (7) TO CONNECTION POINT 2

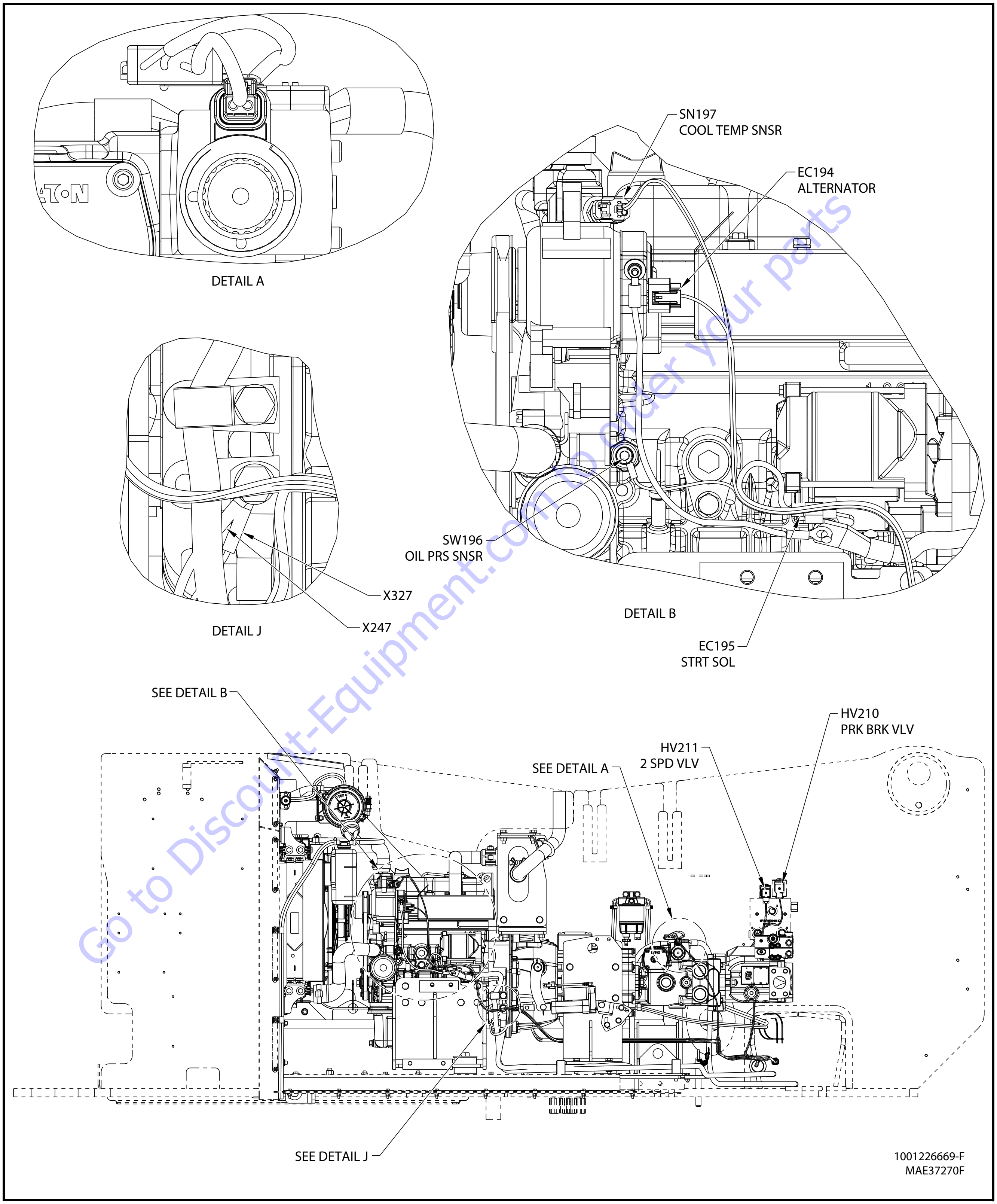


Figure 3-60. Engine Installation - Sheet 1 of 5

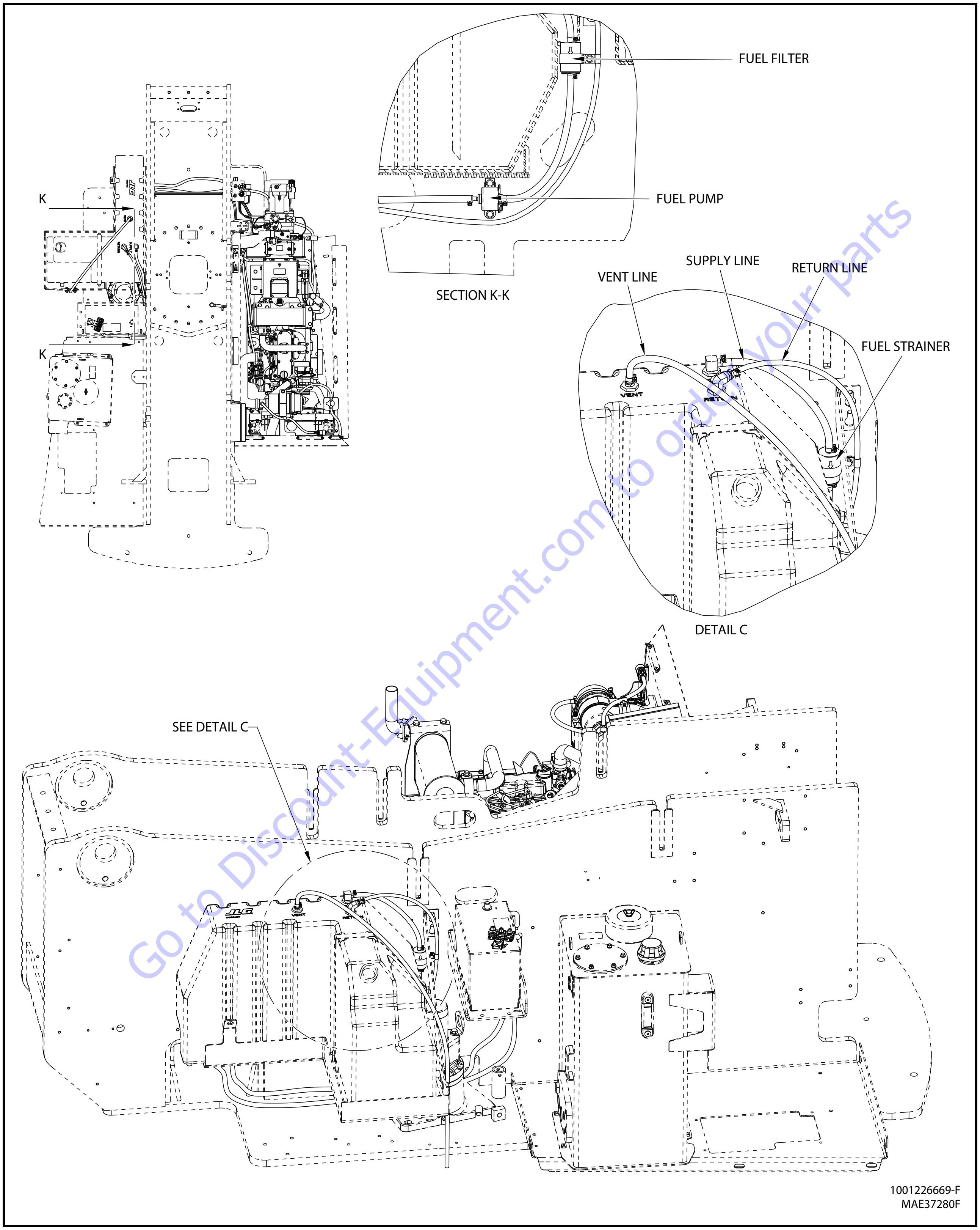


Figure 3-61. Engine Installation - Sheet 2 of 5

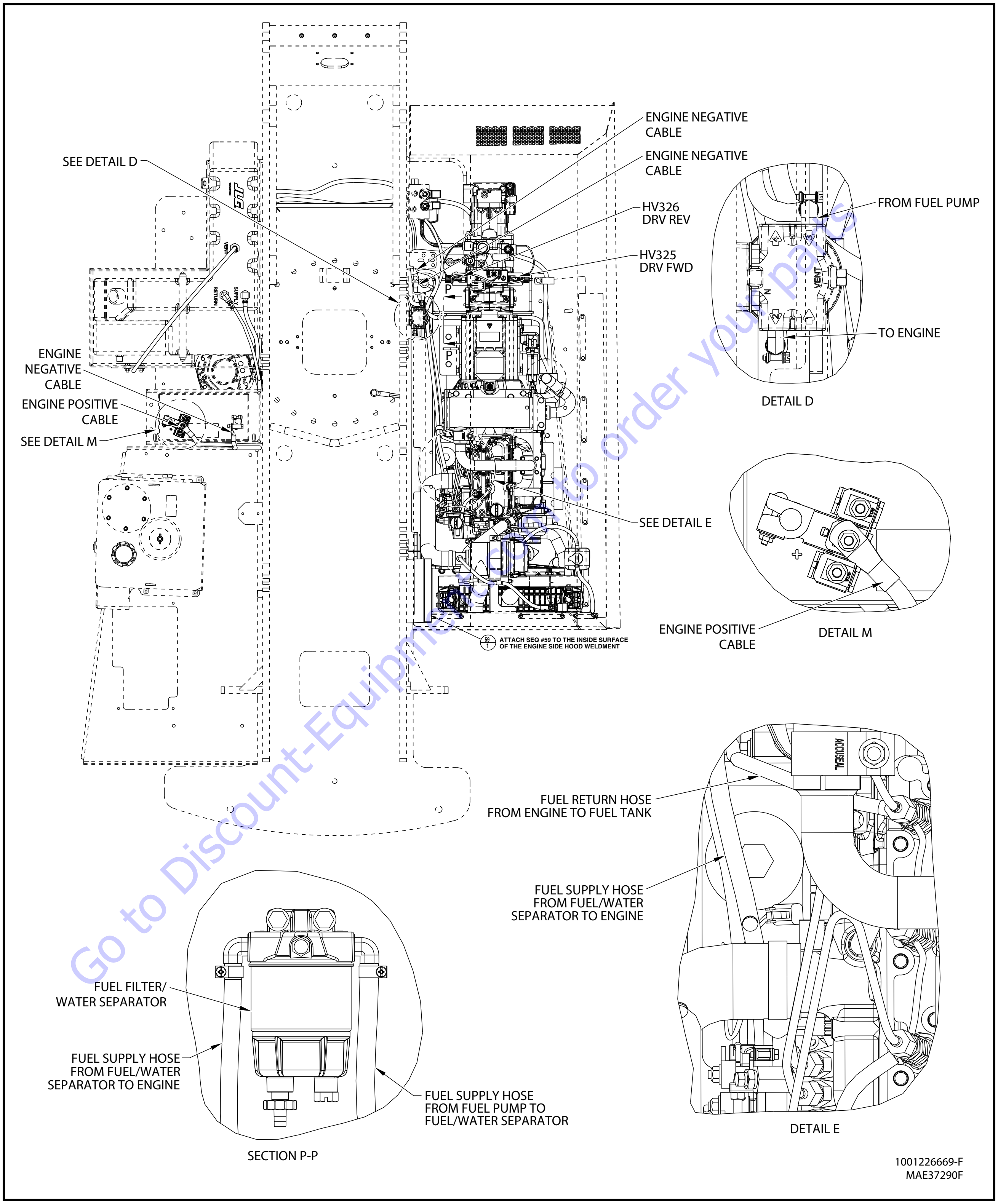


Figure 3-62. Engine Installation - Sheet 3 of 5

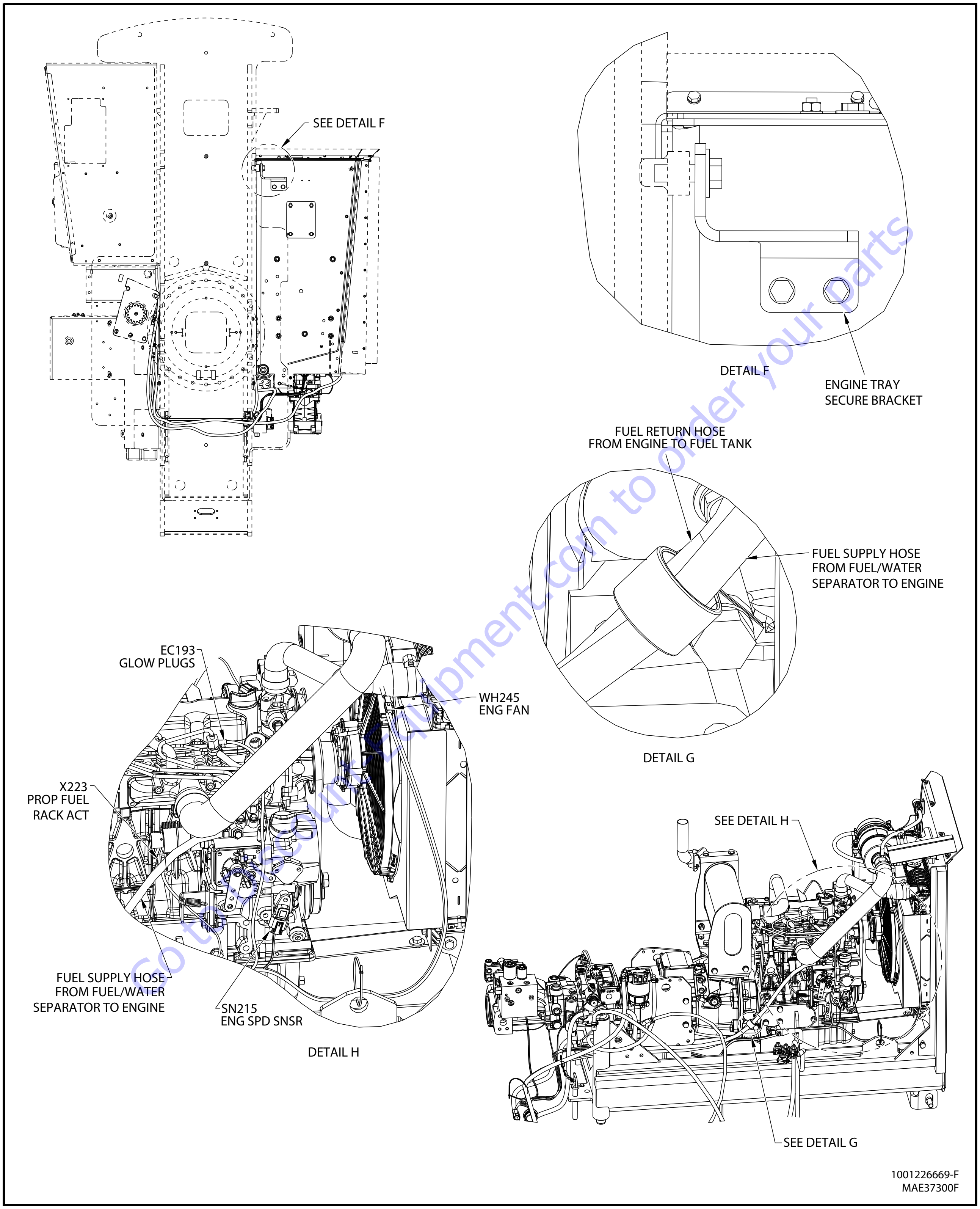


Figure 3-63. Engine Installation - Sheet 4 of 5

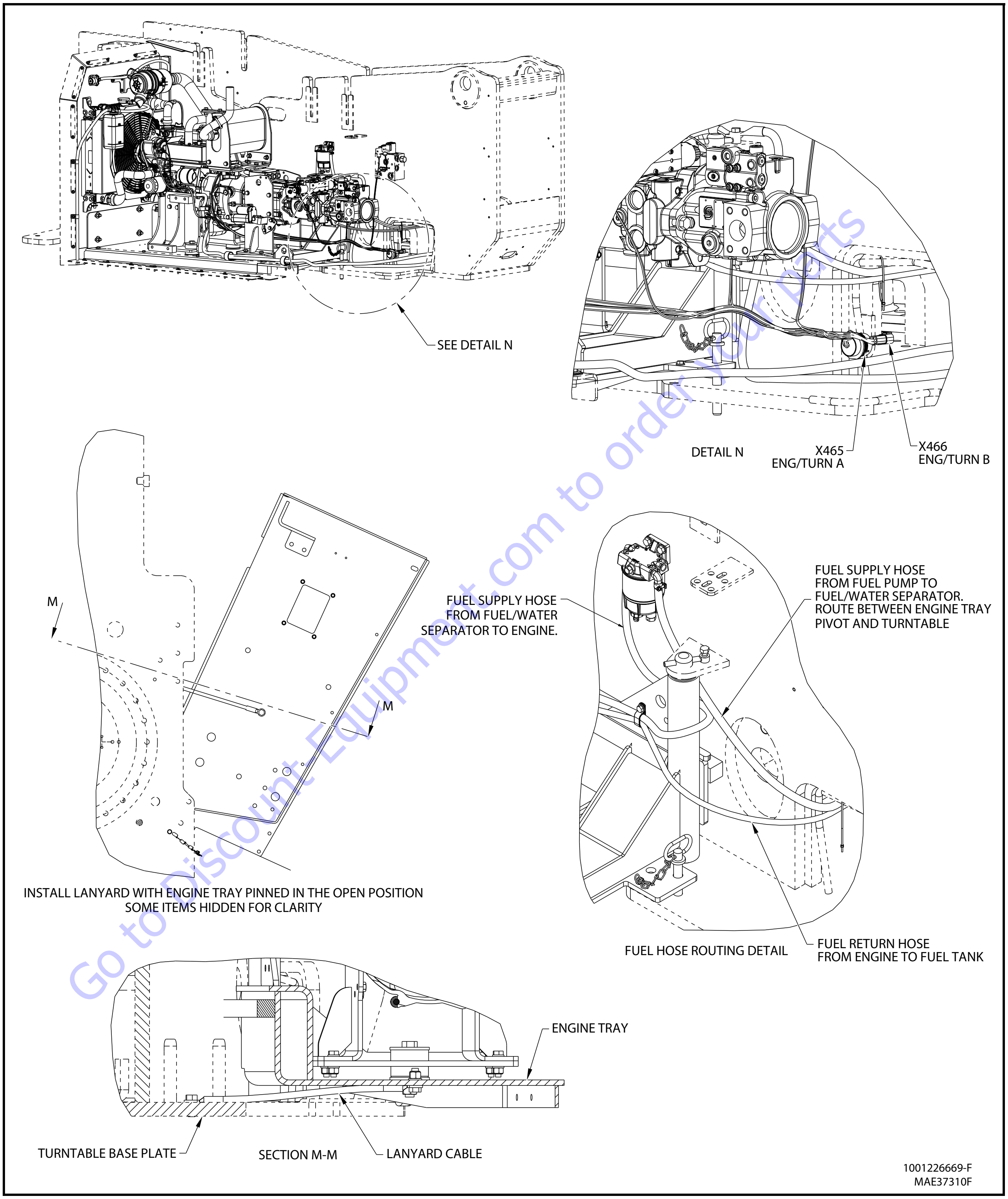


Figure 3-64. Engine Installation - Sheet 5 of 5

3.22 COLD START SYSTEM

The machine control system monitors the engine coolant and ambient temperature to make an assessment of cylinder preheating requirements. If the coolant temperature is below 122° F (50° C) when control power is turned on, the glow plugs will be automatically fired for a duration that is based on the ambient temperature up to a maximum of 20 seconds. During this preheat period, the glow plug indicators will flash. Dependent on ambient conditions, the glow plugs may continue to warm the cylinders shortly after engine start.

Engine Warmup

When it is below 32°F (0°C), the clutch is disengaged from the engine when started. When engine operating temperature reaches 86°F (30°C), the Integrated Motor Generator (IMG) will spin at 1800 rpm for 10 seconds. After the 10 second period, the clutch (also spinning at 1800 rpm) will engage with the IMG.

NOTE: *When in Engine Warmup, after turning on ignition, operator must wait until glow plug indicator light goes out before cranking engine. As soon as the operator begins to crank the engine to start, the indicator will come on steady and an Engine Warmup DTC will be set. When the engine reaches an operating temperature of 86°F (30°C) and the clutch engages, the light will go out and the DTC will go away.*

3.23 CLUTCH ADAPTER PLATE INSTALLATION

1. Place the Clutch Adapter Plate against the engine fly-wheel and start all bolts approximately 1/2 to 1 turn.
2. Using the pattern shown in Figure 3-65., Clutch Adapter Plate Torque Sequence, work back and forth around the pressure plate turning each bolt not more than 3 turns before turning the other bolts to a similar level.

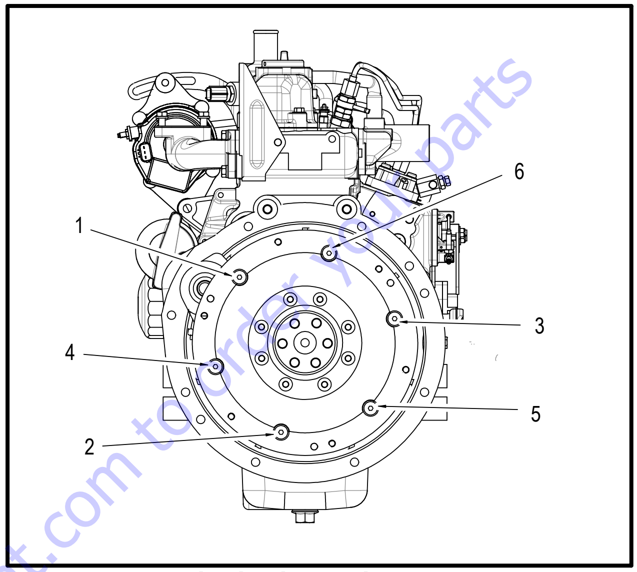


Figure 3-65. Clutch Adapter Plate Torque Sequence

3. Using the same torque pattern, torque each bolt to 16 ft.lbs. (22 Nm).
4.

3.24 CLUTCH KIT & RELEASE SHAFT INSTALLATION

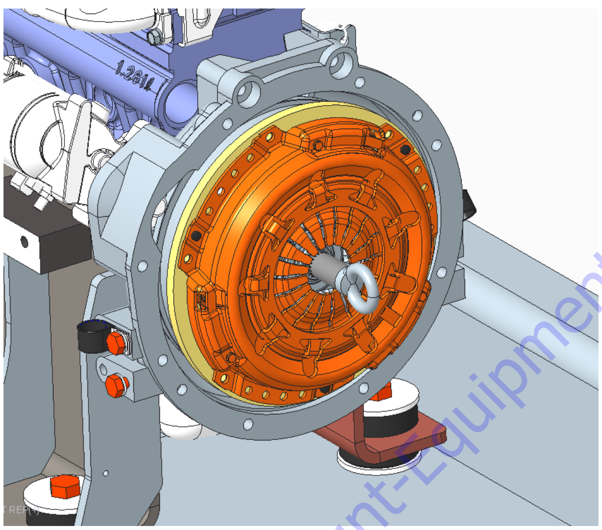
Clutch Kit

NOTE: *To properly install the clutch, JLG service tool PN 1001227898 must be used.*

NOTE: *Don't use power or air tools during this install.*

1. Apply blue JLG Threadlocker PN 0100011 to all bolts and start all bolts ½ to 1 turn.
2. Center the clutch disc in the pressure plate using JLG PN 1001227898.

NOTE: *Disc orientation is critical. The hub must face outwards, Away from engine.*



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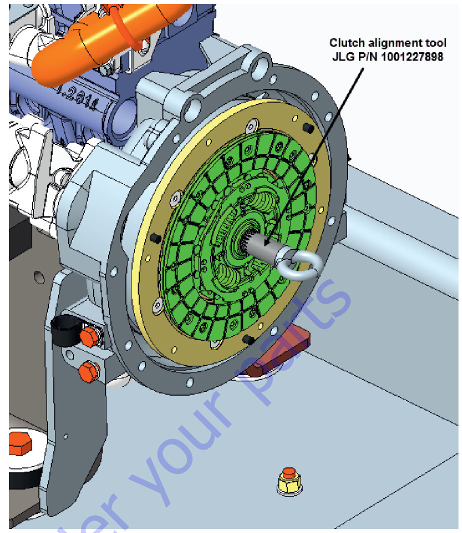

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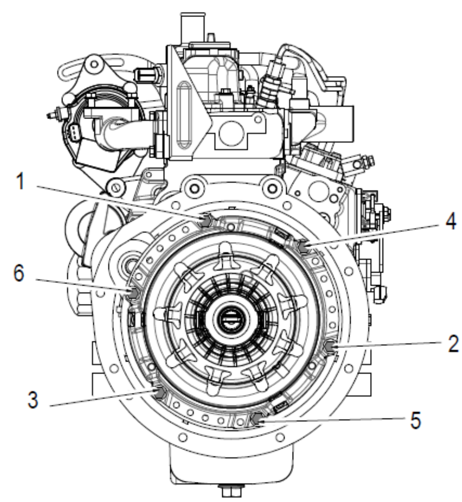
3. Using an alternating star pattern (1-6) work around the pressure plate, turning each bolt no more than 3 turns before turning the other bolts to a similar level.

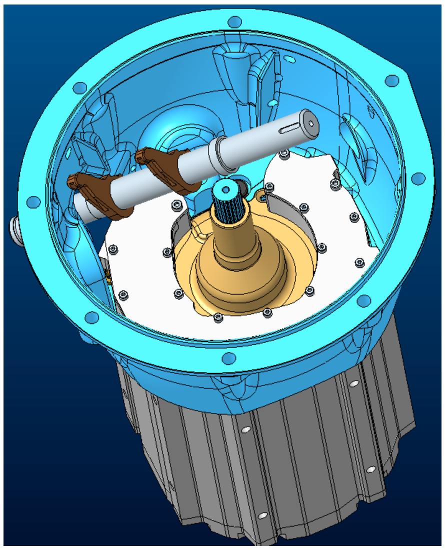


MAE37910

4. Continue step 3 until the pressure plate contacts the adapter plate at all 6 bolt locations.
5. Using the same pattern, torque each bolt to 35 - 25 Nm.

Release Shaft

1. Insert shaft from the top of the IMG and through the opening on the side.



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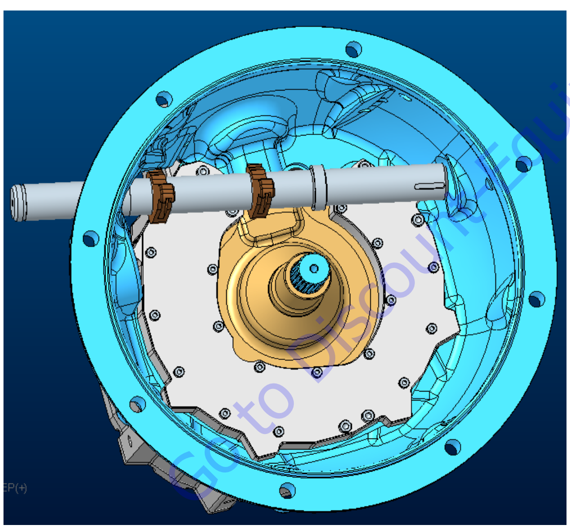
2. Align the shaft with the right side bore.



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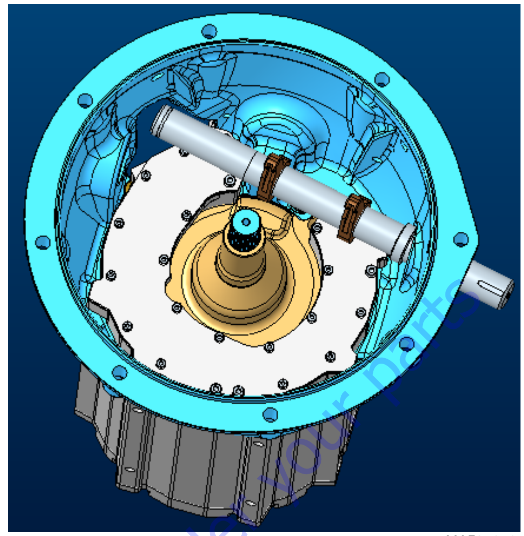
3. Insert shaft further into bearing bore at right.



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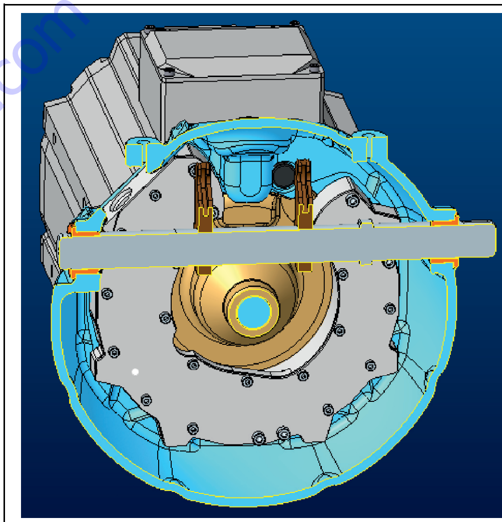
4. Install bronze bearings, retaining clip on one end and actuation lever on the other.



MAE38420

3.25 CLUTCH INSTALLATION

1. Place the clutch against the adapter plate and start all retaining bolts approximately 1/2 turn.
2. Center the friction disk (clutch) in the pressure plate using the alignment tool.
3. Using the pattern shown in Figure 3-66., Clutch Plate Torque Sequence, work back and forth around the clutch turning each bolt not more than 3 turns before turning the other bolts to a similar level. Stop when the pressure plate contacts the flywheel adapter. Do not apply final torque.

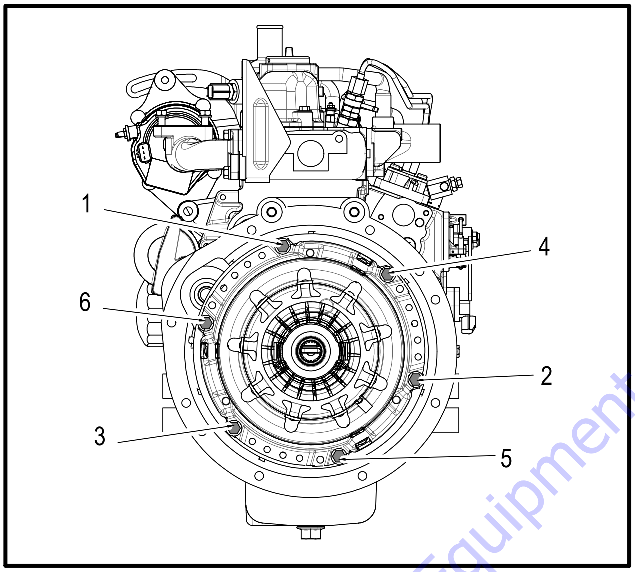


Figure 3-66. Clutch Plate Torque Sequence

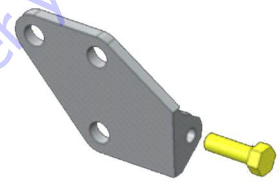
4. Using the same torque pattern, torque each bolt to 22 ±3.5 ft.lbs. (30 ± 5 Nm).

3.26 CLUTCH LINEAR ACTUATOR/THROWOUT BEARING POSITIONING INSTALLATION PROCEDURE

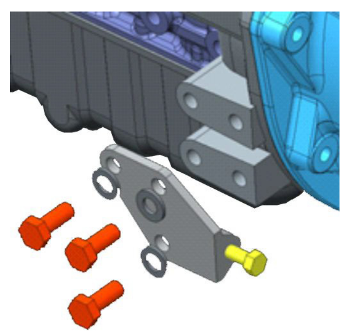
NOTE: *To properly position the clutch actuator/throwout bearing, the Service Kit (JLG PN 1001227147) must be used.*

NOTE: *If performing maintenance on machine and reusing linear actuator, before starting work on replacing clutch, disconnect forward pin, and allow linear actuator to hang from rear pin. Then with the machine on, turn machine to "Electric Mode." This will fully extend the linear actuator as required for steps 6 thru10.*

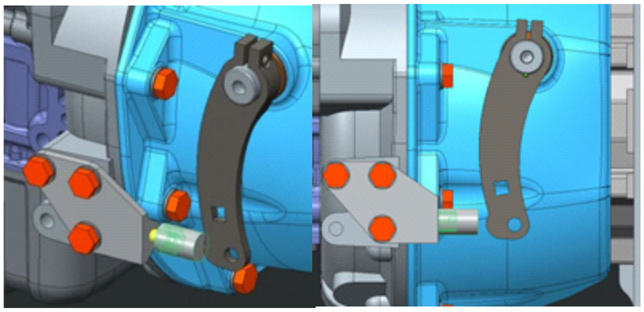
1. Install the adjustment bolt into the Clutch Gauge bracket, about halfway. The bolt will be adjusted later.



2. Assemble Clutch Gauge bracket onto outboard side of flywheel housing using the 3 bolts and washers provide with the kit.



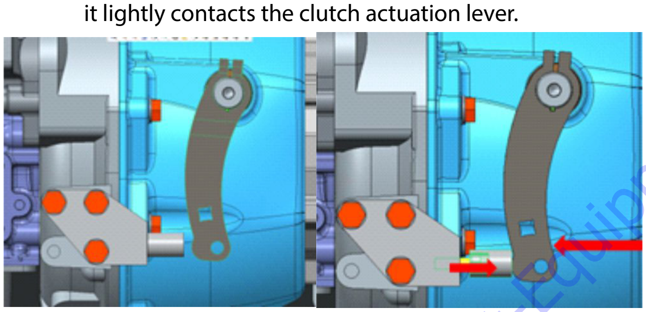
3. Assemble Clutch Gauge onto the end of the bolt. Rotate Clutch Gauge and bolt until Gauge is contacting the clutch gauge bracket.



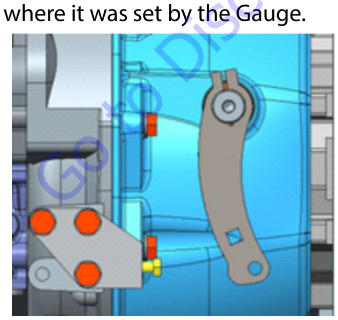
4. Lightly pull the clutch actuation lever arm toward the engine, until resistance is felt or it stops. This should not require excessive force.

NOTE: *The resistance or stop is the throwout bearing now lightly resting upon the spring of the pressure plate portion of the clutch inside the housing.*

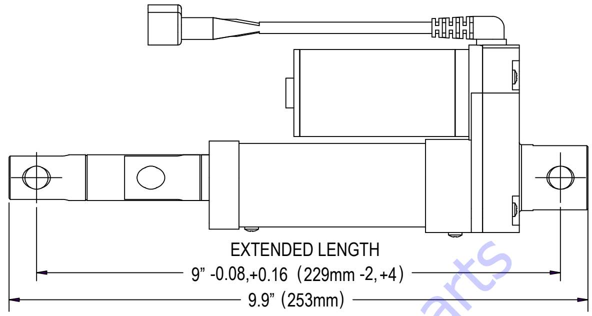
While holding clutch actuation lever in the position from the previous step, unscrew the bolt/Clutch Gauge until it lightly contacts the clutch actuation lever.



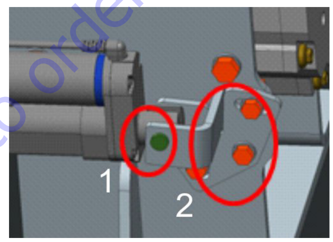
5. Now that the Clutch Gauge has set the bolt head height, release the clutch actuation lever and carefully remove the Clutch Gauge off of the bolt head, but leave the bolt position where it was set by the Gauge.



6. Before the continuing, ensure the Linear actuator is in the fully extended position as shown below.

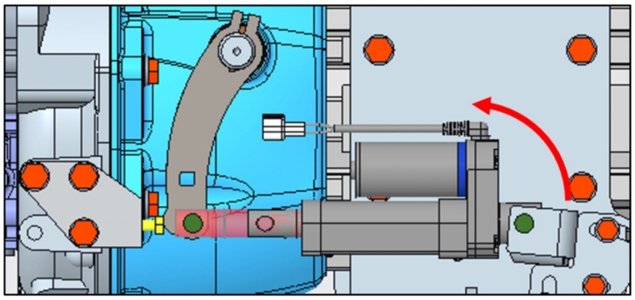


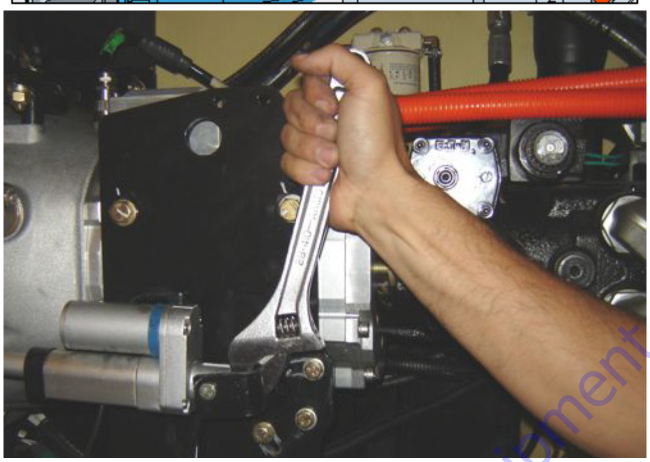
7. Pin the rear mounting hole of linear actuator to rear mounting bracket as shown by position 1 below. Three bolts in rear mounting bracket should be installed loosely to allow for movement of the bracket as shown by position 2 below.



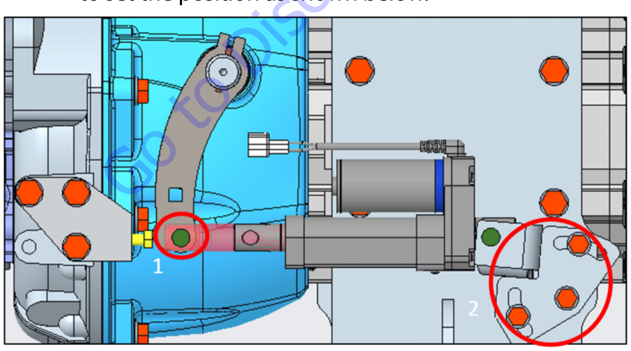
NOTE: *Steps 8 & 9 may require two people.*

8. Next using a wrench rotate the rear mounting bracket toward the engine until the lever arm makes contact with the bolt head as shown below. This requires some force to achieve, as it is compressing the pressure plate to set the full throwout bearing stroke possible by the linear actuator.

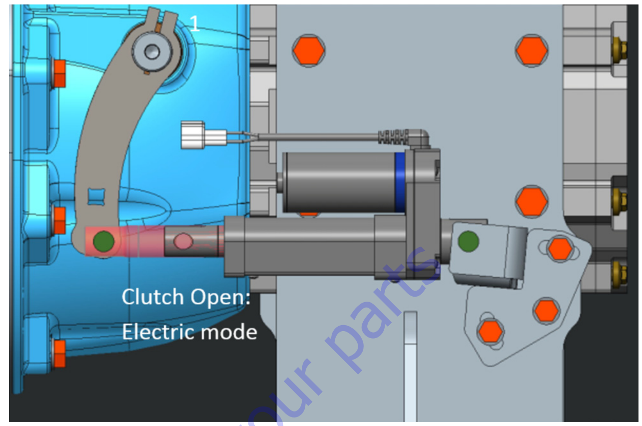




9. While the lever arm is still touching the bolt head from the previous step, assemble the linear actuator to the clutch actuation lever as shown below. Adjust rear linear actuator mounting bracket as needed to allow the pin hole to line up correctly. After hole is pinned, tighten down the three linear actuator mounting bracket bolts to set the position as shown below.



10. Remove the Clutch Gauge bracket from flywheel housing. Installation is now complete.



NOTE: *After the clutch linear actuator/throwout bearing position installation procedure is completed, the clutch will be in the "OPEN" state, corresponding to the Electric vehicle mode. The clutch will need to be cycled (linear actuator pulled in) to activate Hybrid mode.*

3.27 COUNTERWEIGHT

If the counterweight has been removed, ensure the retaining bolts are torqued to the proper value as shown in Figure 3-67., Counterweight Bolt Torque.

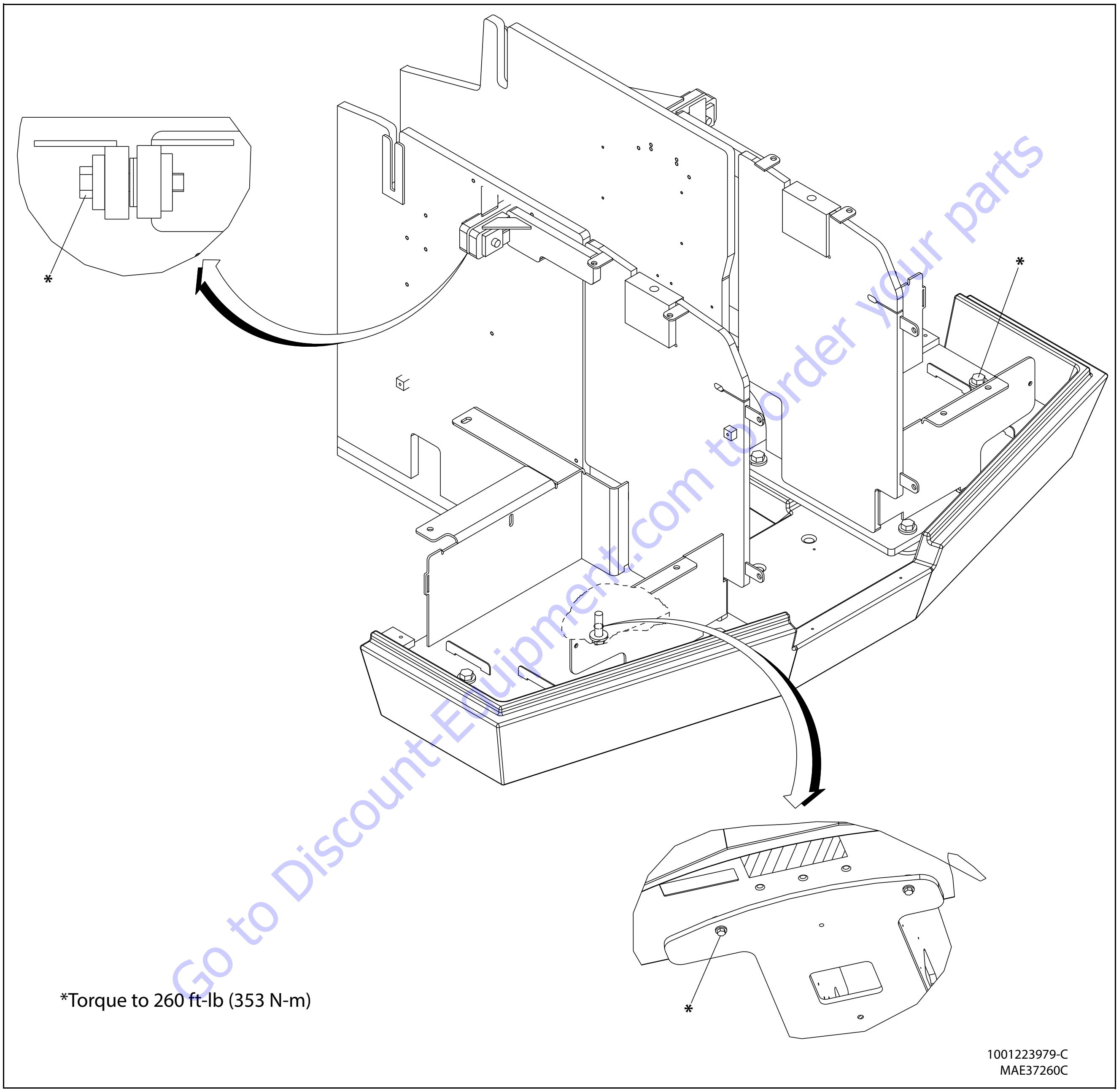
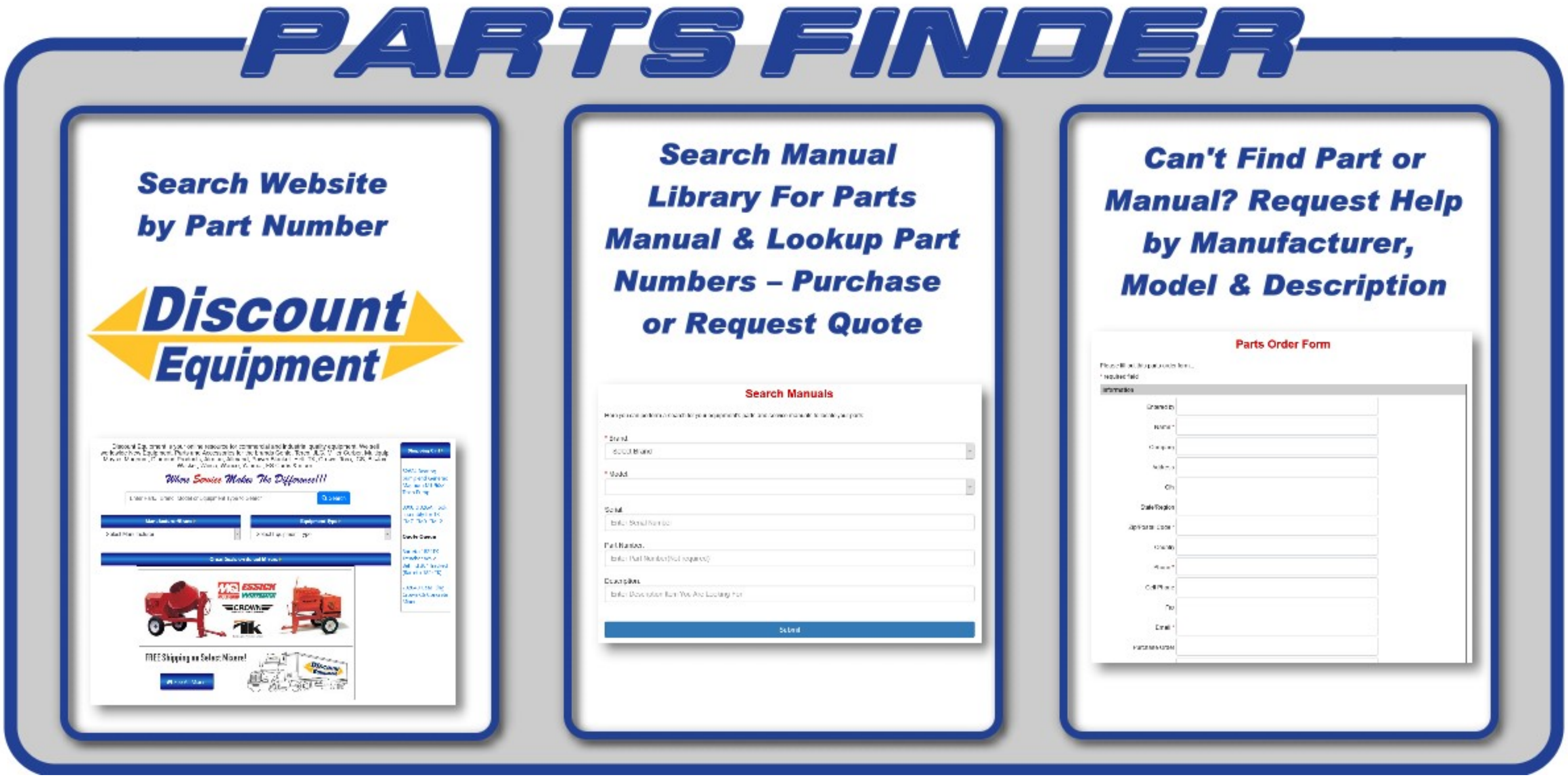


Figure 3-67. Counterweight Bolt Torque



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SECTION 4. BOOM & PLATFORM

4.1 BOOM SYSTEMS

Switch Systems

The Capacity Indicator, Transport Position Interlock, and Above Elevation Systems use normally closed electrical switches with "positive opening" contacts.

Above Elevation (Above Horizontal) Cutout System

The above elevation cutout system uses a main boom angle switch and a tower boom angle switch to sense when the boom is raised substantially above horizontal. The articulated jib of the H800AJ may be in any position.

When above elevation the machine will be put into creep speed mode and will activate the Drive Speed Cutback. With the exception of the speed cutback, this is a warning system only. The machine will continue to function. The operator is responsible to prevent the machine from attaining an unstable position.

Beyond Transport Position - Drive Speed Cutback System

When above elevation, as described in the Above Elevation Cutout System, the engine speed is automatically restricted from attaining the high engine speed and the drive motors are automatically restricted to their maximum displacement position (slow speed). See Drive System for more details on the drive speeds and see the Chassis Tilt Indicator System in Section 3 for interaction with the tilt sensor.

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

The transport position interlock system uses the Above Elevation (Above Horizontal) Cutout System switches with the addition of a main boom telescope switch to sense when the boom is out of the transport (nearly stowed) position. The jib of the machine may be in any position. All controls are simultaneously functional when the booms are within the transport position as on the standard machine. When the boom is beyond the transport position, the control functions are interlocked to prevent simultaneous operation of any boom function with drive/steer. The first function set to be operated in this mode, becomes the master function set. In other words, while operating drive/steer functions the boom functions are inoperable. Likewise, while operating boom functions drive/steer functions are inoperable.

Transport Position Interlock System (CE only)

The transport position interlock system uses the "above elevation cutout system" switches with the addition of a main boom telescope switch to sense when the boom is out of the transport (nearly stowed) position. The articulated jib of the 800AJ may be in any position All controls are simultaneously functional when the booms are within the transport position as on the standard machine. When the booms are outside of the transport position, the control functions are interlocked to prevent simultaneous operation of any boom function with drive/steer. The first function set to be operated in this mode, becomes the master function set. In other words, while operating drive/steer functions the boom functions are inoperable. Likewise, while operating boom functions drive/steer functions are inoperable. In addition to being an interlock, this system also disallows high speed operation while the booms are beyond the transport position. While in this position, the machine will respond in the same way as described in the Above Elevation Cutout System. As described in the Positive Opening Switch System, the "safe" condition of the machine is when the use of multiple function operation is allowed (at low boom angles and short boom lengths).

Platform Control Enable System

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

Function Speed Control System

The platform controls for the platform rotate, platform level, jib lift, telescope, tower telescope, and tower lift functions are controlled through a common variable speed control knob. This knob provides a common control signal allowing a smooth ramp up and controlled maximum output speed. Each function has its own personality settings allowing the characteristics of each function to be modified using the standard analyzer. Not all functions will respond the same to the changes in the function speed knob position.

Platform

The standard platform utilizes a hinged swing gate for ease of entry and 3/4" expanded metal floor mesh. The optional drop bar gate platform utilizes 1/2" expanded metal floor mesh.

Main Lift End Stroke Dampening System

The main boom lift cylinder is constructed in a way that causes the lift cylinder oil flow to be restricted by an orifice while raising the boom within 5 degrees of maximum elevation. This restriction slows the boom lift speed while raising the boom. The oil flow is not restricted while lowering the boom and therefor the speed is not altered.

QuikStick Lift System

The main boom lift cylinder is pinned between the main boom and the nose of the tower fly boom. This causes an interdependency between the tower and main boom. The main boom changes angle when the tower is raised or lowered. In addition, the maximum angle achieved by the main boom is dependent on the position of the tower boom. When the tower boom is stowed, the main boom's maximum angle is 25 degrees. When the tower boom is fully raised, the main boom's maximum angle is 70 degrees. The main boom can be also be raised or lowered independent of the tower boom within the limits of the boom rests and main boom lift cylinder stroke to a minimum angle of -35 degrees. This allows the platform to reach the ground at any position of the tower boom.

Tower Boom Sequence Valve System

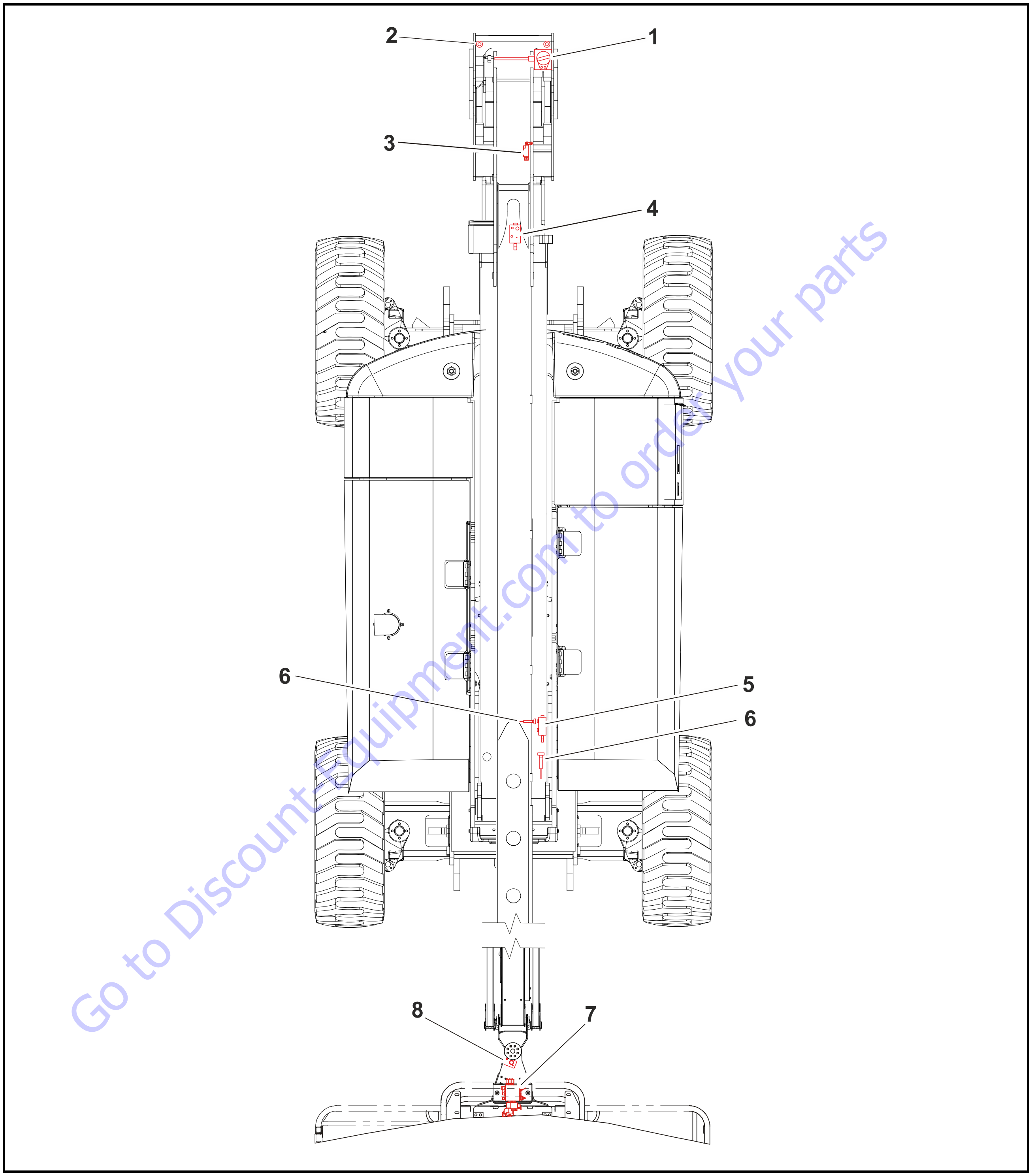
The two section tower boom uses two hydraulic lockout valves to prevent the boom from being telescoped until the boom is fully raised and to prevent the tower boom from being lowered until it is fully retracted. Until the valve mounted in the turntable is actuated by the cam on the tower lift cylinder barrel (at max tower angle), the tower telescope oil flow is blocked preventing the tower from telescoping out. Similarly, until the valve mounted on the tower fly boom is actuated by the tower base boom, the tower lift cylinder oil flow is blocked preventing the tower from lifting down. This is an automatic system.

Upright Level Override System

As the tower boom is raised the upright is leveled by a master-slave cylinder arrangement between the tower lift cylinder and the upright level cylinder. The upright can become out of level in two directions, towards the platform or away from the platform. If the upright is out of level towards the platform, it will automatically correct itself when the tower is lowered by dumping oil from the upright level cylinder over a relief valve mounted in the upright until the tower lift cylinder reaches the end of its stroke. If the upright is out of level away from the platform, the tower lift cylinder is fully retracted with stroke remaining in the upright level cylinder. To correct this condition a re-leveling valve (with a red pull knob) allows the tower to be raised (from ground control) without extending the upright level cylinder. The upright will then correct itself when the tower is lowered to the stowed position.

Ground Control Keyswitch System

The ground control keyswitch is used for selecting the active control of the machine between the platform or ground control stations and as another shut off switch for machine power. On the standard keyswitch, the key is removable only in the off position. This allows the ground control station to have ultimate priority over the platform control.



1. UMS Sensor
2. Main Boom Angle Switch
3. Tower Boom Angle Switch
4. Tower Telescope Plunger Valve
5. Tower Lift Plunger Valve
6. Proximity Switch
7. Rotator Valve
8. Platform Control Valve

Figure 4-1. Boom Component Location

4.2 MAIN BOOM ASSEMBLY

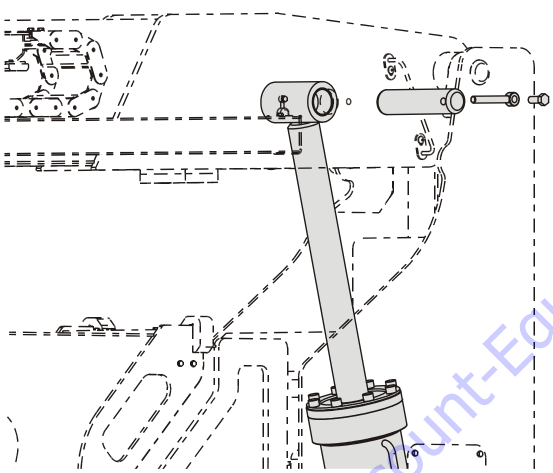
Removal

1. Using a suitable lifting equipment, adequately support boom assembly weight along entire length.

NOTICE

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

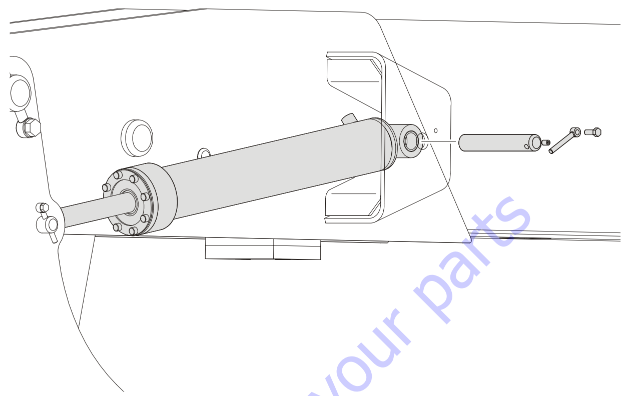
2. Tag and disconnect hydraulic lines from telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Using a suitable brass drift and hammer, remove hardware securing the main boom lift cylinder rod end pin to the base boom section. Remove the main boom lift cylinder pin from base boom. Retract the main boom lift cylinder by using the auxiliary power switch.



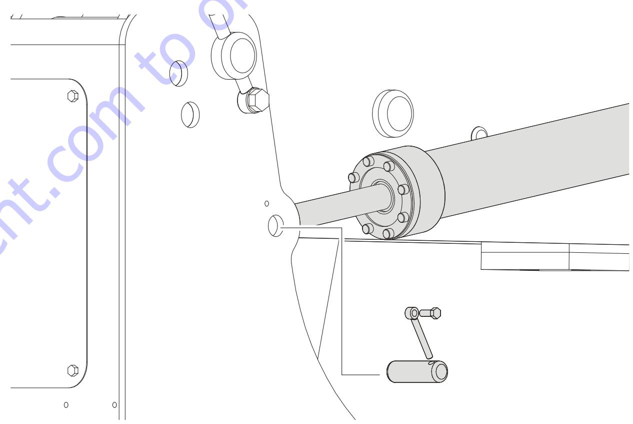
4. Remove the Master Cylinder as follows:
   a. Using an adequate supporting device, support the master cylinder so it doesn't fall when the retaining pins are removed.

NOTE: *The master cylinder weighs approximately 63 lbs. (28.6 kg).*

   b. Tag and disconnect hydraulic lines from Master Cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
   c. Remove the bolt and keeper pin securing the master cylinder barrel end pin to the base boom section. Next, install a 3/8-16 UNC threaded lifting eye into the threaded hole of the pin and pull pin out.

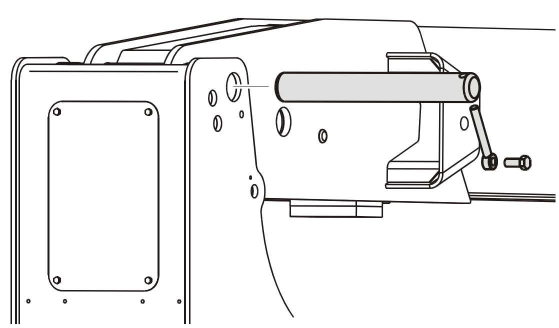


   d. Remove the bolt and keeper pin securing the master cylinder rod end pin to the upright. Remove the pin.



NOTE: *When installing the master cylinder rod end pin, insert the keeper hardware pin to prevent the pin from inserting too far.*

5. Remove the bolt and keeper pin securing the main boom to the upright. Using a suitable brass drift and hammer.



6. Using all applicable safety precautions, carefully lift main boom assembly clear of upright and lower to ground or suitably supported work surface.

NOTE: *The main boom alone weighs approximately 2226 lbs. (1010 kg). Including the slave cylinder, rotator, and platform support the assembly weighs approximately 3185 lbs. (1445 kg).*

Disassembly

1. Remove hardware securing telescope cylinder to back end of the base boom section.
2. Remove hardware securing the powertrack to fly boom.
3. Remove hardware which secures the wear pads to the base boom section; remove the wear pads from the top, sides and bottom of the base boom section.
4. Using suitable lifting device, remove fly boom assembly from base section.
5. Using a suitable brass drift and hammer remove the telescope cylinder pin from fly boom section.
6. Pull the telescope cylinder partially from aft end of the fly boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
7. Carefully remove the telescope cylinder and place telescope cylinder on a suitable trestle.

NOTE: *The Main Boom Telescope Cylinder can be removed without disassembling the main boom by disconnecting hydraulic lines, top attaching pin of main boom lift cylinder and telescope cylinders as directed above, and pulling out the telescope cylinder from the rear, thru the access plate opening of the upright.*

8. Remove hardware which secures the wear pads to the aft end of fly boom section; remove the wear pads from the top, sides and bottom of the fly boom section.

Inspection

NOTE: *When inspecting pins and bearings, refer to Section 2, Pins and Composite Bearing Repair Guidelines.*

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

Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Measure inside dimensions of the base section to determine the number of shims required for proper fit.
2. Install side, top and bottom wear pads to the aft end of fly section; shim evenly to the measurements of the inside of base boom section.

NOTICE

WHEN ASSEMBLING BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

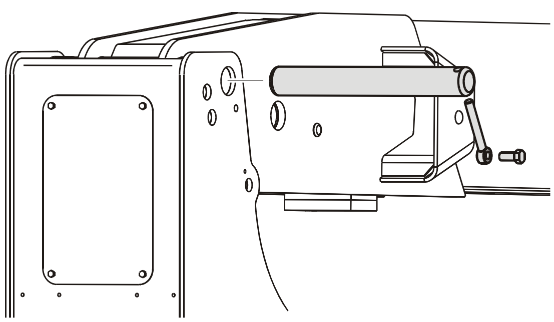
3. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the fly boom section.
4. Slide telescope cylinder into the aft end of fly boom section. Align attachment holes in fly boom section with hole in rod end of telescope cylinder.
5. Install telescope cylinder pin and secure with mounting hardware.
6. Secure the sling and lifting device at the fly boom assembly approximate center of gravity.
7. Slide fly boom assembly into the base boom section. Shim boom, if necessary, for a total of 1/32 inch (metric equivalent) clearance.
8. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 1/32 inch (metric equivalent) clearance.
9. Align the cylinder with the slots at aft end of base boom section, then secure cylinder with mounting hardware.

Installation

1. Using all applicable safety precautions, carefully lift boom assembly to align the pivot holes in the boom with those of the upright.

NOTE: *The main boom alone weighs approximately 2226 lbs. (1010 kg). Including the slave cylinder, rotator, and platform support the assembly weighs approximately 3185 lbs. (1445 kg).*

2. Using a suitable brass drift and hammer, install the pivot pin into the upright. Install the bolt and keeper pin securing the main boom pivot pin to the upright.

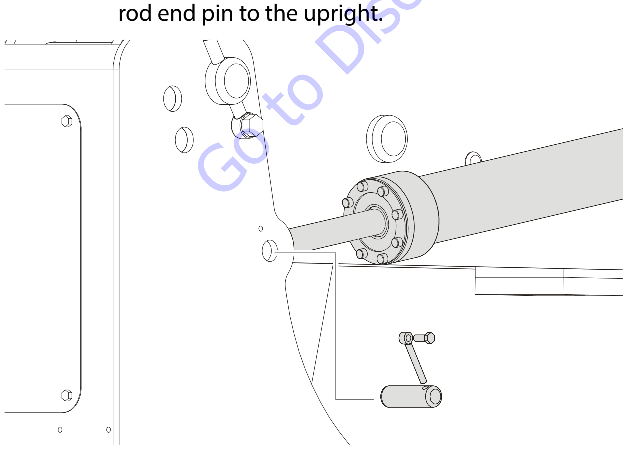


3. Install the Master Cylinder as follows:

   a. Using an adequate supporting device, align the master cylinder with the mounting holes on the boom and upright.

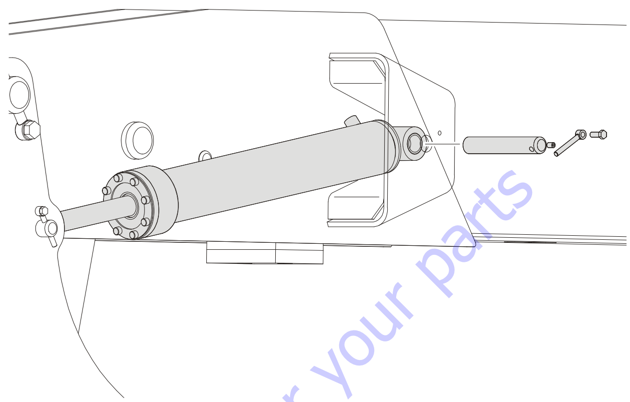
NOTE: *The master cylinder weighs approximately 63 lbs. (28.6 kg).*

   b. Install the master cylinder rod end pin. Install the bolt and keeper pin securing the master cylinder rod end pin to the upright.



NOTE: *When installing the master cylinder rod end pin, insert the keeper hardware pin to prevent the pin from inserting too far.*

   c. Install the barrel end retaining pin. Install the bolt and keeper pin securing the master cylinder barrel end pin to the base boom section.



   d. Connect hydraulic lines to the master cylinder as tagged during removal.

4.3 UPRIGHT

Removal

NOTICE

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

1. Remove the main boom assembly. Refer to Section 4.6, UMS Troubleshooting and Fault Messages.

2. Tag and disconnect hydraulic lines to the main boom lift cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

3. Remove mounting hardware from main boom lift Cylinder barrel end. Using a suitable brass drift and hammer, remove pin (1) from Upright and remove Main Boom Lift Cylinder.

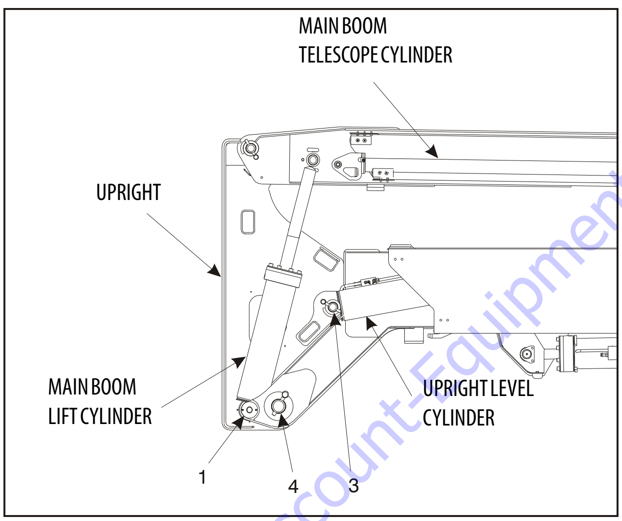


Figure 4-2. Location of Components - Upright

4. Disconnect wiring harness to horizontal limit switch.

5. Disconnect the Upright Level Cylinder as follows:

   a. Using a suitable lifting device, support the Upright.

   b. Remove mounting hardware securing hose bracket in upright, and remove the hose bracket.

   c. Remove mounting hardware securing the upright level cylinder to the upright. Using a suitable brass drift and hammer, remove pin (3) from upright and disconnect the upright level cylinder from the upright.

6. Remove mounting hardware from the Upright Pivot Pin using a suitable brass drift and hammer. Remove pin (4) from tower boom assembly and remove the upright from the machine.

NOTE: *Steps 7 thru 10 are only necessary if the upright level cylinder is to be removed.*

7. With upright removed, override tower telescope limit switch and extend the tower boom to gain access to the upright level cylinder rod end attach pin.

8. Tag and disconnect hydraulic lines to the upright lift cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

9. Using an overhead crane or suitable lifting device, support the upright lift cylinder, remove mounting hardware from the barrel end of the upright lift cylinder and remove the pin.

10. Carefully remove the upright lift cylinder and place on a suitable work surface.

Installation

NOTE: *Steps 1 thru 4 are only necessary if the upright level cylinder is to be removed.*

1. Using a suitable lifting device, carefully install the upright lift cylinder into place in the tower boom.

2. Install the pin and mounting hardware at the barrel end of the upright lift cylinder.

3. Connect the hydraulic lines to the upright lift cylinder as tagged during removal.

4. Override the tower telescope limit switch and retract the tower boom.

5. Using an adequate lifting device, install the upright into position. Install pin (4) into the tower boom assembly and secure it in place with the mounting hardware.

6. Connect the Upright Level Cylinder as follows:

   a. Align the holes in the cylinder and upright for pin (3), and install the pin into the upright and connect the upright level cylinder to the upright. Install the mounting hardware securing the pin.

   b. Install the hose bracket and secure in place with the mounting hardware.

7. Connect the wiring harness to horizontal limit switch.

8. Align the holes in the main boom lift cylinder and upright for pin (1) and install the pin. Secure the pin in place with the mounting hardware.

9. Connect the hydraulic lines to the main boom lift cylinder as tagged during removal.

10. Install the main boom. Refer to Section 4.6, UMS Troubleshooting and Fault Messages.

4.4 TOWER BOOM ASSEMBLY

Removal

NOTICE

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

1. Remove the main boom assembly. Refer to Section 4.6, UMS Troubleshooting and Fault Messages.

2. Using an overhead crane or suitable lifting device, support the entire Tower Boom Assembly and separately support the tower lift cylinder.

3. Remove mounting hardware from tower lift cylinder rod end. with a brass drift and hammer, remove the tower Lift cylinder Pin disconnecting the tower lift cylinder.

4. Remove mounting hardware from the tower boom pivot pin. Using a suitable brass drift and hammer, remove pin (1) from turntable assembly.

5. Using all applicable safety precautions, carefully lift the Tower Boom Assembly clear of turntable and lower to ground or a suitable supported work surface.

6. Remove mounting hardware from the upright leveling cylinder rod end. with a brass drift and hammer, remove the pin, disconnecting the upright cylinder. Remove with suitable lifting device.

NOTE: *Using a suitable lifting device, support the upright.*

7. Remove the Tower Fly as follows:

   a. Mark all hoses and wiring harnesses at bracket on rear end of tower base boom for future assembly. Remove hoses and wiring from tower boom Powertrack.

   b. Remove mounting hardware that secures the Powertrack to tower base boom and remove the Powertrack.

   c. Remove mounting hardware from tower boom telescope cylinder barrel and rod end.

   d. Slide the telescope cylinder out of the base boom, support with an overhead crane or suitable lifting device.

   e. Remove mounting hardware that secures the wear pads to the front of tower base boom section; Remove the wear pads from the top sides and bottom of the tower base boom.

   f. Using an overhead crane or suitable lifting device, remove the fly section.

Inspection

NOTE: *Refer to Section 2, Pins and Composite Bearing Repair Guidelines.*

1. Inspect tower boom pivot pin for wear scoring, tapering, and ovality, or other damage. Replace pins as necessary.

2. Inspect tower boom pivot attach points for scoring, tapering, and ovality, or other damage. Replace pins as necessary.

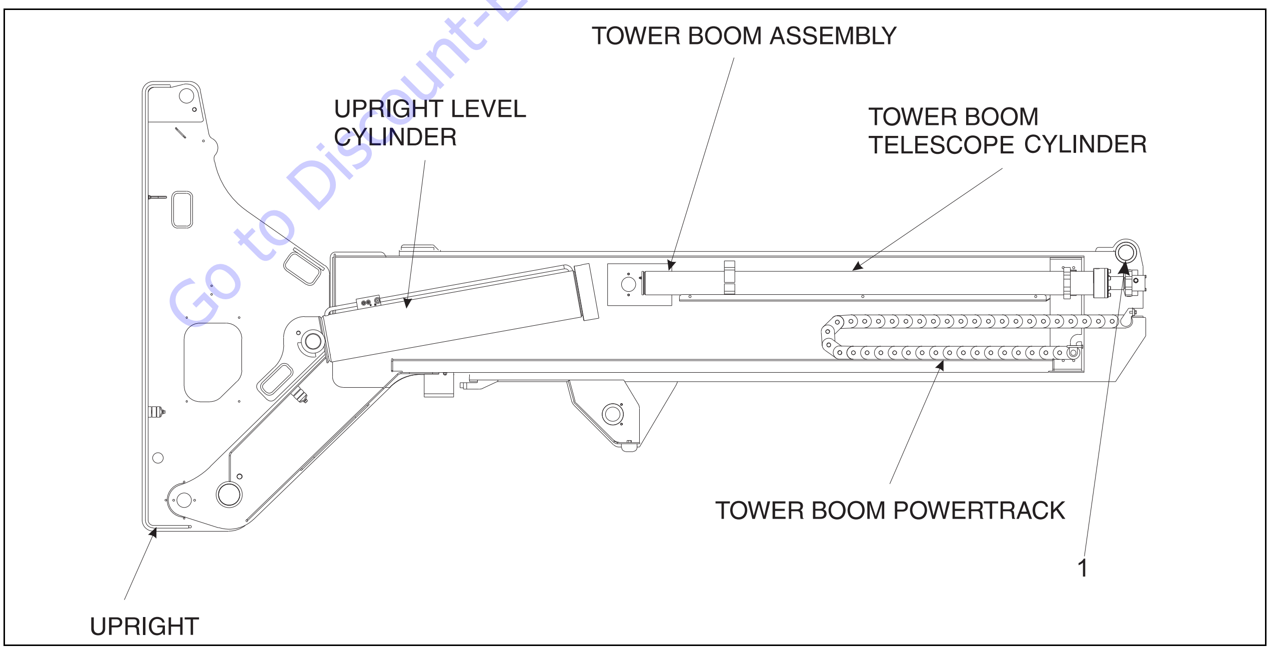


Figure 4-3. Location of Components - Tower Boom Powertrack

3. Inspect inner diameter of tower boom pivot bearings for scoring, distortion, wear, or other damage.

4. Inspect lift cylinder attach pin for wear, scoring, tapering, and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.

5. Inspect inner diameter of upright attach point bearings for scoring, distortion, wear, or other damage. Replace bearing as necessary.

6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.

7. Inspect structural units of tower boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

8. Inspect Powertrack for damage such as cracking, wear, or other damage. Replace links or assembly, as necessary.

Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Measure inside dimensions of the tower base section to determine the number of shims required for proper fit.

2. Install side, top, bottom wear pads to the aft end of tower fly section; shim evenly to the measurements of the inside of the base boom section.

NOTICE

WHEN ASSEMBLING TOWER BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

3. Align upright leveling cylinder with attach holes in tower fly boom. Using a soft head mallet, install the cylinder pin into tower fly boom and secure with mounting hardware.

4. Secure the sling and lifting device at the tower fly boom assembly's approximate center of gravity.

5. Slide tower fly boom assembly into the tower base boom section, for a total of 1/32 inch (metric equivalent) clearance.

6. Install wear pads into the forward position of the tower base boom section. Shim boom, if necessary, for a total of 1/32 inch (metric equivalent) clearance.

7. Align the telescope cylinder with the slots at the aft end of tower base boom section, then secure cylinder with mounting hardware.

8. Attach internal Powertrack to tower base boom at bottom only and extended out of boom that the Powertrack links are opened at top.

9. Attach hoses and wiring harnesses at front end of base boom and route thru the Powertrack. Secure hoses and wiring harnesses with hose brackets.

10. Roll the Powertrack back into the base boom section and attach loose end of the Powertrack to the inside top of the fly boom section.

Installation

1. Using a suitable lifting device, position boom assembly on turntable so that the pivot holes in both boom and turntable are aligned.

2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on turntable.

3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.

4. Connect all wiring connectors to the correct connectors.

5. Connect all hydraulic lines of boom assembly.

6. Using all applicable safety precautions, operate lifting device in order to position boom lift cylinder so that holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.

7. Using all applicable safety precautions, operate from the lower controls and raise and extend boom fully, noting the performance of the extension cycle.

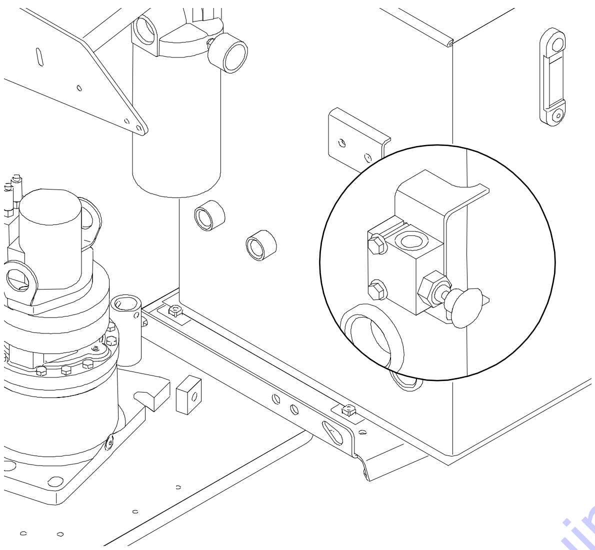
8. Retract and lower boom, noting the performance of the retraction cycle.

Tower Out of Sync

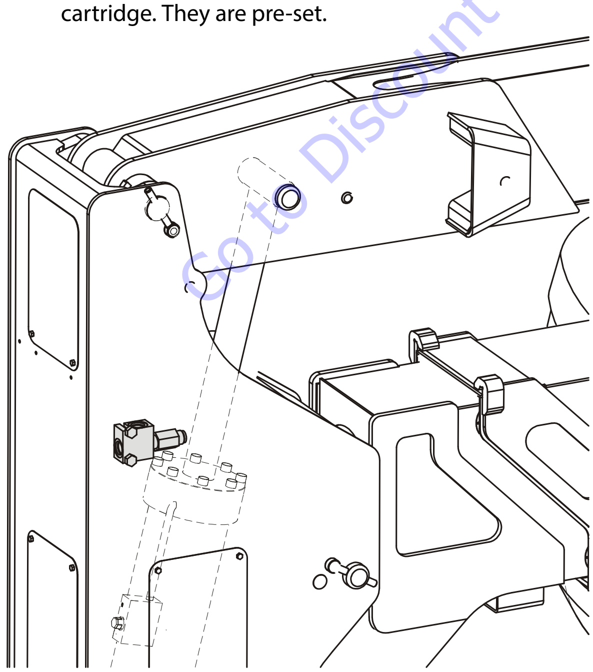
Tower is out of sync backwards, upright leaning toward the platform.

When towering down the upright cylinder bottoms out before the lower lift. Problems that could cause this are:

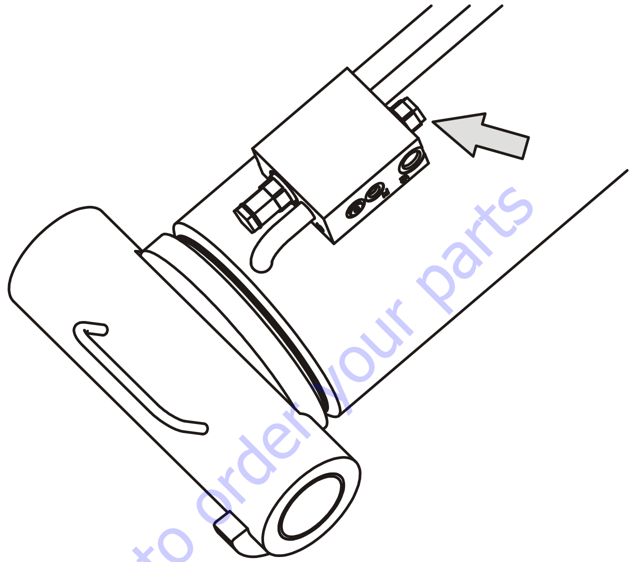
1. The releveling valve (red knob on the oil tank P/N: 4640866), this is a poppet valve that could be leaking fluid out of the closed loop. Manually opening the valve and flushing it can eliminate any contaminate on the seat. The seat could also be damaged, so replacing the cartridge might be necessary.



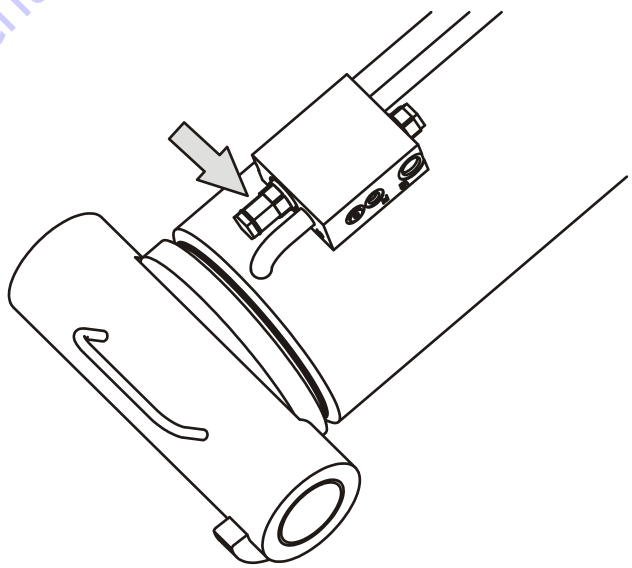
2. A relief valve is located in the upright. This relief valve could be leaking backwards out of the loop. Replace the cartridge. They are pre-set.



3. The counter/balance valve in the piston end of the upright level cylinder. There could be a leak path from the valve port to the pilot port.
   Replace the counter/balance valve.



4. The counter/balance valve in the rod end of the lower lift cylinder. There could be a leak path from the valve port to the pilot port. Replace the counter/balance valve.

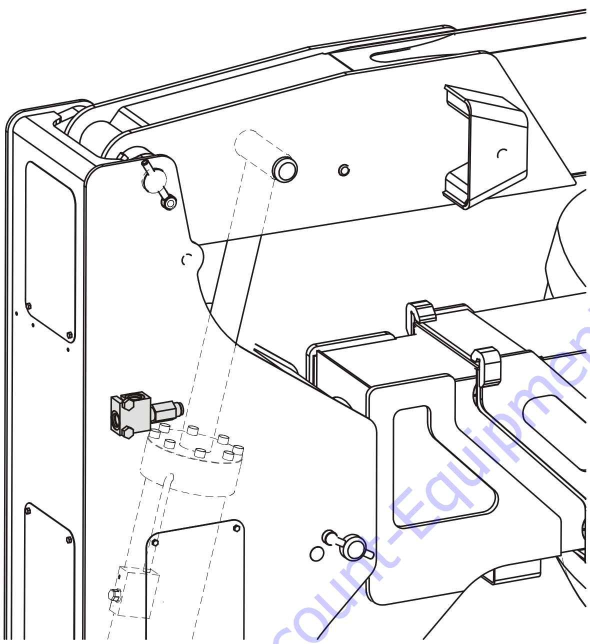


5. The packing on either the upright or lower cylinder can cause this. Do cylinder tests to determine if either cylinder needs new packing.

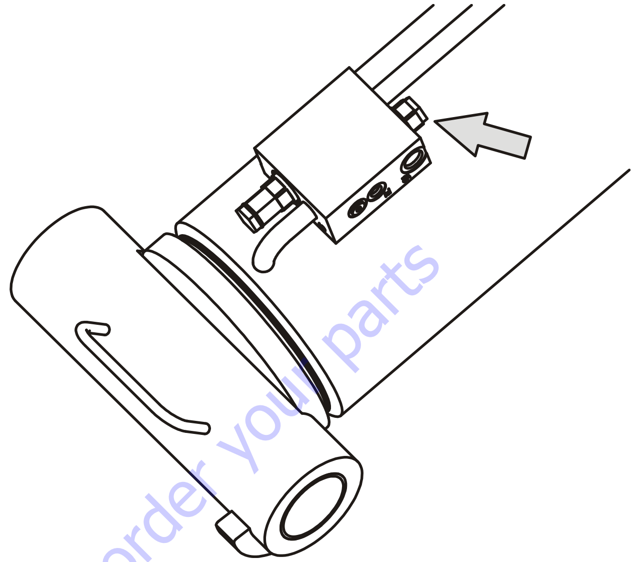
Tower is out of sync forwards, upright leaning toward the steer axle.

When towering down, the lower lift cylinder bottoms out before the upright level cylinder. This is caused by too much oil between the two cylinders. Problems that could cause this are:

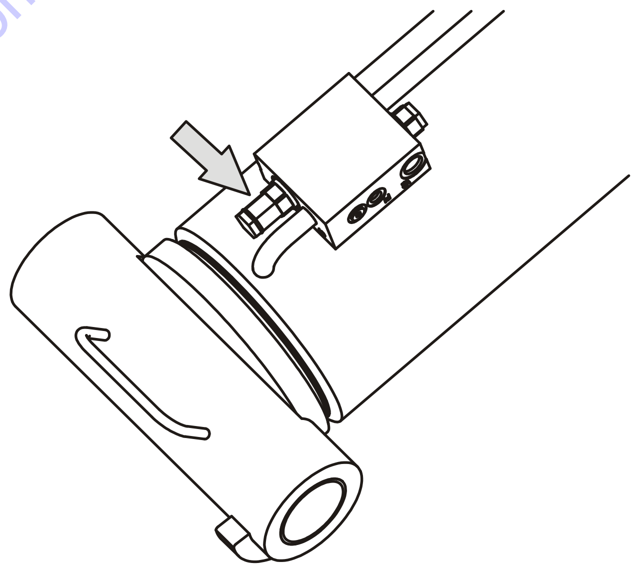
1. The relief valve located in the upright (P/N: 4640929). If this valve is set too low or has contaminate in it causing it to leak prematurely, when lifting down oil can pass through it causing the volume to grow between the cylinders. Flush the valve out and reinstall it, or replace the cartridge. The cartridge pressure is pre-set so no adjustment can be made.



2. The counterbalance valve in the piston end of the upright level cylinder. There could be a leak path from the pilot port to the valve port. Replace the counterbalance valve.



3. The counterbalance valve in the rod end of the lower lift cylinder. There could be a leak path from the pilot port to the valve port. Replace the counterbalance valve.



4. The packing on the lower lift cylinder can cause this. Do a cylinder test to check this out. Refer to Cylinder Drift Test in Section 2.

4.5 UPRIGHT MONITORING SYSTEM

The UMS provides a visual and audible warning to the operator when the limits of the upright assembly alignment have been reached. In addition, the UMS will not allow the tower boom to be lowered when the upright assembly is misaligned in a direction oriented away from the work platform.

Re-Synchronizing Upright

A pull type control valve allows the operator to adjust the upright level cylinder if the upright is not 90° (vertical) relative to the chassis (Refer to Figure 4-4.). This valve is located in the tank compartment area.

Perform the following steps with the aid of an assistant:

1. Turn the key switch to the ground control position.
2. Start the engine.
3. Pull and hold the red relevel knob located next to the main control valve. Refer to (See Figure 4-4.)
4. Raise the tower boom 6 feet (1.8 m).
5. Release the red relevel knob.
6. Lower the tower boom fully and continue to hold down the switch to Tower Down for an additional 20 seconds.
7. Repeat steps 3 thru 6 as necessary until the upright is 90° (vertical) relative to the chassis.

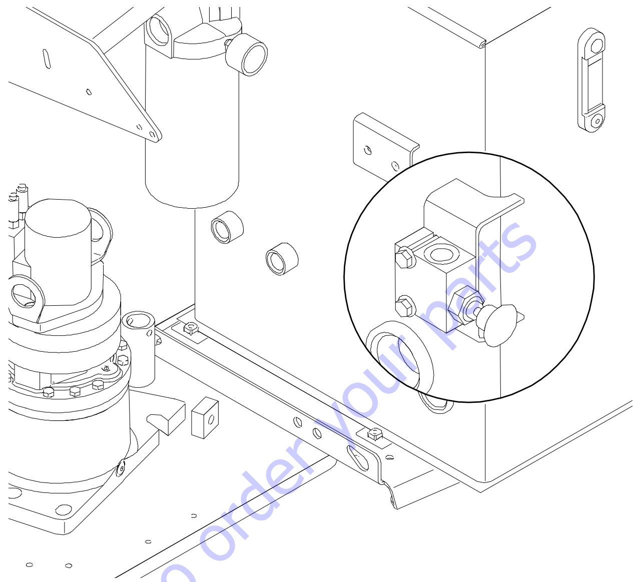


Figure 4-4. Releveling Valve

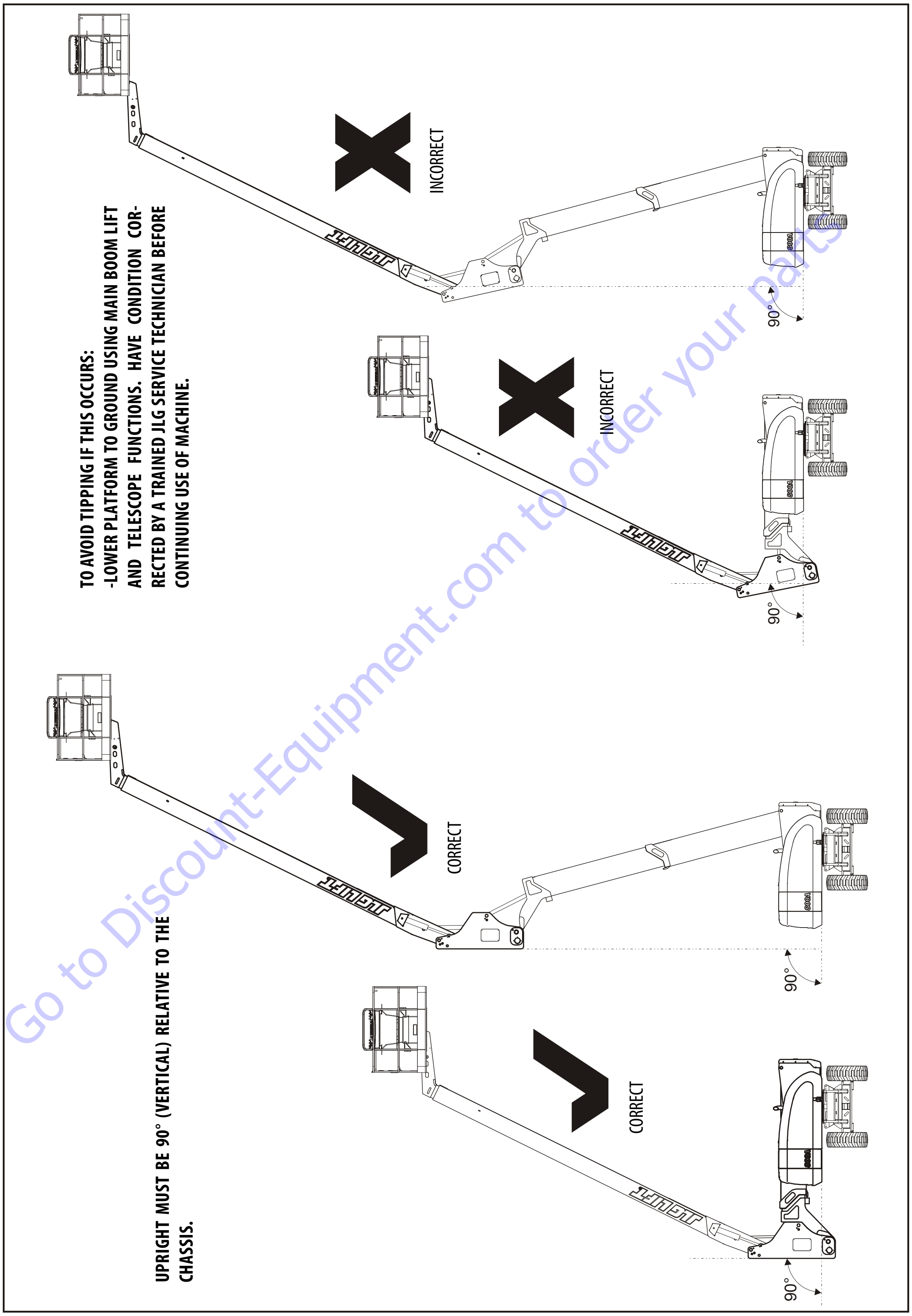


Figure 4-5. Boom Upright Positioning

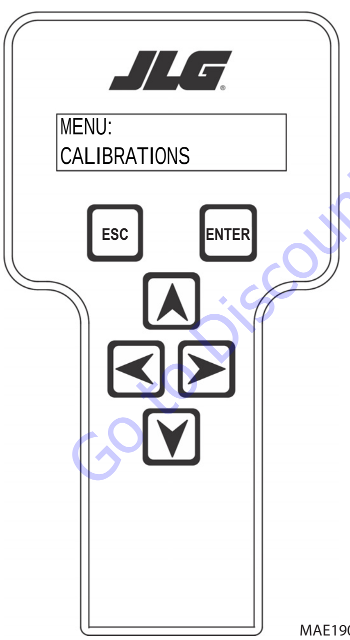
Calibration

1. Connect the JLG Hand-held analyzer to the original analyzer connection in the ground box.

NOTICE

DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

2. Pull out the emergency stop button at the ground control station and start the engine from the ground controls.
3. To calibrate the Upright Monitoring System through the hand-held analyzer, you must be in access level 1. To advance to access level 1, scroll to the ACCESS LEVEL menu and press "ENTER" . Using the arrows on the keypad, enter the password "33271" and press "ENTER" .
4. Calibrate the upright monitoring system sensor by the following procedure:
   a. In access level 1, scroll through the menu items until "CALIBRATIONS" is displayed on the second line of the analyzer screen. The screen will display the following:

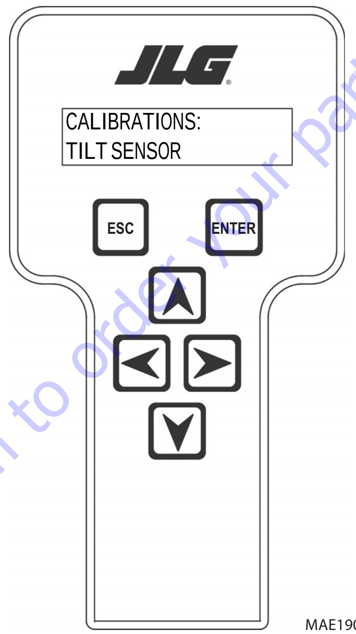


MAE19060

NOTICE

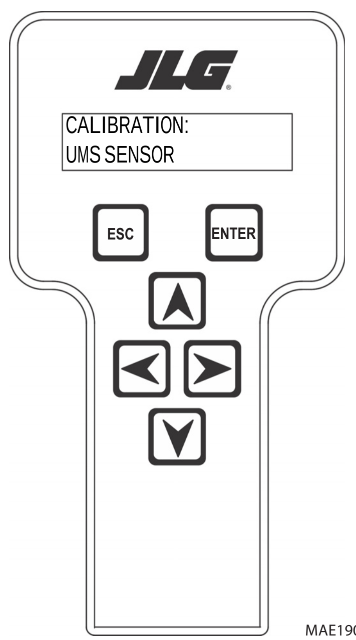
IT IS NOT NECESSARY TO CALIBRATE THE TILT SENSOR IN THE GROUND CONTROL MODULE AT THIS TIME. HOWEVER, WHEN THE TILT SENSOR IN THE GROUND CONTROL MODULE IS RECALIBRATED, THE UPRIGHT MONITORING SYSTEM TILT SENSOR MUST BE RECALIBRATED AS WELL.

   b. after pressing 'ENTER" one of the following screens will be displayed:



MAE19060

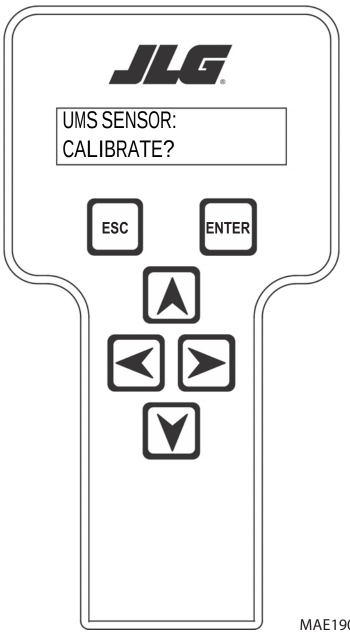
Or



MAE19060

c. Scroll left to right through the above menu items until "UMS SENSOR" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" key.

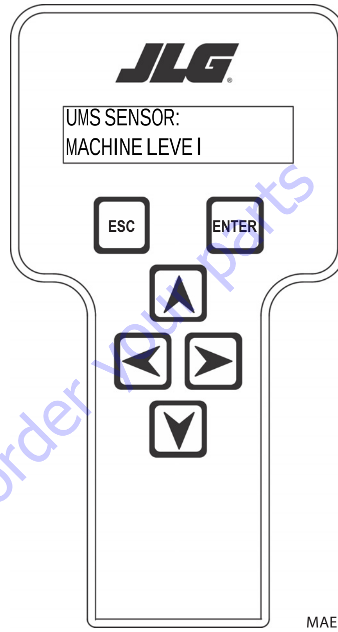
d. After selecting "UMS SENSOR", the following screen will appear:



MAE19060

NOTE: *By pressing the left or right arrow keys in this screen, you may view the output of the sensor.*

e. Press "ENTER" and the next screen will display the following, asking if the machine is on a level surface:

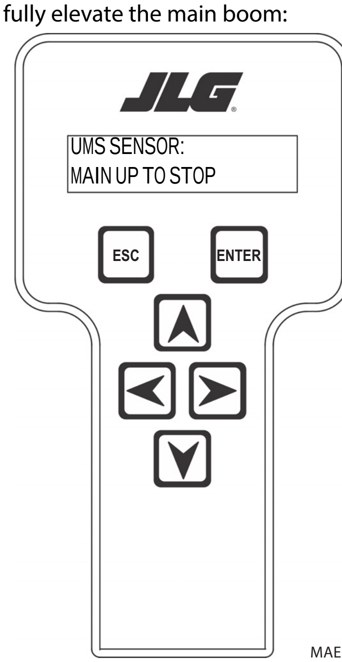


MAE19060

NOTICE

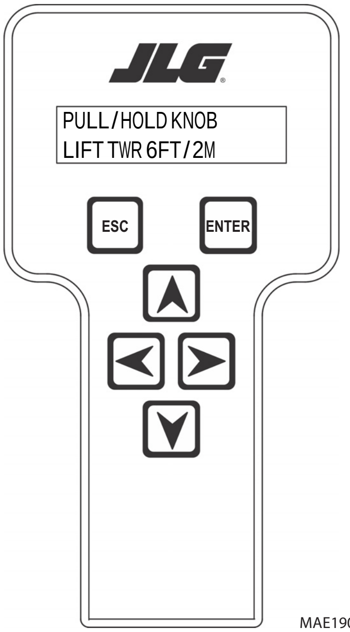
THE MACHINE MUST BE LEVEL FOR PROPER CALIBRATION.

f. Verify the machine is level and press "ENTER". The screen will display the following, asking you to fully elevate the main boom:



MAE19060

g. After the main boom has been fully elevated, press "ENTER" . The analyzer will display the following:

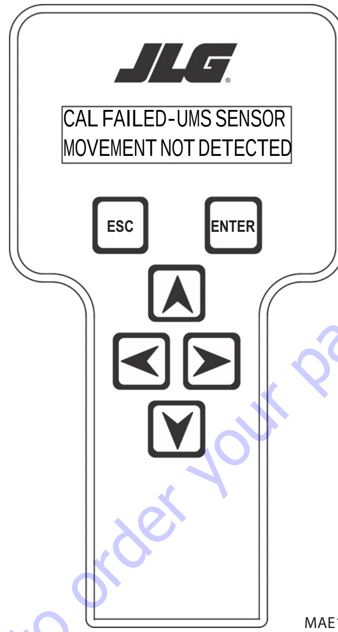


MAE19060

NOTE: *By pressing the left or right arrows in this screen, you may view the output of each sensor.*

h. With the aid of an assistant, pull and hold the red releveling knob on the hydraulic tank while lifting the tower boom. Raise the tower boom six (6) feet or two (2) meters. After elevating the tower the required distance, press “ENTER” .

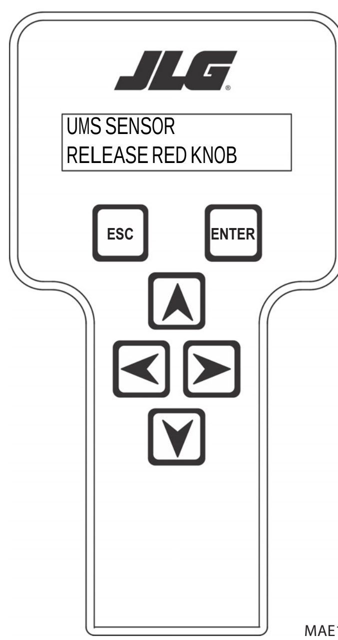
If the upright monitoring system did not detect adequate sensor activity, the screen will display:



MAE19060

Should you get the above message, verify that the sensor is installed correctly and verify the sensor connection to the sensor harness is secure. Also, ensure the red knob is held fully open for the required time.

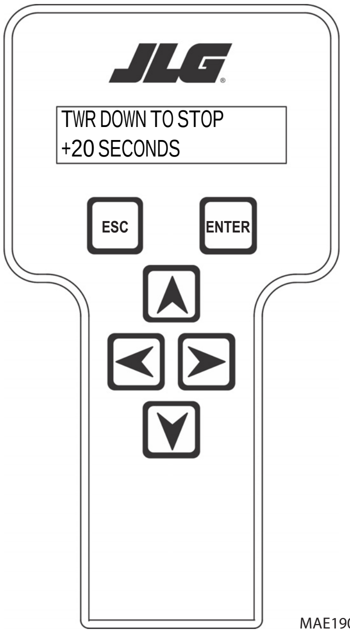
If the calibration is executing properly, you shall see the following display:



MAE19060

i. When viewing the above display, press "ENTER" 

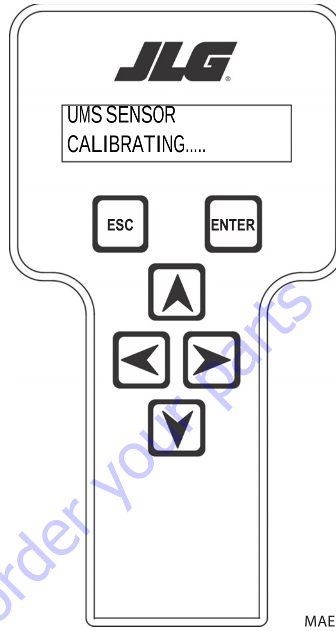
. The screen will display the following:



MAE19060

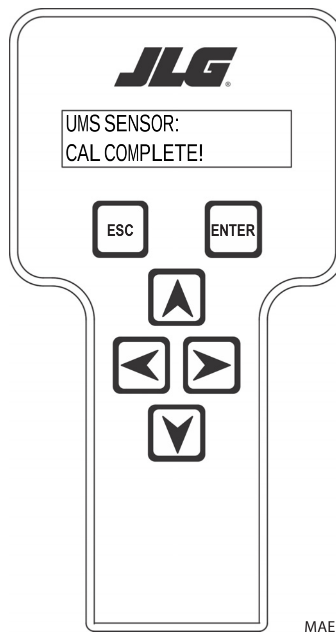
j. Lower the tower boom onto the boom stop. Continue to hold the tower boom down function for at least twenty (20) seconds **WITHOUT RELEASING THE FUNCTION SWITCH**. The calibration must recognize continuous activation of the tower down function switch for the required time.
After the required activation time has passed, release the function switch and press "ENTER" 

. The analyzer will display the following message:



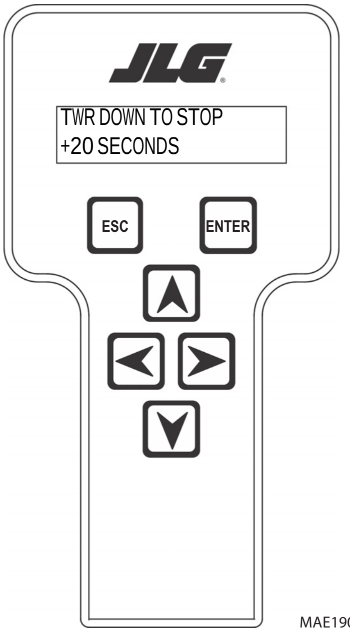
MAE19060

If the calibration has been completed successfully, the screen will automatically change to:



MAE19060

If the calibration has not been completed successfully, the display will automatically change to:



MAE19060

Repeat step j until the calibration time requirement has been satisfied.

⚠ WARNING

DO NOT RAISE THE TOWER BOOM AGAIN DURING CALIBRATION.

k. To correctly complete the calibration process, fully retract and fully lower the main boom. Once the machine is in the stowed position, turn off the machine and disconnect the analyzer.

Calibration Faults

CAL Failed-Chassis Not Level

In the event the turntable tilt switch input is logic low indicating that the machine is not level the UMS calibration screens shall display this fault.

CAL Failed-UMS Sensor Raw Output Out Of Range

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the UMS sensor.

CAL Failed-Turntable Sensor Raw Output Out Of Range

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the turntable sensor.

CAL Failed-Calibration Disrupted

If calibration is disrupted, the control system shall display this fault.

CAL Failed- UMS Sensor Movement Not Detected

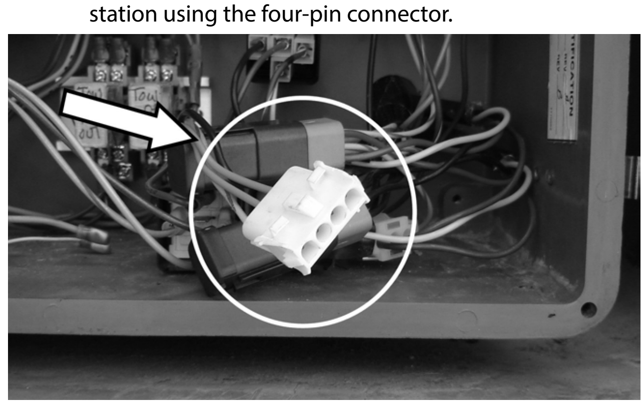
The UMS angle has not detected the required amount of movement during calibration.

Function Check

NOTICE

ON ADE EQUIPPED MACHINES, DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

1. Connect the hand-held analyzer at the ground control station using the four-pin connector.

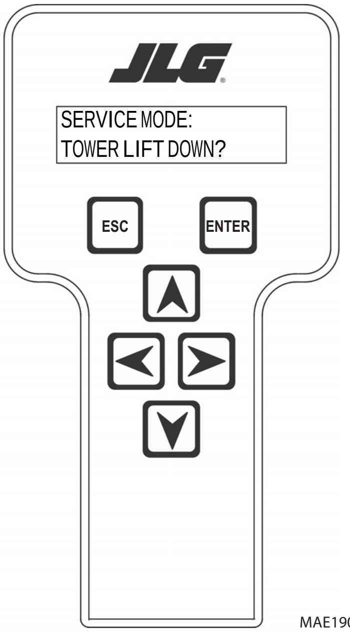


2. Pull out the emergency stop button at the ground control station and turn the key switch to ground controls. Start the engine.

3. Advance to access level 1 by scrolling to the ACCESS LEVEL menu and press "ENTER" ENTER. Using the arrows on the keypad, enter the password "33271" and press "ENTER" ENTER.

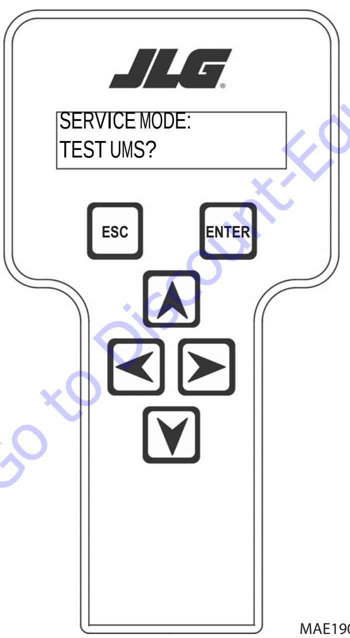
4. Scroll through the top level menu until SERVICE MODE appears. Press "ENTER" 

to select this menu item. After pressing "ENTER" one of the following screens will be displayed:



MAE19060

Or

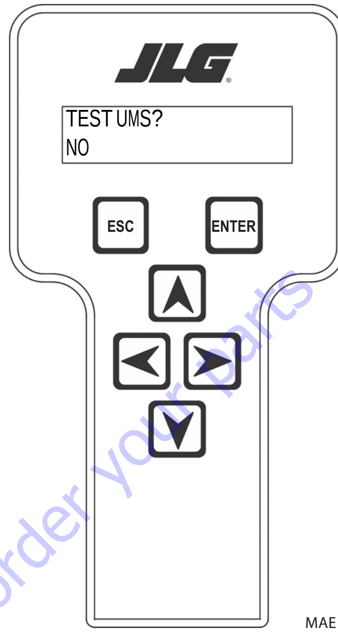


MAE19060

5. Scroll left to right through the above menu items until "TEST UMS?" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" 

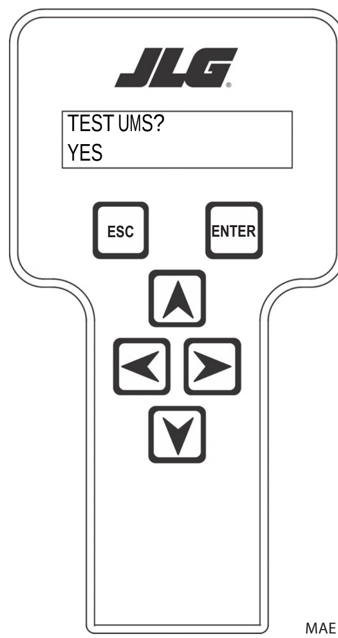
key.

6. The controller will now display the following:



MAE19060

or, by pressing the up and down arrow keys:



MAE19060

7. When the "YES" message is displayed, press the "ENTER" 

key to automatically perform a function test. Upon the function test, the system will activate the Upright Monitoring System, warning lights, and alarm. Verify that the alarm sounds, the boom malfunction indicator lights (platform and ground) are illuminated.

8. From the ground controls, raise the tower boom several feet. Verify that the tower boom will not lower.
9. To end the system test, press the Emergency Stop Switch (EMS) at the ground controls. Upon loss of power (pressing the EMS) to the system, the upright monitoring system will reset and all functionality will be restored to the machine.

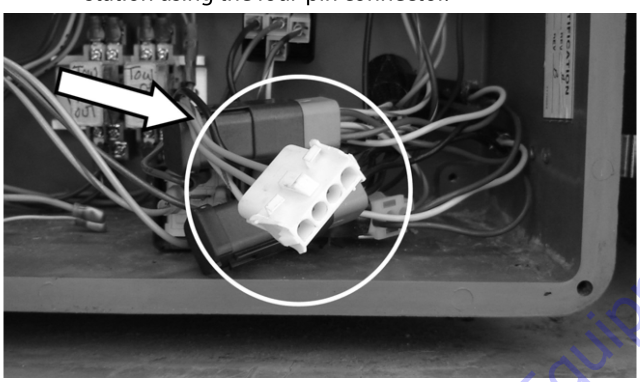
Service Mode/Tower Boom Retrieval

The UMS software incorporates a service mode to temporarily disengage the UMS and allow a tower lift down operation when the UMS has detected a backward stability concern.

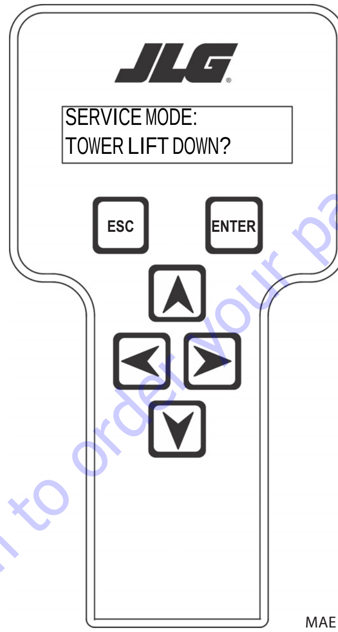
NOTICE

ON ADE EQUIPPED MACHINES, DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

1. Connect the hand-held analyzer at the ground control station using the four-pin connector.

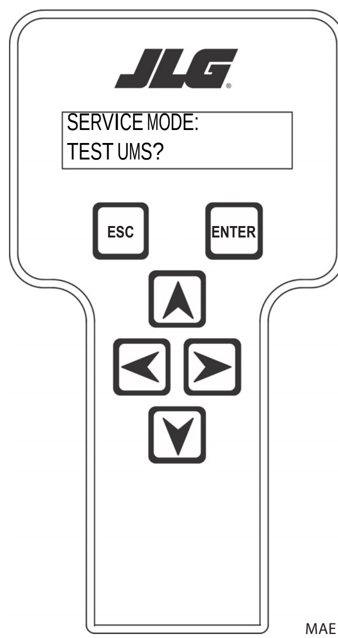


2. Pull out the emergency stop button at the ground control station and turn the key switch to ground controls. Start the engine.
3. Advance to access level 1 by scrolling to the ACCESS LEVEL menu and press "ENTER" ENTER. Using the arrows on the keypad, enter the password "33271" and press "ENTER" ENTER.
4. Scroll through the top level menu until SERVICE MODE appears. Press "ENTER" ENTER to select this menu item. After pressing "ENTER" one of the following screens will be displayed:



MAE19060

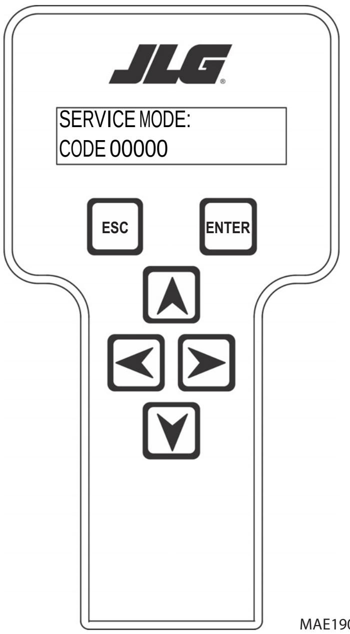
Or



MAE19060

5. Scroll left to right through the above menu items until "TOWER LIFT DOWN?" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" key.

6. The controller will now display the following:



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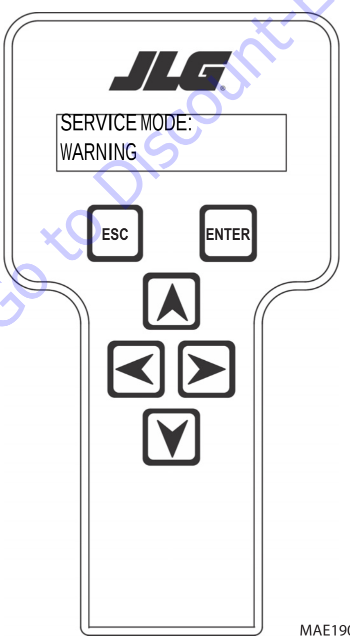
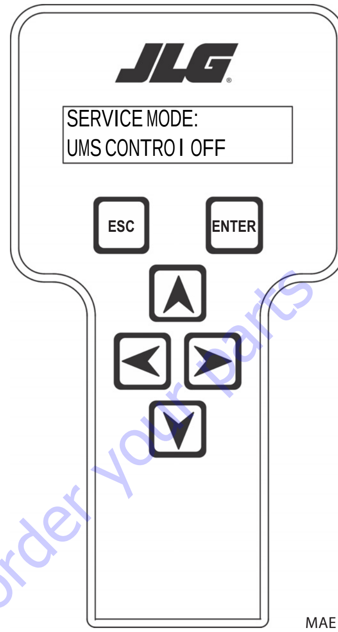
7. Enter the service code "**81075**" and press the "ENTER" key. The controller display will now display the following,



MAE19060

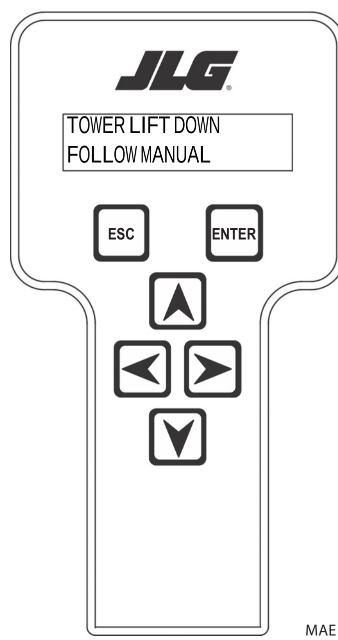
followed by:



MAE19060

The flashing and scrolling messages will repeat until the "ENTER" key is pressed.

8. When the "ENTER" key is pressed, the UMS will be disabled and the display will read:



MAE19060

9. Before using tower lift down adhere to the following:

- Make sure the main boom is fully retracted.
- Make sure the tower boom is fully retracted.
- Slowly lower the tower boom.

10. When the platform has been safely lowered to the ground, exit the service mode by pressing the Emergency Stop Switch (EMS) at the ground controls. Upon loss of power (pressing the EMS) to the system, the upright monitoring system will reset and all functionality will be restored to the machine.

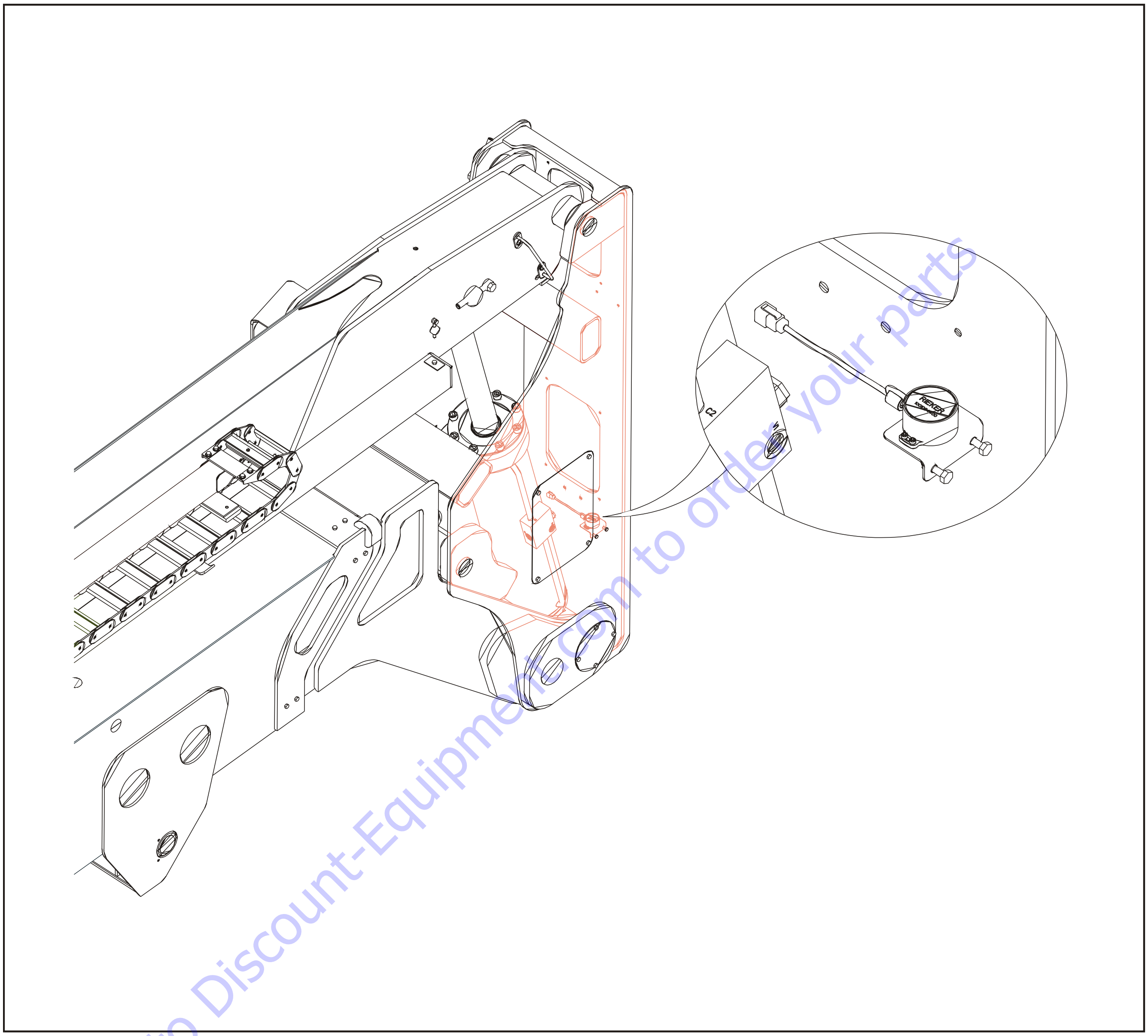


Figure 4-6. UMS Sensor Location

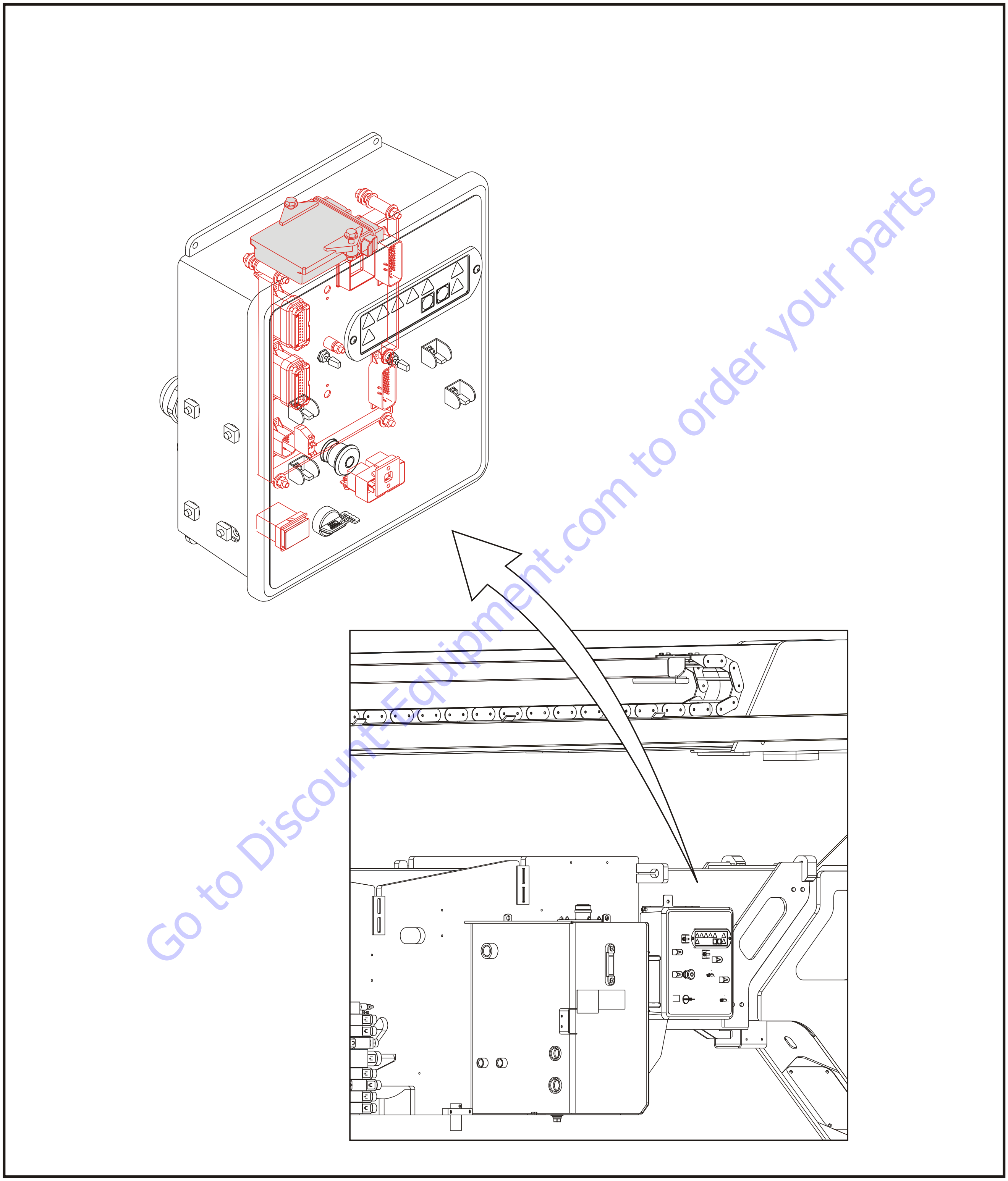


Figure 4-7. UMS Module Location

J1		J2	
1	IGN POWER (7-33V)	1	+5V ANALOG EXCITATION
2	GROUND	2	ANALOG INPUT 0
3	DIGITAL INPUT 0	3	ANALOG GROUND
4	DIGITAL INPUT 1	4	+5V ANALOG EXCITATION
5	DIGITAL INPUT 2	5	ANALOG INPUT 1
6	DIGITAL INPUT 3	6	ANALOG GROUND
7	DIGITAL OUTPUT 0 (PWM, IF)	7	ANALOG INPUT 2
8	DIGITAL OUTPUT 1 (PWM, IF)	8	ANALOG INPUT 3 (NOT POPULATED)
9	DIGITAL OUTPUT 2 (PWM, IF)	9	CANBUS HIGH
10	DIGITAL OUTPUT 3 (PWM, IF)	10	CANBUS LOW
11	DIGITAL OUTPUT 4 (PWM)	11	ANALYZER TRANSMIT
12	DIGITAL OUTPUT 5 (PWM)	12	ANALYZER RECEIVE

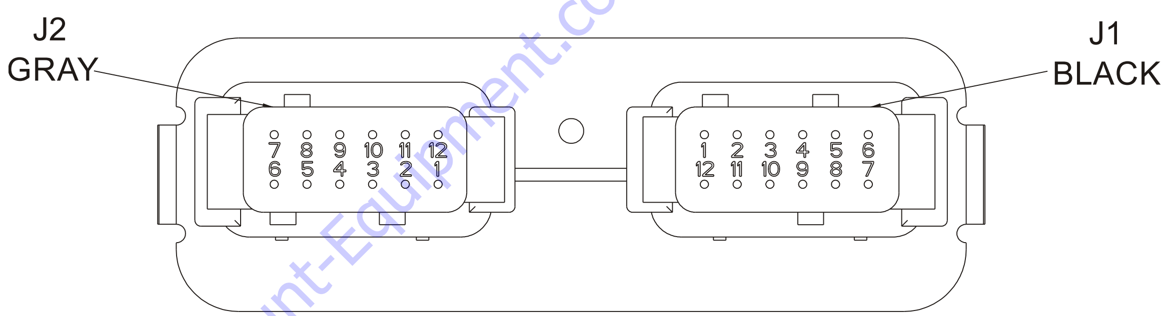


Figure 4-8. UMS Module Pin Identification

4.6 UMS TROUBLESHOOTING AND FAULT MESSAGES

Backward Stability Concern Message

2/5 UMS SENSOR BACKWARD LIMIT REACHED

When the upright angle relative to the turntable is higher than +2.5° (away from the work platform), tower lift down will be disallowed immediately. Tower Lift Down will be re-allowed when the upright angle relative to the turntable is less than 2.0°. If Tower Lift Down is disabled for more than 1.5 seconds, the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm will light/sound continually and a fault shall be raised. These conditions will be latched along with Tower Lift Down until the upright angle is less than 2.0° for 2 seconds and the Tower Lift Down command is returned to neutral.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Follow the corrective action listed on decal 1702265 located near the red knob of the machine.
- Inspect machine hydraulics. Refer to Holding Valve Checks in Section 5 - Hydraulics.

Forward Stability Concern Message

2/5 UMS SENSOR FORWARD LIMIT REACHED

When the upright angle relative to the turntable is less than –4.0° for longer than 1.5 seconds, the ground control boom malfunction indicator lamp, the platform malfunction indicator lamp, and platform alarm will light/sound continually and a fault will be raised. The light/alarm signal will stop only when the upright angle reaches values greater than –3.0° for 2 seconds.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Tower lift down.
- Inspect machine hydraulics. Refer to Holding Valve Checks in Section 5 - Hydraulics.

Auto Detection Input Low Message

2/5 AUTO DETECTION INPUT LOW

If the UMS detects a valid ground module software version but digital input 2 is not tied high the UMS module shall report a fault.

Solution:

- Inspect wire harness, there should be 12 volts going into pin J1-5 (black connector) of UMS module.

UMS Sensor Communications lost

6/6 UMS SENSOR COMMUNICATIONS LOST

If the UMS detects a valid ground module software version but digital input 2 is not tied high the UMS module shall report a fault.

Solution:

- Inspect wire harness; CANbus communications are on pins J2-9 & J2-10 (gray connector) of the UMS module.
- Using access level 1 of the UMS module, under “DIAGNOSTICS” CAN, EX/SEC and TX/SEC should be values greater than 0. Also “BUS OFF:” and “BUS ERR:” should be 0 and “PASSIVE:” should be a low value.

Out of Usable Range Message

8/1 UMS SENSOR OUT OF USABLE RANGE

When both the Chassis tilt sensor and the UMS sensor read greater than 10° in the same direction the UMS will be disengaged until the condition no longer exists and a fault shall be raised.

Solution:

- Verify the message clears when operating the machine on grade less than 10°.
- Inspect sensor mounting.
- Verify sensor calibration on level pad.

UMS Sensor Not Calibrated Message

8/1 UMS SENSOR NOT CALIBRATED

If the control system detects a sensor out of range condition or a not calibrated fault with the UMS angle sensor, the control system shall report a fault and disable Tower Lift Down and activate the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm continually

If the control system detects that the UMS angle sensor has not been calibrated, the ground boom malfunction lamp will flash at a 3 Hz rate until the system is calibrated or disabled.

Solution:

- Calibrate sensor.

UMS Sensor Faulted Message

8/1 UMS SENSOR FAULTED

If the system detects that the UMS sensor frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range the control system shall report a fault.

Solution:

- Inspect wire harness going to the sensor and UMS module.
- Inspect sensor mounting.
- Replace sensor.

Incompatible Software Detected Message

9/9 INCOMPATIBLE SOFTWARE DETECTED

If the control system detects that the ground module software is incompatible with the UMS module, the UMS module shall report a fault and disable the footswitch signal to the ground module.

Solution:

- Update ground module software.

Calibration Faults

CAL FAILED-CHASSIS NOT LEVEL

The control system shall display a fault in the event the raw sensor output is greater than ±5° for the chassis sensor.

CAL FAILED-UMS SENSOR RAW OUTPUT OUT OF RANGE

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the UMS sensor.

CAL FAILED-CALIBRATION DISRUPTED

If calibration is disrupted, the control system shall display this fault.

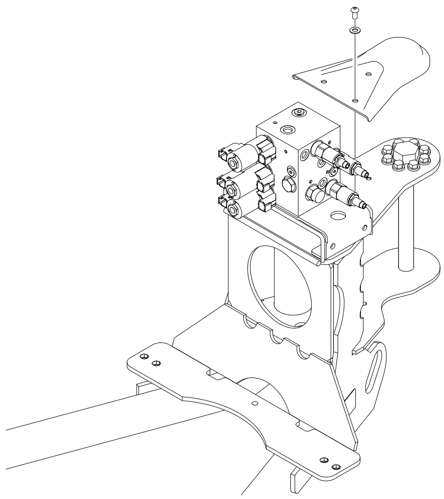
CAL FAILED- UMS SENSOR MOVEMENT NOT DETECTED

The UMS angle has not detected the required amount of movement during calibration.

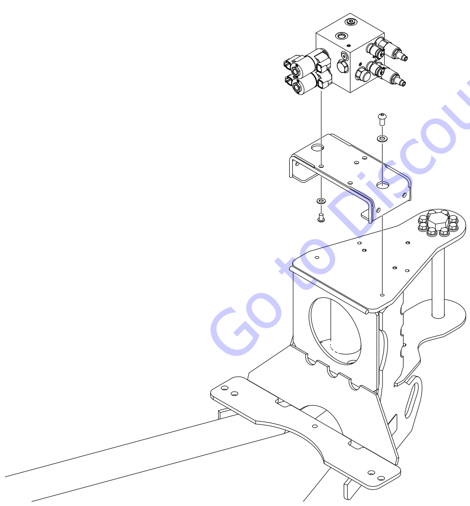
4.7 PLATFORM

Platform Valve Removal

1. Tag and disconnect the hydraulic lines from the platform control valve. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
2. Remove hardware securing cover from the platform support. Remove cover.

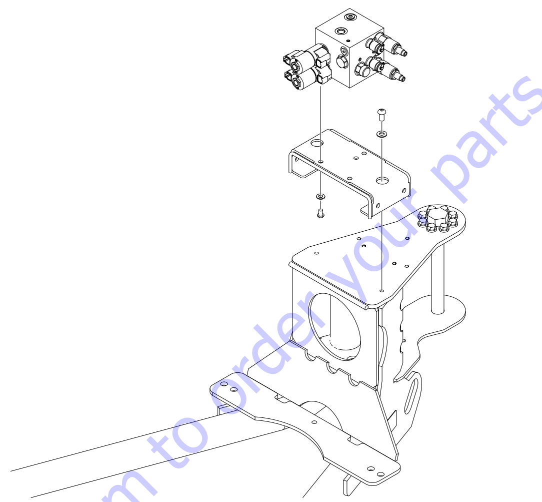


3. Remove hardware securing the mounting bracket to the platform support. Take out the mounting bracket along with platform control valve.
4. Remove hardware securing the platform control valve to the mounting bracket. Remove platform control valve.

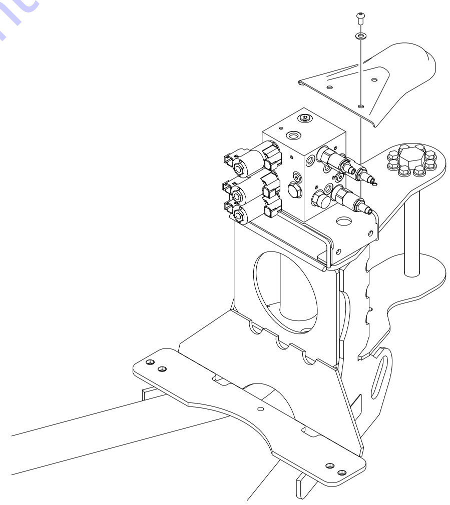


Platform Valve Installation

1. Install platform control valve onto the mounting bracket and secure using hardware.
2. Install the mounting bracket onto the platform support and secure using hardware.



3. Install cover onto the platform support securing hardware.



4. Remove tag and reconnect the hydraulic lines to the platform control valve.

Platform Support Removal

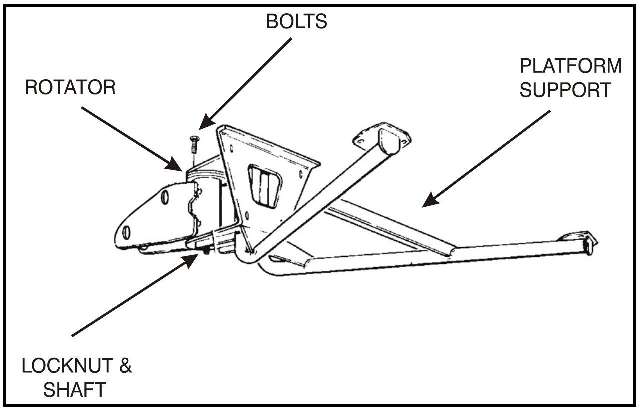
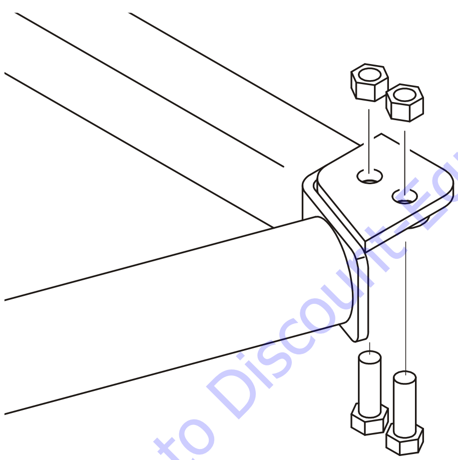


Figure 4-9. Location of Components Platform Support

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

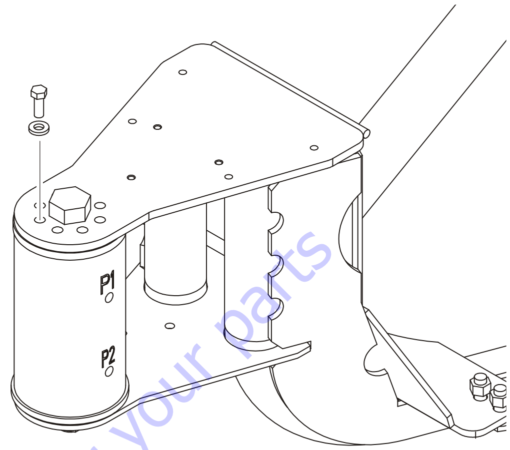
NOTE: *The platform weighs approximately 220 lbs (100 kg).*



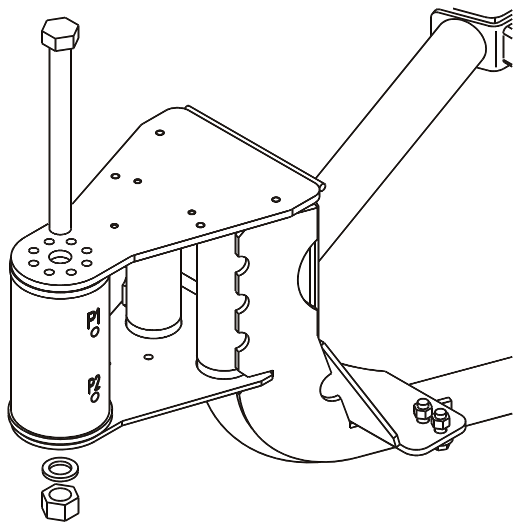
4. Using a suitable device, support the platform support.

NOTE: *The platform support weighs approximately 81.6 lbs. (37 kg).*

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



6. Using a suitable brass drift and hammer, remove the rotator shaft, remove the support from the rotator.

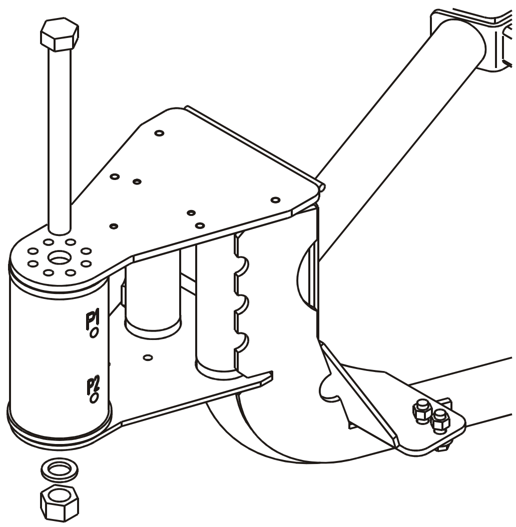


Support Installation

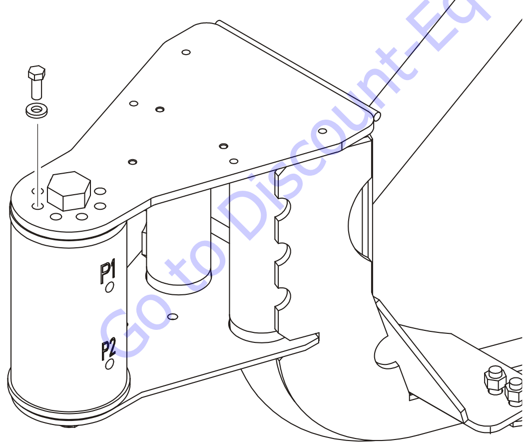
1. Using a suitable device, support the platform support and position it on the rotator.

NOTE: *The platform support weighs approximately 81.6 lbs. (37 kg).*

2. Install the rotator center bolt.

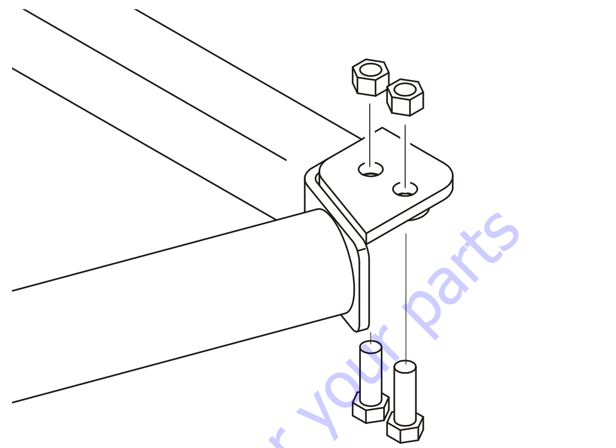


3. Apply JLG Threadlocker P/N 0100011 to the eight bolts and locknuts securing the support to the rotator and install the bolts and locknuts.



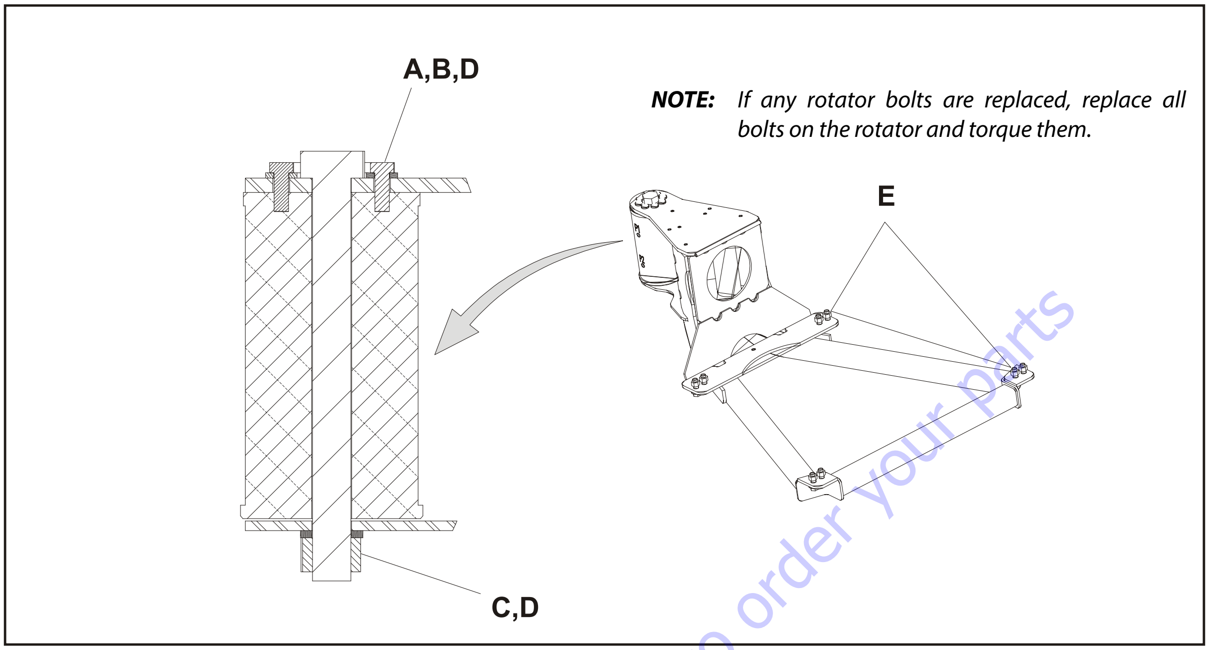
4. Torque the nut on the rotator center bolt to 586 ft. lbs. (795 Nm). Torque the retaining bolts to 40 ft. lbs. (55 Nm).

5. Position the platform on the platform support and install the bolts securing the platform to the platform support. Torque the bolts to 75 ft. lbs. (102 Nm).



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

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



A	Torque to 40 ft.lbs. (55 Nm)
B	JLG Thread locker (#0100011)
C	Torque to 480 ft. lbs. (650 Nm)
D	Check torque every 150 hours of operation
E	Torque to 75 ft. lbs. (102 Nm)

Figure 4-10. Platform Support Torque Values

4.8 BOLT-ON EXTERNAL FALL ARREST

The bolt-on external fall arrest system is designed to provide a lanyard attach point while allowing the operator to access areas outside the platform. Exit/Enter the platform through the gate area only. The system is designed for use by one person.

Personnel must use fall protection at all times. A full body harness is required with lanyard not to exceed 6 ft. (1.8 M) in length, that limits the maximum arrest force to 900 lbs. (408 kg).

Bolt-On External Fall Arrest System capacity is 310 lb (140 kg) - one (1) person maximum.

Do not move the platform during use of the bolt-on external fall arrest system.

⚠ WARNING

DO NOT OPERATE ANY MACHINE FUNCTIONS WHILE OUTSIDE OF PLATFORM. BE CAREFUL WHEN ENTERING/EXITING THE PLATFORM AT ELEVATION.

⚠ WARNING

IF THE BOLT-ON EXTERNAL FALL ARREST SYSTEM IS USED TO ARREST A FALL OR IS OTHERWISE DAMAGED, THE ENTIRE SYSTEM MUST BE REPLACED AND THE PLATFORM FULLY INSPECTED BEFORE RETURNING TO SERVICE. REFER TO THE SERVICE MANUAL FOR REMOVAL AND INSTALLATION PROCEDURES.

THE BOLT-ON EXTERNAL FALL ARREST SYSTEM REQUIRES AN ANNUAL INSPECTION AND CERTIFICATION. THE ANNUAL INSPECTION AND CERTIFICATION MUST BEPERFORMED BY A QUALIFIED PERSON OTHER THAN THE USER.

Inspection Before Use

The bolt-on external fall arrest system must be inspected before each use of the aerial work platform. Replace components if there are any signs of wear or damage.

Before each use, perform a visual inspection of the following components:

- Cable: Inspect cable for proper tension, broken strands, kinks, or any signs of corrosion.

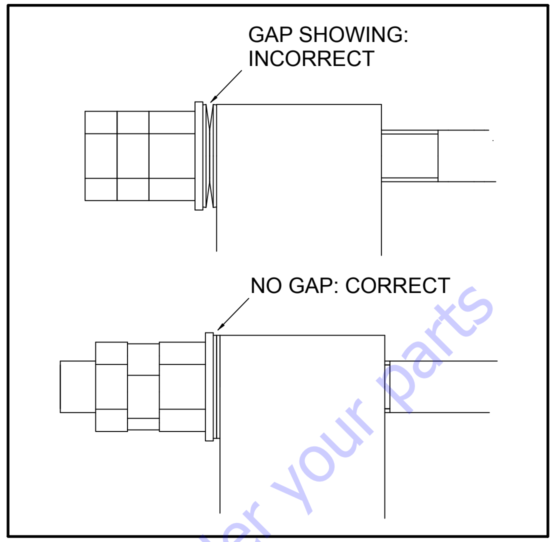
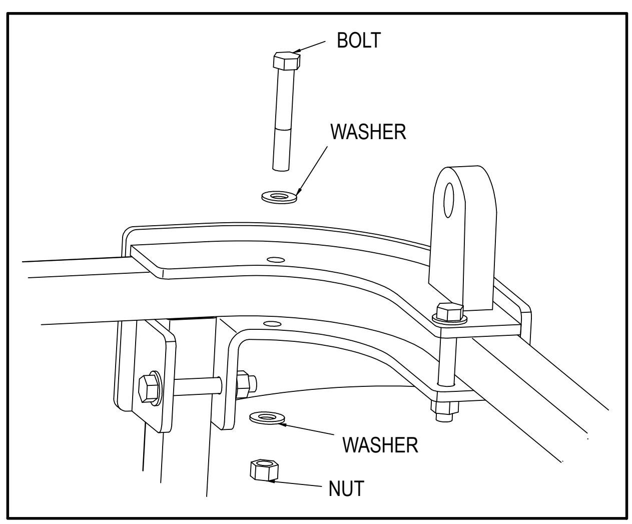


Figure 4-11. Bolt-On External Fall Arrest Cable Tension

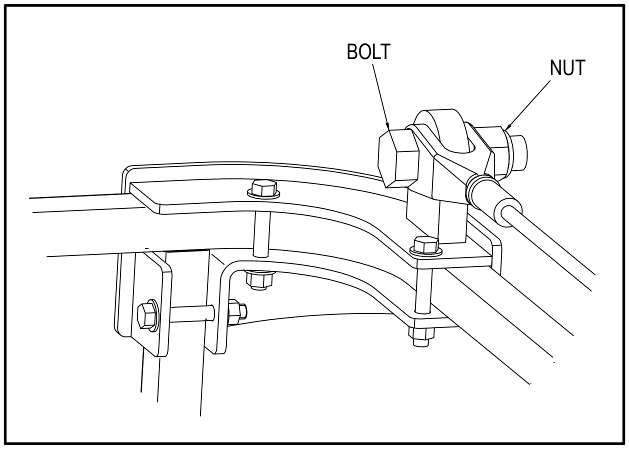
- Fittings & Brackets: Ensure all fittings are tight and there are no signs of fractures. Inspect brackets for any damage.
- Attachment Ring: No cracks or signs of wear are acceptable. Any signs of corrosion requires replacement.
- Attaching Hardware: Inspect all attaching hardware to ensure there are no missing components and hardware is properly tightened.
- Platform Rails: No visible damage is acceptable.

Installation

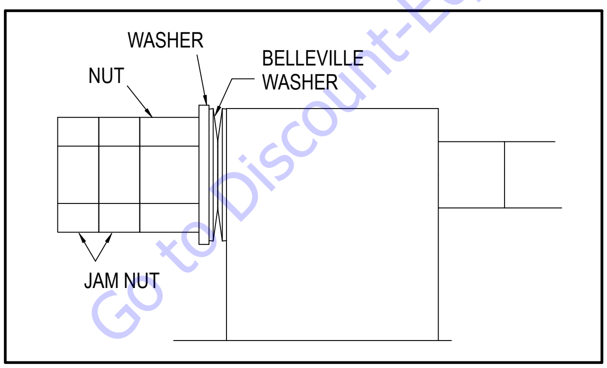
1. Install the retaining hardware (bolts, nuts, and washers) and secure the brackets to the platform rail. Tighten the nuts but do not torque them yet.



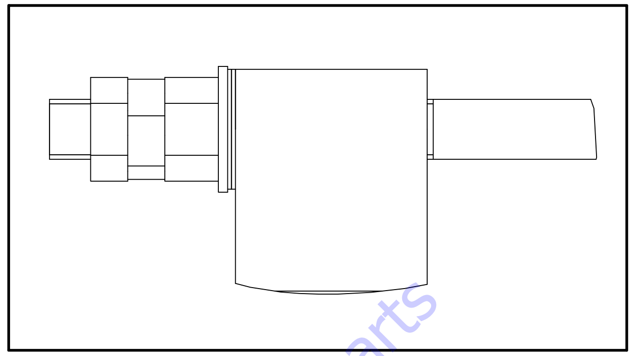
2. Attach the fall arrest cable to the right hand bracket Using the attaching bolt and nut. Orient the bolt as shown below. Do not tighten the nut so cable can still rotate.



3. Install the Attachment Ring onto the cable.
4. Without twisting the fall arrest cable, pull it thru the left hand bracket and mark the top of the swaged cable end. Install the fall arrest cable through the left hand bracket and secure it using the belleville washers, washer, retaining nut, and jam nuts. Orient the hardware as shown below and with the belleville washers so the gap is present at the outside diameter of the washers. install the nuts onto the cable finger tight so the mark on the cable does not move.



5. Use the two jam nuts to prevent the cable from rotating while the nut is tightened. Tighten the nut until the belleville washers are fully compressed and no gap is present at the outside diameter of the washers. Ensure the cable has not rotated during tightening.



6. Tighten the first jam nut against the retaining nut to keep the nut from loosening. Tighten the remaining jam nut against the first jam nut.
7. Torque the nuts and bolts securing the brackets to 15 ft.lbs. (20 Nm).

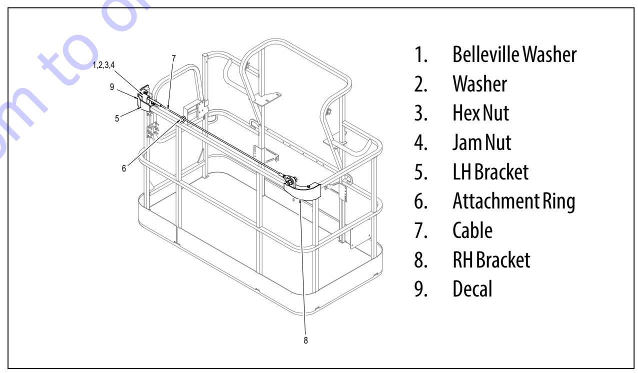


Figure 4-12. Bolt-On External Fall Arrest System

4.9 ARTICULATING JIB

NOTE: *Pin numbers listed in the following procedures are referenced in Figure 4-13., Location of Components-Articulating Jib.*

NOTE: *Using a suitable lifting device, support the jib.*

Removal

1. For platform/support removal see platform/support removal diagram. (See Section 4.7, Platform).
2. Position the articulating jib boom level with the ground.
3. Tag and disconnect hydraulic lines from level cylinder and lift cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
4. Remove mounting hardware from slave cylinder pin (1). Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.
5. Remove mounting hardware from articulating jib boom pivot pin (2). Using a suitable brass drift and hammer, remove the pivot pin from boom assembly.

Disassembly

1. Remove mounting hardware from articulating jib boom pivot pins (3) and (4). Using a suitable brass drift and hammer, remove the pins from articulating jib boom pivot weldment.
2. Remove mounting hardware from rotator support pins (5) and (6). Using a suitable brass drift and hammer, remove the pins from rotator support.
3. Remove mounting hardware from lift cylinder pin (7). Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.

Inspection

NOTE: *When inspecting pins and bearings Refer to Pins and Composite Bearing Repair Guidelines in Section 2.*

1. Inspect articulating fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect articulating fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of articulating fly boom pivot bearings for scoring, distortion, wear, or other damage. Replace bearings as necessary.
4. Inspect lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of rotator attach point bearings for scoring, distortion, wear, or other damage.

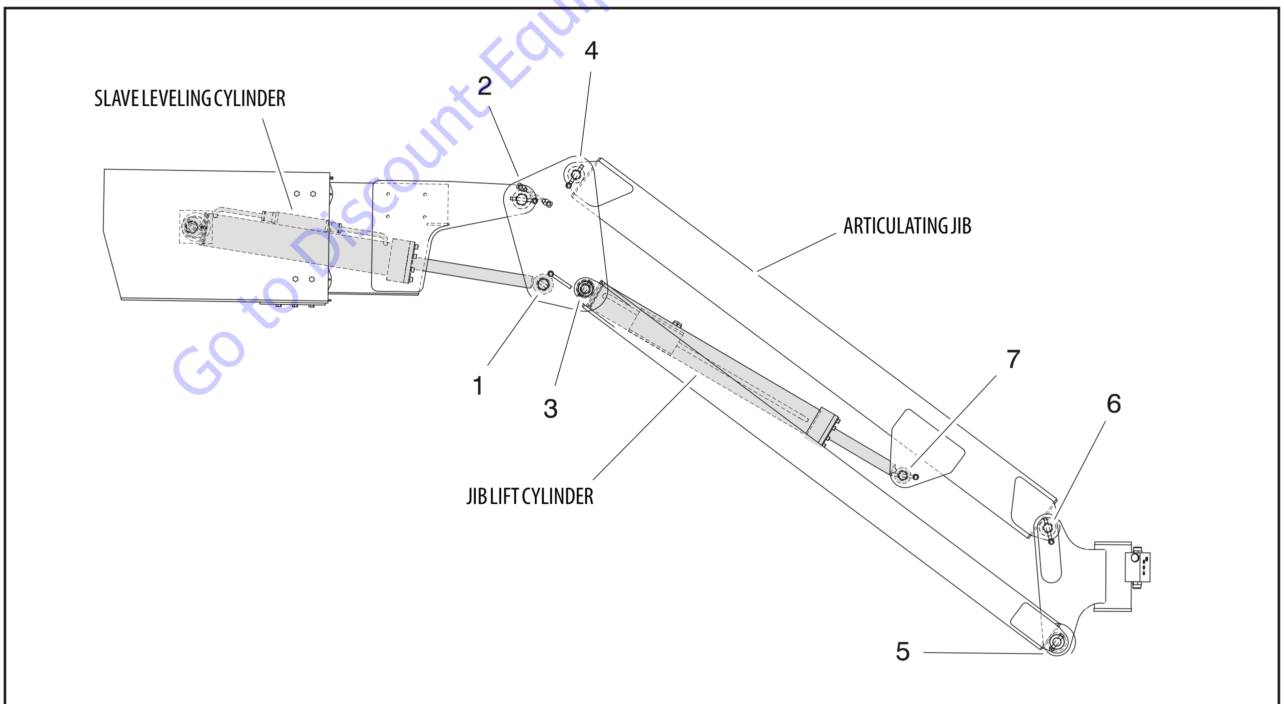


Figure 4-13. Location of Components-Articulating Jib

6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.

7. Inspect structural units of articulating jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

1. Align lift cylinder with attach holes in articulating jib boom. Using a soft head mallet, install cylinder pin (7) into articulating jib boom and secure with mounting hardware.

2. Align bottom tubes with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin (3) into articulating jib boom pivot weldment and secure with mounting hardware.

3. Align rotator support with attach hole in articulating jib boom. Using a soft head mallet, install rotator support pin (6) into articulating jib boom and secure with mounting hardware.

4. Align bottom tubes with attach holes in rotator support. Using a soft head mallet, install rotator support pin (5) into articulating jib boom and secure with mounting hardware.

5. Align articulating jib boom with attach hole in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin (4) into articulating jib boom and secure with mounting hardware.

6. Align articulating jib boom pivot weldment with attach holes in fly boom assembly. Using a soft head mallet, install pivot pin (2) into fly boom assembly and secure with mounting hardware.

7. Align the slave leveling cylinder with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install slave leveling cylinder pin (1) into articulating jib boom pivot weldment and secure with mounting hardware.

8. Untag and connect hydraulic lines from level cylinder and lift cylinder.

4.10 ROTATOR AND SLAVE CYLINDER

Removal

1. Tag and disconnect hydraulic lines to rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

2. Supporting the rotator, remove hardware from pin (1). Using a suitable brass drift and hammer remove pin (1) from the fly boom.

3. Remove the hardware from pin (2). Using a suitable brass drift and hammer, remove pin (2) from the fly boom and remove the rotator.

4. Telescope the fly section out approximately 20 inches (50 cm) to gain access to the slave leveling cylinder. (800 AJ only)

5. Supporting the slave, cylinder remove the hardware from pin (3). Using a suitable brass drift and hammer remove pin (3) from the fly boom.

6. Tag and disconnect hydraulic lines to the slave leveling cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports. Remove the slave cylinder.

4.11 SEQUENCE FOR HOSE REPLACEMENT IN THE TOWER BOOM

1. Remove the tower boom front cover bolts, exposing the Powertrack.
2. Remove bolts to disconnect the top bar of the Powertrack
3. Pull the Powertrack out of base boom. (as far as hoses will allow)
4. At left side rear of upright, remove access cover plate (4) bolts. (others if necessary)
5. Remove access cover plate, (4) bolts, from bottom front of fly boom.
6. Cut cable ties that attach hose to be replaced.
7. Disconnect hose that is to be replaced, and cap the male fitting.
8. Attach the new hose to the end of the hose to be replaced.
9. Pull these lines thru the upright and out the bottom, then feed back into the fly boom.
10. At the Powertrack, in front of the tower boom, open the Powertrack links to expose the hose to be replaced.
11. Pull hose to be replaced, attached to the new hose, thru the fly boom and thru the Powertrack links.
12. Disconnect new hose from the replaced hose and connect to fitting where the damaged hose was connected.
13. Roll Powertrack back into base, and attach the top bar of the Powertrack (2) bolts to the inside top of the fly boom section.
14. Check for leaks and hardware tightened securely.
15. Replace access cover plates and front cover.

4.12 LIMIT SWITCHES ADJUSTMENT

Main Boom Horizontal Limit Switch

1. Place machine on level surface.
2. Raise main boom 5 to 10 degrees above horizontal. limit switch should activate before this point.
3. Lower main boom until limit switch resets. This should be 1 degree above to 4 degrees below horizontal. (See Figure 4-15.) for adjustments.

NOTE: *Angle indicator should be placed approx. 2 ft. from the main boom pivot pin and the attach point on the main boom. Tower angle switch must be reset before main boom angle switch can be activated.*

Tower Boom Horizontal Limit Switch

1. Place machine on level surface.
2. Raise Tower Boom 8 to 13 degrees above horizontal. The tower angle limit switch should activate at this point.
3. Lower the tower boom until the limit switch resets. This should be 2 to 7 degrees below where the switch was activated. (See Figure 4-14. and Figure 4-15. for adjustments).

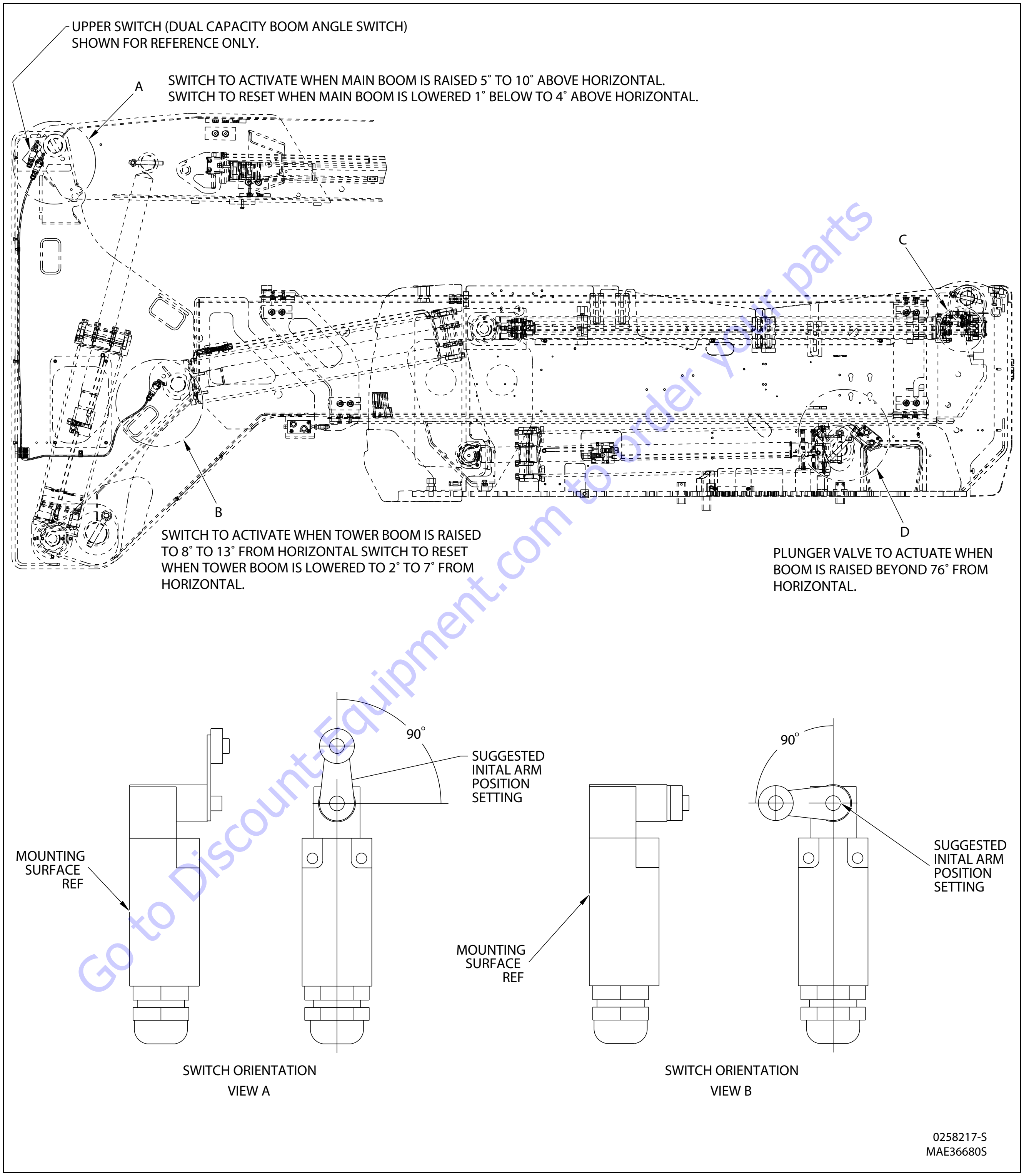


Figure 4-14. Boom Valve and Limit Switches Location (Sheet 1 of 2)

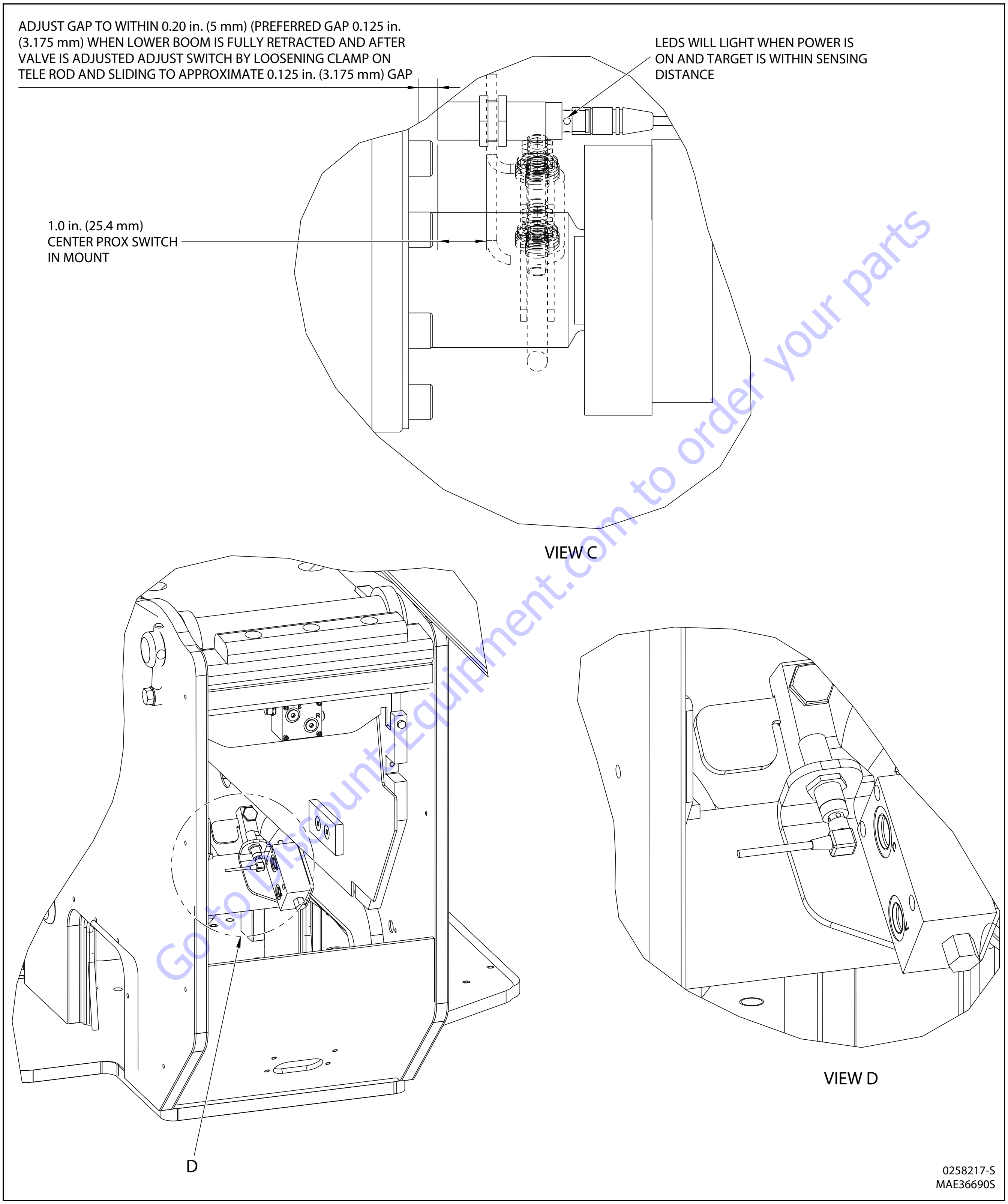


Figure 4-15. Boom Valve and Limit Switches Location (Sheet 2 of 2)

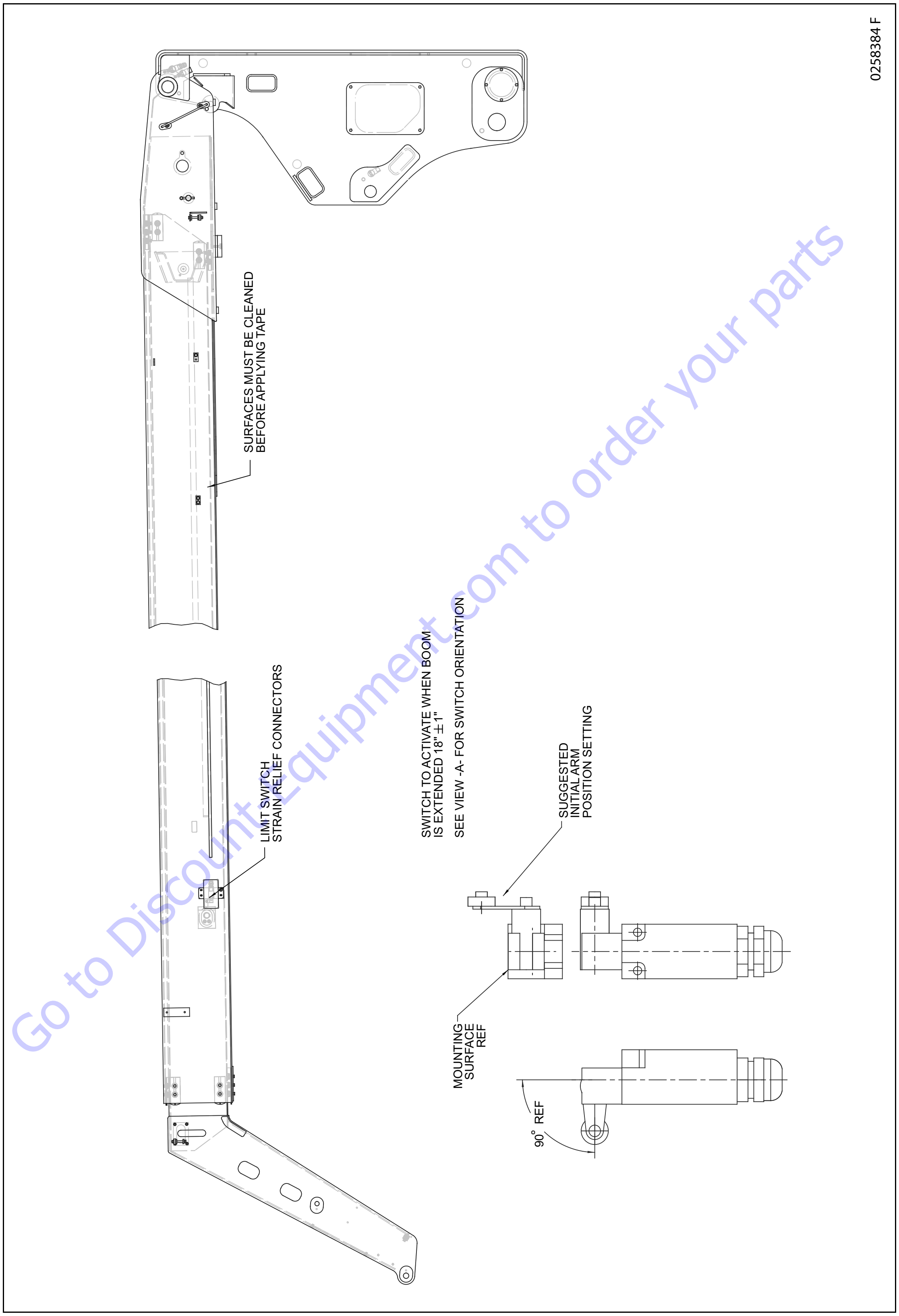


Figure 4-16. Transportation Switch Installation (CE only)

4.13 BOOM VALVE ADJUSTMENT

1. Adjust the screws so the plunger on the valves has 0.250 in. (6.35 mm) travel remaining when the lower boom is fully raised and retracted.
2. After the valves are adjusted, adjust the proximity switches to within 0.314 in. (8 mm) of their target. The LED's on the proximity switches will light when the power is on and the switch is within 0.314 in. (8 mm) of the target. There is a proximity switch to backup both valves.

NOTE: *The cam valve under the boom requires the tower boom to be completely lowered and the cam valve mounted on T/T requires the tower boom to be fully elevated prior to adjustment.*

Tower Boom

1. Shim up wear pads until 1/32 inch (0.8 mm) clearance to adjacent surface.
2. When adjusting wear pads, removing or adding shims, bolt length must also be changed.
   a. When adding shims, longer bolts must be used to ensure proper thread engagement in insert.
   b. When shims are removed, shorter bolts must be used so bolt does not protrude from insert and come into contact with boom surface.

Main Boom

1. Shim up wear pads to within 1/32 inch (0.8 mm) clearance between wear pad and adjacent surface.
2. Adjusting wear pads, removing or adding shims, bolt length must also be changed.
   a. When adding shims, longer bolts must be used to ensure proper thread engagement in insert.
   b. When shims are removed, shorter bolts must be used so bolt does not protrude from insert and Sheaves and wire rope must be replaced as sets.

4.14 BOOM CLEANLINESS GUIDELINES

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

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

4.15 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness connectors located in tower upright.

NOTICE

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

2. Tag and disconnect hydraulic lines from connectors at boom assembly. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Disconnect dual capacity indicator limit switch from side of boom section. (800A only)
4. Remove hydraulic lines and electrical cables from Powertrack.
5. Using suitable lifting equipment, adequately support Powertrack weight along entire length.
6. Remove hardware (1) securing the push tube on the fly boom section.
7. Remove hardware(2) securing the push tube on the mid boom section.
8. With Powertrack supported and using all applicable safety precautions, remove hardware (3), (4) and (5) securing rail to the base boom section. Remove Powertrack from boom section.

Installation

1. With powertrack supported and using all applicable safety precautions, install bolt(3), (4) and (5) securing rail to the base boom section.
2. With adequate support and lifting device align, place mid boom push tube on the mid boom section to get access to install hardware (2).
3. Install bolt(1) securing the push tube on the fly boom section.
4. Connect hydraulic lines and electrical cables to Powertrack. Uncap all hydraulic lines and ports.
5. Connect dual capacity indicator limit switch from side of boom section. (800A only)
6. Disconnect wiring harness connectors located in tower upright.

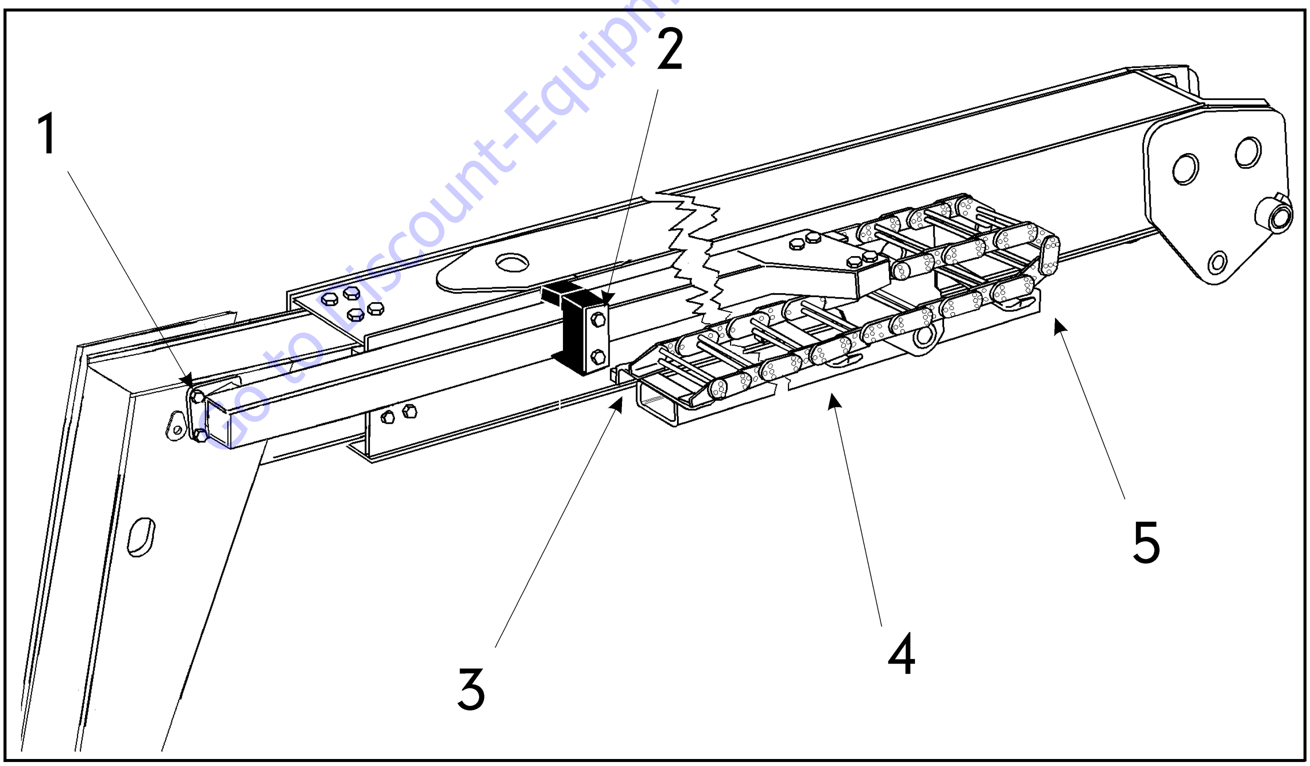


Figure 4-17. Main Boom Powertrack Removal and Installation

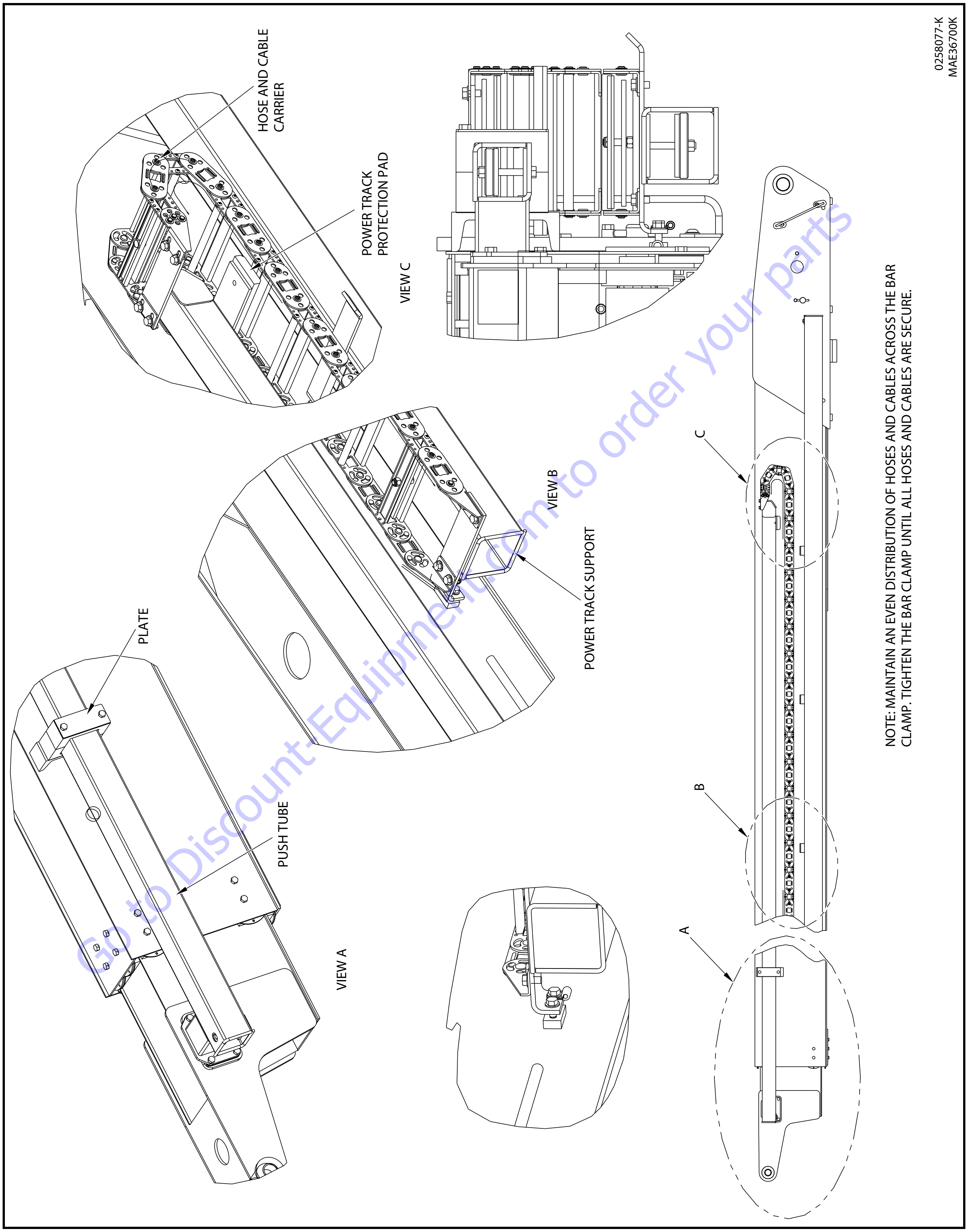


Figure 4-18. Powertrack Installation Main Boom

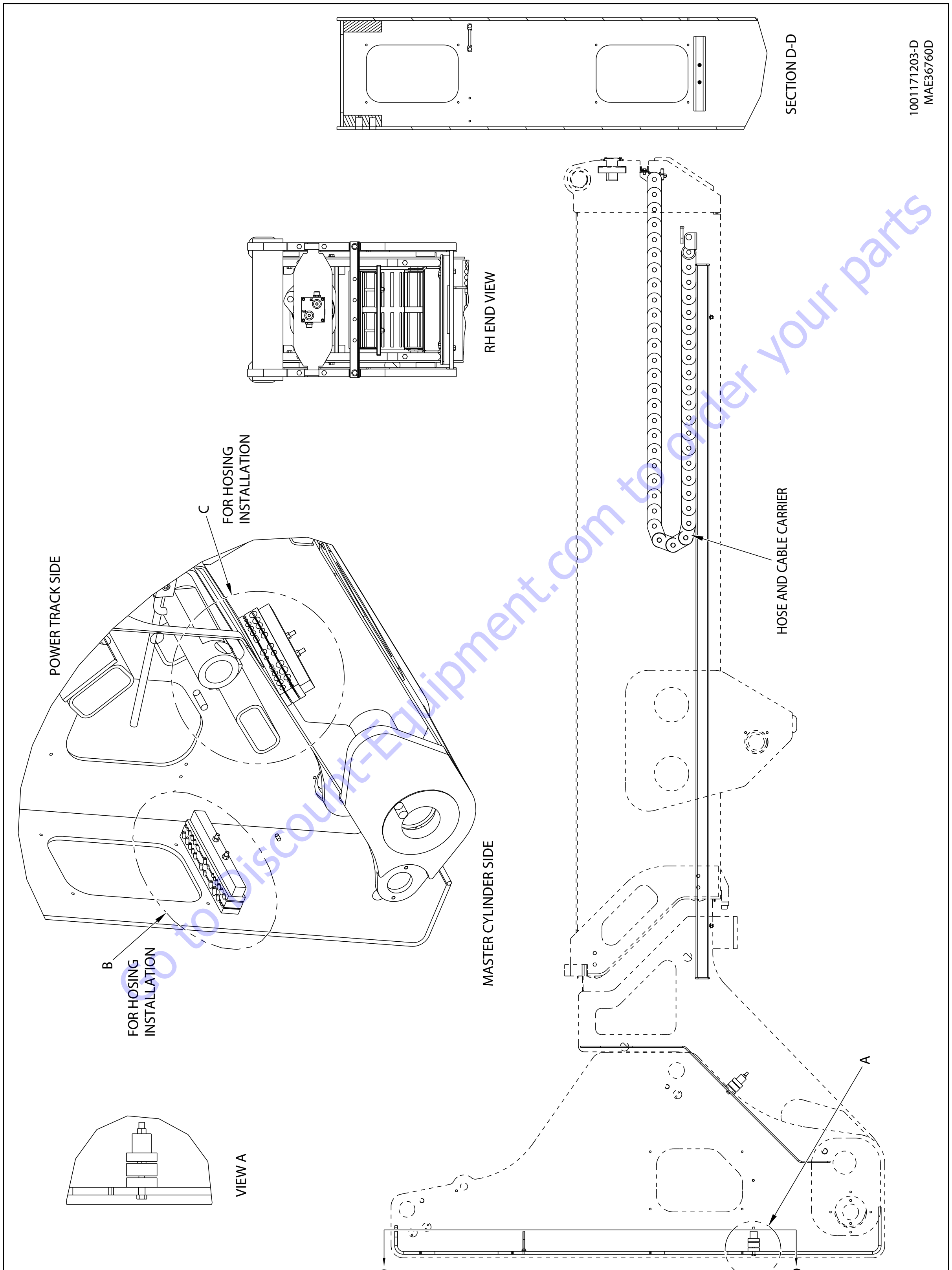


Figure 4-19. Powertrack Installation Tower Boom (Sheet 1 of 3)

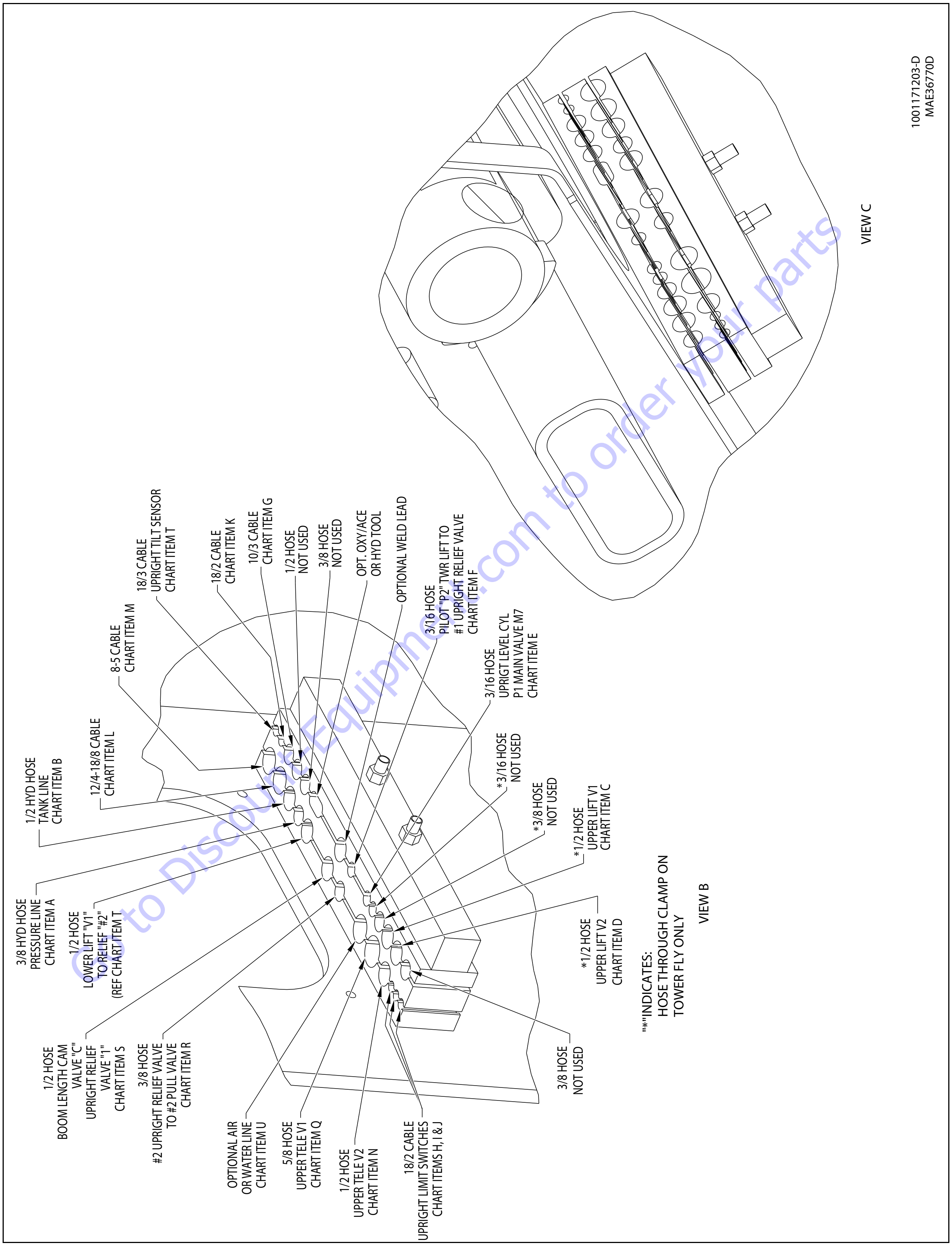
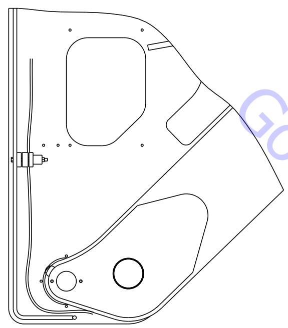


Figure 4-20. Powertrack Installation Tower Boom (Sheet 2 of 3)



ITEM	PART# / DESCRIPTION (REF.)	DIM "X"	DIM "Y"
A	PRESSURE LINE	42.00"	7.00"
B	TANK LINE	42.00"	7.00"
C	UPPER LIFT V1	60.00"	29.00"
D	UPPER LIFT V2	60.00"	29.00"
E	UPRIGHT LEVEL CYL, P1 MAIN VALVE M7	82.00"	50.00"
F	PILOT P2 TWR LIFT TO #1 UPRIGHT RELIEF VALVE	64.00"	29.00"
G	10/3 CABLE TOWER	52.00"	20.00"
H	UPRIGHT LIMIT SWITCH, 18/2 CAP ANGLE	97.00"	60.00"
I	UPRIGHT LIMIT SWITCH,18/2 UPPER ELEV	97.00"	60.00"
J	UPRIGHT LIMIT SWITCH, 18/2 TOWER ELEV	77.00"	40.00"
K	ALL EXCP.DOM "AJ", 18/2 BOOM LEN	52.00"	20.00"
L	12/4-18/8 CABLE STP	52.00"	20.00"
M	SKY POWER TOWER, 8-5 CABLE	52.00"	20.00"
N	UPPER TELE V2	46.00"	11.00"
O	UPPER TELE V1	46.00"	11.00"
P	#2 UPRIGHT RELIEF VALVE TO #2 PULL VALVE	82.00"	50.00"
Q	BOOM LENGTH CAM VALVE C, UPRIGHT RELIEF #1	76.00"	44.00"
R	LOWER LIFT V1 TO RELIEF #2	65.00"	30.00"
S	1/2 AIRLINE	46.00"	11.00"
T	UPRIGHT TILT SENSOR	37.00"	12.00"

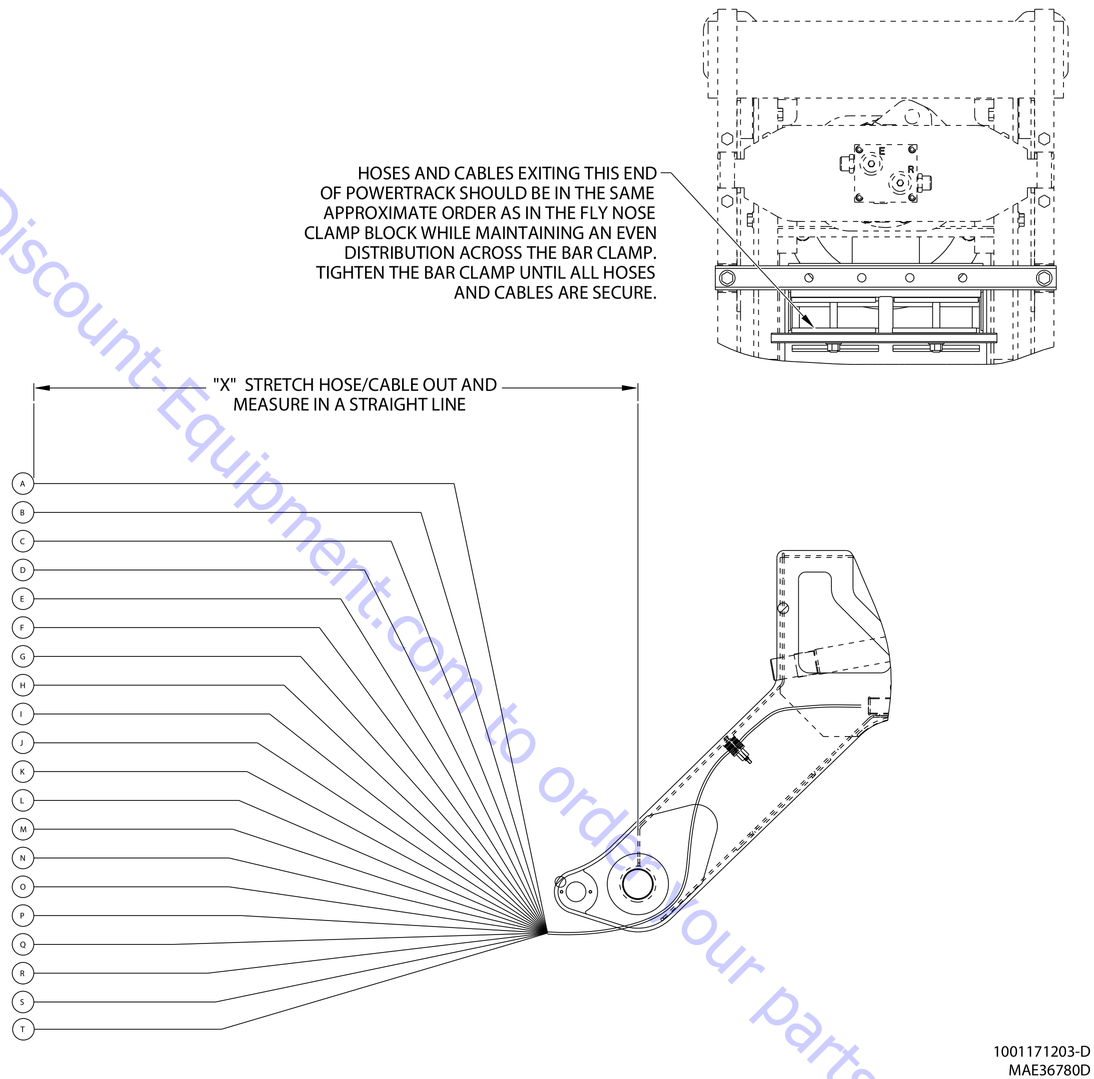
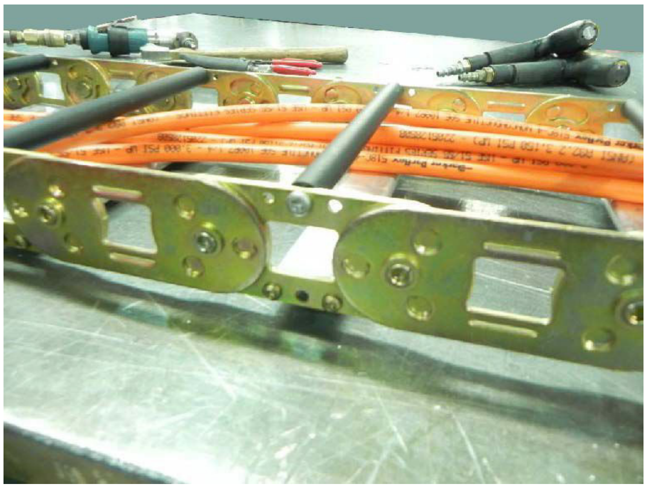


Figure 4-21. Powertrack Installation Tower Boom (Sheet 3 of 3)

4.16 POWERTRACK MAINTENANCE

Flat Bar Removal

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



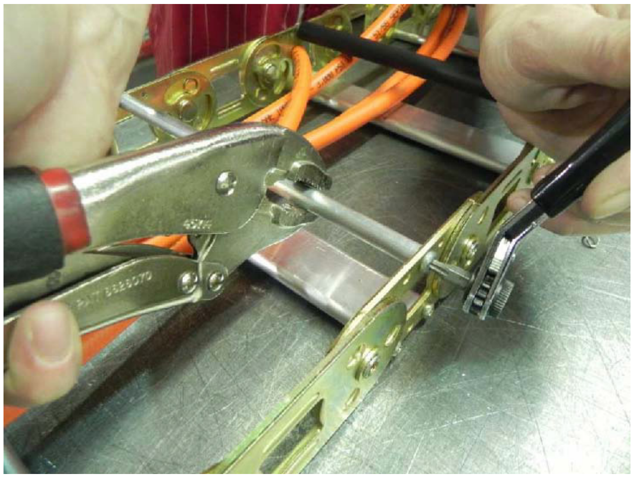
1. Use a small ¼” ratchet and a T-20 Torx bit. Remove the 8-32 x 0.500 screws from both sides. (If the track also has a flat bar on the inside of the track instead of round bar/poly, perform the same step to remove it.)

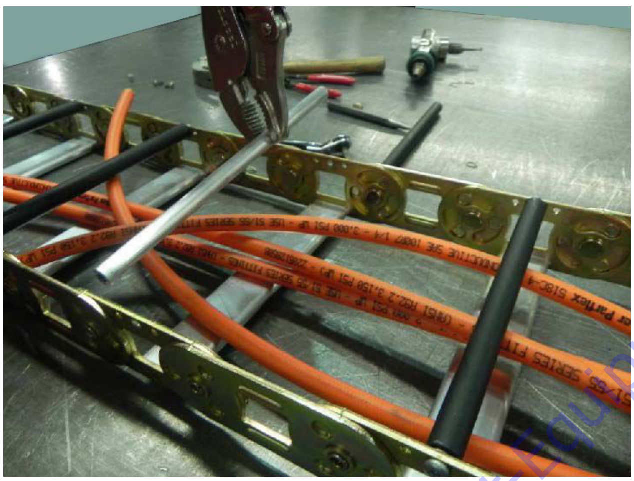
Round Bar/Poly Bar Removal

1. Use a small ¼” ratchet with a T-25 Torx bit. Remove the 10-24 x 0.812 screw. (If the bar spins then grip the bar and poly tightly with a vise-grip).

2. Lift up one end of the bar and slide the poly roller off.

3. While gripping the bar tightly, remove the other 10-24 x 0.812 screw.

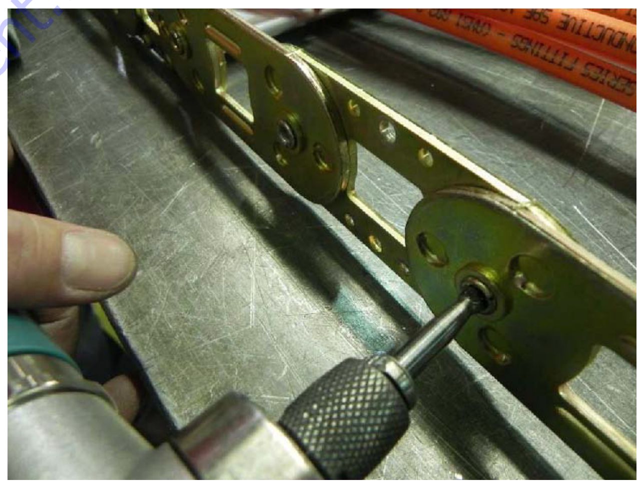




Removing and Installing Links

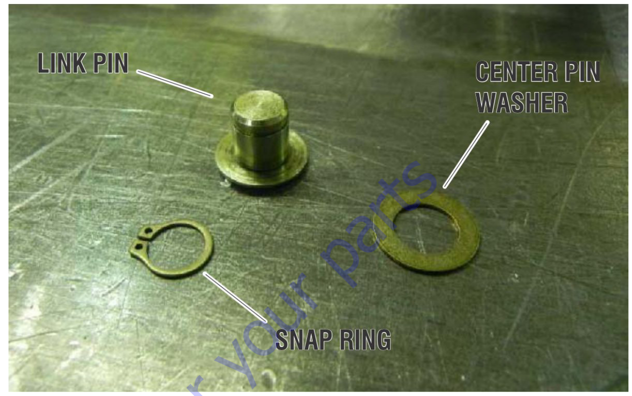
1. To remove the links, the rivets holding the links together must be removed. The following will show one way this can be done. Use a right angle die grinder with a ¼" ball double cut bur.

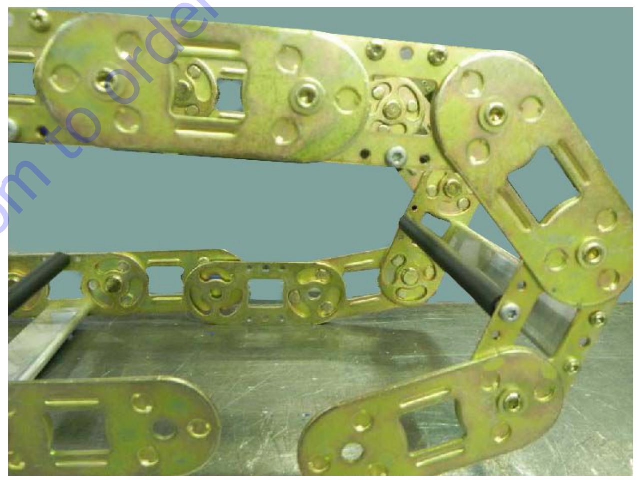
2. Insert the tool into the rolled over end of the rivet as shown. Grind out the middle of the rivet until the rolled over part of the rivet falls off. Repeat this step for all rivets that must be removed.



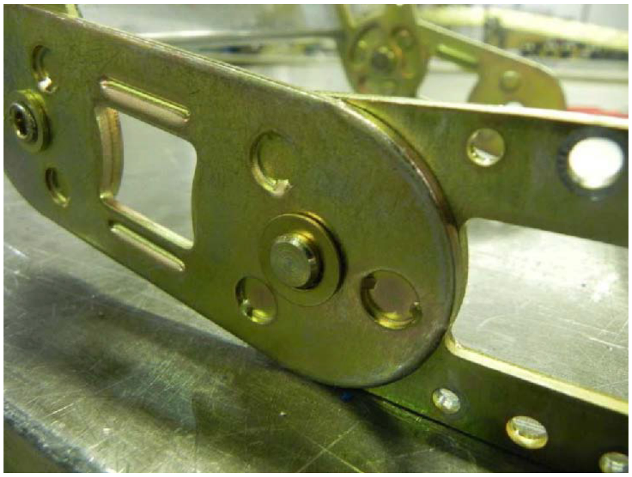
3. After grinding, it is sometimes necessary to use a center punch to punch out the rivet from the link.

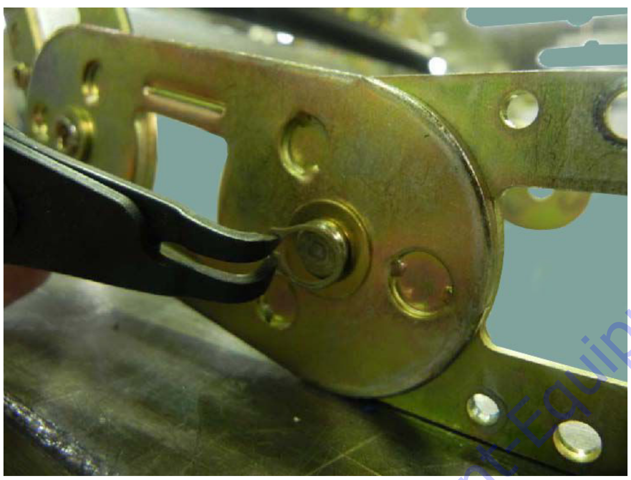
4. To install new links, extend the main moving end over the lower part of the track so the new connection point is in the curved part of the track. This will allow the round half-shears to be rotated in a way they will fit into the peanut-shaped cut-outs.





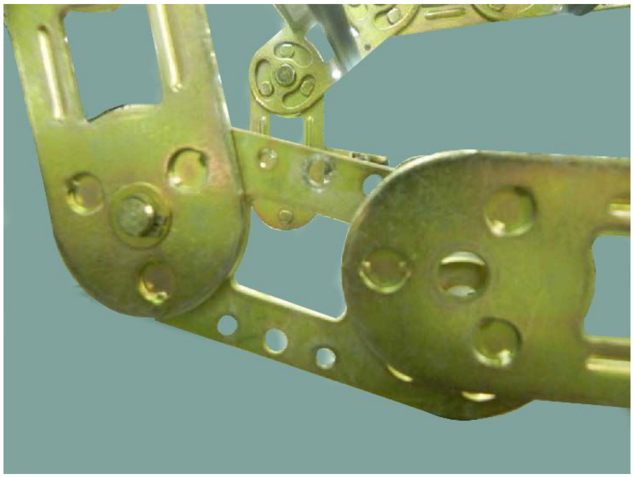
5. Install the pin into the center hole, then slide the washer over the pin. Install the snap ring into the groove in the pin.

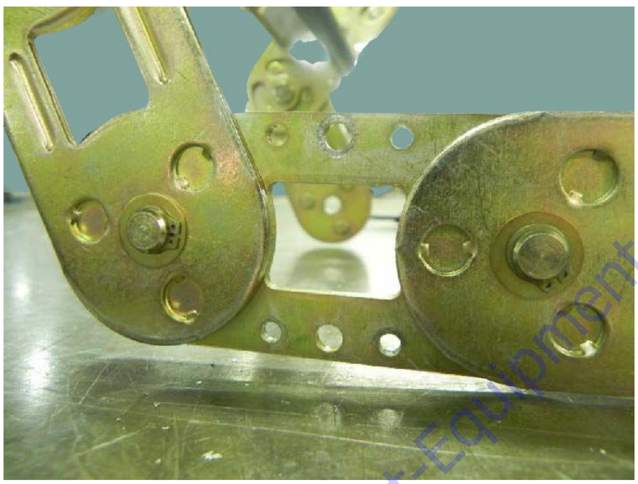




NOTE: *When installing snap rings make sure they are seated in the pin groove and closed properly.*

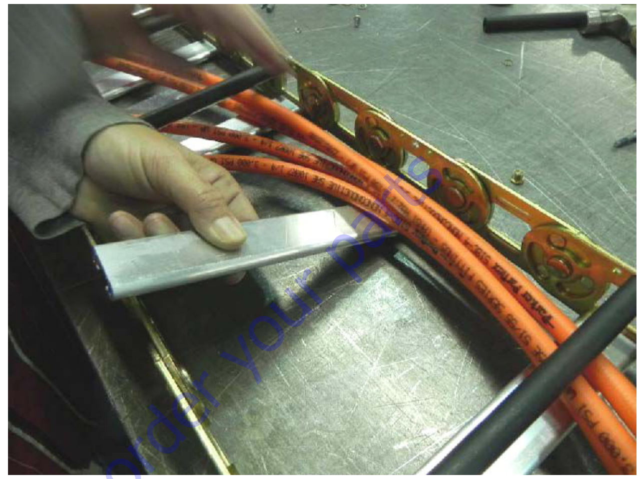
6. Install more pins, washers, and snap rings into all the links where a rivet was removed.

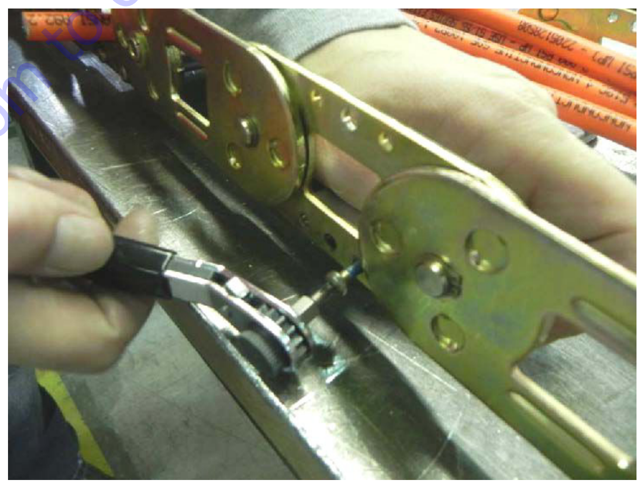




Installing a New Flat Bar

1. While holding the flat bar, install new 8-32 x 0.500 self threading torx screws into both holes on each side of track.





NOTE: *Maximum tightening torque for the 8-32 screw is 18-20 in-lbs (2-2.2 Nm).*

Installing a New Round Bar/Poly Roller

1. While tightly holding the round bar, install the new 10-24 x 0.812 self threading torx screw. Next lift up the other end and slide a new poly roller on. Install another 10-24 x 0.812 screw on the other side.

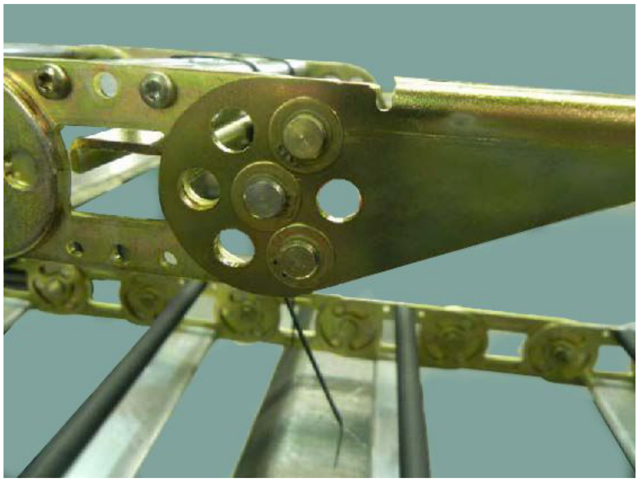
NOTE: *Maximum tightening torque for the 10-24 screw is 45-50 in-lbs (5-5.6 Nm).*

Replacing a Fixed End Bracket

1. Remove the bracket by removing the center pin, washer, and snap ring. Install a new bracket then reinstall the pin, washer, and new snap ring. After installing the new bracket make sure that it rotates correctly.

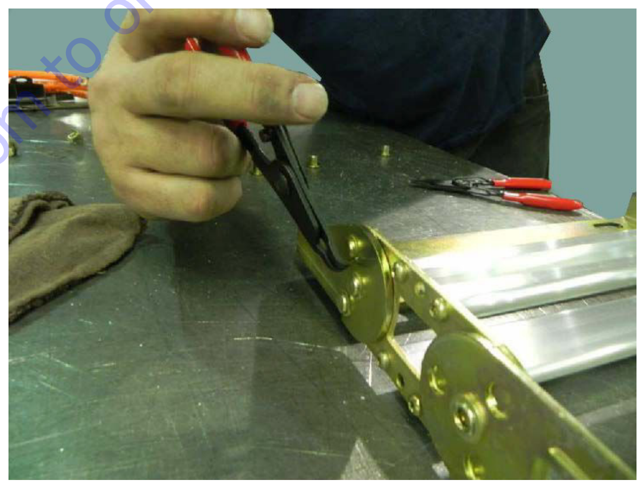
Replacing a Moving End Bracket

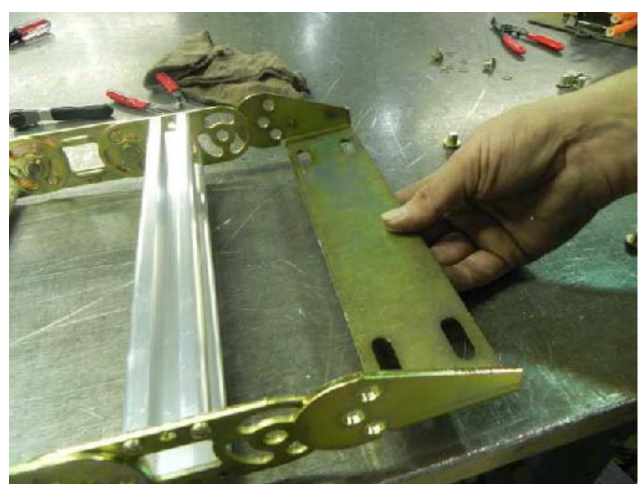
1. Remove bracket by removing all pins, washers, and snap rings. Replace with a new bracket and reinstall the pins, washers, and new snap rings. After installing a new bracket make sure that it rotates correctly.



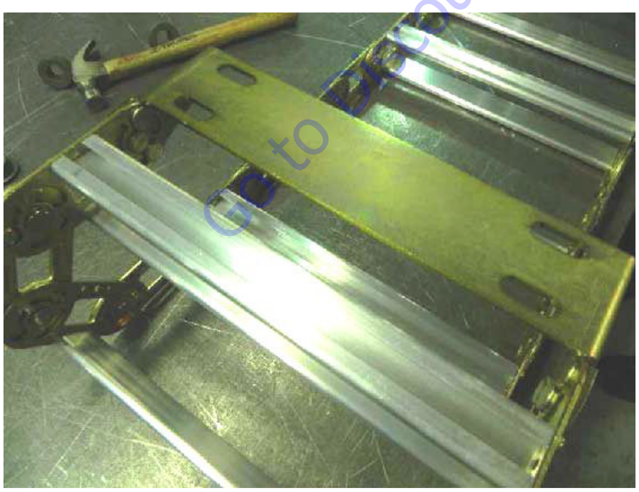
Replacing a One Piece Bracket

1. Remove all pins, washers, and snap rings and slide the bracket off of the links.





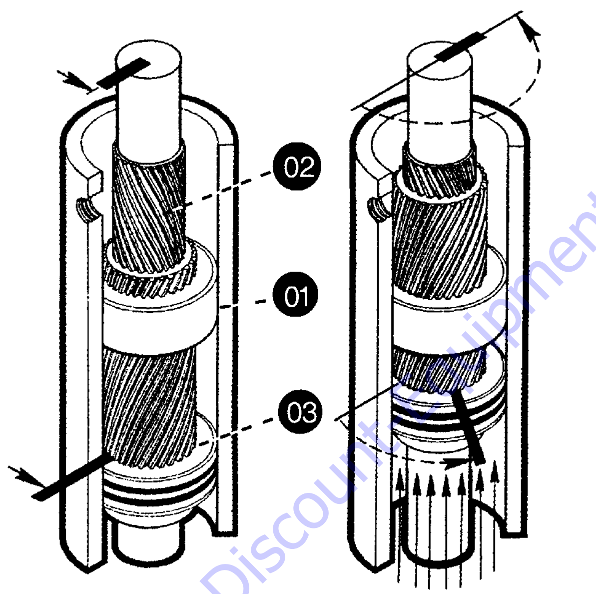
2. To install a new bracket, slide the bracket over the links and reinstall the pins, washers, and new snap rings. After installing the new bracket make sure that it rotates correctly.



4.17 ROTATOR ASSEMBLY

Theory of Operation

The L20 Series rotary actuator is a simple mechanism that uses the sliding spline operating concept to convert linear piston motion into powerful shaft rotation. Each actuator is composed of a housing with integrated gear teeth (01) and only two moving parts: the central shaft with integrated bearing tube and mounting flange (02), and the annular piston sleeve (03). Helical spline teeth machined on the shaft engage matching splines on the in- side diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage with matching splines in the housing. As hydraulic pressure is applied, the piston is displaced axially within the housing - similar to the operation of a hydraulic cylinder - while the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the actuator, preventing piston movement and locking the shaft in position.



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

As fluid pressure is applied, the piston is displaced axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston.

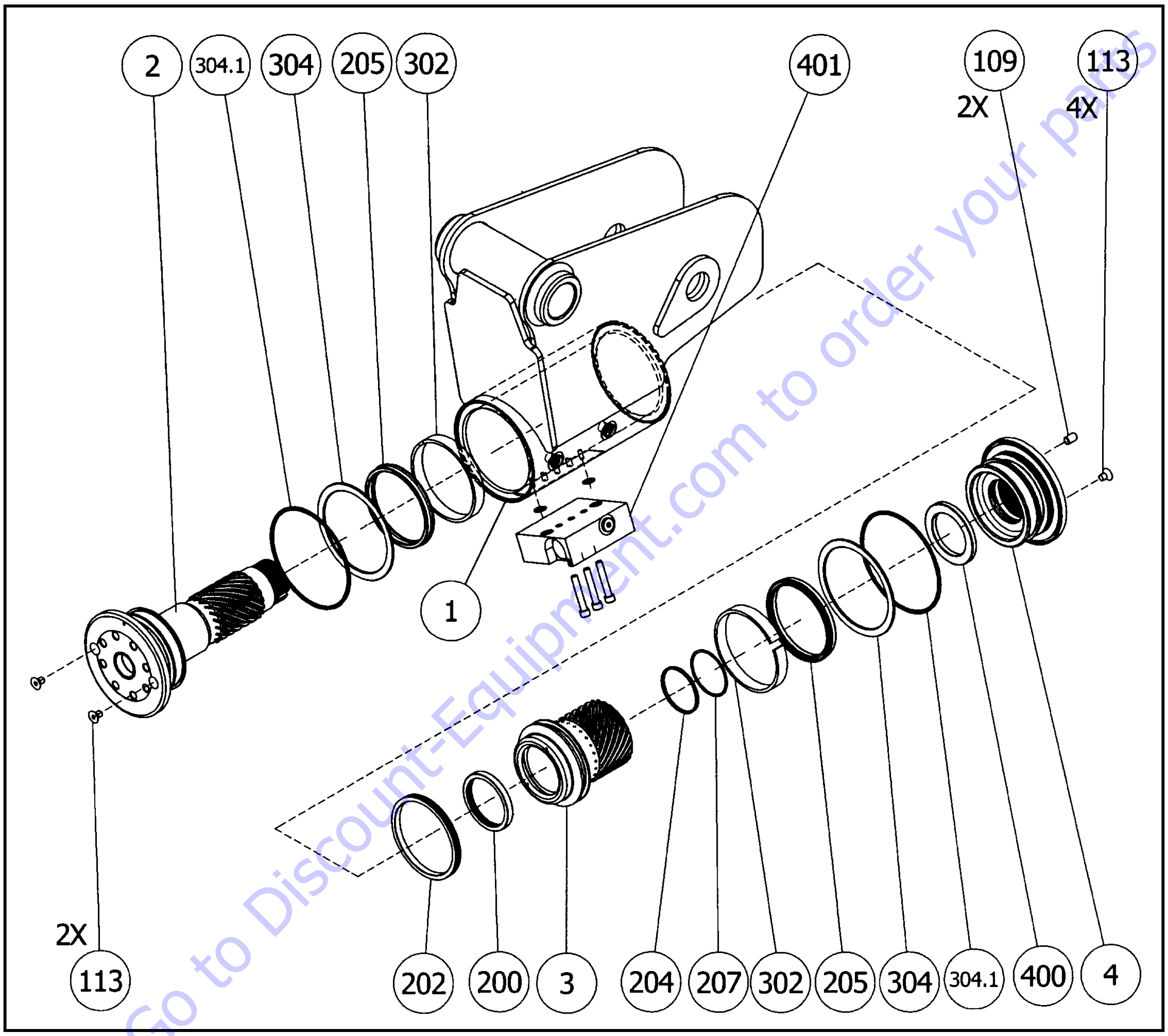
The shaft is supported radially by the large main radial bearing and the lower radial bearing. Axially, the shaft is separated from the housing by the main and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

Required Tools

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

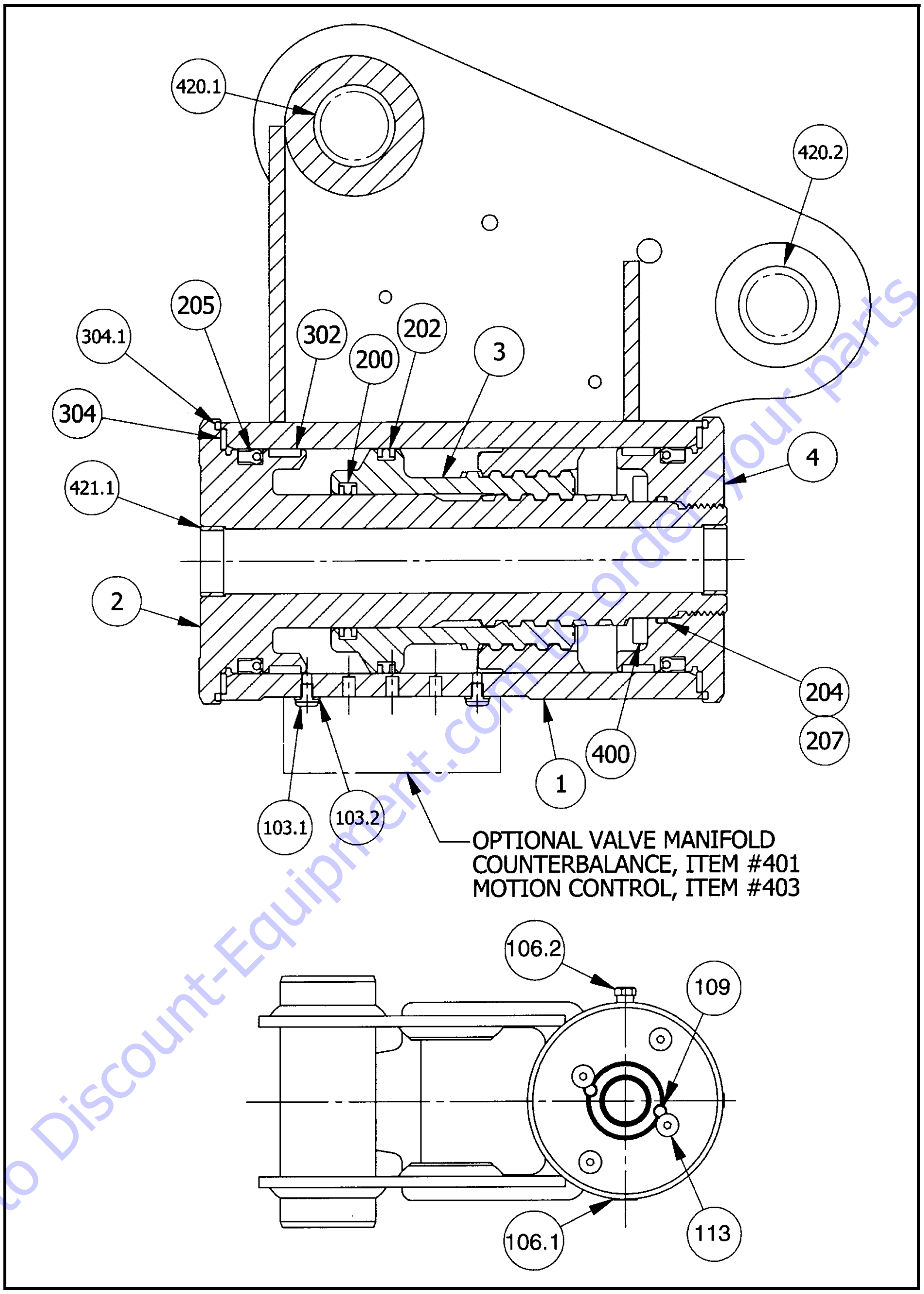
1. Flashlight - helps examine timing marks, component failure and overall condition.
2. Felt Marker - match mark the timing marks and outline troubled areas.
3. Allen wrench - removal of port plugs and set screws.
4. Box knife - removal of seals.
5. Seal tool - assembly and disassembly of seals and wear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

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



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

Figure 4-22. Rotator - Exploded View



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

Figure 4-23. Rotator- Assembly Drawing

Disassembly

⚠ CAUTION

SECURE PRODUCT TO SLOTTED TABLE OR VISE.

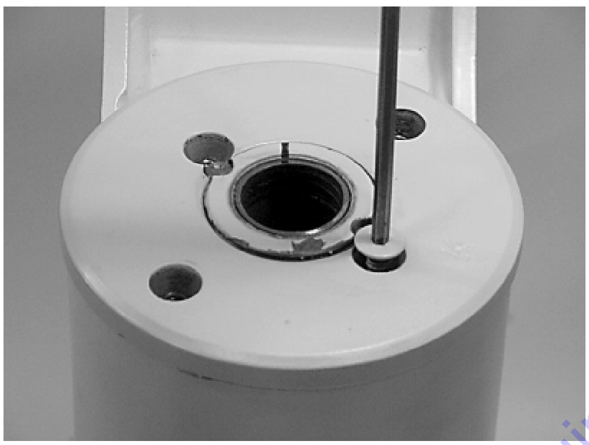
⚠ CAUTION

CONTENTS UNDER PRESSURE. WEAR APPROVED EYE PROTECTION. USE CAUTION WHEN REMOVING PORT PLUGS AND FITTINGS.

NOTICE

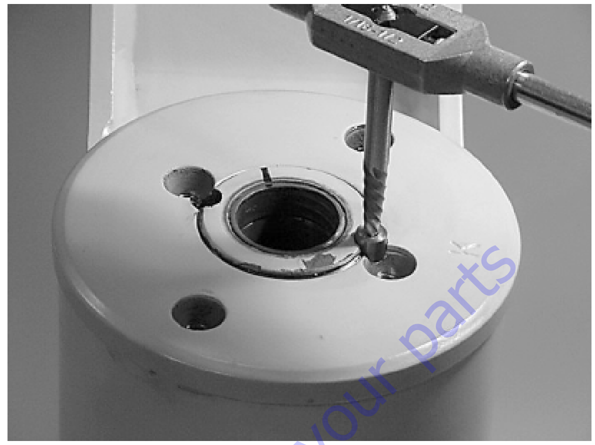
MAKE SURE WORK AREA IS CLEAN.

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



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

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



If the pin will not come out with the "Easy Out", use 5/16" drill bit to a depth of 1/2" (12.7mm) to drill out the entire pin.

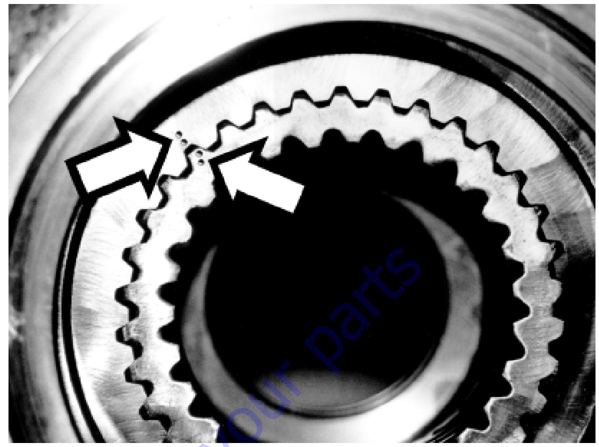
4. Install the end cap (4) removal tools provided with the Helac seal kit.

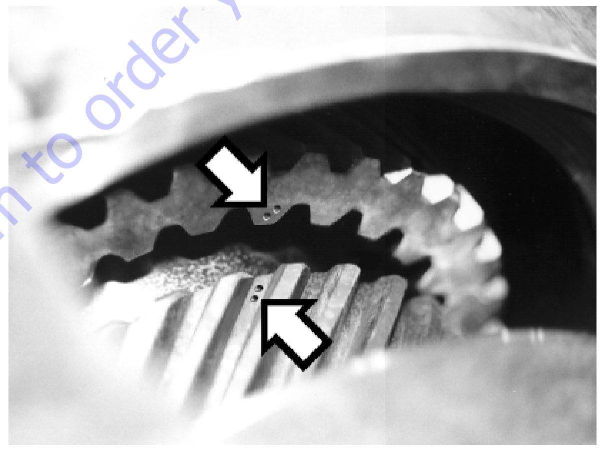
5. Using a metal bar, or similar tool, unscrew the end cap (4) by turning it counter clockwise.

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

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

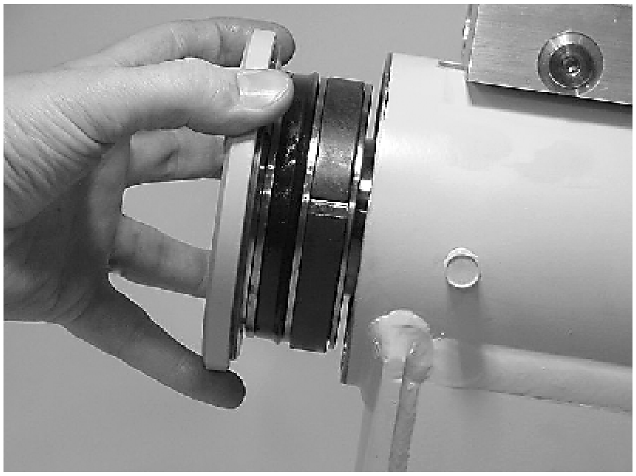
8. Every actuator has timing marks for proper engagement.





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

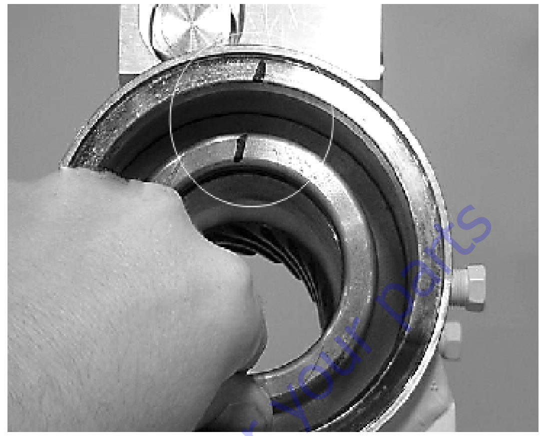
10. Remove the shaft (2). It may be necessary to strike the threaded end of the shaft with a rubber mallet.



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

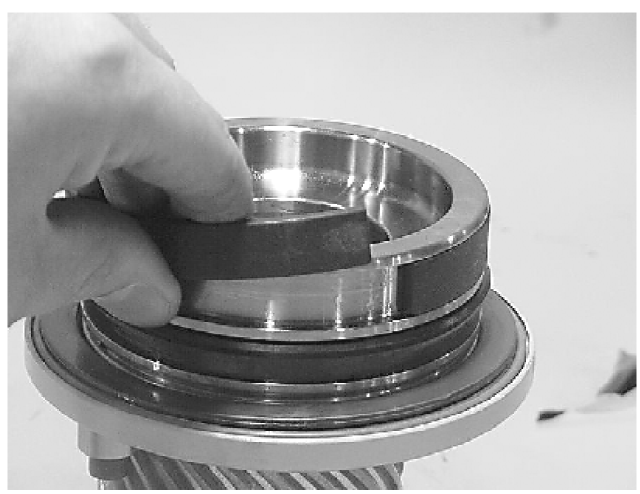
12. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is not damaged.

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

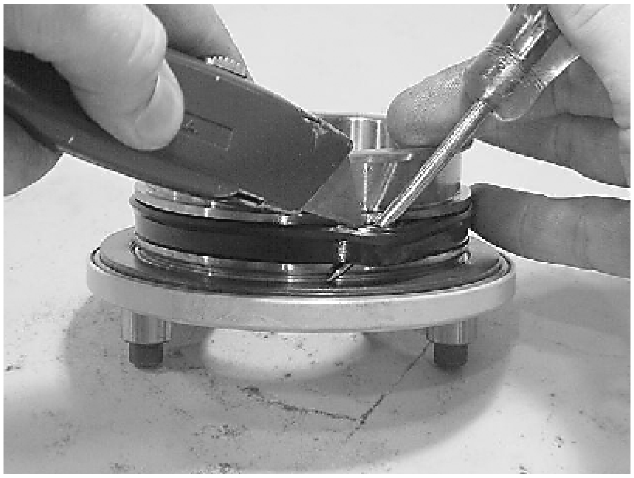


14. Remove the o-ring (204) and backup ring (207) from end cap (4) and set aside for inspection.

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



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



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

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

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

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

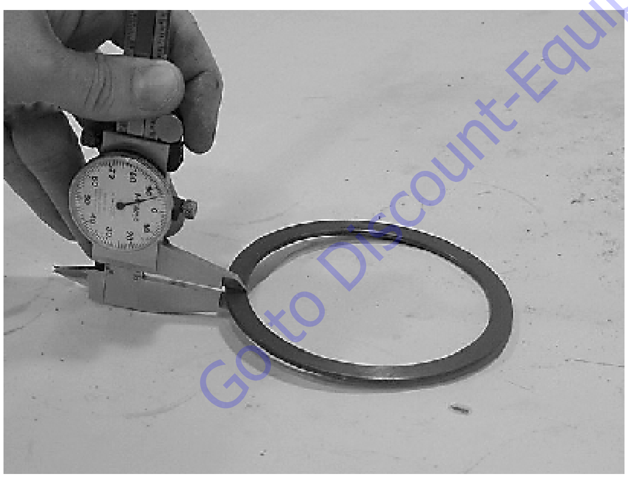
Inspection

NOTICE

SMALL OR MINOR SURFACE SCRATCHES CAN BE CAREFULLY POLISHED.

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

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

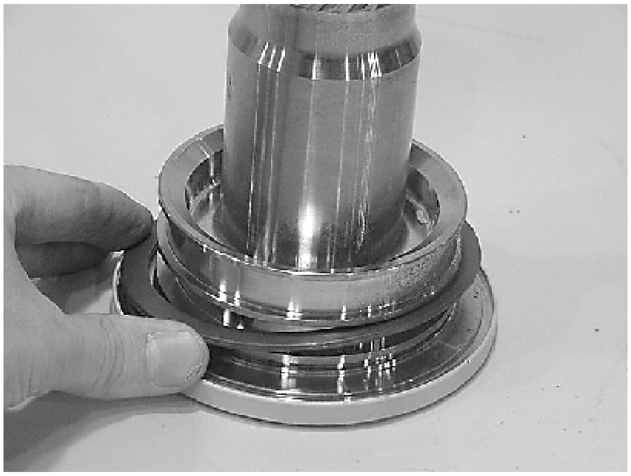


3. Inspect the wear guide condition and measure thickness (not less than 0.123" or 3.12 mm).

Assembly

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

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



3. Install the wiper seal (304.1/green 0-ring) into the groove on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).

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

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

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

7. Install the inner T-seal (200) into the piston (3) using a circular motion.

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

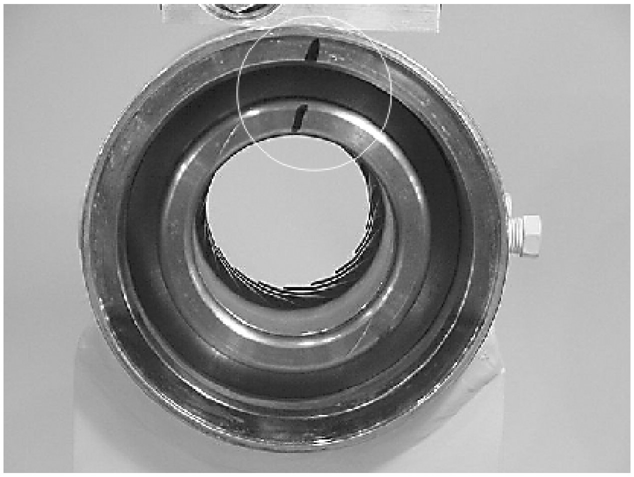
   Each T-seal has 2 backup rings (see drawing for orientation).

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

   Repeat this step for the outer seal (202).

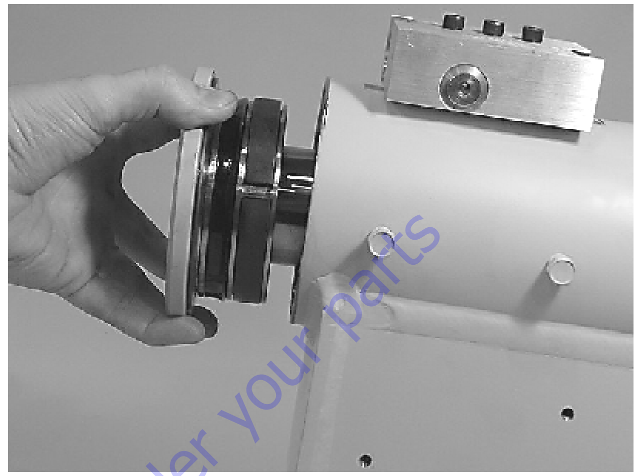
8. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) is touching inside the housing bore.

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

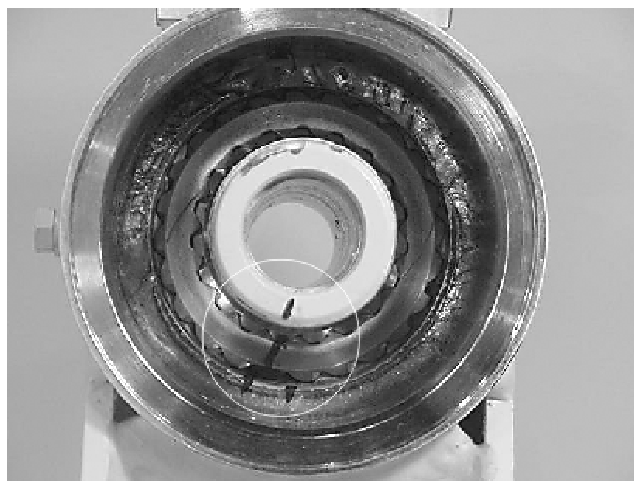


10. Looking from the opposite end of the housing (1) you can see if your timing marks are lining up. When they do, tap the piston (3) in until the gear teeth mesh together. Tap the piston into the housing the rest of the way until it bottoms out.

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



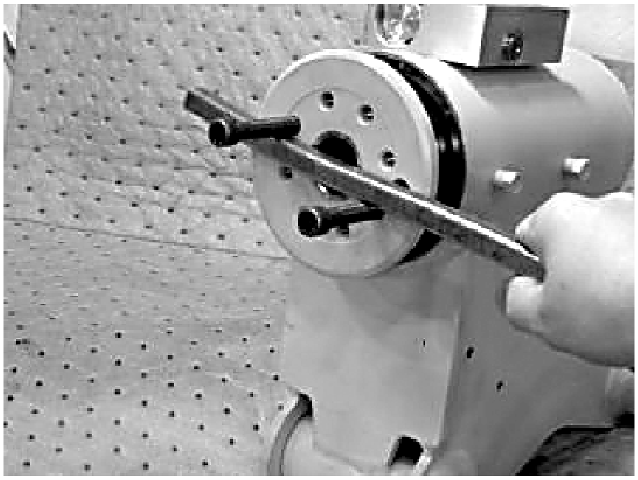
12. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.



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

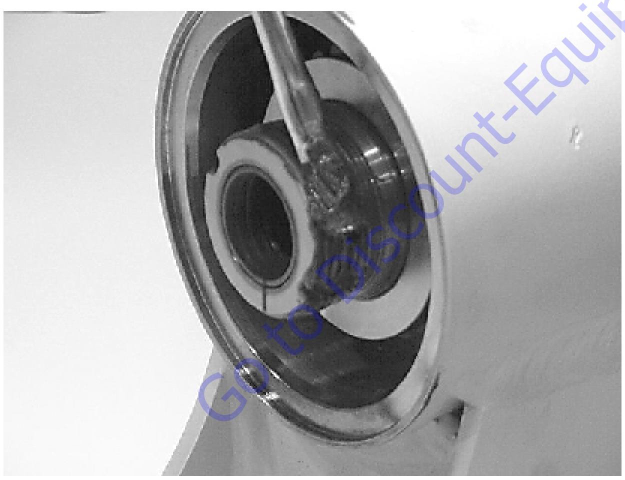
NOTICE

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



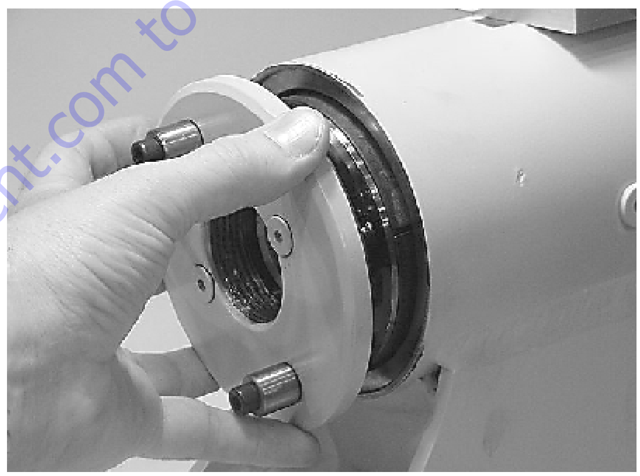
14. Install the stop tube onto the shaft end, if equipped. Stop tube is an available option to limit the rotation of an actuator.

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

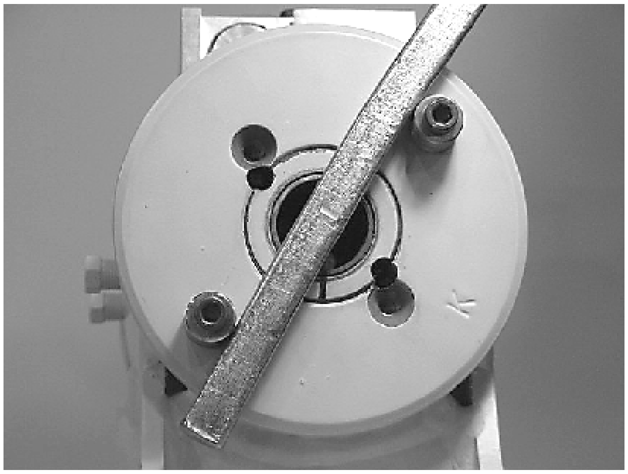


16. Install the 0-ring (204) and backup ring (207) into the inner seal groove on the end cap (4).

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



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



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

20. Insert the set screws (113) over the lock pins. Tighten them to 25 in. lbs. (2.825 Nm).

Installing Counterbalance Valve

Refer to Figure 4-24., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old JLG Threadlocker P/N 0100011.
2. Make sure the new valve has the O-rings in the counterbores of the valve to seal it to the actuator housing.
3. The bolts that come with the valve are grade 8 bolts. New bolts should be installed with a new valve. JLG Threadlocker P/N 0100011 should be applied to the shank of the three bolts at the time of installation.
4. Torque the 1/4-inch bolts 110 to 120 in.lbs. (12.4 to 13.5 Nm). Do not torque over 125 in.lbs. (14.1 Nm). Torque the 5/16-inch bolts 140 in.lbs. (15.8 Nm). Do not torque over 145 in.lbs. (16.3 Nm).
5. Make sure the valve is seated against the housing valve flat. If it is raised up on any side or corner, remove the valve to determine what the obstruction is. If possible, test this using a hydraulic hand pump or electric test.

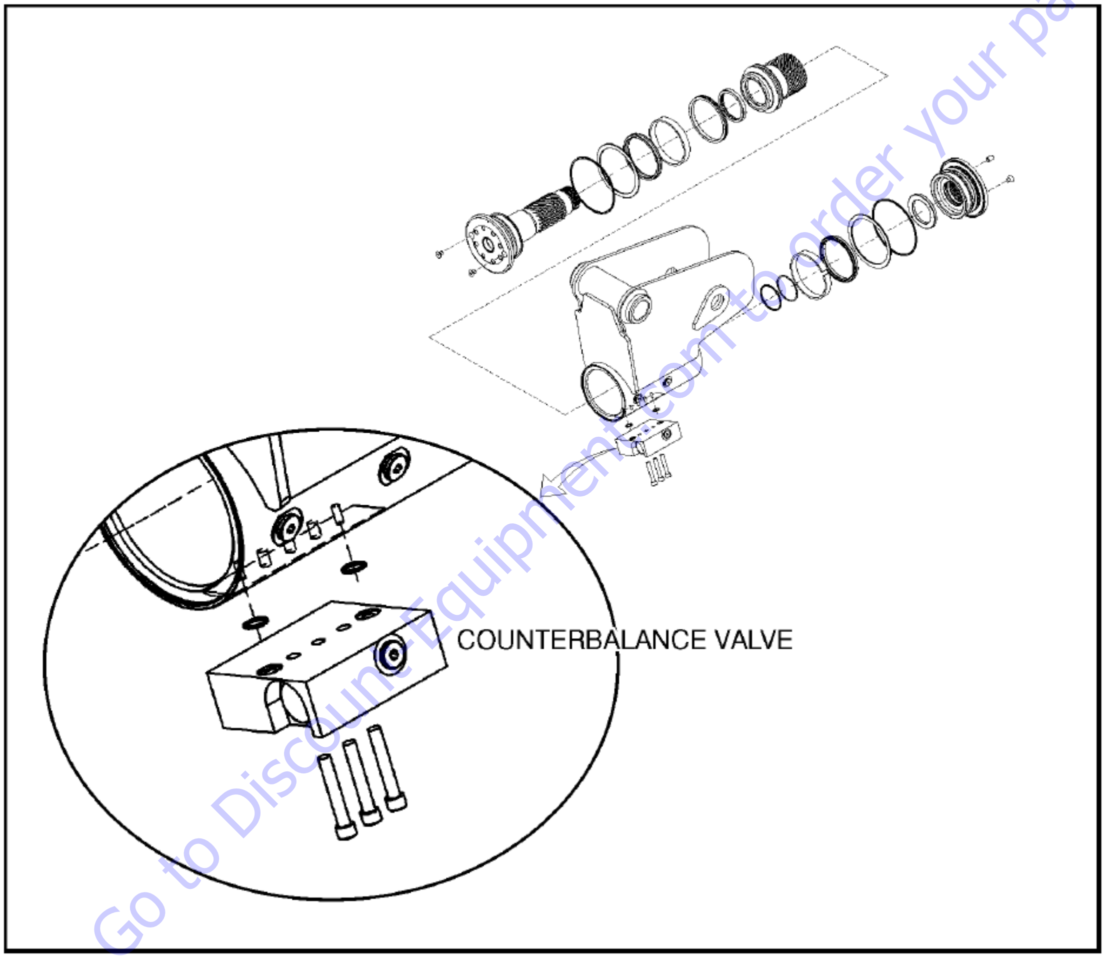


Figure 4-24. Rotator Counterbalance Valve

Greasing Thrust Washers

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

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

NOTICE

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

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

Testing the Actuator

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

TESTING THE ACTUATOR FOR INTERNAL LEAKAGE

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

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

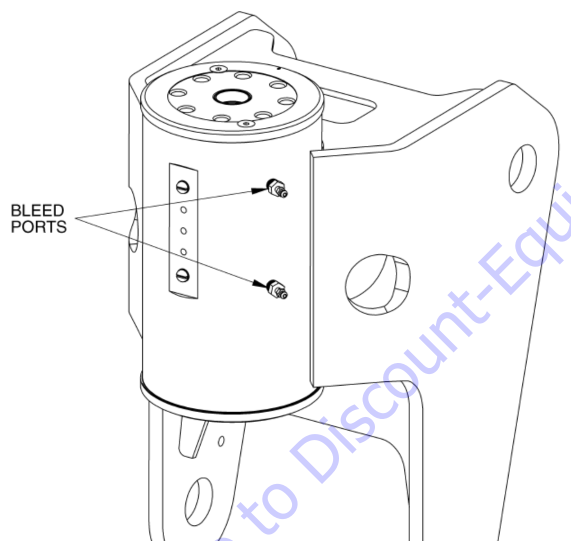
Installation and Bleeding

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

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

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

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



TYPICAL CONFIGURATION
OF ACTUATOR

2. With an operator in the platform, open both bleed nipples 1/4 turn. Hydraulically rotate the platform to the end of rotation (either clockwise or counterclockwise), and maintain hydraulic pressure. Oil with small air bubbles will be seen flowing through the tubes. Allow a 1/2 gallon of fluid to be purged from the actuator.
3. Keep the fittings open and rotate the platform in the opposite direction to the end position. Maintain hydraulic pressure until an additional 1/4 gallon of fluid is pumped into the container.
4. Repeat steps 2 & 3. After the last 1/2 gallon is purged, close both bleed nipples before rotating away from the end position.

4.18 FOOT SWITCH ADJUSTMENT

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

Troubleshooting

Table 4-1. Troubleshooting

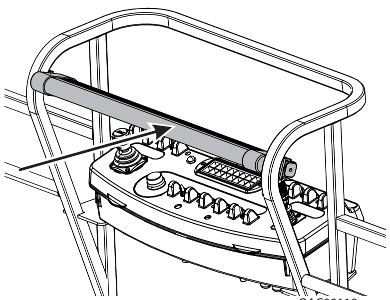
Problem	Cause	Solution
1. Shaft rotates slowly or not at all	a. Insufficient torque output	a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.
	b. Low rate of fluid flow	b. Inspect ports for obstructions and hydraulic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

4.19 SKYGUARD

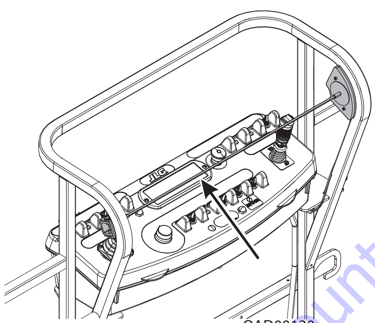
Operation

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

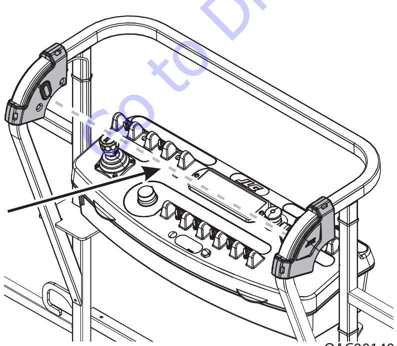
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



SkyGuard



SkyGuard SkyLine™



SkyGuard SkyEye™

⚠ WARNING

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

Function Test

SKYGUARD ONLY

Perform this function test if **SkyGuard only** is selected in machine setup (refer to Table 6-2).

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

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

In Ground Mode:

Operation is allowed regardless of SkyGuard activation.

SOFT TOUCH ONLY

If **Soft Touch only** is selected in machine setup (refer to Table 6-2), machine will treat the Soft Touch/SkyGuard override switch as if it is a Soft Touch switch.

SKYGUARD NOT SELECTED IN MACHINE SETUP

If the SkyGuard system is installed on the machine, but no option is selected in the machine setup (refer to Table 6-2), SkyGuard sensor status will be ignored. No function cutout or reversal will be implemented.

Diagnostics & Troubleshooting

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

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

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

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

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

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

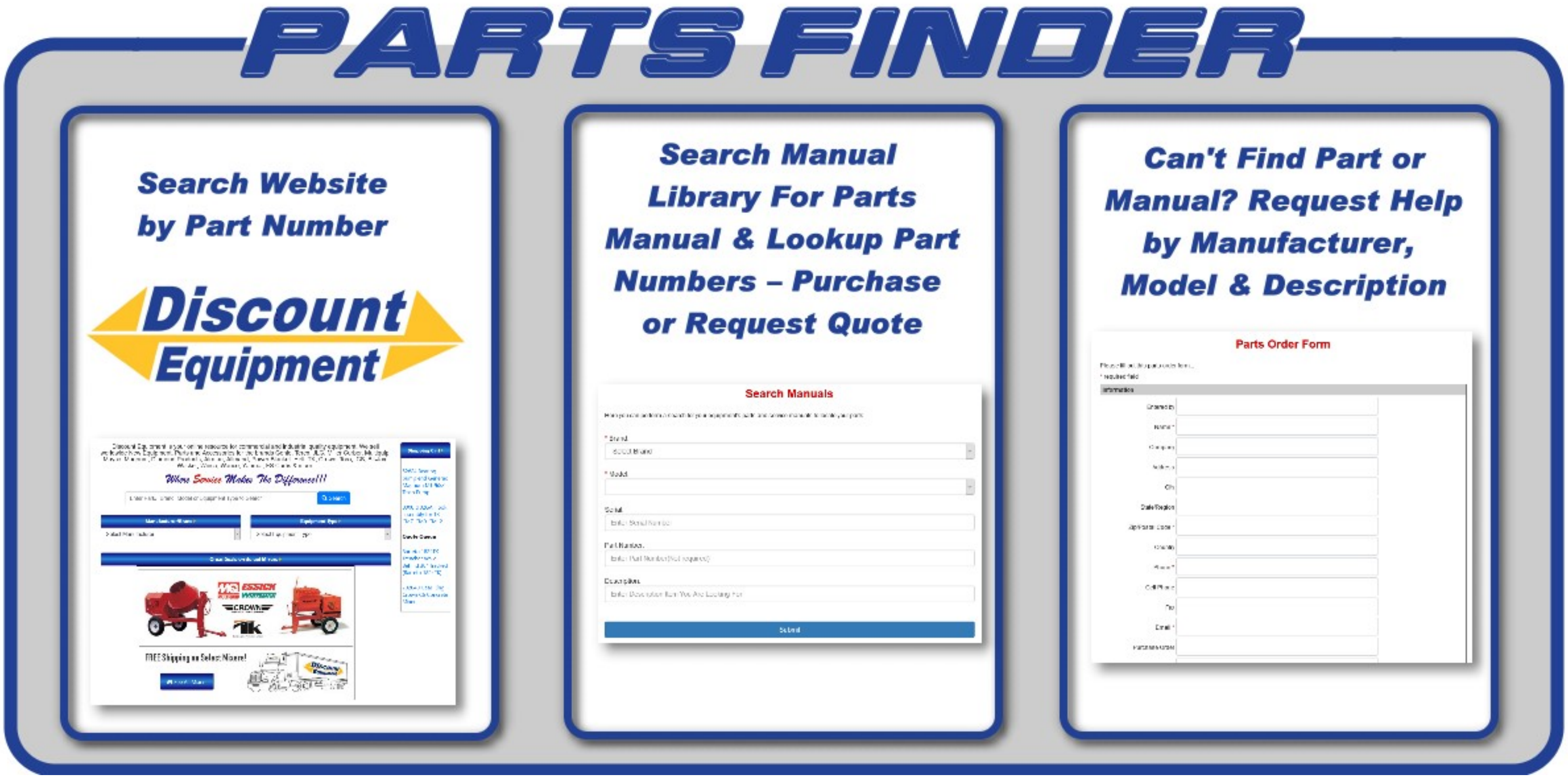
FAULT CODES

Refer to Table 6-14 for more fault code information

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

Table 4-2. SkyGuard Function Table

Drive Fwd	Drive Rev	Steer	Swing	Tower Lift up	Tower Tele Out	Tower Lift Down	Tower Tele In	Boom Lift up	Boom Lift Down	Boom Tele Out	Boom Tele In	Jib Lift	Basket Level	Basket Rorate
R*/C**	R	C	R	R	C	C	C	R	R	R	C	C	C	C
R = Indicates Reversal is Activated														
C = Indicates Cutout is Activated														
* If SkyGuard has been activated before Soft Touch the function will reverse, If Soft Touch has been activated before SkyGuard the function will cutout.														



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

SECTION 5. BASIC HYDRAULIC INFORMATION & HYDRAULIC SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

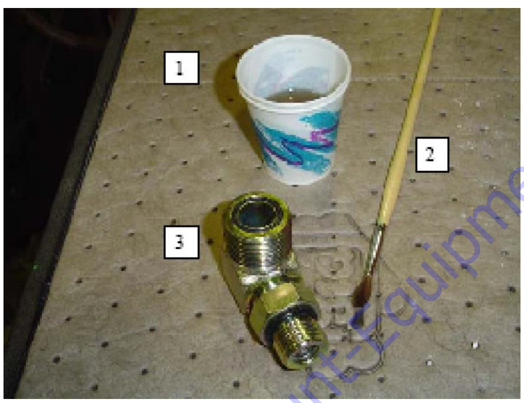
When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

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 CONNECTION ASSEMBLY AND TORQUE SPECIFICATION

Tapered Thread Types

NPTF = national tapered fuel (Dry Seal) per SAE J476/J512

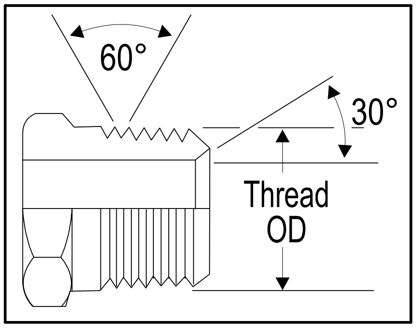


Figure 5-1. NPTF Thread

BSPT = British standard pipe tapered per ISO7-1

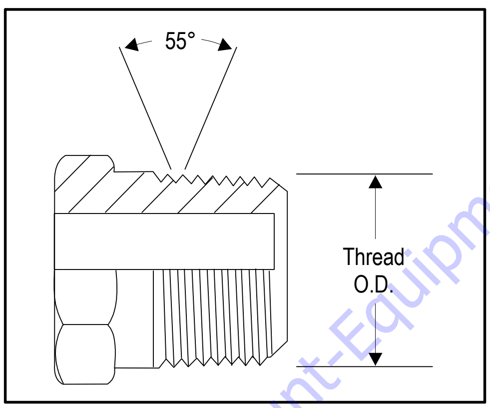


Figure 5-2. BSPT Thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

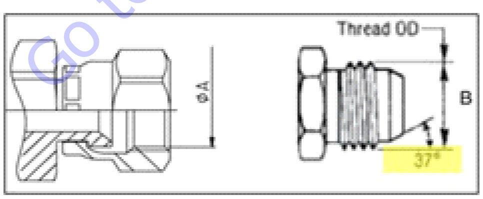


Figure 5-3. JIC Thread

SAE = 45° flare per SAE J512

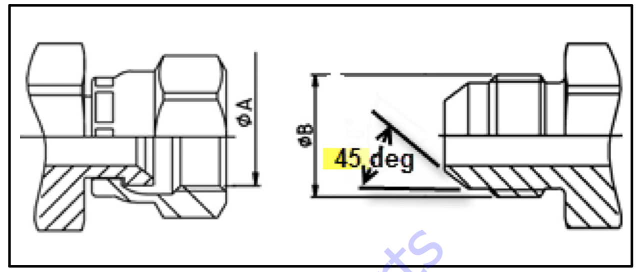


Figure 5-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

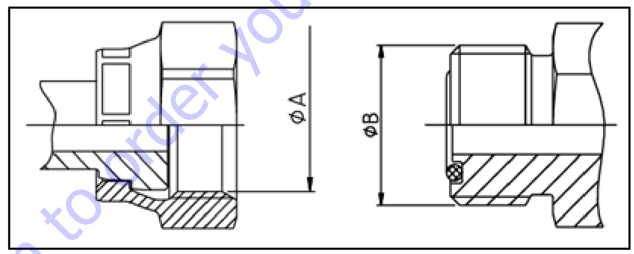


Figure 5-5. ORFS Thread

MBTL = metric flareless bite type fitting, pressure rating L (medium) per ISO 8434, DIN 2353

MBTS = metric flareless bite type fitting, pressure rating S (high) per ISO 8434, DIN 2353

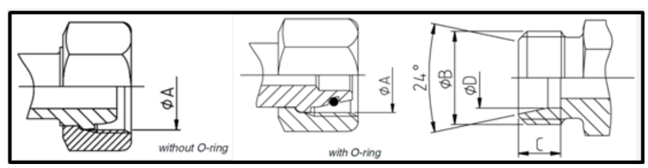


Figure 5-6. MTBL-MBTS Thread

BH = bulkhead connection – JIC, ORFS, MBTL, or MBTS types

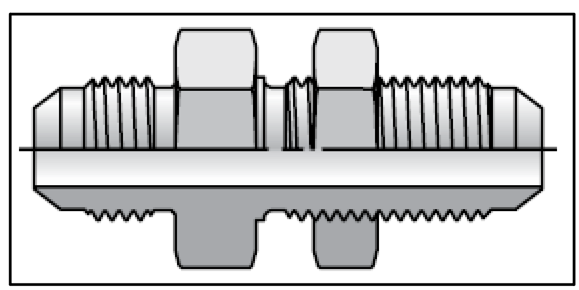


Figure 5-7. Bulkhead Thread

Straight Thread Types, Port Connections

ORB = o-ring boss per SAE J1926, ISO 11926

MPP = metric pipe parallel o-ring boss per SAE J2244, ISO 6149, DIN 3852

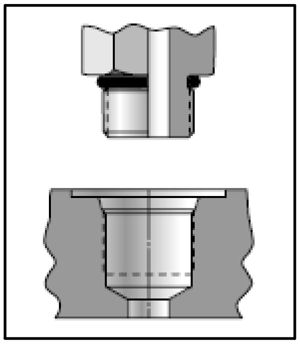


Figure 5-8. ORB-MPP Thread

MFF = metric flat face port per ISO 9974-1

BSPP = British standard parallel pipe per ISO 1179-1, DIN 3852-2

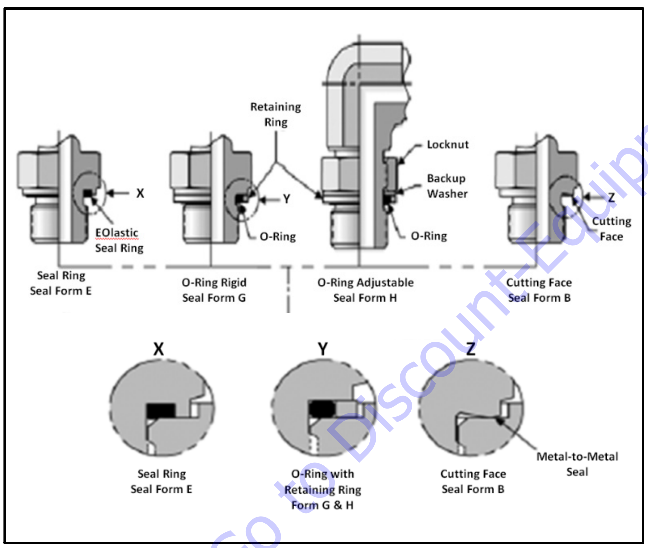


Figure 5-9. MFF-BSPP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

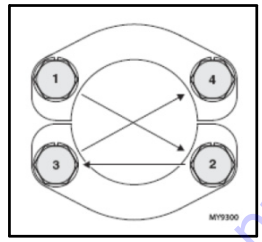


Figure 5-10. ORB-MPP Thread

Tightening Methods

Torque = Application of a twisting force to the applicable connection by use of a precise measurement instrument (i.e. torque wrench).

Finger Tight = The point where the connector will no longer thread onto the mating part when tightened by hand or fingers. Finger Tight is relative to user strength and will have some variance. The average torque applied by this method is 3 ft-lbs [4 N-m] Also referred to as 'Hand Tight.'

TFFT = Turns From Finger Tight; Application of a preload to a connection by first tightening the connection by hand (fingers) and applying an additional rotation counted by a defined number of turns by use of a tool.

FFWR = Flats from Wrench Resistance; Application of a preload to a connection by tightening to the point of initial wrench resistance and turning the nut a described number of 'flats'. A 'flat' is one side of the hexagonal tube nut and equates to 1/6 of a turn. Also referred to as the 'Flats Method.'

Assembly And Torque Specifications

Prior to selecting the appropriate torque from the tables within this section, it is necessary to properly identify the connector being installed. Refer to the Figures and Tables in this section.

GENERAL TUBE TYPE FITTING ASSEMBLY INSTRUCTIONS

1. Take precautions to ensure that fittings and mating components are not damaged during storage, handling or assembly. Nicks and scratches in sealing surfaces can create a path for leaks which could lead to component contamination and/or failure.
2. When making a connection to tubing, compression or flare, inspect the tube in the area of the fitting attachment to ensure that the tube has not been damaged.
3. The assembly process is one of the leading causes for contamination in air and hydraulic systems. Contamination can prevent proper tightening of fittings and adapters from occurring.
   a. Avoid using dirty or oily rags when handling fittings.
   b. If fittings are disassembled, they should be cleaned and inspected for damage. Replace fittings as necessary before re-installing.
   c. Sealing compounds should be applied where specified; however, care should be taken not to introduce sealant into the system.
   d. Avoid applying sealant to the area of the threads where the sealant will be forced into the system. This is generally the first two threads of a fitting.
   e. Sealant should only be applied to the male threads.
   f. Straight thread fittings do not require sealants. O-rings or washers are provided for sealing.
   g. When replacing or installing an O-ring, care is to be taken while transferring the O-ring over the threads as it may become nicked or torn. When replacing an O-ring on a fitting, the use of a thread protector is recommended.
   h. When installing fittings with O-rings, lubrication shall be used to prevent scuffing or tearing of the O-ring. See O-ring Installation (Replacement) in this section.
4. Take care to identify the material of parts to apply the correct torque values.
   a. Verify the material designation in the table headings.
   b. If specifications are given only for steel fittings and components, the values for alternate materials shall be as follows: Aluminum and Brass- reduce steel values by 35%; Stainless Steel- Use the upper limit for steel.
5. To achieve the specified torque, the torque wrench is to be held perpendicular to the axis of rotation.

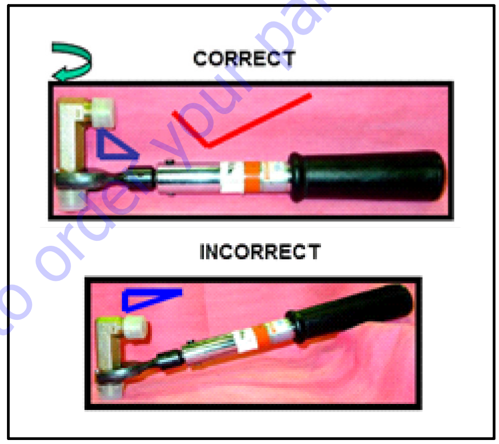


Figure 5-11. Torque Wrench Angle

6. Refer to the appropriate section in this manual for more specific instructions and procedures for each type of fitting connection

Assembly Instructions for American Standard Pipe Thread Tapered (NPTF) Connections.

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as Loctite 567, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

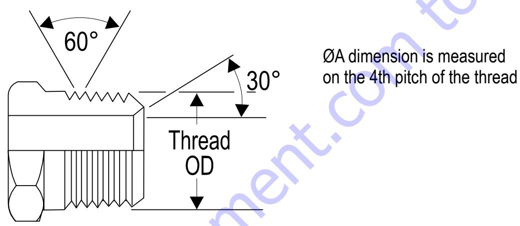
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-1, NPTF Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 5-1, NPTF Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-1. NPTF Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
Material	Dash Size	Thread Size (UNF)	ØA* (in)	ØA* (mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH STEEL, ALUMINUM, OR BRASS MATING C OMPONENTS	2	1/8 - 27	0.40	10.24	2 to 3
	4	1/4 - 18	0.54	13.61	2 to 3
	6	3/8 - 18	0.67	17.05	2 to 3
	8	1/2 - 14	0.84	21.22	2 to 3
	12	3/4 - 14	1.05	26.56	2 to 3
	16	1 - 11 1/2	1.31	33.22	1.5 to 2.5
	20	1 1/4 - 11 1/2	1.65	41.98	1.5 to 2.5
	24	1 1/2 - 11 1/2	1.89	48.05	1.5 to 2.5
	32	2 - 11 1/2	2.37	60.09	1.5 to 2.5

* ØA thread dimension for reference only.

** See FFWR and TFFT Methods subsection for TFFT procedure requirements.

Assembly Instructions for British Standard Pipe Thread Tapered (BSPT) Connections

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as Loctite 567, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

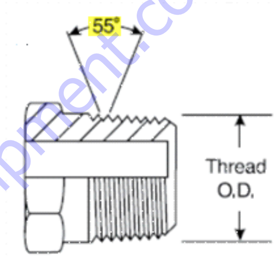
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-2, BSPT Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 5-2, BSPT Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-2. BSPT Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
MATERIAL	Dash Size	Thread Size (BSPT)	ØA* (in)	ØA* (mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH STEEL, ALUMINUM, OR BRASS MATING COMPONENTS	2	1/8 - 28	0.38	9.73	2 to 3
	4	1/4 - 19	0.52	13.16	2 to 3
	6	3/8 - 19	0.66	16.66	2 to 3
	8	1/2 - 14	0.83	20.96	2 to 3
	12	3/4 - 14	1.04	26.44	2 to 3
	16	1 - 11	1.31	33.25	1.5 to 2.5
	20	1 1/4 - 11	1.65	41.91	1.5 to 2.5
	24	1 1/2 - 11	1.88	47.80	1.5 to 2.5
	32	2 - 11	2.35	59.61	1.5 to 2.5

* ØA thread dimension for reference only.

** See Appendix B for TFFT procedure requirements.

Assembly Instructions for 37° (JIC) Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting and start threads by hand.

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

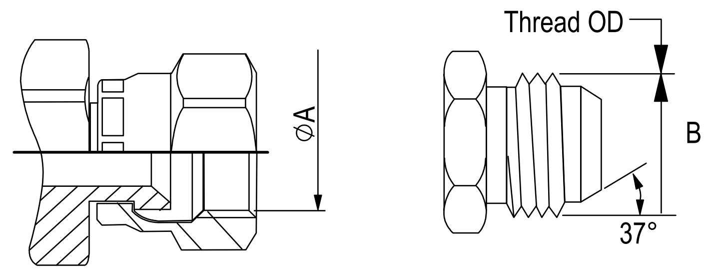
3. Torque assembly to value listed in Table Table 5-3, 37° Flare (JIC)Thread - Steel or Table 5-4, 37° Flare (JIC)Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

NOTE: *Torque values provided in Table Table 5-3, 37° Flare (JIC)Thread - Steel and Table 5-4, 37° Flare (JIC)Thread - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-3. 37° Flare (JIC)Thread - Steel

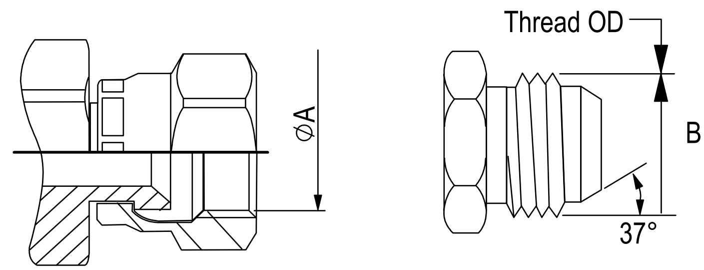


MATERIAL	Type/Fitting Identification						Torque						Flats from Wrench Resistance (F.F.W.R)**
	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	7	8	9	10	--
	3	3/8-24	0.34	8.60	0.37	9.50	8	9	10	11	12	14	--
	4	7/16-20	0.39	10.00	0.44	11.10	13	14	14	18	19	19	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	14	15	15	19	20	21	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	22	23	24	30	31	33	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	42	44	46	57	60	63	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	60	63	66	81	85	89	1 to 1-1/2
	12	1 1/16-12	0.97	24.60	1.06	27.00	84	88	92	114	120	125	1 to 1-1/2
	14	1 3/16-12	1.11	28.30	1.19	30.10	100	105	110	136	142	149	1 to 1-1/2
	16	1 5/16-12	1.23	31.30	1.31	33.30	118	124	130	160	168	176	3/4 to 1
	20	1 5/8-12	1.54	39.20	1.63	41.30	168	176	185	228	239	251	3/4 to 1
	24	1 7/8-12	1.80	45.60	1.87	47.60	195	205	215	264	278	291	3/4 to 1
	32	2 1/2-12	2.42	61.50	2.50	63.50	265	278	292	359	377	395	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Table 5-4. 37° Flare (JIC)Thread - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	4	4	5	5	6	7	--
	3	3/8-24	0.34	8.60	0.37	9.50	5	6	7	7	8	9	--
	4	7/16-20	0.39	10.00	0.44	11.10	8	9	9	11	12	13	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	9	10	10	12	13	14	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	14	15	16	19	20	21	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	27	29	30	37	39	41	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	39	41	43	53	56	58	1 to 1-1/2
	12	1 1/16-12	0.97	24.60	1.06	27.00	55	57	60	74	78	81	1 to 1-1/2
	14	1 3/16-12	1.11	28.30	1.19	30.10	65	68	72	88	93	97	1 to 1-1/2
	16	1 5/16-12	1.23	31.30	1.31	33.30	77	81	84	104	109	114	3/4 to 1
	20	1 5/8-12	1.54	39.20	1.63	41.30	109	115	120	148	155	163	3/4 to 1
	24	1 7/8-12	1.80	45.60	1.87	47.60	127	133	139	172	180	189	3/4 to 1
	32	2 1/2-12	2.42	61.50	2.50	63.50	172	181	189	234	245	257	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

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Assembly Instructions for 45° SAE Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting.
3. Tighten fitting by hand until hand tight.

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

Torque fitting to value listed in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass while using the Double Wrench Method outlined in this section. Refer to FFWR and TFFT Methods for procedure requirements if using the TFFT method.

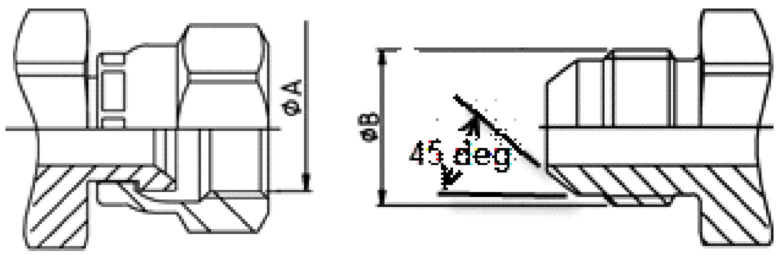
NOTE: *Torque values provided in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS

mating components.

Table 5-5. 45° Flare (SAE) - Steel

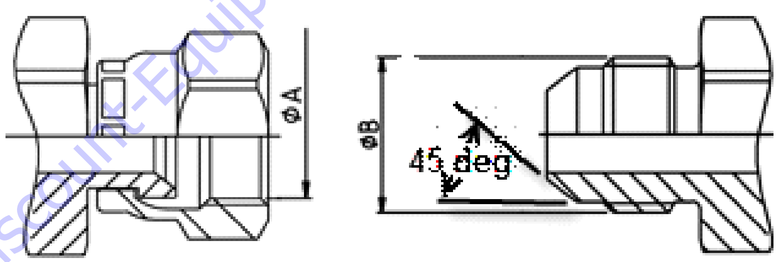


TYPE/FITTING IDENTIFICATION							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	13	14	14	18	19	19
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89
	12	1 1/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methodsfor FFWR procedure requirements.

Table 5-6. 45° Flare (SAE) - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	8	9	9	11	12	12
	6	5/8-18	0.56	14.30	0.63	15.90	14	15	15	19	20	20
	8	3/4-16	0.69	17.50	0.75	19.10	27	29	30	37	39	41
	10	7/8-14	0.81	20.60	0.87	22.20	39	41	43	53	56	58
	12	1 1/16-14	0.98	25.00	1.06	27.00	55	58	61	75	79	83

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for TFFT procedure requirements.

Assembly Instructions for O-Ring Face Seal (ORFS) Fittings

1. Ensure proper O-ring is installed. If O-ring is missing install per O-ring Installation (Replacement).

2. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

CAUTION

CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.

4. Place the tube assembly against the fitting body so that the flat face comes in contact with the O-ring. Hand thread the nut onto the fitting body.

5. Torque nut to value listed in Table 5-7, O-ring Face Seal (ORFS) - Steel or Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass while using the Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

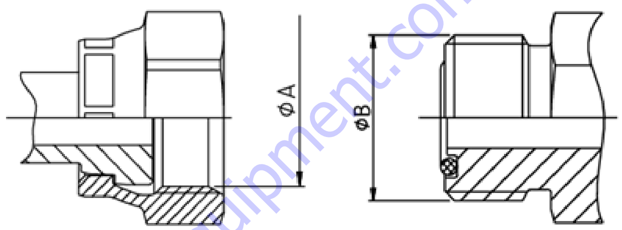
NOTE: *Torque values provided in Table 5-7, O-ring Face Seal (ORFS) - Steel and Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or

BRASS mating components

Table 5-7. O-ring Face Seal (ORFS) - Steel

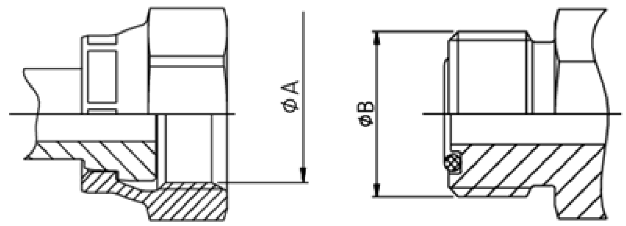


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size (UNF)	ØA* (in)	ØA* (mm)	ØB* (in)	ØB* (mm)	[Ft-Lb] Min	[Ft-Lb] Nom	[Ft-Lb] Max	[N-m] Min	[N-m] Nom	[N-m] Max	Tube Nuts	Swivel & Hose Ends
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	18	19	20	25	26	27	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	30	32	33	40	43	45	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	40	42	44	55	57	60	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	60	63	66	81	85	89	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	85	90	94	115	122	127	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	110	116	121	149	157	164	1/4 to 1/2	1/2 to 3/4
	20	111/16-12	1.59	40.50	1.69	42.90	150	158	165	203	214	224	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	230	242	253	312	328	343	1/4 to 1/2	1/2 to 3/4
	32	21/2-12	2.43	61.67	2.50	63.50	375	394	413	508	534	560	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Table 5-8. O-ring Face Seal (ORFS) - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	26	28	29	35	38	39	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	39	41	43	53	56	58	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	55	58	61	75	79	83	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	72	76	79	98	103	107	1/4 to 1/2	1/2 to 3/4
	20	1 11/16-12	1.59	40.50	1.69	42.90	98	103	108	133	140	146	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	32	2 1/2-12	2.43	61.67	2.50	63.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

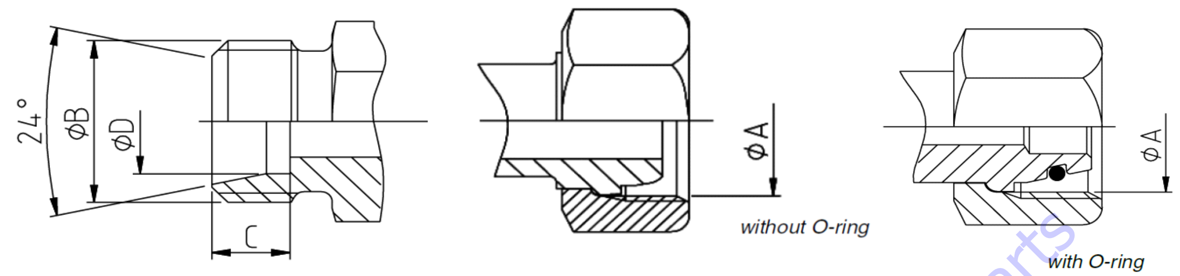
Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

CAUTION

A NON-SQUARE TUBE END CAN CAUSE IMPROPERLY SEATED FITTINGS AND LEAKAGE.

1. Inspect the components to ensure free of contamination, external damage, rust, splits, dirt, foreign matter, or burrs. Ensure tube end is visibly square. If necessary replace fitting or tube.
2. Lubricate thread and cone of fitting body or hardened pre-assembly tool, as well as the progressive ring and nut threads.
3. Slip nut and progressive ring over tube, assuring that they are in the proper orientation.
4. Push the tube end into the coupling body.
5. Slide collet into position and tighten until finger tight. Mark nut and tube in the finger-tight position. Tighten nut to the number of flats listed in Table Table 5-9, DIN 24°Cone (MBTL & MBTS) while using the Double Wrench Method. The tube must not turn with the nut.

Table 5-9. DIN 24°Cone (MBTL & MBTS)



TYPE/FITTING IDENTIFICATION								DIN 24° CONE FLARELESS BITE FITTING (With or Without O-Ring)						
MATERIAL	TYPE	Tube O.D. (mm)	Thread M Size (Metric)	ØA* (mm)	ØB* (mm)	C* (mm)	ØD* (mm)	Torque [Ft-Lb] Min	Nom	Max	[N-m] Min	Nom	Max	Flats from Wrench Resistance (F.F.W.R)**
STEEL FITTINGS WITH STEEL MATING COMPONENTS	DIN 24° CONE FLARELESS BITE (MBTL) FITTING	6	M12 x 1.5	10.50	12.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Refer to the specific procedure in the						1.5 to 1.75
		8	M14 x 1.5	12.50	14.00	7.00	8.20							1.5 to 1.75
		10	M16 x 1.5	14.50	16.00	7.00	10.20							1.5 to 1.75
		12	M18 x 1.5	16.50	18.00	7.00	12.20							1.5 to 1.75
		15	M22 x 1.5	20.50	22.00	7.00	15.20							1.5 to 1.75
		18	M26 x 1.5	24.50	26.00	7.50	18.20							1.5 to 1.75
		22	M30 x 2	27.90	30.00	7.50	22.20							1.5 to 1.75
		28	M36 x 2	33.90	36.00	7.50	28.20							1.5 to 1.75
		35	M45 x 2	42.90	45.00	10.50	35.30							1.5 to 1.75
		42	M52 x 2	49.90	52.00	11.00	42.30							1.5 to 1.75
	TYPE	Tube O.D. (mm)	Thread M Size (Metric)	ØA* (mm)	ØB* (mm)	C* (mm)	ØD* (mm)	Torque [Ft-Lb] Min	Nom	Max	[N-m] Min	Nom	Max	Flats from Wrench Resistance (F.F.W.R)**
	DIN 24° CONE FLARELESS BITE (MBTS) FITTING	6	M14 x 1.5	12.50	14.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Refer to the specific procedure in the						1.5 to 1.75
		8	M16 x 1.5	14.50	16.00	7.00	8.20							1.5 to 1.75
		10	M18 x 1.5	16.50	18.00	7.50	10.20							1.5 to 1.75
		12	M20 x 1.5	18.50	20.00	7.50	12.20							1.5 to 1.75
		14	M22 x 1.5	20.50	22.00	8.00	14.20							1.5 to 1.75
		16	M24 x 1.5	22.50	24.00	8.50	16.20							1.5 to 1.75
		20	M30 x 2	27.90	30.00	10.50	20.20							1.5 to 1.75
		25	M36 x 2	33.90	36.00	12.00	25.20							1.5 to 1.75
		30	M42 x 2	39.90	42.00	13.50	30.20							1.5 to 1.75
		38	M52 x 2	49.90	52.00	16.00	38.30							1.5 to 1.75

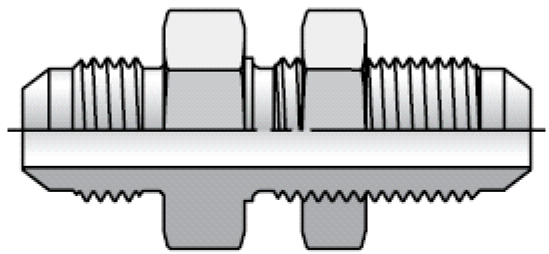
* ØA, ØB, C, & ØD thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Assembly Instructions for Bulkhead (BH) Fittings

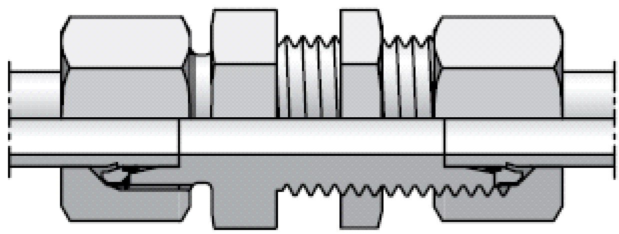
1. Ensure threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand thread the locknut onto the bulkhead end of the fitting body.
5. Torque nut onto fitting per Table 5-10 and Table 5-11 while using the Double Wrench Method.

Table 5-10. Bulkhead Fittings (BH) - INCH



TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT for Bulkhead Connectors					
MATERIAL	TYPE	Dash Size	Thread Size	Torque					
				[Ft-Lb]			[N-m]		
			(UNF)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS	O-RING FACE SEAL (ORFS) BULKHEAD FITTING	4	9/16-18	15	16	17	20	22	23
		6	11/16-16	25	27	28	34	37	38
		8	13/16-16	55	58	61	75	79	83
		10	1-14	85	90	94	115	122	127
		12	1 3/16-12	135	142	149	183	193	202
		14	1 5/16-12	170	179	187	230	243	254
		16	1 7/16-12	200	210	220	271	285	298
		20	1 11/16-12	245	258	270	332	350	366
		24	2-12	270	284	297	366	385	403
	TYPE	Dash Size	Thread Size	Torque					
				[Ft-Lb]			[N-m]		
			(UNF)	Min	Nom	Max	Min	Nom	Max
	37° FLARE (JIC) BULKHEAD FITTING	3	3/8-24	8	9	9	11	12	12
		4	7/16-20	13	14	14	18	19	19
		5	1/2-20	20	21	22	27	28	30
		6	9/16-18	25	27	28	34	37	38
		8	3/4-16	50	53	55	68	72	75
		10	7/8-14	85	90	94	115	122	127
		12	1 1/16-12	135	142	149	183	193	202
		14	1 3/16-12	170	179	187	230	243	254
		16	1 5/16-12	200	210	220	271	285	298
		20	1 5/8-12	245	258	270	332	350	366
		24	1 7/8-12	270	284	297	366	385	403
		32	2 1/2-12	310	326	341	420	442	462

Table 5-11. Bulkhead Fittings (BH) - METRIC



TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT for Bulkhead Connectors					
MATERIAL	TYPE	Connecting Tube O.D.	Thread M Size	Torque					
				[Ft-Lb]			[N-m]		
		(mm)	(metric)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS	DIN 24° CONE FLARELESS BITE (MBTL) BULKHEAD FITTING	6	M12x1.5	14	15	16	19	20	22
		8	M14x1.5	17	18	19	23	24	26
		10	M16x1.5	22	23	24	30	31	33
		12	M18x1.5	35	37	39	47	50	53
		15	M22x1.5	44	47	50	60	64	68
		18	M26x1.5	70	75	80	95	102	108
		22	M30x2	115	120	125	156	163	169
		28	M36x2	150	157	164	203	213	222
		35	M45x2	155	162	169	210	220	229
		42	M52x2	220	230	240	298	312	325
	DIN 24° CONE FLARELESS BITE (MBTS) BULKHEAD FITTING	Connecting Tube O.D.	Thread M Size	Torque					
				[Ft-Lb]			[N-m]		
		(mm)	(metric)	Min	Nom	Max	Min	Nom	Max
		6	M14x1.5	17	15	16	23	20	22
		8	M16x1.5	22	18	19	30	24	26
		10	M18x1.5	35	23	24	47	31	33
		12	M20x1.5	40	35	37	54	47	50
		14	M22x1.5	44	47	50	60	64	68
		16	M24x1.5	70	75	80	95	102	108
		20	M30x2	115	120	125	156	163	169
		25	M36x2	150	157	164	203	213	222
		30	M42x2	155	162	169	210	220	229
		38	M52x2	220	230	240	298	312	325

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Assembly Instructions for O-Ring Boss (ORB) Fittings

1. Inspect components to ensure that male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Ensure proper O-ring is installed. If O-ring is missing install per O-ring Installation (Replacement).

CAUTION

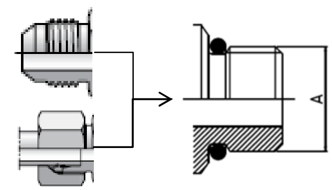
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-12 thru Table 5-17 while using the Double Wrench Method.
   a. The table headings identify the straight thread O-ring port and the type on the other side of the fitting. The torque will be applied to the straight thread O-ring port.
   b. Torque values provided in Table 5-12 thru Table 5-17 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counter bore of the port.

Table 5-12. O-ring Boss (ORB) - Table 1 of 6



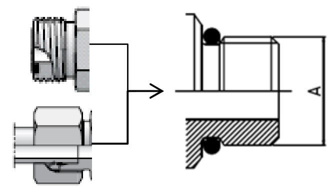
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(94)	10	10	11
	3	3/8-24	0.37	9.52	(155)	(163)	(171)	18	18	19
	4	7/16-20	0.44	11.11	22	23	24	29	31	33
	5	1/2-20	0.50	12.70	23	25	26	32	34	35
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	2.50	63.50	375	394	413	510	534	560

TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(55)	(58)	(61)	6	7	7
	3	3/8-24	0.37	9.52	(101)	(106)	(111)	11	12	13
	4	7/16-20	0.44	11.11	14	15	16	19	20	22
	5	1/2-20	0.50	12.70	15	16	17	20	22	23
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-13. O-ring Boss (ORB) - Table 2 of 6

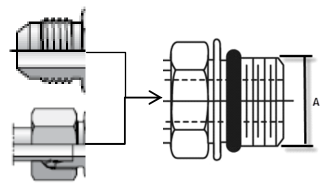


TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	26	27	28	35	37	38
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	17	18	18	23	24	24
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-14. O-ring Boss (ORB) - Table 3 of 6

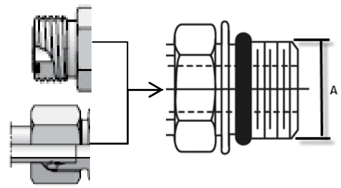


TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(60)	(63)	(66)	7	7	7
	3	3/8-24	0.37	9.52	(100)	(105)	(110)	11	12	12
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	21	22	23	28	30	31
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(39)	(41)	(43)	4	5	5
	3	3/8-24	0.37	9.52	(65)	(69)	(72)	7	8	8
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	15	19	20	20
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-15. O-ring Boss (ORB) - Table 4 of 6

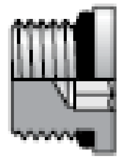


TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-16. O-ring Boss (ORB) - Table 5 of 6

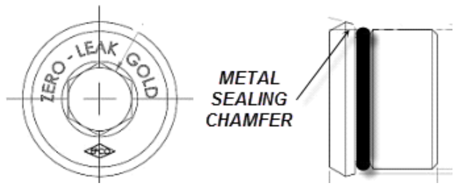


TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(30)	(32)	(33)	3	4	4
	3	3/8-24	0.37	9.52	(55)	(58)	(61)	6	7	7
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	16	19	20	22
	6	9/16-18	0.56	14.28	34	36	38	46	49	52
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(20)	(21)	(21)	2	2	2
	3	3/8-24	0.37	9.52	(36)	(38)	(40)	4	4	5
	4	7/16-20	0.44	11.11	6	7	7	8	9	9
	5	1/2-20	0.50	12.70	9	10	10	12	14	14
	6	9/16-18	0.56	14.28	22	24	25	30	33	34
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-17. O-ring Boss (ORB) - Table 6 of 6



TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	11/16-12	1.06	27.00	51	54	57	69	73	77
	14	13/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	15/16-12	1.31	33.30						
	20	15/8-12	1.63	41.30						
	24	17/8-12	1.87	47.60						
	32	21/2-12	2.50	63.50						
TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	11/16-12	1.06	27.00	51	54	57	69	73	77
	14	13/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	15/16-12	1.31	33.30						
	20	15/8-12	1.63	41.30						
	24	17/8-12	1.87	47.60						
	32	21/2-12	2.50	63.50						

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

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Assembly Instructions for Adjustable Port End Metric (MFF) Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.
2. If O-ring is not pre-installed, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

CAUTION

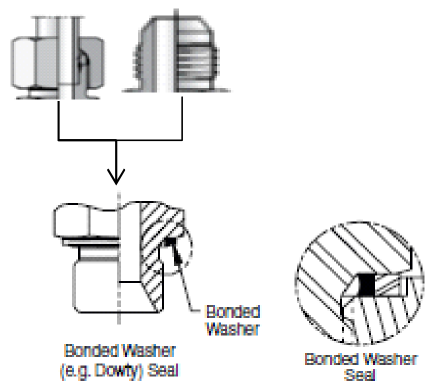
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

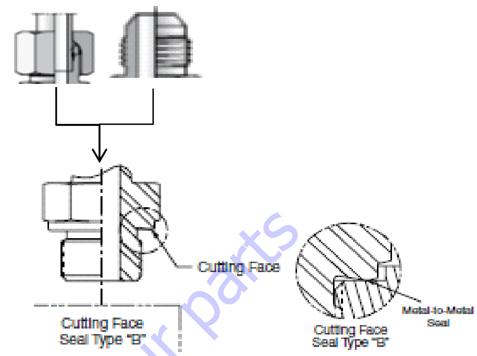
3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, or Table 5-23 while using the Double Wrench Method.
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
   b. Torque values provided in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, and Table 5-23 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counter bore of the port.

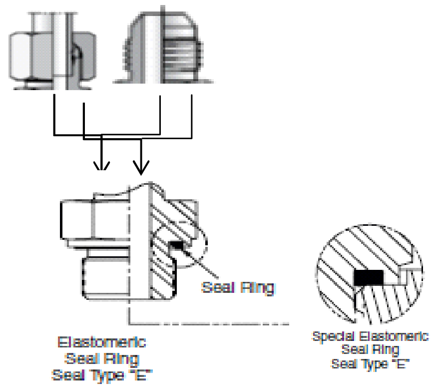
Table 5-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3

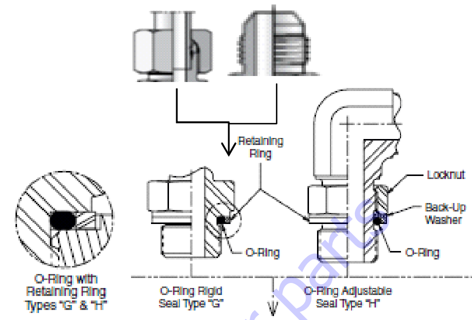




TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	7	8	8	9	11	11	13	14	14	18	19	19
	M12x1.5	8	15	16	17	20	22	23	22	23	24	30	31	33
	M14x1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16x1.5	12	33	35	36	45	47	49	48	51	53	65	69	72
	M18x1.5	15	41	43	45	55	58	61	59	62	65	80	84	88
	M22x1.5	18	48	51	53	65	69	72	103	108	113	140	146	153
	M27x2	22	66	70	73	90	95	99	140	147	154	190	199	209
	M33x2	28	111	117	122	150	159	165	251	264	276	340	358	374
	M42x2	35	177	186	195	240	252	264	369	388	406	500	526	550
	M48x2	42	214	225	235	290	305	319	465	489	512	630	663	694
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	4	5	5	5	7	7	8	9	9	11	12	12
	M12x1.5	8	10	11	11	14	15	15	14	15	16	19	20	22
	M14x1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16x1.5	12	21	22	23	28	30	31	31	33	34	42	45	46
	M18x1.5	15	27	28	29	37	38	39	38	40	42	52	54	57
	M22x1.5	18	31	33	34	42	45	46	67	70	73	91	95	99
	M27x2	22	43	45	47	58	61	64	91	96	100	123	130	136
	M33x2	28	72	76	79	98	103	107	163	171	179	221	232	243
	M42x2	35	115	121	127	156	164	172	240	252	264	325	342	358
	M48x2	42	139	146	153	188	198	207	302	318	332	409	431	450

Table 5-19. Metric Flat Face Port (MFF) - L Series - Table 2 of 3





TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	15	18	19	20
	M12x1.5	8	18	19	20	25	26	27	18	19	20	25	26	28
	M14x1.5	10	33	35	36	45	47	49	30	31	32	40	42	44
	M16x1.5	12	41	43	45	55	58	61	41	43	45	55	58	61
	M18x1.5	15	52	55	57	70	75	77	52	54	57	70	74	77
	M22x1.5	18	92	97	101	125	132	137	66	70	73	90	95	99
	M27x2	22	133	140	146	180	190	198	133	139	146	180	189	198
	M33x2	28	229	241	252	310	327	342	229	240	252	310	326	341
	M42x2	35	332	349	365	450	473	495	332	348	365	450	473	495
	M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12
	M12x1.5	8	12	13	13	16	18	18	12	13	13	16	18	18
	M14x1.5	10	21	22	23	28	30	31	19	20	21	26	27	29
	M16x1.5	12	27	28	29	37	38	39	26	28	29	36	38	39
	M18x1.5	15	34	36	37	46	49	50	34	35	37	46	48	50
	M22x1.5	18	60	63	66	81	85	89	43	45	47	59	61	64
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
	M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386

Table 5-20. Metric Flat Face Port (MFF) - L Series - Table 3 of 3

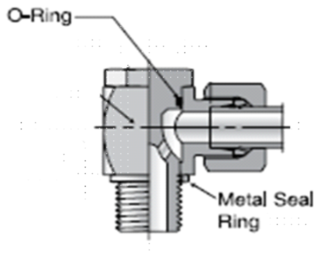
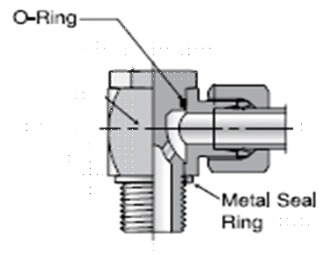
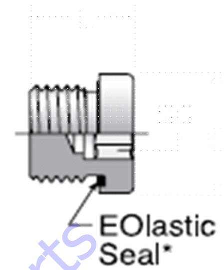
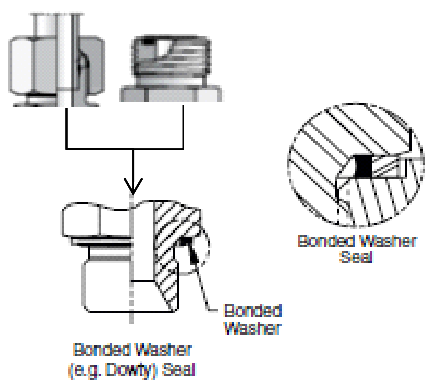
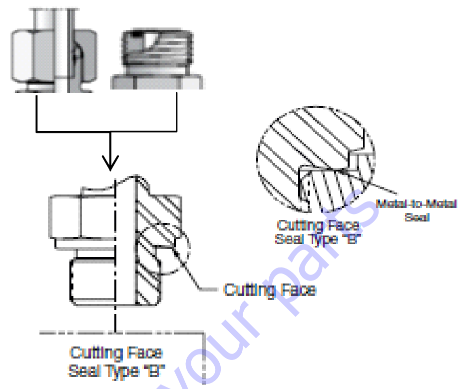
																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	14	18	19	19	9	10	10	12	14	14
	M12x1.5	8	26	28	29	35	38	39	33	35	36	45	47	49	18	19	20	25	26	27
	M14x1.5	10	37	39	41	50	53	56	41	43	45	55	58	61	26	28	29	35	38	39
	M16x1.5	12	44	46	48	60	62	65	59	62	65	80	84	88	41	43	45	55	58	61
	M18x1.5	15	59	62	65	80	84	88	74	78	81	100	106	110	48	51	53	65	69	72
	M22x1.5	18	89	94	98	120	127	133	103	108	113	140	146	153	66	70	73	90	95	99
	M27x2	22	96	101	106	130	137	144	236	248	260	320	336	353	100	105	110	135	142	149
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	166	175	183	225	237	248
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	266	280	293	360	380	397
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	266	280	293	360	380	397
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	M12x1.5	8	17	18	19	23	24	26	21	22	23	28	30	31	12	13	13	16	18	18
	M14x1.5	10	24	26	27	33	35	37	27	28	29	37	38	39	17	18	19	23	24	26
	M16x1.5	12	29	30	31	39	41	42	38	40	42	52	54	57	27	28	29	37	38	39
	M18x1.5	15	38	40	42	52	54	57	48	51	53	65	69	72	31	33	34	42	45	46
	M22x1.5	18	58	61	64	79	83	87	67	70	73	91	95	99	43	45	47	58	61	64
	M27x2	22	62	66	69	84	89	94	153	161	169	207	218	229	65	69	72	88	94	98
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	108	114	119	146	155	161
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	173	182	190	235	247	258
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	173	182	190	235	247	258

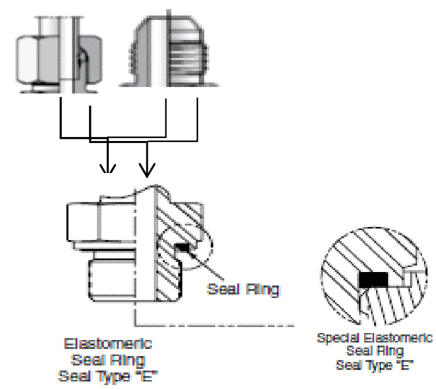
Table 5-21. Metric Flat Face Port (MFF) - S Series - Table 1 of 3

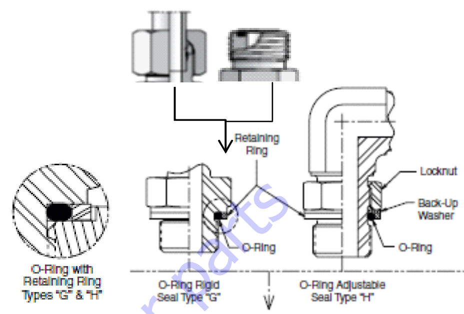




TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	15	16	17	20	22	23	26	28	29	35	38	39
	M14x1.5	8	26	28	29	35	38	39	41	43	45	55	58	61
	M16x1.5	10	33	35	36	45	47	49	52	55	57	70	75	77
	M18x1.5	12	41	43	45	55	58	61	81	85	89	110	115	121
	M20x1.5	14	41	43	45	55	58	61	111	117	122	150	159	165
	M22x1.5	16	48	51	53	65	69	72	125	132	138	170	179	187
	M27x2	20	66	70	73	89	95	99	199	209	219	270	283	297
	M33x2	25	111	117	122	150	159	165	302	317	332	410	430	450
	M42x2	30	177	186	195	240	252	264	398	418	438	540	567	594
	M48x2	38	214	225	235	290	305	319	516	542	568	700	735	770
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	10	11	11	14	15	15	17	18	19	23	24	26
	M14x1.5	8	17	18	19	23	24	26	27	28	29	37	38	39
	M16x1.5	10	21	22	23	28	30	31	34	36	37	46	49	50
	M18x1.5	12	27	28	29	37	38	39	53	56	58	72	76	79
	M20x1.5	14	27	28	29	37	38	39	72	76	79	98	103	107
	M22x1.5	16	31	33	34	42	45	46	81	86	90	110	117	122
	M27x2	20	43	45	47	58	61	64	129	136	142	175	184	193
	M33x2	25	72	76	79	98	103	107	196	206	216	266	279	293
	M42x2	30	115	121	127	156	164	172	259	272	285	351	369	386
	M48x2	38	139	146	153	188	198	207	335	352	369	454	477	500

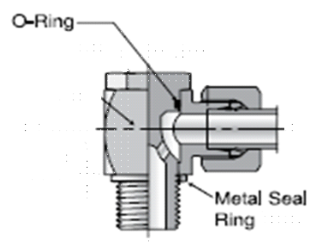
Table 5-22. Metric Flat Face Port (MFF) - S Series - Table 2 of 3

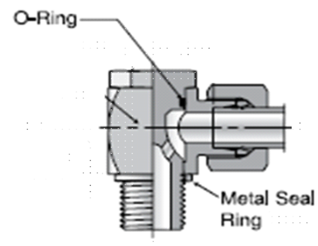


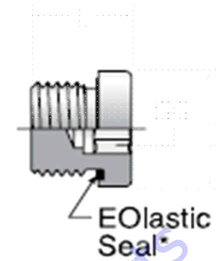


TYPE/FITTING IDENTIFICATION			FORM E (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	26	28	29	35	38	39
	M12x1.5	8	33	35	36	45	47	49	41	43	45	55	58	61
	M14x1.5	10	52	55	57	70	75	77	52	55	57	70	75	77
	M16x1.5	12	66	70	73	90	95	99	66	70	73	90	95	99
	M18x1.5	15	92	97	101	125	132	137	92	97	101	125	132	137
	M22x1.5	18	100	105	110	135	142	149	100	105	110	135	142	149
	M27x2	22	133	140	146	180	190	198	133	140	146	180	190	198
	M33x2	28	229	241	252	310	327	342	229	241	252	310	327	342
	M42x2	35	332	349	365	450	473	495	332	349	365	450	473	495
	M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	17	18	19	23	24	26
	M12x1.5	8	21	23	23	29	31	32	27	28	29	37	38	39
	M14x1.5	10	34	36	37	46	49	50	34	36	37	46	49	50
	M16x1.5	12	43	45	47	58	61	64	43	45	47	58	61	64
	M18x1.5	15	60	63	66	81	85	89	60	63	66	81	85	89
	M22x1.5	18	65	69	72	88	94	98	65	69	72	88	94	98
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
	M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386

Table 5-23. Metric Flat Face Port (MFF) - L Series - Table 3 of 3







TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with S series DIN (MBTS) opposite end						HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	33	35	36	45	47	49	--	--	--	--	--	--
	M12x1.5	8	37	39	41	50	53	56	41	43	45	55	58	61	--	--	--	--	--	--
	M14x1.5	10	44	46	48	60	62	65	59	62	65	80	84	88	--	--	--	--	--	--
	M16x1.5	12	59	62	65	80	84	88	74	78	81	100	106	110	--	--	--	--	--	--
	M18x1.5	15	81	85	89	110	115	121	92	97	101	125	132	137	59	62	65	80	84	88
	M22x1.5	18	89	94	98	120	127	133	100	105	110	135	142	149	--	--	--	--	--	--
	M27x2	22	100	105	110	135	142	149	236	248	260	320	336	353	--	--	--	--	--	--
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	--	--	--	--	--	--
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	--	--	--	--	--	--
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	--	--	--	--	--	--
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	21	22	23	28	30	31	--	--	--	--	--	--
	M12x1.5	8	24	26	27	33	35	37	27	28	29	37	38	39	--	--	--	--	--	--
	M14x1.5	10	29	30	31	39	41	42	38	40	42	52	54	57	--	--	--	--	--	--
	M16x1.5	12	38	40	42	52	54	57	48	51	53	65	69	72	--	--	--	--	--	--
	M18x1.5	15	53	56	58	72	76	79	60	63	66	81	85	89	38	40	42	52	54	57
	M22x1.5	18	58	61	64	79	83	87	65	69	72	88	94	98	--	--	--	--	--	--
	M27x2	22	65	69	72	88	94	98	153	161	169	207	218	229	--	--	--	--	--	--
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	--	--	--	--	--	--
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	--	--	--	--	--	--
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	--	--	--	--	--	--

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Assembly Instructions for Metric ISO 6149 (MPP) Port Assembly Stud Ends

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.
2. If O-ring is not preinstalled, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

CAUTION

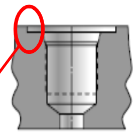
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-24 while using the Double Wrench Method.
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
   b. Torque values provided in Table 5-24 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

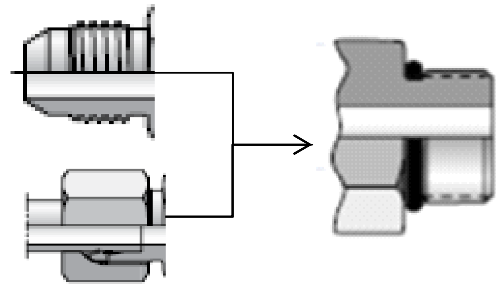
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

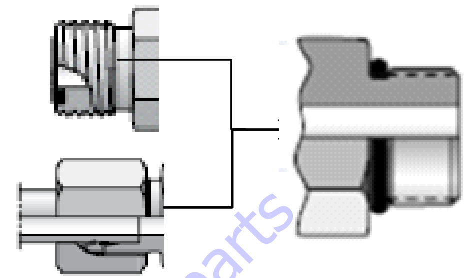
7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counter bore of the port.

Table 5-24. Metric Pipe Parallel O-Ring Boss (MPP)



Note: Metric O-ring only style (ISO 6149) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB),**but is not interchangeable.**





TYPE/FITTING IDENTIFICATION			STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M8 x 1	4	6	7	7	8	9	9	8	9	9	10	12	12
	M10 x 1	6	11	12	12	15	16	16	15	16	17	20	22	23
	M12 x 1.5	8	18	19	20	25	26	27	26	28	29	35	38	39
	M14 x 1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16 x 1.5	12	30	32	33	40	43	45	41	43	45	55	58	61
	M18 x 1.5	15	33	35	36	45	47	49	52	55	57	70	75	77
	M20 x 1.5	--	--	--	--	--	--	--	59	62	65	80	84	88
	M22 x 1.5	18	44	46	48	60	62	65	74	78	81	100	106	110
	M27 x 2	22	74	78	81	100	106	110	125	132	138	170	179	187
	M30 x 2	--	95	100	105	130	136	142	175	184	193	237	249	262
	M33 x 2	25	120	126	132	160	171	179	230	242	253	310	328	343
	M38 x 2	--	135	142	149	183	193	202	235	247	259	319	335	351
	M42 x 2	30	155	163	171	210	221	232	245	258	270	330	350	366
	M48 x 2	38	190	200	209	260	271	283	310	326	341	420	442	462
	M60 x 2	50	230	242	253	315	328	343	370	389	407	500	527	552
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M8 x 1	4	4	5	5	5	7	7	5	6	6	7	8	8
	M10 x 1	6	7	8	8	9	11	11	10	11	11	14	15	15
	M12 x 1.5	8	12	13	13	16	18	18	17	18	19	23	24	26
	M14 x 1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16 x 1.5	12	20	21	21	27	28	28	27	28	29	37	38	39
	M18 x 1.5	15	21	22	23	28	30	31	34	36	37	46	49	50
	M20 x 1.5	--	--	--	--	--	--	--	30	40	42	41	54	57
	M22 x 1.5	18	29	30	31	39	41	42	48	51	53	65	69	72
	M27 x 2	22	48	51	53	65	69	72	81	86	90	110	117	122
	M30 x 2	--	62	65	68	84	88	92	114	120	125	155	163	169
	M33 x 2	25	78	82	86	106	111	117	150	157	164	203	213	222
	M38 x 2	--	88	93	97	119	126	132	153	161	168	207	218	228
	M42 x 2	30	101	106	111	137	144	150	159	168	176	216	228	239
	M48 x 2	38	124	130	136	168	176	184	202	212	222	274	287	301
	M60 x 2	50	150	157	164	203	213	222	241	253	265	327	343	359

Assembly instructions for Adjustable Port End (BSPP) Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.
2. If O-ring is not preinstalled, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

CAUTION

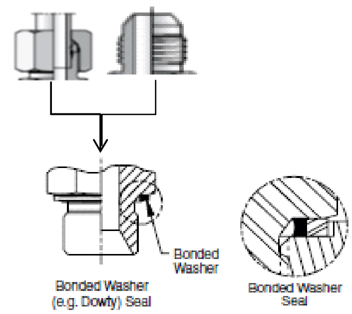
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

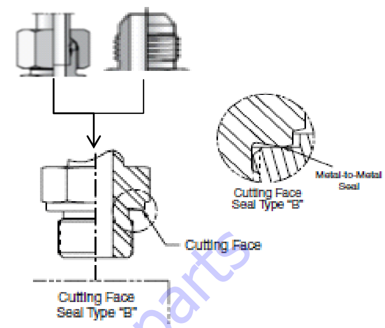
3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, or Table 5-30 while using the Double Wrench Method.
   a. The table headings identify the BSPP port and the type on the other side of the fitting. The torque will be applied to the BSPP port.
   b. Torque values provided in Table 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, and Table 5-30 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counter bore of the port.

Table 5-25. British Standard Parallel Pipe Port (BSPP) - L Series - Table 1 of 3





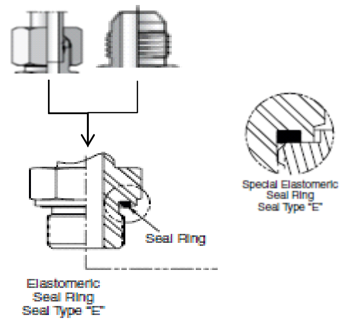
TYPE/FITTING IDENTIFICATION			FORM A**(SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B** (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	7	8	8	9	11	11	13	14	14	18	19	19
	G1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G3/8A	12	33	35	36	45	47	49	52	55	57	70	75	77
	G1/2A	15	48	51	53	65	69	72	103	108	113	140	146	153
	G1/2A	18	48	51	53	65	69	72	74	78	81	100	106	110
	G3/4A	22	66	70	73	90	95	99	133	140	146	180	190	198
	G1A	28	111	117	122	150	159	165	243	255	267	330	346	362
	G1-1/4A	35	177	186	195	240	252	264	398	418	438	540	567	594
	G1-1/2A	42	214	225	235	290	305	319	465	489	512	630	663	694
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	4	5	5	5	7	7	8	9	9	11	12	12
	G1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G3/8A	12	21	22	23	28	30	31	34	36	37	46	49	50
	G1/2A	15	31	33	34	42	45	46	67	70	73	91	95	99
	G1/2A	18	31	33	34	42	45	46	48	51	53	65	69	72
	G3/4A	22	42	45	47	57	61	64	86	91	95	117	123	129
	G1A	28	72	76	79	98	103	107	158	166	174	214	225	236
	G1-1/4A	35	115	121	127	156	164	172	259	272	285	351	369	386
	G1-1/2A	42	139	146	153	188	198	207	302	318	333	409	431	451

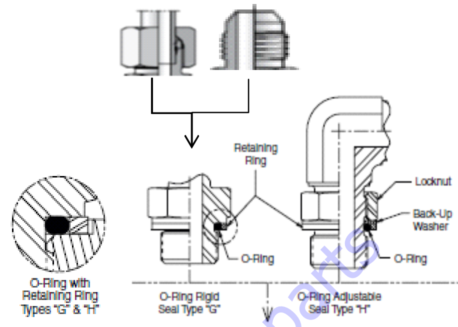
* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-26. British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3





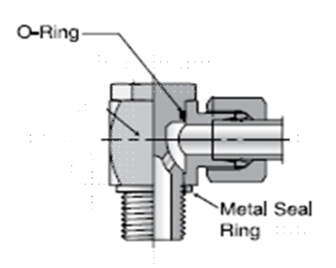
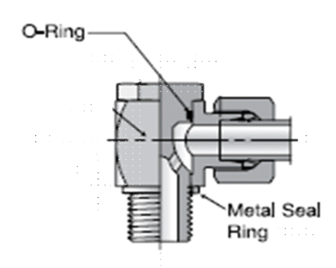
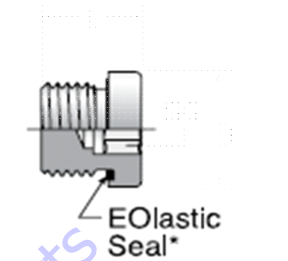
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	52	55	57	70	75	77	52	55	57	70	75	77
	G 1/2A	15	66	70	73	90	95	99	66	70	73	90	95	99
	G 1/2A	18	66	70	73	90	95	99	66	70	73	90	95	99
	G 3/4A	22	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	28	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	35	332	349	365	450	473	495	332	349	365	450	473	495
	G 1-1/2A	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	34	36	37	46	49	50	34	36	37	46	49	50
	G 1/2A	15	43	45	47	58	61	64	43	45	47	58	61	64
	G 1/2A	18	43	45	47	58	61	64	43	45	47	58	61	64
	G 3/4A	22	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	28	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	35	216	227	237	293	308	321	216	227	237	293	308	321
	G 1-1/2A	42	259	272	285	351	369	386	259	272	285	351	369	386

* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-27. British Standard Parallel Pipe Port (BSPP) - L Series - Table 3 of 3

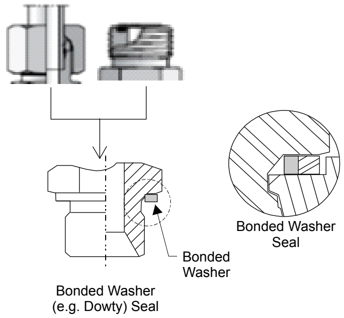
																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19	10	11	11	13	15	15
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G 1/4A	10	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77	44	46	48	60	62	65
	G 1/2A	15	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G 1/2A	18	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G 3/4A	22	92	97	101	125	132	137	170	179	187	230	243	254	103	108	113	140	146	153
	G 1A	28	--	--	--	--	--	--	236	248	260	320	336	353	148	156	163	200	212	221
	G 1-1/4A	35	--	--	--	--	--	--	398	418	438	540	567	594	295	313.5	332	400	425	450
	G 1-1/2A	42	--	--	--	--	--	--	516	542	568	700	735	770	332	349	365	450	473	495
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	G 1/4A	8	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G 1/4A	10	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50	29	30	31	39	41	42
	G 1/2A	15	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G 1/2A	18	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G 3/4A	22	60	63	66	81	85	89	111	117	122	150	159	165	67	70	73	91	95	99
	G 1A	28	--	--	--	--	--	--	153	161	169	207	218	229	96	101	106	130	137	144
	G 1-1/4A	35	--	--	--	--	--	--	259	272	285	351	369	386	216	227	237	293	308	321
	G 1-1/2A	42	--	--	--	--	--	--	335	352	369	454	477	500	216	227	237	293	308	321

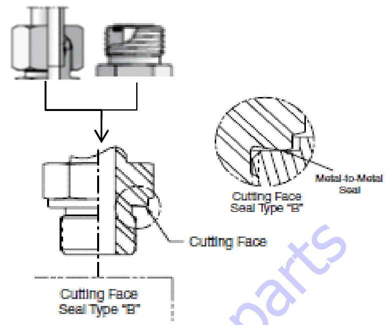
* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-28. British Standard Parallel Pipe Port (BSPP) - S Series - Table 1 of 3





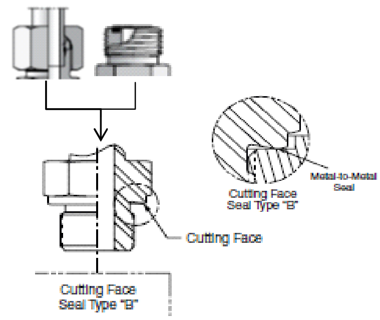
TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B** (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/4A	6	26	28	29	35	38	39	41	43	45	55	58	61
	G1/4A	8	26	28	29	35	38	39	41	43	45	55	58	61
	G3/8A	10	33	35	36	45	47	49	66	70	73	90	95	99
	G3/8A	12	33	35	36	45	47	49	66	70	73	90	95	99
	G1/2A	14	48	51	53	65	69	72	111	117	122	150	159	165
	G1/2A	16	48	51	53	65	69	72	96	101	106	130	137	144
	G3/4A	20	66	70	73	90	95	99	199	209	219	270	283	297
	G1A	25	111	117	122	150	159	165	251	264	276	340	358	374
	G1-1/4A	30	177	186	195	240	252	264	398	418	438	540	567	594
	G1-1/2A	38	214	225	235	290	305	319	516	542	568	700	735	770
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/4A	6	17	18	19	23	24	26	27	28	29	37	38	39
	G1/4A	8	17	18	19	23	24	26	27	28	29	37	38	39
	G3/8A	10	21	22	23	28	30	31	43	45	47	58	61	64
	G3/8A	12	21	22	23	28	30	31	43	45	47	58	61	64
	G1/2A	14	31	33	34	42	45	46	72	76	79	98	103	107
	G1/2A	16	31	33	34	42	45	46	62	66	69	84	89	94
	G3/4A	20	43	45	47	58	61	64	129	136	142	175	184	193
	G1A	25	72	76	79	98	103	107	163	171	179	221	232	243
	G1-1/4A	30	115	121	127	156	164	172	259	272	285	351	369	386
	G1-1/2A	38	139	146	153	188	198	207	335	352	369	454	477	500

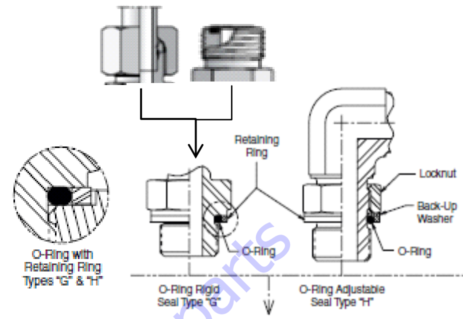
* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

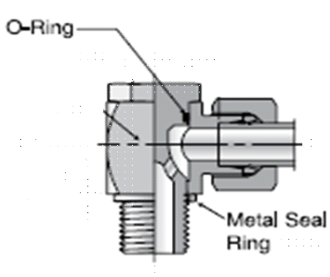
Table 5-29. British Standard Parallel Pipe Port (BSPP) - S Series - Table 2 of 3

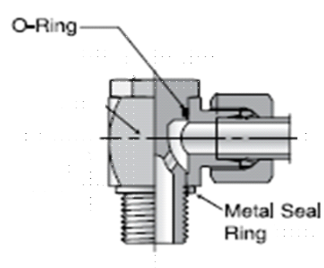


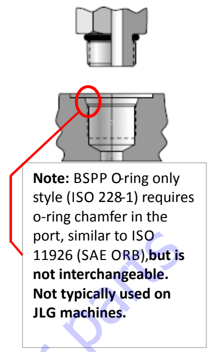


TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	41	43	45	55	58	61	26	28	29	35	38	39
	G 1/4A	8	41	43	45	55	58	61	26	28	29	35	38	39
	G 3/8A	10	59	62	65	80	84	88	52	55	57	70	75	77
	G 3/8A	12	59	62	65	80	84	88	52	55	57	70	75	77
	G 1/2A	14	85	90	94	115	122	127	66	70	73	90	95	99
	G 1/2A	16	85	90	94	115	122	127	66	70	73	90	95	99
	G 3/4A	20	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	25	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	30	332	349	365	450	473	495	332	349	365	450	473	495
	G 1-1/2A	38	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	27	28	29	37	38	39	17	18	19	23	24	26
	G 1/4A	8	27	28	29	37	38	39	17	18	19	23	24	26
	G 3/8A	10	38	40	42	52	54	57	34	36	37	46	49	50
	G 3/8A	12	38	40	42	52	54	57	34	36	37	46	49	50
	G 1/2A	14	55	58	61	75	79	83	43	45	47	58	61	64
	G 1/2A	16	55	58	61	75	79	83	43	45	47	58	61	64
	G 3/4A	20	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	25	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	30	216	227	237	293	308	321	216	227	237	293	308	321
	G 1-1/2A	38	259	272	285	351	369	386	259	272	285	351	369	386
* Typical for JLG Straight Male Stud Fittings														
** Non typical for JLG Straight Male Stud Fittings, reference only.														
*** Typical for JLG Adjustable Fittings														

Table 5-30. British Standard Parallel Pipe Port (BSPP) - S Series - Table 3 of 3







TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with S series DIN (MBTS) opposite end						HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end						JIS/BSPP O-RING ONLY					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	30	32	33	40	43	45	33	35	36	45	47	49	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49						
	G 3/8A	10	48	51	53	65	69	72	52	55	57	70	75	77						
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77						
	G 1/2A	14	66	70	73	90	95	99	89	94	98	120	127	133						
	G 1/2A	16	66	70	73	90	95	99	89	94	98	120	127	133						
	G 3/4A	20	92	97	101	125	132	137	170	179	187	230	243	254						
	G 1A	25	--	--	--	--	--	--	236	248	260	320	336	353						
	G 1-1/4A	30	--	--	--	--	--	--	398	418	438	540	567	594						
	G 1-1/2A	38	--	--	--	--	--	--	516	542	568	700	735	770						
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	20	21	21	27	28	28	22	22	23	30	30	31	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	20	21	21	27	28	28	22	22	23	30	30	31						
	G 3/8A	10	31	33	34	42	45	46	34	36	37	46	49	50						
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50						
	G 1/2A	14	43	45	47	58	61	64	58	61	64	79	83	87						
	G 1/2A	16	43	45	47	58	61	64	58	61	64	79	83	87						
	G 3/4A	20	60	63	66	81	85	89	111	117	122	150	159	165						
	G 1A	25	--	--	--	--	--	--	153	161	169	207	218	229						
	G 1-1/4A	30	--	--	--	--	--	--	259	272	285	351	369	386						
	G 1-1/2A	38	--	--	--	--	--	--	335	352	368	454	477	499						

* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

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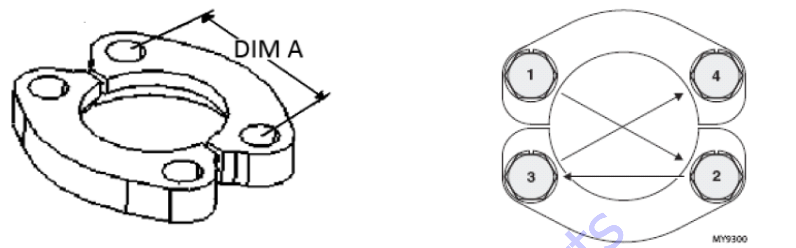
Assembly Instructions for Flange Connections: (FL61 and FL62)

1. Make sure sealing surfaces are free of rust, splits, scratches, dirt, foreign matter, or burrs.
2. See Figure for O-ring installation instructions.
3. Pre-lubricate the O-ring with Hydraulic Oil.
4. Position flange and clamp halves.
5. Place lock washers on bolt and bolt through clamp halves.
6. Tighten all bolts by hand.
7. Torque bolts in diagonal sequence in two or more increments to the torque listed on Table Table 5-31and Table 5-32.

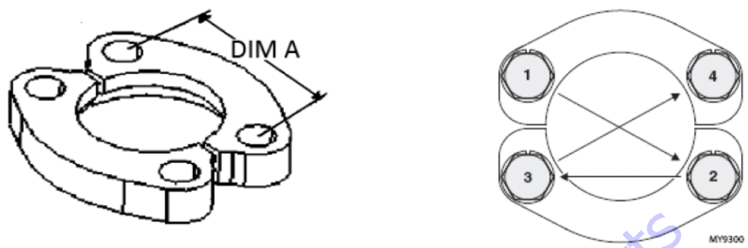
Table 5-31. Flange Code (FL61 & FL62) - Inch Fasteners



TYPE/FITTING IDENTIFICATION							STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)												
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10	5/16-18	18	19	19	24	25	26	24	25	26	32	34	35
	12	0.75	19	1.88	47.75	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66
	16	1.00	25	2.06	52.32	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66
	20	1.25	32	2.31	58.67	7/16-14	52	54	57	70	74	77	68	71	75	92	97	101
	24	1.50	38	2.75	69.85	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	32	2.00	51	3.06	77.72	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	40	2.50	64	3.50	88.90	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165
	48	3.00	76	4.19	106.43	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	56	3.50	89	4.75	120.65	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	64	4.00	102	5.13	130.30	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
	80	5.00	127	6.00	152.40	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	5/16-18	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	3/8-16	--	--	--	--	--	--	44	46	49	60	63	66
	16	1.00	25	2.25	57.15	7/16-14	--	--	--	--	--	--	68	71	75	92	97	101
	20	1.25	32	2.62	66.55	1/2-13	--	--	--	--	--	--	111	116	122	150	158	165
	20	1.25	32	2.62	66.55	--	--	--	--	--	--	--	--	--	--	--	--	--
	24	1.50	38	3.12	79.25	5/8-11	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	3/4-10	--	--	--	--	--	--	332	348	365	450	473	495

* A dimension for reference only.

Table 5-32. Flange Code (FL61 & FL62) - Metric Fasteners



TYPE/FITTING IDENTIFICATION							STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)											
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
	12	0.75	19	1.88	47.75	M8 x 1.25	18	19	19	24	25	26	18	19	19	24	25	26
	16	1.00	25	2.06	52.32	M10 x 1.5	37	39	41	50	53	55	37	39	41	50	53	55
	20	1.25	32	2.31	58.67	M10 x 1.5	37	39	41	50	53	55	37	39	41	50	53	55
	24	1.50	38	2.75	69.85	M10 x 1.5	37	39	41	50	53	55	37	39	41	50	53	55
	32	2.00	51	3.06	77.72	M12 x 1.75	68	71	75	92	97	101	68	71	75	92	97	101
	40	2.50	64	3.50	88.90	M12 x 1.75	68	71	75	92	97	101	68	71	75	92	97	101
	48	3.00	76	4.19	106.43	M12 x 1.75	68	71	75	92	97	101	68	71	75	92	97	101
	56	3.50	89	4.75	120.65	M16 x 2	155	163	170	210	221	231	155	163	170	210	221	231
	64	4.00	102	5.13	130.30	M16 x 2	155	163	170	210	221	231	155	163	170	210	221	231
	80	5.00	127	6.00	152.40	M16 x 2	155	163	170	210	221	231	155	163	170	210	221	231
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	M8 x 1.25	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	M10 x 1.5	--	--	--	--	--	--	52	54	57	70	74	77
	16	1.00	25	2.25	57.15	M12 x 1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M12 x 1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M14 x 2	--	--	--	--	--	--	133	139	146	180	189	198
	24	1.50	38	3.12	79.25	M16 x 2	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	M20 x 2.5	--	--	--	--	--	--	406	426	446	550	578	605

* A dimension for reference only.

Double Wrench Method

To prevent undesired hose or connector rotation, two wrenches must be used; one torque wrench and one backup wrench. If two wrenches are not used, inadvertent component rotation may occur which absorbs torque and causes improper joint load and leads to leaks. For hose connections, the 'layline' printed on the hose is a good indicator of proper hose installation. A twisted lay-line usually indicates the hose is twisted. See Figure 5-12. for double wrench method requirements.

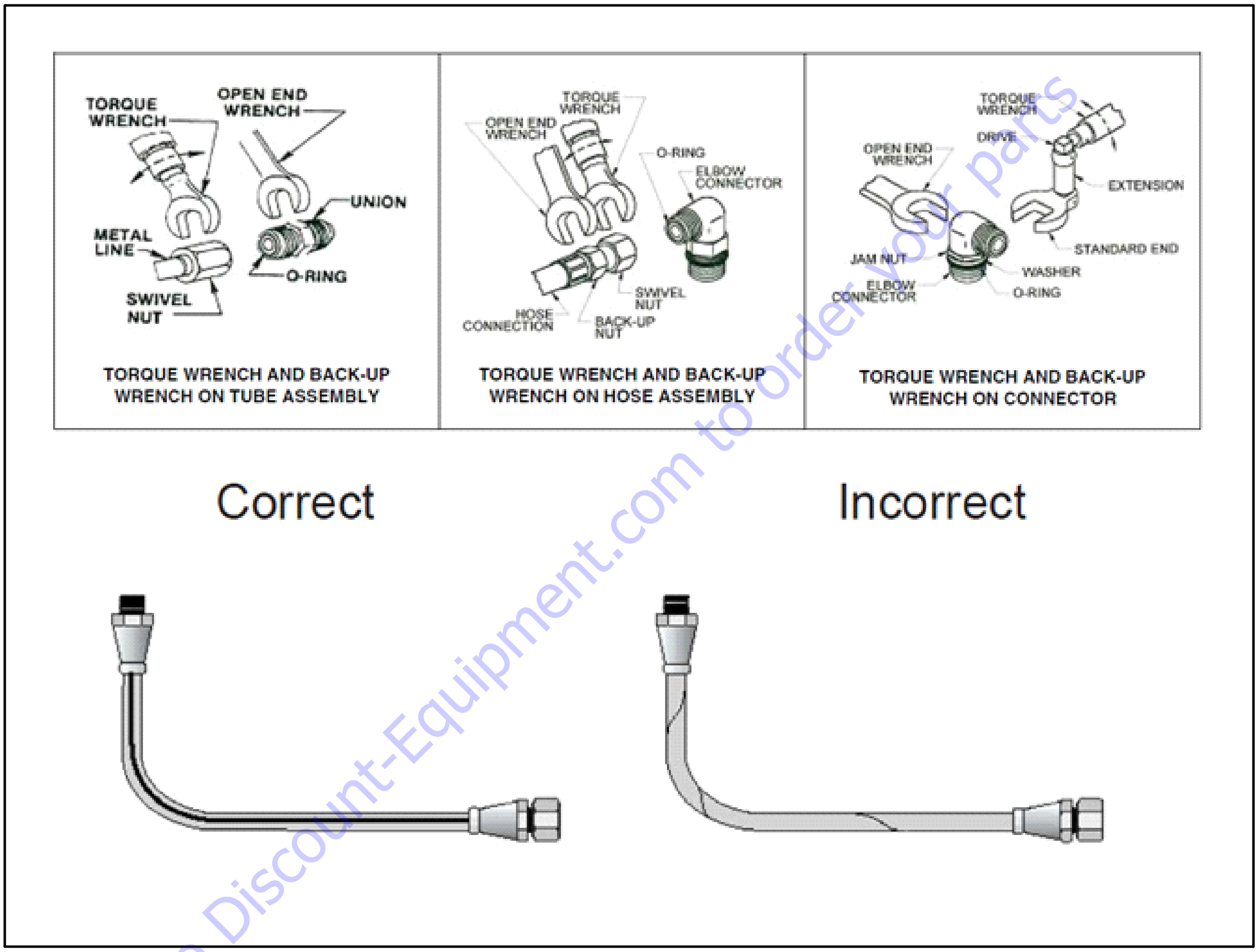


Figure 5-12. Double Wrench Method

FFWR and TFFT Methods

FFWR (FLATS FROM WRENCH RESISTANCE METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter. See Figure B.1.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten as shown in Figure B.1. The nut is to be rotated clockwise the number of hex flats as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened. See Figure 5-13.

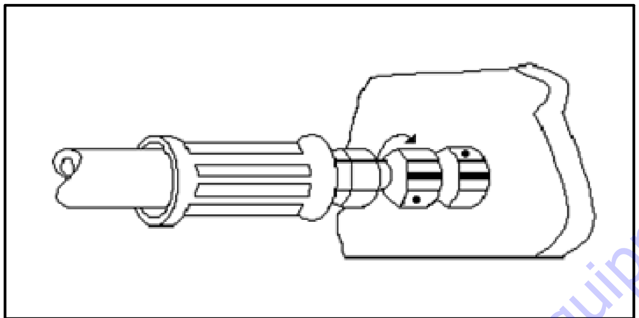


Figure 5-13. FFWR Method

TFFT (TURNS FROM FINGER TIGHT METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten. The nut is to be rotated clockwise the number of turns as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened.

Adjustable Stud End Assembly

For Adjustable Stud End Connections; the following assembly steps are to be performed:

1. Lubricate the o-ring with a light coat of hydraulic oil.
2. Position #1 – The o-ring should be located in the groove adjacent to the face of the backup washer. The washer and o-ring should be positioned at the extreme top end of the groove as shown.
3. Position #2 – Position the locknut to just touch the backup washer as shown. The locknut in this position will eliminate potential backup washer damage during the next step.
4. Position #3 – Install the connector into the straight thread box port until the metal backup washer contacts the face of the port as shown.
5. Position #4 – Adjust the connector to the proper position by turning out (counterclockwise) up to a maximum of one turn as shown to provide proper alignment with the mating connector, tube assembly, or hose assembly.
6. Position #5 – Using two wrenches, use the backup wrench to hold the connector in the desired position and then use the torque wrench to tighten the locknut to the appropriate torque.
7. Visually inspect, where possible, the joint to ensure the o-ring is not pinched or bulging out from under the washer and that the backup washer is properly seated flat against the face of the port.

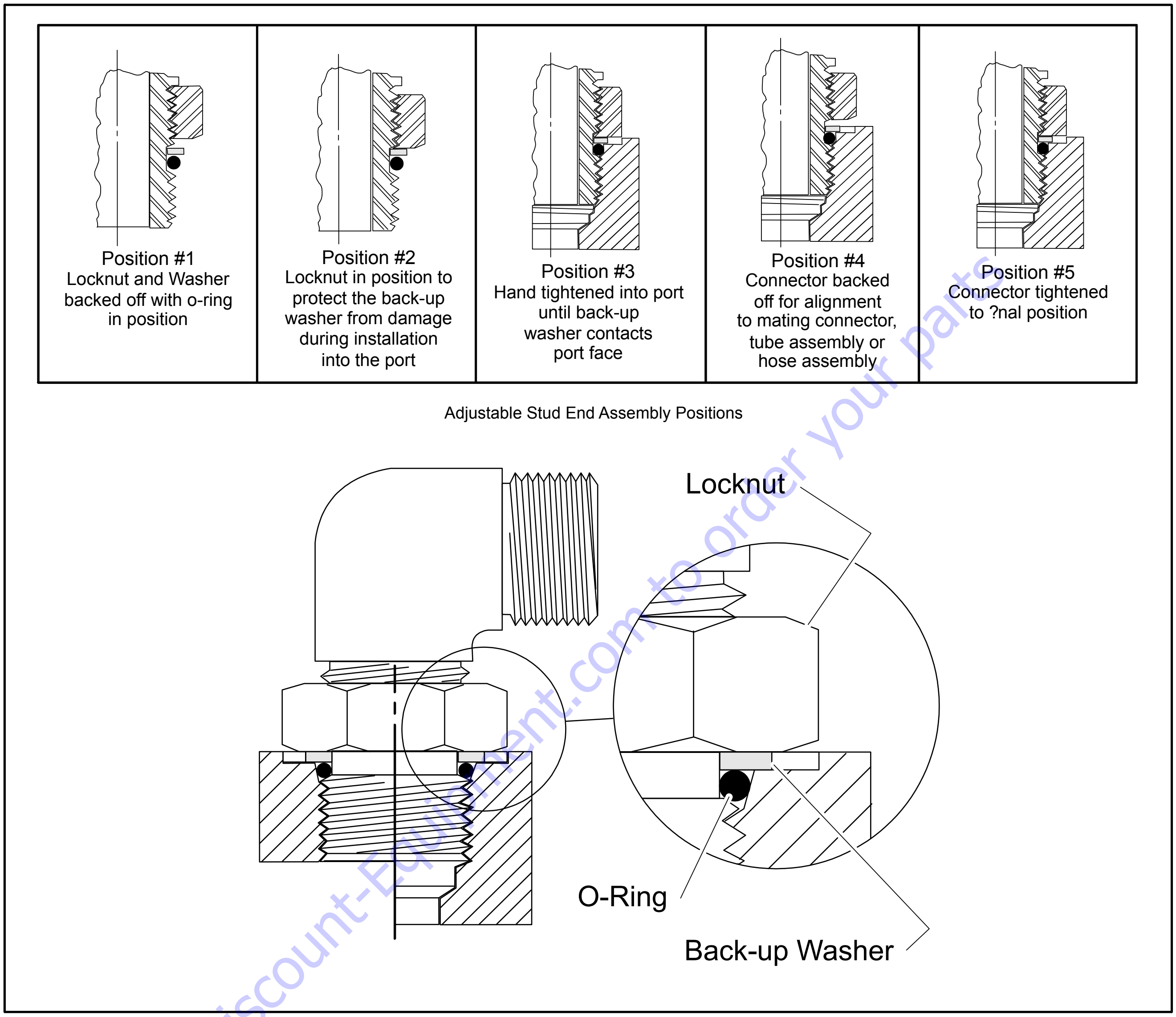


Figure 5-14. Adjustable Stud End Assembly

O-ring Installation (Replacement)

Care must be taken when installing O-rings over threads during replacement or installation. O-rings could become nicked or torn. A damaged O-ring could lead to leakage problems.

1. Inspect O-ring for tears or nicks. If any are found replace O-ring.
2. Ensure proper O-ring to be installed. Many O-rings look the same but are of different material, different hardness, or are slightly different diameters or widths.
3. Use a thread protector when replacing O-rings on fittings.
4. In ORB; ensure O-ring is properly seated in groove. On straight threads, ensure O-ring is seated all the way past the threads prior to installation.
5. Inspect O-ring for any visible nicks or tears. Replace if found.

5.3 HYDRAULIC CYLINDERS

Axle Lockout Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

⚠ WARNING

ROD CAN FALL OUT OF BARREL AND CAUSE INJURY OR DAMAGE TO THE EQUIPMENT. BE CAREFUL WHEN REMOVING AXLE CYLINDER. OPENING BLEED VALVE CAN CAUSE ROD TO FALL OUT OF BARREL.

1. Open bleeder valve. Rotate rod and remove from barrel.
2. Remove wiper. Do not scratch barrel bore.
3. Remove two wear rings and rod seal from grooves of rod bore. Do not scratch barrel bore.
4. Remove counterbalance valve.

CLEANING AND INSPECTION

1. Inspect bore and rod for scoring, pitting, or excessive wear.
2. Remove minor surface blemishes with wet sandpaper. Pitting requires replacement of barrel and rod.
3. Clean all parts with approved solvent and dry with compressed air.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

NOTICE

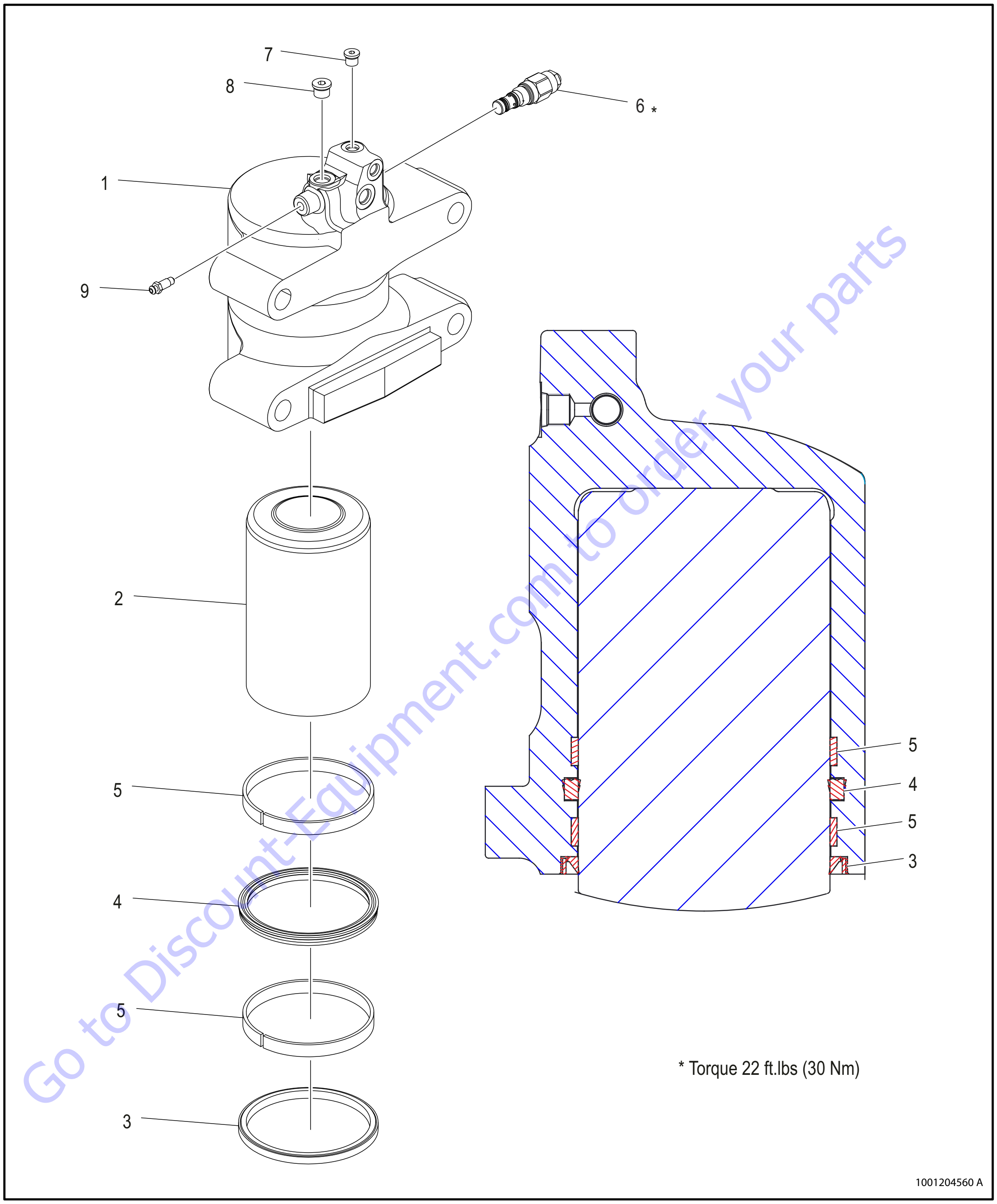
WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

1. Install two new wear rings and rod seal in rod bore grooves. Make sure they are not twisted.
2. Install new wiper in barrel.
3. Lubricate rod bore with clean hydraulic fluid.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE ROD. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE ROD AND CYLINDER BARREL SURFACES.

4. Install rod in bore and push to top of the bore.
5. Install counterbalance valve. Torque to 22 ft.lbs. (30 Nm).
6. Bleed system.



1. Barrel
2. Rod
3. Wiper
4. Rod Seal
5. Wear Ring
6. Counterbalance Valve
7. O-ring Plug
8. O-ring Plug
9. Bleeder Valve

Figure 5-15. Axle Lockout Cylinder

Slave Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

⚠ WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove cartridge valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

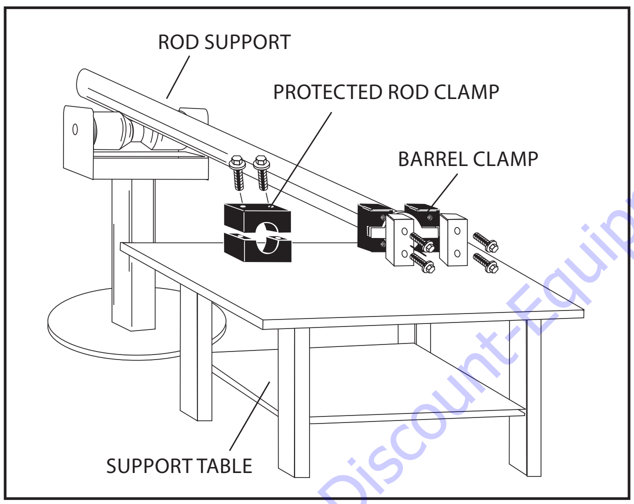


Figure 5-16. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

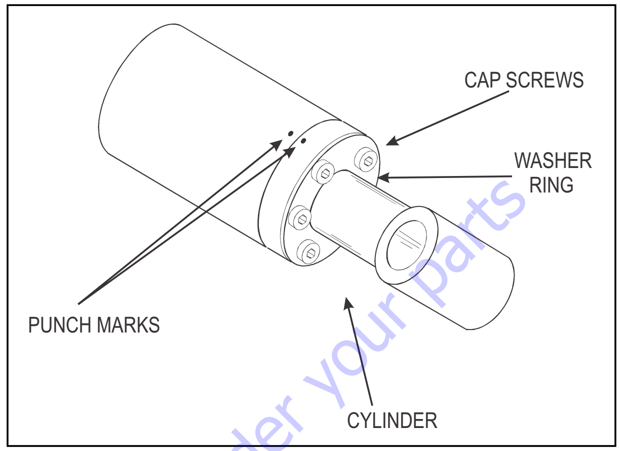


Figure 5-17. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

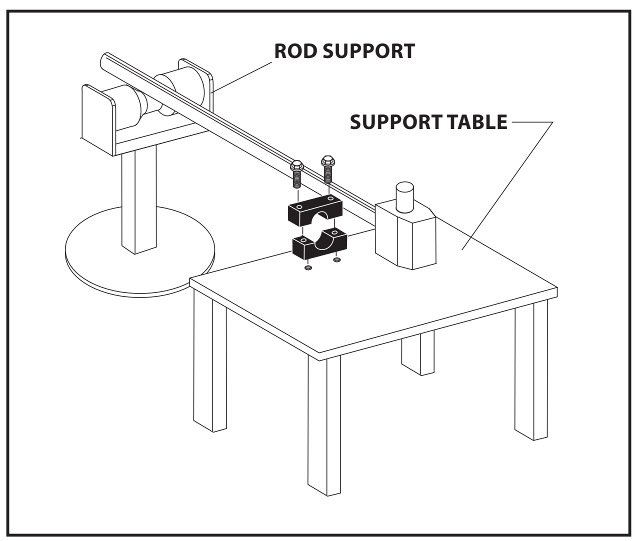
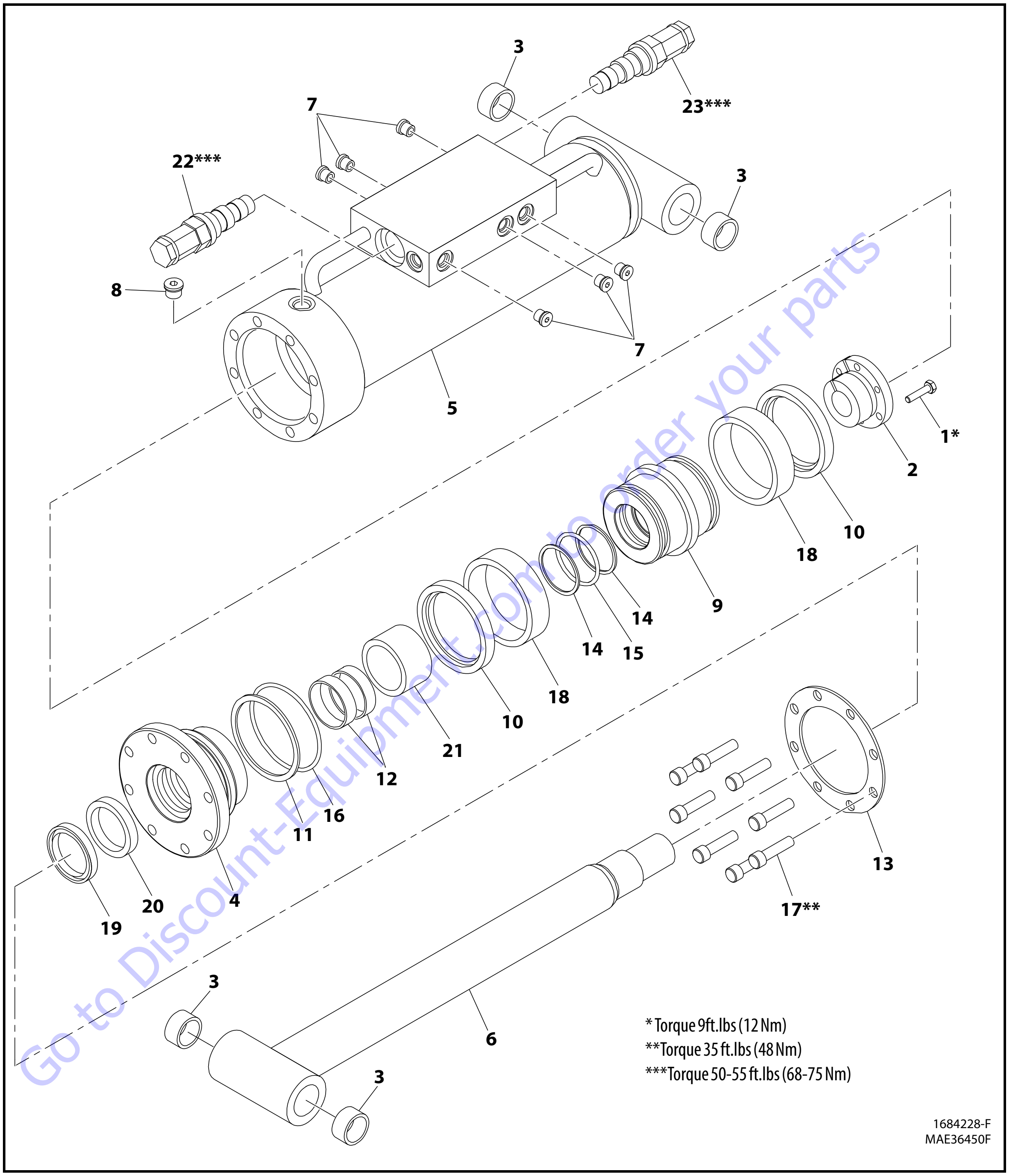
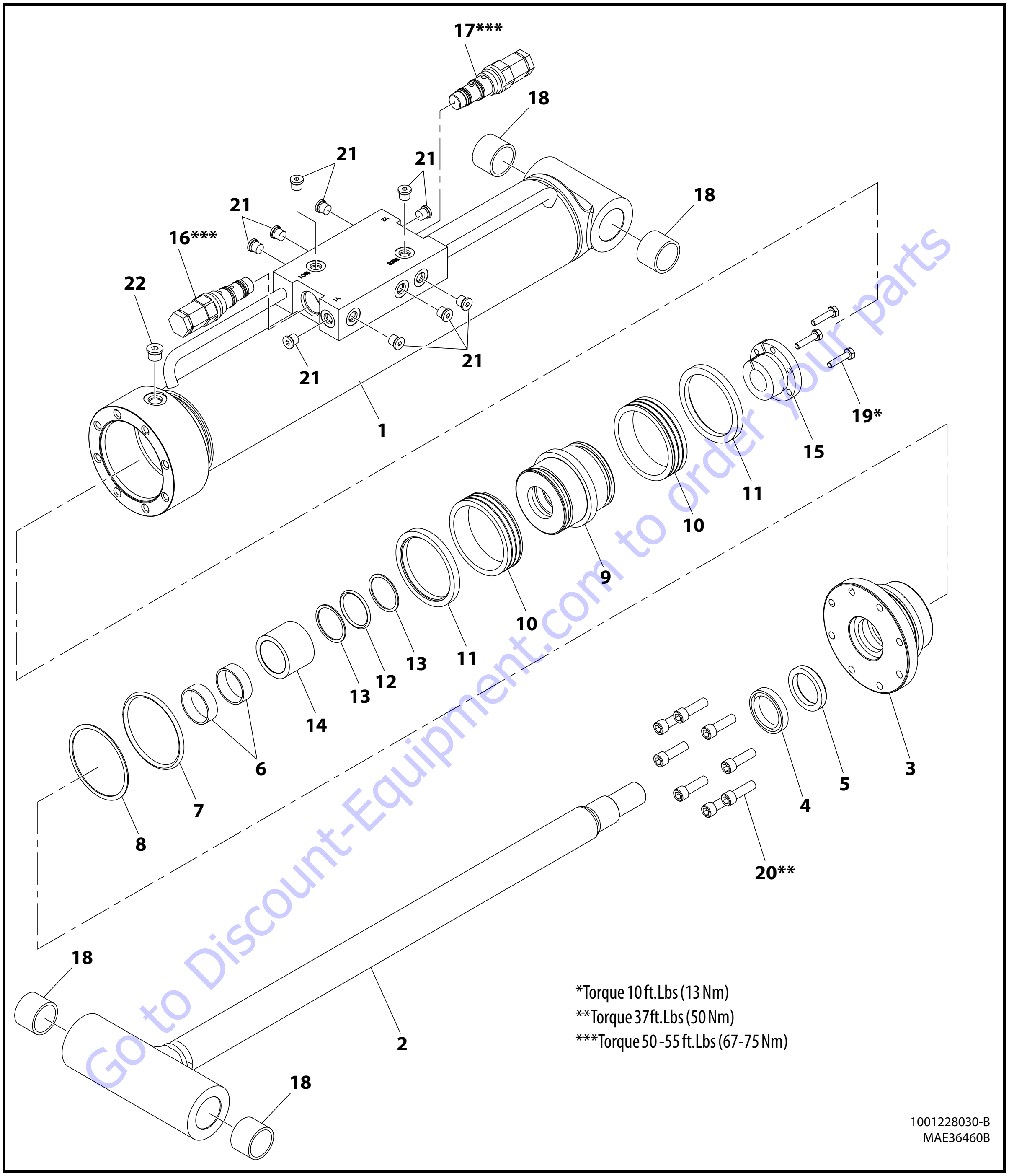


Figure 5-18. Cylinder Rod Support



1. Capscrew
2. Tapered Bushing
3. Bushing
4. Head
5. Barrel
6. Rod
7. Plug
8. Plug
9. Piston
10. Lock Ring
11. Backup Ring
12. Wear Ring
13. Washer Ring
14. Backup Ring
15. O-ring
16. O-ring
17. Capscrew
18. Seal
19. Wiper
20. Seal
21. Tube Spacer
22. Cartridge Valve
23. Cartridge Valve

Figure 5-19. Slave Cylinder (Prior to SN 0300247156)



1. Barrel	6. Wear Ring	11. Lock Ring	16. Cartridge valve	21. O-Ring Plug
2. Rod	7. O-Ring	12. O-Ring	17. Cartridge valve	22. O-Ring Plug
3. Head	8. Backup Ring	13. Backup Ring	18. Bushing	
4. Wiper	9. Piston	14. Spacer	19. Bolt	
5. Seal	10. Seal	15. Tapered Bushing	20. Capscrewl	

Figure 5-20. Slave Cylinder (SN 0300247156 to Present)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

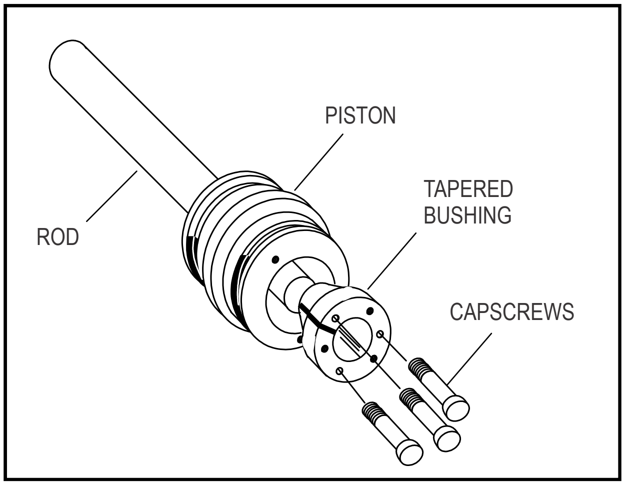


Figure 5-21. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove piston spacer, if applicable, from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

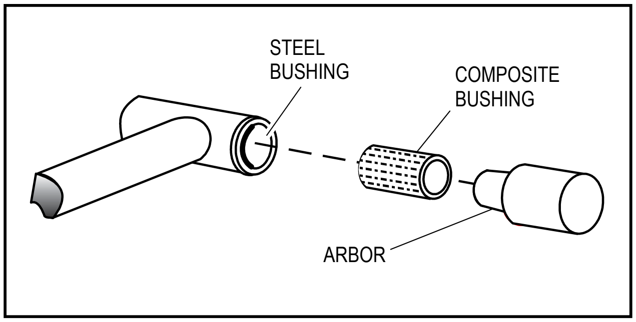


Figure 5-22. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.

13. If applicable, inspect port block fittings and holding valve. Replace as necessary.

14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

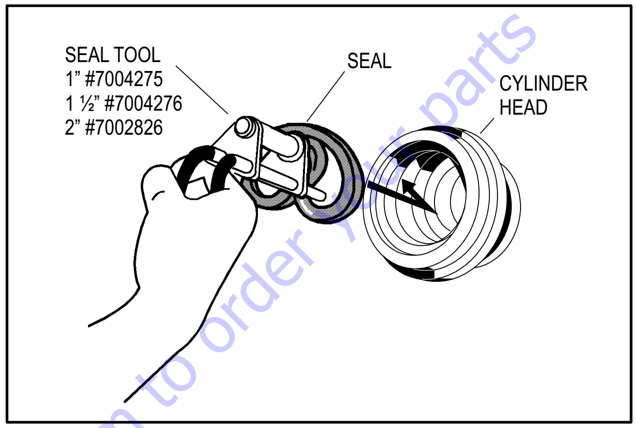


Figure 5-23. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

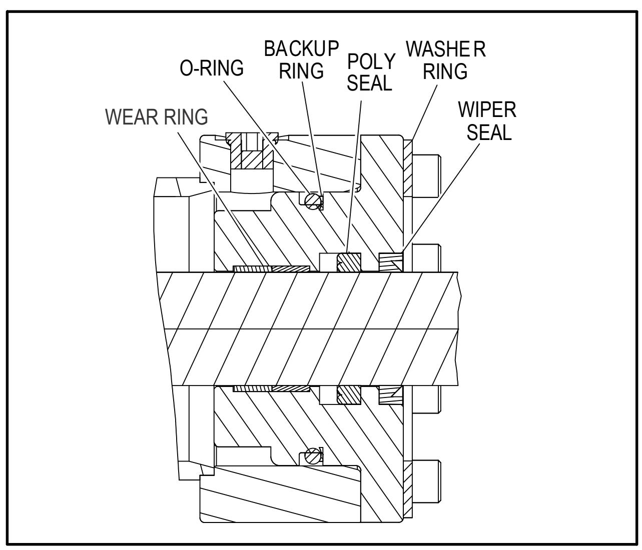
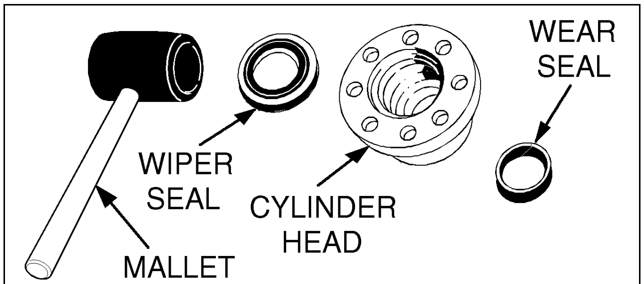


Figure 5-24. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-25. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

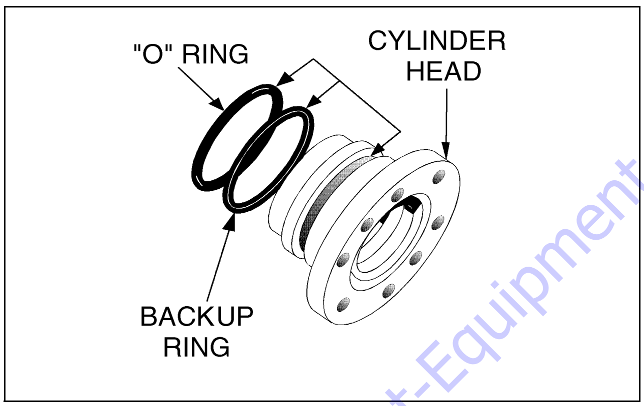


Figure 5-26. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Place a new o-ring and backup rings in the inner piston diameter groove.

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

8. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

9. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

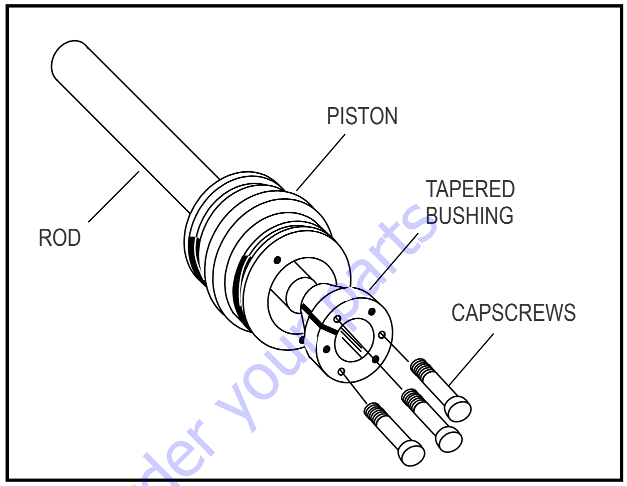


Figure 5-27. Tapered Bushing Removal

10. Tighten the capscrews evenly and progressively in rotation.

11. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

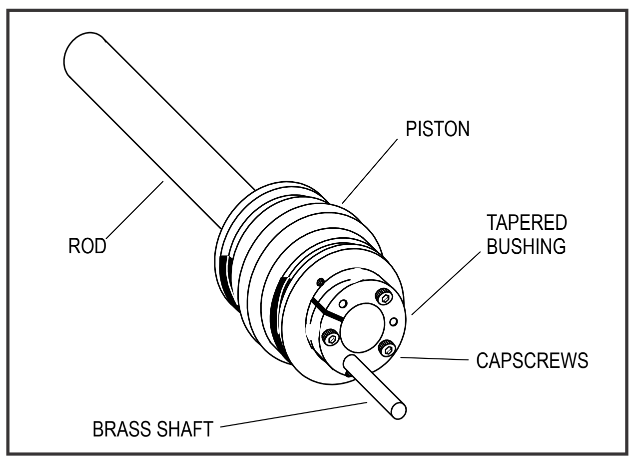


Figure 5-28. Seating the Tapered Bearing

12. Rotate the capscrews evenly and progressively in rotation.
13. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

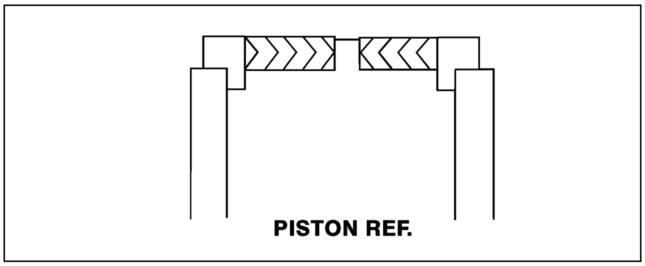


Figure 5-29. Hydrolock Piston Seal Installation

14. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

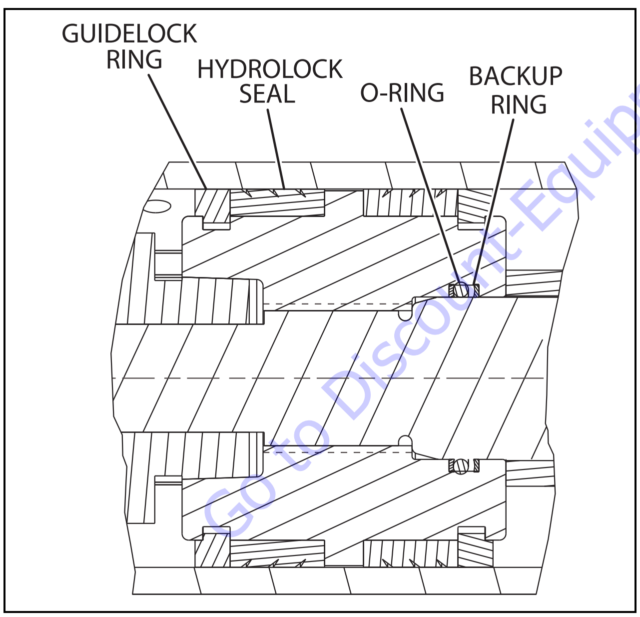


Figure 5-30. Piston Seal Kit Installation

15. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

16. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
17. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

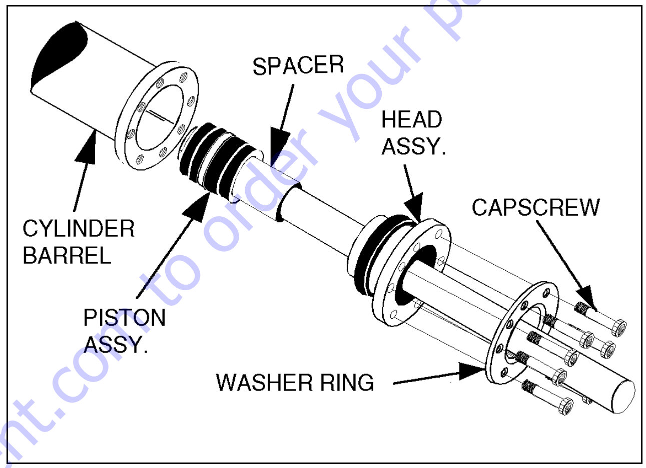


Figure 5-31. Rod Assembly Installation

18. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts.
19. 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.
20. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valve to 50-55 ft.lbs. (68-75 Nm).

Upright Level Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the cartridge valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

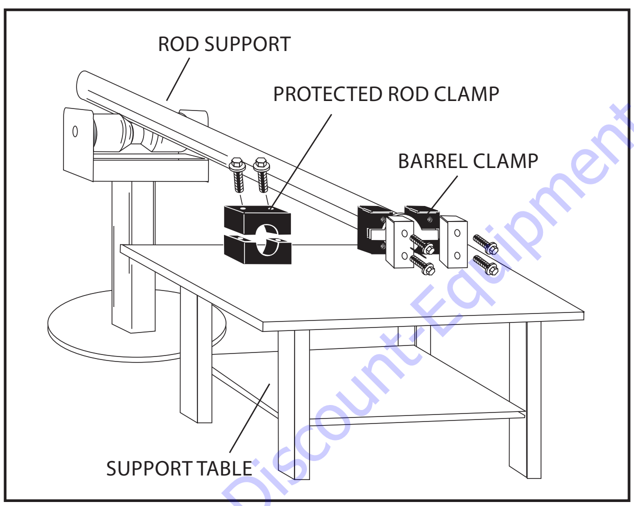


Figure 5-32. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

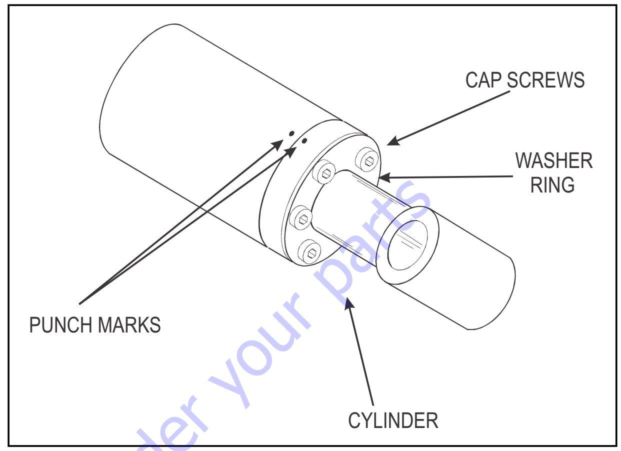


Figure 5-33. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

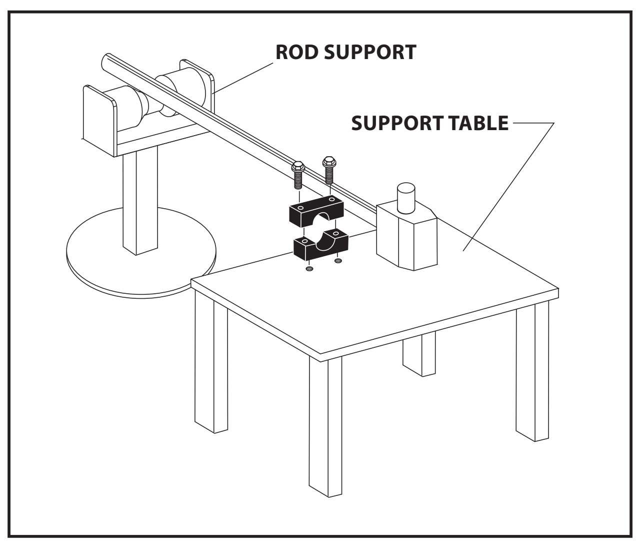
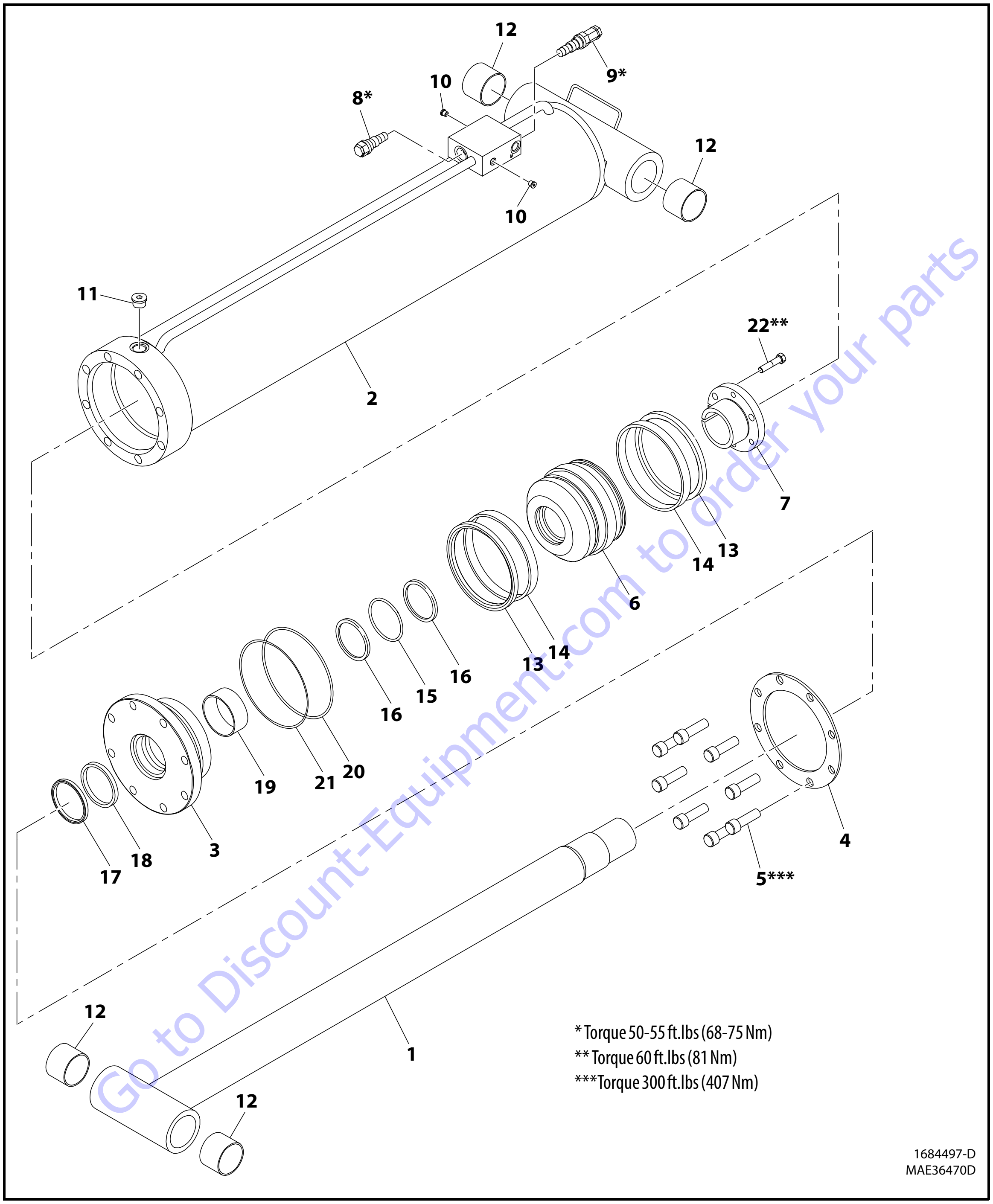
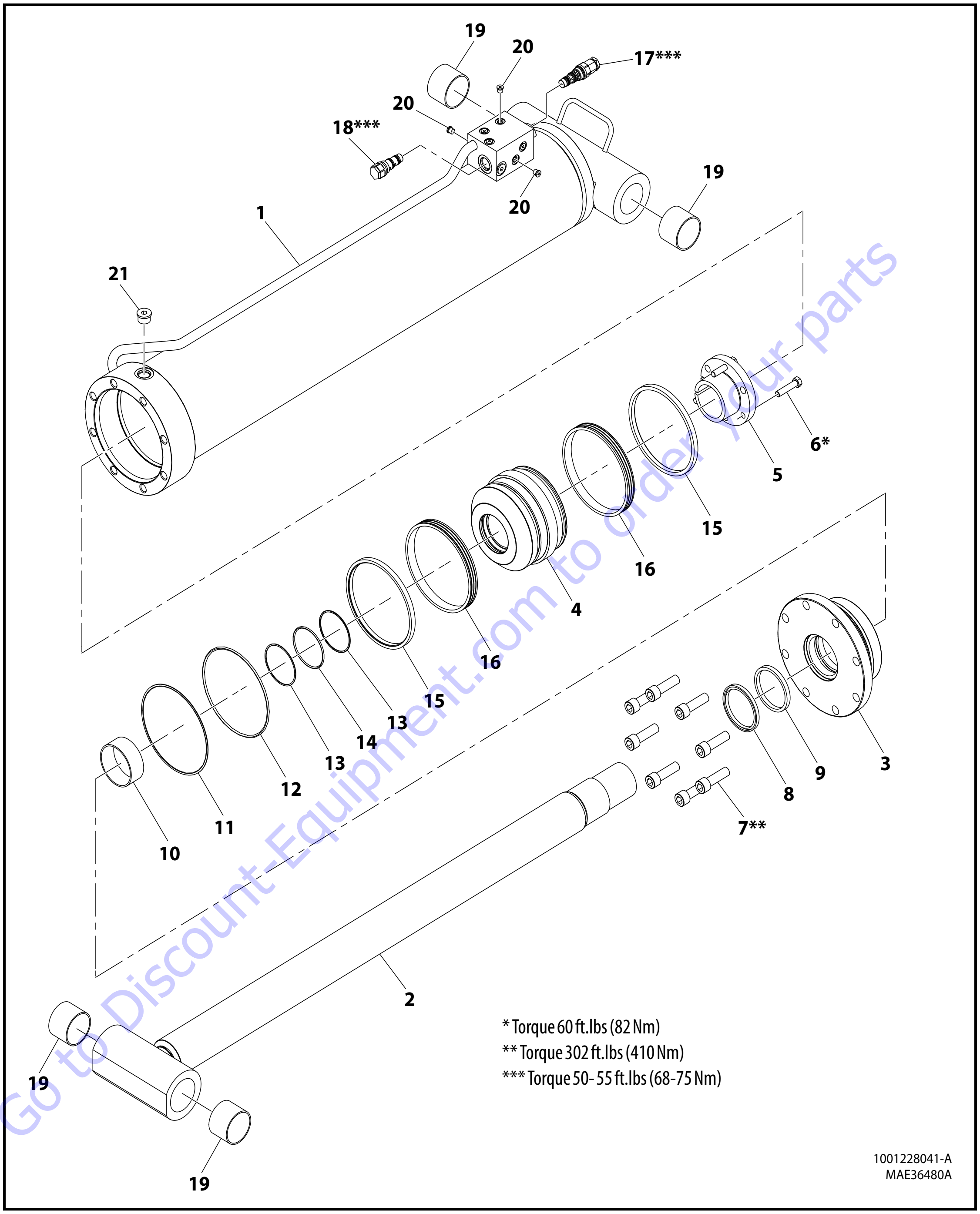


Figure 5-34. Cylinder Rod Support



1. Rod	6. Piston	11. O-ring Plug	16. Backup Ring	21. Backup Ring
2. Barrel	7. Tapered Bushing	12. Bushing	17. Wiper	22. Bolt
3. Head	8. Cartridge Valve	13. Lock Ring	18. Rod Seal	
4. Washer Ring	9. Cartridge Valve	14. Seal	19. Wear Ring	
5. Bolt	10. O-ring Plug	15. Washer Ring	20. O-ring	

Figure 5-35. Upright Level Cylinder (Prior to 0300247156)



1. Barrel
2. Rod
3. Head
4. Piston
5. Tapered Bushing
6. Bolt
7. Capscrew
8. Wiper
9. Rod Seal
10. Wear Ring
11. Backup Ring
12. O-Ring
13. Backup Ring
14. Washer Ring
15. Lock Ring
16. Seal
17. Cartridge Valve
18. Cartridge Valve
19. Bushing
20. O-Ring Plug
21. O-Ring Plug

Figure 5-36. Upright Level Cylinder (SN 0300247156 to Present)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.

10. Remove the bushing from the piston.

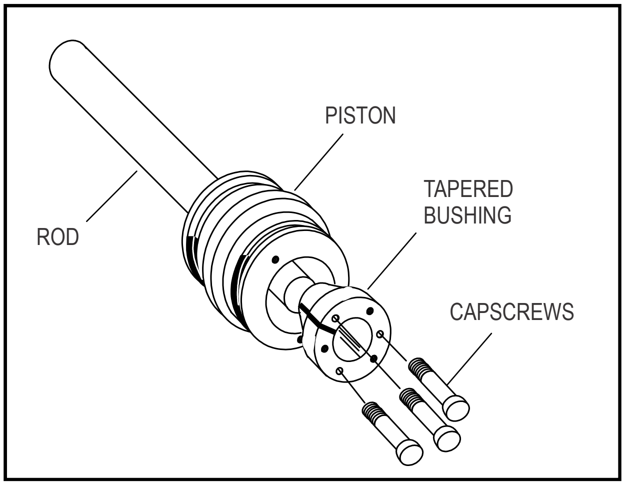


Figure 5-37. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.

12. Remove and discard the piston o-rings, seal rings, and backup rings.

13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.

2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.

6. Inspect threaded portion of piston for damage. Dress threads as necessary.

7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.

8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.

9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.

10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.

11. 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 inside of steel bushing prior to bearing installation.

    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

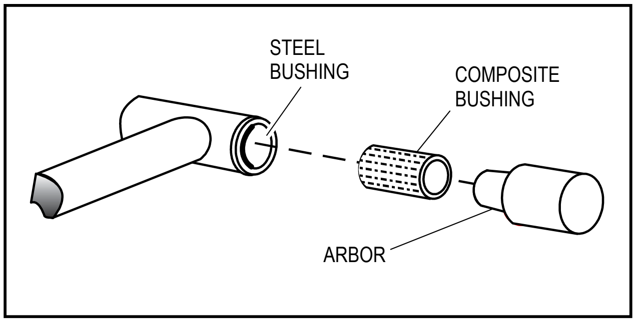


Figure 5-38. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.

13. If applicable, inspect port block fittings and holding valve. Replace as necessary.

14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

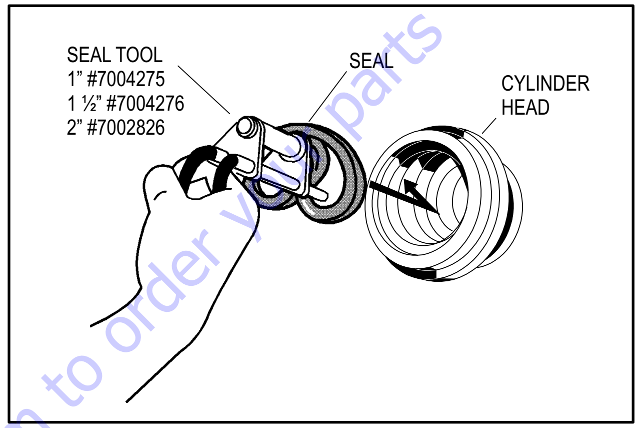


Figure 5-39. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

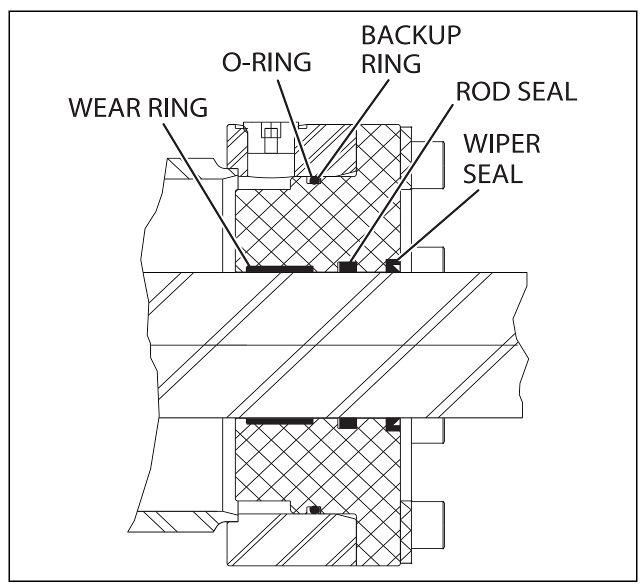
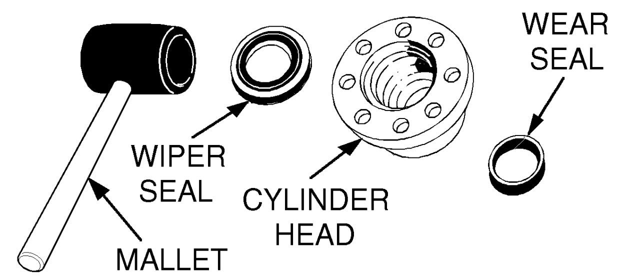


Figure 5-40. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-41. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

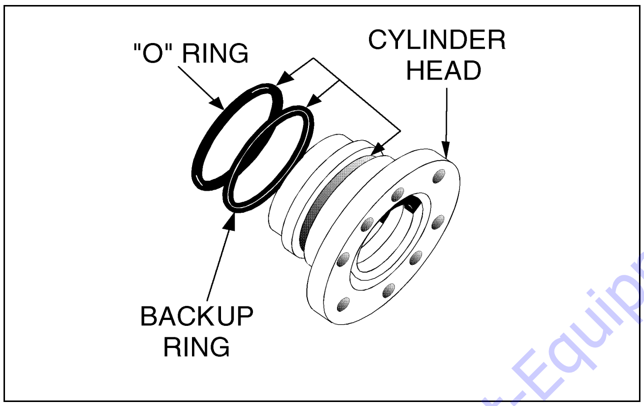


Figure 5-42. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Place a new o-ring and backup rings in the inner piston diameter groove.

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

8. Thread piston onto rod and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

9. Install the bolt in tapered bushing.

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

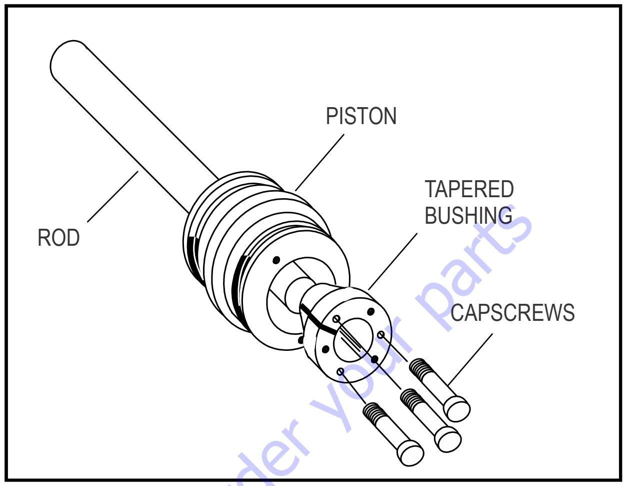


Figure 5-43. Tapered Bushing Removal

11. Tighten the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

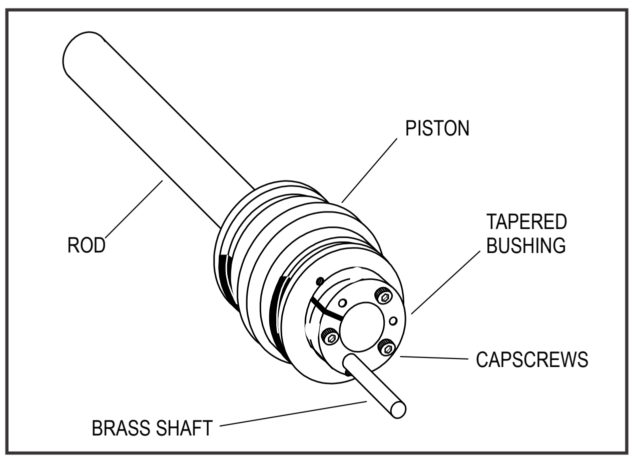


Figure 5-44. Seating the Tapered Bearing

13. Rotate the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).

14. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

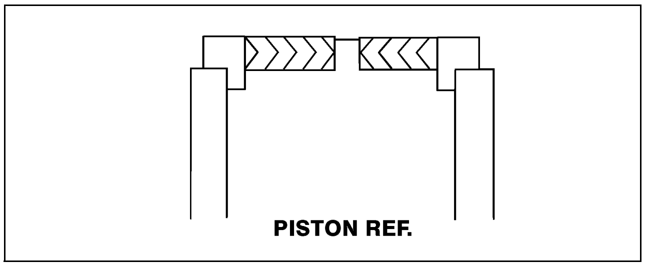


Figure 5-45. Hydrolock Piston Seal Installation

15. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

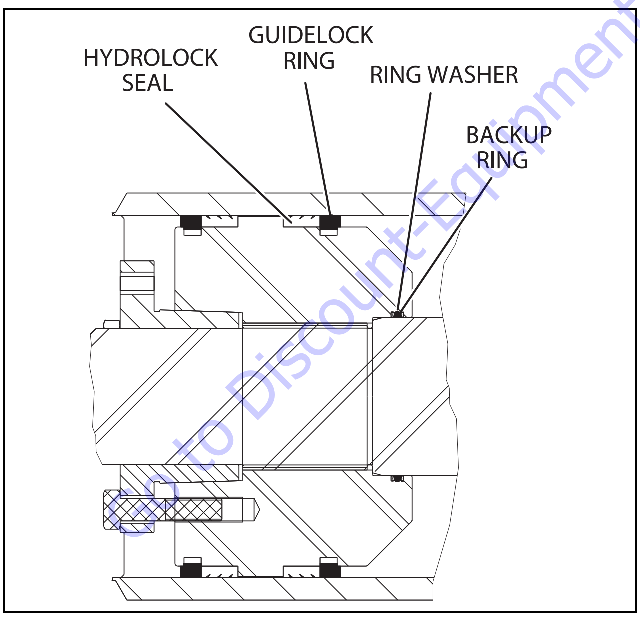


Figure 5-46. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

17. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

18. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

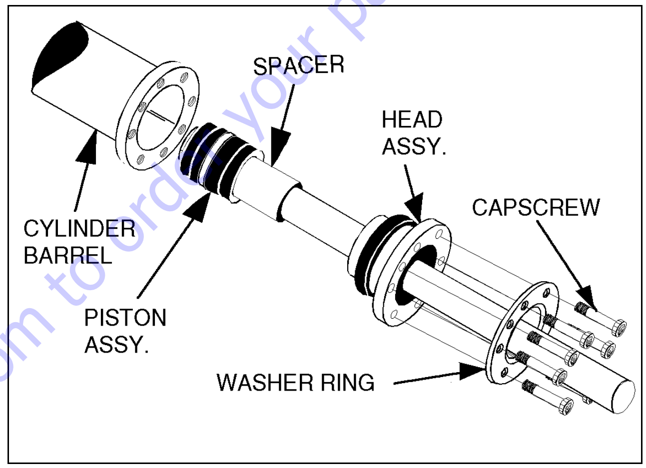


Figure 5-47. Rod Assembly Installation

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts.

20. 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.

21. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Jib Lift Cylinder (800AJ Only)

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the counterbalance holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

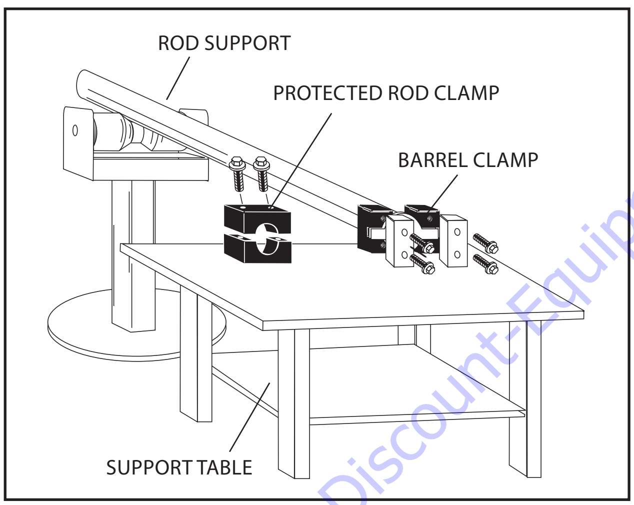


Figure 5-48. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

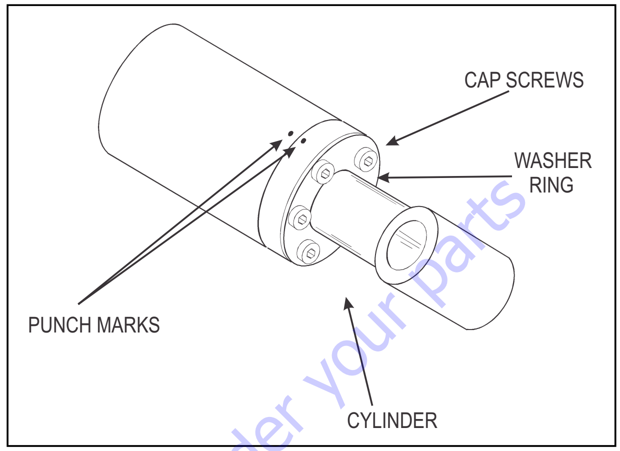


Figure 5-49. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

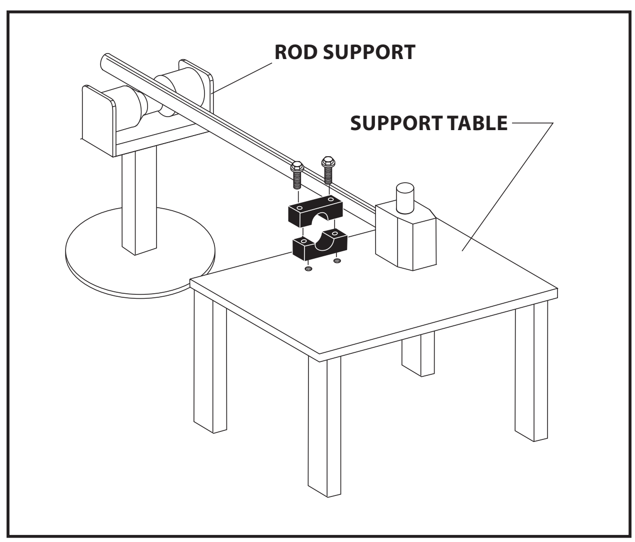
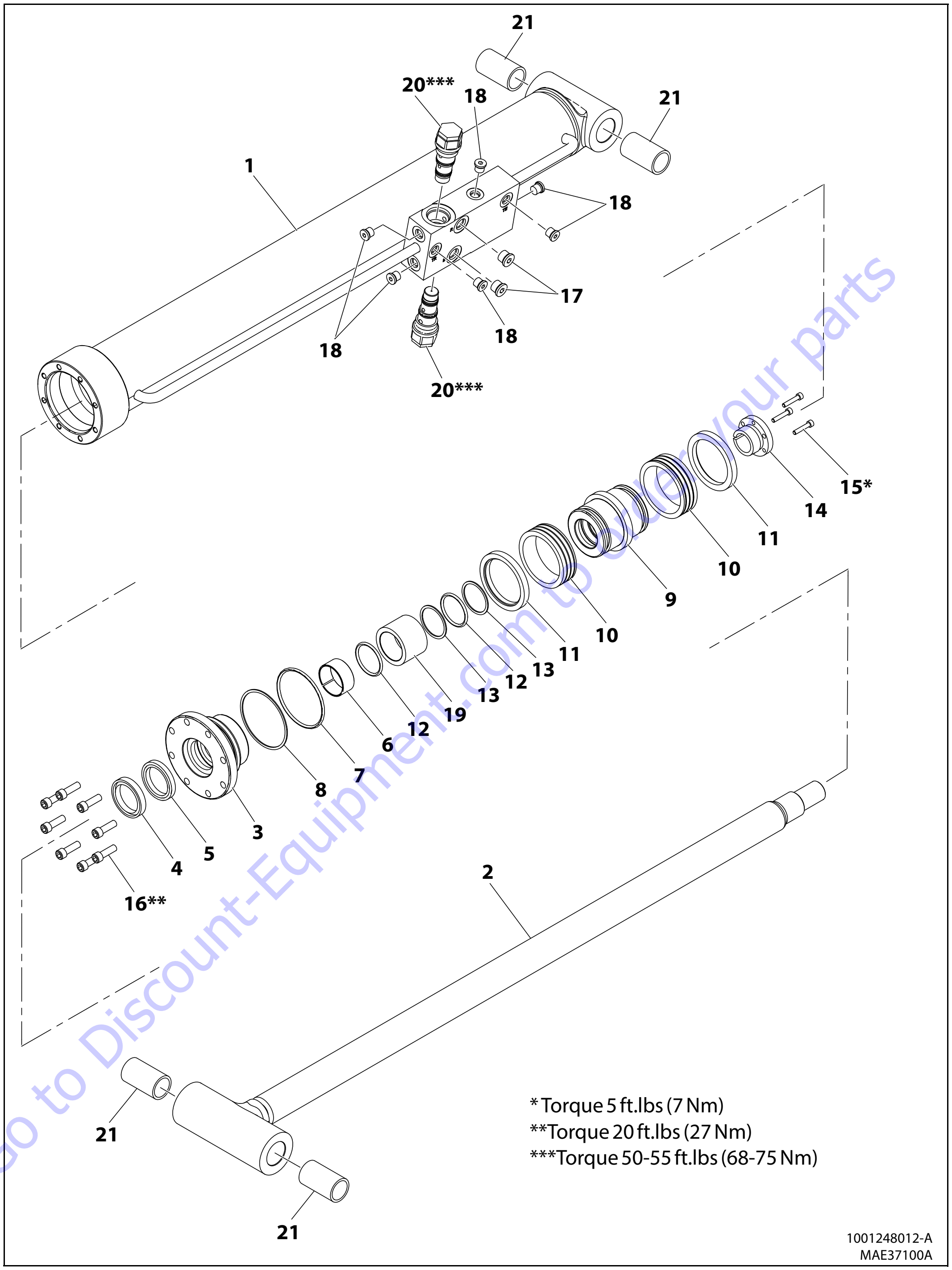


Figure 5-50. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper
5. Rod Seal
6. Wear Ring
7. O-Ring
8. Backup Ring
9. Piston
10. Seal
11. Lock Ring
12. O-Ring
13. Backup Ring
14. Tapered Bushing
15. Capscrew
16. Capscrew
17. O-ring Plug
18. O-ring Plug
19. Spacer
20. Cartridge valve
21. Bushing

Figure 5-51. Jib Lift Cylinder (800AJ Only)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

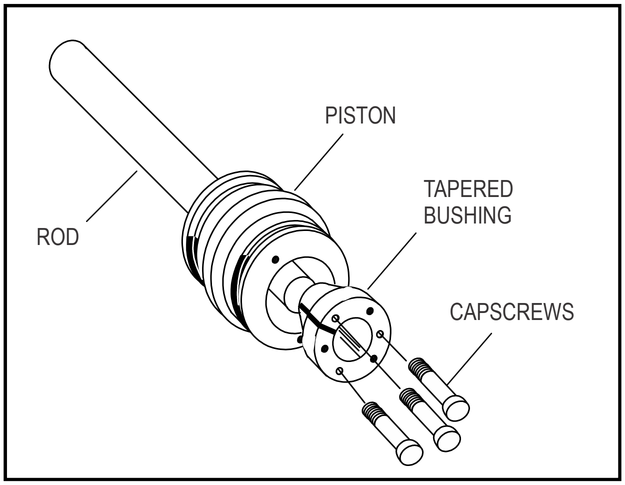


Figure 5-52. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove piston spacer, if applicable, from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

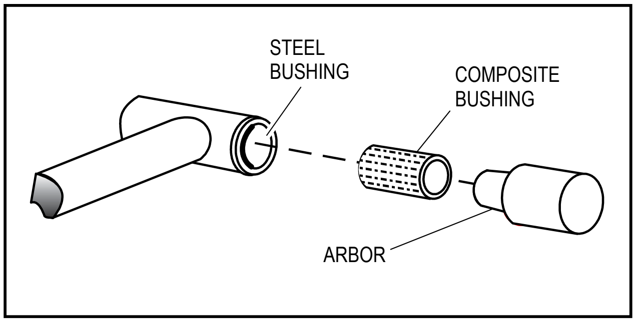


Figure 5-53. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
13. If applicable, inspect port block fittings and holding valve. Replace as necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

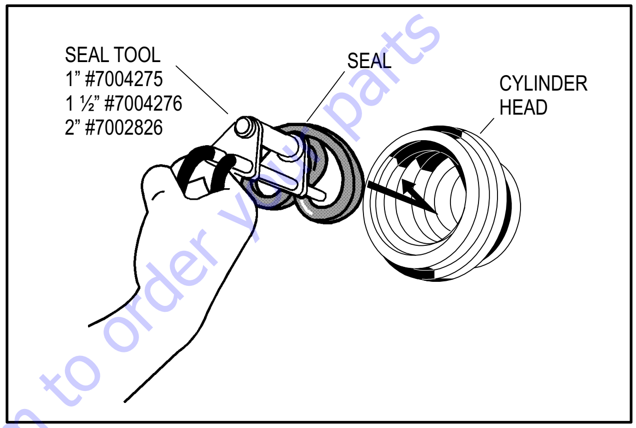


Figure 5-54. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

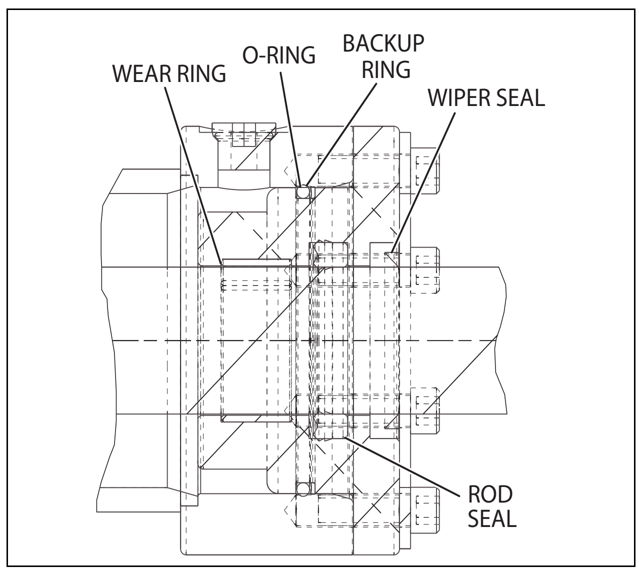
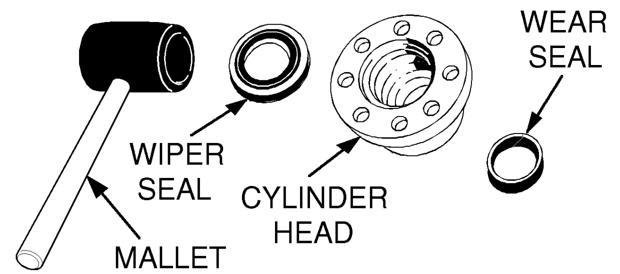


Figure 5-55. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-56. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

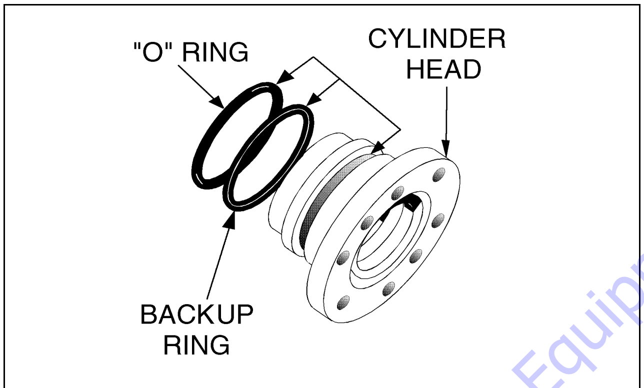


Figure 5-57. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod.

6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

7. Place a new o-ring and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

10. Install the bolts in tapered bushing.

11. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

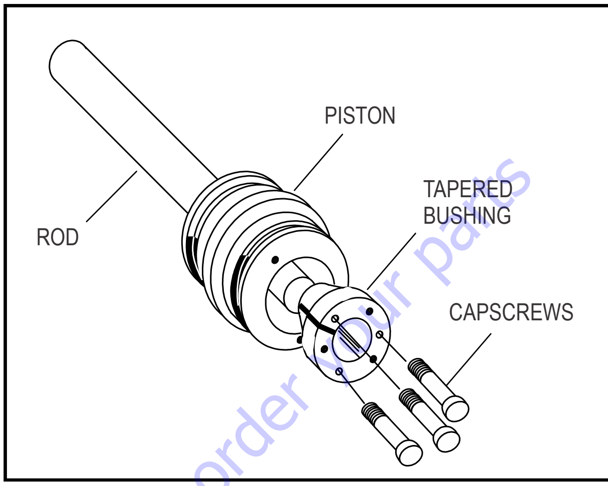


Figure 5-58. Tapered Bushing Removal

12. Tighten the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).

13. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

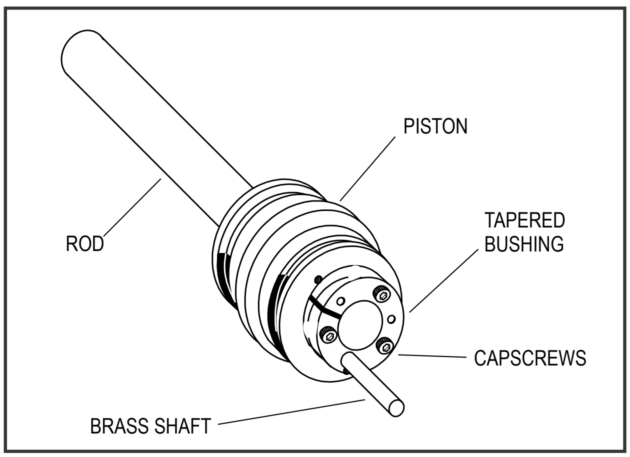


Figure 5-59. Seating the Tapered Bearing

14. Rotate the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).

15. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

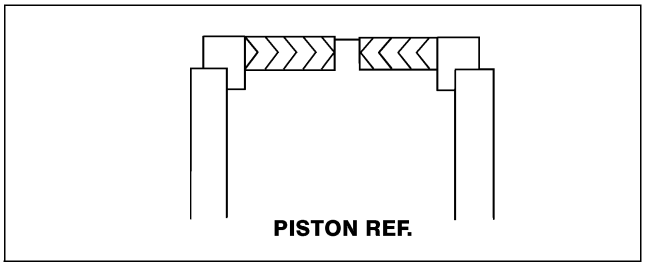


Figure 5-60. Hydrolock Piston Seal Installation

16. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

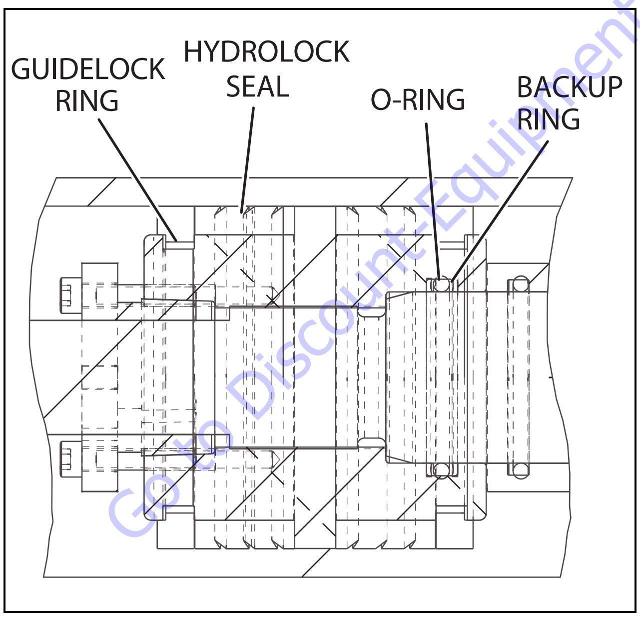


Figure 5-61. Piston Seal Kit Installation

17. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

18. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

19. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

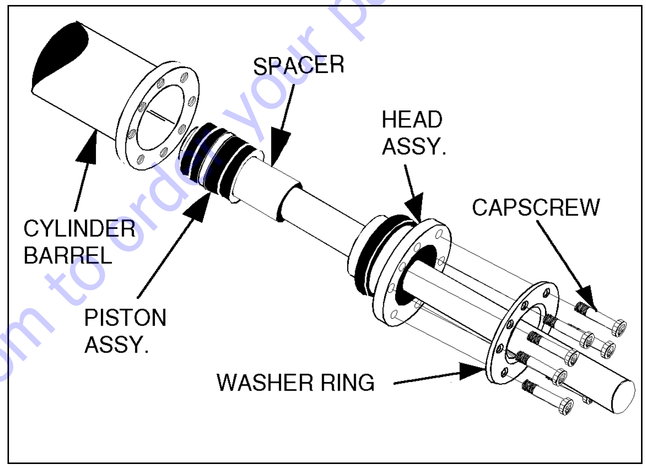


Figure 5-62. Rod Assembly Installation

20. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 20 ft.lbs. (27 Nm).

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

22. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft.lbs. (68-75 Nm).

Main Boom Lift Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the cartridge valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

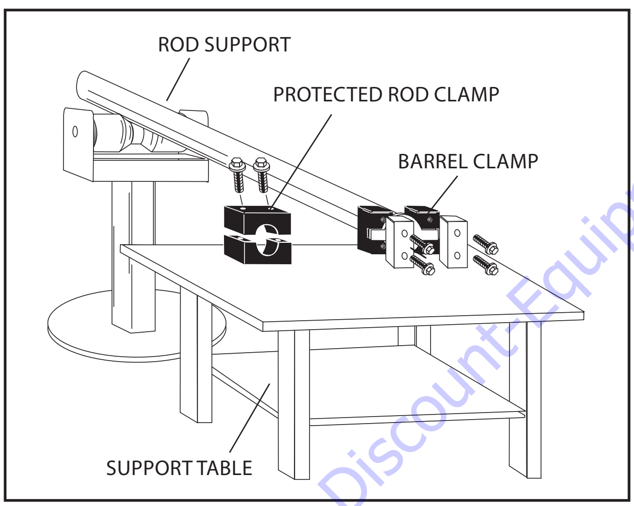


Figure 5-63. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

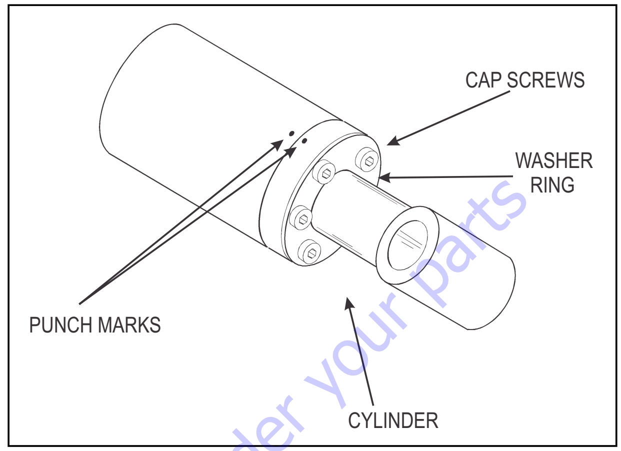


Figure 5-64. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

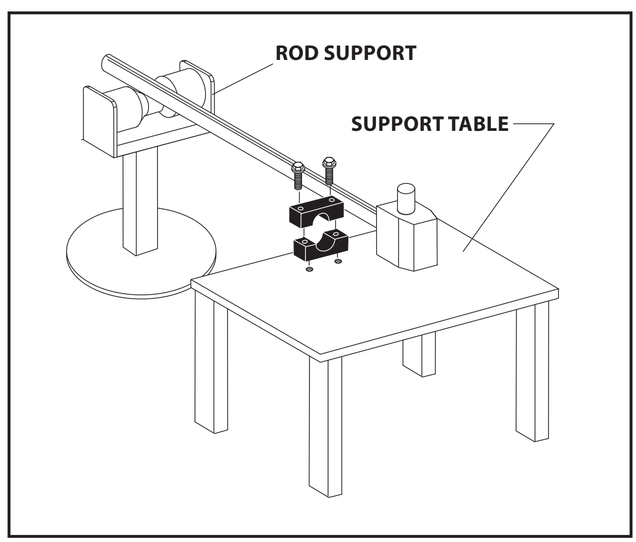
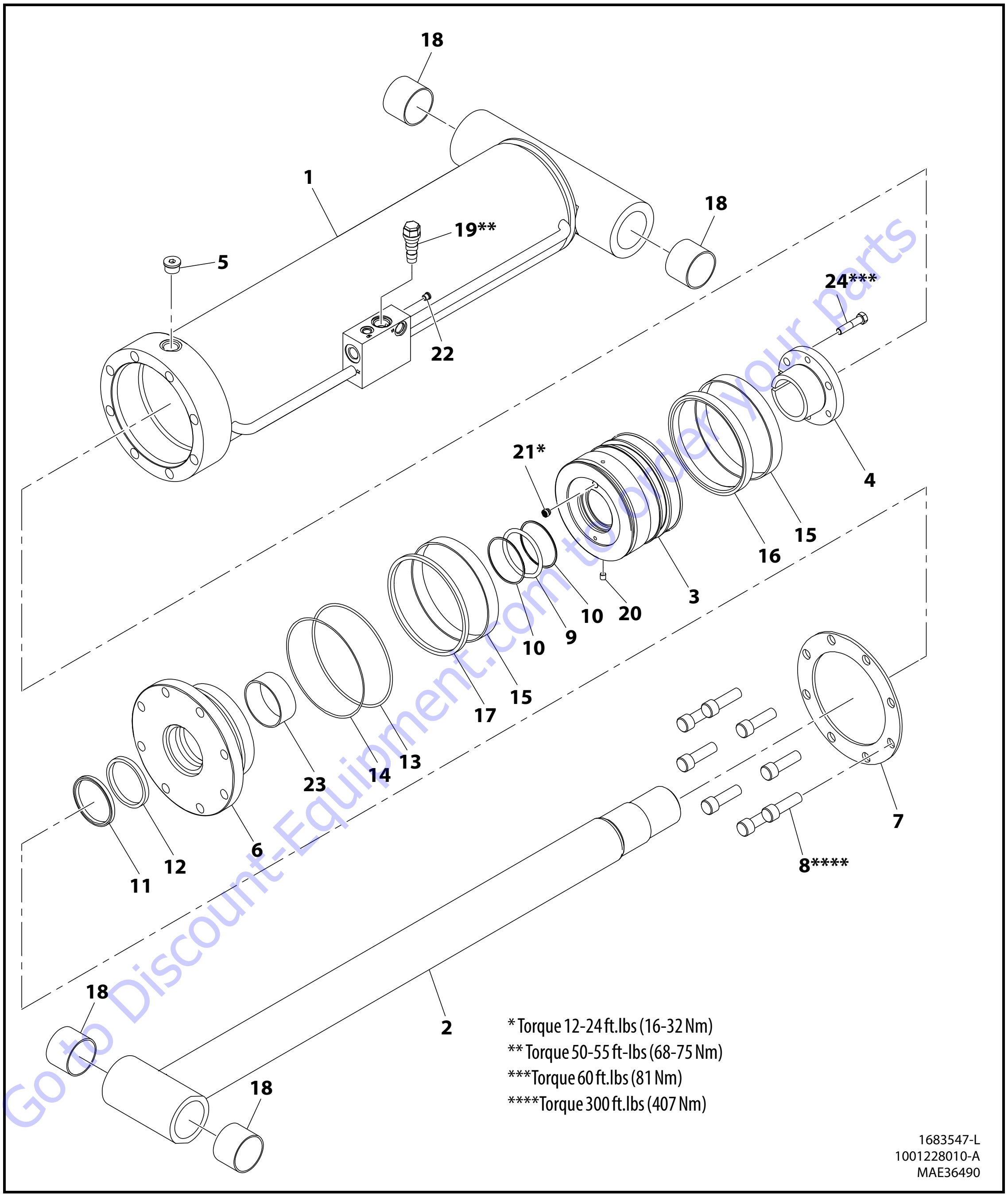


Figure 5-65. Cylinder Rod Support



1. Barrel
2. Rod
3. Piston
4. Tapered Bushing
5. O-ring Plug
6. Head
7. Washer Ring
8. Bolt
9. O-ring
10. Backup Ring
11. Wiper
12. Rod Seal
13. O-ring
14. Backup Ring
15. Wear Ring
16. T-Seal
17. Seal
18. Bushing
19. Cartridge Valve
20. Orifice
21. Check Valve
22. Plug
23. Wear Ring
24. Bolt

Figure 5-66. Main Boom Lift Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.

10. Remove the bushing from the piston.

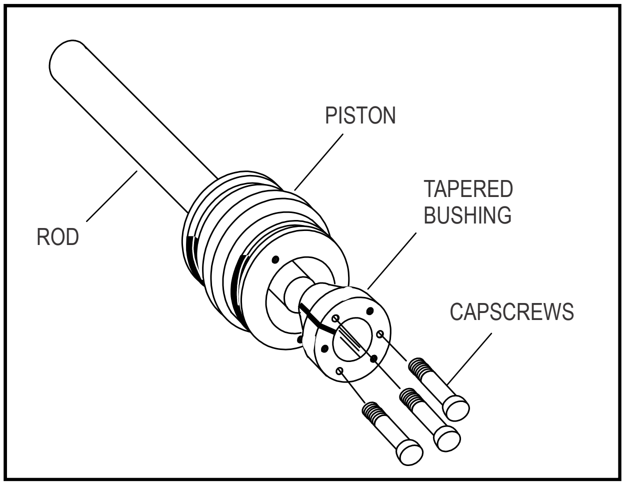


Figure 5-67. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.

12. Remove and discard the piston o-rings, seal rings, and backup rings.

13. Remove check valve from the piston.

14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.

2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.

6. Inspect threaded portion of piston for damage. Dress threads as necessary.

7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.

8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.

9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.

10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.

11. 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 inside of steel bushing prior to bearing installation.

    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

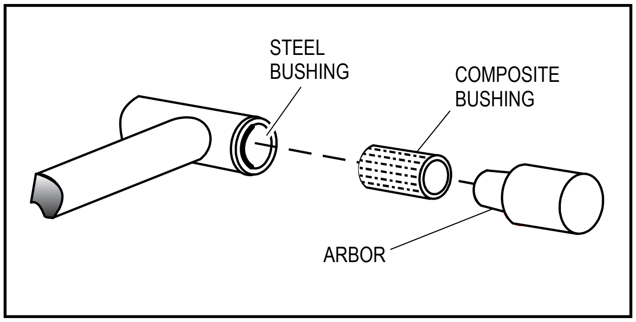


Figure 5-68. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
13. If applicable, inspect port block fittings and holding valve. Replace as necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

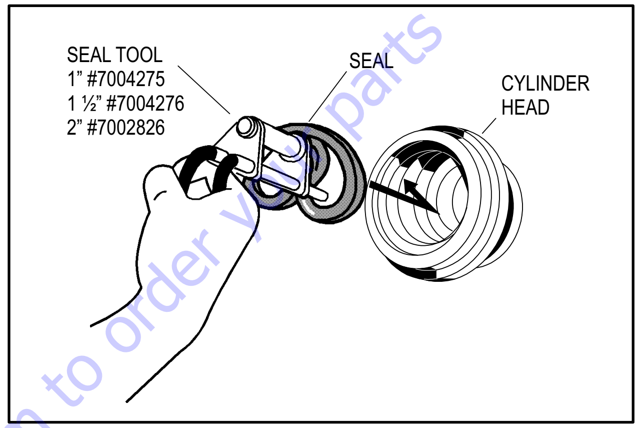


Figure 5-69. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

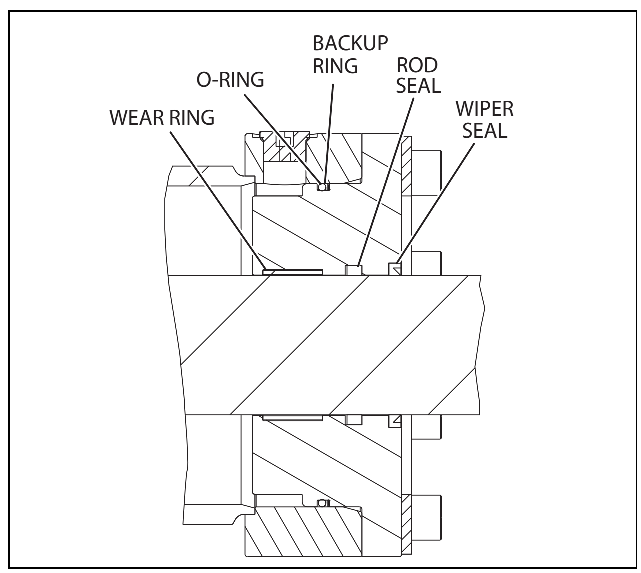
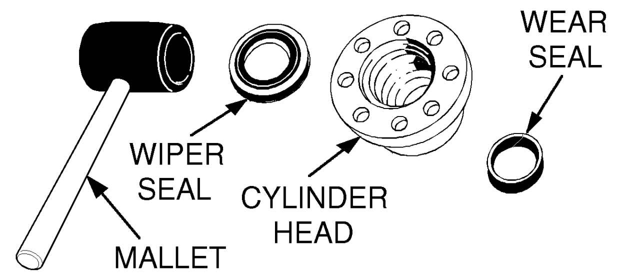


Figure 5-70. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-71. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

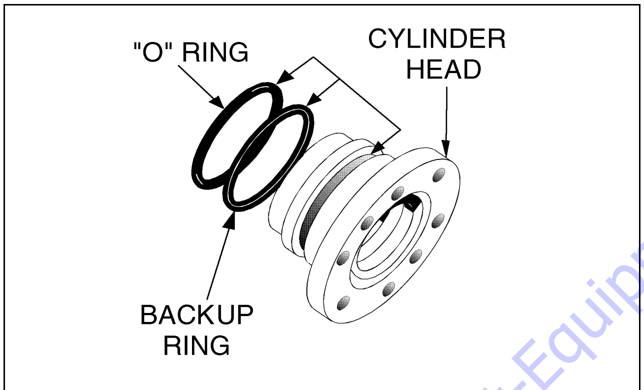


Figure 5-72. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Place a new o-ring and backup rings in the inner piston diameter groove.

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

8. Thread piston onto rod hand tight and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

9. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

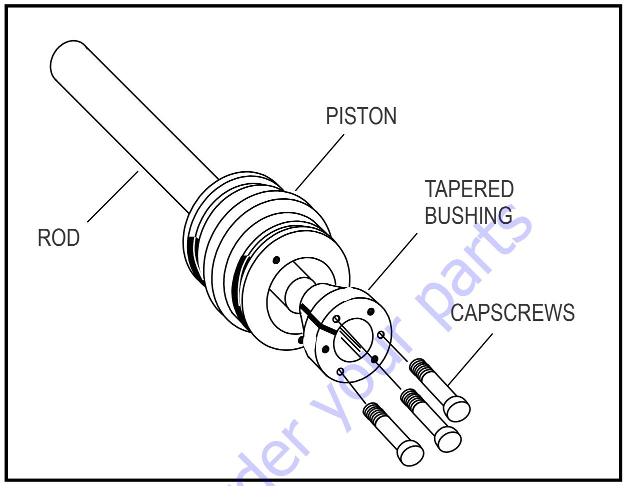


Figure 5-73. Tapered Bushing Removal

10. Tighten the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).

11. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

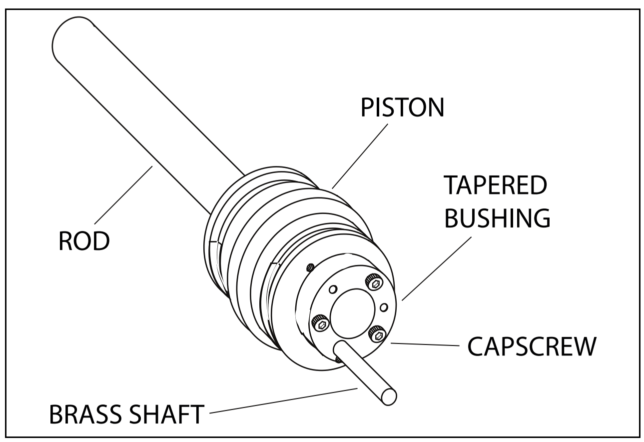


Figure 5-74. Seating the Tapered Bearing

12. Rotate the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).

13. Remove the cylinder rod from the holding fixture.

14. Place new T-seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

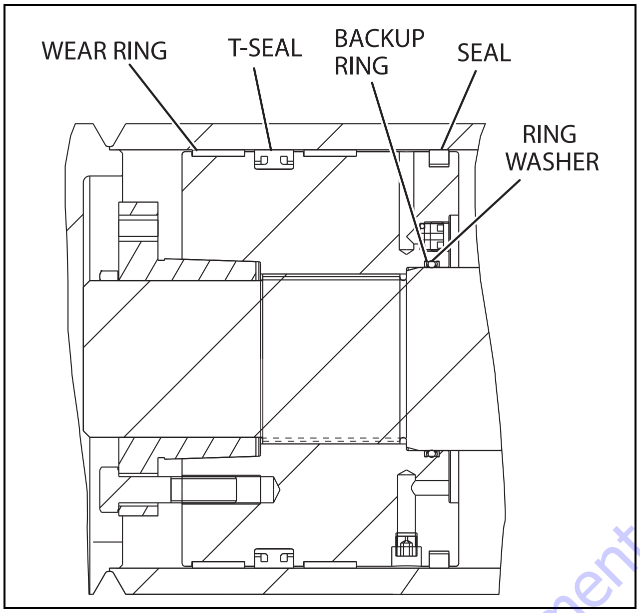


Figure 5-75. Piston Seal Kit Installation

15. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

16. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

17. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

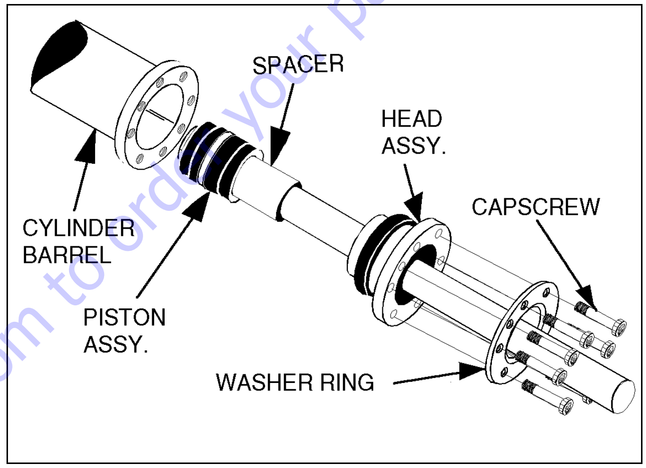


Figure 5-76. Rod Assembly Installation

18. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 300 ft.lbs. (407 Nm).

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

20. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft.lbs. (68-75 Nm).

Tower Boom Lift Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the cartridge valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

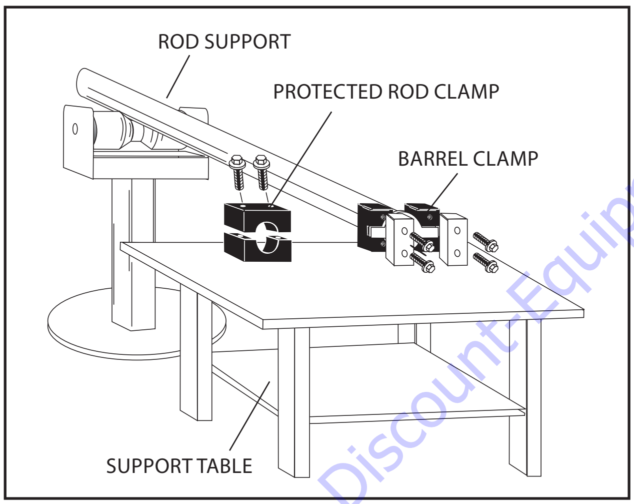


Figure 5-77. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

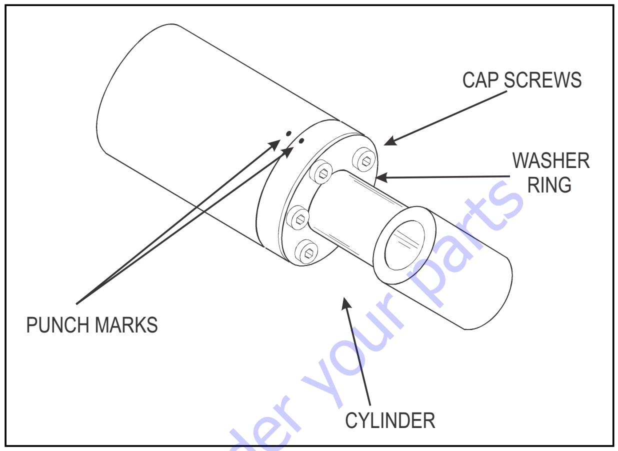


Figure 5-78. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

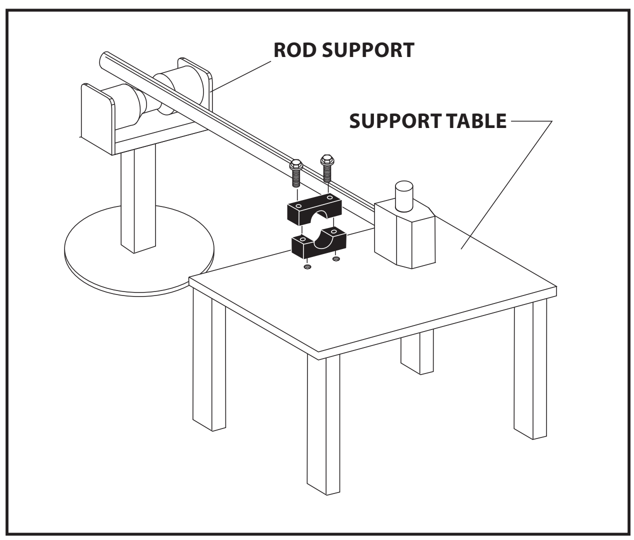
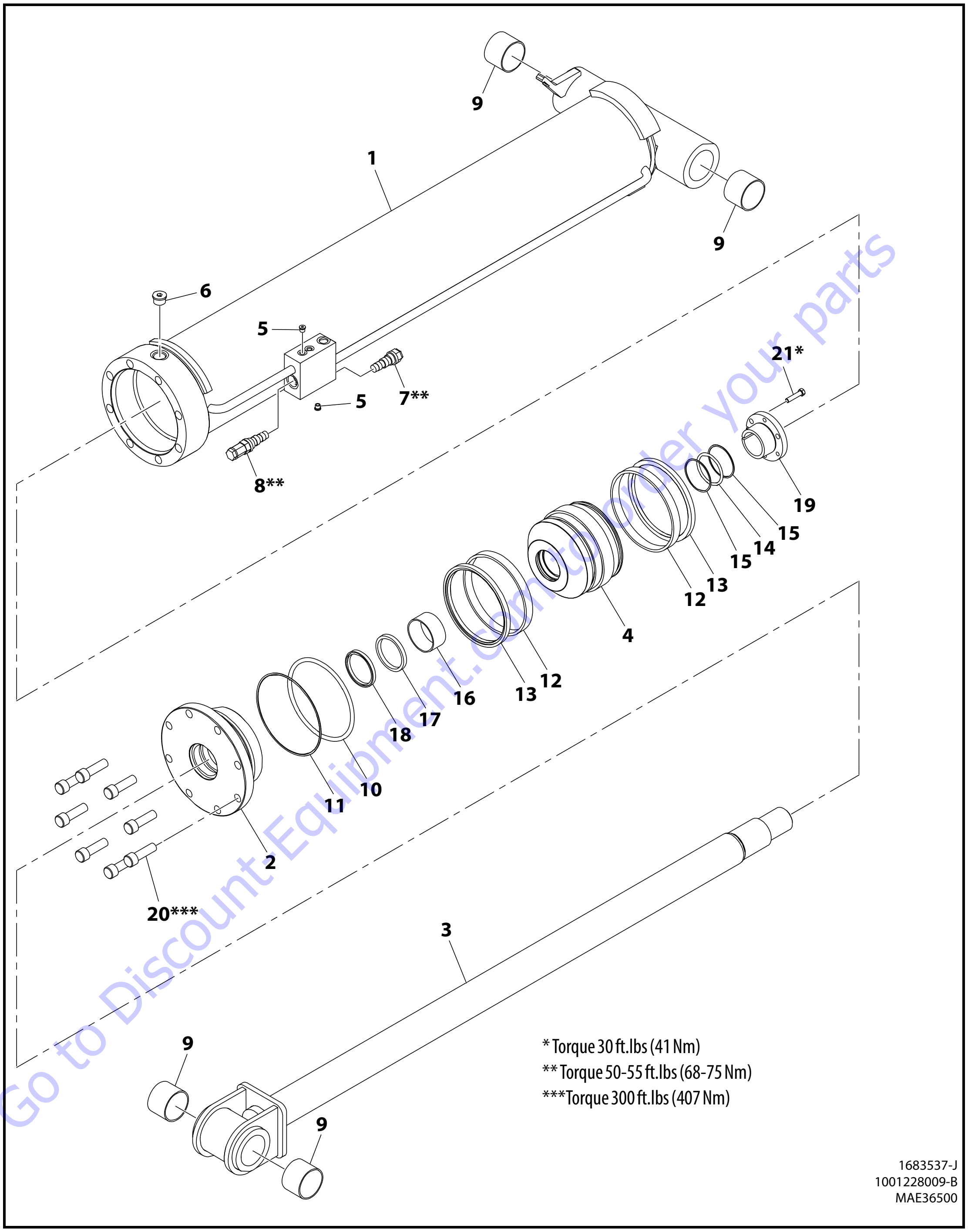


Figure 5-79. Cylinder Rod Support



1. Barrel	6. O-ring Plug	11. Lock Ring	16. Wear Ring	21. Bolt
2. Head	7. Cartridge Valve	12. Seal	17. Seal	
3. Rod	8. Cartridge Valve	13. Lock Ring	18. Wiper	
4. Piston	9. Bushing	14. O-ring	19. Tapered Bushing	
5. O-ring Plug	10. O-ring	15. Backup Ring	20. Capscrew	

Figure 5-80. Tower Boom Lift Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

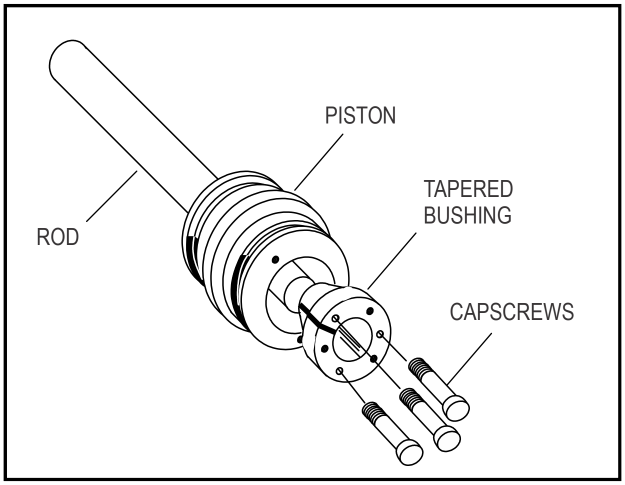


Figure 5-81. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

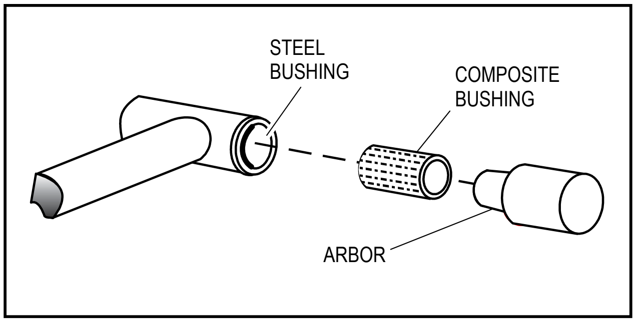


Figure 5-82. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.

13. If applicable, inspect port block fittings and holding valve. Replace as necessary.

14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

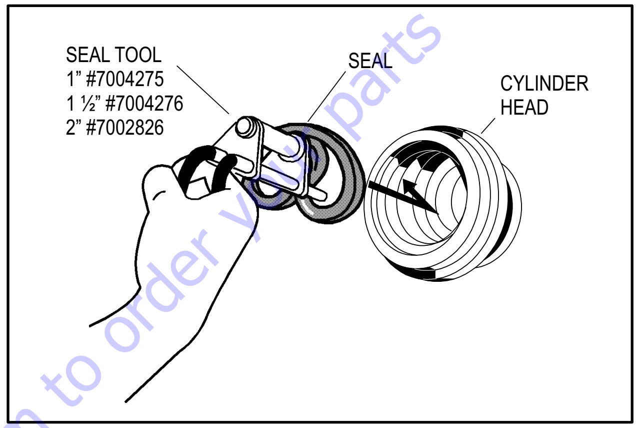


Figure 5-83. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

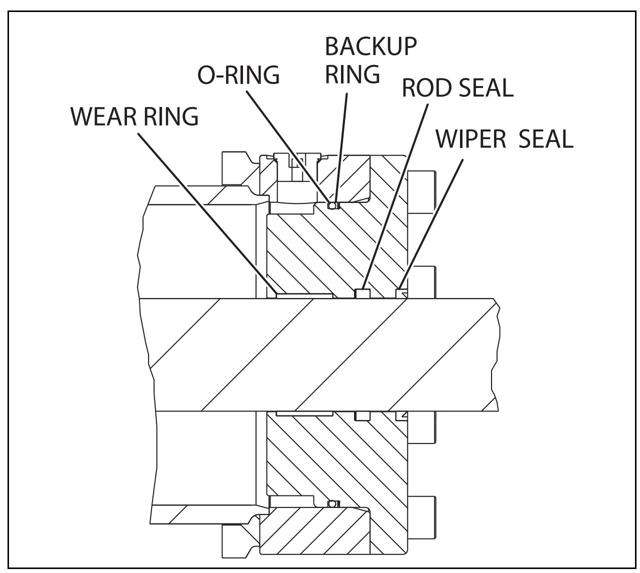
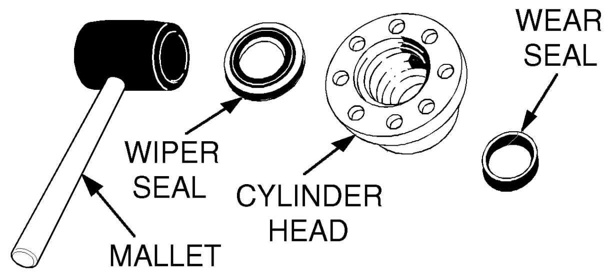


Figure 5-84. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-85. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

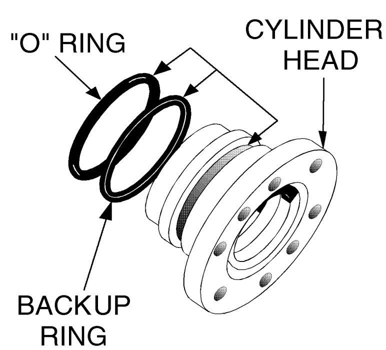


Figure 5-86. Installation of Head Seal Kit

4. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Place a new o-ring and backup rings in the inner piston diameter groove.

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

8. Thread piston onto rod hand tight and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

9. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

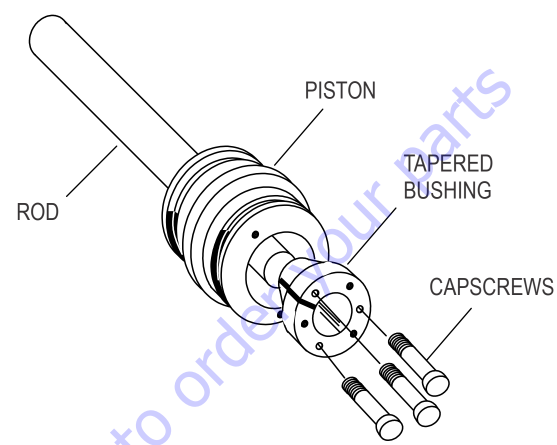


Figure 5-87. Tapered Bushing Removal

10. Tighten the capscrews evenly and progressively in rotation to 30 ft.lbs. (41 Nm).

11. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

   a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

   b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

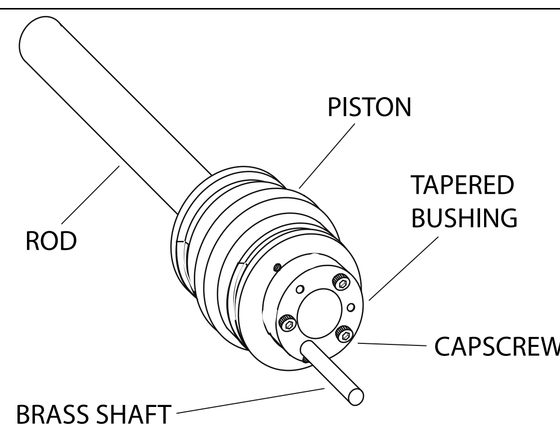


Figure 5-88. Seating the Tapered Bearing

12. Rotate the capscrews evenly and progressively in rotation to 30 ft.lbs. (41 Nm).

13. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

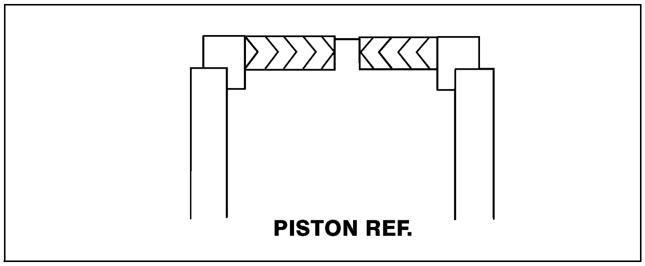


Figure 5-89. Hydrolock Piston Seal Installation

14. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

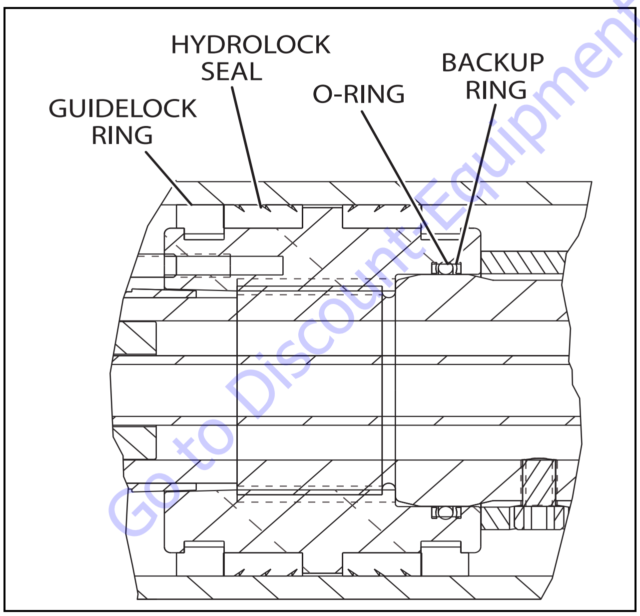


Figure 5-90. Piston Seal Kit Installation

15. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

16. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

17. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

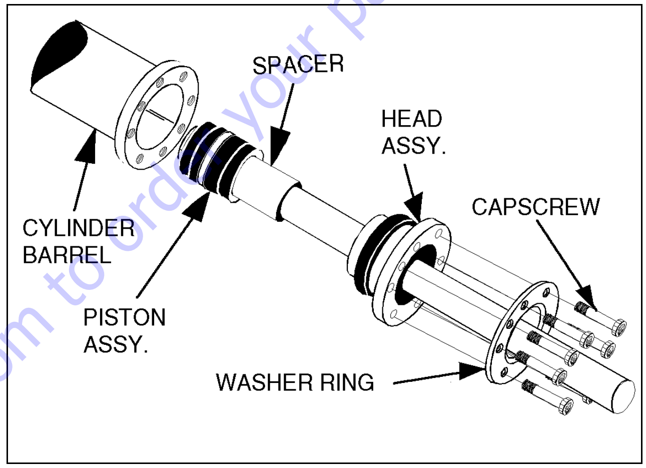


Figure 5-91. Rod Assembly Installation

18. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 300 ft.lbs. (407 Nm).

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

20. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft.lbs. (68-75 Nm).

Master Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Place the cylinder barrel into a suitable holding fixture.

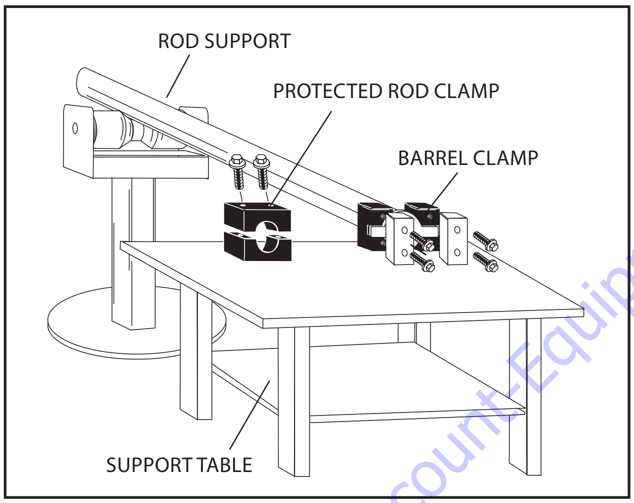


Figure 5-92. Cylinder Barrel Support

4. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

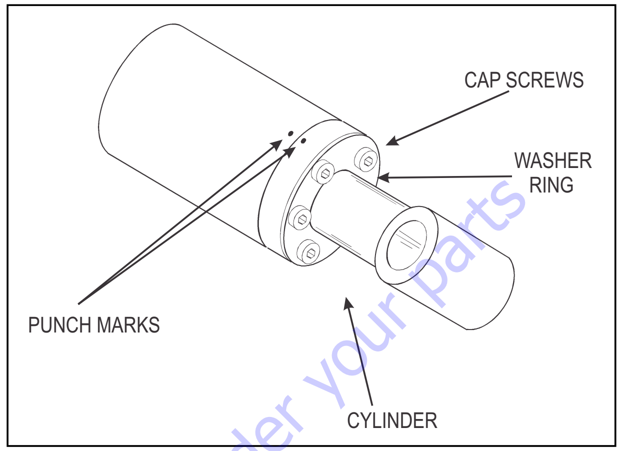


Figure 5-93. Capscrew Removal

5. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

6. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

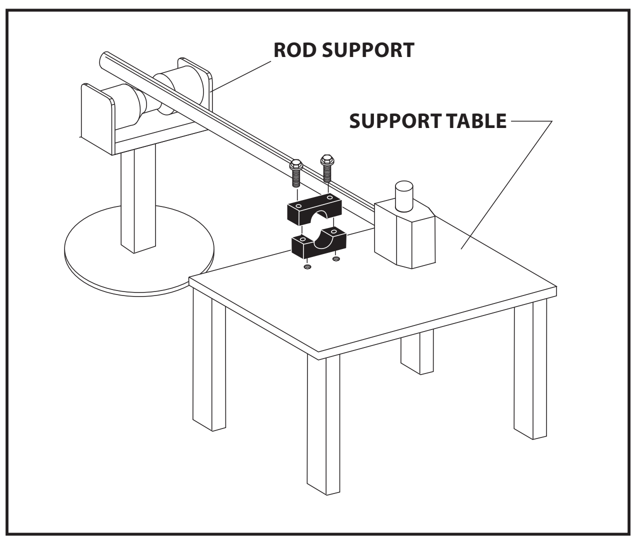
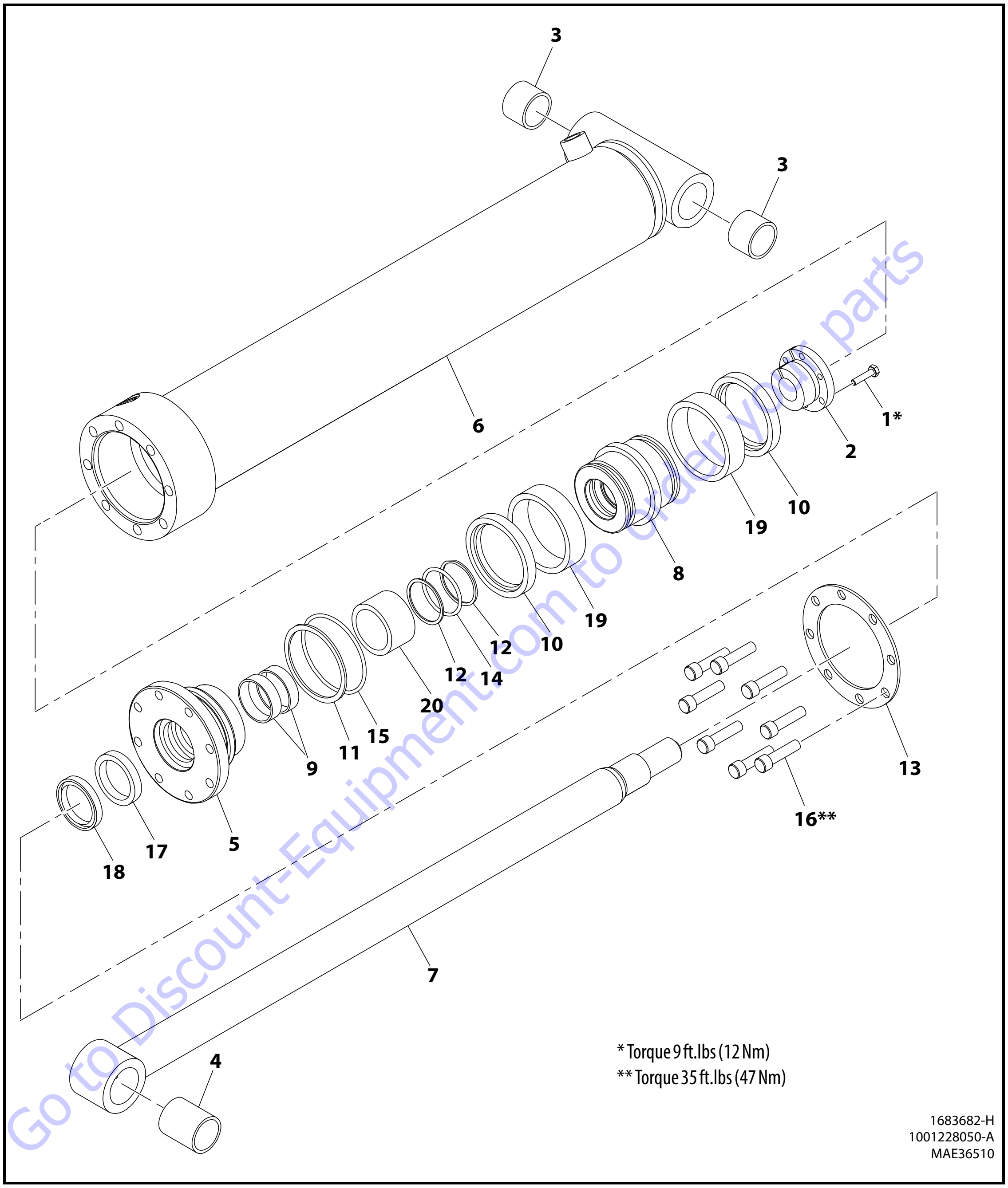


Figure 5-94. Cylinder Rod Support



1. Capscrew
2. Tapered Bushing
3. Bushing
4. Bushing
5. Head
6. Barrel
7. Rod
8. Piston
9. Wear Ring
10. Lock Ring
11. Backup Ring
12. Backup Ring
13. Washer Ring
14. O-ring
15. O-ring
16. Capscrew
17. Rod Seal
18. Wiper
19. Seal
20. Tube Spacer

Figure 5-95. Master Cylinder

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
9. Remove the bushing from the piston.

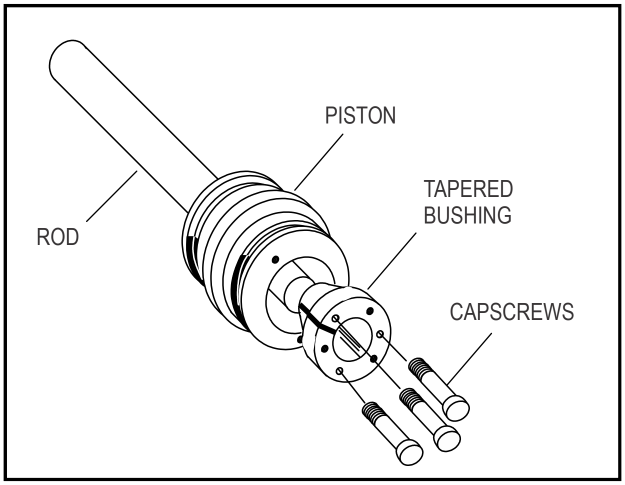


Figure 5-96. Tapered Bushing Removal

10. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
11. Remove and discard the piston o-rings, seal rings, and backup rings.
12. Remove piston spacer from the rod.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

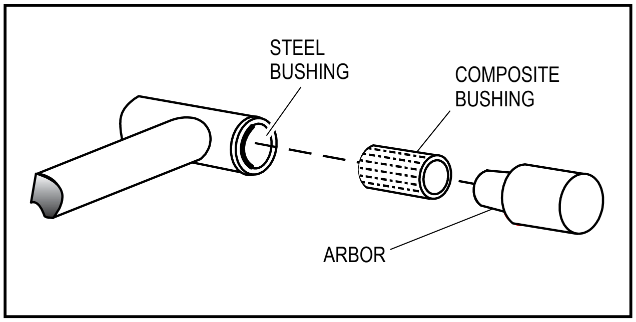


Figure 5-97. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
13. If applicable, inspect port block fittings and holding valve. Replace as necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

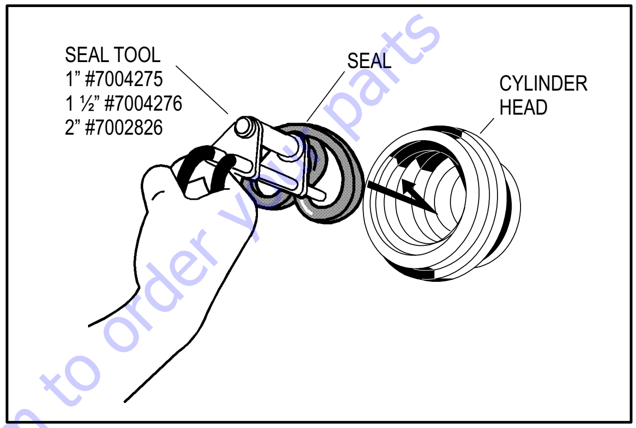


Figure 5-98. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

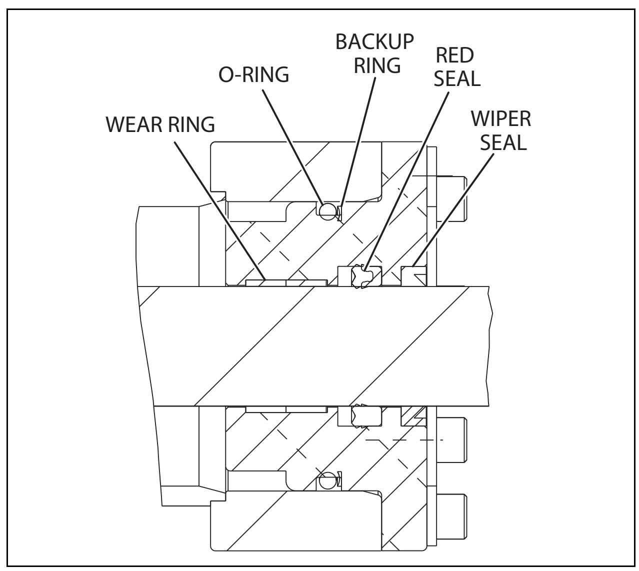
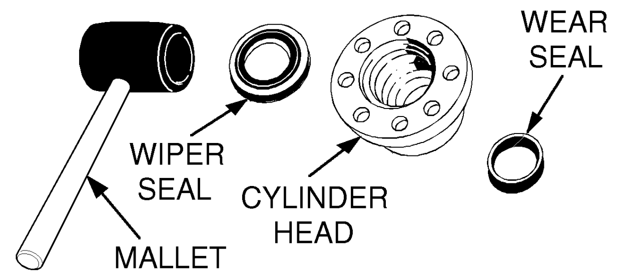


Figure 5-99. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-100. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

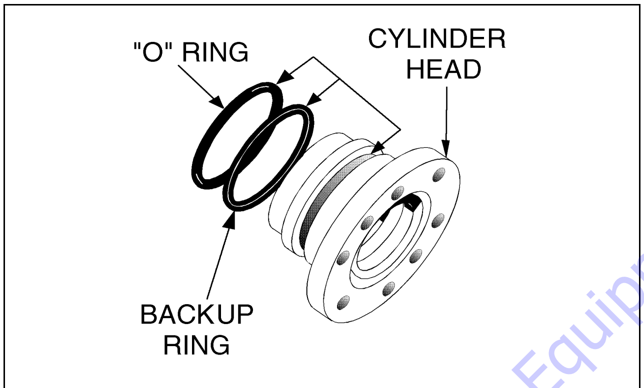


Figure 5-101. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Place a new o-ring and backup rings in the inner piston diameter groove.

7. Install piston spacer onto the cylinder rod.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

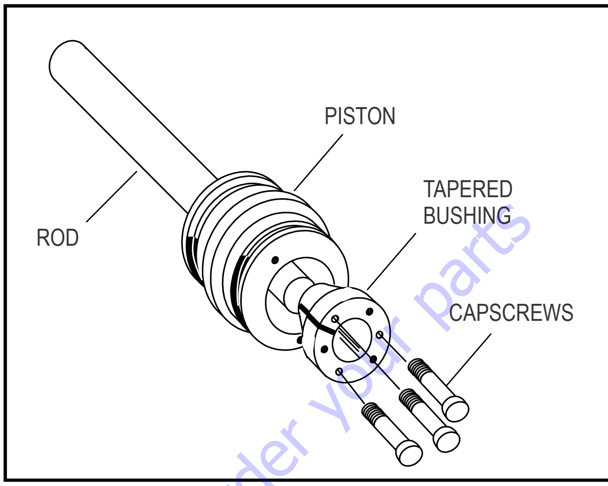


Figure 5-102. Tapered Bushing Removal

11. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

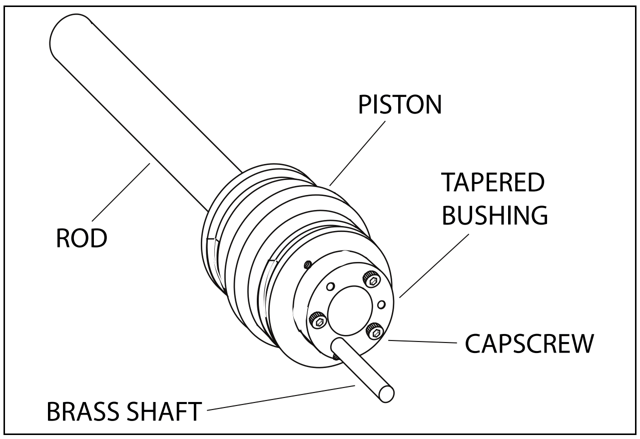


Figure 5-103. Seating the Tapered Bearing

13. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

14. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

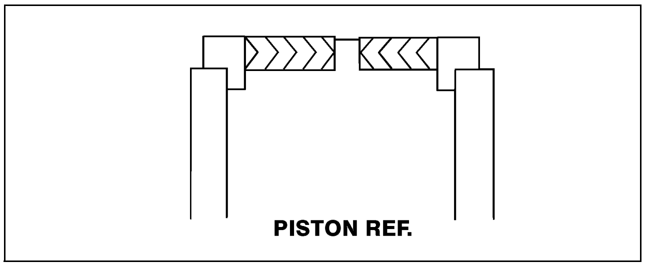


Figure 5-104. Hydrolock Piston Seal Installation

15. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

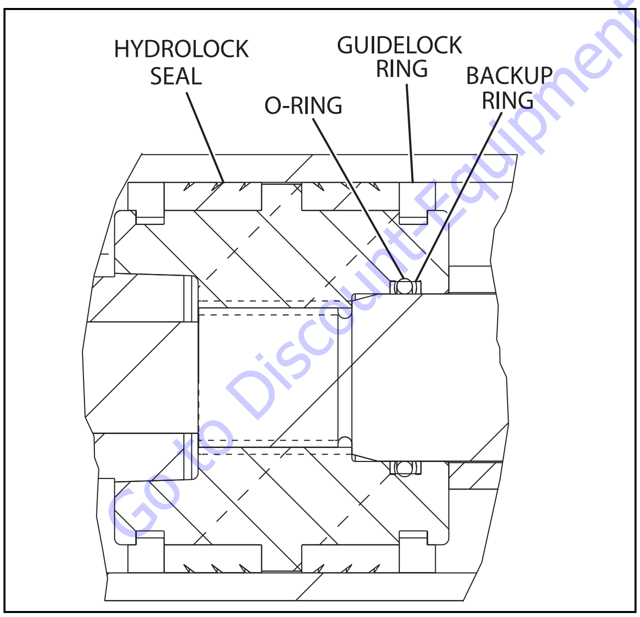


Figure 5-105. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

17. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

18. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

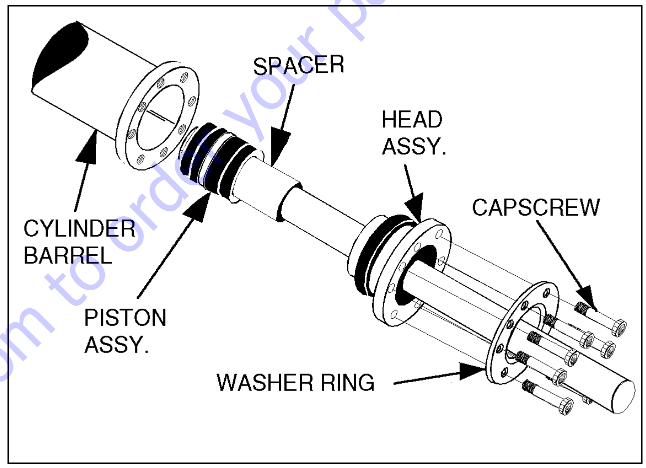


Figure 5-106. Rod Assembly Installation

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 35 ft.lbs. (50 Nm).

Steer Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

⚠ WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Place the cylinder barrel into a suitable holding fixture.

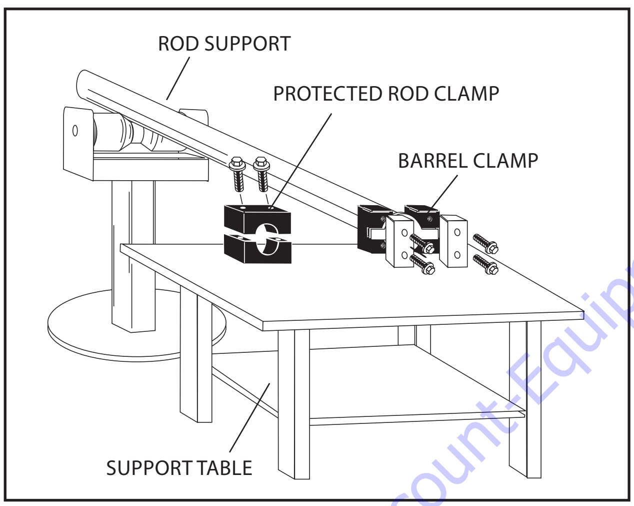


Figure 5-107. Cylinder Barrel Support

4. Using a hook spanner, loosen the spanner nut retainer and remove spanner nut from cylinder barrel.

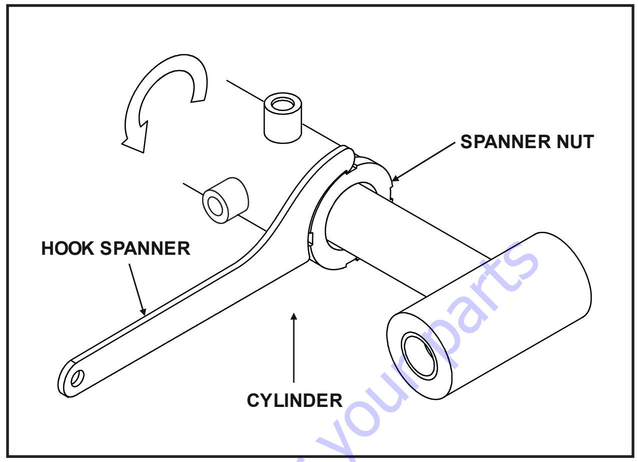


Figure 5-108. Spanner Nut Removal

5. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

6. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

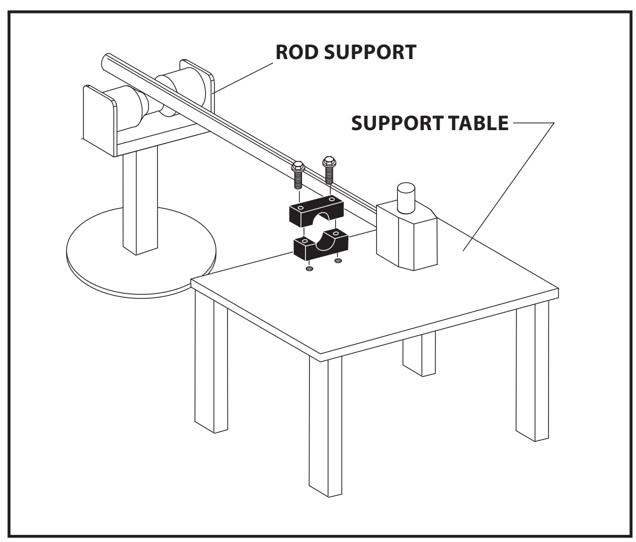
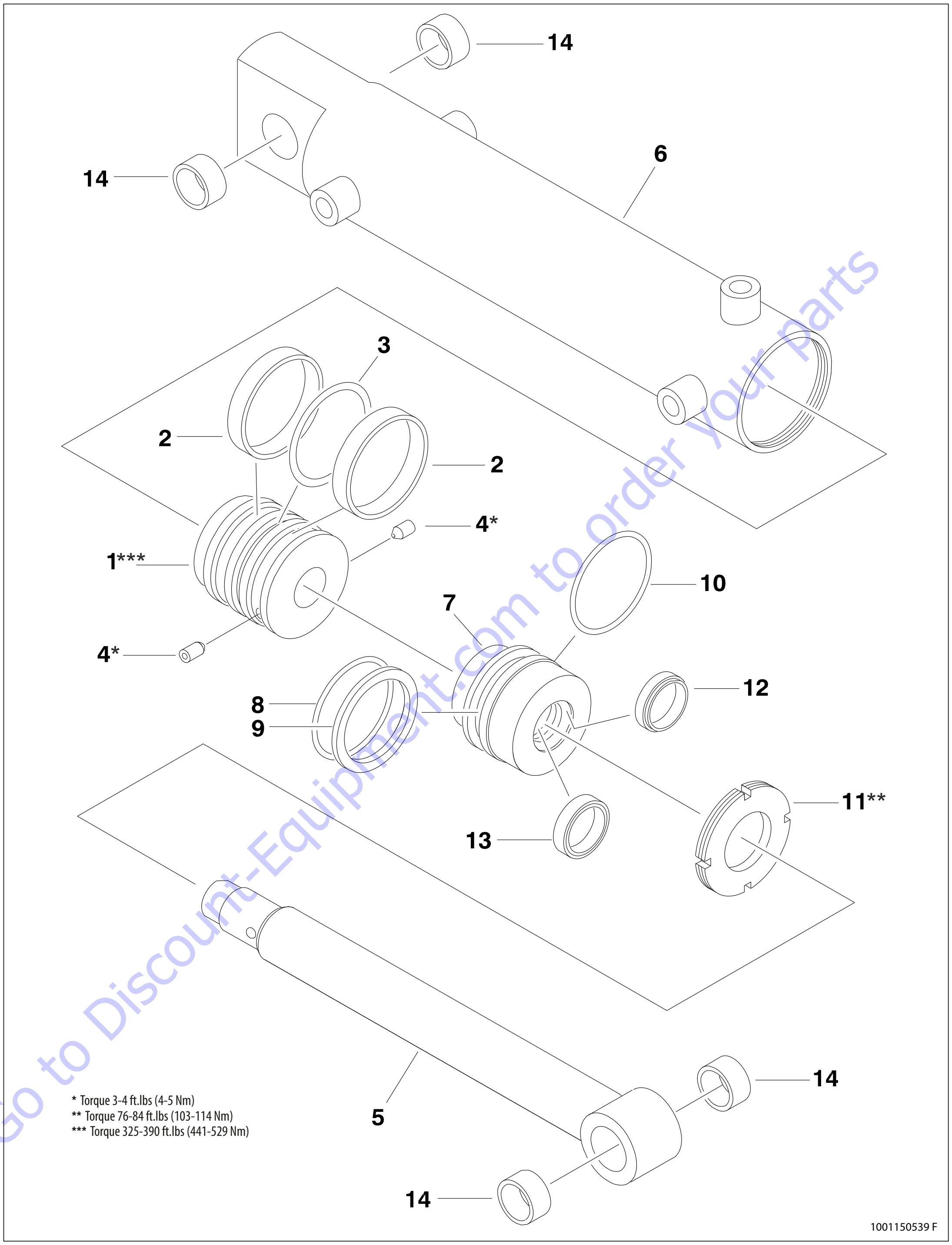


Figure 5-109. Cylinder Rod Support



1. Piston
2. Wear Ring
3. Seal
4. Setscrew
5. Rod
6. Barrel
7. Head
8. O-ring
9. Backup Ring
10. C-Ring
11. Spanner Nut
12. Wiper Seal
13. Rod Seal
14. Bushing

Figure 5-110. Steer Cylinder

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Remove the setscrews from the piston.
9. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
10. Remove and discard the piston seal and wear rings.
11. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-ring, backup ring, c-ring, rod seal, and wiper seal.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of barrel for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

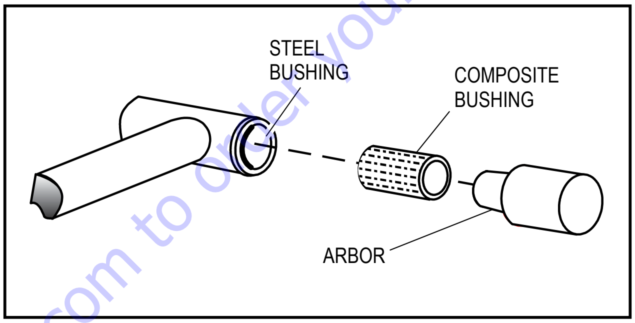


Figure 5-111. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
13. If applicable, inspect port block fittings and holding valve. Replace as necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

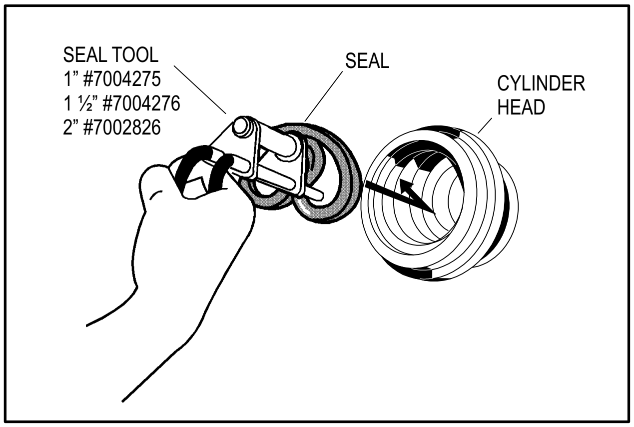


Figure 5-112. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

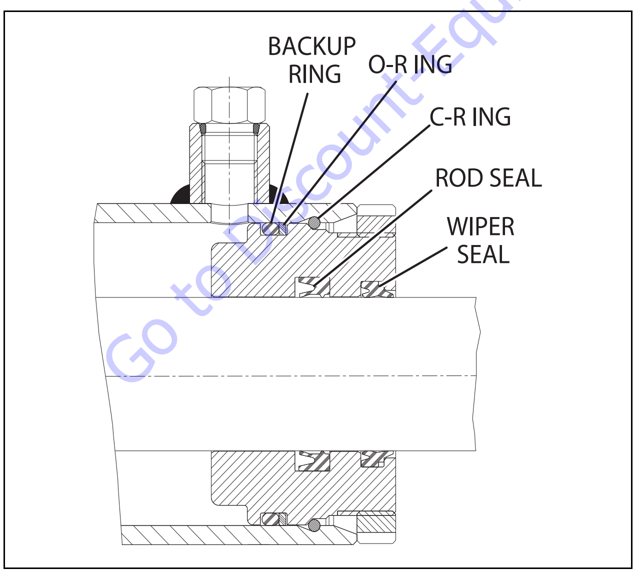
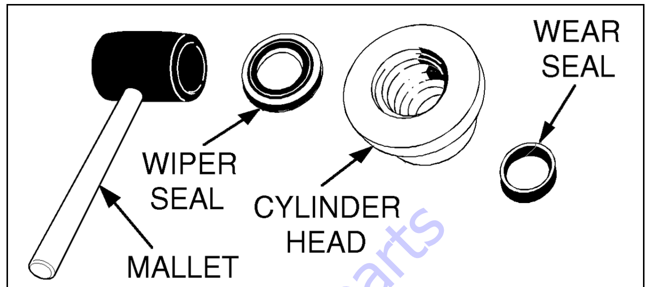


Figure 5-113. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-114. Wiper Seal Installation

3. Place a new o-ring, backup ring and c-ring in the applicable outside diameter groove of the cylinder head.

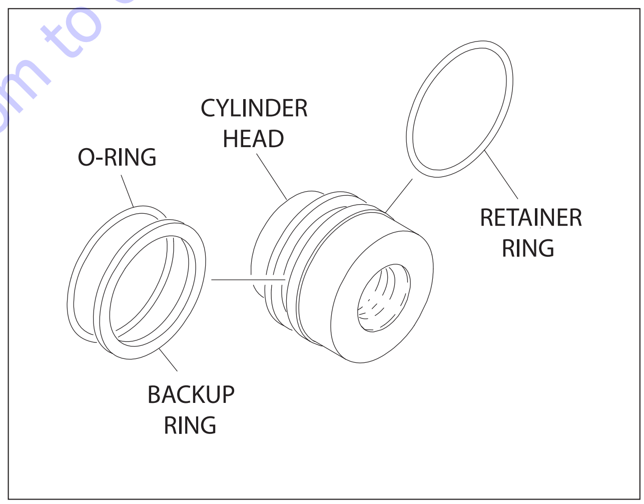


Figure 5-115. Installation of Head Seal Kit

4. Install spanner nut onto rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

7. Install the setscrews on the piston.

8. Remove the cylinder rod from the holding fixture.

9. Place new seal and wear ring in the outer piston diameter grooves. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

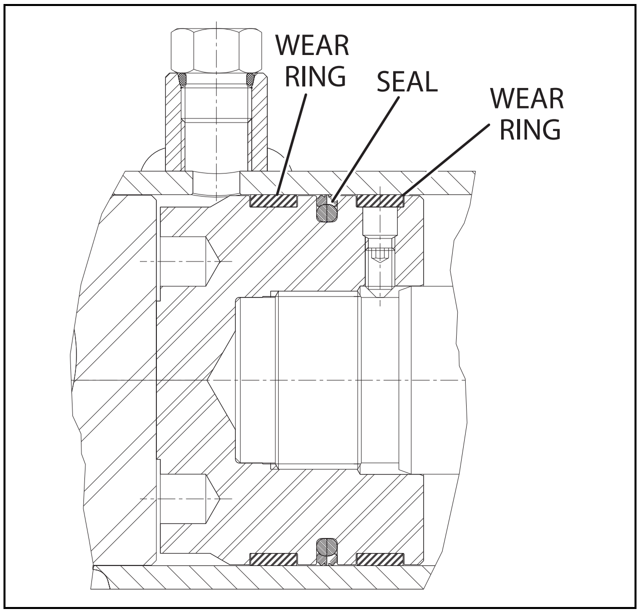


Figure 5-116. Piston Seal Kit Installation

10. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

11. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

12. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

13. Secure spanner nut into the cylinder barrel. Torque nut to 325-390 ft.lbs. (441-529 Nm).

14. 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, if applicable.

Main Boom Telescope Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove capscrews and valve assembly from the barrel end. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

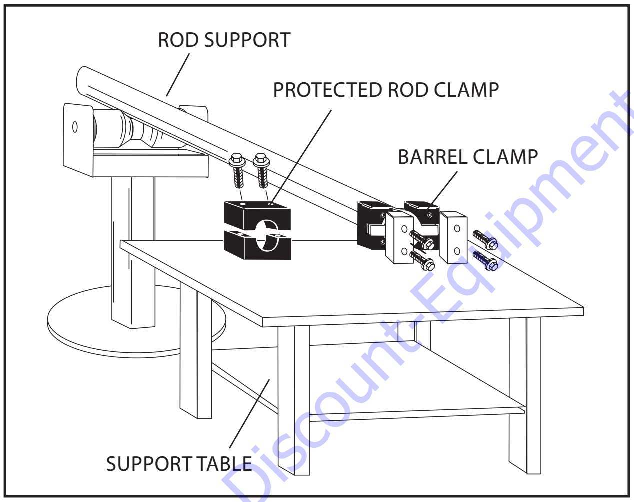


Figure 5-117. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

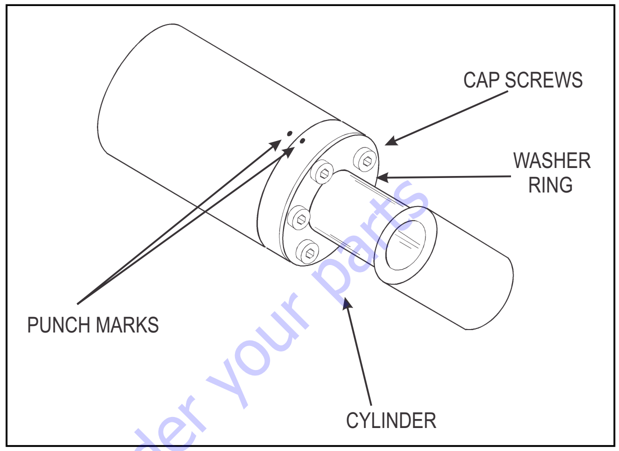


Figure 5-118. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

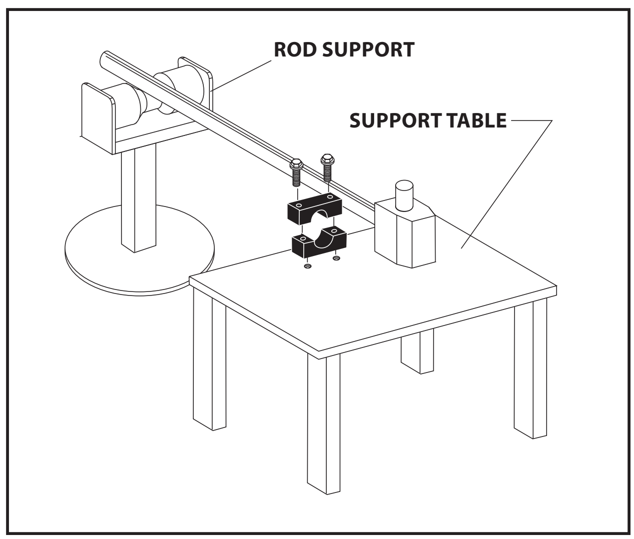
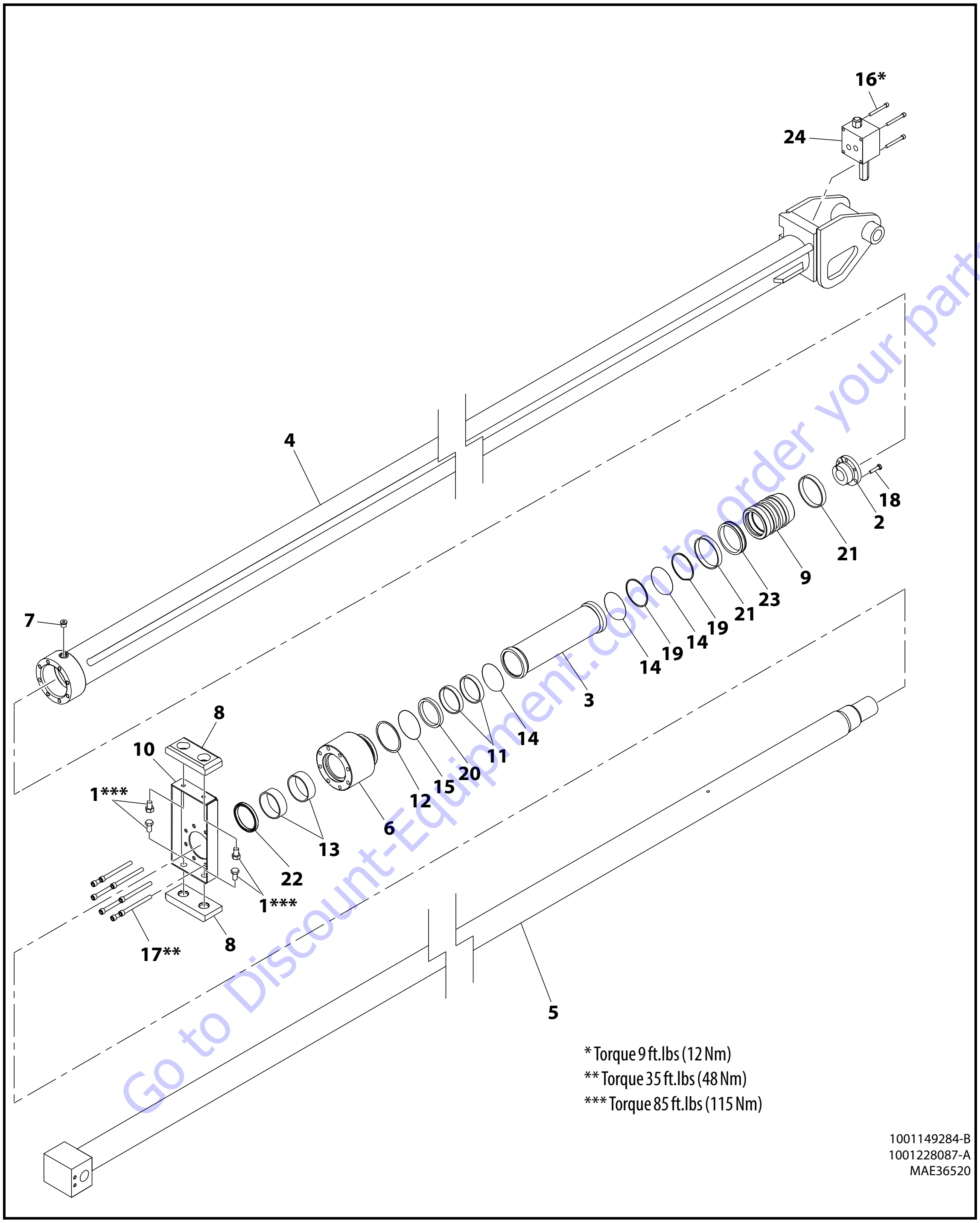


Figure 5-119. Cylinder Rod Support



1. Bolt
2. Tapered Bushing
3. Tube Spacer
4. Barrel
5. Rod
6. Head
7. O-ring Plug
8. Wear Pad
9. Piston
10. Plate
11. Wear Ring
12. Backup Ring
13. Wear Ring
14. O-ring
15. O-ring
16. Capscrew
17. Capscrew
18. Bolt
19. Backup Ring
20. Rod Seal
21. Wear Ring
22. Wiper
23. T-Seal
24. Valve Assembly

Figure 5-120. Main Boom Telescopic Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.

10. Remove the bushing from the piston.

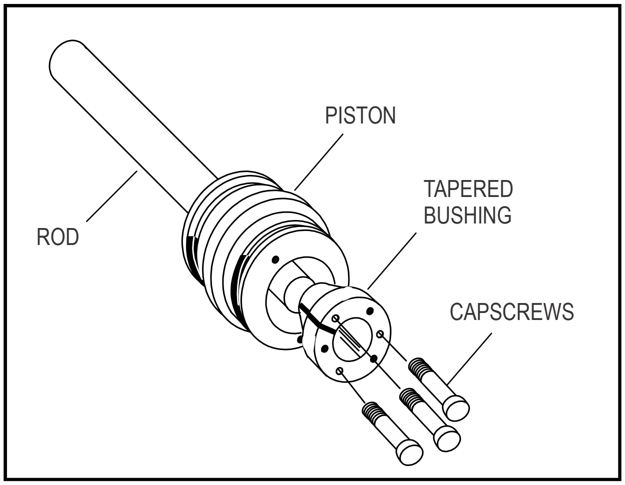


Figure 5-121. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.

12. Remove and discard the piston o-rings, seal rings, and backup rings.

13. Remove o-rings from piston spacer. Remove piston spacer from the rod.

14. Remove capscrews to remove plate and wear pads.

15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.

2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.

6. Inspect threaded portion of piston for damage. Dress threads as necessary.

7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.

8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.

9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.

10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.

11. 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 inside of steel bushing prior to bearing installation.

    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

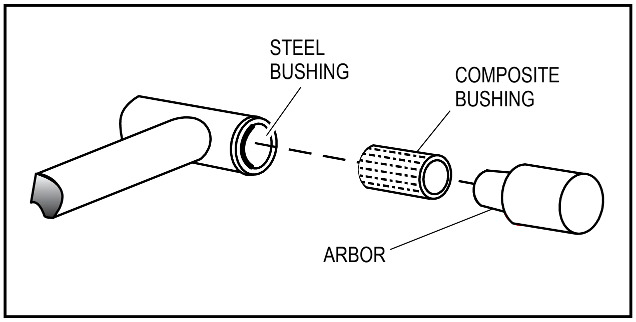


Figure 5-122. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
13. If applicable, inspect port block fittings and holding valve. Replace as necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

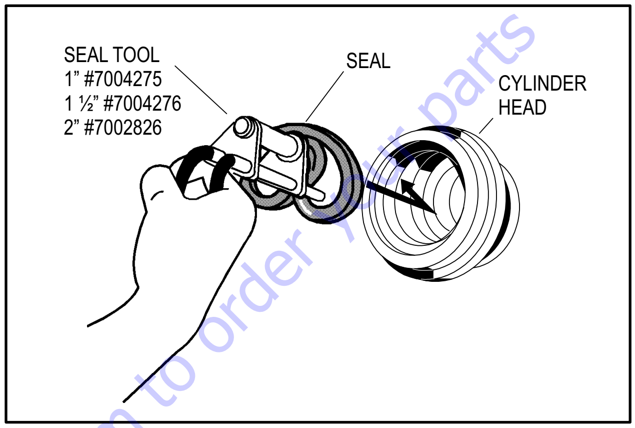


Figure 5-123. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

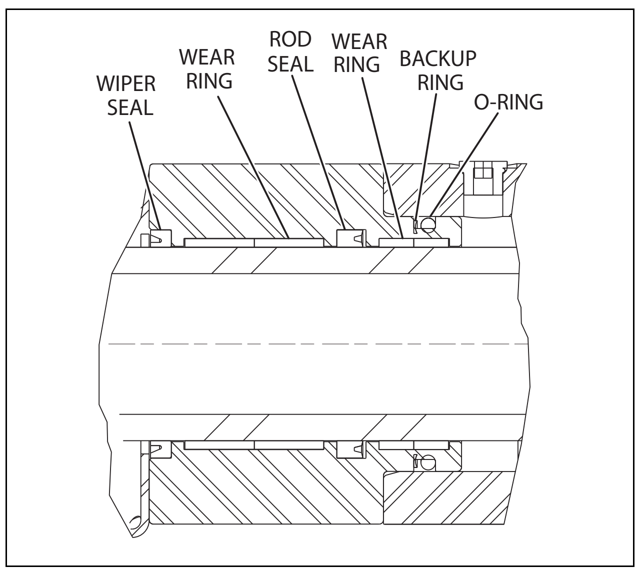
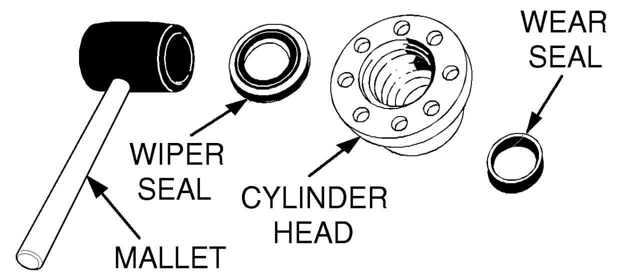


Figure 5-124. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-125. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

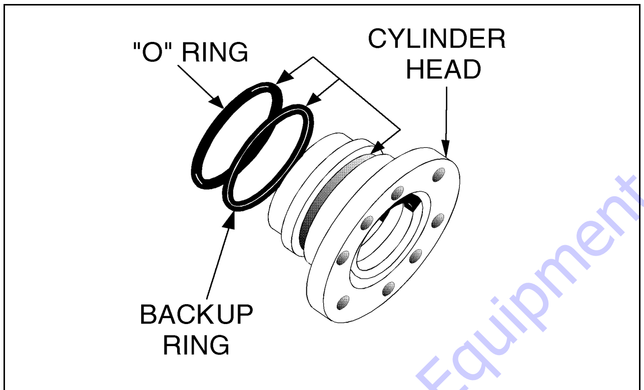


Figure 5-126. Installation of Head Seal Kit

4. Install plate on to the rod. Use capscrews to attach wear pads on the plate.

5. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

6. Install o-rings inside grooves of the piston spacer. Carefully slide the spacer on the rod.

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

8. Place a new o-ring and backup rings in the inner piston diameter groove.

9. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

10. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

11. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

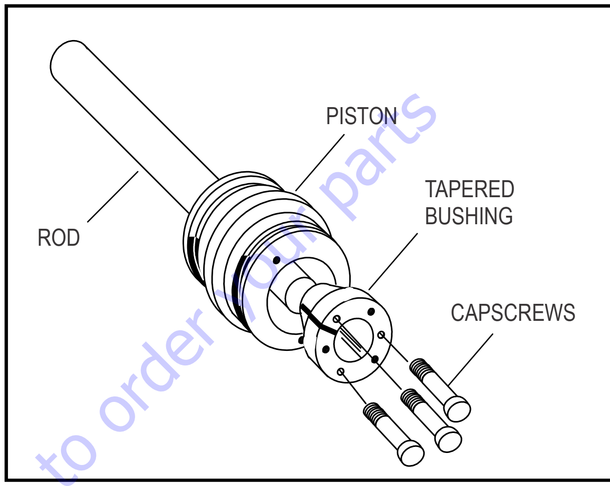


Figure 5-127. Tapered Bushing Removal

12. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

13. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

   a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

   b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

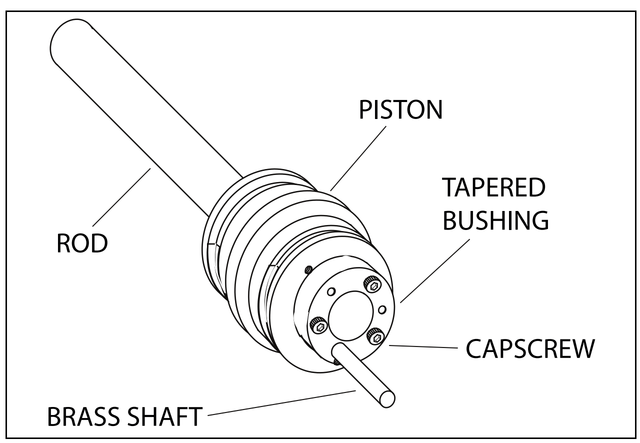


Figure 5-128. Seating the Tapered Bearing

14. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

15. Remove the cylinder rod from the holding fixture.

16. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

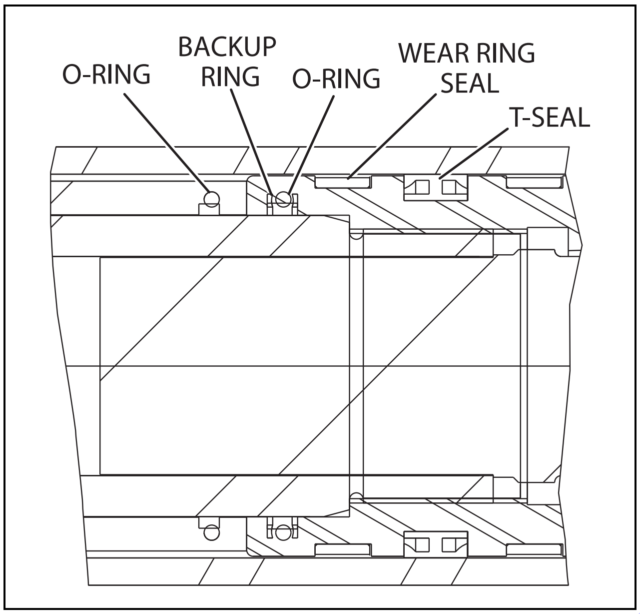


Figure 5-129. Piston Seal Kit Installation

17. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

18. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

19. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

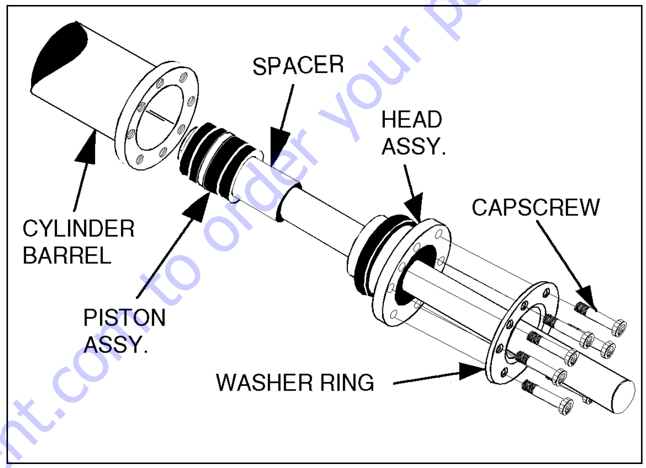


Figure 5-130. Rod Assembly Installation

20. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 35 ft.lbs. (50 Nm).

21. 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.

22. Install the valve assembly. Torque capscrews to 9 ft.lbs. (12 Nm).

Tower Boom Telescope Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

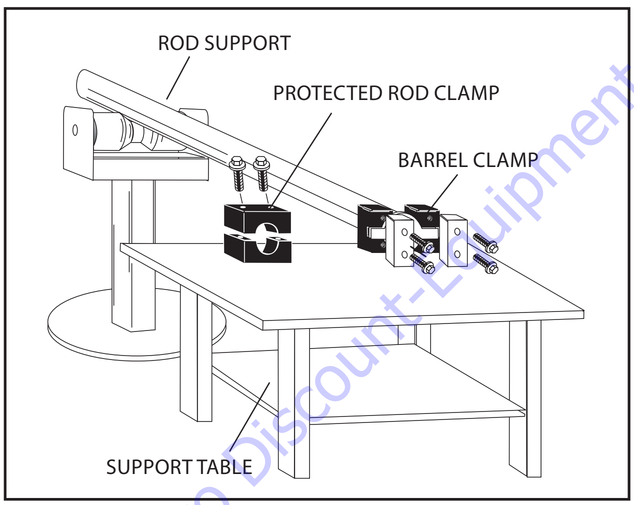


Figure 5-131. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

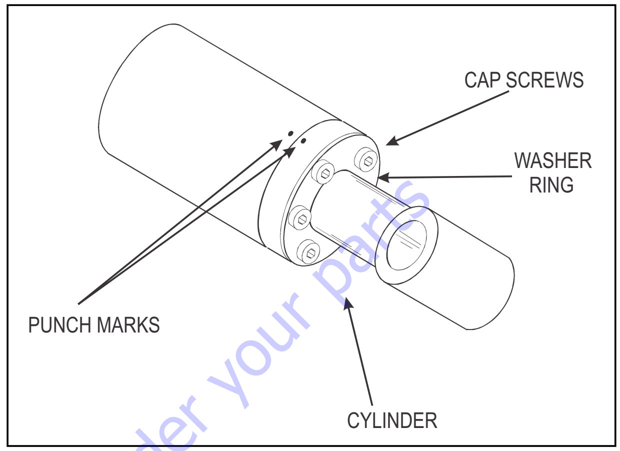


Figure 5-132. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

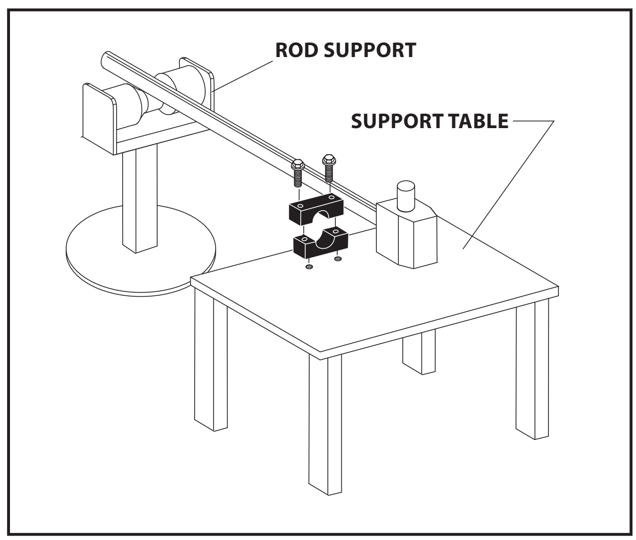
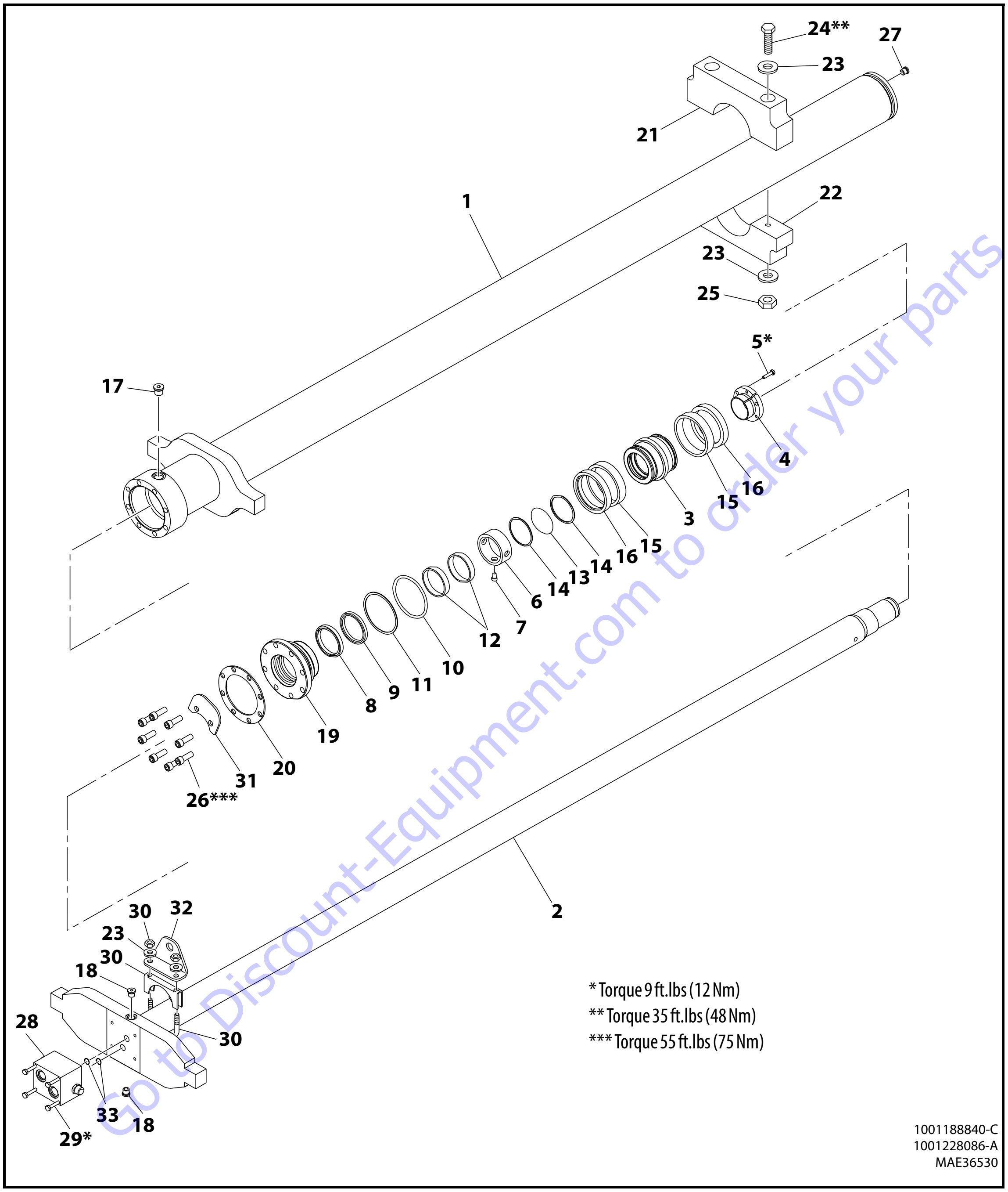


Figure 5-133. Cylinder Rod Support



1. Barrel
2. Rod
3. Piston
4. Tapered Bushing
5. Bolt
6. Tube Spacer
7. Setscrew
8. Wiper
9. Seal
10. O-ring
11. Backup Ring
12. Wear Ring
13. O-ring
14. Backup Ring
15. Seal
16. Lock Ring
17. O-ring Plug
18. O-ring Plug
19. Head
20. Washer Ring
21. Support Pad
22. Support Pad
23. Flatwasher
24. Bolt
25. Locknut
26. Capscrew
27. O-ring Plug
28. Valve Assembly
29. Capscrew
30. Clamp
31. Target Plate
32. Target Plate
33. O-ring

Figure 5-134. Tower Boom Telescopic Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

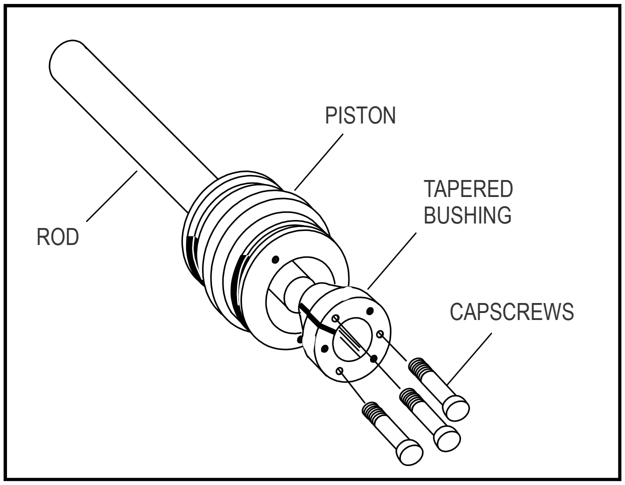


Figure 5-135. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove setscrew from the piston spacer. Remove spacer from the rod.
14. Remove the rod from the holding fixture. Remove capscrews, target plate and washer ring. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

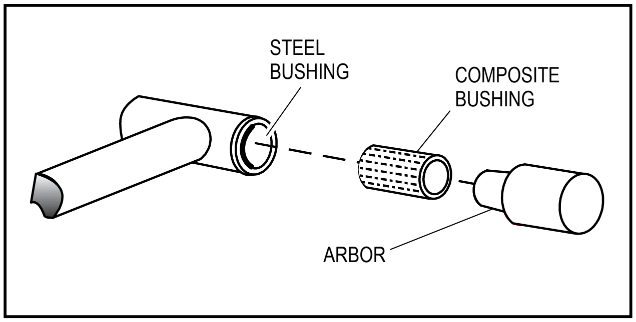


Figure 5-136. Composite Bearing Installation

12. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
13. If applicable, inspect port block fittings and holding valve. Replace as necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

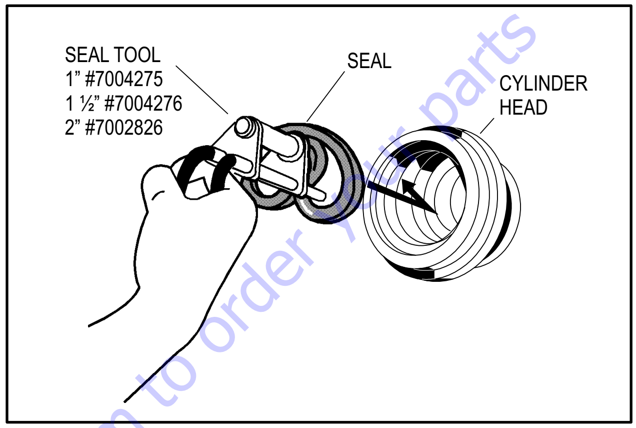


Figure 5-137. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

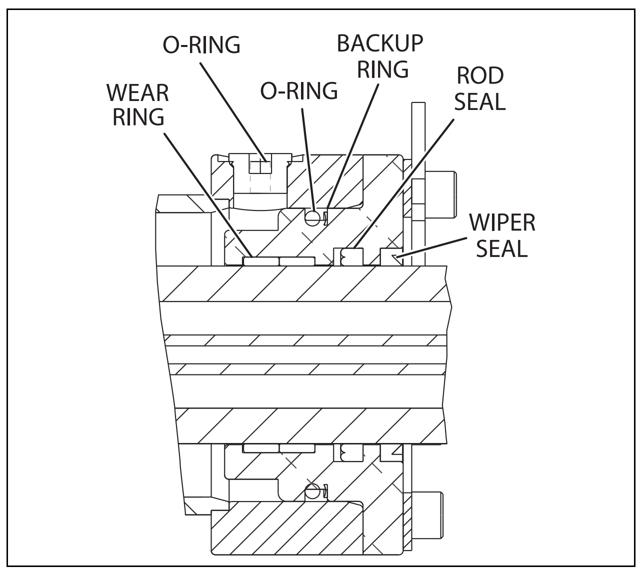
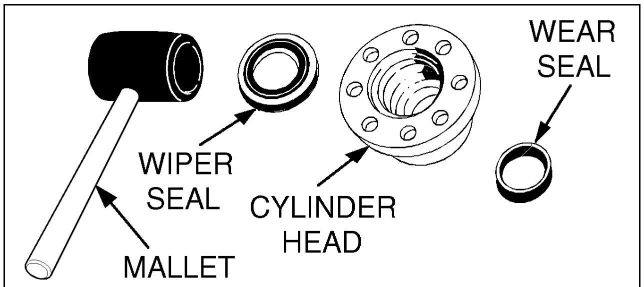


Figure 5-138. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-139. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

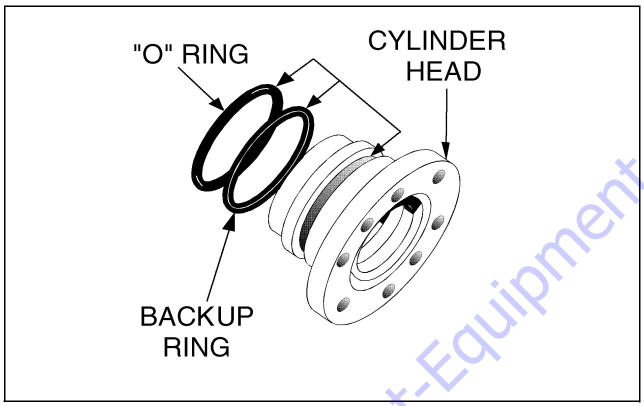


Figure 5-140. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod. Install setscrew on the spacer.

6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

7. Place a new o-ring and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

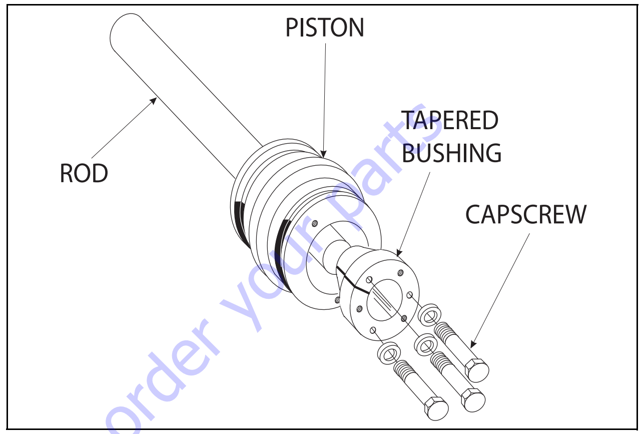


Figure 5-141. Tapered Bushing Installation

11. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

   a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

   b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

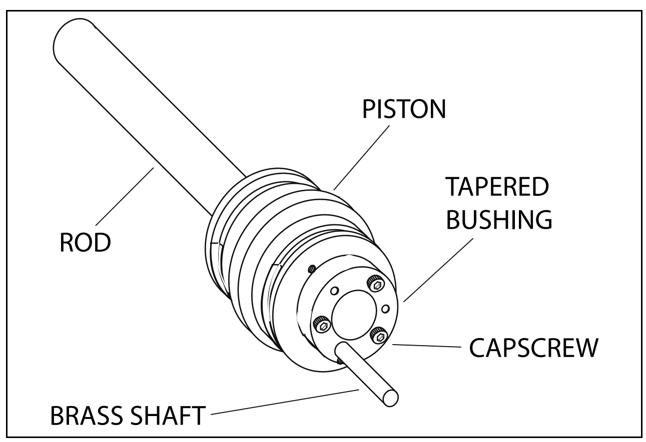


Figure 5-142. Seating the Tapered Bearing

13. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

14. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

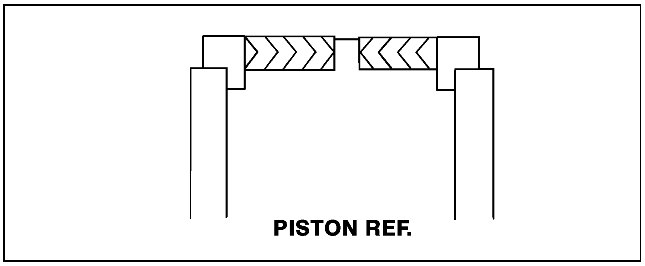


Figure 5-143. Hydrolock Piston Seal Installation

15. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

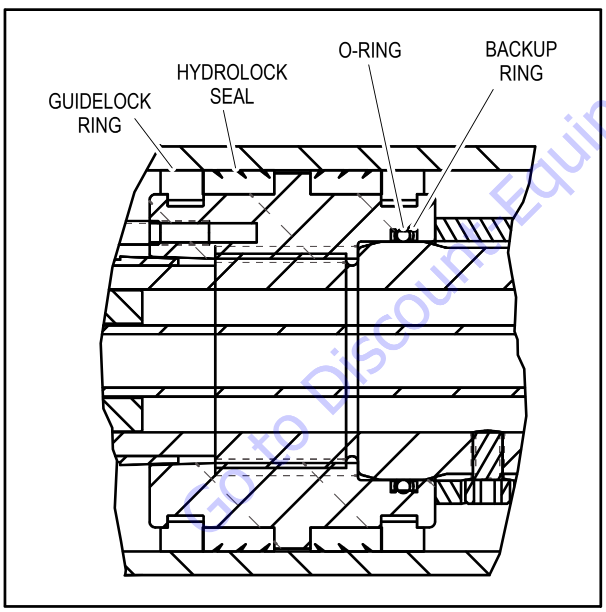


Figure 5-144. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

17. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

18. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

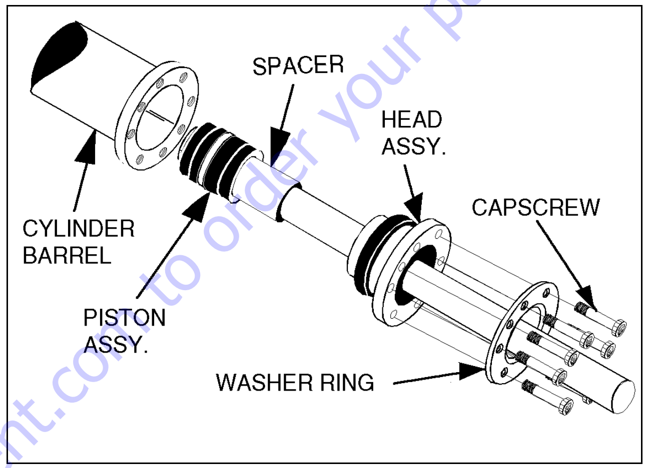


Figure 5-145. Rod Assembly Installation

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 55 ft.lbs. (74 Nm).

20. 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.

21. Install the valve assembly. Torque capscrews to 9 ft.lbs. (12 Nm).

5.4 PRESSURE SETTING PROCEDURES

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 ± 5% of specified pressures.

To ensure all pressures are set correctly, the following procedures must be followed in order.

1. All applicable steps must be followed.
2. Set up of the function pump.
3. Adjustments Made at the Main Valve Block.
4. Adjustments Made at the Platform Valve Block

Set Up the Function Pump

(the pump that is mounted on the back of the drive pump).

1. **Set Stand by pressure or load sense pressure**

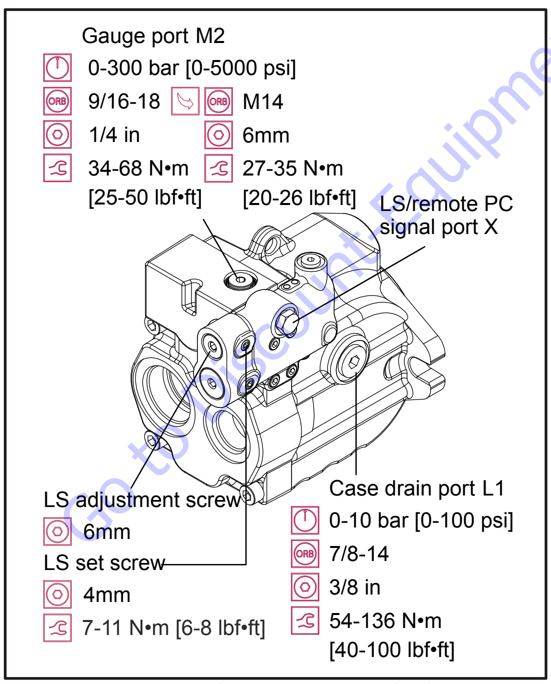


Figure 5-146. Load Sensing Control Adjustment

a. Install a low pressure gauge at port **"MP"** of the main valve block. A gauge capable of reading **400 psi (27.58 bar)**.

b. Start the engine and let it idle. The gauge should be reading **400-440 psi (28-30 bar).**

c. To make an adjustment to this pressure, go to the engine compartment, locate the function pump. There are (2) adjustments at the top of the pump. They are located on the pump compensator which has (4) bolts mounting it to the pump. The stand by adjustment is at the top.

d. To adjust this, a 4 mm and 6 mm Allen wrench will be needed. The adjustment screw is facing the front of the pump, or toward the engine. First, using the 4 mm wrench, loosen the setscrew on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn.

e. Then using the 6 mm wrench adjust the main adjustment clockwise to increase or counter-clockwise to decrease. The pressure should read between **400-440 psi (27.58-30.34 bar)**.

2. **Set High pressure relief**

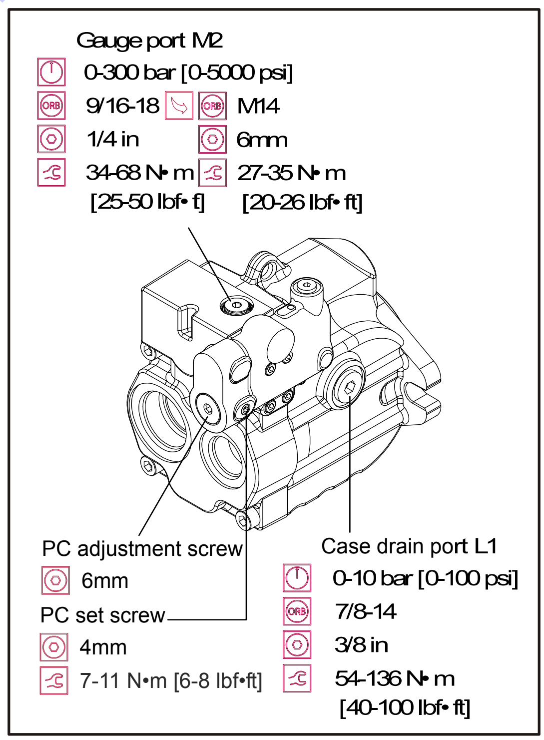


Figure 5-147. Pressure Compensation Control Adjustment

a. Install a high pressure gauge at the **"MP"** port of the main valve block.

b. Activate main boom telescope in. The gauge should read **2600-2700 psi (179-186 bar).**

c. To make an adjustment to this pressure, go back to the engine compartment to the function pump. The high pressure relief adjustment is the lower one of the (2) on the compensator. To adjust this, a 4 mm and 6 mm Allen wrench will be needed. The adjustment screw is facing the front of the pump, or toward the engine.

d. First, using the 4 mm wrench, loosen the setscrew on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn.

e. Then using the 6 mm wrench adjust the main adjustment clockwise to increase or counter-clockwise to decrease. This is the **maximum** relief pressure for all functions governed by this pump.

Adjustments Made at the Main Valve Block

MAIN LIFT DOWN

3. Install a high pressure gauge (3000 psi) into the external pressure tap at the tee fitting in port L.S of main control valve. Right side of manifold.

4. Activate main boom lift down. The gauge should read **2100 psi (145 bar)**.

5. The adjustment cartridge is located to the right of port # T2. Turn clockwise to increase, counterclockwise to decrease.

SWING

NOTE: *left and right are done with one adjustment.*

1. Install a high pressure gauge at the "**MP**" port of the main valve block. Lock the turn-table lock pin.

2. Activate swing, the gauge should read **1400 psi (97 bar)**. The adjustment cartridge is located on the right side of the block, right above "**MP**".

3. Turn clockwise to increase, and counterclockwise to decrease.

2 WHEEL STEER

1. Install a high pressure gauge at the "**MS**" port of the main valve block. Activate steer left or right. The gauge should read **1800 psi (124 bar)** (2-wheel steer) both directions.

2. One relief cartridge is located on the right side of the block, above port "**MS**". The other one is located on the left side next to port #15.

3. Turn clockwise to increase, and counterclockwise to decrease.

4 WHEEL STEER

1. Install a high pressure gauge at the "**MS**" port of the main valve block.

2. Activate front wheel steer left or right. One relief cartridge is located on the right side of the block, above port "**MS**". The other one is located on the left side next to port #15.Turn clockwise to increase, counterclockwise to decrease.

3. Adjust **2350 psi (162 bar)** front steer. Remove the coil from the front wheel steer directional valve.

4. Activate 4 wheel steer. Adjust the rear wheel steer reliefs to **2250 psi (155 bar)**. Those reliefs are located on the both sides of the 4-wheel steer block bolted on the top of the main control valve.

5. There must be a minimum of 100 psi difference between the front axle reliefs and rear axle reliefs.

TOWER TELESCOPE OUT

1. Install a high pressure gauge at gauge port **"M2"** located on the right side of the valve block, at the bottom.

2. Activate tower telescope out, the gauge should read **2200 psi (152 bar)**. This can be done with the tower lift down or up. If the tower lift is up, you must run tower telescope out to the end of stroke.

3. The tower telescope out relief valve is located on the left side, at the bottom next to port #2. Turn clockwise to increase, counterclockwise to decrease.

Adjustments Made at the Platform Valve Block

PLATFORM LEVEL UP

1. Install a high pressure gauge at the gauge port **"M1"** of the platform valve. There is pressure trapped at this test port.

2. To release this Pressure, activate level down to the end of stroke (the pressure in the up side goes to 0). This will allow you to snap a gauge on at this port.

3. Activate level up to the end of stroke, the gauge should read 2600-2700 psi (179-186 bar). The level up relief valve is located next to the port **"M1"**.

4. Turn clockwise to increase, and counterclockwise to decrease.

PLATFORM LEVEL DOWN

1. Install a high pressure gauge at gauge port **"M2"**, of the Platform Valve.
2. To get a gauge on this point activate level up to the end of stroke (the pressure in the down side will go to 0, allowing you to snap a gauge on).
3. Activate level down to the end of stroke, reading 1800 psi. The level down relief valve is located next to Port **"M2".**
4. Turn clockwise to increase, counterclockwise to decrease.

ARTICULATING JIB DOWN.

1. Install a high pressure gauge at the gauge port **"M3"** of the platform valve.
2. Activate jib down, you should read **1500 psi (103 bar)**. The down relief valve is located next to port **M3**.
3. Turn clockwise to increase, and counterclockwise to decrease.

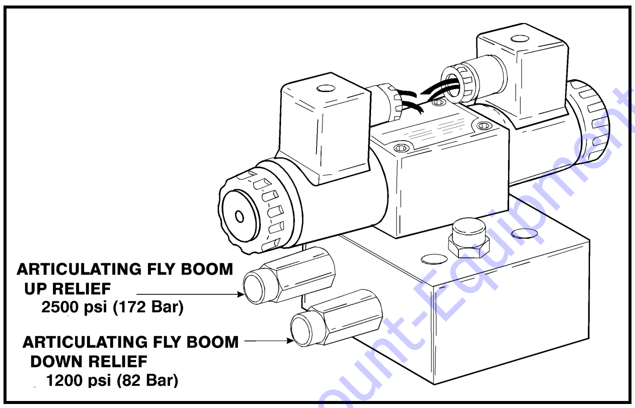


Figure 5-148. Articulating Jib Boom Pressure adjust.

4 WHEEL STEER (IF EQUIPPED)

1. At the platform console using the steer select switch activate "4 wheel steer".
2. Install a pressure gauge in port **"G"** on the control valve.
3. With the aid of an assistant, activate steer left and right, adjust front steer relief valve to **2500 psi (172.4 bar)**. This pressure only affects the front axle.
4. At the platform console using the steer select switch activate "crab" or "coordinated" steer.
5. At the main control valve block disconnect the wire din connectors on the front steer valve. When steer is activated only the rear steer will work.
6. Install a pressure gauge in port **"G"** on the control valve.
7. With the aid of an assistant, activate steer left and right, adjust rear steer relief valve to **2500 psi (172 bar)** Reading at the valve bank. **2500 psi (172 bar)** will give you **2000 psi (138 bar)** at the cylinders.
8. Re-connect the front steer din connectors at the valve bank.

5.5 HYDRAULIC COMPONENT START-UP PROCEDURES AND RECOMMENDATIONS

From a hydrostatic component standpoint, the goal at system start up is to put into functional operation, the hydrostatic system in such a way as to preserve the designed life span of the system. The following start-up procedure should be adhered to whenever a new pump or motor is initially installed into a machine, or a system is restarted after either a pump or motor has been removed and/or replaced.

⚠ WARNING

THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, WORK FUNCTIONS DISCONNECTED, ETC.). WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY. TAKE NECESSARY SAFETY PRECAUTIONS BEFORE MOVING THE VEHICLE/MACHINE.

Prior to installing the pump and/or motor, inspect the unit(s) for damage that may have been incurred during shipping and handling. Make certain that all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Fill the reservoir with recommended hydraulic fluid. This fluid should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components, which may result in unexpected vehicle/machine movement.

NOTE: *If a pump or motor is being replaced due to internal damage, the remaining units (pump or motors) need to be inspected for damage and contamination, and the entire hydraulic system will need to be flushed and the fluid replaced. Failure to do so may cause considerable damage to the entire system.*

The inlet line leading from the reservoir to the pump must be filled prior to start-up. Check the inlet line for property tightened fittings and make sure it is free of restrictions and air leaks.

NOTE: *In most cases, the reservoir is above the pump inlet so that the pressure head created by the higher oil level helps to keep the inlet pressures within an acceptable range and prevent high vacuum levels. However, due to hose routing or low reservoir locations, there may be air trapped within this line. It is important to assure that the air is bled from this line. This can be accomplished by loosening the hose at the fitting closest the pump. When oil begins to flow, the line is full, the air has been purged, and the fitting can be retightened to its specified torque. If the tank needs to be pressurized in order to start the flow of oil, a vacuum reading should be taken at the inlet of the pump during operation in order to verify that the pump is not being asked to draw an inlet vacuum higher than it is capable of.*

Be certain to fill the pump and/or motor housing with clean hydraulic fluid prior to start up. Fill the housing by pouring filtered oil into the main case drain port.

NOTE: *It is highly recommended to use the highest possible case drain port, this ensures that the housing contains as much oil as possible and offers the greatest amount of lubrication to the internal components.*

NOTE: *In initial start-up conditions, it may be convenient to fill the housing, just prior to installing the case drain line. Component, (especially motor), location may be such that access to the case drain port after installation is not realistic.*

NOTE: *Make certain that the oil being used to fill the component housing is as clean as possible, and store the fill container in such a way as to prevent it from becoming contaminated.*

Install a 60 bar (or 1000 psi) pressure gauge in the charge pressure gauge port in order to monitor the charge pressure during start-up.

It is recommended that the external control input signal, (electrical connections for EDC), be disconnected at the pump control until after initial start-up. This will ensure that the pump remains in its neutral position.

⚠ WARNING

DO NOT START THE ENGINE UNLESS PUMP IS IN THE NEUTRAL POSITION (0 DEGREES SWASHPLATE ANGLE). TAKE PRECAUTIONS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.

"Jog" or slowly rotate the engine until charge pressure starts to rise. Start the engine and run at the lowest possible RPM until charge pressure has been established. Excess air should be bled from the system lines as close to the motors as possible.

NOTE: *With the engine on low idle, "crack", (loosen-don't remove), the system lines at the motor(s). Continue to run the engine at low idle and tighten the system lines as soon as oil is observed to leak from them. When oil is observed to "leak" at the motor the line is full, the air has been purged, and the system hoses should be retightened to their specified torque.*

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be as indicated in the pump model code. If charge pressure is inadequate, shut down and determine the cause for improper pressure.

⚠ WARNING

INADEQUATE CHARGE PRESSURE WILL AFFECT THE OPERATOR'S ABILITY TO CONTROL THE MACHINE.

Shut down the engine and connect the external control input signal. Also reconnect the machine function(s), if disconnected earlier. Start the engine, checking to be certain the pump remains in neutral. With the engine at normal operating RPM, slowly check for forward and reverse machine operation.

Charge pressure may slightly decrease during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

Shut down engine, remove gauges, and plug ports. Check reservoir level and add filtered fluid if needed.

The machine is now ready for operation.

5.6 HYDRAULIC DRIVE PUMP PRE-FILL PROCEDURE

⚠ CAUTION

HYDRAULIC DRIVE PUMP MUST BE PRE-FILLED BEFORE STARTING THE ENGINE. FAILURE TO DO SO CAN CAUSE PREMATURE FAILURE OF THE PUMP.

1. Fill the hydraulic reservoir.
2. Determine if the hydraulic oil tank sight level gauge is higher than other hydraulic components.
   a. Determine if the hydraulic oil tank sight level gauge is higher than the hydraulic drive pump assembly.
   b. Determine if the hydraulic oil tank sight level gauge is higher than all hydraulic hope loops and the routings between the hydraulic tanks and the hydraulic drive pump assembly.
   c. If sight level gauge is the highest hydraulic oil level point, proceed to step 3.
   d. if sight level gauge is NOT the highest oil level point, low pressure air may need to applied to the hydraulic oil tank (fill cap via air regulator) in conjunction with step 4 to get hydraulic oil to move over the air locks created by these high spots.
3. If the machine is to be equipped with a hydraulic oil cooler option.
   a. Determine if there is hydraulic "tee" fittings installed at the hydraulic drive pump that has a "cap" fittings attached to it. (this will generally be at or near the top of the hydraulic drive pump body). This "cap" fitting is to be used to manually fill the hydraulic drive pump case.
   b. Remove "cap" fitting.
   c. Fill hydraulic drive pump case with hydraulic oil.
   d. Attach and torque "cap" fitting.
   e. Pre-filling of hydraulic drive pump w/oil cooler option is complete. (Step #4 can be omitted at this point).
4. If machine is NOT equipped with a hydraulic oil cooler option.
   a. Locate a case access port on the hydraulic drive pump. Preferably one located on at or near the top or under sides of the pump.
   b. Using the proper wrench, Remove the O-ring plug to allow air to escape from the hydraulic drive pump case.
   c. Hydraulic oil will flow by gravity from the hydraulic tank to the drive pump.
   d. The pump is full, when hydraulic oil starts to flow out of this port.
   e. Install the O-ring plug and torque.
5. Pre-filled of the hydraulic drive pump is complete.