JLG®

An Oshkosh Corporation Company

Service and Maintenance Manual

Models
EC600SJ,
H600SJ,
EC600SJP,
H600SJP

PVC 2001

31215028

Sepetember 12, 2019 - Rev A

ANSI

CE

AS/NZS

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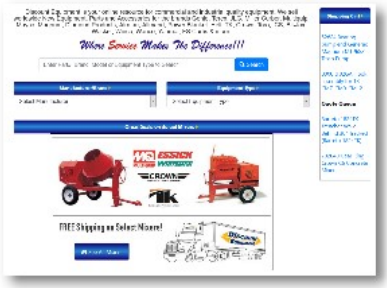

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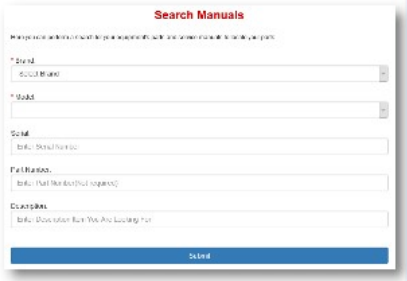

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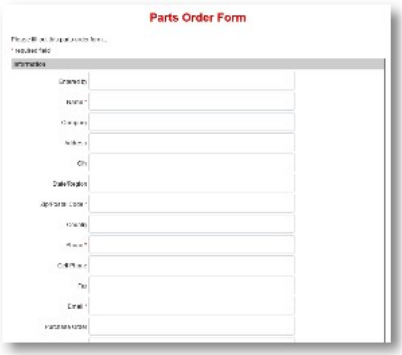

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

MODIFICATION OR ALTERATION OF A MOBILE ELEVATING WORK PLATFORM SHALL BE MADE ONLY WITH WRITTEN PERMISSION FROM THE MANUFACTURER.

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

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

⚠ WARNING

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

B HYDRAULIC SYSTEM SAFETY

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

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

C MAINTENANCE

⚠ WARNING

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

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

REVISON LOG

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FIGURE NO. **TITLE** **PAGE NO.**

FIGURE NO. **TITLE** **PAGE NO.**

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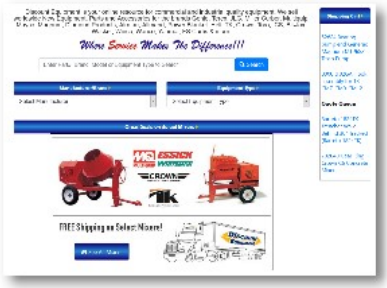

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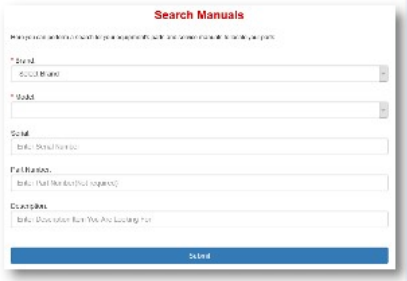

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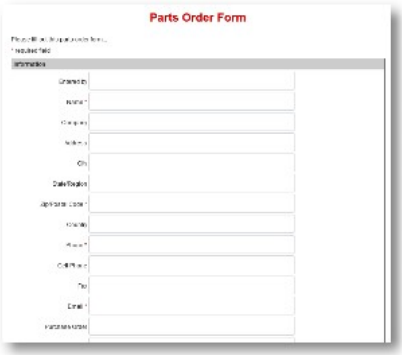

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Machine Specifications

Maximum Work Load (Capacity) ANSI Markets Unrestricted:	500 lb (227 kg)
Maximum Work Load (Capacity) CE & Australia Markets Unrestricted:	500 lb (230 kg)
Maximum Travel Grade (Gradeability) with Boom retracted and approximately horizontal. Tower Boom fully lowered.)	30%
Maximum Travel Grade (Side Slope) with Boom retracted and approximately horizontal. Tower Boom fully lowered.	5°
Tilt Alarm Setting (See Section 3) 600SJ/H600SJ 600SJP/H600SJP	 4° 3°
Maximum Vertical Platform Height:	60 ft. (18.29 m)
Maximum Horizontal Platform Reach EC600SJ/H600SJ EC600SJP/H600SJP	 43 ft. 3 in.(13.19 m) 44 ft. 5 in. (13.56 m)
Machine Width 2WD 4WD	 7.94 ft. (2.42 m) 7.94 ft. (2.42 m)
Machine Length EC600SJ/H600SJ EC600SJP/H600SJP	 30.8 ft. (9.38 m) 33.3 ft. (10.15 m)
Turning Radius (outside)	15.26 ft. (4.65 m)
Turning Radius (inside)	4 ft. (1.23 m)
Maximum Tire Load:	7700 lb (3493 kg)
Maximum Ground Bearing Pressure EC600SJ/H600SJ EC600SJP/H600SJP	 52 psi (3.7 kg/cm2) 51 psi (3.6 kg/cm2)
Maximum Drive Speed:	4.0 mph (1.79 m/s)
Electrical System Voltage	48 volts
Maximum Hydraulic System Pressure	3200 psi (221 Bar)
Maximum Wind Speed	28 mph (12.5 m/s)
Maximum Manual Force	400N
Gross Machine Weight (Platform Empty) EC600SJ/H600SJ EC600SJP/H600SJP	 16,710 lb (7,580 kg) 17,210 lb (7,807 kg)

1.2 CAPACITIES

Generator Fuel Tank (H Models Only)	13 gal. (49.2L)
Hydraulic Tank	15.9 gal.(60.2 L) 12.4 gal. (46.9 L) to full mark
Drive Hub	0.4 gal. (1.5 liters)

1.3 TIRES

Size	Type	Pressure
36/14 LL-22.5	foam filled	N/A

1.4 FUNCTION SPEED

Function	Speed (In Seconds)
Main Lift Up & Down	55-61
Swing Right & Left	72-84
Main Telescope In & Out	46-50
Jib Lift Up	25-27
Jib Lift Down	21-23
Jib Swing Right & Left (EC600SJP/H600SJP)	30-40
Platform Rotate Right & Left	12-16
Drive Below Elevation FWD	34-39
Drive Reduced/Reverse Below Elevation	65-70
Drive Above Elevation (ANSI- EC600SJP / EC600SJP) /(CE- EC600SJ & H600SJ)	112 min.
Drive Above Elevation (CE) (EC600SJP / H600SJP)	112 min.

1001250453-A

1.5 BATTERIES

Description	DOUGLAS	AGM
Battery Type	6V-415S	EVL16A-A
Number of Cell	3	3
AMP Hours Rating (@20 hr)	415 Ah	390 Ah
Reserve Capacity (Minutes)	890	841

1.6 HYDRAULIC OIL

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

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.*

NOTE: *When temperatures remain consistently below 15°F. (-9° C.), JLG Industries recommends the use of Premium Hydraulic Fluid.*

Table 1-1. DTE 10 Excel 15 Specs

ISO Viscosity Grade	15
Pour Point, Max	-65°F (-54°C)
Flash Point, Min	360°F (182°C)
Viscosity	
at 40° C	15.8 cSt
at 100° C	4.1 cSt
at 100° F	15.8 cSt
at 210° F	4.1 cSt
Viscosity Index	168

Table 1-2. Mobil EAL Envirosyn H 32 Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	32
Density at 15° C	.869
Pour Point, Max	-38°F (-39°C)
Flash Point, Min.	514°F (268°C)
Viscosity	
at 40° C	33.1 cSt
at 100° C	6.36 cSt
Viscosity Index	147

Table 1-3. Mobil EAL Envirosyn SHC 32 Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	32
Density at 15° C	.936
Pour Point, Max	-27°F (-33°C)
Flash Point, Min.	540°F (282°C)
Viscosity	
at 40° C	33.1 cSt
at 100° C	6.2 cSt
Viscosity Index	152

Table 1-4. DTE 10 Excel 32 Specs

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

1.7 TORQUE REQUIREMENTS

Description	Torque Value (Dry)	Interval Hours
Wheel Lugs	170 ft. lbs.(238 Nm)	150
T/T Counterweight Bolts	400 ft.lbs.(560 Nm)	A/R
Swing Bearing Bolts	190 ft.lbs.(260 Nm)	50/600*
*Check swing bearing bolts for security after first 50 hours of operation and every 600 hours thereafter. (See Swing Bearing in Section 3.)		
NOTE: *When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart to determine proper torque value.*		

1.8 MAJOR COMPONENT WEIGHTS

Component	Pounds	Kilograms
Frame (bare)	1381	626
T/T (bare)	2093	950
Boom Assembly (EC600SJ/H600SJ)	4464	2025
Boom Assembly (EC600SJP/H600SJP)	4464	2025
Tire & Wheel	226	102.5
Swing Drive	70	32
Swing Bearing	100	45.4
Platform Console	25	11
Side Entry Platform - 30x72 (bare)	175	80
Side Entry Platform - 30x48 (bare)	144	66
Counterweight	2560	1161

1.9 SERIAL NUMBER LOCATION

A serial number plate is affixed to the right side of the frame. If the serial number plate is damaged or missing, the machine serial number is stamped on the left side of the frame at the top.

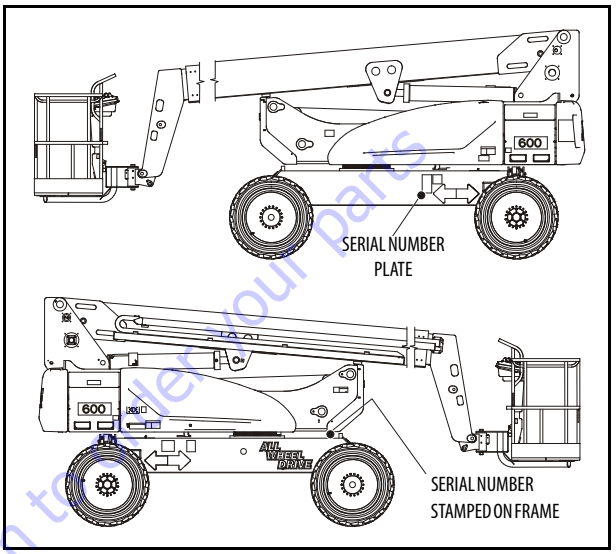


Figure 1-1. Serial Number Location

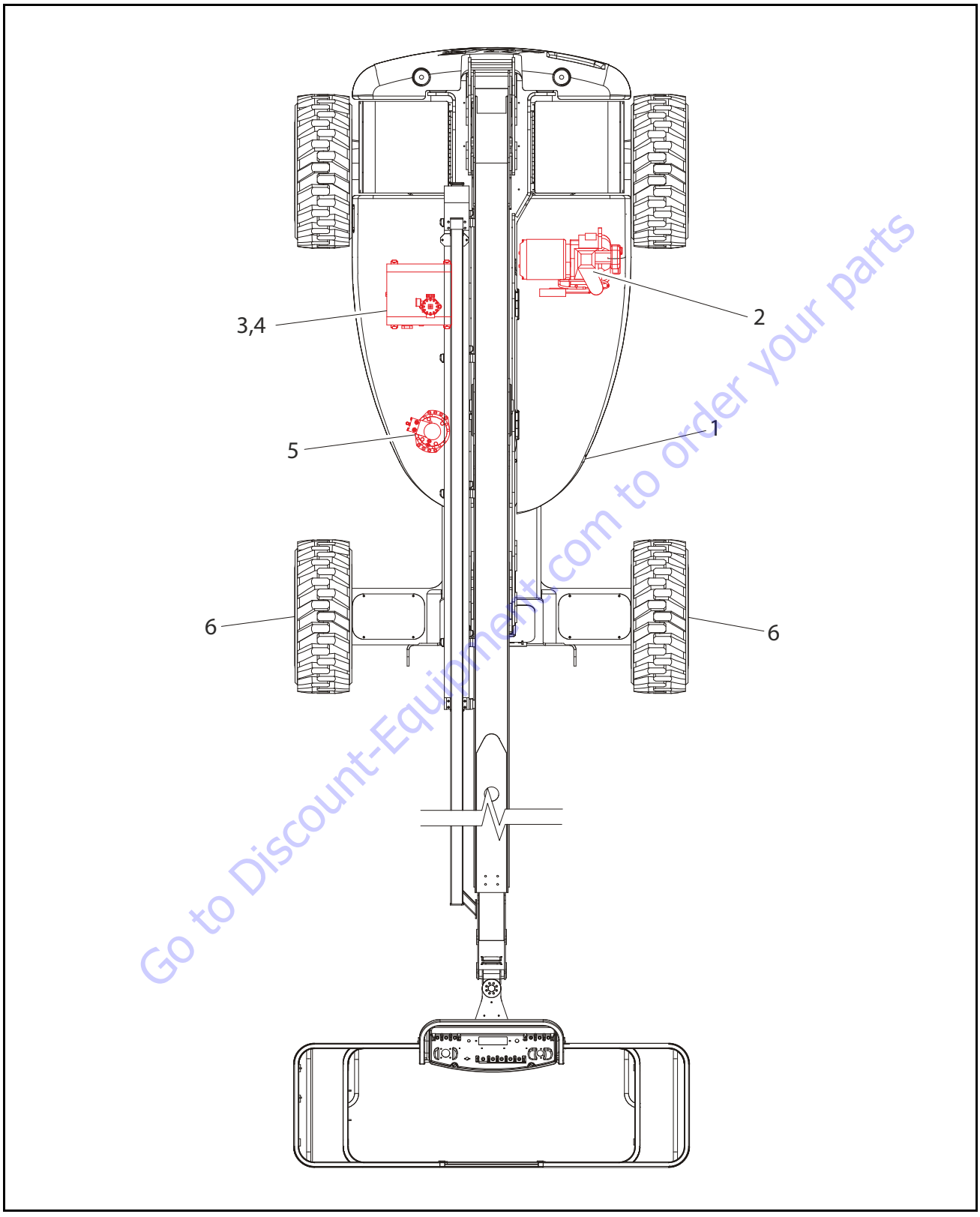


Figure 1-2. Operator Maintenance and Lubrication Diagram

1.10 OPERATOR MAINTENANCE

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

Table 1-5. Lubrication Specifications.

Key	Specification
MPG	Multipurpose Grease having a minimum dripping point of 350 degrees F. Excellent water resistance and adhesive qualities; and being of extreme pressure type (Timken OK 40 pounds minimum).
EPGL	Extreme Pressure Gear Lube (oil) meeting API Service Classification GL-5 or Mil-Spec Mil-L-2105.
HO	Hydraulic Oil. Mobil DTE-11M
OG*	Open Gear Lube - Tribol Molub-Alloy 936 Open Gear Compound. (JLG Part No. 3020027)
BG*	Bearing Grease (JLG Part No. 3020029) Mobilith SHA 460.
LL	Synthetic Lithium Lubricant, Gredag 741 Grease. (JLG Part No. 3020022)
EO	Engine (crankcase) Oil. Gas - API SF/SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.
*MPG may be substituted for these lubricants, if necessary, but service intervals will be reduced.	

NOTICE

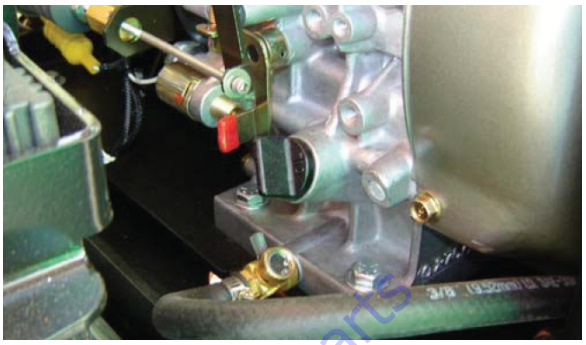
LUBRICATION INTERVALS ARE BASED ON MACHINEOPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTISHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

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

1. Swing Bearing - Internal Ball Bearing

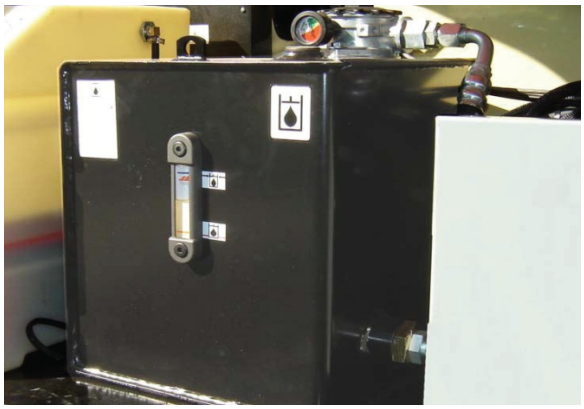
Lube Point(s) - 1 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

2. Generator Engine (If Equipped)



Lube Point(s) - Fill Cap
Capacity - Refer to Engine Manual
Lube - EO
Comments - Check daily.Change in accordance with engine manual.

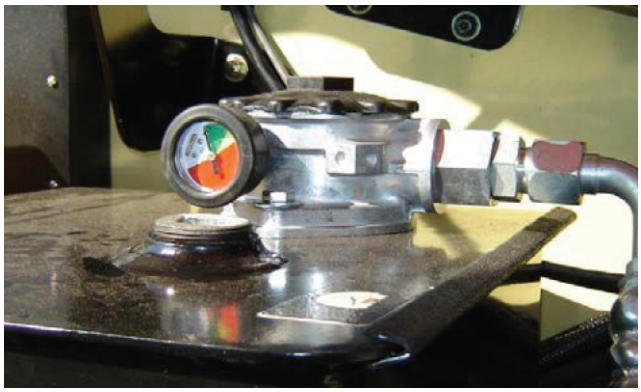
3. Hydraulic Tank



Lube Point(s) - Fill Cap

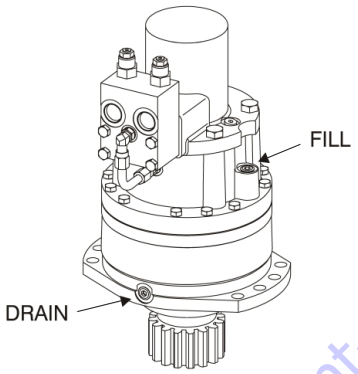
Capacity -15.9 gal. system (56.7L) 12.4 gal. (46.9 L) to Full Mark
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.

4. Hydraulic Filter



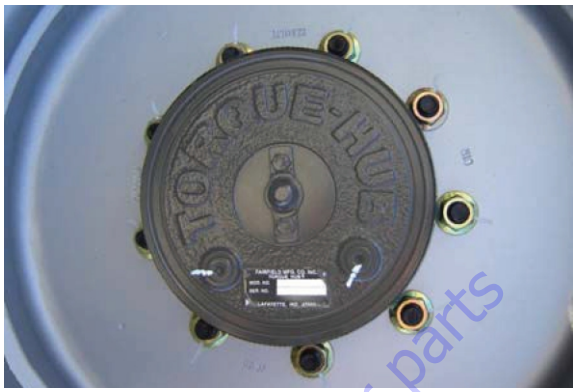
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter or as indicated by Condition Indicator.
Comments - Under certain conditions, it may be necessary to replace the filter on a more frequent basis.

5. Swing Drive Hub



Lube Point(s) - Level/Fill Plug
Capacity - 24 oz. (0.7 L)
Lube - EPGL
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

6. Wheel Drive Hub



Lube Point(s) - Level/Fill Plug
Capacity - 0.4 gal. (1.5 L)
Lube - EPGL
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

1.11 THREADLOCKING COMPOUND

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

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

1.12 TORQUE CHARTS

SAE Fastener Torque Chart

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8				
	48	0.1120	0.00661	420	8	0.9				
6	32	0.1380	0.00909	580	14	1.5				
	40	0.1380	0.01015	610	14	1.6				
8	32	0.1640	0.01400	900	25	2.8				
	36	0.1640	0.01474	940	26	2.9				
10	24	0.1900	0.01750	1120	36	4.1				
	32	0.1900	0.02000	1285	42	4.7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9		
	28	0.2500	0.0364	2320	99	11.1	95	11		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20
	24	0.3125	0.0580	3700	15	20	15	21	15	20
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34
	24	0.3750	0.0878	5600	30	40	28	38	25	34
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48
	20	0.4375	0.1187	7550	45	60	44	60	40	54
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75
	20	0.5000	0.1599	10700	75	100	71	97	65	88
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109
	18	0.5625	0.2030	12950	105	145	97	132	90	122
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156
	18	0.6250	0.2560	16300	145	195	136	185	125	170
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272
	16	0.7500	0.3730	23800	255	345	238	324	225	306
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435
	14	0.8750	0.5090	32400	400	545	378	514	355	483
1	8	1.0000	0.6060	38600	545	740	515	700	480	653
	12	1.0000	0.6630	42200	600	815	563	765	530	721
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809
	12	1.1250	0.8560	47500	755	1025	713	969	670	911
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237

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

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

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

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

SAE Fastener Torque Chart (Continued)

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

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

5000059K

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

3. * ASSEMBLY USES HARDENED WASHER

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

Metric Fastener Torque Chart

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

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

5000059K

Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS, CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAPSCREWS M3 - M5*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.20	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25	23	19
8	1.25	36.60	22.8	37	33	27
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

NOTES:

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

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2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0
3.5	0.6	6.78	2.95	1.8	1.7	1.5
4	0.7	8.78	3.82	2.6	2.4	2.3
5	0.8	14.20	6.18	5.3	4.9	4.6
6	1	20.10	8.74	9	8.4	7.9
7	1	28.90	12.6	15	14	13
8	1.25	36.60	15.9	22	20	19
10	1.5	58.00	25.2	43	40	38
12	1.75	84.30	36.7	75	70	66
14	2	115	50.0	119	110	105
16	2	157	68.3	186	175	165
18	2.5	192	83.5	256	240	225
20	2.5	245	106.5	362	340	320
22	2.5	303	132.0	494	465	435
24	3	353	153.5	627	590	555
27	3	459	199.5	916	860	810
30	3.5	561	244.0	1245	1170	1100
33	3.5	694	302.0	1694	1595	1495
36	4	817	355.5	2176	2050	1920
42	4.5	1120	487.0	3477	3275	3070

NOTES:

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

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Metric Fastener Torque Chart (Continued)

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

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

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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 mobile elevating work platform. The frequency of inspections and maintenance must be increased as environment, severity and frequency of usage requires.

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.
2. The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in the Lubrication Chart in Section 1. Always examine filters for evidence of metal particles.
3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.
4. It is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

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

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.
2. JLG recommends Premium Hydraulic Fluid, which has an SAE viscosity of 10W and a viscosity index of 168.

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 for evaluation.
- Damaged or worn piston seal.
- Normal thermal expansion and contraction of the hydraulic oil within cylinders (See Cylinder Thermal Drift below).

The first two circumstances may result in cylinder movement due to oil leakage 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.

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

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

Cylinder Thermal Drift

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
   a. Excessive sloppiness in joints.
   b. Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
   a. Frayed or separated fibers on the liner surface.
   b. Cracked or damaged liner backing.
   c. Bearings that have moved or spun in their housing.
   d. Debris embedded in liner surface.
3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):
   a. Detectable wear in the bearing area.
   b. Flaking, pealing, scoring, or scratches on the pin surface.
   c. Rusting of the pin in the bearing area.
4. Re-assembly of pinned joints using filament wound bearings.
   a. Housing should be blown out to remove all dirt and debris. Bearings and bearing housings must be free of all contamination.
   b. Bearing / pins should be cleaned with a solvent to remove all grease and oil. Filament wound bearing are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).
   c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

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

Do NOT Do the Following When Welding on JLG Equipment

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

NOTICE

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

Table 2-2. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL	
	Pre-Delivery[1] or Frequent[2] Inspection	Annual[3] (Yearly) Inspection
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	1,2
Railing	1	1,2
Gate	1,5	1,5
Floor	1	1,2
Rotator	5,9,15	5,9,15
Lanyard Anchorage Point	1,2,10	1,2,10
Turntable Assembly		
Swing Bearing	1,2,14	1,2,3,13,14
Oil Coupling	9	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	5,8
Outrigger or Extendable Axle Systems	5,8	5,8
Steer Components	1,2	1,2
Drive Motors	1,2	1,2
Drive Hubs	11	11
Functions/Controls		
Platform Controls	5,6	6

Table 2-2. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL	
	Pre-Delivery[1] or Frequent[2] Inspection	Annual[3] (Yearly) Inspection
Ground Controls	5,6	6
Function Control Locks, Guards, or Detents	1,5	5
Foot switch	5	5
Emergency Stop Switches (Ground & Platform)	5	5
Function Limit or Cutout Switch Systems	5	5
Capacity Indicator	5	5
Drive Brakes	5	5
Swing Brakes	5	5
Boom Synchronization/Sequencing Systems	5	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	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		
Operation and Safety Manual in Storage Box	21	21
ANSI Manual of Responsibilities and AEM Safety Manual in Storage Box (ANSI and ANSI Export Only)	21	21
Capacity Decals Installed, Secure, Legible	21	21
All Decals/Placards Installed, Secure, Legible	21	21

Table 2-2. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL	
	Pre-Delivery[1] or Frequent[2] Inspection	Annual[3] (Yearly) Inspection
Annual Machine Inspection Due	21	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:

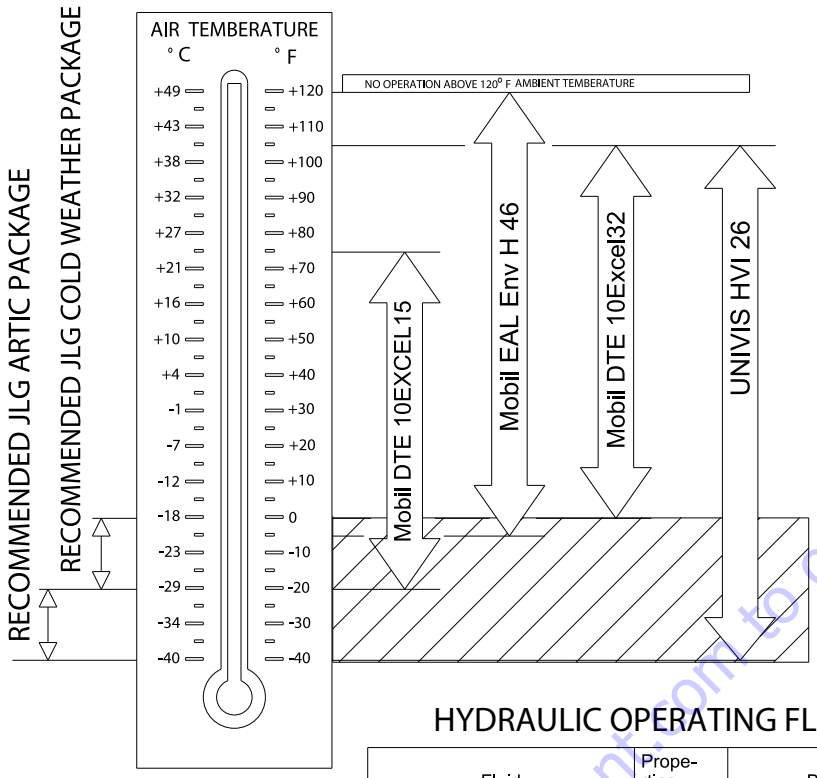
[1] Prior to each sale, lease, or delivery

[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



HYDRAULIC OPERATING FLUID CHART

Fluid	Prope-rties		Base					Classi-fication		
Description	Visc @ 40 C	Visc Index	Mineral Oils	Vegetable Oils	Synthetic	Synthetic Polyol Esters	Water Glycol	Readilly Biodegradeable*	Virtually Non-toxic**	Fire Resistant***
Mobil DTE 10Excel32	32	141	X							
UNIVIS HVI 26	26	376	X							
Mobil EAL Env H 46	46	145			X			X	X	
Mobil DTE 10EXCEL15	15	168	X							

* Readily biodegradable classification indicates one of the following:
CO2 Conversion>60% per EPA 560/6-82-003
CO2 Conversion>80% per CEC-L-33-A-93

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

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

NOTE: *DRIVE PERFORMANCE MAY BE REDUCED BELOW 0 DEG F.*

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

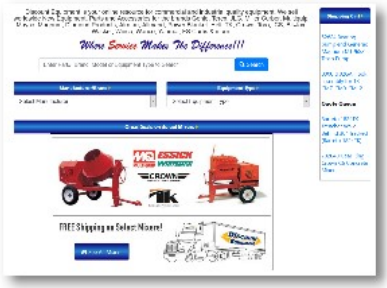
1001211621 A

Figure 2-1. Hydraulic Oil Specification

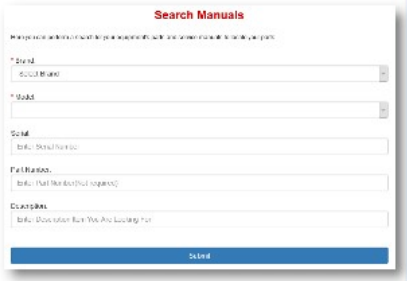
PARTS FINDER

Search Website by Part Number

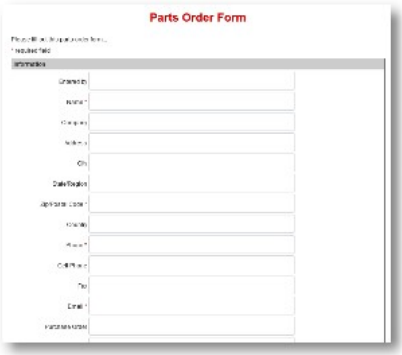
Discount Equipment



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



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



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Click on this link: http://www.discount-equipment.com/category/5443-parts/ and choose one of the options to help get the right parts and equipment you are looking for. Please have the machine model and serial number available in order to help us get you the correct parts. If you don't find the part on the website or on once of the online manuals, please fill out the request form and one of our experienced staff members will get back to you with a quote for the right part that your machine needs.

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

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES & 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
- TMf"tread contact width equal or greater than original
- Wheel diameter, width, and offset dimensions equal to the original
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load)

Unless specifically approved by JLG Industries Inc. do not replace a foam filled or ballast filled tire assembly with a pneumatic tire. Due to size variations between tire brands, both tires on the same axle should be the same.

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

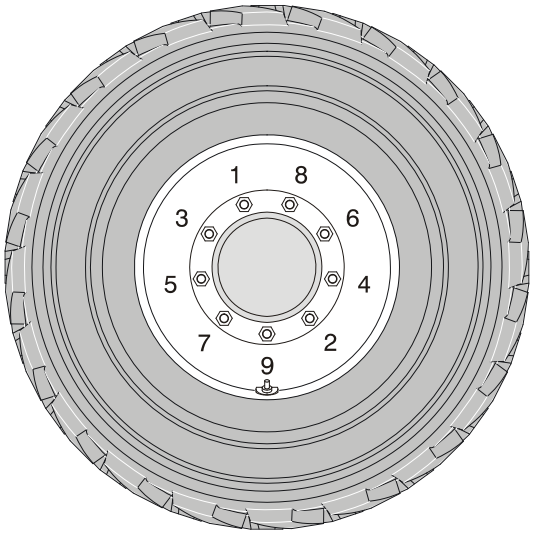
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ 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
40 ft. lbs. (55 Nm)	100 ft. lbs. (130 Nm)	170 ft. lbs. (255 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 SPINDLE, 2WD

Setting Wheel Bearing End Play

NOTICE

BE SURE NOT TO OVER-TIGHTEN THE SPINDLE NUT.

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

Specifications

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

Checking

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

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

Greasing Requirements

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

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

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

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

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

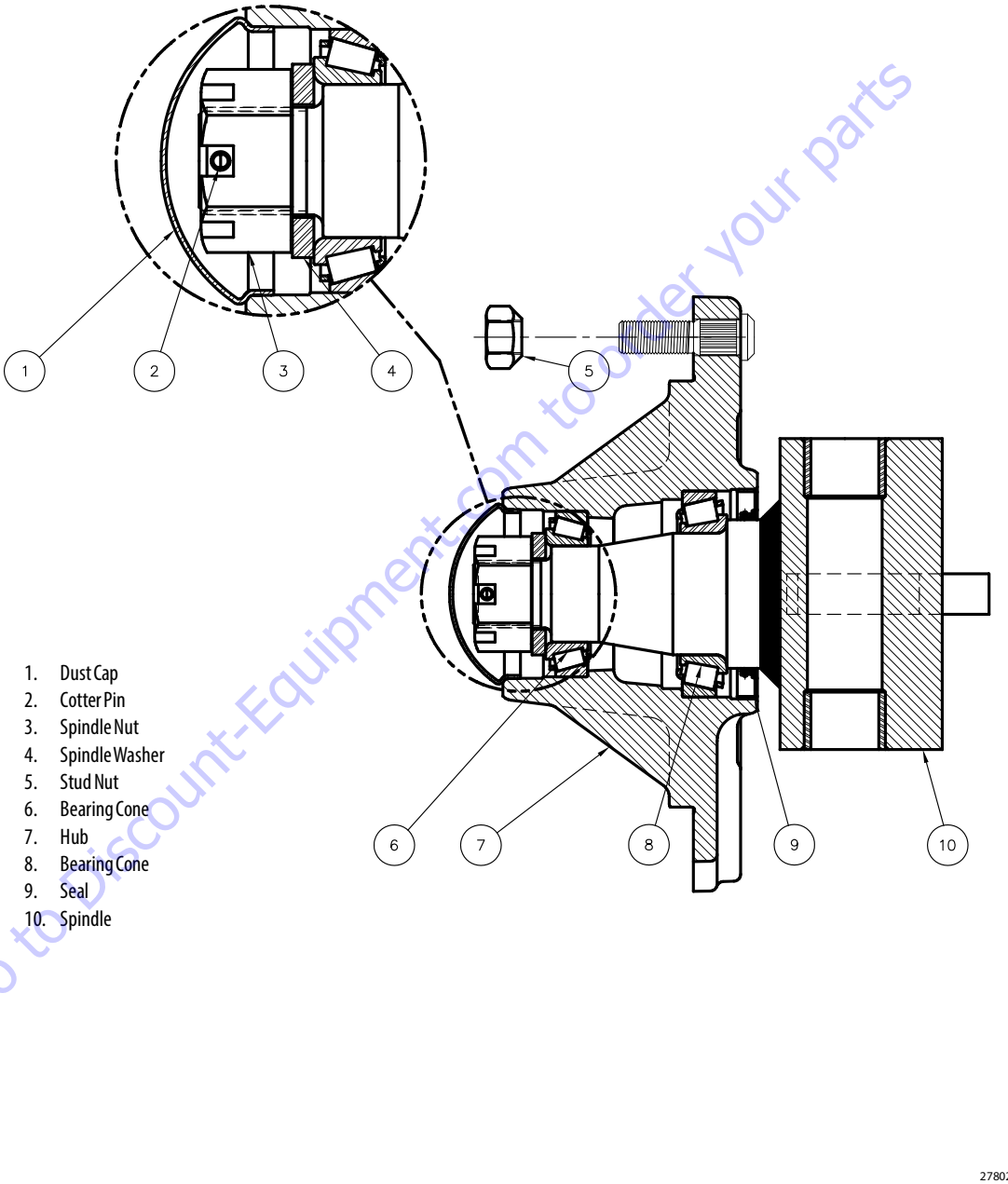


Figure 3-1. Spindle Assembly

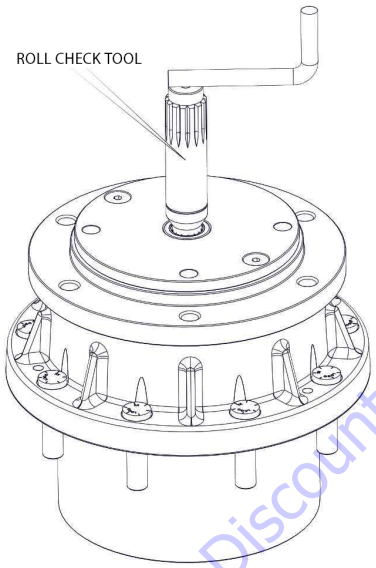
3.3 DRIVE HUB

Roll and Leak Testing

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

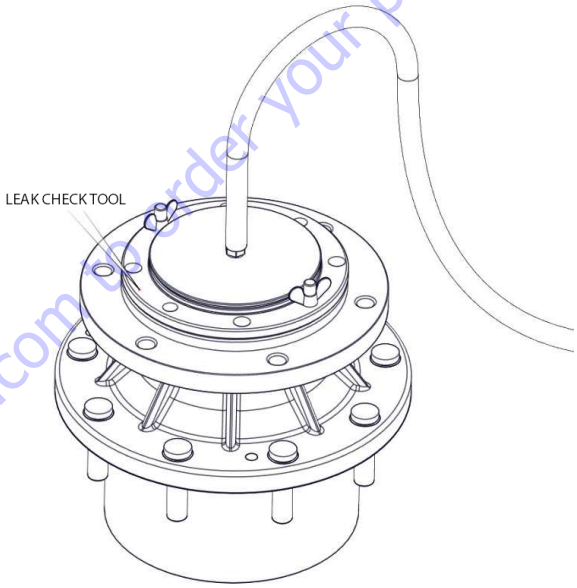
THE ROLL TEST

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



THE LEAK TEST (MAIN UNIT)

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

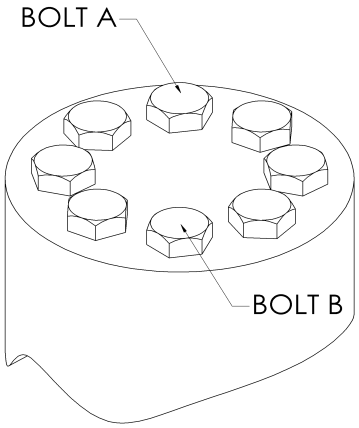


Tightening and Torquing Bolts

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.

Main Disassembly

NOTE: *Refer to Figure 3-2., Main Disassembly Drawing 1, and Figure 3-3., Main Disassembly Drawing 2,*

1. Perform a roll check and leak check prior to disassembling the unit.
2. Remove the two Magnetic Pipe Plugs (6F) and drain the oil out of the gearbox.

NOTE: *Record the condition and volume of the oil.*

3. Remove Retaining Ring (6G) from the Cover Subassembly.
4. Lift the Cover Subassembly off the unit.
5. Remove the Input Sun Gear (10) if applicable.

NOTE: *On units with a ratio of greater than 36:1, there will be no Input Sun Gear (10). The teeth will be integrated on the Input Shaft.*

6. Lift out the Input Carrier Subassembly from Hub-Spindle Subassembly.
7. Remove the Input Shaft Subassembly out of the Hub-Spindle Subassembly.

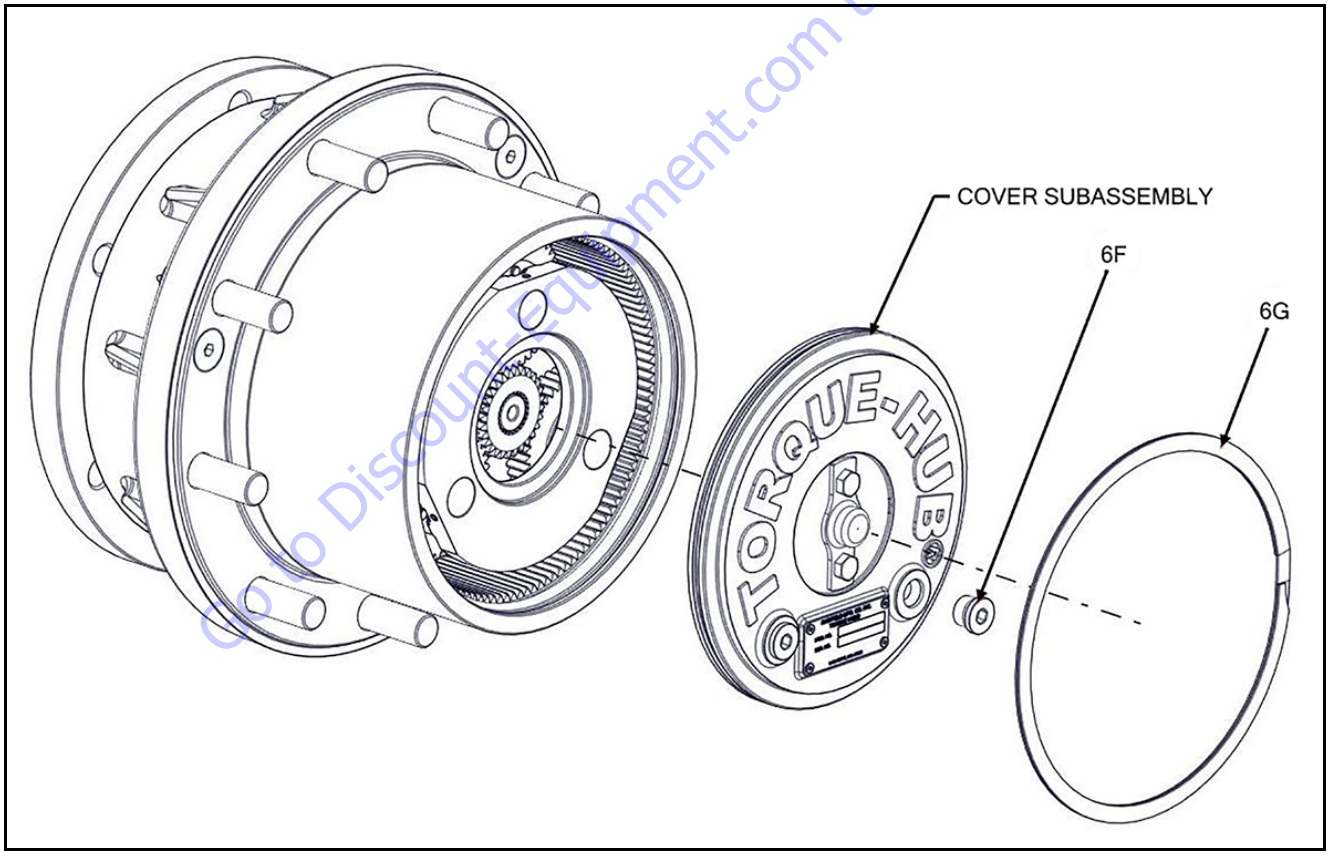
⚠ CAUTION

SAFETY GLASSES MUST BE WORN DURING THESE NEXT STEPS

8. Remove the Retaining Ring (5) from the Input Shaft (9).
9. Remove the Second Stage Sun Gear (11).
10. Remove the Retaining Ring (20) from the Second Stage Sun Gear (11).

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

11. Loosen and remove the three Flat Head Bolts (19) that retain the Ring Gear (1E) to the Housing (1G).
12. Lift the Ring Gear (1E) from Hub-Spindle Subassembly.



6F. Magnetic Pipe Plug

6G. Retaining Ring

Figure 3-2. Main Disassembly Drawing 1

NOTE: *Discard the O-ring in the step below. Do not re-use it.*

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

14. Using a 1/8" diameter punch, drive the Roll Pin (4G) into the Planet Shaft (4E) until it bottoms against the Hub-Spindle Subassembly.

15. Grasp the Roll Pin (4G) using needle nosed pliers or some sort of hooked tool, and pull the Planet Shaft (4E) out of the Hub-Spindle Subassembly.

Using a 1/8" diameter punch, drive the Roll Pin (4G) out of the Planet Shaft (4E).

NOTE: *The Roll Pins (4G) should not be reused when reassembling the unit.*

16. Slide the Planet Gear Subassembly (4F) out of the Hub-Spindle Subassembly being careful not to drop the Needle Bearings (4C) in the process.

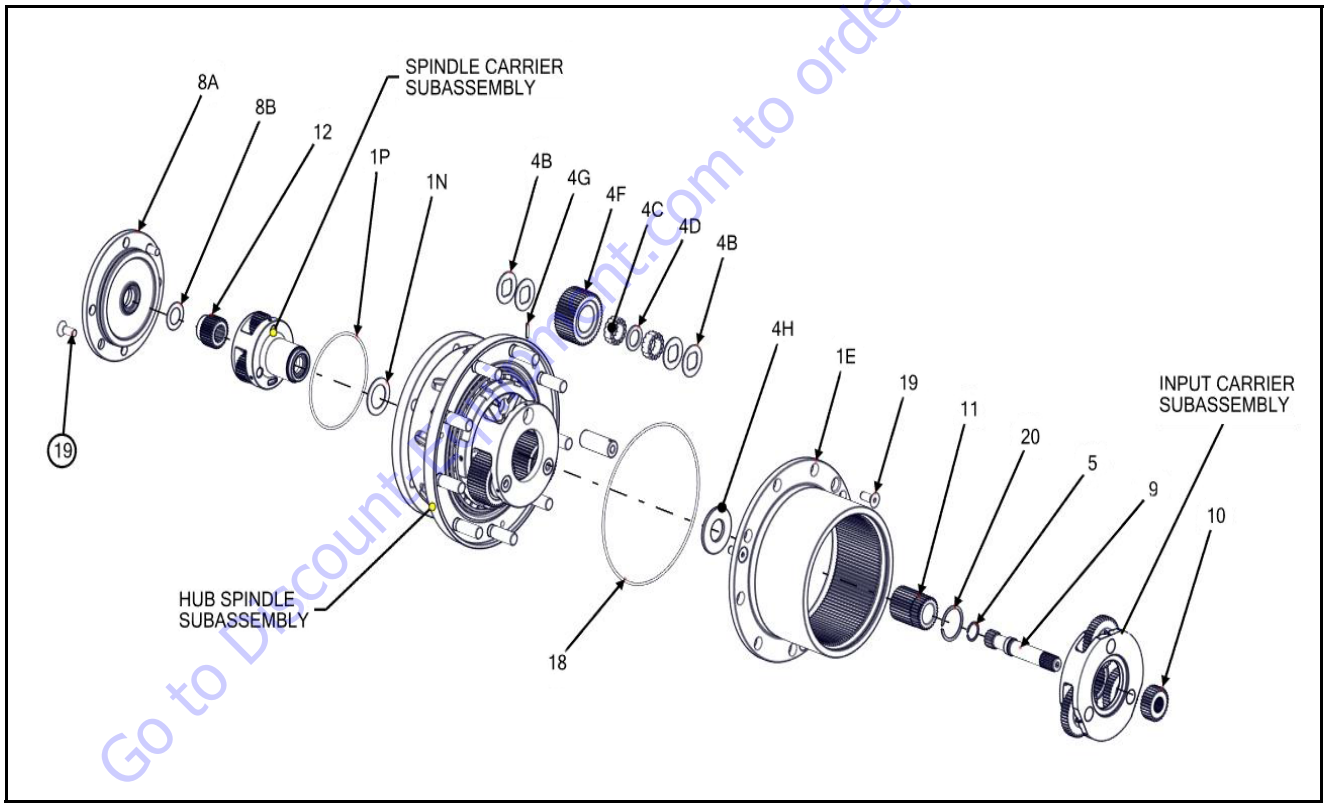
17. Remove Thrust Washer (4H) from the counterbore in the spindle.

18. Set unit on planet carrier end of spindle.

NOTE: *Discard the O-ring in the step below. Do not re-use it.*

19. Remove Flat Head Screws (19) from Spindle (1A). Remove Adapter Plate (8A). Remove O-ring (1P) and Thrust Washer (8B).

20. Remove Carrier Sub-assembly inside the Spindle (1A). Remove Thrust Washer (1N).



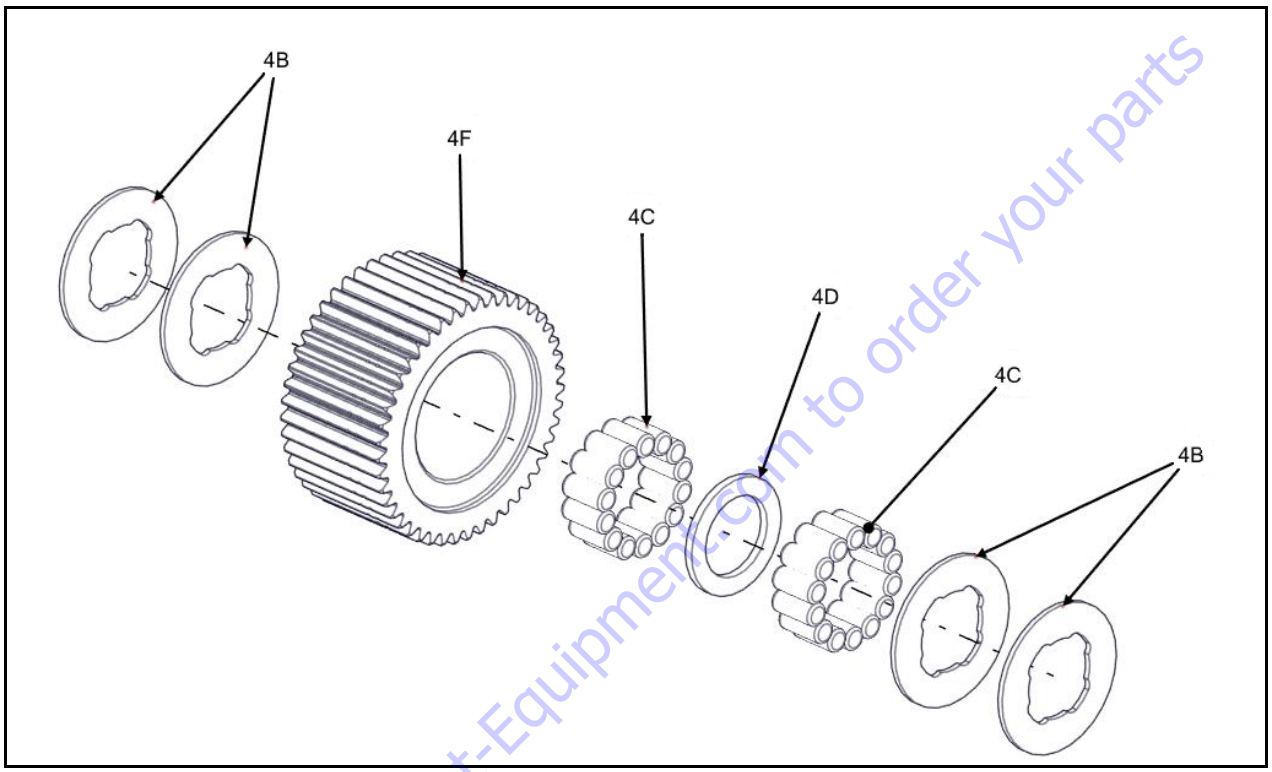
1G. Ring Gear
1N. Thrust Washer
1P. O-ring
4B. Thrust Washer
4C. Needle Bearing
4D. Thrust Spacer
4F. Planet Gear Subassembly
4G. Roll Pin
4H. Thrust Washer
5. Retaining Ring
8A. Adapter Plate
8B. Thrust Washer
9. Input Shaft
10. Sun Gear
11. Second Stage Sun Gear
12. Sun Gear
18. O-ring
19. Flat Head Bolt
20. Retaining Ring

Figure 3-3. Main Disassembly Drawing 2

Output Planet Gear Disassembly

NOTE: *Refer to Figure 3-4., Output Planet Gear Disassembly*

1. Remove 4 Thrust Washers (4B) from the Planet Gear (4F).
2. Remove 28 Needle Rollers (4C) from the Planet Gear (4F).
3. Remove the Thrust Spacer (4D) from the Planet Gear (4F).
4. Repeat Steps 1 through 3 for the remaining two Planet Gears (4F).



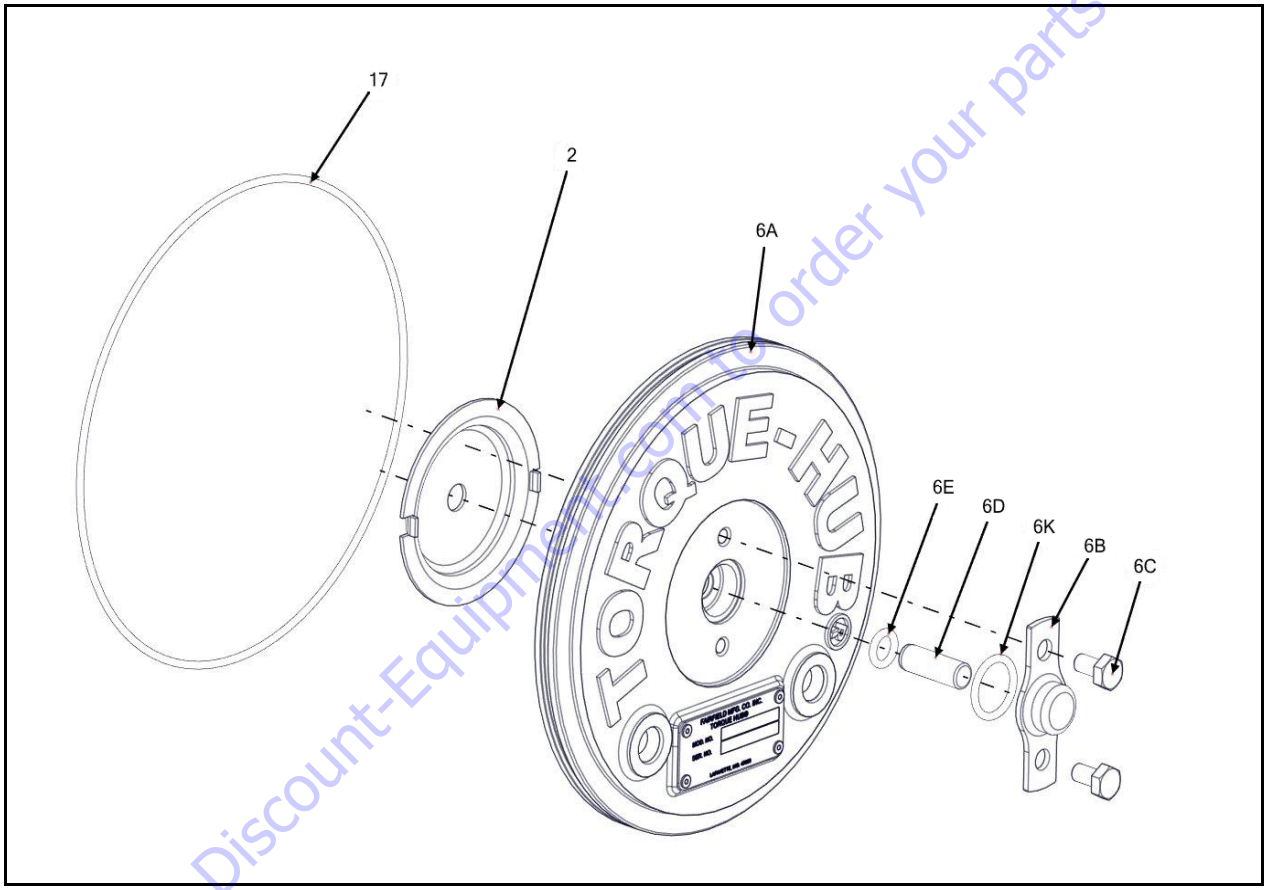
4B. Thrust Washer
4C. Needle Bearing
4D. Thrust Spacer
4F. Planet Gear Subassembly

Figure 3-4. Output Planet Gear Disassembly

Cover Disassembly

NOTE: *Figure 3-5., Cover Disassembly*

1. Remove the O-Ring (17) from groove in the Cover (6A) and discard O-Ring.
2. Remove Thrust Washer (2) from pockets in the Cover (6A).
3. Unscrew the Hex Head Bolts (6C) from the Disengage Cap (6B), if required.
4. Remove the Disengage Cap (6B) from the Cover (6A).
5. Pull the Disengage Rod (6D) out of the Cover (6A).
6. Remove O-Ring (6E) from the Cover (6A) and discard.



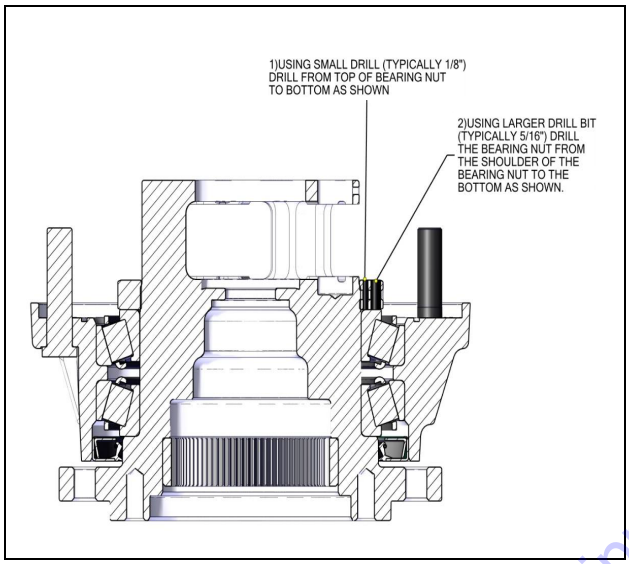
2. Thrust Washer
6A. Cover
6B. Disengage Cap
6C. Hex Head Bolt
6D. Disengage Rod
6E. O-ring
6K. O-ring
17. O-ring

Figure 3-5. Cover Disassembly

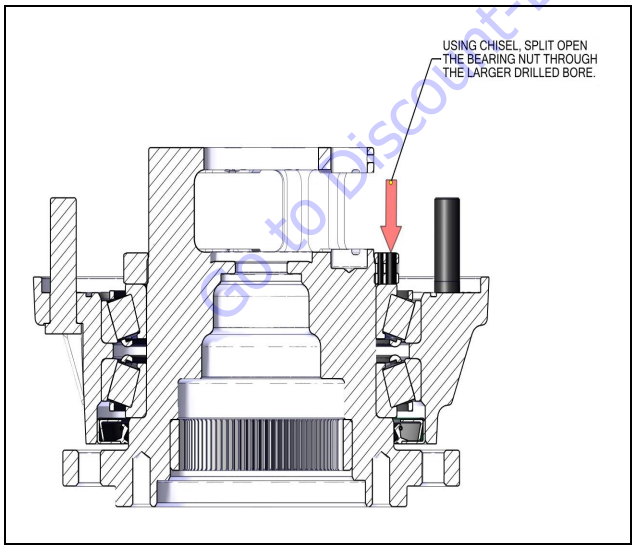
Housing-Spindle Disassembly

NOTE: *Refer to Figure 3-6., Housing Spindle Disassembly*

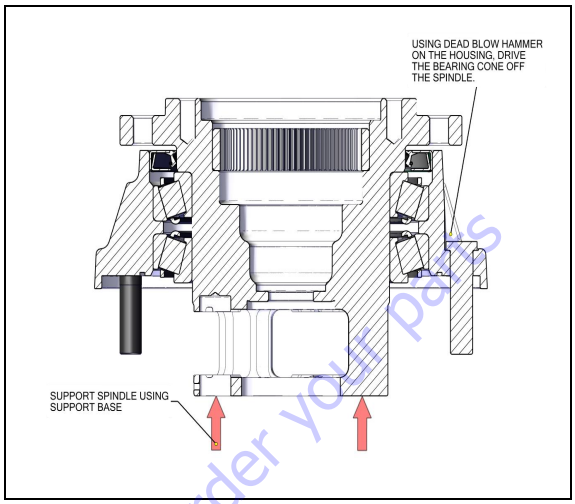
1. Set the unit on a bench so that the Spindle (1A) flange is down.
2. Using a small drill bit (typically 1/8”), drill from the top of the bearing nut to the bottom as shown below.
3. Using a larger drill bit (typically 5/16”), drill the bearing nut from the shoulder of the bearing nut to the bottom as shown below.



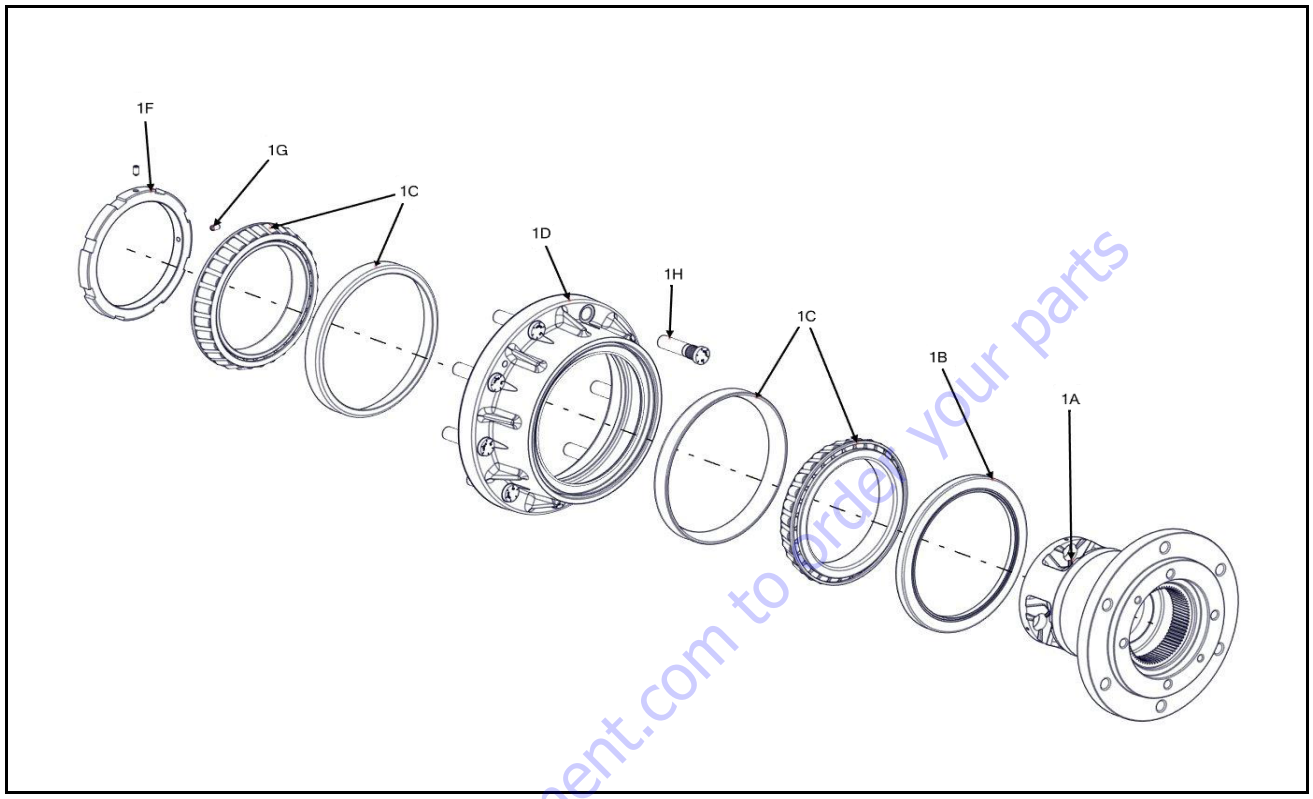
4. Using a chisel, split open the bearing nut through the larger drilled bore as shown below.



5. Turn the unit over and carefully place the unit on a support base until the Spindle (1A) rests on it. Ensure there is enough gap to lower the Housing (1D) down.



6. Use a dead blow hammer on the Housing (1D) flange to drive the inboard Bearing Cone (1C) off of the Spindle.
7. Lift the Spindle (1A) out of the Housing (1D).
8. If necessary, remove the Boot Seal (1Q).
9. Remove Lip Seal (1B) from Housing (1D).
10. Remove the Bearing Cone (1C) from Housing (1D).
11. Using a hammer and punch drive the inboard Bearing Cup (1C) out of the Housing (1D). Be careful not to damage the counterbore in the housing.
12. Turn the Housing (1D) over and drive the outboard Bearing Cup (1C) out of the Housing. Be careful not to damage the counterbore in the housing.



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

Figure 3-6. Housing Spindle Disassembly

Housing-Spindle Subassembly

NOTE: *Refer to Figure 3-6., Housing Spindle Disassembly*

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

1. Press one Bearing Cup (1C) into bearing counterbore of spindle end of housing until seated against shoulder in Housing (1D).
2. Turn Housing (1D) over and press one Bearing Cup (1C) into bearing counterbore of cover end of Housing (1D) making sure that it is fully seated against shoulder in the housing.
3. Place one Bearing Cone (1C) into the Housing (1D).
4. Spray the housing seal bore with alcohol, then wipe with a clean rag. Ensure there is no debris left in the bore.

NOTE: *Generally seals should not be reused.*

5. Spray the O.D. of the Lip Seal (1B) with alcohol and wipe with a clean rag. Place and visually align the Lip Seal (1B) with spring side down into the housing (1D) seal bore. Press the seal into the housing. When the seal press tool makes contact with the Housing (1G) the seal is fully seated.
6. Spray the Spindle (1A) seal diameter with alcohol and wipe with a clean rag. Apply a coat of oil to the Spindle (1A) seal lip diameter.
7. If necessary, install Boot Seal (1Q) onto Housing (1D), apply a small amount to grease to the flap of the boot seal.
8. Install the Housing (1D) onto the spindle with seal side down.
9. Place other Bearing Cone (1C) onto Spindle (1A) until it is seated in Bearing Cup (1C) in Housing (1G) and spray with a light coat of oil.
10. Apply Threadlocking compound to the threads of Bearing nut (1F) and Spindle (1A).
11. Install Bearing Nut (1F) onto Spindle (1A) and tighten using locknut wrench. Torque Bearing Nut (1F) to 150 ft-lbs, rotate Housing (1G) in both directions, and then torque Bearing Nut to 150 ft-lbs. Rotate Housing (1G) in both directions again and torque bearing nut to 150 ft-lbs. Repeat this until Bearing Nut (1F) does not move when 150 ft-lbs of torque is applied.
12. Apply Threadlocking compound to Set Screws (1G) and install them into Bearing Nut threaded holes. Make sure Set Screw is driven into the spindle thread. Tighten the set screws to damage the thread and stake the edge of the nut around the Set Screws (1G) so the nut will not loosen.

Output Planet Gear Subassembly

NOTE: *Refer to Figure 3-4., Output Planet Gear Disassembly*

1. Apply a liberal coat of grease to the bore of the Planet Gear (4F). This will enable the Needle Rollers (4C) to be held in place during assembly.
2. Install Needle Rollers (4C) into the inside of the Planet Gear (4F).

NOTE: *The last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers that form the space, and then slide parallel to the other rollers into place.*

3. Place one Spacer (4D) on top of the Needle Rollers (4C) inside the Planet Gear (4F).
4. Install Needle Rollers (4C) into the other side of the Planet Gear (4F), as above.
5. Apply grease to hold two Thrust Washers (4B) together and onto Output Planet Gear (4F) counterbore. Do the same to the other side.
6. Repeat Steps 1-5 to finish the assembly of the remaining Output Planet Gears (4F).

Cover Subassembly

NOTE: *Refer to Figure 3-5., Cover Disassembly*

1. Install two Pipe Plugs (6F) into the Cover (6A).
2. Grease the O-ring (17) and place it in the groove in the Cover (6A). Grease O-ring (6K) and place in face-groove in the center of the cover.
3. Grease the Thrust Washer (2) and place on the inner hub of the Cover (6A), keeping the two tangs aligned with the cast slots in the Cover (6A).
4. Grease the O-ring (6E) and install into the internal groove in the Cover (6A).
5. Attach the Disengage Cap (6B) to the Cover (6A) using Hex Bolts (6C). Tighten the Bolts to a torque of 70-80 in-lbs.
6. Turn the Cover (6A) over and push Disengage Rod (6D) until Disengage Rod (6D) bottoms out on the Disengage Cap (6B).

Main Assembly

NOTE: *Refer to Figure 3-7., Main Assembly Drawing*

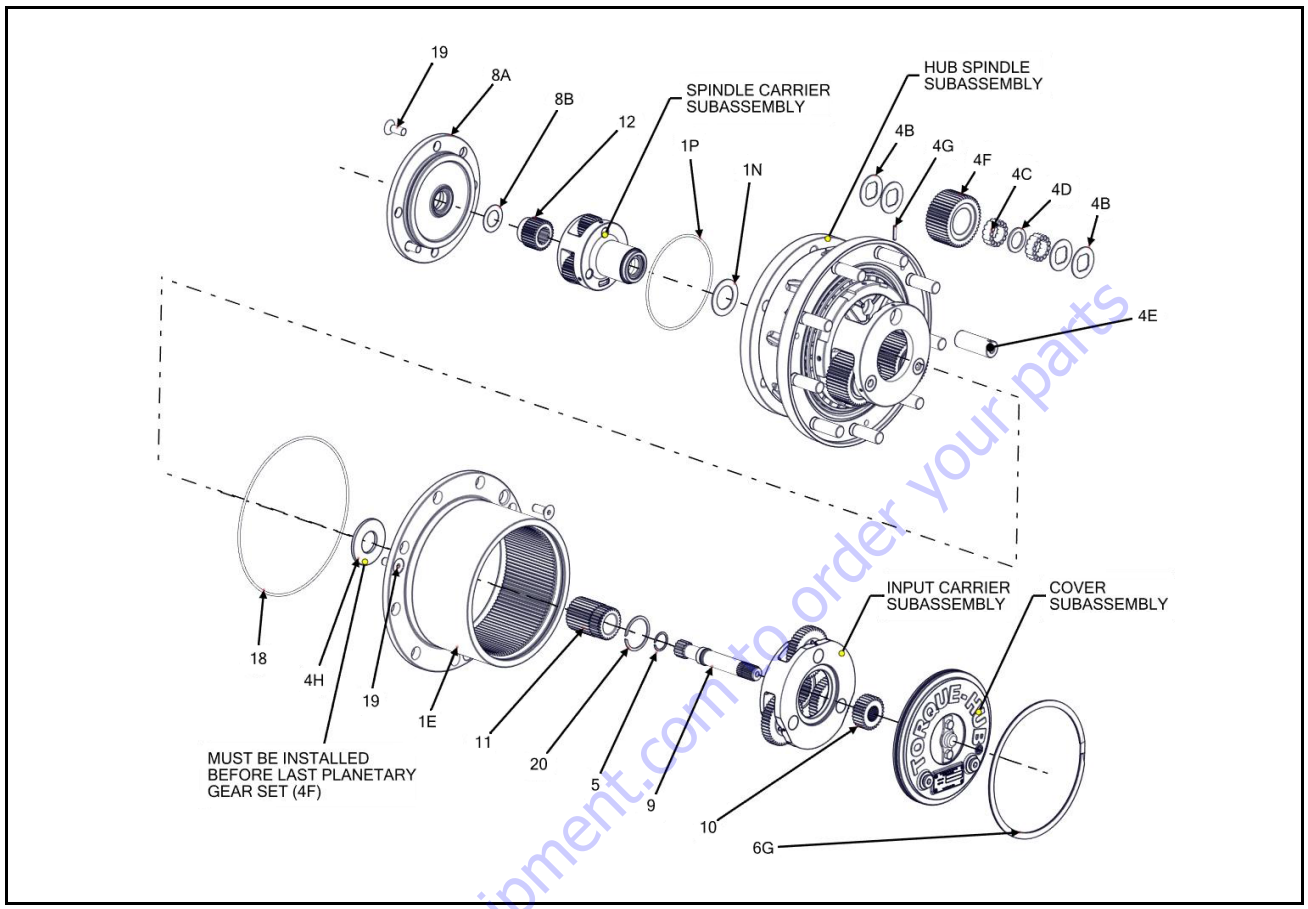
NOTE: *Spray component parts with a liberal amount of oil as they are being assembled.*

1. Place Hub-Spindle Subassembly with spindle flange side up.
2. Using a small amount of grease, install Thrust Washer (1N) into the spindle counterbore.
3. Install Input Carrier Sub-Assembly into the spindle. Install Sun Gear (12) into the Input Carrier Sub-Assembly
4. Install O-ring (1P) into groove of Input Adapter (8A) with grease. Install Thrust Washer (8B) into Input Adapter (8A) counterbore with grease.
5. Install Input Adapter (8A) onto spindle, install Flat Head Bolts (19) through Adapter into spindle, torque to 15-20 ft.lbs.
6. Turn Hub-Spindle Sub-Assembly over and place on spindle flange. Install the Thrust Washer (4H) in the counterbore in the Hub-Spindle Subassembly.
7. Place output planet gear assembly (4F) into the windows of spindle (1A). The output planets must have their part number facing up. Align the planet gear holes with planet shaft holes.
8. Install Planet Shaft (4E) with pin hole chamfer side up into spindle. Make sure to align the pin hole in the Planet Shaft (4E) with pin hole in Spindle (1A) while installation.
9. Using a 1/8" diameter punch, drive the Roll Pin (4G) in the Planet Shaft (4E). Insure everything is aligned and push the planet shaft (4E) into the Spindle (1A) until roll pin holes are aligned. Use an alignment punch or similar tool to align roll pin holes on Spindle (1A) and Planet Shaft (4E).
10. Drive Roll Pin (4G) down into t he aligned roll pin holes. Pin should be flush with OD of spindle.
11. Install O-Ring (18) onto groove of Housing (1G).
12. Place Ring Gear (1E) onto Housing (1D). Align the three shipping Cap Screw Holes on Hub (1D) and Ring Gear (1E).
13. Install three shipping Cap Screws (19) into Ring Gear (1E) and Housing (1D). Torque them to 15-20 ft-lbs.

⚠ CAUTION

SAFETY GLASSES MUST BE WORN DURING THESE NEXT STEPS.

14. Install the Retaining Ring (20) on to the Sun Gear (11).
15. Install Sun gear (11) into output planet gear mesh with spline side up.
16. Install Retaining Ring (5) into Input Shaft (9).
17. Insert Input Shaft Input into Carrier until seated.
18. Install Input Sun Gear (10) onto input Shaft.
19. Install Cover Subassembly (6A) to Housing (1G) using Retaining Ring (6G).
20. The unit should now be leak and roll checked as per instructions on page 9, 10, 11and 12. The motor can be reinstalled into the gearbox for the leak check to seal it off, and the unit pressurized through a pipe plug hole on the cover.



1E. Ring Gear
1N. Thrust Washer
1P. O-ring
4B. Thrust Washer
4C. Needle Bearing
4D. Thrust Spacer
4E. Planet Shaft
4F. Planet Gear Subassembly
4G. Roll Pin
4H. Thrust Washer
5. Retaining Ring
6G. Retaining Ring
8A. Adapter Plate
8B. Thrust Washer
9. Input Shaft
10. Sun Gear
11. Sun Gear
12. Sun Gear
18. O-ring
19. Flat Head Bolt
20. Retaining Ring

Figure 3-7. Main Assembly Drawing

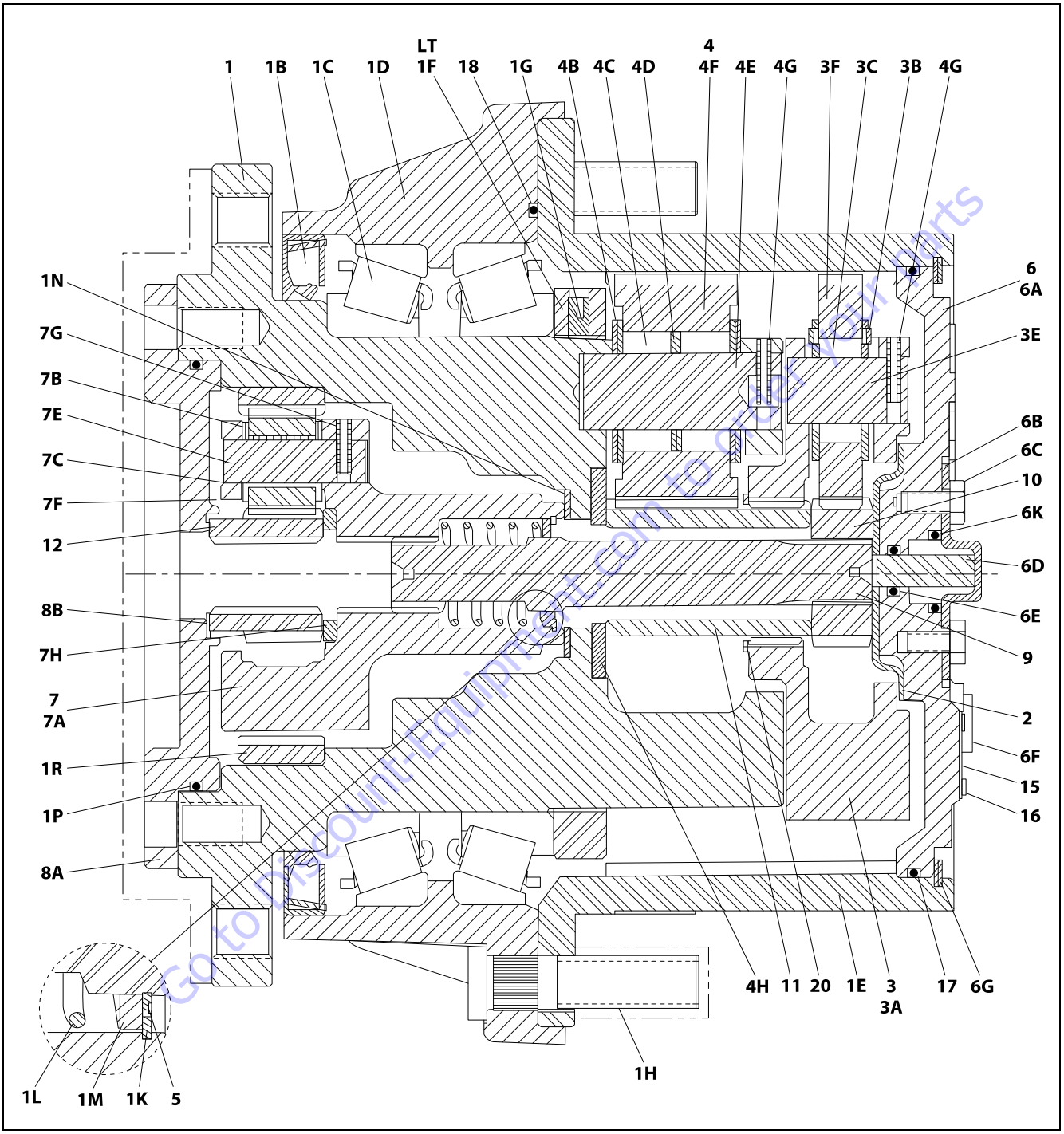


Figure 3-8. Hub Assembly - Sheet 1 of 2

1A. Spindle
1B. Lip Seal
1C. Tapered Bearing Cup
1D. Housing
1E. Ring Gear
1F. Bearing Nut
1G. Housing
1H. Wheel Stud
1K. Retaining Ring
1L. Spring
1M. Thrust Washer
1N. Thrust Washer
1P. O-ring
1R. Ring Gear
2. Thrust Spacer
3. Carrier
3A. Input Carrier
3B. Thrust Washer
3C. Bearing
3E. Planet Shaft
3F. Planet Gear
4. Planet Gear Subassembly
4B. Thrust Washer
4C. Needle Bearing
4D. Thrust Spacer
4E. Planet Shaft
4F. Planet Gear Subassembly
4G. Roll Pin
4H. Thrust Washer
5. Retaining Ring
6. Gear Cover Subassembly
6A. Cover
6B. Disengage Cap
6C. Hex Head Bolt
6D. Disengage Rod
6E. O-ring
6F. Oil Plug
6G. Retaining Ring
6K. O-ring
7. Carrier Subassembly
7A. Input Carrier Spindle
7B. Thrust Washer
7C. Bushing
7E. Planet Shaft
7F. Gear Planet
7G. Roll Pin
7H. Thrust Washer
8A. Adapter Plate
8B. Thrust Washer
9. Input Shaft
10. Sun Gear
11. Sun Gear
12. Sun Gear
15. ID Plate
16. Rivet
17. O-ring
18. O-ring
19. Flat Head Bolt
20. Retaining Ring

Figure 3-9. Hub Assembly - Sheet 2 of 2

3.4 DRIVE MOTOR

Removal

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

Disassembly

NOTE: *Refer to Figure 3-10., Drive Motor.*

1. Place the motor in a soft jawed vice, with coupling shaft from motor pointing down and the vise jaws clamping firmly to the sides of the end shield (8).

⚠ WARNING

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

2. Remove the three nuts (4) and relevant washers (5) from the terminal board (3).
3. Remove the terminal board (3) from the terminal base (6).
4. Remove the screws (7). Make sure that the screws are not damage.
5. Remove the terminal base (6) from the stator (2).
6. Remove the temperature sensor (27) from the stator (2).
7. Remove the screws (22) from the retaining plate (23).
8. Remove the retaining plate (23) from the cover (21).
9. Remove the cover (21) from the shield end (18).
10. Remove the seals (20) and (19).
11. Disconnect the connector (40) from the sensor (13).
12. Remove the sensor (13) from shield end.
13. Remove four screws (26) attached to the drive end plate (8).
14. Remove end plate and shield end.
15. Remove the Shaft Seal (10). 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.
16. Remove Washer (12), O-ring (9) and Bearing from Stator (2).
17. Remove the retainer clips (31) and (30).
18. Remove the Bearing (24), O-ring (28) and retainer clip (25).
19. Use mallet to remove the Gear (33) and remove Gear Key (32) from the Rotor (29).
20. Remove the rotor (29) from the stator (2).
21. Remove the stator (2).
22. Keep all parts in a clean work area.

Inspection

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.

Assembly

NOTE: *Refer to Figure 3-10., Drive Motor.*

1. Install the rotor (29) into the stator (2).
2. Install the gear key (32) on to the rotor shaft.
3. Align the gear notch with key and install the gear (33) on to the rotor shaft.
4. Install the bearing (24), o-ring (28) and retainer clip (25).
5. Install the retainer clips (31) and (30).
6. Install washer (12), o-ring (9) and bearing into the stator (2).
7. Install the shaft seal (10).
8. Attach four bolts to secure the drive end plate with the shield end.
9. Connect the connector (40) to the sensor (13).
10. Install the sensor (13) to the shield end.
11. Install the seals (20) and (19).
12. Install the cover (21) onto the shield end (18).
13. Install the retaining plate (23) onto the cover (21).
14. Attach the bolts (22) to secure the retaining plate (23).
15. Attach the temperature sensor (27) to the stator (2).
16. Install the terminal base (6) onto the stator (2).
17. Install the screws (7).
18. Install the terminal board (3) onto the terminal base (6).
19. Attach the three nuts (4) and relevant washers (5) to the terminal board (3).

Installation

1. Install the drive motor to the machine.

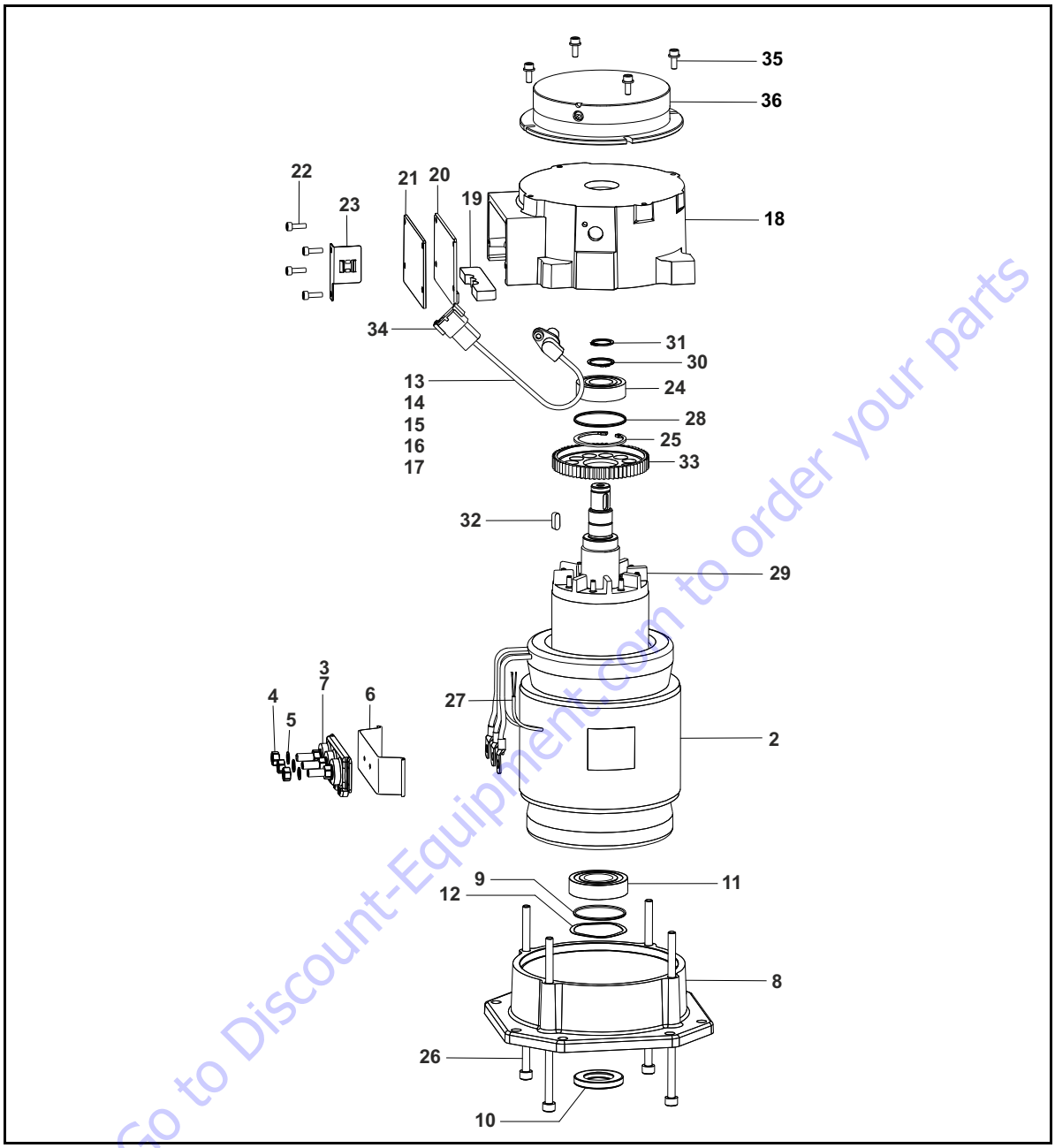
⚠ CAUTION

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

2. Make sure that the pump shaft is properly aligned.
3. Use the four bolts and attach the drive motor to the machine. Tighten the bolts to torque 35 ft. lbs. (48 Nm).

NOTE: *Apply Medium Strength Threadlocking Compound to bolts before installation.*

4. Install drive brake on to the drive motor.
5. Reconnect all electrical connections to the drive motor.
6. Start the machine and check the motor for proper functioning.



1. Not Included
2. Stator
3. Terminal Board
4. Nut
5. Washer
6. Terminal Base
7. Screw
8. Drive End Plate
9. O-Ring
10. Shaft Seal
11. Bearing
12. Washer
13. Speed Sensor
14. Screw
15. Wedge
16. Connector
17. Male Pin
18. End Shield
19. Seal
20. Seal
21. Cover
22. Screw
23. Retaining Plate
24. Bearing
25. Retainer Clip
26. Screw
27. Temperature Sensor
28. O-Ring
29. Rotor
30. Retainer Clip
31. Retainer Clip
32. Key
33. Gear
34. Connector
35. Screw
36. Drive Brake

Figure 3-10. Drive Motor

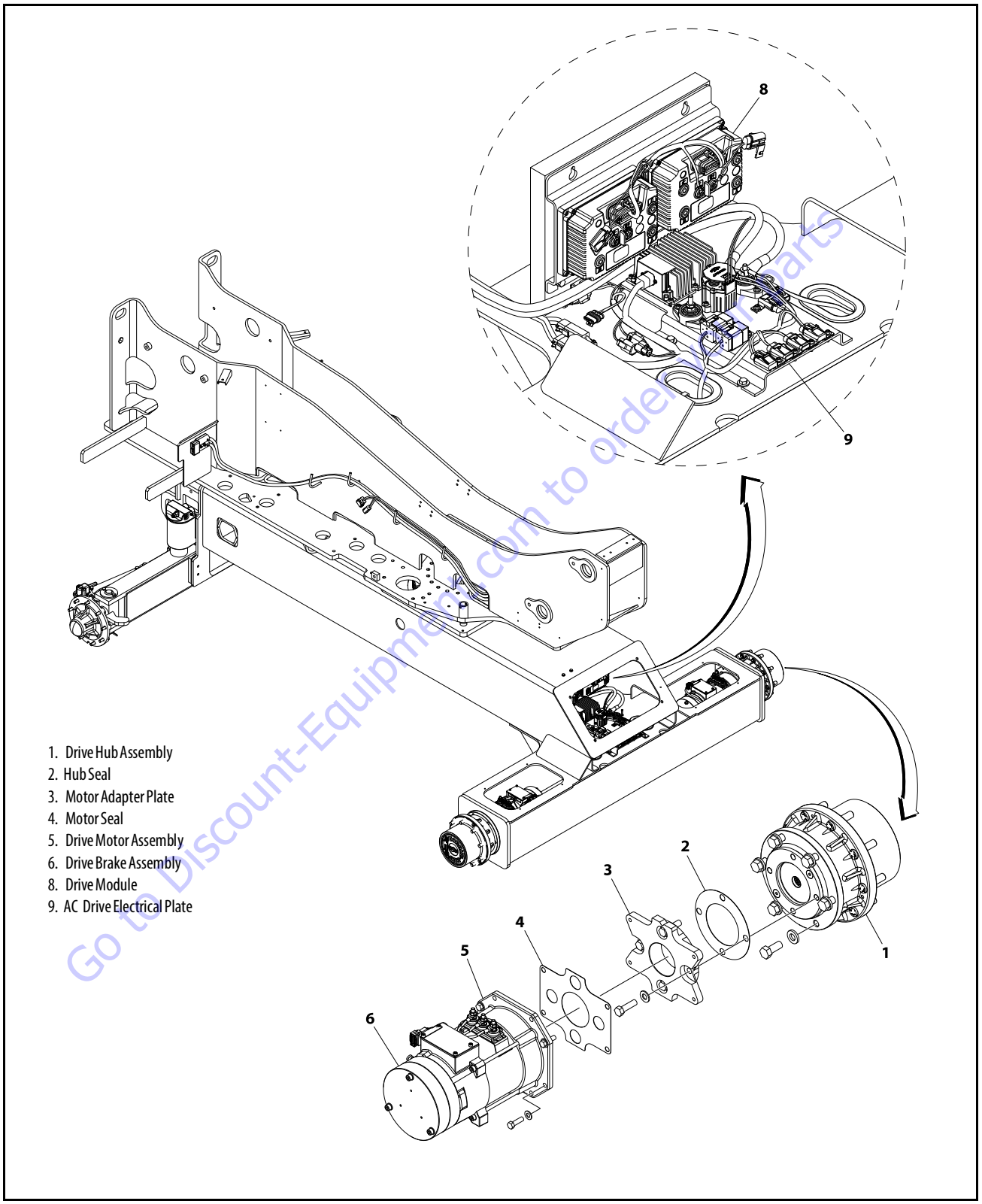


Figure 3-11. Drive Components

3.5 OSCILLATING AXLE LOCKOUT TEST (IF EQUIPPED)

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 inches (15.2 cm) high block with ascension ramp in front of left front wheel.
2. From platform control station, start engine
3. Place the Drive control lever to the forward position and carefully drive machine up ascension ramp until left front wheel is on top of block.
4. Carefully activate Swing control lever and position boom over right side of machine.
5. With boom over right side of machine, place Drive control lever to Reverse and drive machine off of block and ramp.
6. Have an assistant check to see that left front or right rear wheel remains elevated in position off of ground.
7. 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 to activate Drive to release cylinders.
8. Place the 6 inches (15.2 cm) high block with ascension ramp in front of right front wheel.
9. Place Drive control lever to Forward and carefully drive machine up ascension ramp until right front wheel is on top of block.
10. With boom over left side of machine, place Drive control lever to Reverse and drive machine off of block and ramp.
11. Have an assistant check to see that right front or left rear wheel remains elevated in position off of ground.
12. 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 cylinder.
13. If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

3.6 OSCILLATION CYLINDER BLEEDING

NOTE: *The oscillating axle must be checked daily for proper operation.*

Bleeding Procedure

1. Position the boom in the normal stowed transport position.
2. Disconnect the wires from the brake pressure switch.
3. Disengage both drive hubs by bolting its center cap inside out.
4. Attach clear tubing to bleeder valve nipple. Position a small bucket/bottle in front of the lockout cylinder bleeder valve and insert clear tubing.
5. From the platform control box, activate low speed drive and hold using a 3/8" wrench. Loosen the bleeder valve, slowly turning counterclockwise.
6. Bleed air from the top of the ram cylinder. Capture hydraulic oil until a steady unbroken stream of hydraulic oil is flowing. Tighten the bleeder valve while stream of hydraulic oil is running. Then release the drive function and close the bleeder valve.
7. Repeat process on other side of the machine.
8. Reconnect the brake pressure switch and re-engage the drive hubs.

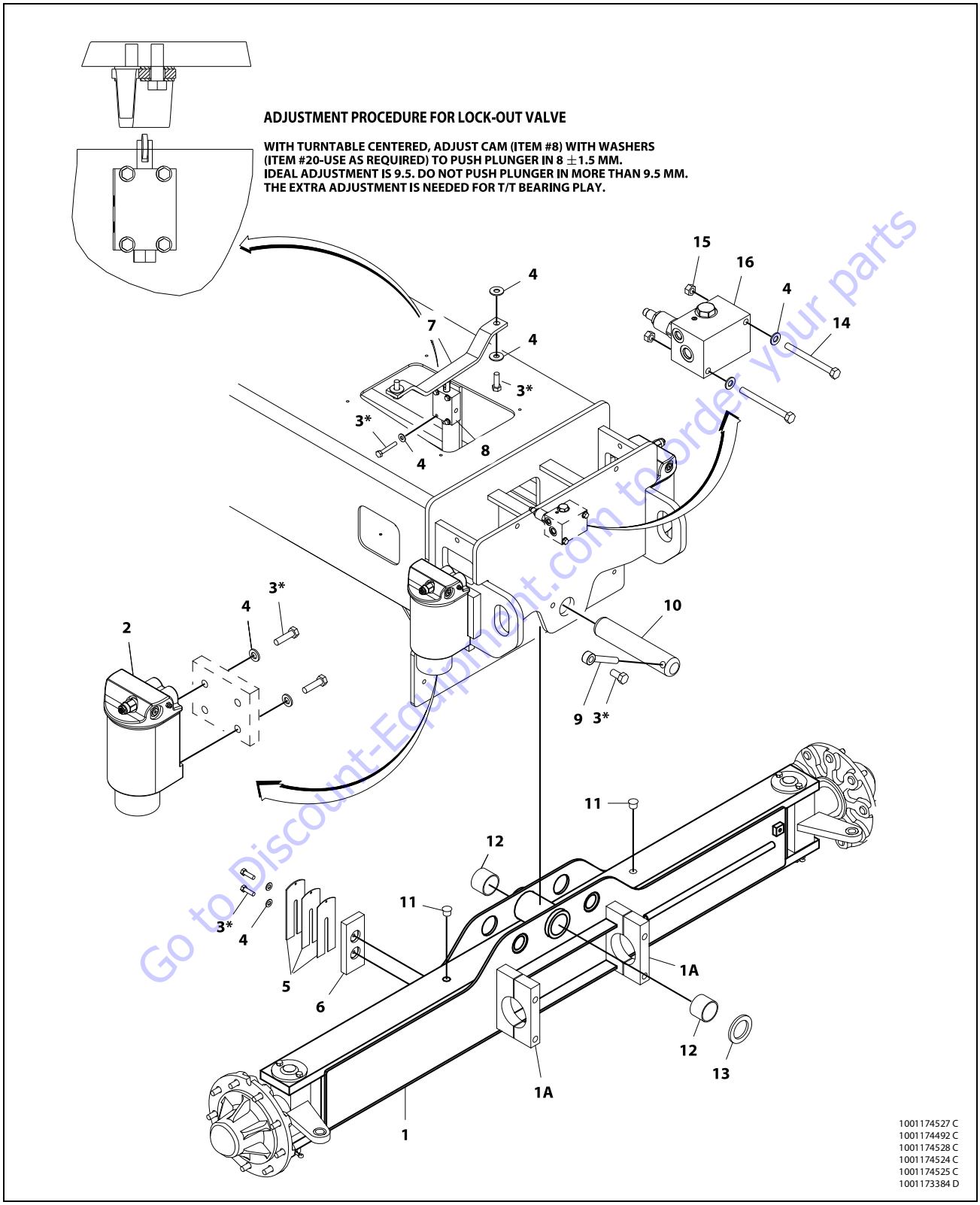
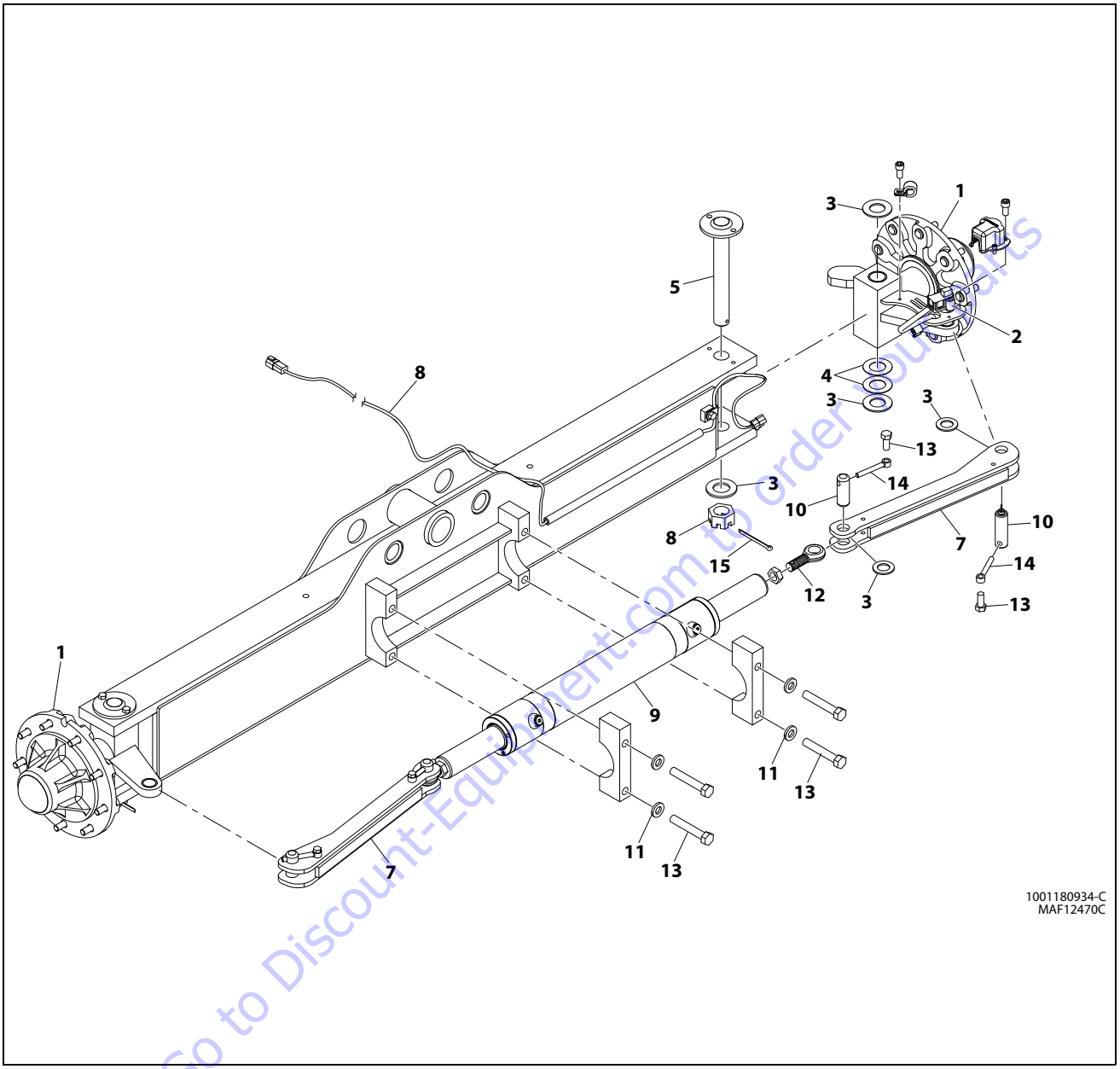


Figure 3-12. Oscillating Axle - Sheet 1 of 2

1. Axle Weldment
1A. Steer Cylinder Mounting Block Assembly
2. Lockout Cylinder Assembly
3. Bolt
4. Washer
5. Shim
6. Wear Pad
7. Lockout Cam
8. Lockout Valve Assembly
9. Pin Keeper
10. Axle Pivot Pin
11. Hole Plug
12. Bushing
13. Thrust Washer
14. Bolt
15. Nut
16. Axle Lockout Valve

Figure 3-13. Oscillating Axle - Sheet 2 of 2



1. Spindle Assembly
2. Rotary Angle Sensor
3. Thrust Washer
4. Shim
5. King Pin
6. Nut
7. Tie Rod
8. Harness, Steering
9. Steer Assebly
10. Pin
11. Washer
12. Rod End
13. Bolt
14. Keeper Pin
15. Pin

Figure 3-14. Axle Oscillation Lockout Valve (2WD)

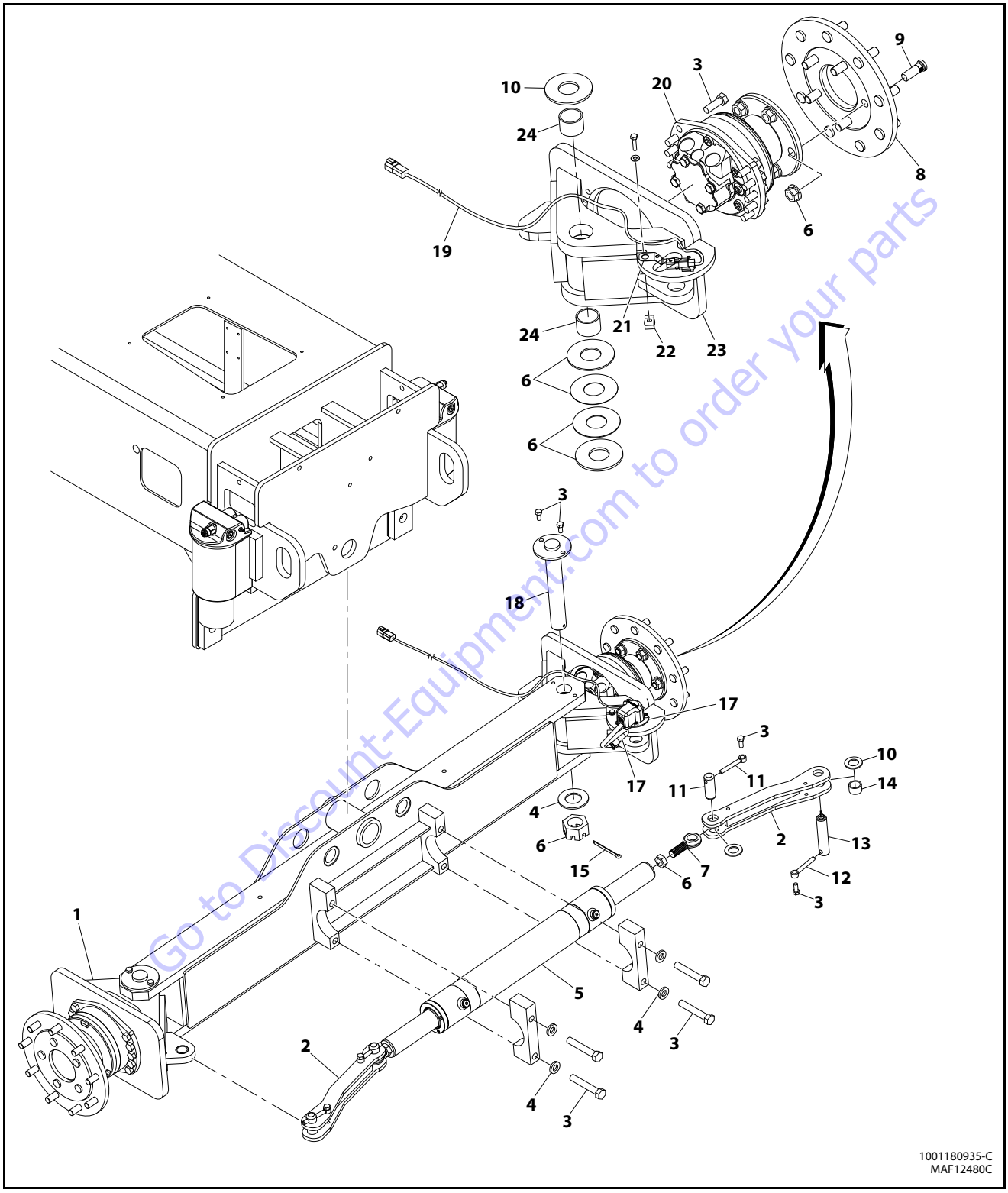


Figure 3-15. Axle Oscillation Lockout Valve (4WD) - Sheet 1 of 2

1. Spindle
2. Tie-Rod
3. Bolt
4. Washer
5. Steer Cylinder Assembly
6. Nut
7. End Rod
8. Drive Adapter Assembly
9. Wheel Stud
10. Thrust Washer
11. Pin
12. Pin Keeper
13. Steer Sensor Pin
14. Bearing Pin
15. Cotter Pin
16. Rotary Angle Sensor Switch
17. Capscrew
18. King Pin
19. Harness, Steering
20. Drive Motor Assembly
21. Mount
22. Locknut
23. Spindle
24. Shim
25. Bushing

Figure 3-16. Axle Oscillation Lockout Valve (4WD) - Sheet 2 of 2

3.7 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 and hydraulic lines to motor removed before performing the roll test.*

THE ROLL TEST

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

THE LEAK TEST (MAIN UNIT)

The purpose of a leak test is to make sure the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your 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 for 20 minutes.

THE BRAKE TEST

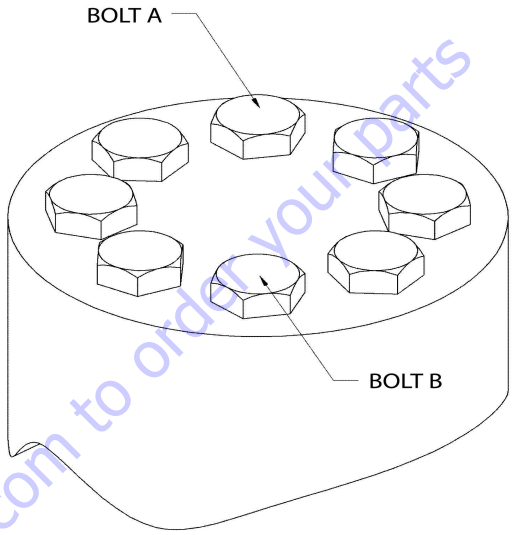
The brake test should be performed prior to disassembly and after reassembly to ensure that the brake functions properly. The brake test procedure can be found in the Motor-Brake Subassembly section of this manual.

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

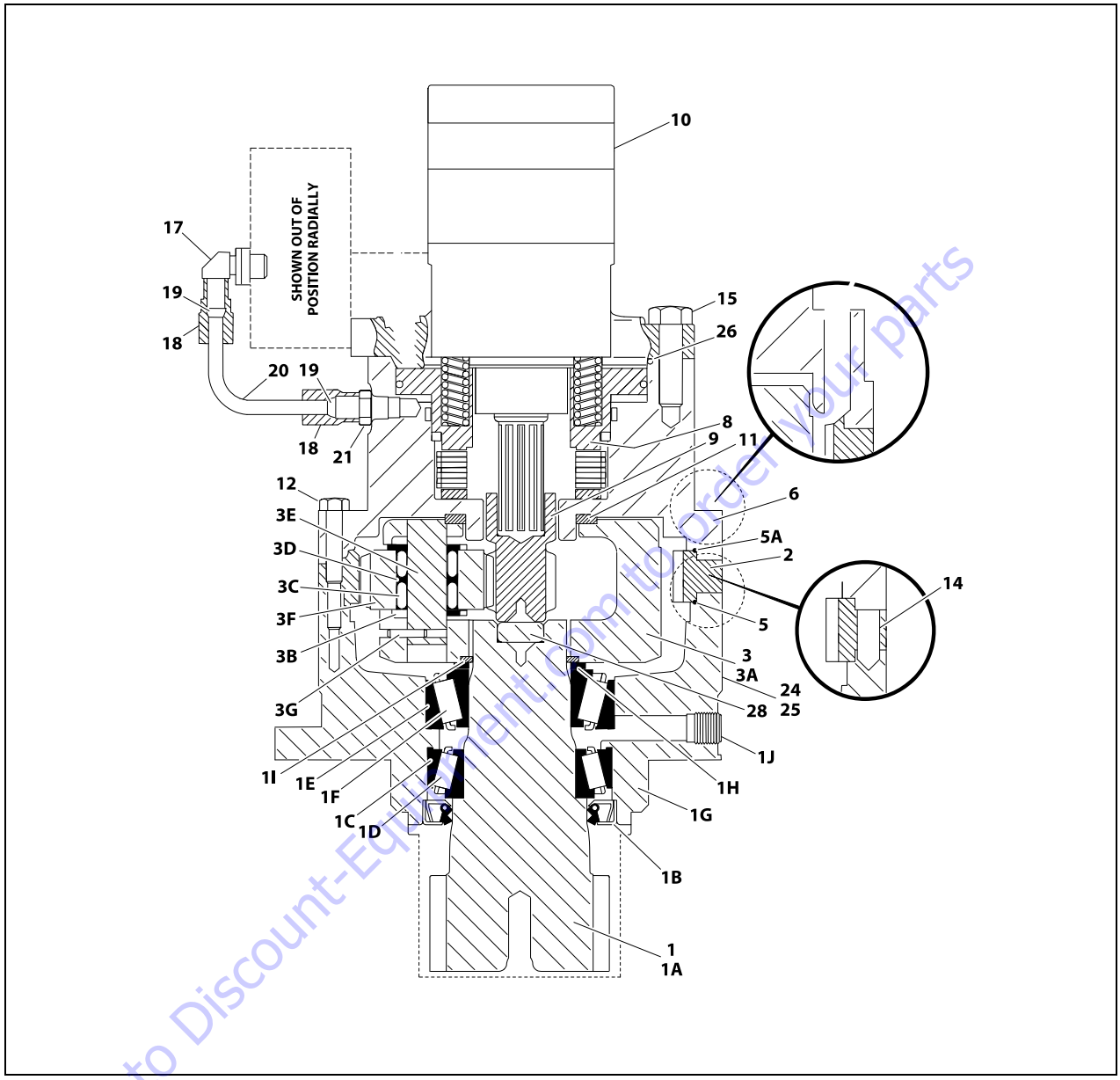
Tightening and Torquing Bolts

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

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



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



1. Housing Assembly
1A. Output Shaft
1B. Lip Seal
1C. Tapered-Cup Bearing
1D. Tapered-Cone Bearing
1E. Tapered-Cup Bearing
1F. Tapered-Cone Bearing
1G. Housing
1H. Thrust Washer
1I. Retaining Ring
1J. Pipe Plug
2. Gear Ring
3. Carrier Assembly
3A. Carrier
3B. Thrust Washer
3C. Needle Bearing
3D. Thrust Spacer
3E. Shaft Planet
3F. Gear Planet
3G. Roll Pin
5. O-ring
5A. O-ring
6. Brake Hub
8. Input Brake
9. Sun Gear
10. Hydraulic Motor
11. Thrust Washer
12. Bolt
14. Dowel Pin
15. Bolt
17. Elbow
18. Tube Nut
19. Female Tube
20. Tubing
21. Connector
24. ID Plate
25. Screw Drive
26. O-Ring
28. Spacer

Figure 3-17. Swing Motor Assembly - Sectional View

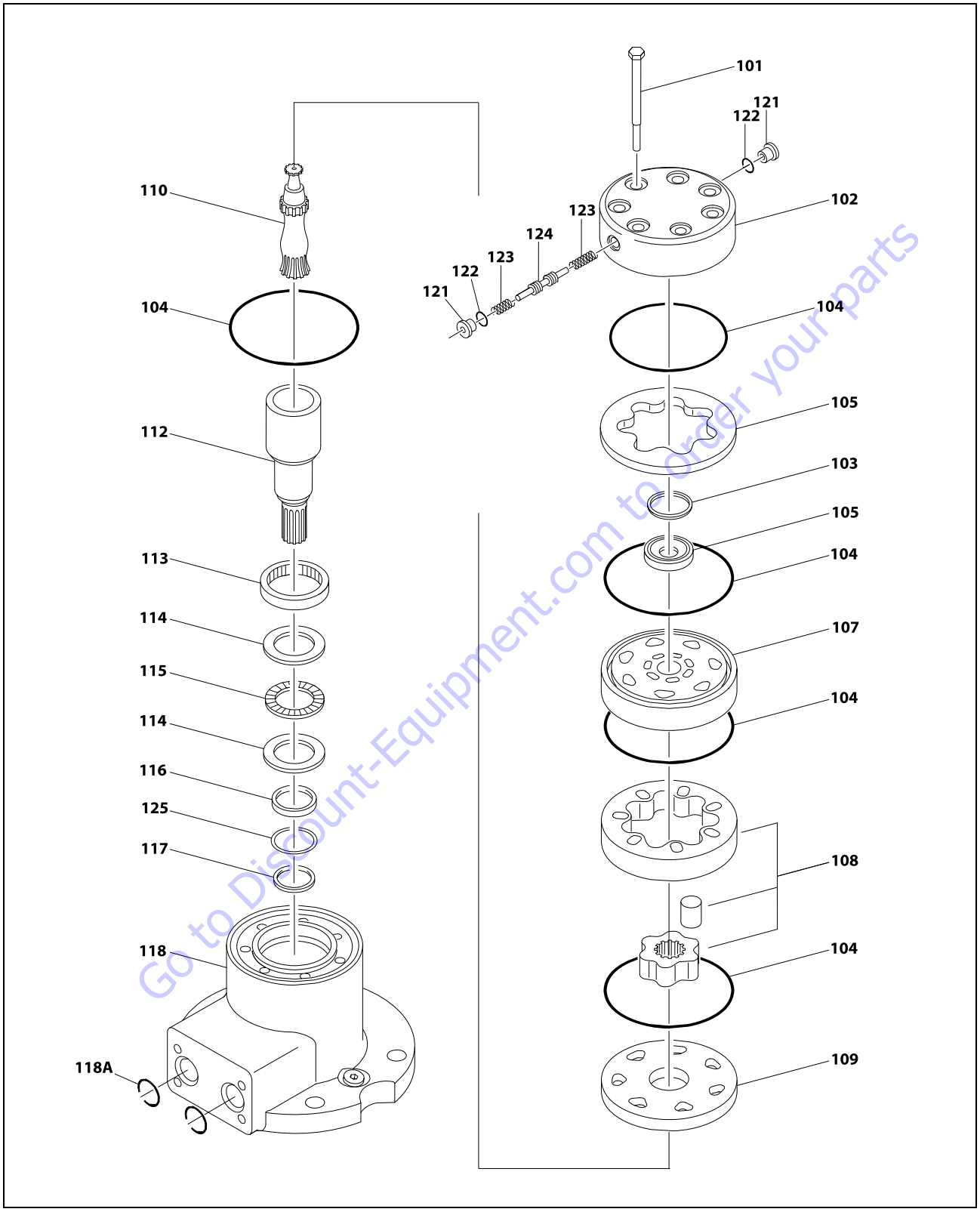


Figure 3-18. Swing Motor Assembly - Sheet 1 of 2

101. Bolt
102. End Cover
103. Commutator Seal
104. Seal Ring
105. Commutator and Ring Assembly
107. Manifold
108. Rotor Set
109. Wear Plate
110. Drive Link
112. Coupling Shaft
113. Bushing
114. Thrust Washer
115. Thrust Bearing
116. Seal
117. Backup Washer
118. Housing
118A O-Ring
121. Plug
122. O-Ring
123. Spring
124. Valve
125. Backup Washer

Figure 3-19. Swing Motor Assembly - Sheet 2 of 2

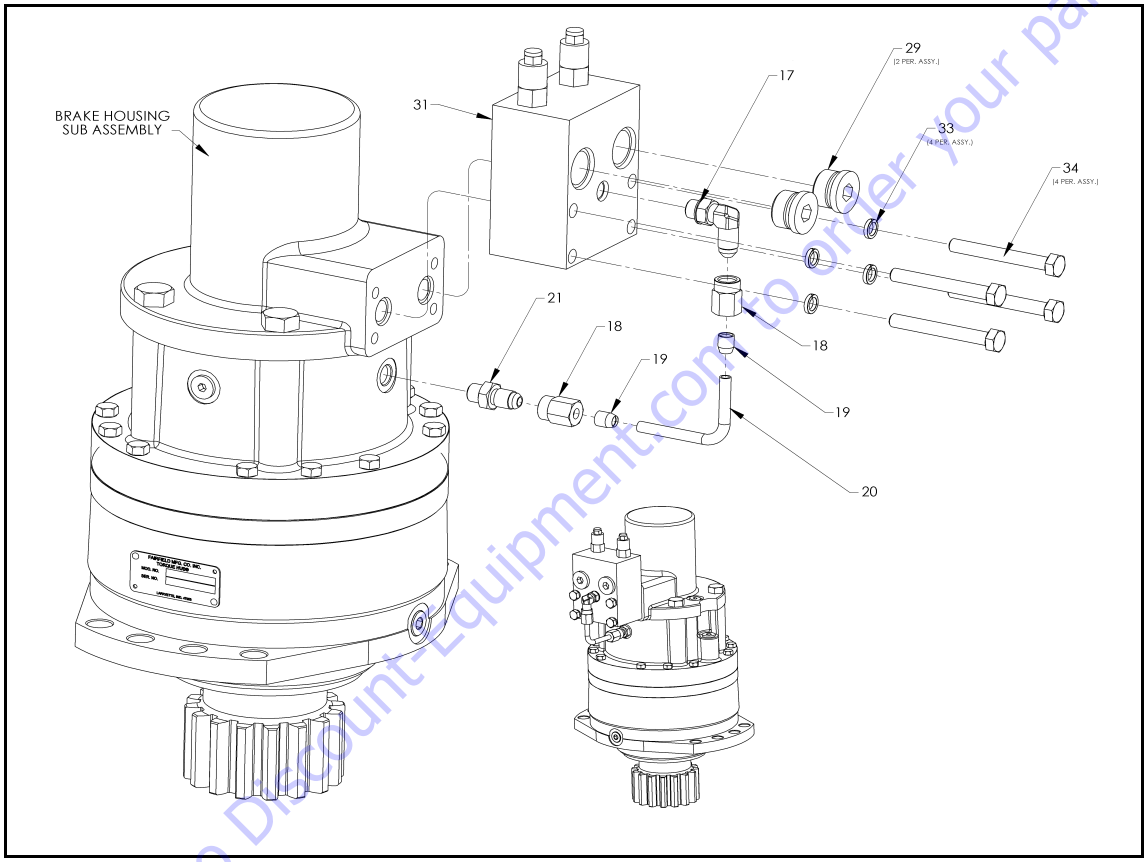
Motor Control Valve Disassembly

NOTE: *Refer to Figure 3-20., Motor Control Valve*

1. Place unit on bench with the motor end up.
2. Remove Hydraulic Tubing Assembly (20) by loosening Fittings (18) on both ends of tube with a wrench.

NOTE: *Items (18) & (19) are included on Item (20) when ordering a replacement Tubing Assembly.*

3. Using a wrench, loosen jam nut on Elbow Fitting (17) and remove fitting from Motor Control Valve (31).
4. Using a wrench, remove Fitting (21) from Brake Housing.
5. Remove Motor Control Valve (31) from Motor (10) by removing the four Bolts (34) and washers (33).



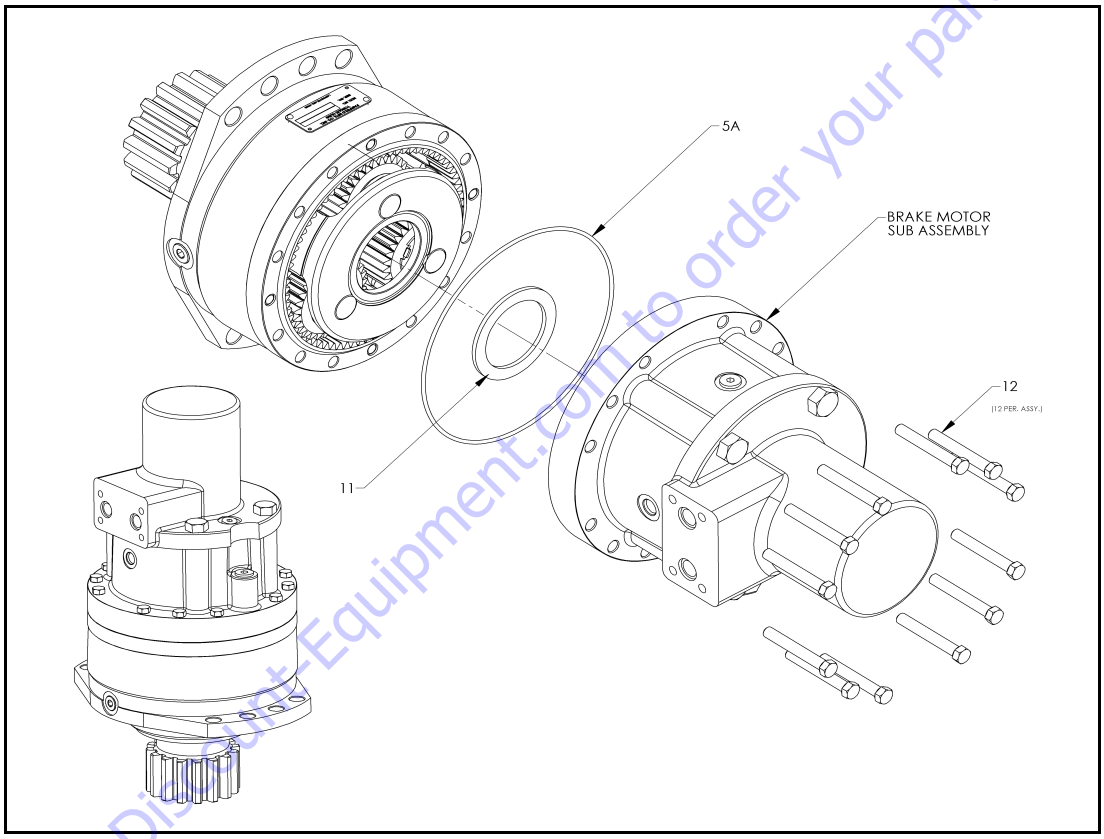
17. Elbow Fitting
18. Fittings
19. Ferrule
20. Tubing Assembly
21. Fitting
29. Plug
31. Motor Control Valve
33. Washers
34. Bolts

Figure 3-20. Motor Control Valve

Motor and Brake Disassembly

NOTE: *Refer to Figure 3-21., Motor and Brake*

1. With unit resting on bench with Motor (10) end up, loosen Hex Bolts (12) and remove Brake/Motor Subassembly from the Housing (1G) (See assembly drawing).
2. Remove O-Ring (5A) from between Brake/Motor Subassembly and Housing (1G) (See assembly drawing).
3. Remove Thrust Washer (11) from between Brake/ Motor Subassembly and Carrier.
4. Remove one O-Ring Plug (13) from Motor (10) and one O-Ring Plug (13) from Brake Housing (6).
5. Remove O-Ring Plug (4) from Brake Housing (6).



5A. O-ring
11. Thrust Washer
12. Hex Bolts

Figure 3-21. Motor and Brake

6. Remove Motor (10) from Brake Housing (6) by removing four Bolts (15) incrementally until spring pressure is relieved.

7. Remove O-Ring (26) from between Motor (10) and Brake Housing (6).

8. Remove Springs (8-6) & (8-7) from Brake Piston (8- 2).

⚠ CAUTION

WEAR EYE PROTECTION DURING THE NEXT STEP OF THIS PROCEDURE.

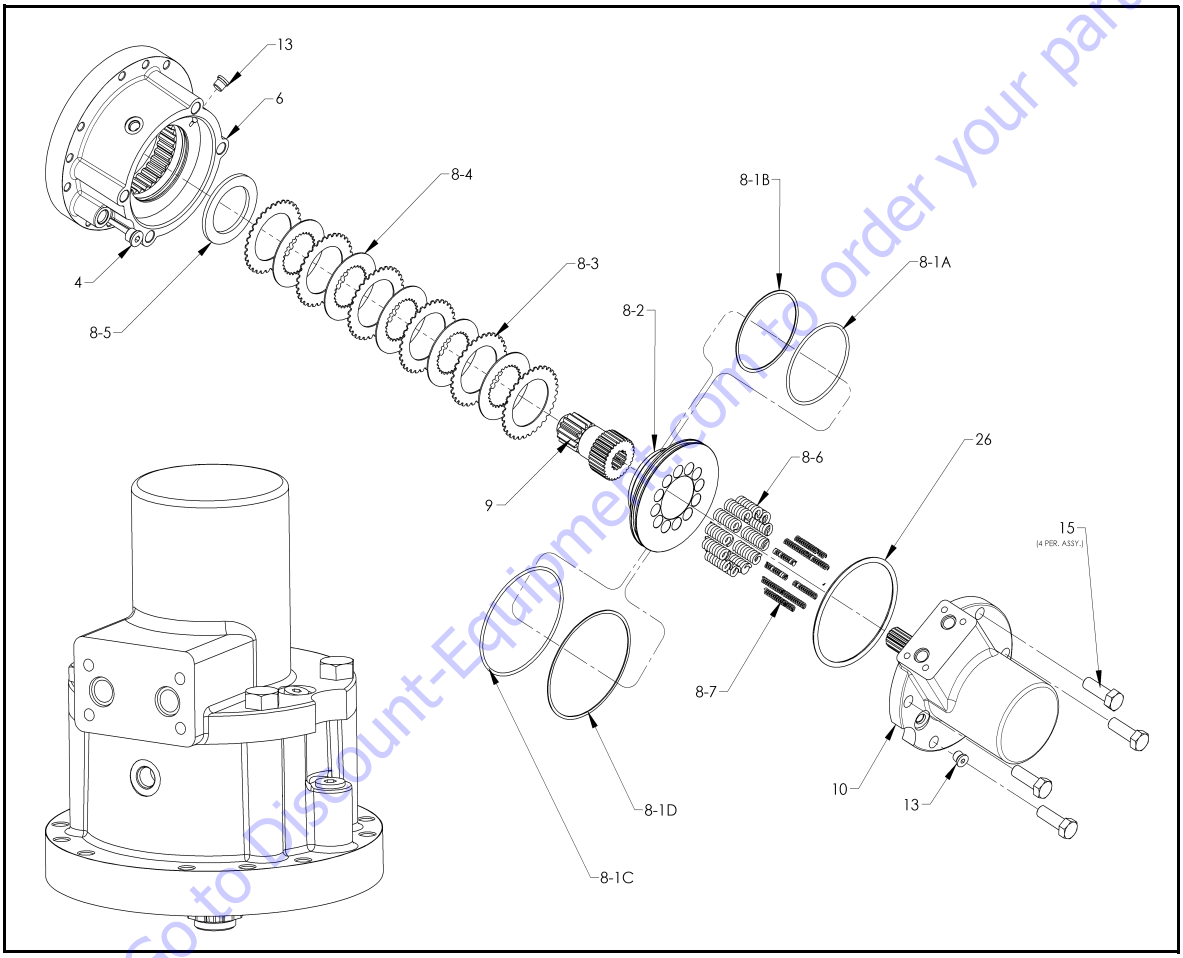
9. Remove Brake Piston (8-2) from Brake Housing (6) by slowly pressurizing brake port in Brake Housing (6) with air.

10. Remove O-Rings (8-1A) & (8-1C) and Backup Rings (8-1B) & (8-1D) from Brake Piston (8-2).

11. Remove Sun Gear (9).

12. Remove Outer Plates (8-3) and Inner Plates (8-4) from the Brake Housing (6).

13. Remove the Thrust Spacer (8-5).



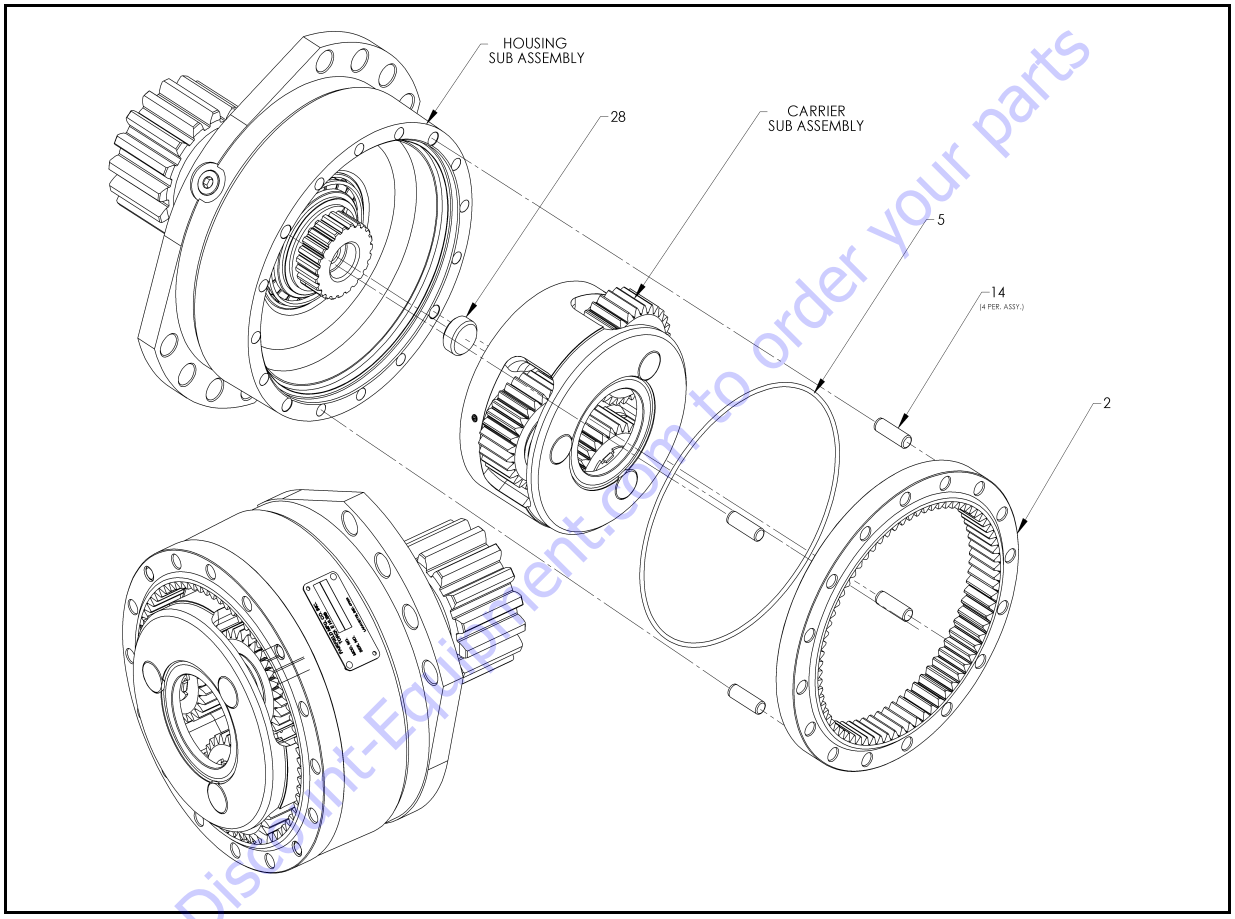
4. O-ring Plug
6. Brake Housing
8-1A. O-ring
8-1B. Backup Ring
8-1C. O-ring
8-1D. Backup Ring
8-2. Brake Piston
8-3. Outer Plates
8-4. Inner Plates
8.5. Thrust Spacer
8-6. Spring
8.7. Spring
9. Sun Gear
10. Motor
13. O-ring Plug
15. Bolts
26. O-ring

Figure 3-22. Brake

Main Disassembly

NOTE: *Refer to Figure 3-23., Main Assembly*

1. With the unit resting on the Output Shaft (Pinion) (1A), remove the Carrier Subassembly.
2. Remove Ring Gear (2) from Housing Subassembly.
3. Remove O-ring (5) from between Ring Gear (2) and Housing Subassembly.
4. Remove four Dowel Pins (14) from Housing Subassembly.



2. Ring Gear
5. O-Ring
14. Dowel Pins
28. Input Spacer

Figure 3-23. Main Assembly

Hub-shaft Disassembly

NOTE: *Refer to Figure 3-24., Hub Shaft*

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

⚠ CAUTION

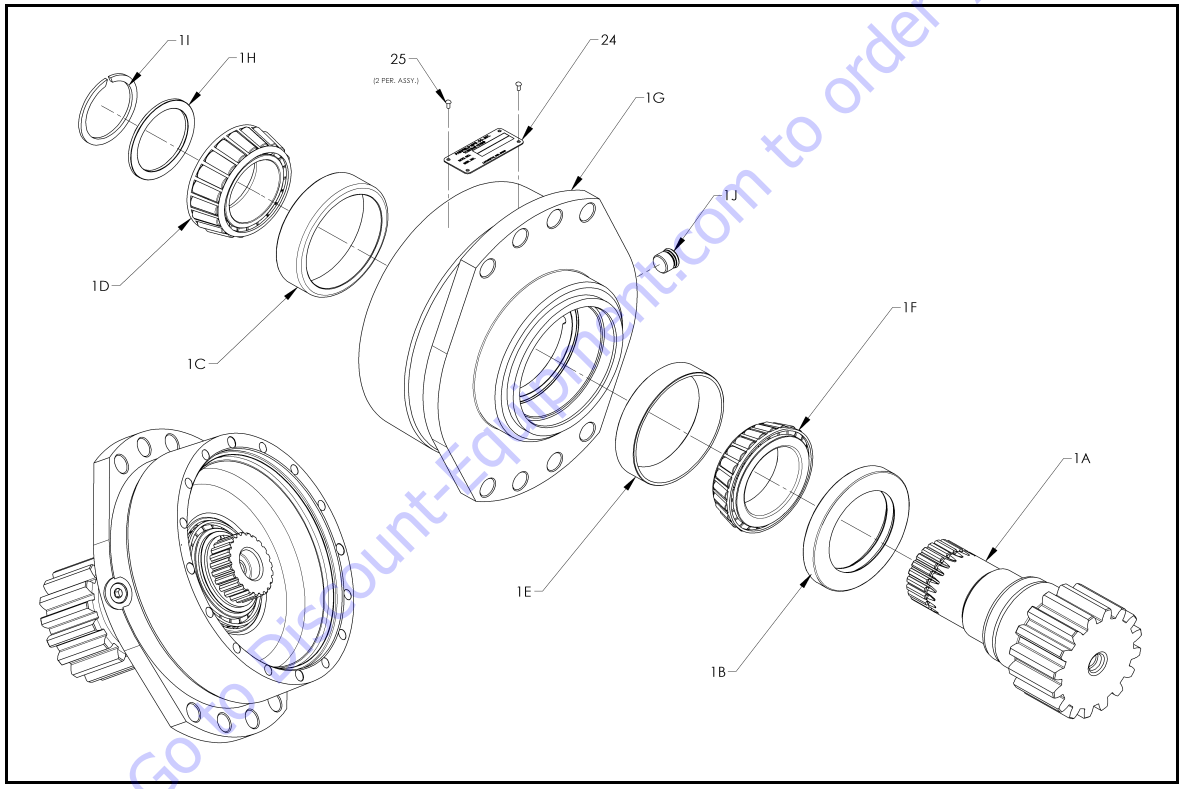
EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.

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) may or may not be pressed out of the Housing (1G) by the Bearing Cone (1D) during this step.*

4. Remove the Bearing Cone (1D) from the Housing (1G).
5. Invert the Housing (1G) and remove the Lip Seal (1B) if not already removed when Output Shaft (1A)was pressed out of Housing (1G).
6. Using a bearing puller, remove the Bearing Cone (1F) from the Output Shaft (1A).
7. Bearing Cups (1C & 1E) will remain in Housing (1G).

NOTE: *If bearing replacement is necessary, the Bearing Cups (1C & 1E) can be removed with a slide hammer puller or driven out with a punch.*



1A. Output Shaft
1B. Lip Seal
1C. Bearing Cup
1D. Bearing Cone
1E. Bearing Cup
1F. Bearing Cone
1G. Housing
1H. Thrust Washer
1I. Retaining Ring
24. ID Plate
25. Drive Screw

Figure 3-24. Hub Shaft

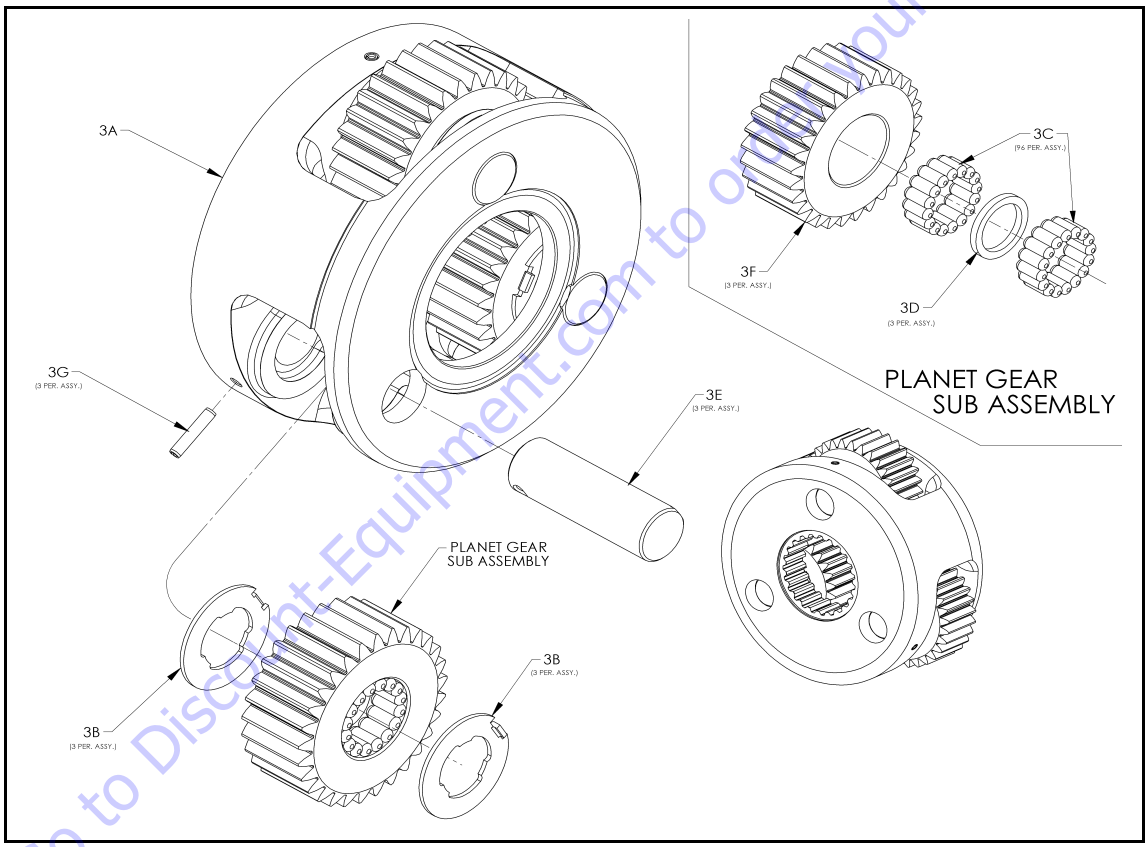
Carrier Disassembly

NOTE: *Refer to Figure 3-25., Carrier*

1. Using a 1/4" 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).
3. Slide the Planet Gear (3F) and 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. Using a 1/4" punch, drive the Roll Pin (3G) out of the Planet Shaft (3E).
6. Repeat Steps 1 through 5 for the remaining two Planet Gears (3F).



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

Figure 3-25. Carrier

Hub-Shaft Sub-Assembly

NOTE: *Refer to Figure 3-24., Hub Shaft*

1. Press Bearing Cup (1E) into Motor end of Housing (1G) using an appropriate pressing tool.
2. Invert Housing (1G) and press Bearing Cup (1C) into Housing (1G) using an appropriate pressing tool.Set Bearing Cone (1F) onto Bearing Cup (1E).
3. Using an appropriate pressing tool, press Seal (1B) into Housing (1G) until it is flush with the end of the Housing (1G).
4. Apply liberal amount of grease to lip of Seal (1B).
5. Invert Housing (1G) and lower onto Output Shaft (1A).

NOTE: *Be careful not to damage seal while lowering Housing onto Output Shaft.*

6. Press Bearing Cone (1D) onto Output Shaft (1A) until it seats against the bearing shoulder.
7. Place Thrust Washer (1H) onto Bearing Cone (1D).

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING THE NEXT STEP OF THIS PROCEDURE.

NOTE: *Retaining Ring (1I) should never be reused in a repair or rebuild.*

8. Using retaining ring pliers, install Retaining Ring (1I) into groove in Output Shaft (1A). If Retaining Ring (1I) will not seat completely into groove, use an appropriate pressing tool to press down on Bearing Cone (1D) while rotating Housing (1G). Reinstall Thrust Washer (1H) and Retaining Ring according to preceding procedures. 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 (1A).
9. Using a soft face hammer, hit the end of the Shaft (1A) to remove the bearing preload.
10. Install O-ring Plug (1J) and torque to 23 to 24 ft-lbs.

Carrier Sub-Assembly

NOTE: *Refer to Figure 3-25., Carrier*

1. Apply a liberal coat of grease to the bore of Planet Gear (3F). This will enable the Needle Rollers (3C) to be held in place during assembly.
2. Install the first row of 16 Needle Rollers (3C) into the bore of Planet Gear (3F).
3. Insert Spacer (3D) into bore of Planet Gear (3F) on top of the Needle Rollers (3C).
4. Place second row of Needle Rollers (3C) into bore of Planet Gear (3F) against Spacer (3D) and remove Planet Shaft (3E).
5. Place Carrier (3A) on bench so that one of the Roll Pin (3G) holes is straight up.
6. Paying attention to the location of the Roll Pin (3G) hole in the Planet Shaft (3E), 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. Place the Planet Gear (3F) into position in Carrier (3A) and push Planet Shaft (3E) through the Planet Gear (3F) without going all the way through.
8. Slide the second Thrust Washer (3B) between the Planet 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 inch diameter punch.

NOTE: *If Planet Shaft (3E) has a flat on the end, position the flat toward the center of the Carrier (3A).*

10. After using a 1/4" punch to align the Roll Pin (3G) holes in the Carrier (3A) and the Planet Shaft (3E), 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 tang slot in the Carrier (3A). Use a 1/4" pin punch to make sure the Roll Pin (3G) is flush in the slot.

NOTE: *On 6:1 Ratios of S1C"s, the pin must be 0.125" below the surface of the outside diameter.*

11. Repeat Steps 1 through 10 for the remaining two Planet Gears (3F).

Main Assembly

NOTE: *Refer to Figure 3-23., Main Assembly*

1. With the Housing-Shaft Subassembly resting on the Shaft (1A) install one Dowel Pin (14) into each of the four counterbored holes in the Housing (1G) (See assembly drawing) until they bottom out. Also at this time, mark the four Dowel Pin (14) holes on the O.D. of the Housing (1G) (See assembly drawing). This is for identification later in the assembly.
2. Install Thrust Spacer (28) into counterbore in splined end of the Output Shaft (1A).
3. Place O-Ring (5) into Housing (1G) counterbore. Use grease to hold O-ring in place.

⚠ CAUTION

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

4. Install Carrier Subassembly with splined end down so that the spline of the Carrier Subassembly is in mesh with the spline of the Housing-Shaft Subassembly. Rotate carrier in assembly to check for freedom of rotation.
5. With large shoulder side of Ring Gear (2) facing down, place Ring Gear (2) onto Housing-Shaft Subassembly with gear teeth in mesh with the Planet Gears (3f) in the Carrier (3A). The side of the Ring Gear (4) with an "X" or punch mark stamped on it should be up and the marked hole should be at a Dowel Pin (14) location.

Motor-Brake Subassembly

NOTE: *See Figure 3-21., Motor and Brake*

1. Place Brake Housing (6) on bench with flange end down. Either block Brake Housing (6) up or place over hole in bench large enough for the shoulder of the Sun Gear (9) to rest on the bottom of the Brake Housing (6). Then install Sun Gear (9) with gear end down into Brake Housing (6).
2. Place Spacer (8-5) into Brake Housing (6) in bottom of small counterbore below splines.
3. Install brake disks, starting with an Outer Plate (8-3), then alternating Inner Plates (8-4) and Outer Plates (8-3) into splined bore.
4. Grease the O Rings (8-1A) & (8-1C) and Backup Rings (8-1B) & (8-1D), and place them in their respective grooves in the Piston (8-2). Make sure the backup-rings are correctly positioned as per the assembly print.

NOTE: *Be sure that Backup Rings (8-1B) & (8-1D) are located as tightly into the grooves in the Piston (8-2) as possible to prevent them from being "shaved" when Piston (8-2) is installed into Brake Housing (6).*

5. Apply grease sparingly to Piston (8-2) O.D. and the cylinder bore of Brake Housing (6). Insert Piston (8- 2) into cylinder of Brake Housing (6), be sure not to cut the O Rings (8-1A) & (8-1C) or Backup Rings (8- 1B) & (8-1D).
6. Install Compression Springs (8-6) into spring pockets in Piston (8-2).
7. Install Compression Springs (8-7) into Compression Springs (8-6) in spring pockets in Piston (8-2).
8. Grease O-Ring (26) and install into counterbore in Brake Housing (6).
9. Assemble Test Cover (See Tools at back of manual for drawing) to Brake Housing (6) using four Bolts (15) evenly tightening Bolts (15) to 80-100 ft-lbs.
10. Check the brake for release. Apply pressure to brake port in side of Brake Housing (6) while trying to rotate Sun Gear (9) by hand. The brake should release between 200-255psi. Remove Test Cover.
11. Assuming that Brake passed the Brake Test, place Motor (10) into Brake Housing (6) with splines of Motor (10) meshing with splines of Sun Gear (9).
12. Attach Motor (10) to Brake Housing (6) with four Bolts (15) and torque to Bolts (15) to 80–100 ft-lbs.

Motor-Brake Assembly

NOTE: *See Figure 3-21., Motor and Brake*

1. Grease Thrust Washer (11) and install into counterbore of Carrier Subassembly, which should already be installed into the Main Subassembly.
2. Grease O-Ring (5A) and install into counterbore of the Brake Housing (6) in the Motor-Brake Subassembly.
3. Install Motor-Brake Subassembly onto Main Assembly using twelve Bolts (12). Torque bolts to 23 – 27 ft.lbs. (31-37 Nm).

Motor Control Valve Assembly

1. Lay assembly down with motor ports facing up. Remove the two plastic plugs in the motor ports on new motors, being careful not to loose the O ring in each port. Assemble the Motor control Valve (31) onto the Motor (10) with Bolts (34) and Washers (33). Torque Bolts (34) to 23-27 ft-lbs.

NOTE: *Be sure to align the holes in the control valve with the motor ports and make sure o-ring is in hole.*

2. Install Straight Fitting (21) into Brake Housing (6) and torque to 13-15 ft-lbs.

3. Install Elbow Fitting (17) into Motor Control Valve (31) with chamfered end of fitting pointing towards straight Fitting (21). Thread fitting all the way in until in the correct position, then torque jam nut to 13-15 ft-lbs.

4. Assemble Tubing (20) Nuts (18) and Ferrules (19) per the procedures below.

Tube Fitting Assembly Procedures

NOTE: *Be sure the tube is inline with the fitting. If required, gently modify the tube bends to be inline.*

1. Assemble nut onto tubing with threaded end toward the assembled end of the tube.

2. Assemble ferrule onto tube with the large tapered end into the nut.

3. Place tube tight against the flared fitting in the assembly.

4. Lubricate threads and fitting end with hydraulic oil.

5. Slide ferrule and nut against fitting and hand tighten nut to the fitting.

6. Mark nut in relation to the fitting.

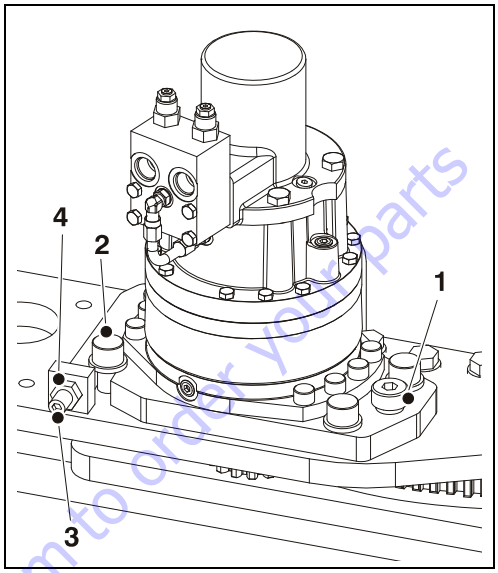
7. Hold tube tight against fitting and tighten nut 1-1/4 turns of the nut past the marked location.

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

8. Pressure test brake, tube and control valve connections by applying 3000 psi pressure to the brake bleed port and holding for 1 minute. Check for leaks at the control-valve-motor interface and the tube connections. Release pressure.

Procedure for Setting Gear Backlash

NOTE: *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.).*



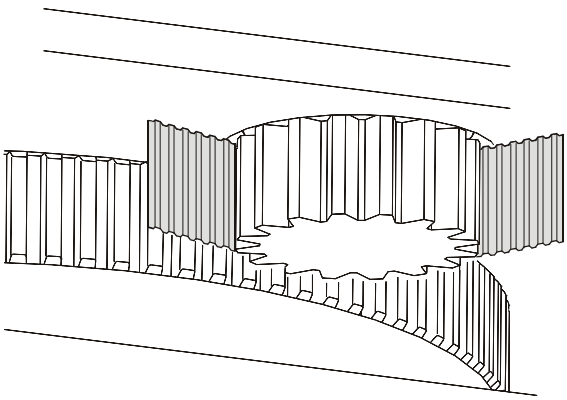
1. Shoulder Screw
2. Capscrew
3. Setscrew
4. Jam Nut

Figure 3-26. Setting Gear Backlash

NOTE: *The bearing high spot will be marked with yellow paint.*

Set backlash to 0.008 in. to 0.012 in. (0.2 mm - 0.3 mm) using the following procedure:

1. Place a shim between the pinion and bearing high spot.



2. Torque the Shoulder Screw (1) to 205 ft.lbs. (278 Nm) with High Strength Threadlocking Compound.

3. Remove the turntable lock pin.

4. Pre-torque the 3/4 inch Capscrews (2) to 30 ft.lbs. (41 Nm) with High Strength Threadlocking Compound.

5. Tighten the Setscrew (3) until the pinion is completely snug against the shim and bearing and then back off the setscrew.
6. Torque the setscrew to 50 ft.lbs. (70 Nm).
7. Tighten the Jam Nut (4).
8. Torque the four 3/4 inch capscrews (2) to 300 ft.lbs. (407 Nm).
9. Remove and discard the shim.

3.8 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

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

Check the frame to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to full elevation and rotate platform 90o.
2. Swing turntable over the side.
3. On the frame, at the rear of the turntable, try to insert the 0.0015" feeler gauge between the bolt head and hardened washer at the indicated position. (Figure 3-25., Swing Bearing Feeler Gauge Check)
4. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
5. Swing the turntable 90 degrees, and check some selected bolts at the new position.
6. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.
7. Lower the boom to horizontal and fully extend the boom.
8. Swing the turntable over the side.
9. On the frame, at the front of the turntable, try to insert the 0.0015" feeler gauge between the bolt head and hardened washer at the indicated position.
10. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
11. Swing the turntable 90 degrees, and check some selected bolts at the new position.
12. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.

Check the turntable to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to full elevation and rotate the platform 90o.
2. Swing the turntable over the side.
3. At turntable rear, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

4. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
5. Swing the turntable 90 degrees, and check some selected bolts at the new position.
6. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.

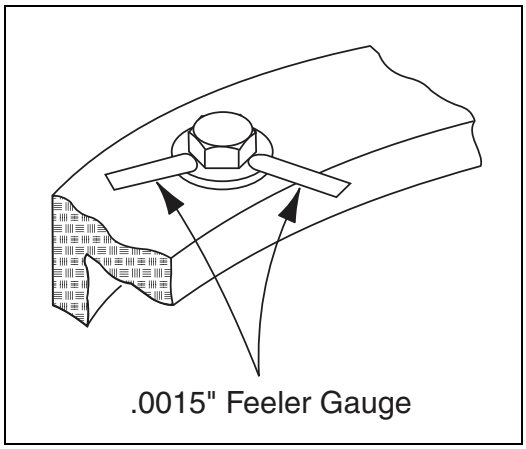


Figure 3-27. Swing Bearing Feeler Gauge Check

7. Lower the boom to horizontal and fully extend the boom.
8. At turntable front, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
9. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
10. Swing the turntable 90 degrees, and check some selected bolts at the new position.
11. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.

Wear Tolerance

1. With the boom positioned over the side of the machine, the Boom horizontal with telescope fully extended, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable front.
2. With the boom positioned over the side of the machine, the Boom fully elevated, retracted, and platform rotated 90o, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable rear.

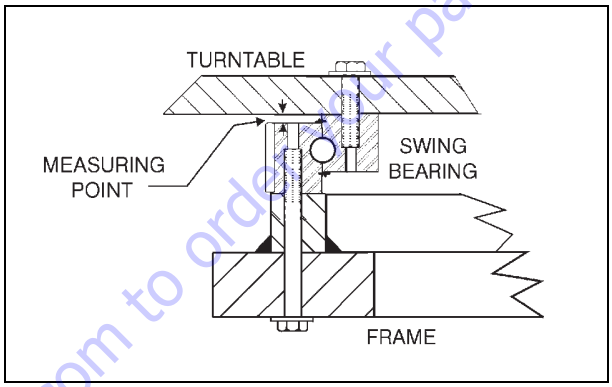
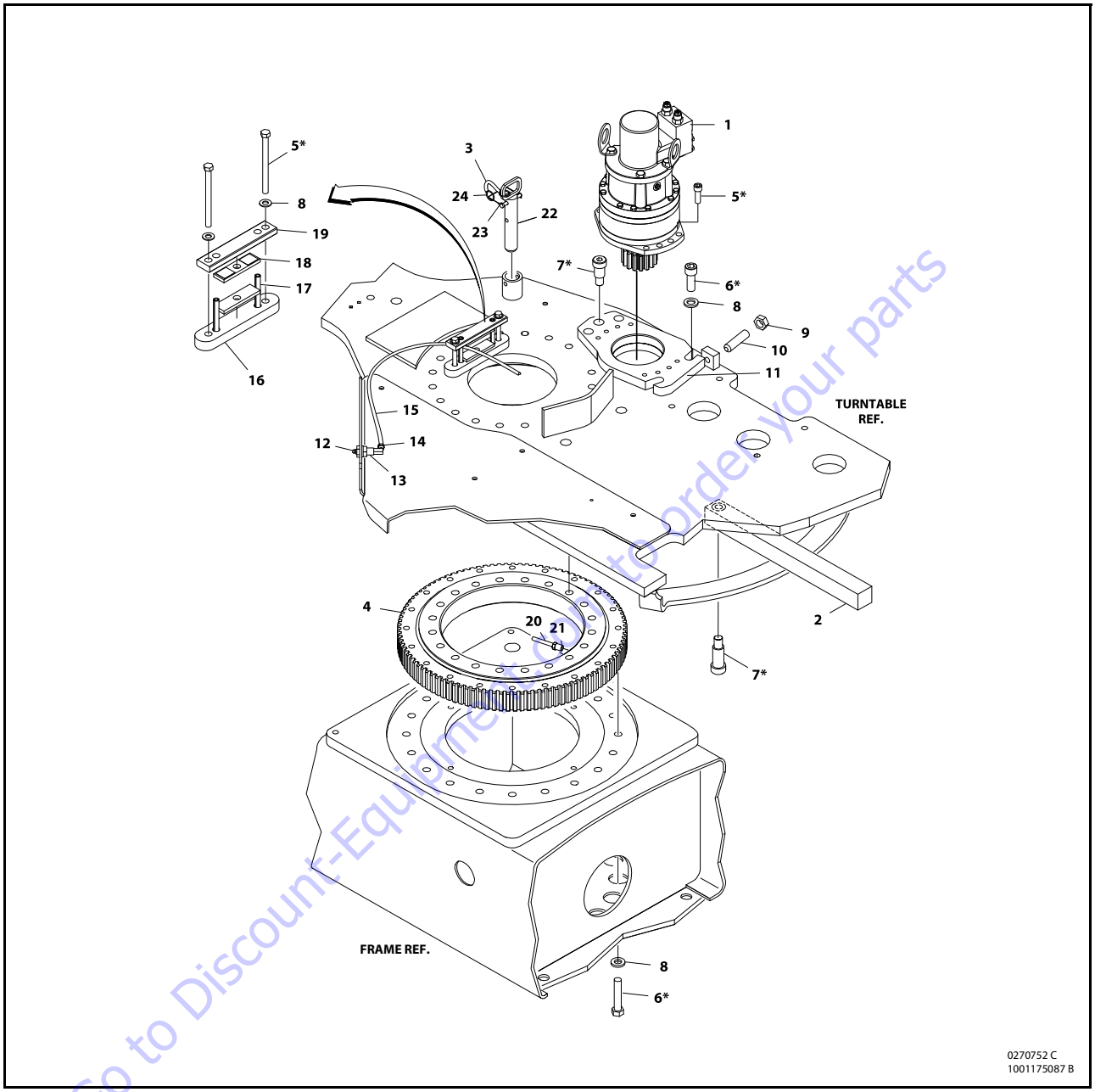


Figure 3-28. Swing Bearing Tolerance Measuring Point

3. If a difference greater than 0.057 in. (1.40 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.057 in. (1.40 mm) is determined, and any of the following conditions exist, the bearing should be removed.
   a. Metal particles in the grease.
   b. Increased drive power.
   c. Noise.\
   d. Rough rotation.
5. If bearing inspection shows no defects, reassemble bearing and return to service.



1. Swing Motor Assembly
2. Turntable Stop
3. Chain
4. Turntable Bearing
5. Capscrew
6. Bolt
7. Shoulder Screw
8. Washer
9. Nut
10. Setscrew
11. Mounting Plate
12. Grease Fitting
13. Bulkhead Fitting
14. Adapter Fitting
15. Hose
16. Clamp
17. Rollpin
18. Rubber Pad
19. Clamp Bar
20. Hose
21. Reducer Fitting
22. Weldment Pin
23. Snap Pin
24. Quick Release Ring

Figure 3-29. Swing Drive and Bearing Installation

Replacement of Swing Bearing

Removal of the swing bearing is as follows:

1. Attach an adequate support sling to the boom and draw all slack from sling. Prop or block the boom if feasible.
2. Tag and disconnect hydraulic lines running through center of turntable and frame. Use a suitable container to retain any residual hydraulic fluid. Cap lines and ports.
3. Attach suitable overhead lifting equipment to the base of turntable weldment.
4. Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This will aid in aligning the bearing upon installation. Remove bolts, nuts and washers which attach the turntable to the bearing inner race. Discard nuts and bolts.
5. Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame mounted components.
6. Carefully place the turntable on a suitably supported trestle.

NOTE: *The bearing weighs approximately 100 lb (45 kg.).*

7. Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing from the frame; move to a clean, suitably supported work area.

Installation of the swing bearing is as follows:

1. Install bearing to turntable with two capscrews, so the grease hose is on the forward side of the frame as close to the centerline of the turntable as the bolt pattern will allow. Do not tighten capscrews.
2. Line up high spot (marked with yellow paint) of bearing with center tooth of bull gear. Set backlash to0.008 - 0.012 inch (0.20 - 0.30 mm). Refer to Swing Drive Installation. Tighten capscrews as shown in Figure 3-28., Swing Bearing Torque Sequence
3. Grease bearing with Mobilith SHC Bearing Grease.Grease fitting is on inside wall of inner race of bearing.

NOTE: *If Mobiltac 375NC is not available, Tribol Molub-Alloy 936 Open Gear Compound or Mobilith SHC Bearing Grease or Multi-Purpose Grease (MPG) can be substituted, however the service interval will be shorter.*

4. Using suitable lifting equipment, install bearing/ assembly to frame with soft spot (red) 90 degree relative to load axis. If reusing old bearing, ensure that scribed line of outer race of the bearing aligns with the scribed mark on the frame.

⚠ CAUTION

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

5. Apply a light coating of High Strength Threadlocking Compound to the new bearing bolts and loosely install the bolts and washers through the frame and outer race of bearing.

⚠ CAUTION

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.

6. Following the torque sequence diagram shown in Figure 3-28., Swing Bearing Torque Sequence, tighten the bolts to an initial torque of 130 ft. lbs. (175 Nm). Then following the same sequence, tighten to a final torque of 190 ft. lbs. (260 Nm).
7. Remove lifting equipment from bearing.
8. Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.
9. Carefully lower the turntable onto the swing bearing. Ensure that the scribed line of the inner race of the bearing aligns with the scribed mark on the turntable. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft centerline of the turntable.
10. Apply a light coating of High Strength Threadlocking Compound to the new bearing bolts and install through the turntable and inner race of bearing.

11. Following the torque sequence shown in Figure 3- 28., Swing Bearing Torque Sequence tighten the bolts to an initial torque of 130 ft. lbs. (175 Nm). Then following the same sequence, tighten the bolts to 190 ft. lbs (260 Nm).
12. Remove the lifting equipment.
13. Route hydraulic lines through center of turntable and frame and connect as tagged prior to removal.
14. Using all applicable safety precautions, activate the hydraulic system and functionally check swing system for proper and safe operation.

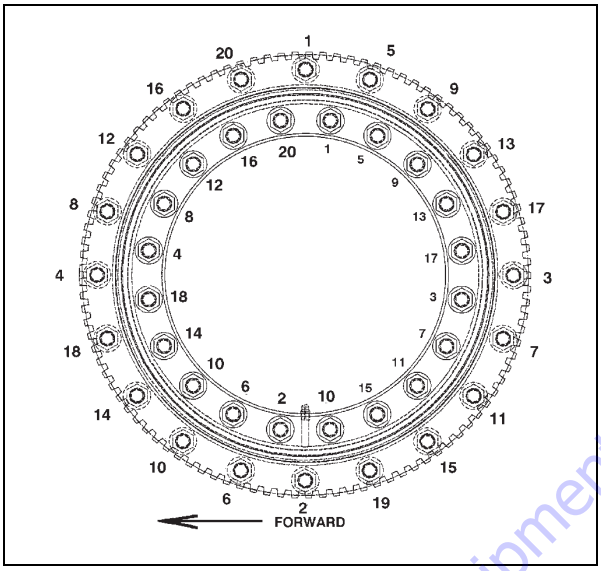


Figure 3-30. Swing Bearing Torque Sequence

Swing Bearing Torque Value

Install with Threadlocking compound - 190 ft. lbs. (260 Nm).

Swing Drive Installation

1. Coat the threads of the socket head bolts securing the swing drive to the mounting plate with High Strength Threadlocking Compound and torque to 120 ft.lbs. (168 Nm).
2. Position swing drive to location of bearing gear max eccentric tooth. High spot is marked with yellow paint in tooth.
3. With the mounting plate pivoting about the shoulder bolt, adjust backlash between the pinion and bearing gear teeth to 0.008 to 0.012 inch backlash (0.20mm to 0.30mm).
4. Tighten the adjusting bolt, jam nut, and shoulder bolt to prevent the swing drive from moving. Coat the threads of the shoulder bolt with High Strength Threadlocking Compound and torque to 420 ft.lbs. (588 Nm).
5. Coat the threads of the mounting plate bolts with High Strength Threadlocking Compound and torque to 420 ft.lbs. (588 Nm).

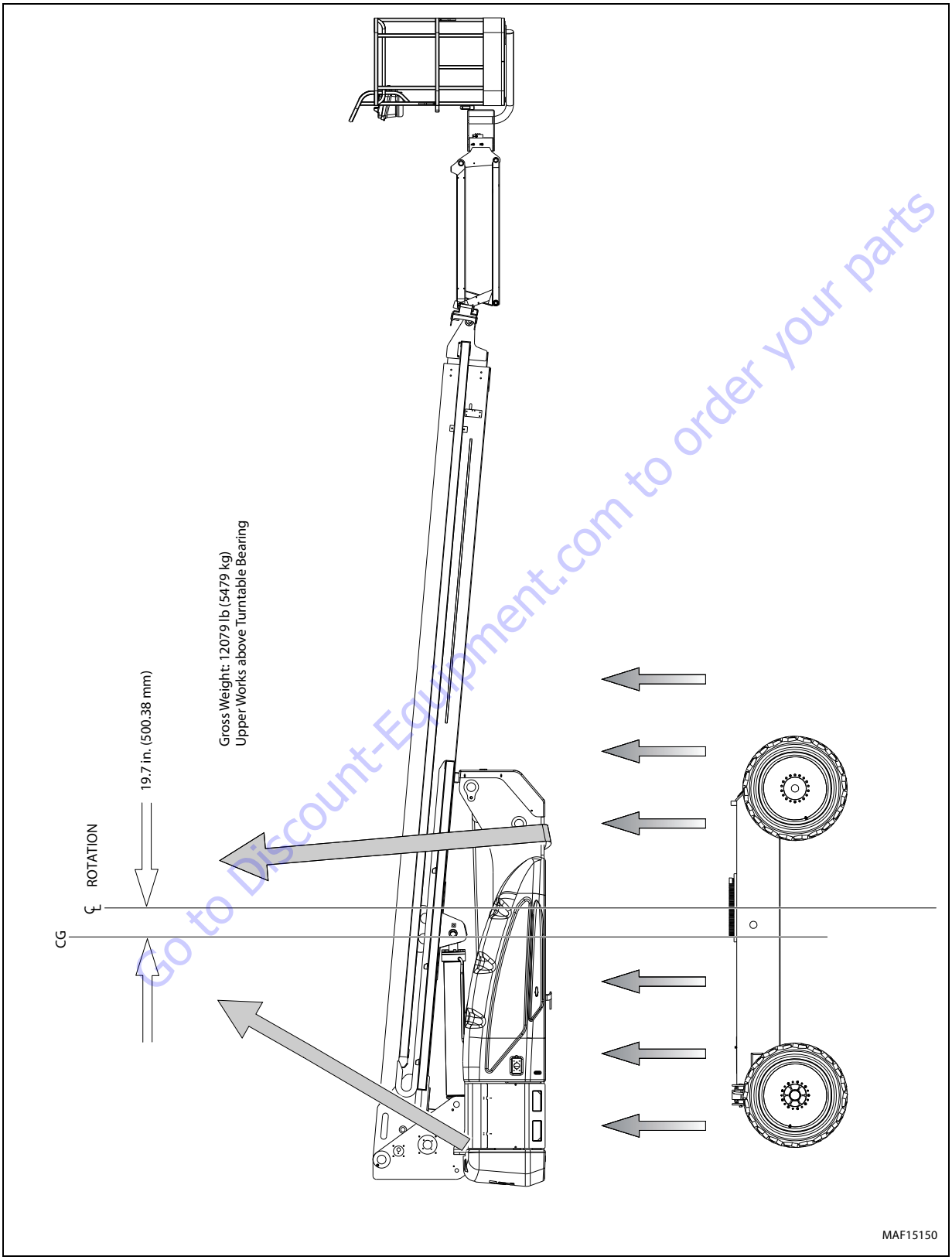


Figure 3-31. Swing Bearing Removal - EC600SJ & H600SJ

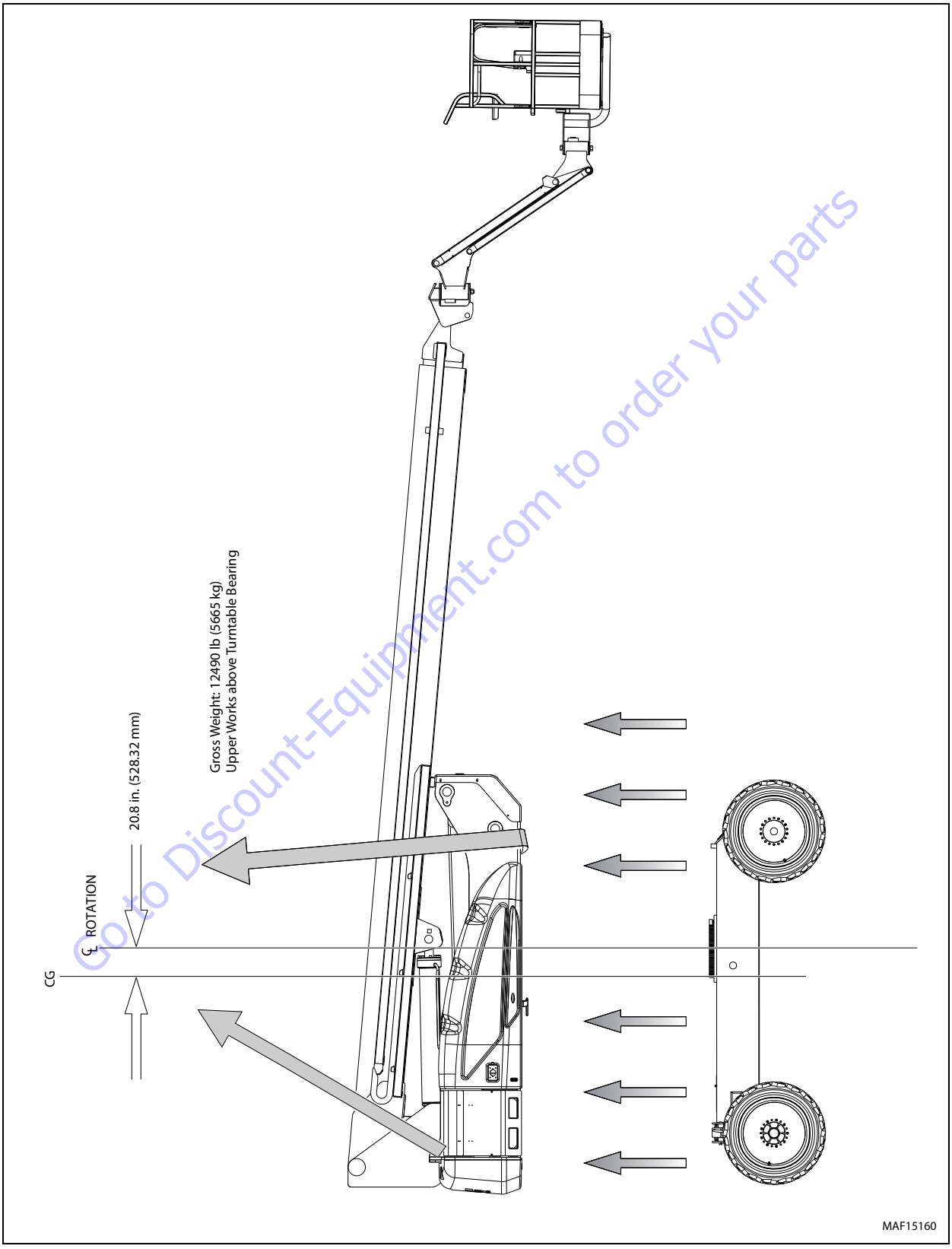


Figure 3-32. Swing Bearing Removal - EC600SJP & H600SJP

3.9 BATTERY MAINTENANCE AND CHARGING

Battery Maintenance, Quarterly

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

NOTICE

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

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

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

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

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

Optional On Board Generator

⚠ WARNING

EXHAUST GAS HAZARD. RUN THE GENERATOR IN A WELL VENTILATED AREA ONLY.

NOTICE

WHEN THE GENERATOR ENABLE CONTROL LOCATED IN THE PLATFORM CONTROL BOX IS IN THE ON POSITION AND THE GROUND EMERGENCY STOP SWITCH IS ON (PULLED OUT), THE GENERATOR WILL START AUTOMATICALLY WHEN THE BATTERIES REACH A LOW-CHARGE STATE, AUTOMATICALLY CHARGING THE BATTERIES. THE GENERATOR WILL ALSO AUTOMATICALLY START IF THE GENERATOR START BATTERY IS LOW.

NOTE: *The engine will automatically shut down under the following conditions:*
High Engine Oil Temperature
Low Engine Oil Pressure
Engine Overspeed
Generator Overvoltage
Batteries fully charged

⚠ WARNING

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

Battery Charging (On Board Charger)

1. For maximum battery life:
   a. Avoid completely discharging the batteries.
   b. Fully charge the batteries each day the machine is used.
   c. Charge the batteries at available times between charging.
   d. Be sure the battery fluid covers the battery plates before charging, but to avoid overflow, do not top off the fluid level until charging.
2. To charge the batteries, connect the charger to a 115 volt source with a 15 amp minimum capacity.
3. The Charger will shut off automatically when the batteries are fully charged.
4. The charge cycle is complete when the ammeter reads 0 amps. Any reading indicates the charge cycle is not complete.
5. Depleted batteries will take approximately 17 hours to charge.

Removing the Battery Box

To remove the battery box, perform the following steps.

1. Pull the pull ring to disconnect the batteries at the battery disconnect beside the box.
2. Remove the two attachment bolts that secure the battery box to the turntable.

NOTE: *The battery box and batteries complete weigh approximately 668 pounds (303 kg).*

3. Using a forklift, lift the battery box up enough to clear the notch on the battery box rails and remove the battery box from the machine.

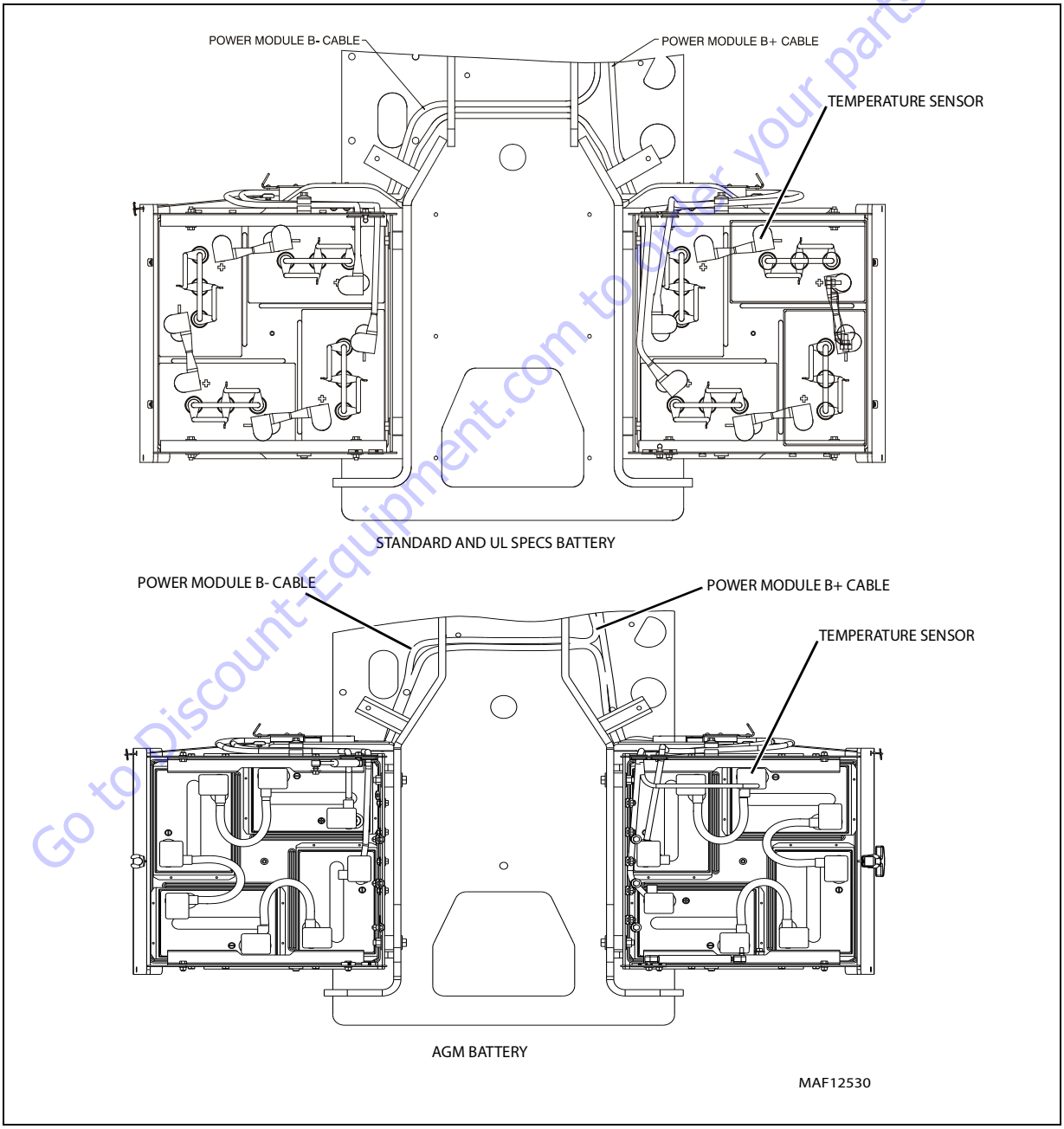


Figure 3-34. Battery Cable Routing

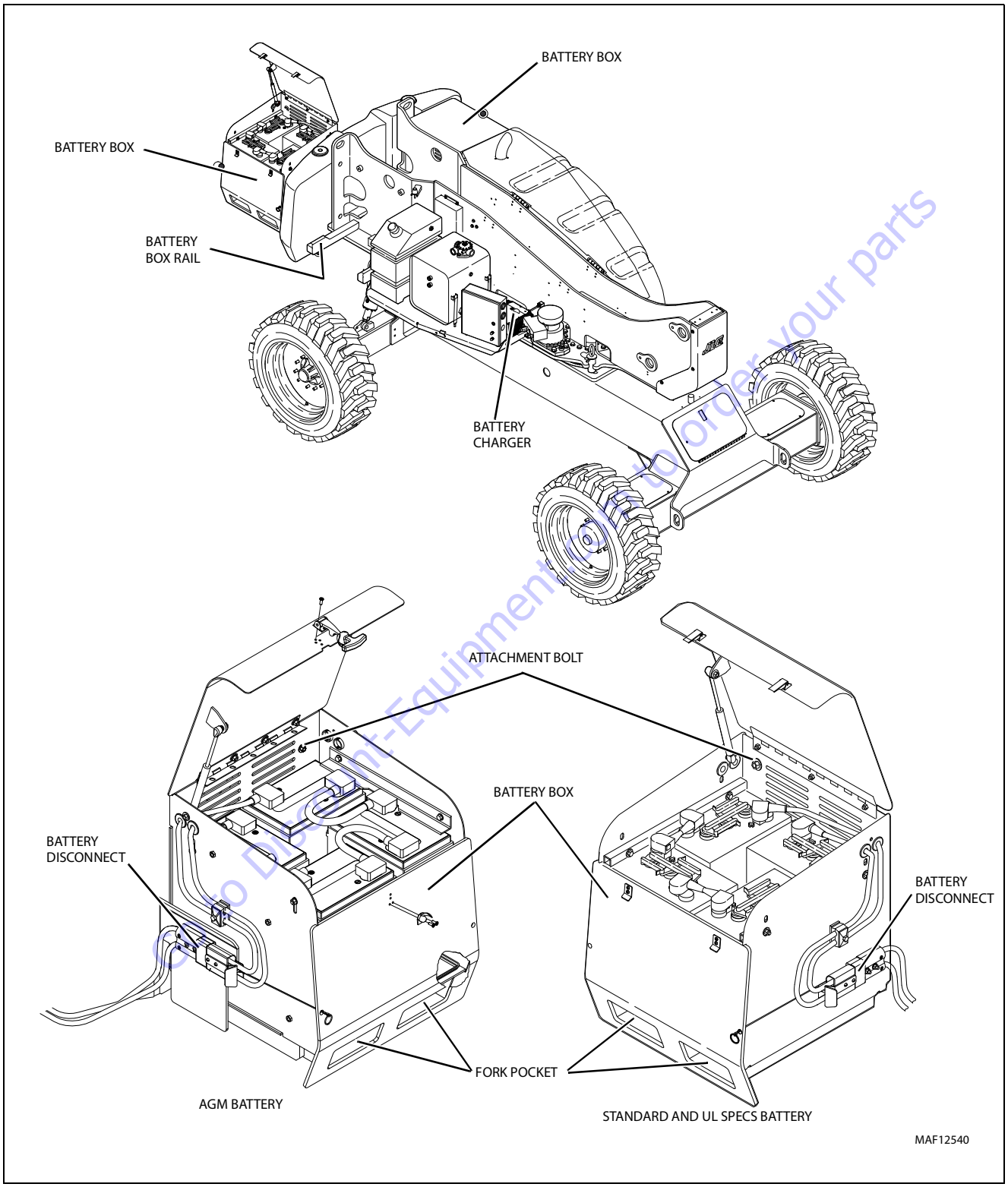


Figure 3-35. Batteries and Battery Charger

3.10 BATTERY CHARGER

NOTICE

JLG MACHINES EQUIPPED WITH DELTA Q BATTERY CHARGERS ARE DESIGNED FOR THE BEST PERFORMANCE WITH OEM FACTORY APPROVED.

APPROVED JLG REPLACEMENT BATTERIES ARE AVAILABLE THROUGH JLG'S AFTERMARKET PARTS DISTRIBUTION CENTERS OR JLG'S AFTERMARKET PROGRAMS. FOR ASSISTANCE WITH PROPER BATTERY REPLACEMENT, PLEASE CONTACT YOUR LOCAL JLG SUPPORT OFFICE.

BATTERIES APPROVED BY JLG HAVE BEEN TESTED FOR COMPATIBILITY WITH THE ALGORITHM PROGRAMMING OF THE DELTA Q BATTERY CHARGER TO OPTIMIZE BATTERY LIFE AND MACHINE CYCLE TIMES. THE USE OF NON APPROVED BATTERIES IN YOUR JLG EQUIPMENT MAY RESULT IN PERFORMANCE ISSUES OR BATTERY CHARGER FAULT CODES. JLG ASSUMES NO RESPONSIBILITY FOR SERVICE OR PERFORMANCE ISSUES ARISING FROM THE USE OF NON APPROVED BATTERIES.

⚠ WARNING

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

⚠ WARNING

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

Operating Instructions

NOTICE

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

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

Maintenance Instructions

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

Battery Charger Fault Codes

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

Table 3-2. Battery Charger Fault Codes (Delta-Q)

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

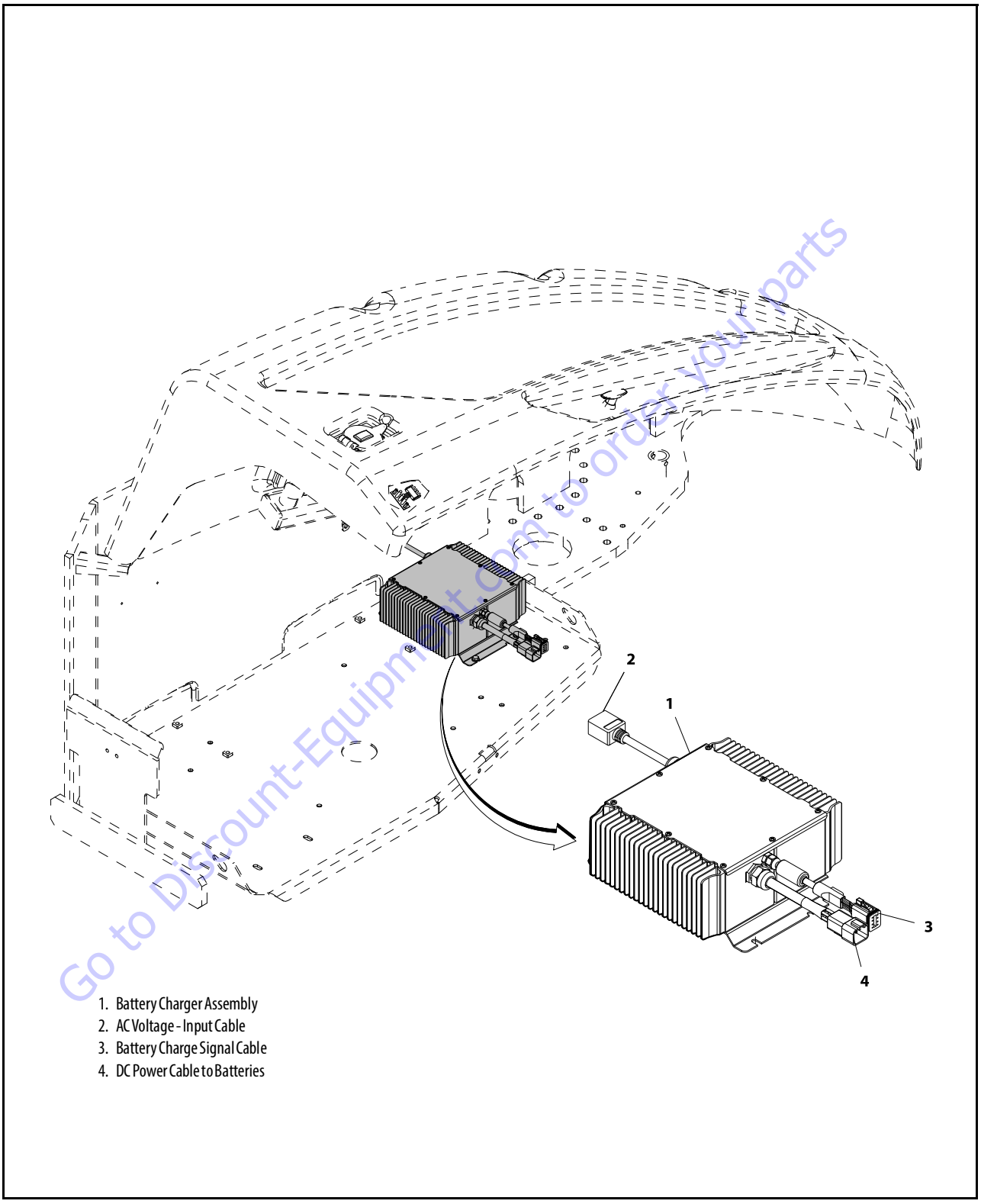


Figure 3-36. Battery Charger

NO LIGHTS AT ALL

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

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

FAULT LED FLASHING

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

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

[1 Flash] - High Battery Voltage

1. Indicates a high battery voltage. Check that the battery charger voltage is consistent with the battery pack voltage. The first two digits of the four digit model name indicate the battery voltage the charger supports.
2. Check for wiring errors.
3. This fault will automatically clear and the charger will restart charging when this problem is removed.
4. High battery voltage could also occur if there is another source charging the battery. Disconnect any other sources during charging.
5. If this problem does not clear after the battery voltage is confirmed to be less than 2.5V per cell, return the charger for service.

[2 Flashes] - Low Battery Voltage

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

[3 Flashes] - Charge Timeout

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

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

[4 Flashes] - Check Battery

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

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

[5 Flashes] - Over Temperature

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

1. This fault indication will not clear automatically, but the charger will restart charging automatically when the temperature drops. The fault indicaiton must be cleared manually by unplugging the AC, waiting 30 seconds and reconnecting the AC power.
2. If possible, move the machine to a cooler location.

3. Confirm that dirt or mud is not blocking the cooling fins of the charger. Clean the charger. Rinse the charger with a low pressure hose if required. Do no use high pressure. Do not us a pressure washer.

[6 Flashes] - Over Load/Over Temperature

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

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

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

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

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

Checking/Changing the Battery Charger Algorithm

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

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

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

To check / change the charging algorithm:

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

Table 3-3. Battery Charger Algorithms

Default Algorithm Setting	JLG PN	Battery Type	Proper Algorithm Setting
173	0400202	6V-415S	173
173	1001228392	6V-EVL16A-A	143

3.11 GENERATOR

NOTE: *Throughout the Generator section, the abbreviation RBS is used. RBS stands for Rotary Battery System, which is the generator system.*

The engine-driven generator is designed to produce a DC output directly without the need of a separate rectifier. Included in the RBS unit is the engine, generator, engine/generator controller, harness and related components.

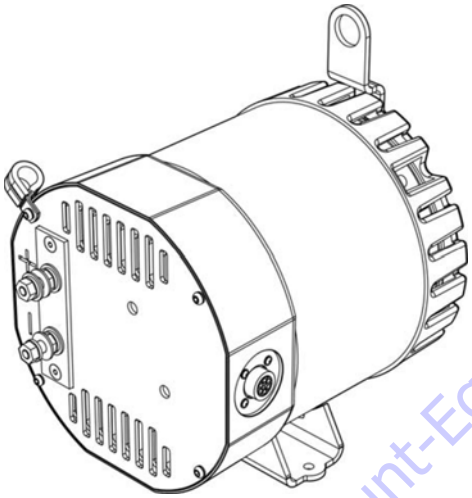
Engine

Peak rating: 6.2 HP

Continuous rating: 5.6 HP at 3600 RPM

Refer to the Engine Manual for a complete description of the engine.

Alternator



The RBS is equipped with a brushless DC output alternator.

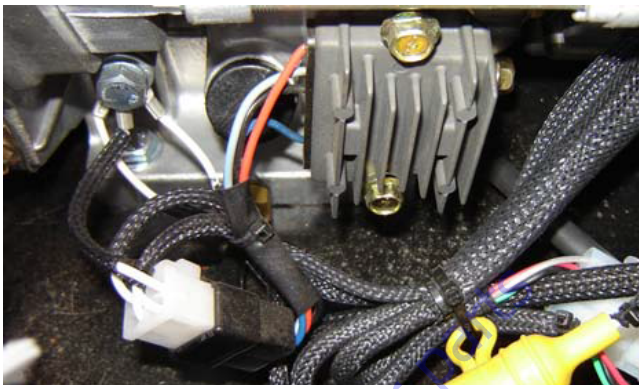
The 3-phase AC output of the alternator is full wave rectified and presented to the output terminals.

Output rating: 58.0V at 45A

Voltage regulation and current limiting is provided by the RBS Engine/Generator Controller.

The rectifier diodes and output current sensor are located in the alternator endbell.

Dynamo and Dynamo Voltage Regulator

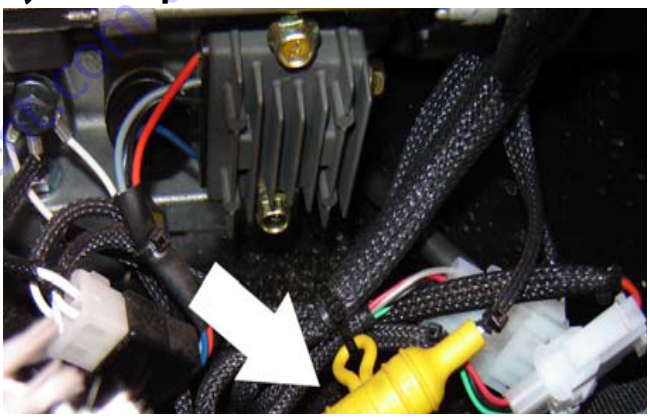


The engine is equipped with a dynamo and dynamo voltage regulator.

Dynamo output: 12V
7A DC

Refer to the Engine Manual for a complete description of the dynamo and dynamo voltage regulator.

Dynamo Output Fuse



This fuse protects the dynamo output; it is located on the left side of the engine.

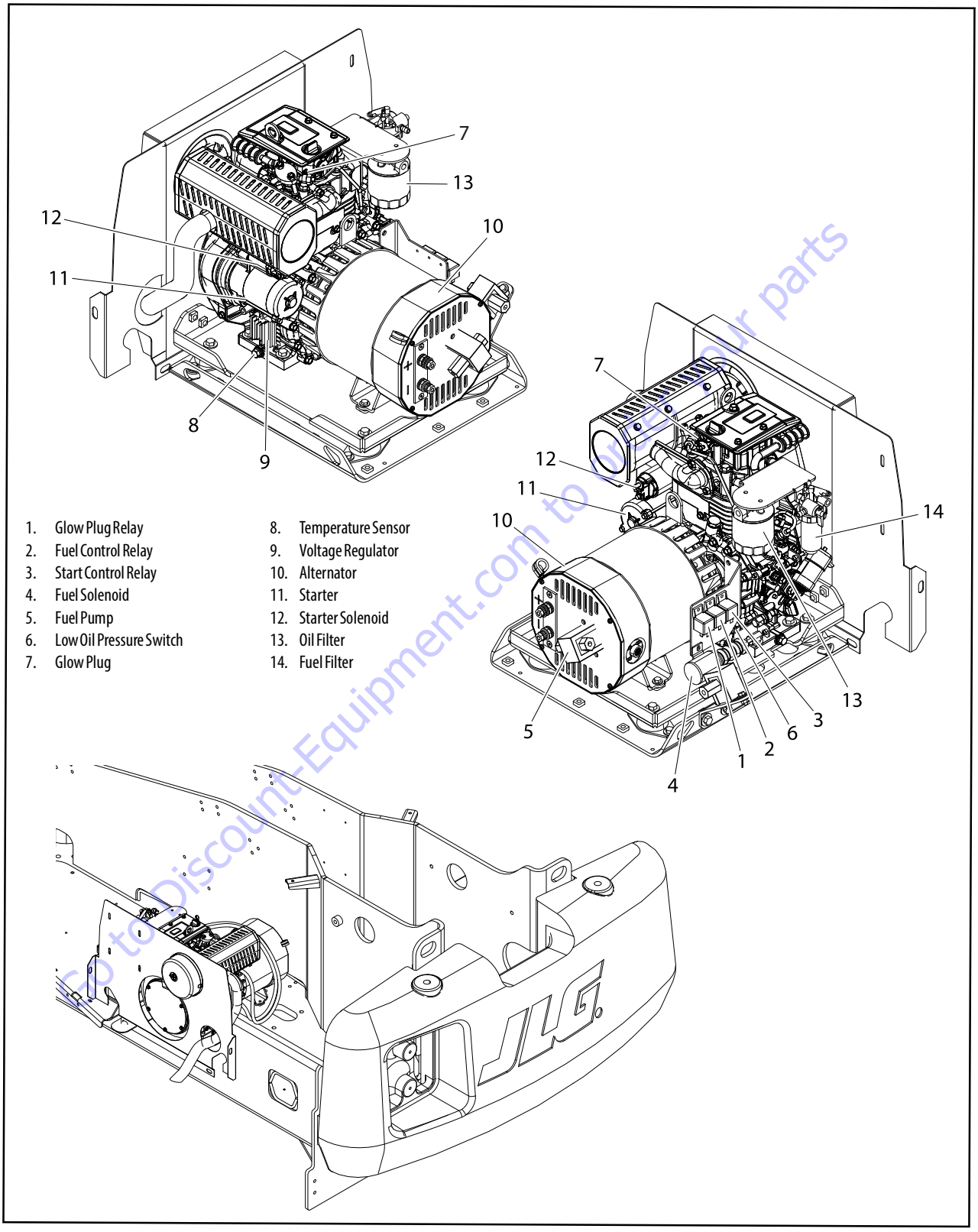
Rating: 20ADC

Control Fuse

The control fuse provides power to the engine/generator controller and the relays for start control, fuel control and glow plug.

Rating: 15ADC

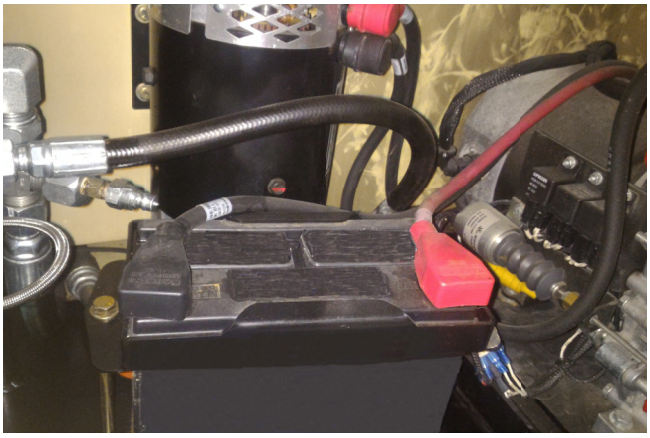
This fuse is located on the right side of the engine.



1. Glow Plug Relay
2. Fuel Control Relay
3. Start Control Relay
4. Fuel Solenoid
5. Fuel Pump
6. Low Oil Pressure Switch
7. Glow Plug
8. Temperature Sensor
9. Voltage Regulator
10. Alternator
11. Starter
12. Starter Solenoid
13. Oil Filter
14. Fuel Filter

Figure 3-37. Generator

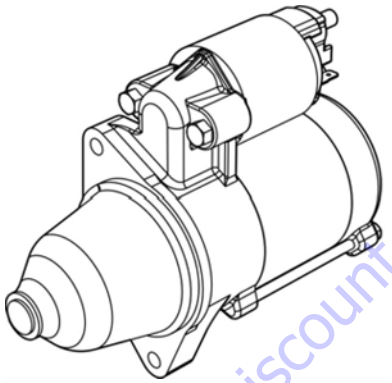
Start Battery



The RBS requires a 12V lead-acid start battery (not supplied with the system), which provides starting power and power for the RBS controls.

This battery is charged by the engine dynamo and dynamo regulator when the engine is running.

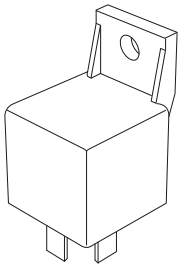
Engine Starter

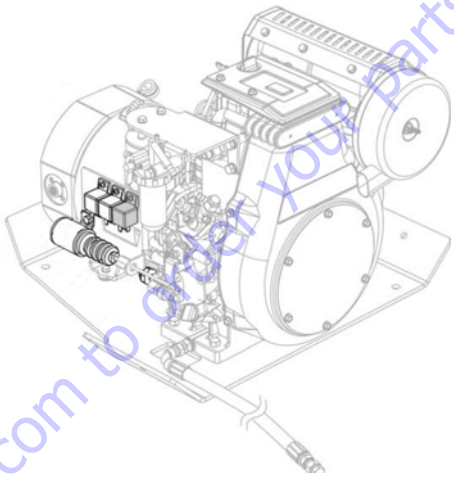


The engine is equipped with a 12VDC starter, which provides the mechanical power to crank the engine. Electrical power for the starter is provided by the start battery.

The starter is energized by the start control relay.

Start Control Relay



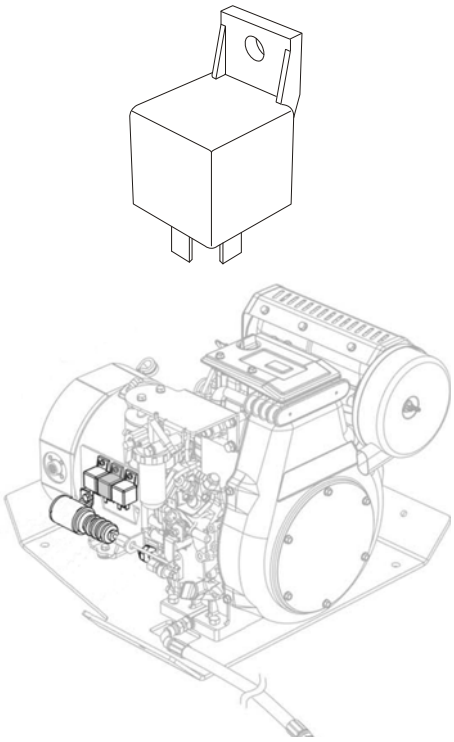


The start control relay energizes the solenoid of the engine starter and the pull coil of the engine fuel solenoid.

The start control relay is energized by the engine/generator controller from pin J2-4.

The start control relay is located on the fuel solenoid bracket on the right side of the engine.

Fuel Control Relay

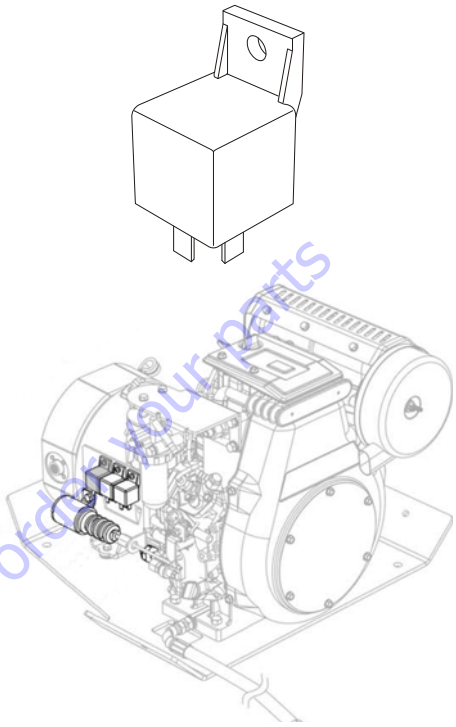


The fuel control relay energizes the hold coil of the fuel solenoid.

The fuel control relay is energized by the engine/generator controller from pin J2-3.

The fuel control relay is located on the fuel solenoid bracket on the right side of the engine.

Glow Plug Control Relay



The glow plug control relay energizes the glow plug. It is energized by the engine/generator controller, pin J2-27.

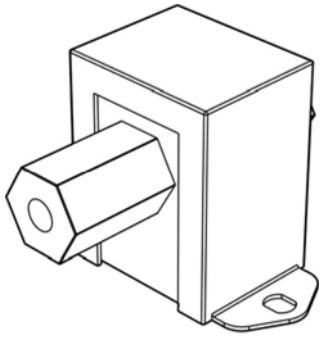
The glow plug control relay is located on the fuel solenoid bracket on the right side of the engine.

Glow Plug

The glow plug is a resistive heating element located in the combustion chamber. It is used during starting at temperatures below 32°F (0°C).

The heater is energized by the glow plug control relay.

Fuel Pump

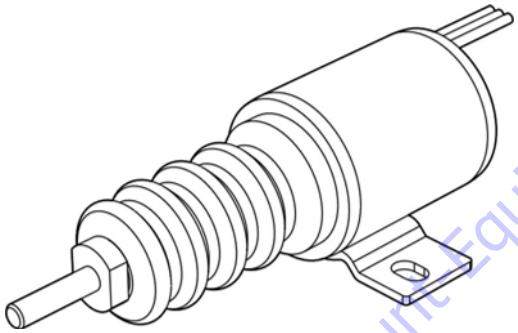


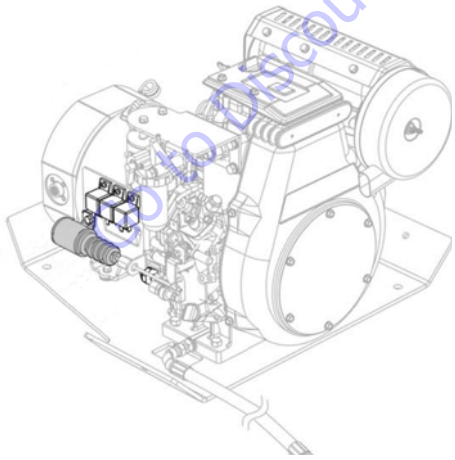
The fuel pump runs in parallel with the fuel solenoid hold coil which is run by the fuel control relay.

The pump runs whenever the engine runs, and keeps the fuel filter filled. Excess fuel flows through the return line back to the fuel tank.

The fuel pump is located on the right side of the engine.

Fuel Solenoid

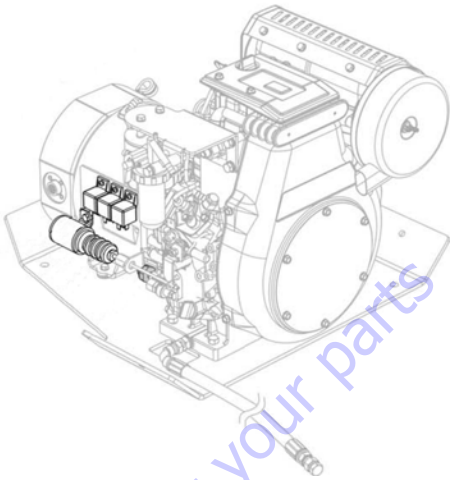




The fuel solenoid actuates the run/stop lever of the engine. This solenoid has a pull coil energized by the start control relay and a hold coil energized by the fuel control relay.

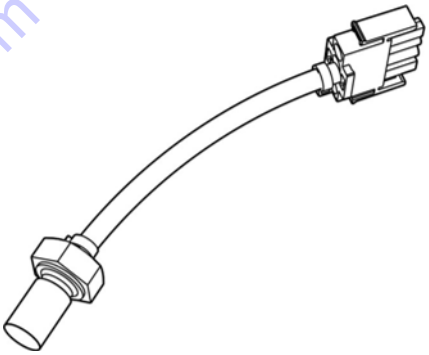
The fuel solenoid is located on the right side of the engine.

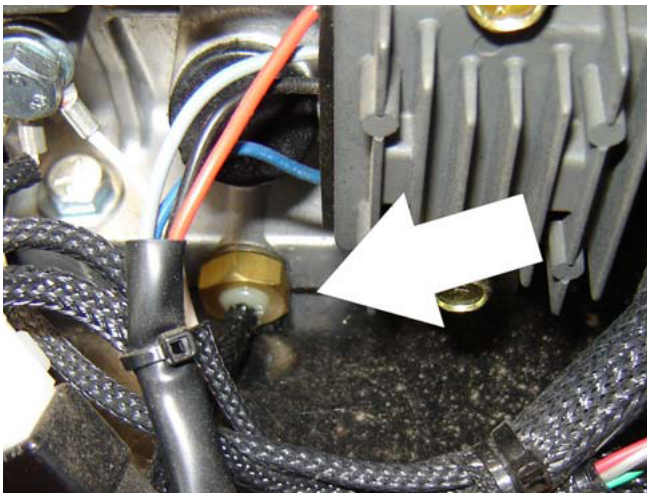
Engine Low Oil Pressure Switch



The engine is equipped with a low oil pressure switch. This switch is closed when the oil pressure is below 7psi. It is mounted on the side cover.

Engine Oil Temperature Sensor





The engine oil temperature sensor is used to sense the temperature of the oil in the sump of the engine.

This sensor provides an analog signal to the engine/generator controller. The primary use of this signal is for high

engine temperature shutdown 248°F (120°C) for the engine. The signal is also used in determining if the air glow plug should be energized.

The engine oil temperature sensor is connected to the engine/generator controller at pins J2-8 and J2-19.

The engine oil temperature sensor is located on the left side of the engine.

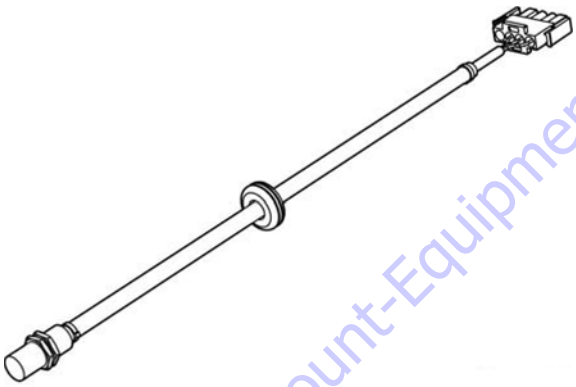
Alternator Output Current Sensor

The alternator output current sensor provides a signal proportional to the output current of the alternator to the engine/generator controller. The output current is regulated at 45ADC.

The alternator output current sensor is connected to the engine/generator controller at pins J2-21, J2-31 and J2-32.

The alternator output current sensor is located inside the rear cover of the alternator.

Engine Speed Sensor



The engine speed sensor provides a signal proportional to the rotational speed of the engine to the engine/generator controller. This signal is used by the engine/generator controller to determine starter cut-out, overspeed fault and underspeed fault. If the signal is not present at the engine/generator controller, the unit will fault with a loss of speed signal indication.

The engine speed sensor is connected to the engine/generator controller at pins J2-9, J2-15 and J2-20.

The engine speed sensor is located inside the recoil starter cover at the front of the engine.

RBS Engine/Generator Controller

The control system enclosure houses the RBS engine/generator controller, which performs all control tasks associated with the RBS.

The engine/generator controller interface is via a J2 35-pin connector.

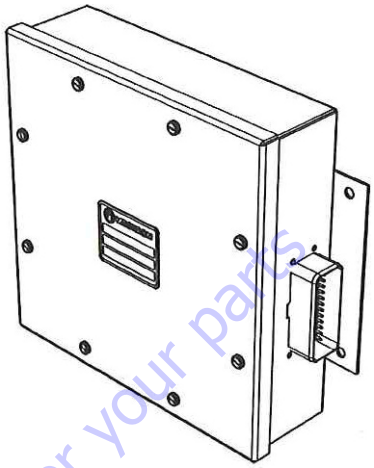


Table 3-4. Controller Interface Pin Assignments

PIN	FUNCTION
1	System 48VDC
2	System 0V DC
3	Fuel solenoid
4	Starter Solenoid
5	Manual call to start
6	Low oil pressure
7	Not used
8	Engine oil temperature
9	Speed sensing input
10	RS-232 +12V
11	RXD
12	TXD
13	LED Driver GND
14	LED Driver +48V
15	Speed sensor GND
16	Not used
17	Not used
18	- Output voltage
19	Engine oil temperature/ambient temp. + 8V
20	Speed Sensing + 8V
21	Output current sensor (GND)
22	Not used
23	RS-232 GND
24	- Field drive
25	+ Start battery
26	- Start battery

Table 3-4. Controller Interface Pin Assignments

27	Pre-heat
28	Inhibit run
29	Engine temp. switch
30	+ Output voltage
31	Speed sensing + 5V
32	Output current senset
33	Not used
34	Not used
35	Field Drive

Warnings and Safety Precautions

⚠ WARNING

THE RBS MAY START WITHOUT WARNING.

⚠ WARNING

MORE THAN ONE LIVE CIRCUIT IS USED INSIDE THE RBS CONTROL PANEL. EXERCISE CAUTION WHEN THE CONTROL PANEL IS OPEN, EVEN WHEN THE RBS IS NOT RUNNING.

System Controls

INHIBIT RUN INPUT

The inhibit run input prevents the RBS from starting, clears any existing calls to start and stops the engine immediately. To return to normal operating mode, the inhibit run input must be removed.

MANUAL CALL TO START

The manual call to start input initiates an automatic run of the RBS unit.

RS232 PORT

The RS232 allows the RBS to be monitored and controlled using an analyzer.

System Status and Performance Monitoring

System status and performance can be monitored by the analyzer.

System Settings

CALL TO START SETTINGS

Low battery voltage call to start level	48.0 VDC
Low battery voltage remove call to start level	54.0 VDC
Low temperature call to start level	5°C
Low temperature remove call to start level	8°C
Low start battery voltage call to start level	12.2 V
Low start battery voltage remove call to start level	12.9 V

CURRENT AND VOLTAGE SETTINGS

Normal output voltage level	58.0 VDC
Extend output voltage level	58.0 VDC
Current limit level	45 ADC
High voltage shutdown level	63 ADC
Finish charging current level	30 ADC

TIME DELAY SETTINGS

TD engine start	30s
TD purge	0s
TD bypass	10s
TD engine run	1800s
TD cool-down	30s
TD high volts	2s

CRANK SETTINGS

Crank time	15s
Reset time	15s
Crank cycles	3

SPEED TIME AND GLOW PLUG SETTINGS

TD no speed signal	5s
TD DC sensing fault	10s
Starter disconnect	1000 Hz
Overspeed shutdown	3800 RPM
Underspeed shutdown	2000 RPM
Glow plug on temperature	5°C
Glow plug on time	15s

RBS Start

Call to start	Manual	48V DC applied to the input
	Automatic	1 Low battery voltage (below 48VDC)
		2 Low engine temperature (below 5°C)
		3 Low start battery voltage (below 12.2V)
Engine start time delay		RBS waits to verify that call to start is valid (not a transient condition).
Preheat delay		- if engine temperature is below 32°F (0°C)
Crank time (Rest time)		RBS will crank and rest until engine starts, or Overcrank fault is indicated after 3 failed crank cycles.
Time delay bypass		RBS waits until normal engine operating conditions are reached before Low oil pressure and Underspeed faults are monitored.

RBS shutdown

Call to start removed	Manually	Inhibit run input applied
	Automatically:	1 Battery voltage above 54VDC and finish charging current below 30ADC
		2 Engine temperature above 8°C
		3 Start battery voltage above 12.9V and finish charging current below 30ADC
Engine run time delay		This period ensures that no further call to start conditions occur prior to cool-down period.
Cool-down period		Alternator output is reduced to a minimal level to allow the engine to cool down.

RBS Alarms and Flash Codes

In the event of an RBS alarm, a flash code will be issued and an alarm indicated on the analyzer.

Table 3-5. RBS Alarms and Flash Codes

Flash Code	Problem		RBS Condition
1-1	Low Oil Pressure [1]	Below 7psi	Shutdown
1-2	High Engine Temp.	Over 248°F (120°C)	Shutdown
1-3	Overspeed	Over 3800 RPM	Shutdown
1-4	Underspeed 1	Below 2000 RPM	Shutdown
	Overcrank	3 failed crank cycles Call to start removed	Call to start removed
1-5	No Speed Signal [2]		Shutdown
2-1	Overvoltage [3]	Over 63VDC	Shutdown
2-2	Engine Starting System fault 4		Alarm
2-4	Loss Of Voltage Sense	Alternator output less than 1/2 of the system nominal voltage (58VDC)	Shutdown
steady	Unit Enabled, no faults		Unit can respond to any call to start
-	Unit Off / Disabled		Unit will not respond to any call to start

Notes:

1 Enabled once time delay bypass period has elapsed after engine startup.

2 Delayed to ensure the fault was not momentary.

3 Measured at the alternator output, shutdown is delayed by a factory set period to ensure the fault was not caused by a transient condition.

4 Indicates a problem with the engine start battery, engine magneto or magneto-voltage regulator.

Alarms must be reset once the fault has been corrected (see below).

Resetting the RBS Controller

The RBS can be reset using the analyzer or by disabling and re-enabling the RBS controller. This will clear any current fault condition with the controller.

Maintenance Schedule

Check oil level every 24 hours

Change engine oil and filter every 150 hours

Troubleshooting

Table 3-6. Troubleshooting

Flash Code	Problem	Solution
-	Unit Off / Disabled (engine will not crank)	Check position of selector switch. Verify that the inhibit run is released. Check the warning LED. Remedy fault if present and restart the RBS. Check the start battery voltage. Check control fuse. Check for loose wiring or connection.
1-1	Low Oil Pressure	Check oil level. Check oil supply lines. Refer to Kubota Workshop manual WSM OC60/80/95. Verify correct operation of oil pressure switch with a test gauge.
1-2	High Engine Temp.	Check for obstructions in the cooling airflow to the engine. Check that the ambient temperature is within the design limits of the engine. Verify correct operation of engine temperature sensor.
1-3	Overspeed	Verify setting of governor lever. Readjust, if required. Refer to Kubota Workshop manual WSM OC60/80/95.
1-4	Underspeed	Ensure there is an adequate supply of fuel to the engine. Ensure there is an adequate supply of combustion air to the engine. Check air cleaner. Verify setting of governor lever. Readjust if required. Refer to Kubota OC60 Engine Manual.
	Overcrank	Check fuel level. Check fuel connections. Verify operation of fuel solenoid and fuel pump. Check the start battery voltage. If the engine exhaust contains white smoke then fuel is entering the engine but the engine is not firing. Refer to the Kubota OC60 Engine Manual for further checks. If the ambient temperature is low, verify that the heater and/or glow plug are operating.
1-5	No Speed Signal	Check wiring connections.
2-1	Overvoltage	Check alternator output voltage.
2-2	Engine Starting System fault	Check engine start battery charging system for current output. Check for failed engine start battery.
2-4	Loss Of Voltage Sense	

APU Engine Start Battery Boosting

Always connect the POSITIVE (+) of the booster battery to the POSITIVE (+) of the APU start battery, and the NEGATIVE (-) of the booster battery to the ground of the engine block.

WARNINGS:

⚠ WARNING

ALWAYS SHIELD YOUR EYES AND AVOID LEANING OVER THE BATTERY WHENEVER POSSIBLE.

⚠ WARNING

DO NOT ALLOW BATTERY ACID TO CONTACT EYES OR SKIN. FLUSH ANY CONTACTED AREA WITH WATER IMMEDIATELY. SEEK MEDICAL ATTENTION IF IRRITATION PERSISTS.

⚠ WARNING

STARTING BATTERIES GENERATE EXPLOSIVE GASES. KEEP SPARKS, FLAME AND LIGHTED CIGARETTES AWAY FROM BATTERIES.

⚠ WARNING

IMPROPER USE OF A BOOSTER BATTERY TO START AN APU MAY CAUSE AN EXPLOSION.

⚠ WARNING

DO NOT ATTEMPT TO JUMP START AN APU WITH A LOW ACID LEVEL IN THE BATTERY.

⚠ WARNING

THE VOLTAGE OF THE BOOSTER BATTERY MUST BE RATED AT 12V. THE AMP-HOUR CAPACITY OF THE BOOSTER BATTERY MUST NOT BE LOWER OR SUBSTANTIALLY HIGHER THAN THAT OF THE DISCHARGED BATTERY. USE OF BATTERIES OF DIFFERENT VOLTAGE OR SUBSTANTIALLY DIFFERENT AMP-HOUR RATING MAY CAUSE AN EXPLOSION OR PERSONAL INJURY. APPLYING A HIGHER VOLTAGE WHILE BOOSTING WILL ALSO CAUSE DAMAGE TO SENSITIVE ELECTRONIC COMPONENTS.

⚠ WARNING

A CHARGING SYSTEM (BATTERY CHARGER OR BATTERY CHARGING ALTERNATOR) MUST NEVER BE ENERGIZED WHILE BOOSTING. DAMAGE TO SENSITIVE ELECTRONIC COMPONENTS WILL RESULT.

NOTICE

THE MAIN BATTERY OF THE LIFT MUST NEVER BE USED TO BOOST THE APU. DAMAGE TO SENSITIVE ELECTRONIC COMPONENTS WILL RESULT.

3.12 SUPPLEMENTARY FUSE FOR APU

The purpose of this section is to describe the procedure to add a supplementary fuse for the Engine Generator Controller for the APU.

Tools and Material

- - Weather proof fuse holder - JLG PN 2400081
- - AGC1, 1 Amp fuse - JLG PN 2400080
- - 45 cm of #16 AWG wire - JLG PN 4920019
- - 2 X insulated butt splice connectors - JLG PN 4460035
- - 6 X medium length wire ties - JLG PN 4240033
- - Wire/Side cutters
- - 5/32" Allen Key
- - Crimping tool

Procedure

⚠ WARNING

BEFORE BEGINNING THIS PROCEDURE, ENSURE THAT ALL SOURCES OF POWER ARE DISCONNECTED FROM THE APU!

This procedure is common for all applications of the APU. The photos contained in this document illustrate the modification performed to an APU supplied in a JLG M450 lift.

1. Locate the harness at the rear of the APU.

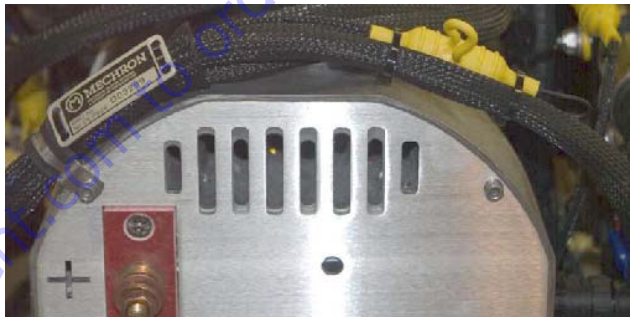
2. where the harness attaches to the rear cover of the generator and the connection point for the new inline fuse.

3. Remove the socket head drive screw with a 5/32" Allen key. Next remove the cable clamp from the harness.

4. Cut and remove the Wire Ties holding the Harness label to the harness. Next, remove the Wire Ties so that the cable sleeve can be moved, exposing the conductors of the harness.

5. Cut wire 106 going to the Engine/Generator Controller after the existing connection point and install the conductors that lead to the new inline fuse holder. Use insulated butt splice connectors for these conductors.

6. Re-install the harness with the new fuse in place.



7. Reconnect the lift and APU start battery. The APU is now ready for use.

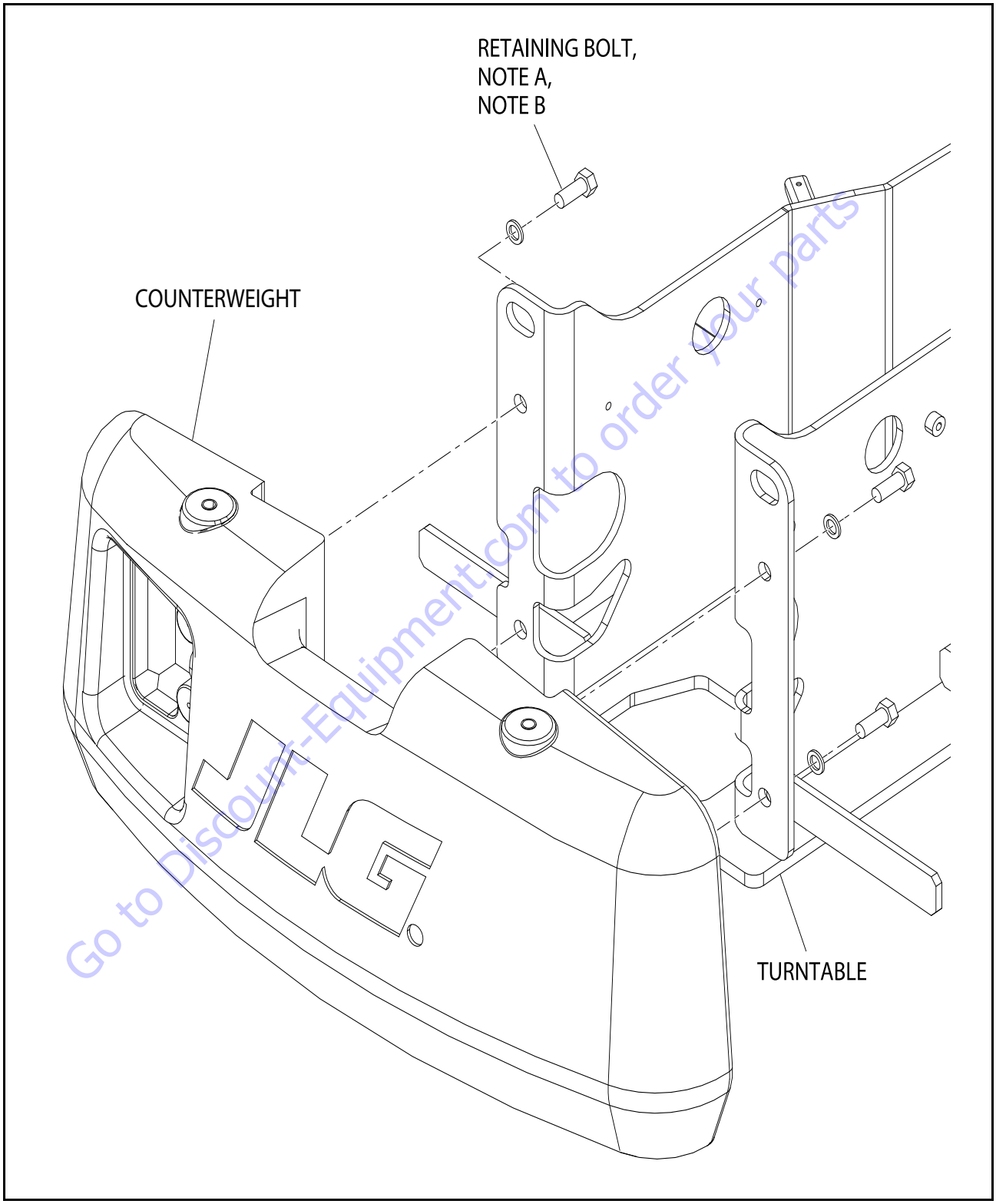
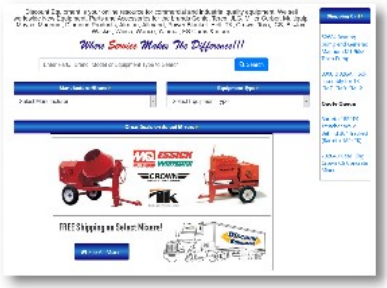


Figure 3-38. Counterweight

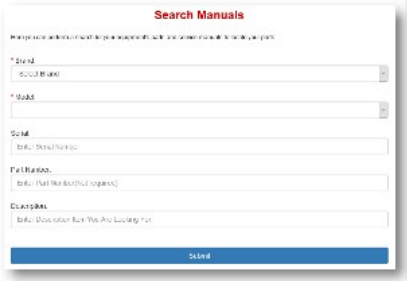
PARTS FINDER

Search Website by Part Number

Discount Equipment



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



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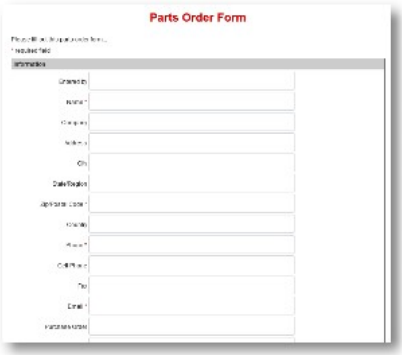

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SECTION 4. BOOM & PLATFORM

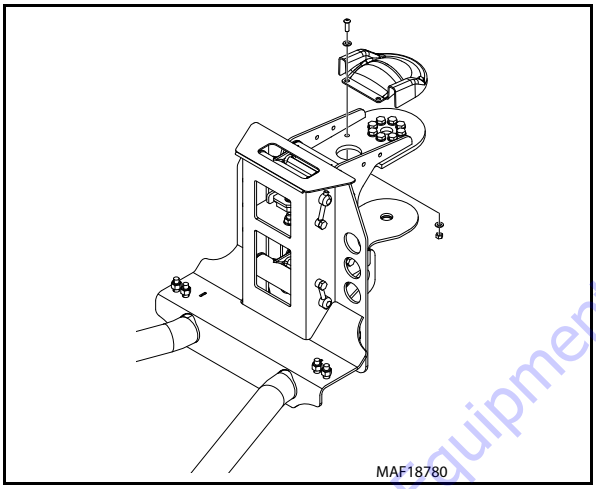
4.1 PLATFORM

Platform Valve Removal

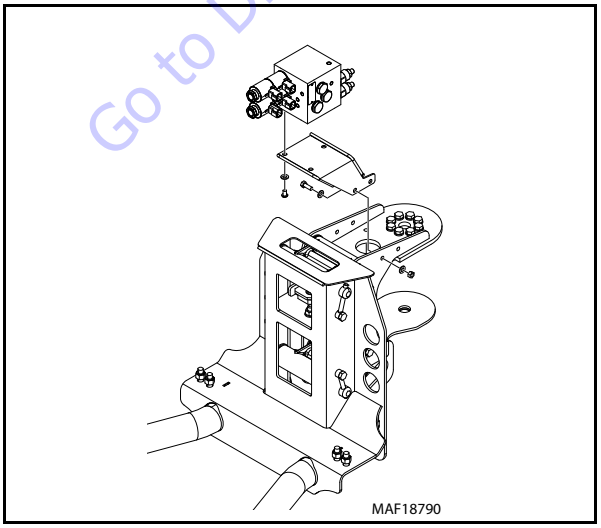
1. Tag and disconnect the hydraulic lines from the platform control valve. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
2. Using a suitable device, support the platform support.

NOTE: *The platform support weighs approximately 125 lb (56.8 kg).*

3. Remove hardware securing cover from the platform support. Remove cover.



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



Support Removal

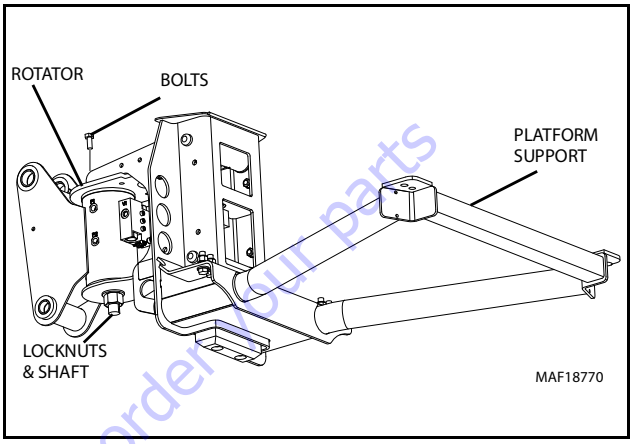
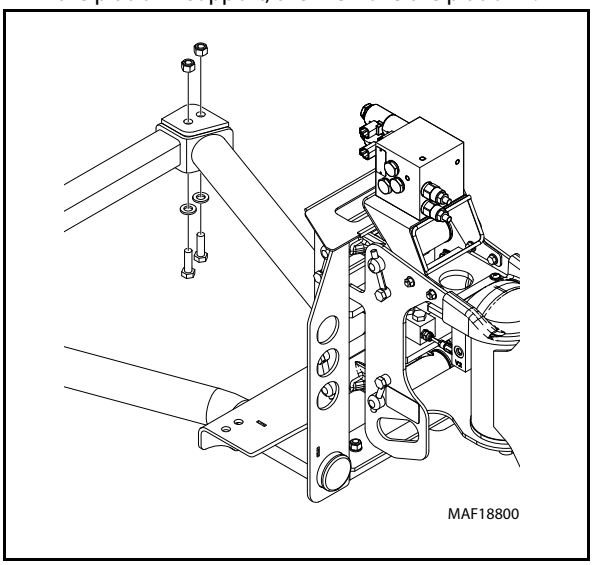


Figure 4-1. Location of Components Platform Support

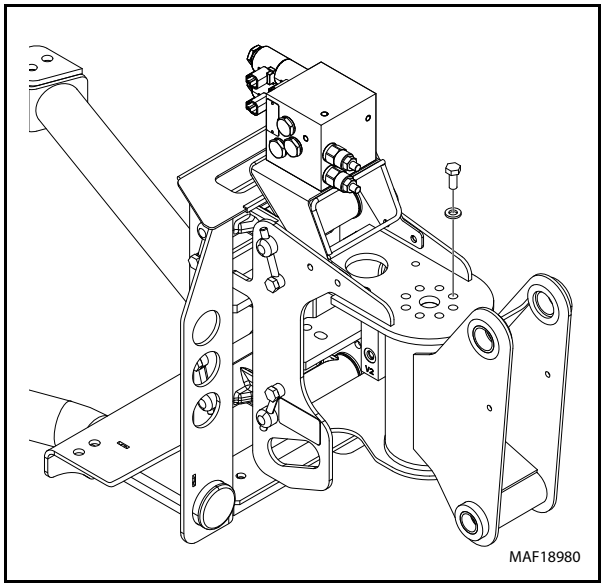
1. Disconnect electrical cables from control console.
2. Remove the bolts and Washers securing the platform to the platform support, then remove the platform.



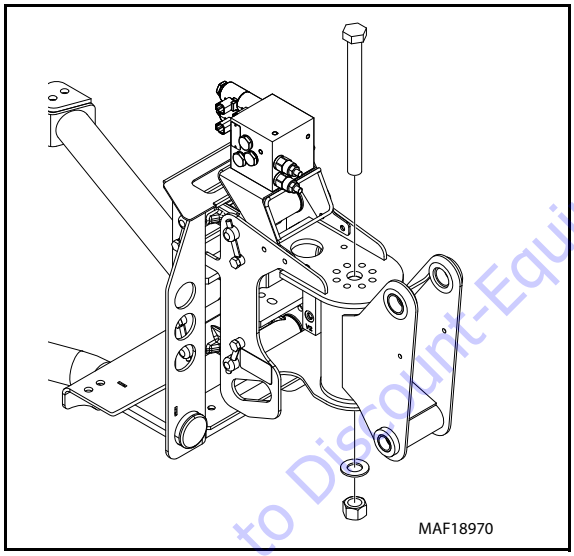
3. Using a suitable device, support the platform support.

NOTE: *The platform support weighs approximately 125 lb (56.8 kg).*

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



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

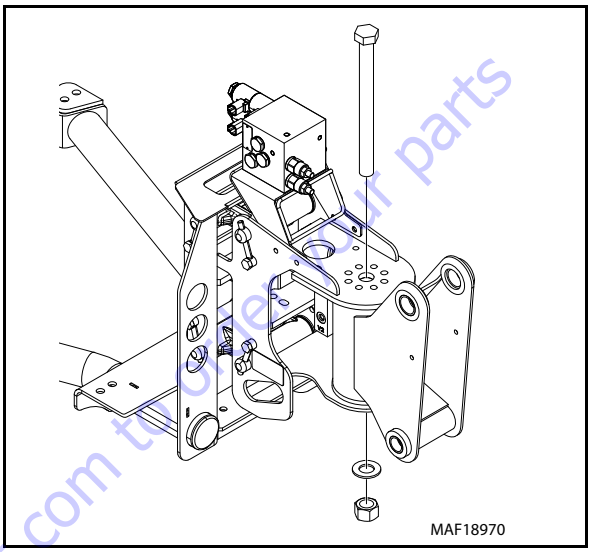


Support Installation

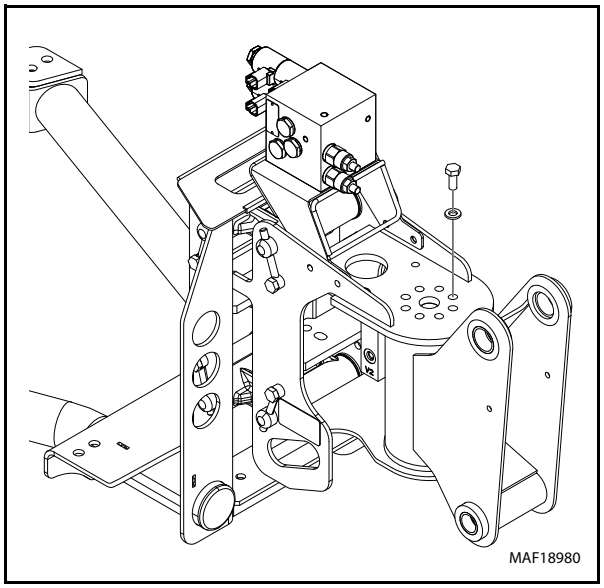
1. Using a suitable lifting device, support the platform support and position it on the rotator.

NOTE: *The platform support weighs approximately 125 lb (56.8 kg).*

2. Install the rotator center bolt.

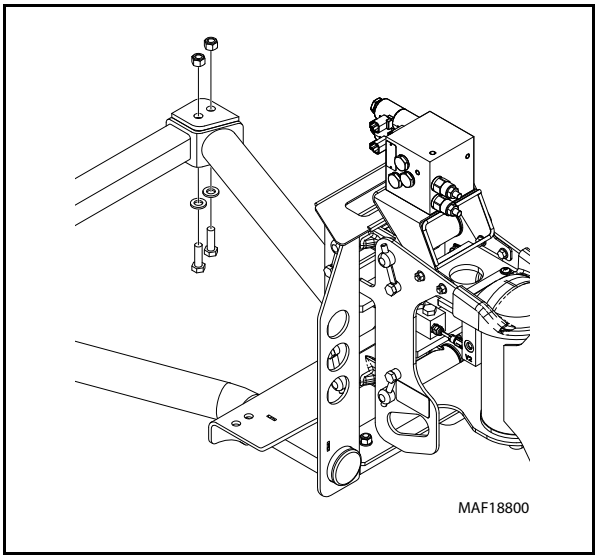


3. Apply Medium Strength Threadlocking Compound to the bolts and locknuts securing the support to the rotator and install the bolts and locknuts.



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 71.5 ft. lbs. (97 Nm).



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

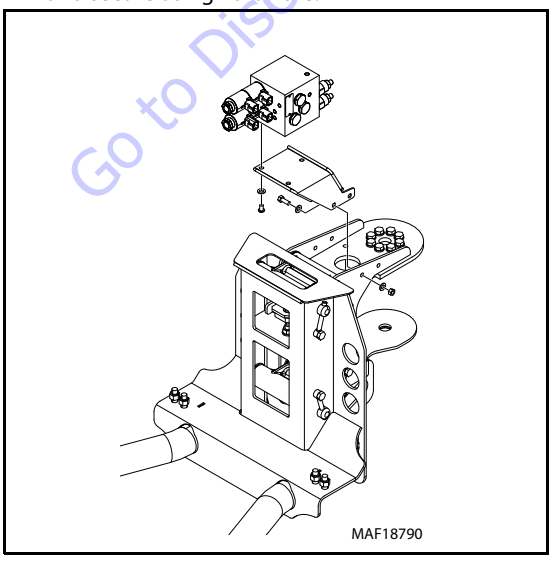
Platform Valve Installation

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

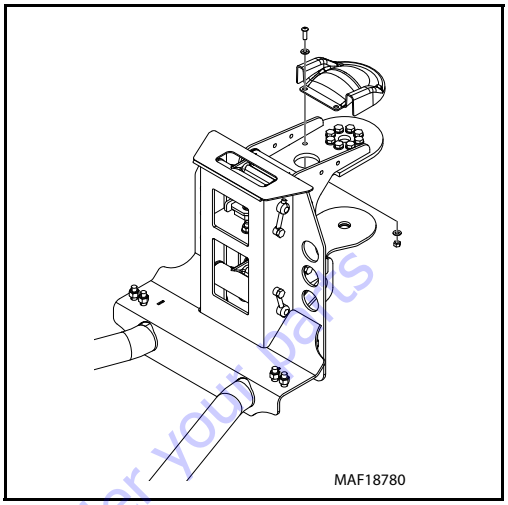
NOTE: *The platform support weighs approximately 125 lb (56.8 kg).*

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

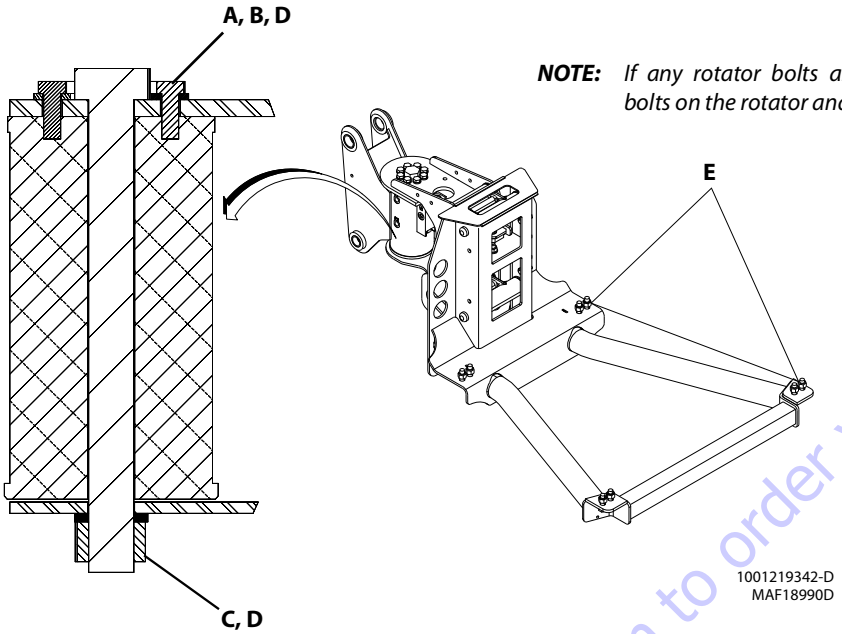
3. Install the mounting bracket onto the platform support and secure using hardware.



4. Install cover onto the platform support securing the hardware.



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



NOTE: *If any rotator bolts are replaced, replace all bolts on the rotator and torque them.*

A	Torque to 40 ft. lbs. (55 Nm)
B	Medium Strength Threadlocking Compound
C	Torque to 586 ft. lbs. (795 Nm)
D	Check torque every 150 hours of operation
E	Torque to 71.5 ft. lbs. (97 Nm)

Figure 4-2. Platform Support Torque Values

4.2 BOOM MAINTENANCE

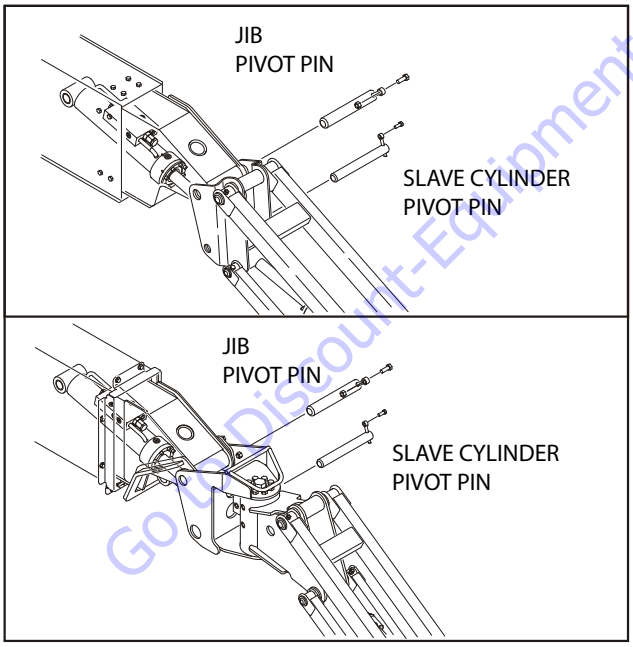
Removal

NOTE: *The main boom assembly weighs approximately 1993 lb (904 kg).*

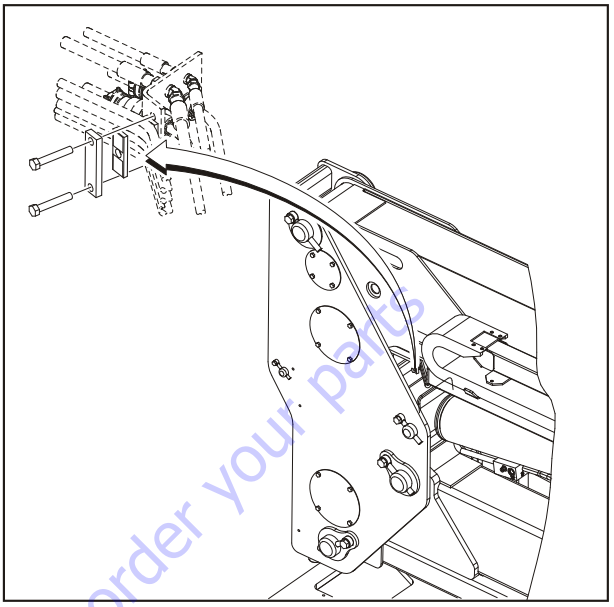
1. Raise the boom to horizontal and make sure that it is adequately supported with a lifting device or blocking.
2. Tag and disconnect the electrical leads at the platform and the platform valve.
3. Tag and disconnect all hydraulic lines on the platform valve and rotator. Cap or plug all openings.
4. Remove the hardware attaching the platform and platform support and remove the platform.

NOTE: *Steps 5 and 6 are only applicable if the machine is equipped with a jib.*

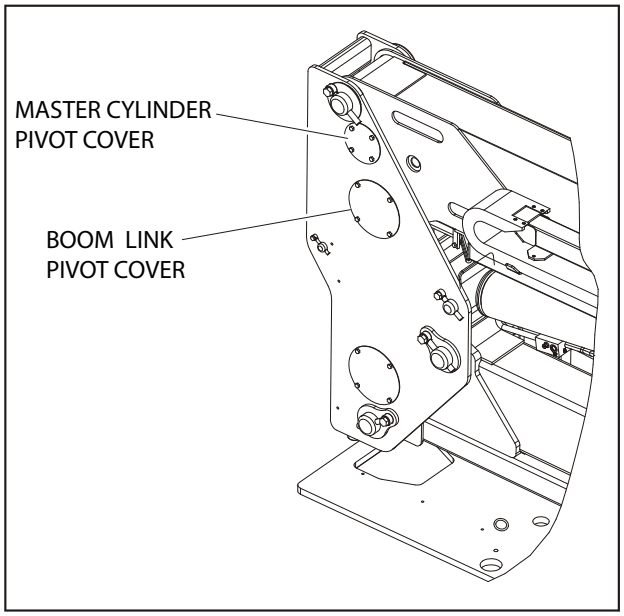
5. If equipped with a jib, place the jib in a horizontal position and support it with blocking. Tag and disconnect the hydraulic lines running to the jib cylinder. If equipped with a side swing jib, also tag and disconnect the hydraulic lines running to the jib rotator.



6. Remove the jib pivot pin and the slave cylinder pivot pin and remove the jib.



7. Disconnect the hydraulic and electrical lines from the bulkhead fittings at the rear of the boom.
8. Remove the cover at the rear of the upright.



9. Remove the covers on the side of the upright for the pivot pins.
10. Tag and disconnect the hydraulic lines running to the telescope cylinder.
11. Tag and disconnect the hydraulic lines running to the master cylinder.
12. Remove the upper lift cylinder pivot pin.

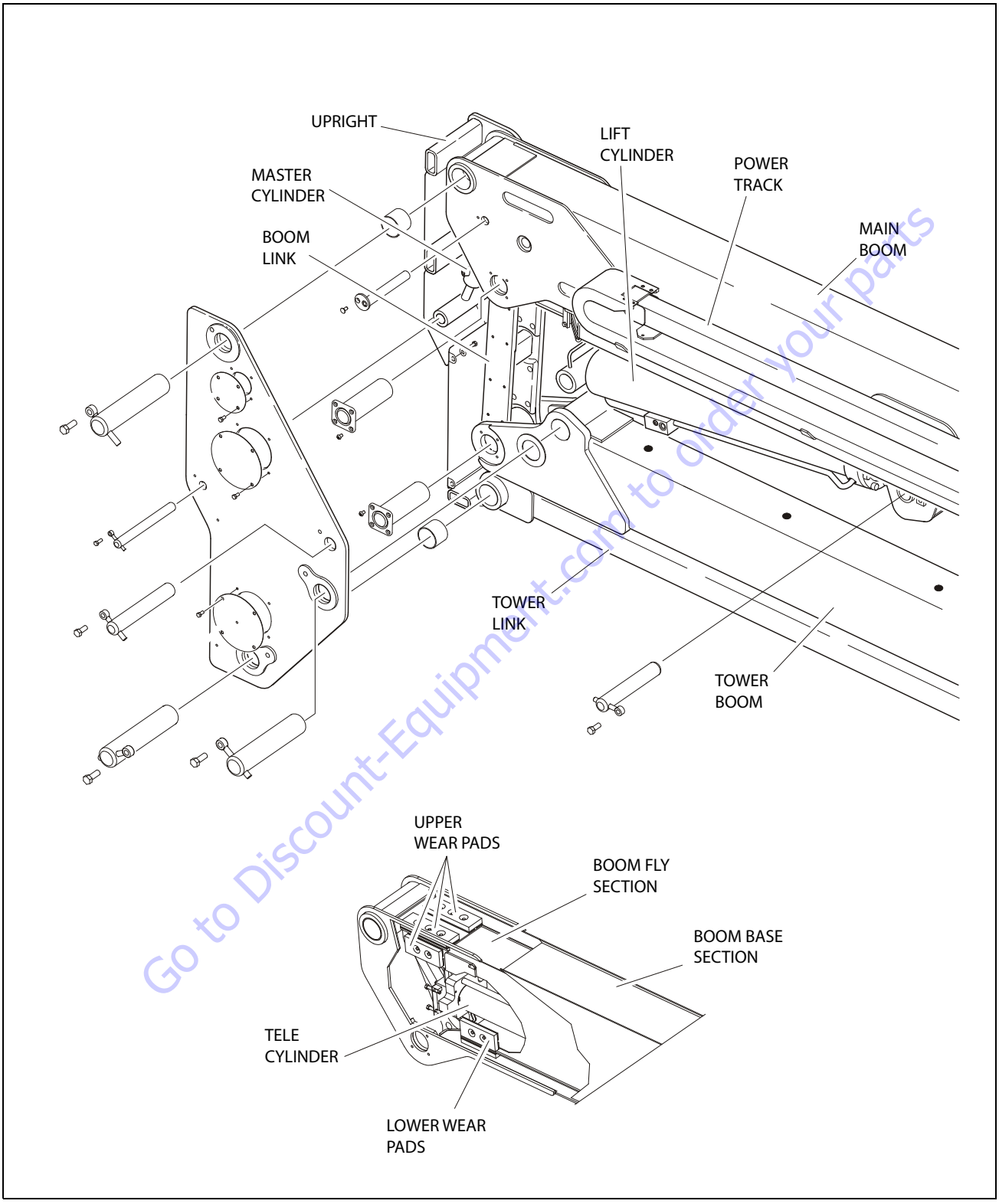


Figure 4-3. Boom Assembly - Sheet 1 of 3

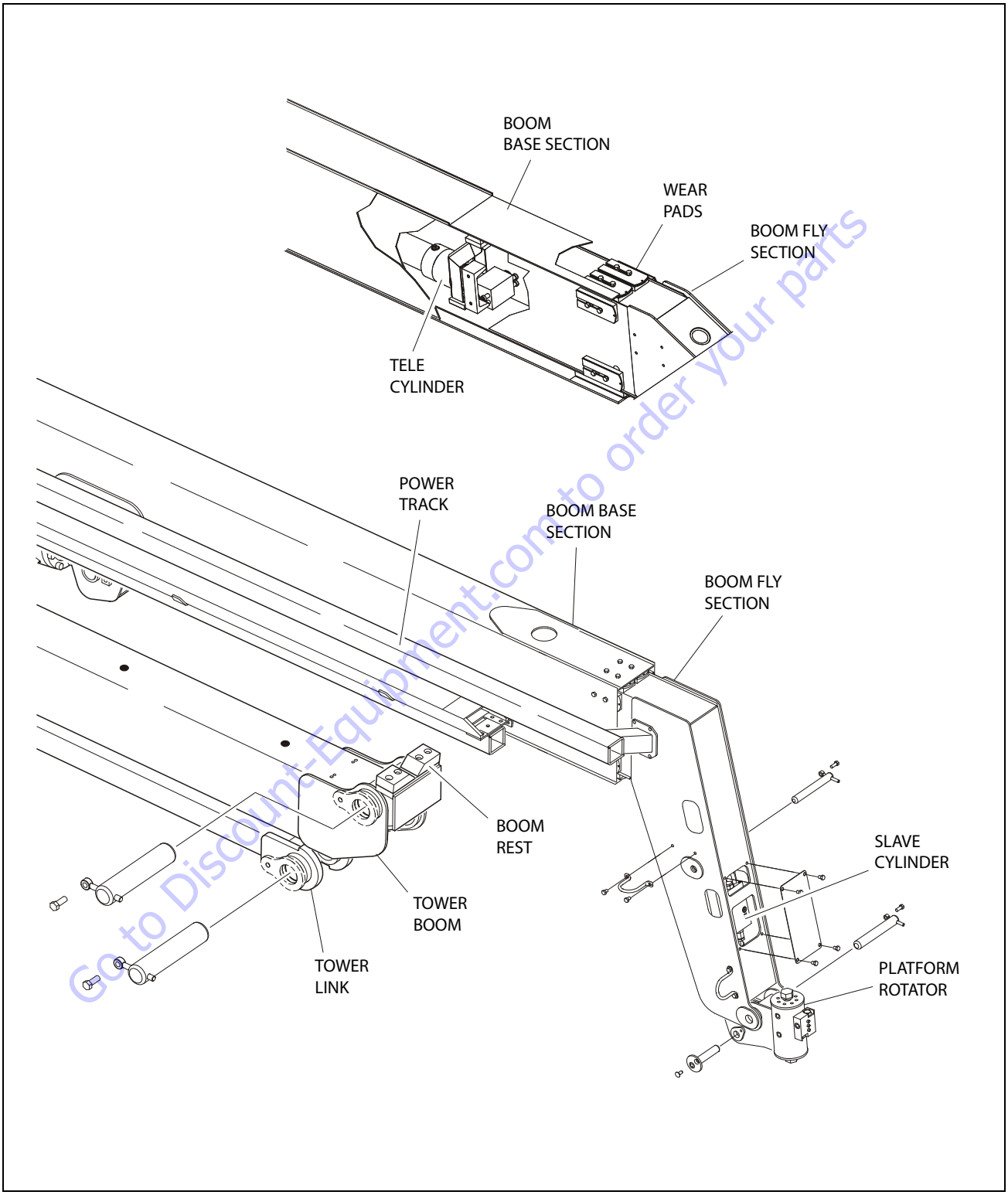


Figure 4-4. Boom Assembly - Sheet 2 of 3

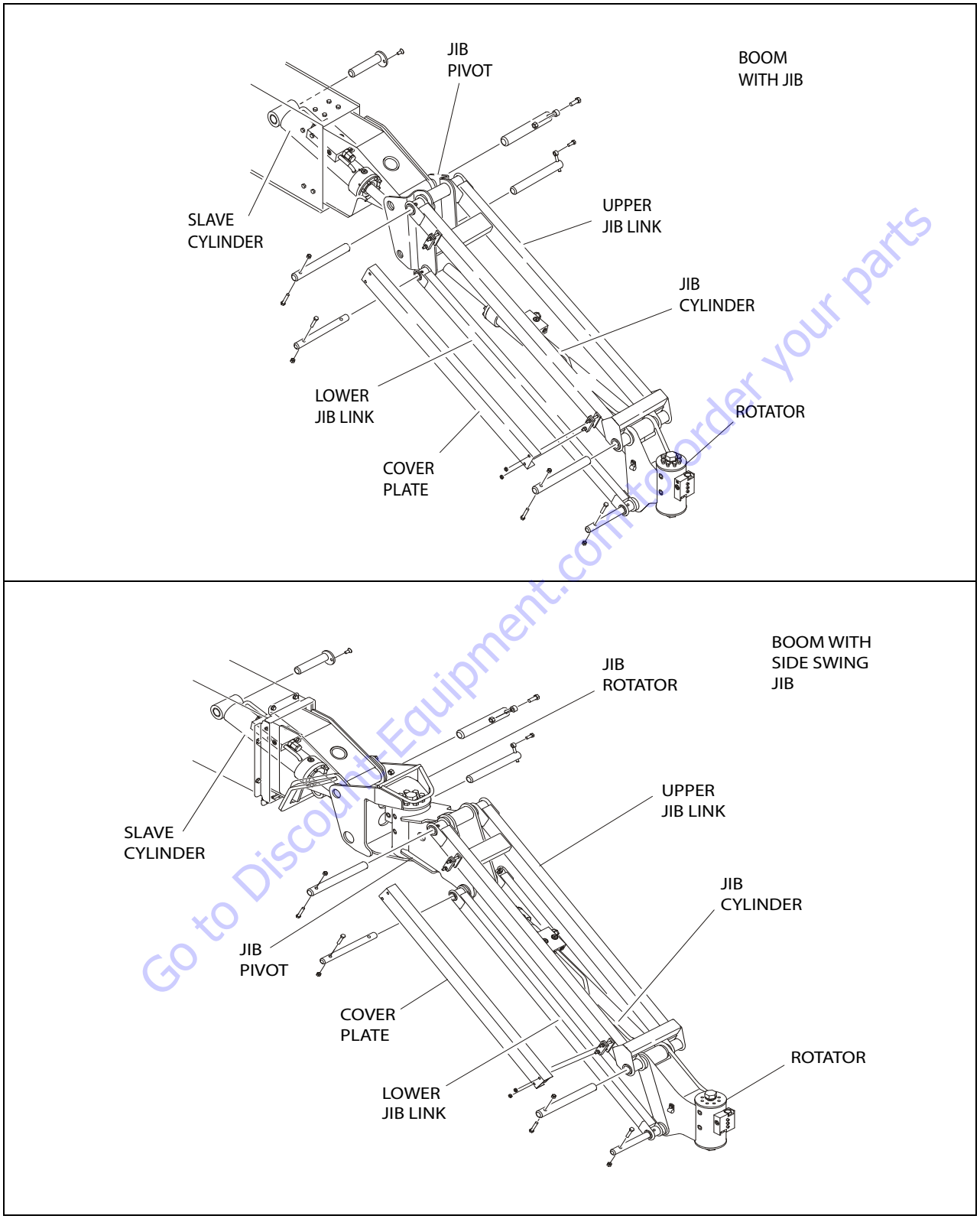
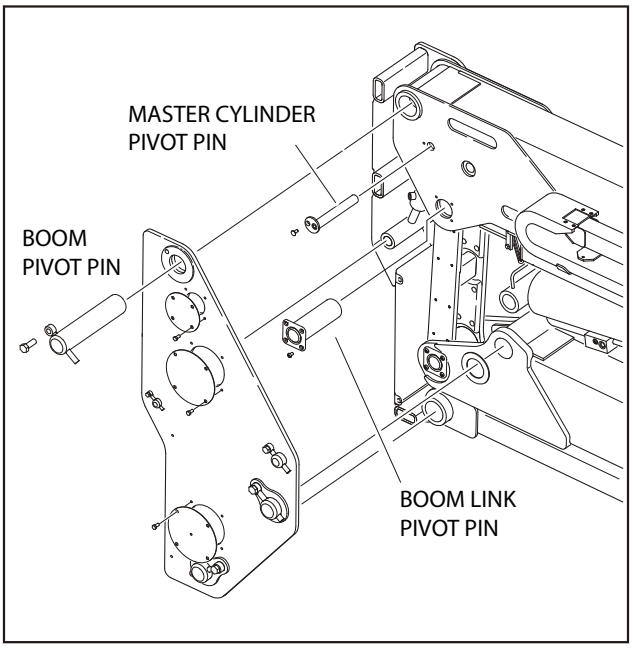


Figure 4-5. Boom Assembly - Sheet 3 of 3



13. Remove the upper master cylinder pivot pin.
14. Remove the boom pivot pin.
15. Remove the boom link pivot pin.

NOTE: *The main boom assembly weighs approximately 1993 lb (904 kg).*

16. Using an adequate lifting device, remove the boom from the machine.

Installation

1. Using an adequate lifting/supporting device, position the boom into the proper position on the upright.
2. Install the boom link pivot pin.
3. Install the boom pivot pin.
4. Install the upper master cylinder pivot pin.
5. Install the upper lift cylinder pivot pin.
6. Connect the hydraulic lines running to the master cylinder as tagged during removal.
7. Connect the hydraulic lines running to the telescope cylinder as tagged during removal.
8. Install the covers on the side of the upright to conceal the pivot pins.
9. Install the rear cover on to the upright.
10. Connect all the hydraulic and electrical lines at the bulkhead fitting at the rear of the boom.

NOTE: *Steps 10 and 11 are only applicable if the machine is equipped with a jib.*

11. Position the jib to the pivot points and install the jib-pivot pin and the slave cylinder pivot pin.
12. Connect the hydraulic lines running to the jib cylinder as tagged during removal. If equipped with a side swing jib, connect the hydraulic lines running to the jib rotator.
13. Install the platform support and platform.
14. Install the hydraulic lines to the platform valve and rotator as tagged during removal.
15. Reconnect the electrical leads at the platform and platform valve as tagged during disassembly.
16. Cycle test the boom from the ground station to ensure all functions operate properly.
17. After verifying that all functions operate properly from the ground station, cycle test the boom from the platform station to ensure all functions operate properly from the platform station as well.

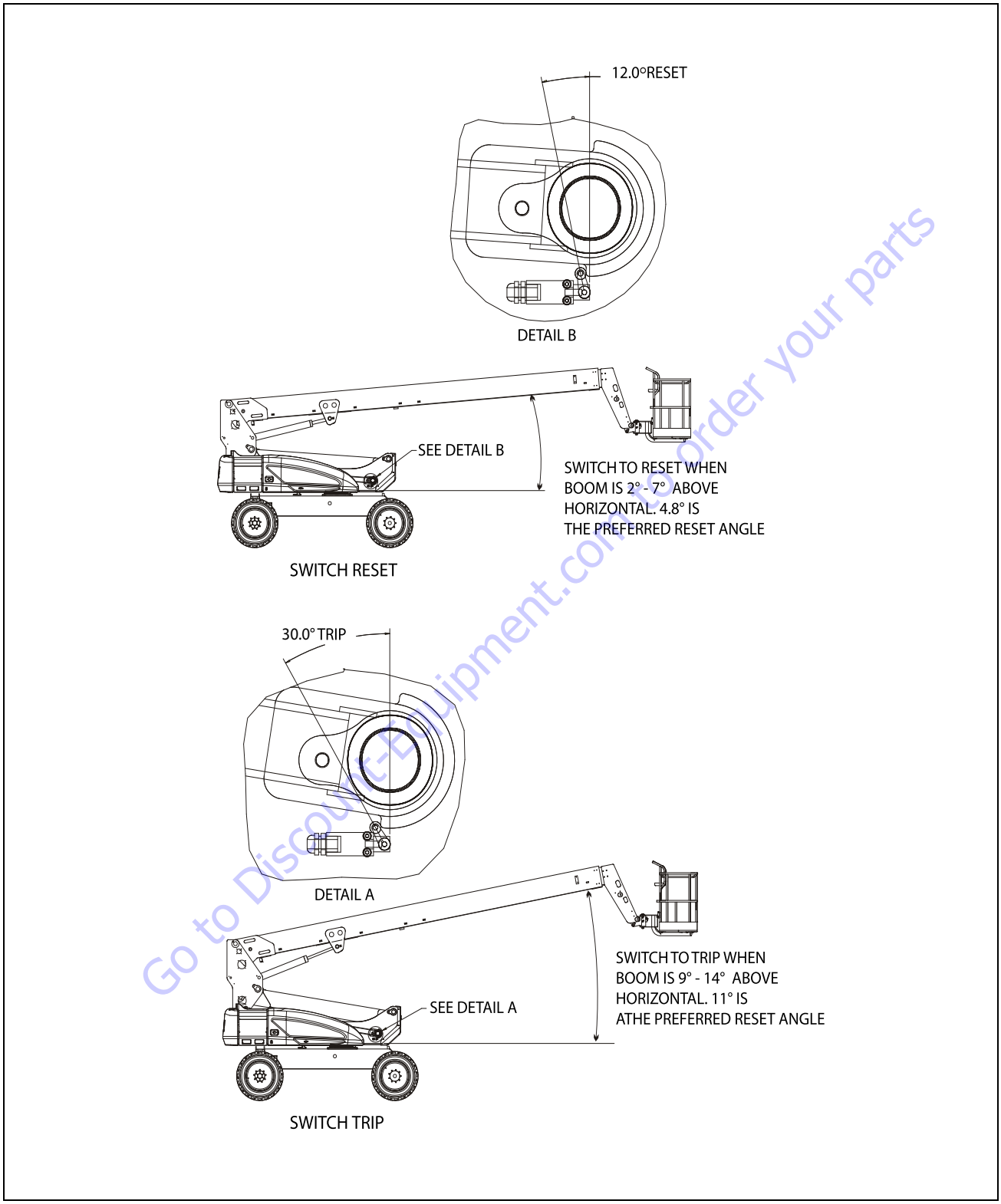


Figure 4-6. Boom Limit Switch Adjustment

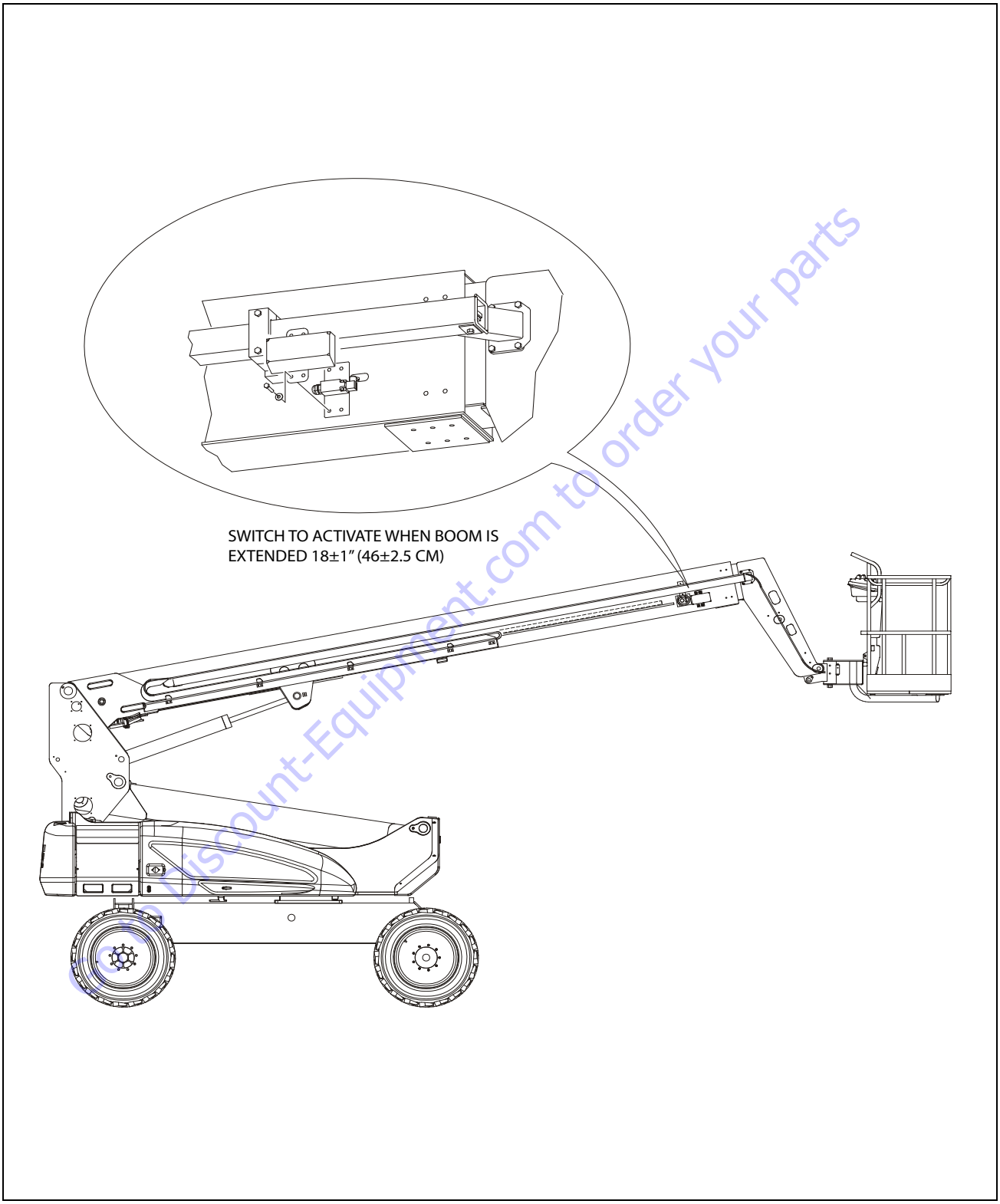


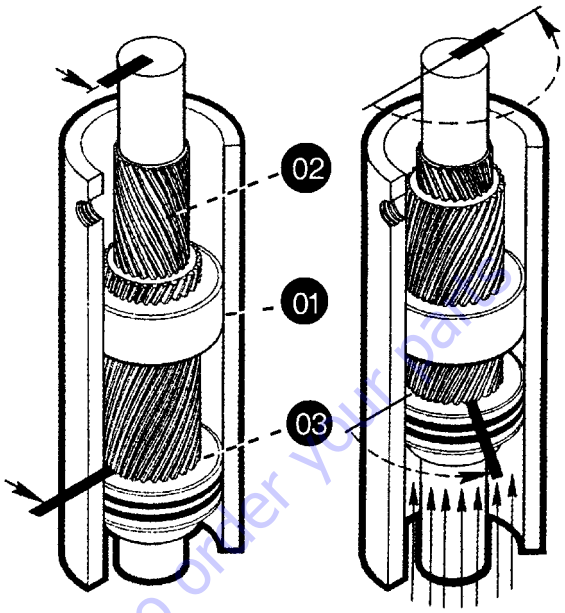
Figure 4-7. Transport Limit Switch (CE Only)

4.3 PLATFORM ROTATOR

Theory of Operation

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

The shaft is supported radially by the large upper radial bearing and the lower radial bearing. Axially, the shaft is separated from the housing by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.



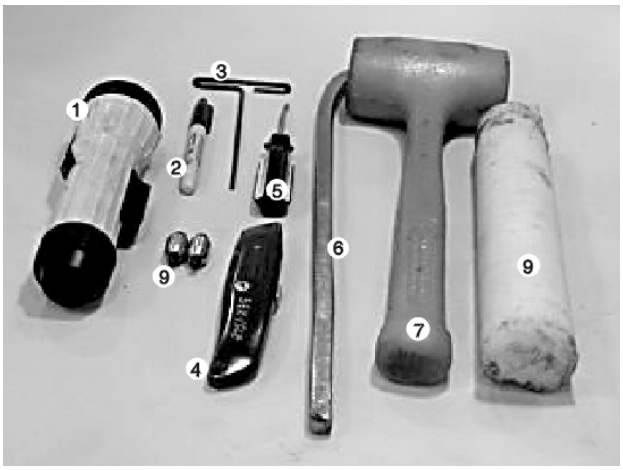
Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.

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.

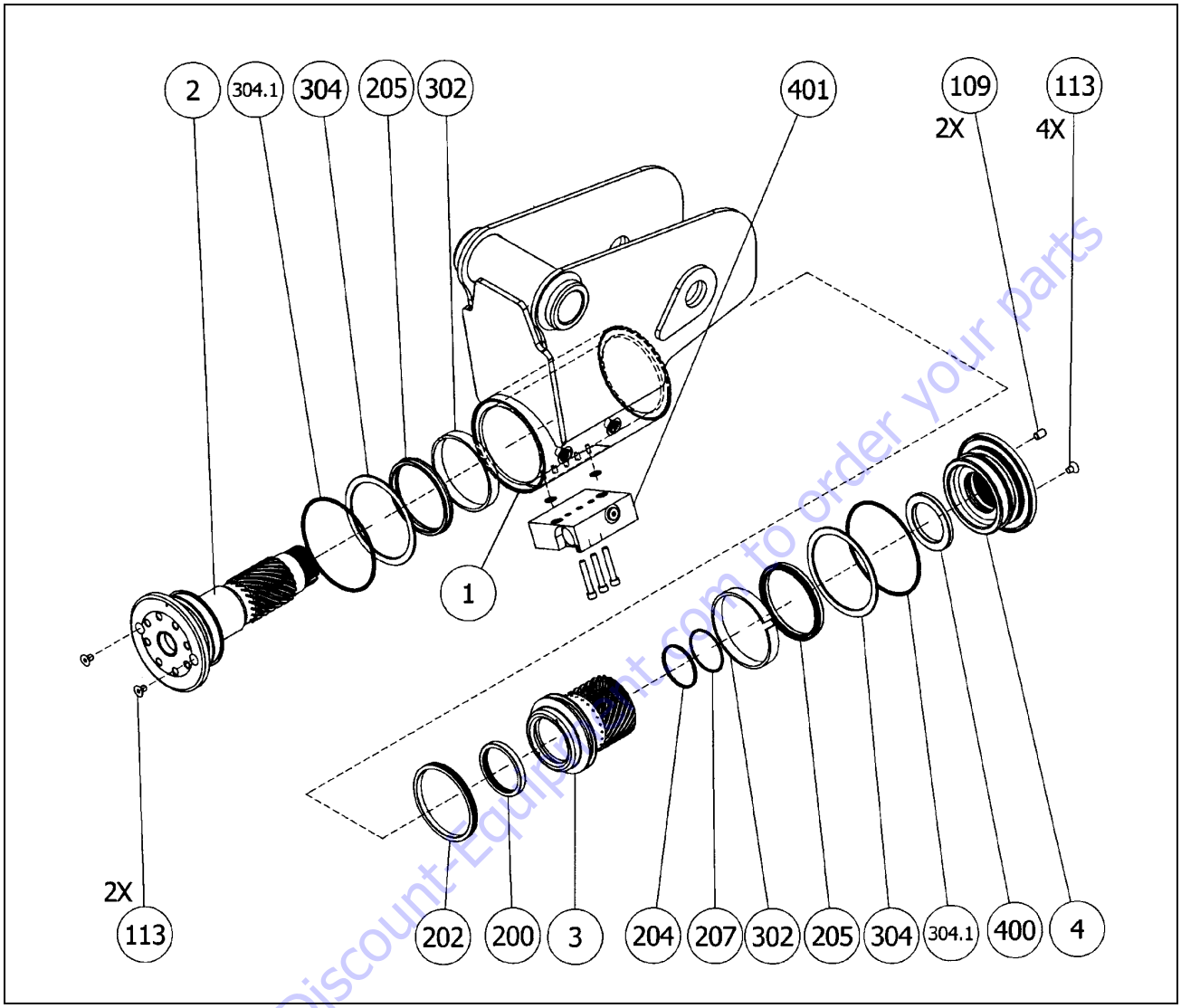
NOTE: *Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.*
As fluid pressure is applied, the piston is displaced axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston.

Tools Required for Assembly/Disassembly

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

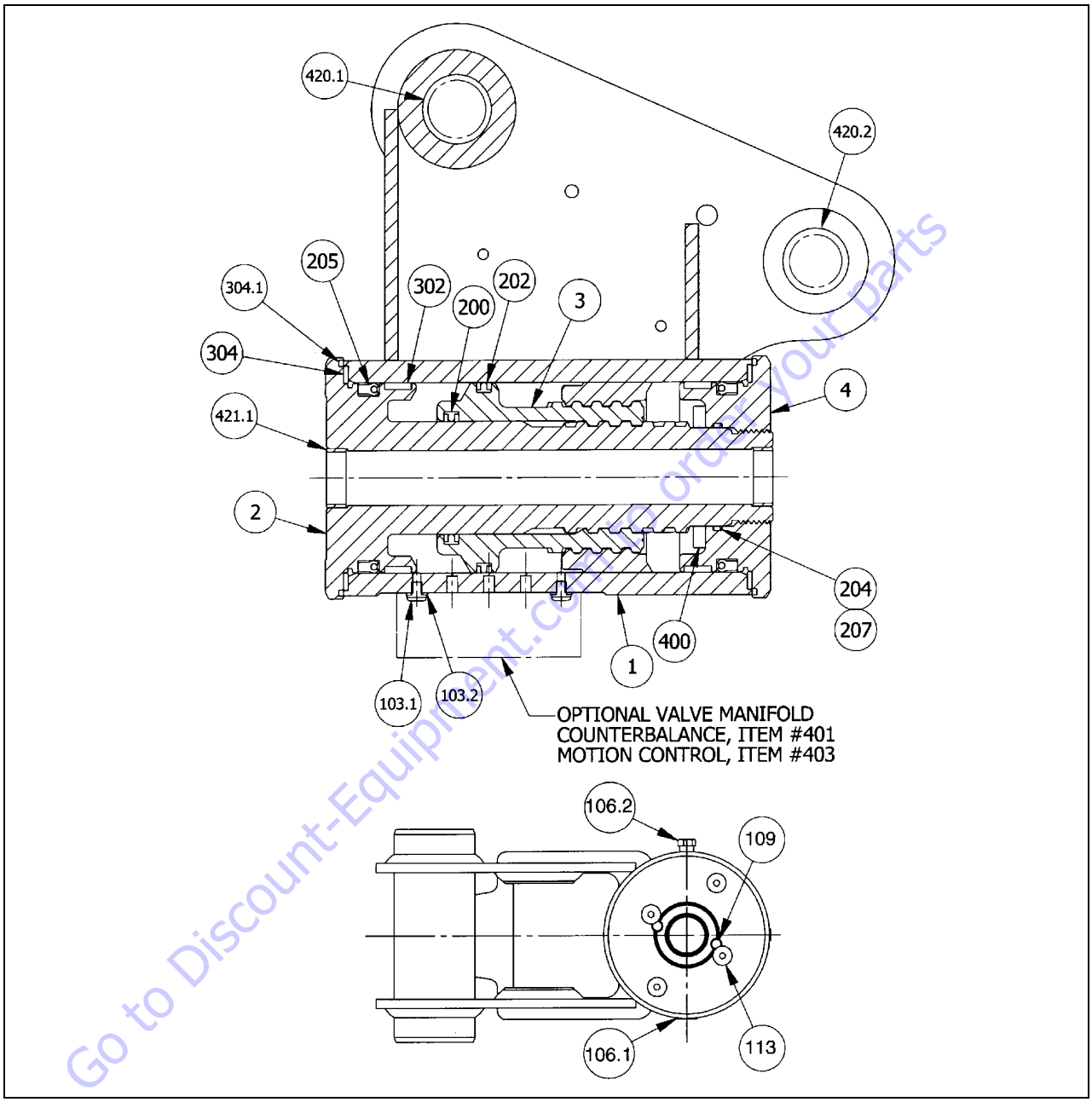


1. Flashlight- helps examine timing marks, component failure and overall condition.
2. Felt Marker- match mark the timing marks and outline troubled areas.
3. Allen wrench- removal of port plugs and setscrews.
4. Box knife- removal of seals.
5. Seal tool- assembly and disassembly of seals and wear guides.
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).



1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap
109. Lock Pin
113. Cap Screw
200. T-Seal
202. T-Seal
204. O-Ring
205. Cup Seal
207. Backup
302. Wear Guide
304. Thrust Washer
304.1. Wiper Seal
400. Stop Tube (Optional)
401. Counterbalance Valve

Figure 4-8. Rotary Actuator (Exploded View)

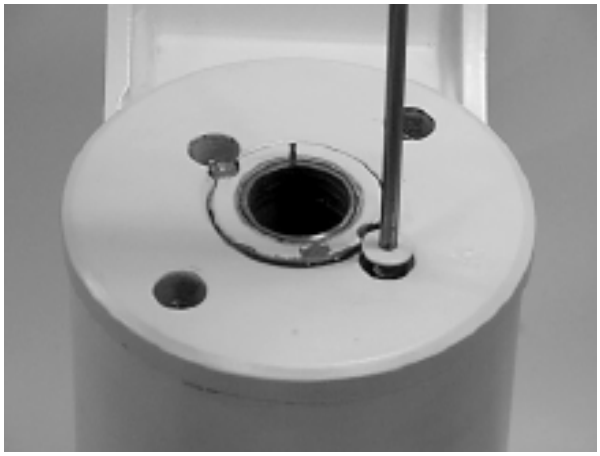


PARTS	HARDWARE	SEALS	BEARINGS	ACCESSORIES
1. Housing	103.1. Screw	200. T-Seal	302. Wear Guide	400. Stop Tube
2. Shaft	103.2. Washer	202. T-Seal	304. Thrust Washer	420.1 Bushing
3. Piston Sleeve	106.1. Port Plug	204. O-ring		420.2 Bushing
4. End Cap	106.2. Port Plug	205. Cup Seal		421.1 Bushing
	109.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

Figure 4-9. Rotator- Assembly Drawing

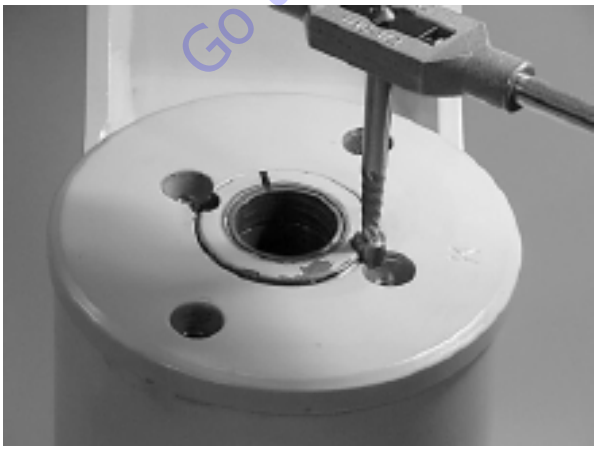
Disassembly

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



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

3. Remove the lock pins using an "Easy Out" (a size #2 is shown). If the pin will not come out with the "Easy Out", use 5/16" drill bit to a depth of 1/2" (12.7mm)todrill out the entire pin.



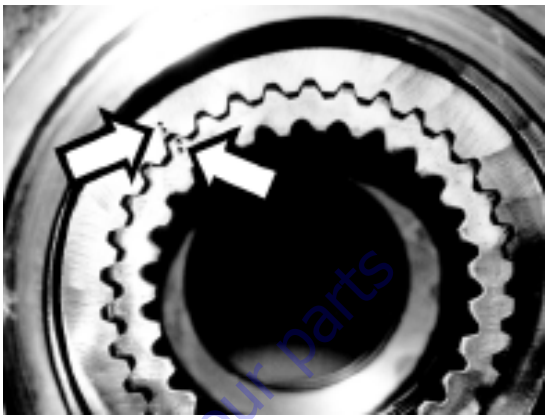
4. Install the end cap (4) removal tools provided with the Helac seal kit.

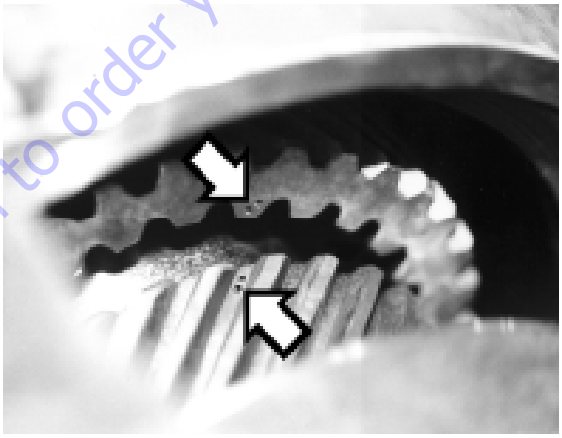
5. Using a metal bar, or something similar, un-screw the end cap (4) by turning it counterclockwise.

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

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

8. Every actuator has timing marks for proper engagement.





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

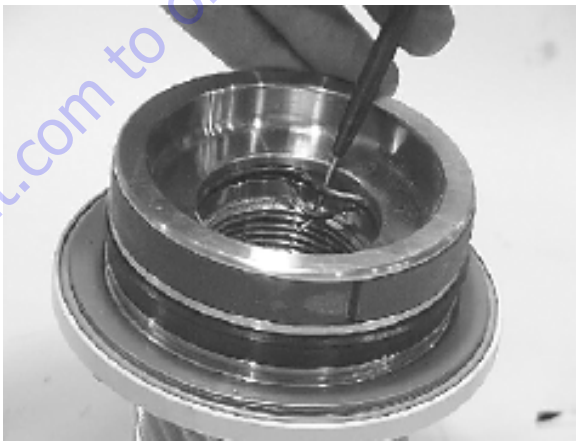
10. Remove the shaft (2). It may be necessary to strike the threaded end of the shaft with a rubber mallet.

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

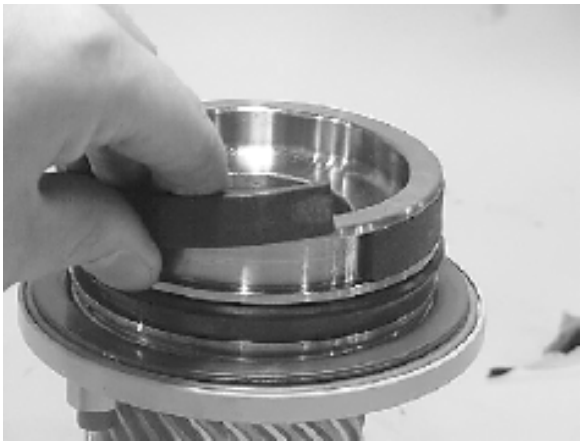
12. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is no damaged.

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

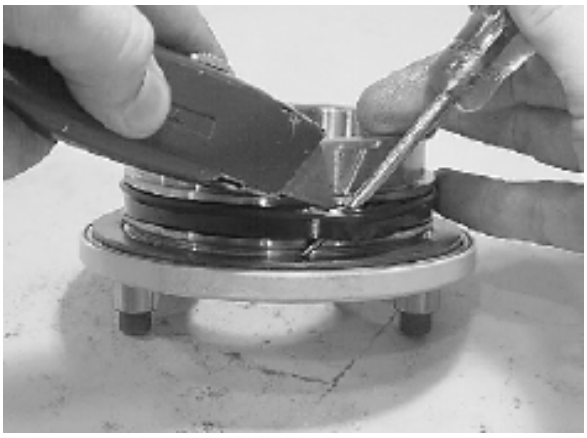
14. Remove the o-ring (204) and backup ring (207) from end cap (4) and set aside for inspection.



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



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



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

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

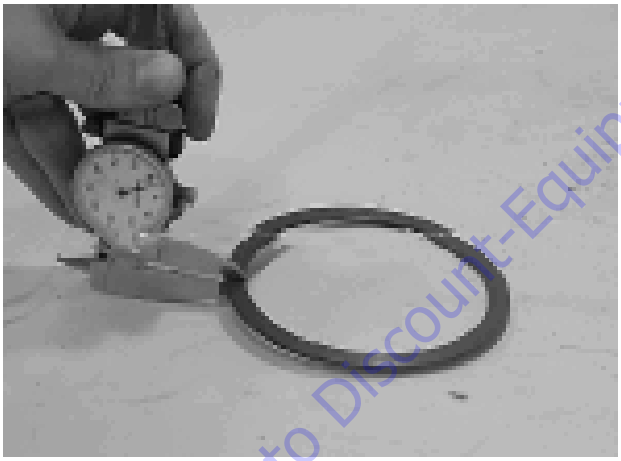
19. Remove the piston O.D. seal (202).

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

Inspection

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

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

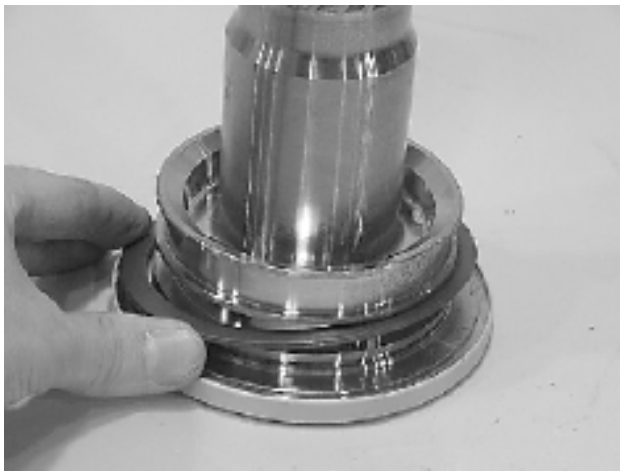


3. Inspect the wear guide condition and measure thickness (not less than 0.123" or 3.12 mm).

Assembly

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

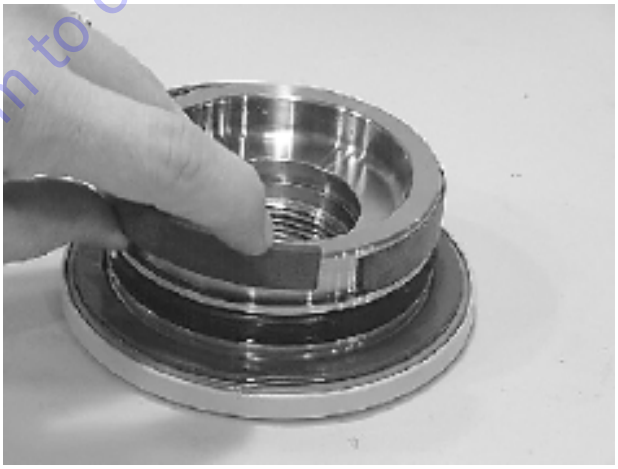
2. Install the thrust washer (304) onto shaft (2) and end cap (4).



3. Install the wiper seal (304.1/green O-ring) into it's groove on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).

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

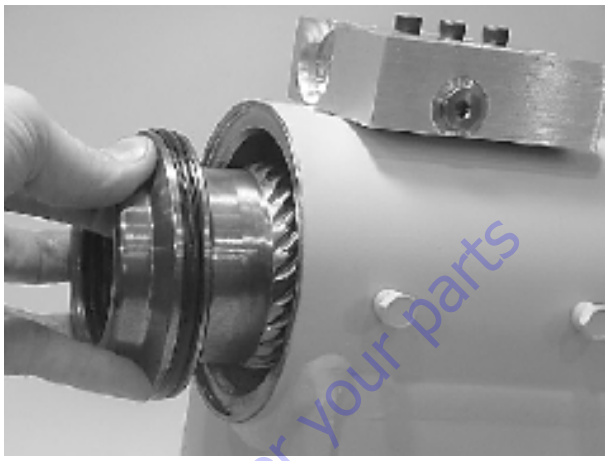
5. Install the wear guide (302) on the end cap (4) and shaft (2).



6. Install the inner T-seal (200) into the piston (3) using a circular motion. Install the outer T-seal (202) by stretching it around the groove in a circular motion. Each T-seal has 2 backup rings (see drawing for orientation).

7. 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.



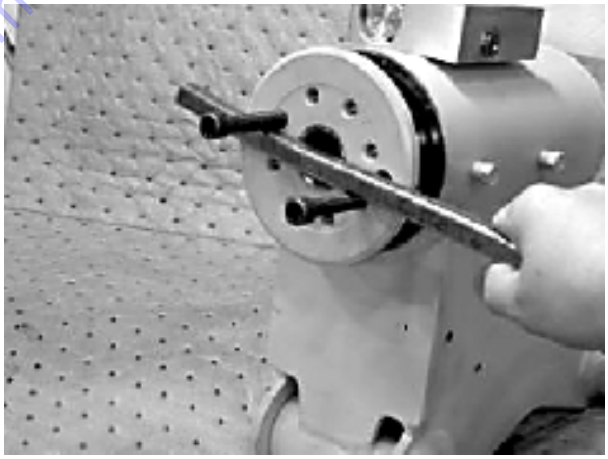
9. Looking from the angle shown, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly line up as shown. Using a rubber mallet, tap the piston into the housing up to the point where the gear teeth meet.

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.

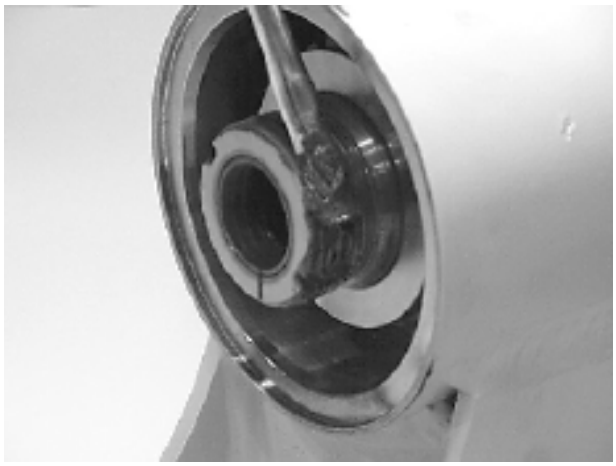
12. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.

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.



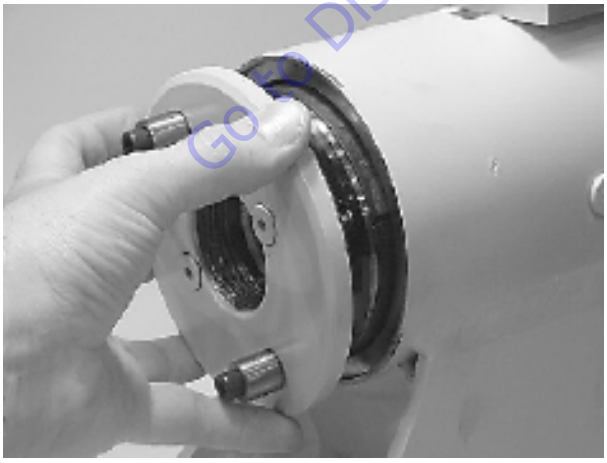
14. Install the stop tube onto the shaft end. Stop tube is an available option to limit the rotation of an actuator.

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

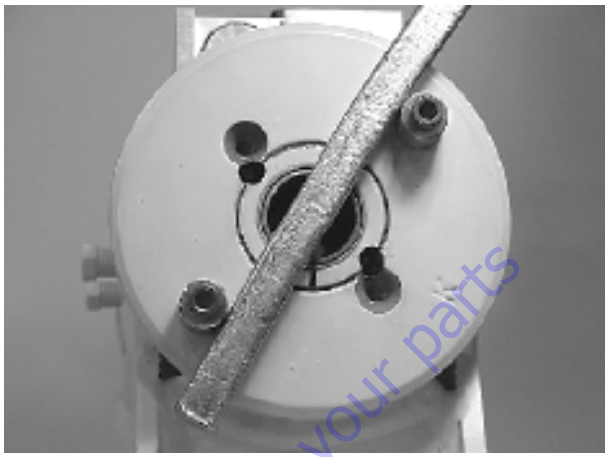


16. Install the O-ring (204) and backup ring (207) into the inner seal groove on the end cap (4).

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

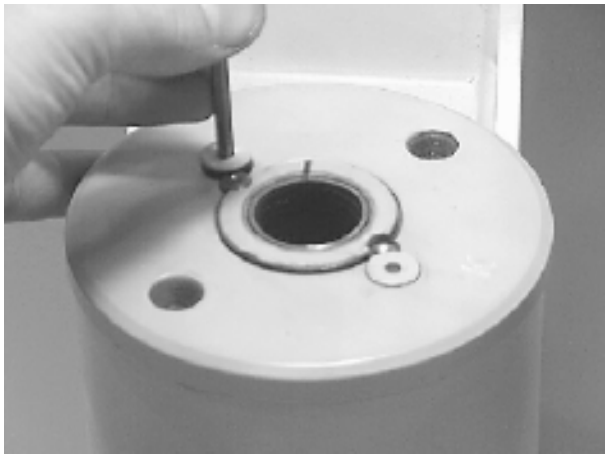


18. Tighten the end cap (4). In most cases the original holes for the lock pins will line up.



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).



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 cap screws (113) or set screws. Remove the grease port screws from the shaft flange and end cap. (See exploded view)

NOTICE

IF A HYDRAULIC TEST BENCH IS NOT AVAILABLE, THE ACTUATOR CAN BE ROTATED BY HAND, OPEN THE PRESSURE PORTS AND USE A PRY BAR WITH 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 cap screws into the grease ports and tighten to 25 in-lbs. (2.8 Nm).

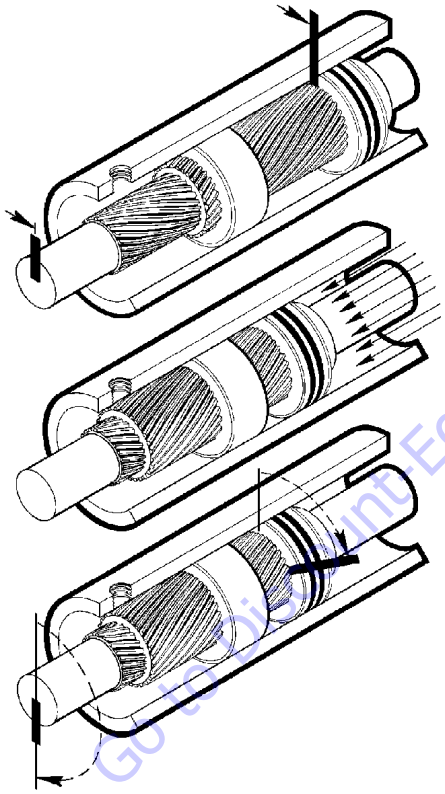
4.4 JIB ROTATOR

Operating Principle

Helac's helical hydraulic rotary actuators use our sliding spline technology which converts linear piston motion into powerful shaft rotation. The actuators are composed of a housing and only two moving parts, the central shaft and the annular piston. Helical spline teeth machined on the shaft engage matching splines on the inside diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage matching splines in the housing's ring gear. As hydraulic pressure powers the piston back and forth within the housing – similar to the operation of a hydraulic cylinder – the splines cause the shaft to rotate.

Disassembly

1. Remove all hydraulic fittings Drain the oil from both sides of the piston through the pressure ports.
2. Place the actuator horizontally on a clean work bench with ample room to place the internal parts as they are removed.
3. Unthread the socket head capscrews (102) from the lockwasher (05). Remove the lock washer from the shaft (02).
4. Secure the actuator firmly to the work surface to prevent movement. A pipe vise works well. Insert two long screws (1/4-20) into the end cap (04) and, using a pry bar, unthread the end cap from shaft by turning in a counterclockwise direction as shown below.

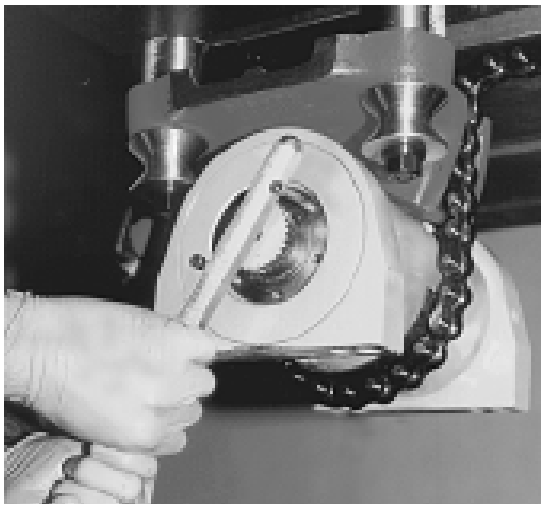


Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing's ring gear remains stationary.

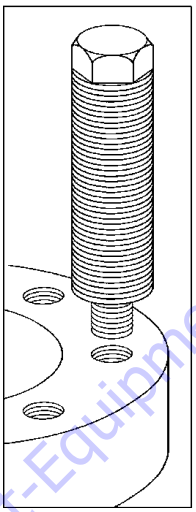
As fluid pressure is applied, the piston is displaced axially while, simultaneously.

The helical gearing forces the rotation of the shaft. Note how the double helix design compounds rotation: shaft rotation is about twice that of the piston.

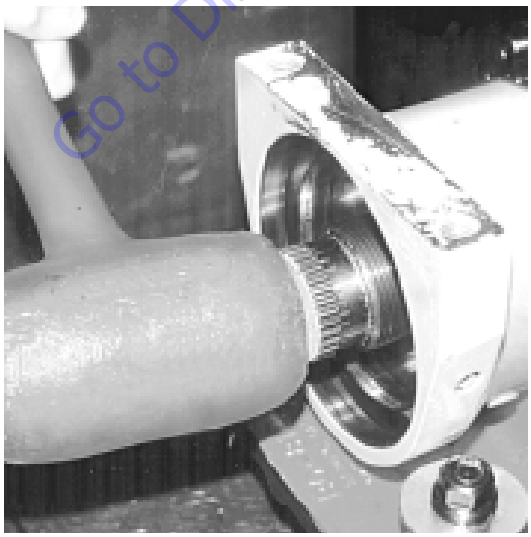
Figure 4-10. Operating Principle - Jib Rotator



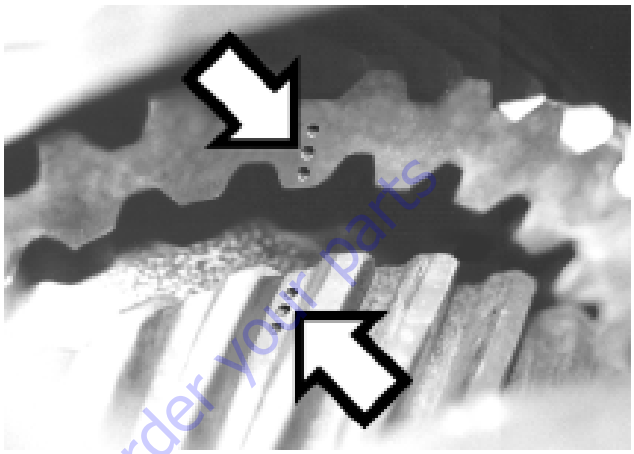
A considerable amount of torque may be required to loosen the end cap. Completely filling the length of the screws with a stack of washers or a bushing as seen in the illustration to the right will permit more force to be applied to the screws and prevent them from bending – be sure to thread the screws completely into the endcap. If the end cap is difficult to break loose, special tooling may be fabricated according to the drawing below



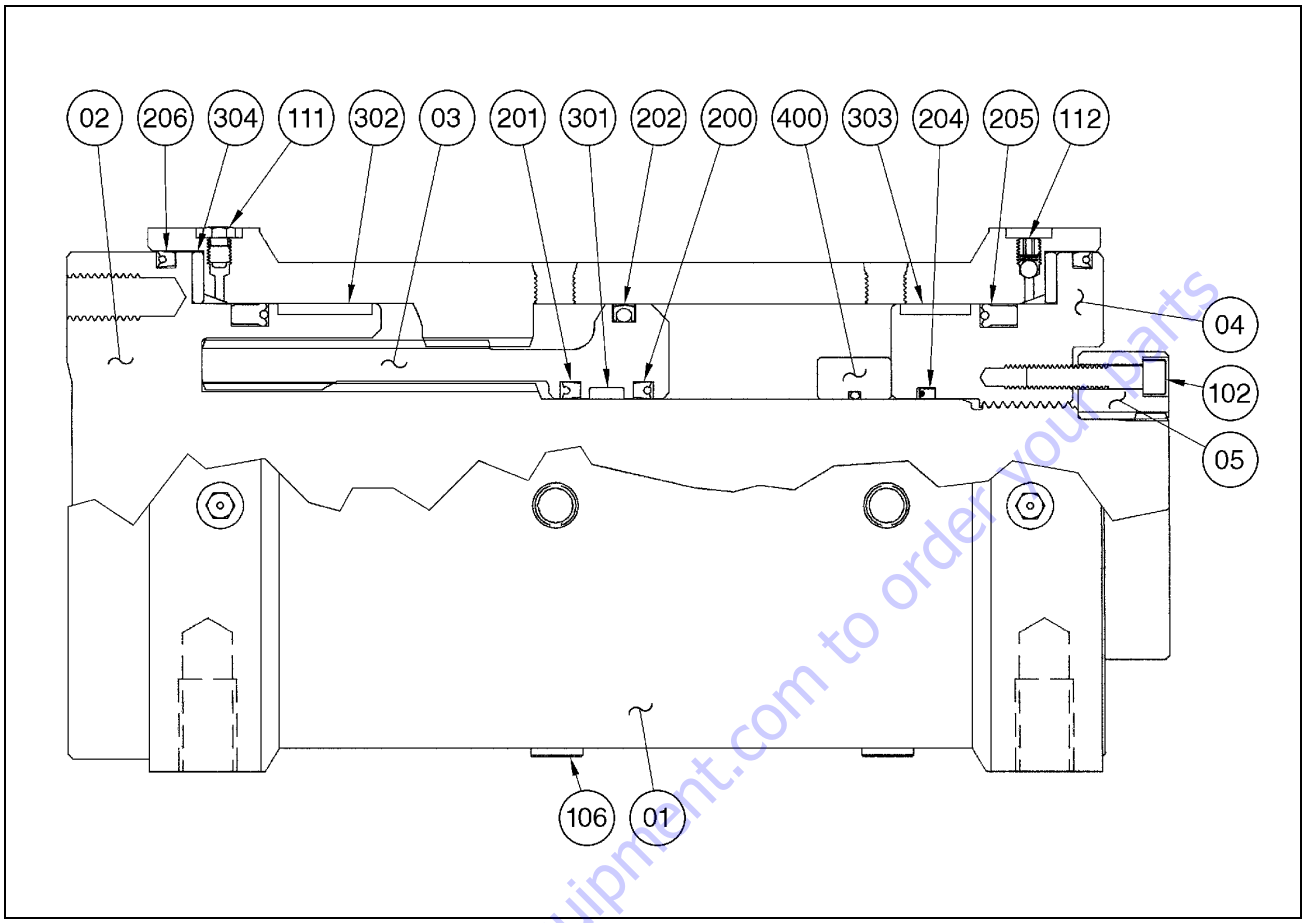
5. Remove the shaft from the housing assembly by driving it out with a plastic hammer as seen below.



Before the shaft and piston gearing are completely disengaged, note the orientation between the spline teeth: small punch marks on the face of the piston and the root of a spline tooth on the shaft gearing indicate timing as seen below



Marking the teeth at this time with a permanent felt tip marker will make the marks easier to see and greatly simplify actuator timing during reassembly. For 120° rotation actuators, remove the stop tube from the shaft before removing the shaft from the housing. Do not remove the 0-ring from the stoptube. It performs no sealing functions and should be reused when the actuator is reassembled.



1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap
5. Locking
102. Socket Head Capscrew
106. Port Plug
111. Grease Fitting
112. Grease Relief Valve
400. Stop Tube
200. Rod Seal
201. Rod Seal
202. Piston Seal
204. Cap Seal
205. Bearing Seal
206. Exclusion Seal
301. Piston Bearing
302. Shaft Bearing
303. Shaft Bearing
304. Thrust Washer

Figure 4-11. Jib Rotator Assembly

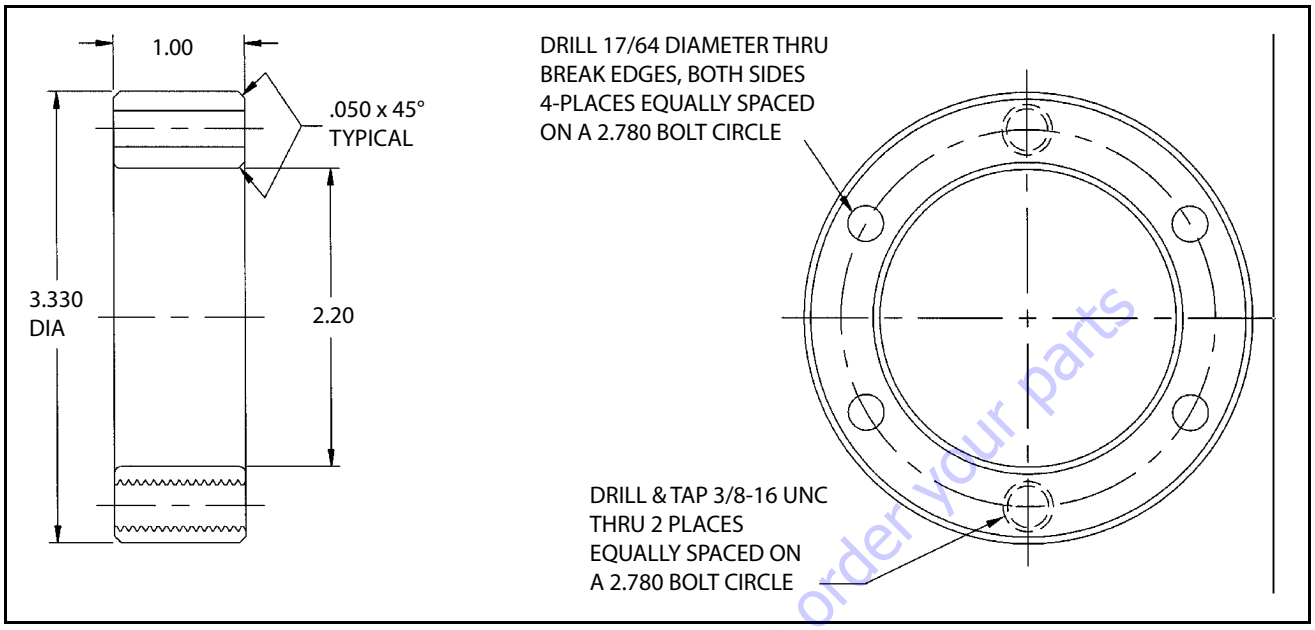
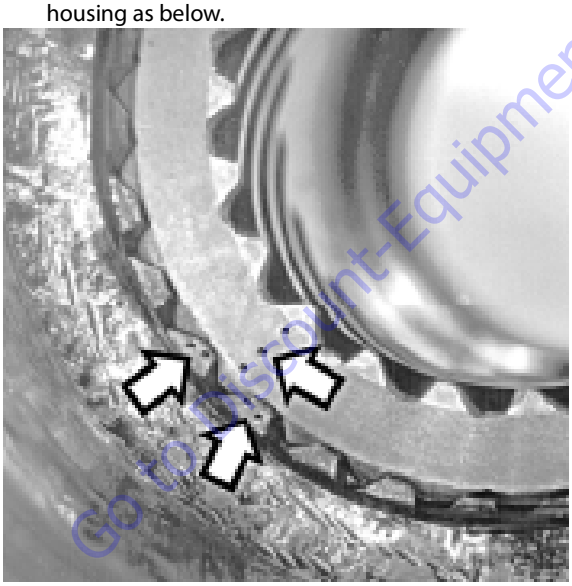
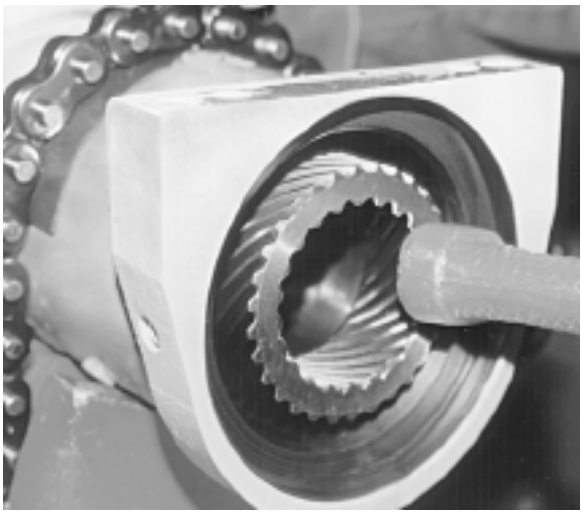


Figure 4-12. Tool for Removing End Cap

6. With the shaft removed, note the orientation of the timing marks on the piston sleeve and ring gear in the housing as below.



The adjacent weld can make the ring gear timing marks difficult to locate; using a light can help. Again, mark the teeth with a felt tip marker to make the marks easier to see and to simplify timing during reassembly. Drive the piston sleeve out of the housing using the handle of a rubber mallet as shown below.



Support the piston sleeve as it is removed from the housing. Great care should be taken to insure that the gear teeth are not damaged and the piston sleeve does not damage the housing bore as it i removed.

7. Remove all seals and bearings from their grooves. Note the orientation of the sealing lips prior to removal.

8. Clean all components thoroughly with solvent or in a parts washer. Be sure to flush all grease and contaminants from the grease fittings and grease relief passages.

Inspection

Inspect all parts for wear, damage, cracks, etc.

HOUSING

Inspect the cylinder bore for wear and scratches. The surface finish should be 32 RMS or better. Rehone if necessary. Minor scratches and damage can be repaired by local polishing. Inspect all bearing contact surfaces for damage and/or contamination and repair and clean as necessary. Inspect the exterior of the housing for damage, cracks, integrity of welds, etc.

SHAFT

Check the sealing surface of the shaft for scratches and damage. Polish if necessary.

GEAR COMPONENTS

Check gearing for excessive wear. Nominal movement between gear components in excess of 1.5 degrees can result in sloppy response.

BEARINGS

All radial bearings are of a reinforced nylon material. If the thickness measures less than 0.123 in. (3.125 mm), the bearings should be replaced.

THRUST WASHERS

Manufactured from an orkot material. If the thickness measures less than 0.113 in. (2.870 mm), or if contaminants are noticed imbedded in the material, the thrust washers should be replaced.

Reassembly

It is recommended that you first practice assembling the actuator with the bearings and thrust washers installed but without the seals. The seals are easily damaged and their increased friction makes assembly more difficult. Be sure that the timing marks on the gear components are engaged in the correct orientation. Mark the timing marks with a felt tip marker for better visibility to make assembly easier.

1. Wash all parts thoroughly in cleaning solvent and blow dry.

2. Pump a high quality NLGI-2 lithium based grease into the grease fittings (111) to flush any contaminants out of the fittings and passages and to insure the fittings are functioning properly. Replace any non functioning fittings. Wipe off all excess grease. The set screws of the relief valves (112) must be flush with the countersunk bore to ensure proper tension on the spring as seen in Photo F. If the set screws are threaded in too far, the seals will be extruded during greasing and damaged. Secure the set screws with Medium Strength Threadlocking Compound.

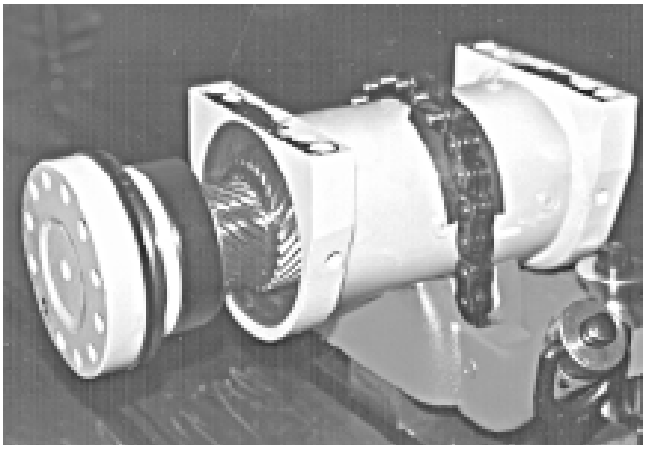
3. Lightly coat the thrust washers (304) with grease and install them on the shaft (02) and end cap (04) prior to seal installation.

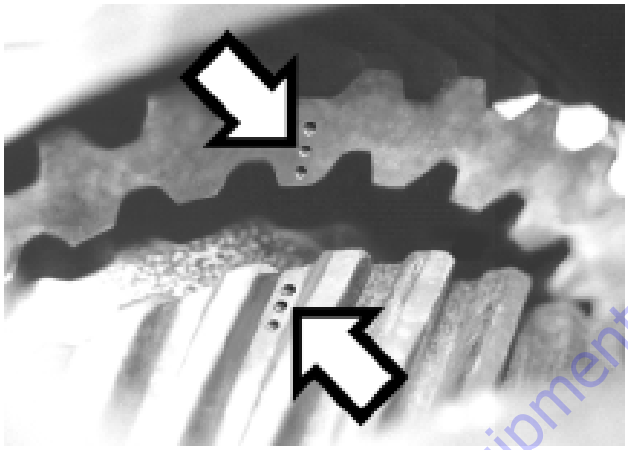
4. Lightly coat all sealing and working surfaces with a good grade of hydraulic oil.

5. Install all seals in their respective grooves. Refer to the Assembly Drawing on page 2 to ensure the correct orientation of all seals. Note that the 0-ring energizer should be removed from seal (201) on the inside diameter of the piston nearest the piston splines. This prevents pressure from being trapped between seals (200) and (201).

6. With the housing positioned horizontally and firmly secured to prevent movement, insert the piston sleeve into the housing bore until the piston seal contacts the housing chamfer. Look through the opposite side (shaft flange side) of the housing bore and rotate the piston sleeve as necessary to align the timing marks on the housing ring gear and piston sleeve. While holding the piston sleeve steady to prevent damage to the cylinder bore, drive the piston sleeve into the housing with a rubber mallet until the gear teeth engage. This assembly step is difficult and might require several attempts to successfully engage the gear teeth. Double check the timing marks and the engagement of the gear teeth to insure correct alignment, then drive the piston sleeve as far as possible into the housing until it comes to a stop against the ring gear.

7. Install the shaft as seen below in timed relation to the piston sleeve by aligning the punched timing marks as shown below. Temporarily taping the threaded portion of the shaft with masking tape will make it easier to clear the rod seals and prevent their damage Once the gear teeth are engaged, rotate the shaft clockwise until it is bottomed out against the piston sleeve. Using a rubber mallet, drive the shaft into the housing until the thrust washer comes to a stop against the housing thrust surface.





8. Remove the masking tape and apply anti-seize to the shaft threads.
9. Install the stop tube if applicable.
10. Apply a thin film of grease to the seals, then thread the end cap onto the shaft to a net fit where the end cap just begins to damp against the thrust washer. Tighten the end cap to approximately 120 FT-LB (163 N.m).
11. Apply a generous amount of anti-seize to the splines at the end of the shaft. Locate the correct position of the locknut to align its bolt circle with that of the end cap. If the bolt circles do not align, unthread the end cap no more than a half a pitch of the shaft splines. Insert the capscrews and torque to 108 IN-LB (147 N.m).
12. Grease the thrust washers. Pump a high quality NLGI-2 lithium based grease into the grease fittings at both ends of the housing until it begins to ooze from the grease reliefs. If possible, rotate the shaft during greasing to ensure even distribution on the thrust surfaces.

Installing Counterbalance Valve

Refer to Figure 4-13., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old Threadlocking compound.
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. Medium Strength Threadlocking Compound should be applied to the shank of the three bolts at the time of installation.
4. Torque the 1/4-inch bolts 110 to 120 inch pounds (12.4 to 13.5 Nm). Do not torque over 125 inch pounds (14.1 Nm). Torque the 5/16-inch bolts 140 inch pounds (15.8 Nm). Do not torque over 145 inch pounds (16.3 Nm).
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 hydraulic hand pump or electric test.

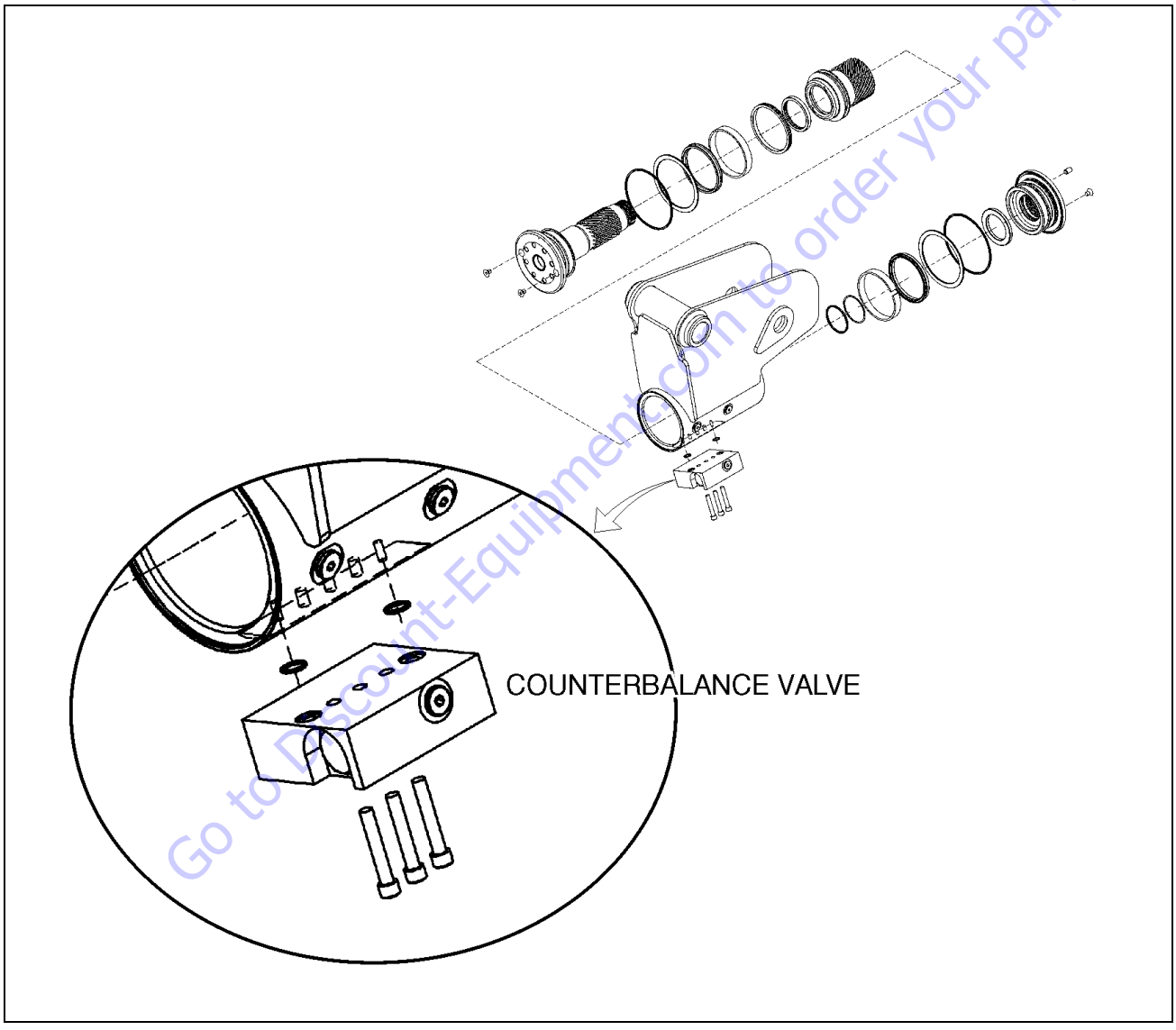


Figure 4-13. Rotator Counterbalance Valve

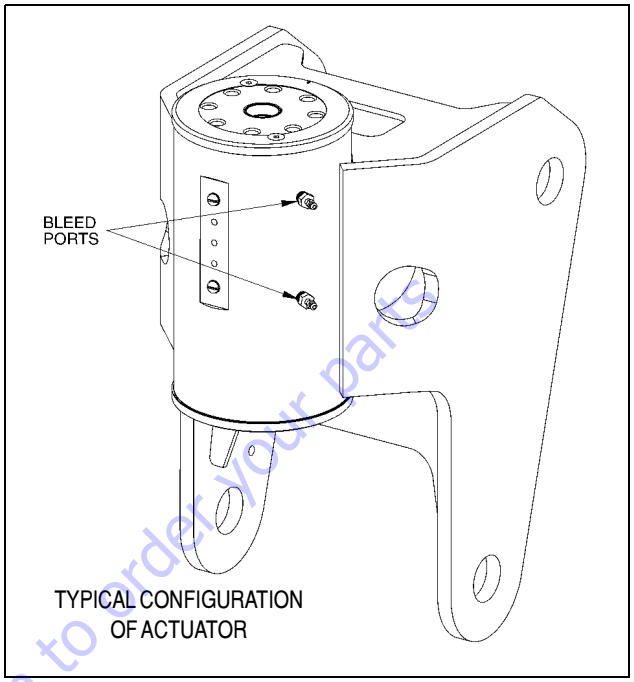
Testing the Actuator

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.



TYPICAL CONFIGURATION
OF ACTUATOR

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.
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.

Table 4-1. Troubleshooting

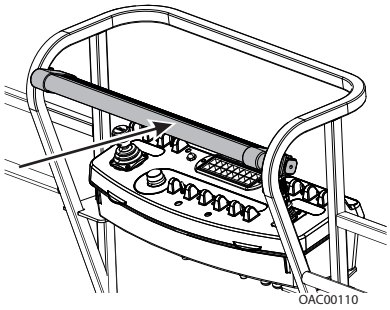
Problem	Cause	Solution
126. Shaft rotates slowly or not at all	a. Insufficient torque output	a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.
	b. Low rate of fluid flow	b. Inspect ports for obstructions and hydraulic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

4.5 SKYGUARD

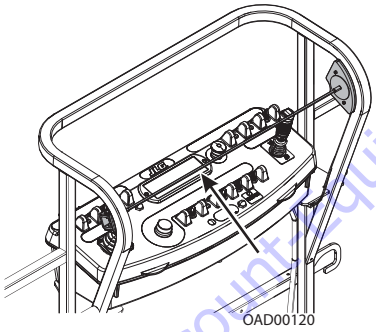
Operation

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.

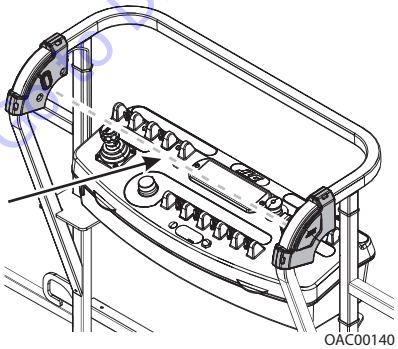
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



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 6-15 for more fault code information

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

Table 4-2. SkyGuard Function Table

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

4.6 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 lb (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 BE PERFORMED 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 mobile elevating 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.

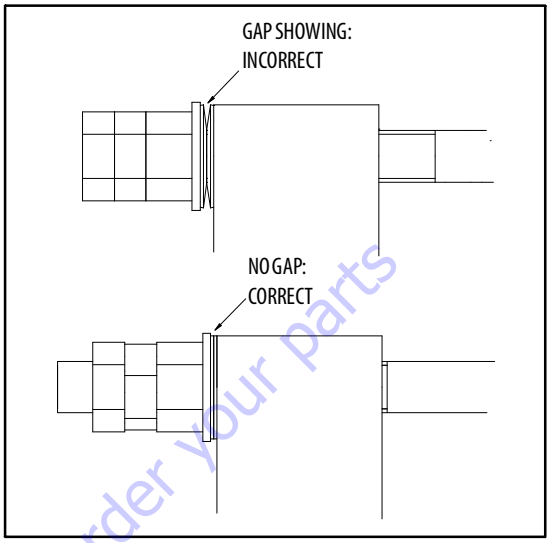
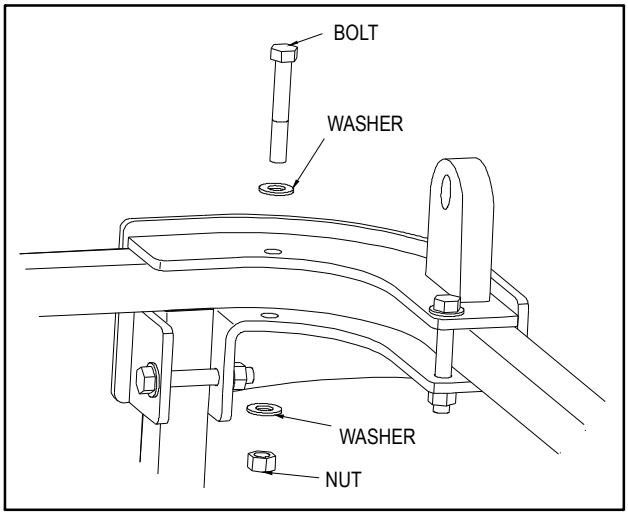


Figure 4-14. Bolt-On External Fall Arrest Cable Tension

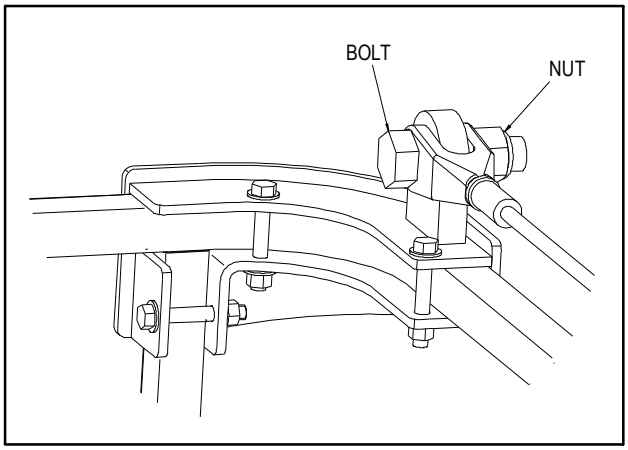
- Fittings & Brackets: Ensure all fittings are tight and there are no signs of fractures. Inspect brackets for any damage.
- Attachment Ring: No cracks or signs of wear are acceptable. Any signs of corrosion requires replacement.
- Attaching Hardware: Inspect all attaching hardware to ensure there are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

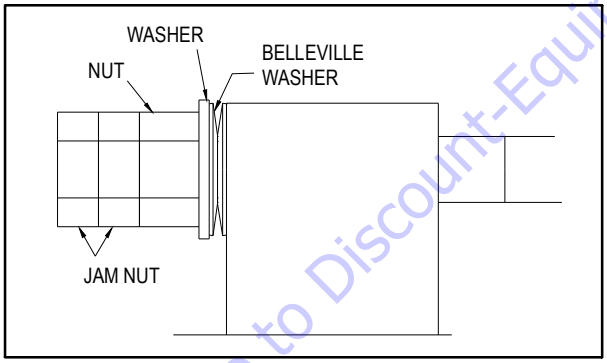


2. Attach the fall arrest cable to the right hand bracket Using the attaching bolt and nut. Orient the bolt as shown below. Do not tighten the nut so cable can still rotate.

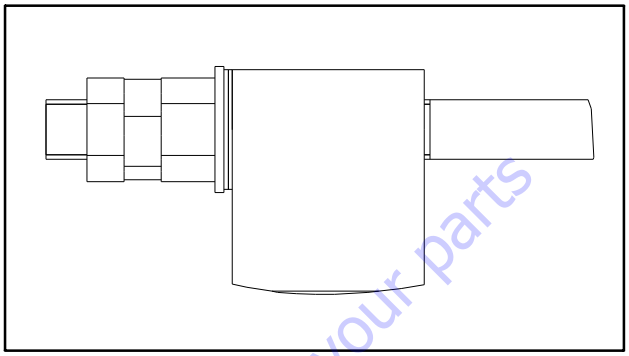


3. Install the Attachment Ring onto the cable.

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.

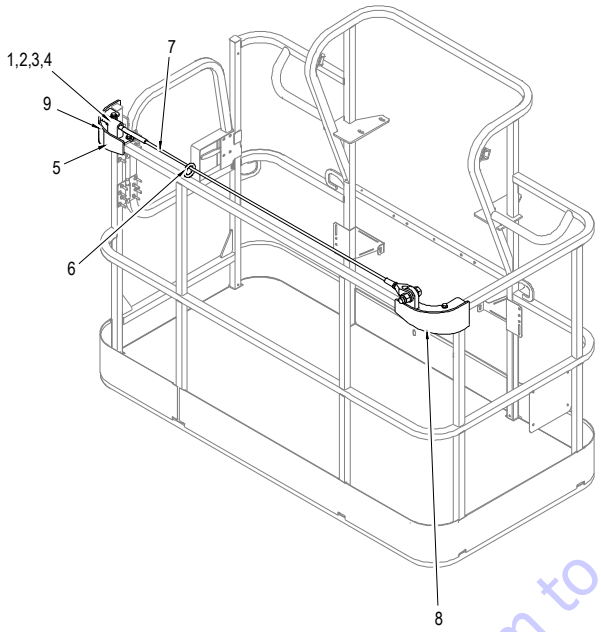


5. Use the two jam nuts to prevent the cable from rotating while the nut is tightened. Tighten the nut until the belleville washers are fully compressed and no gap is present at the outside diameter of the washers. Ensure the cable has not rotated during tightening.



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).



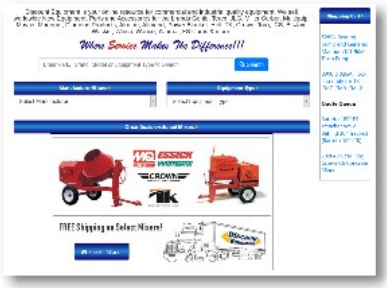
1. Belleville Washer
2. Washer
3. Hex Nut
4. Jam Nut
5. LH Bracket
6. Attachment Ring
7. Cable
8. RH Bracket
9. Decal

Figure 4-15. Bolt-On External Fall Arrest System

PARTS FINDER

Search Website by Part Number

Discount Equipment



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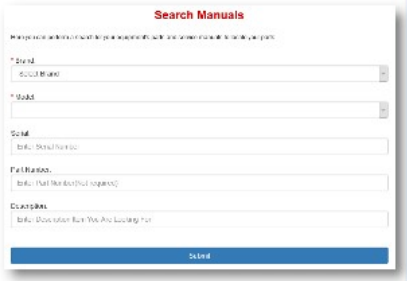

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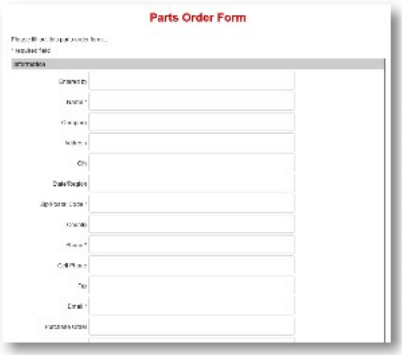

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SECTION 5. BASIC HYDRAULIC INFORMATION & SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

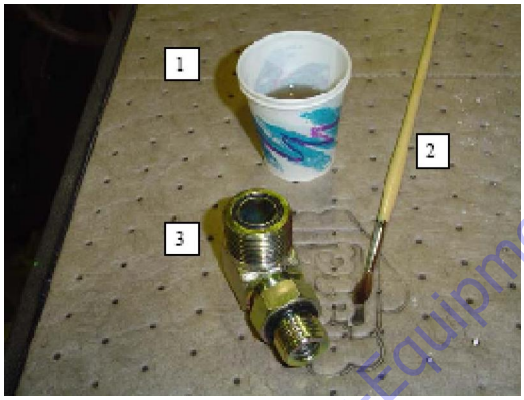
When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

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

Cup and Brush

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

- A small container for hydraulic oil
- Small paint brush



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

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

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

Dip Method

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

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

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

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

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

Spray Method

This method requires a pump or trigger spray bottle.

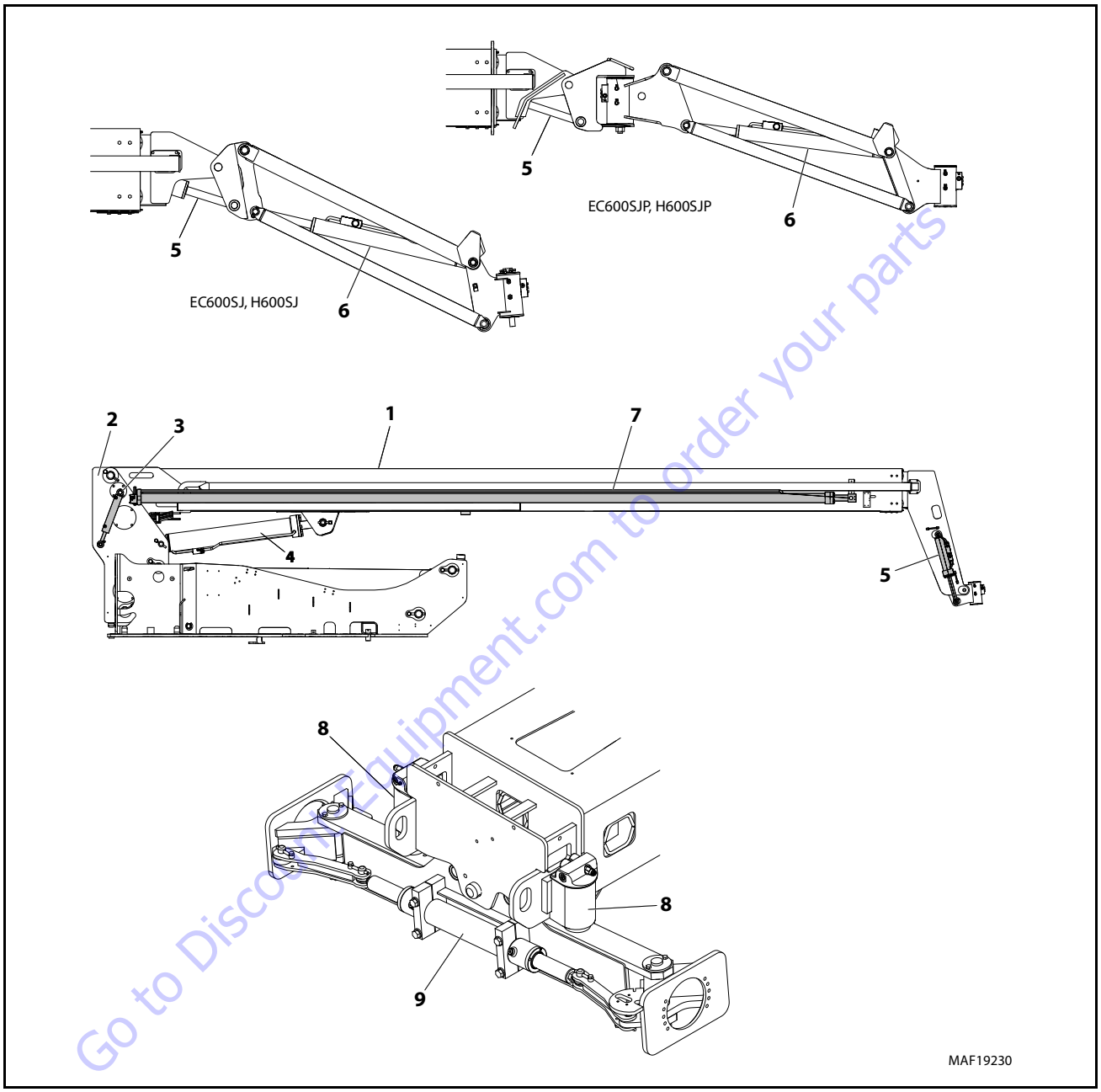
1. Fill the spray bottle with hydraulic oil.
2. Hold the fitting over a suitable catch can.
3. Spray the entire o-ring surface with a medium coat of oil.

Brush-on Method

This method requires a sealed bottle brush.

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

5.2 CYLINDER REMOVAL AND INSTALLATION



1. Main Boom
2. Upright Level
3. Master Cylinder
4. Main Lift Cylinder
5. Slave Cylinder
6. Jib Lift Cylinder
7. Main Telescope Cylinder
8. Axle Lockout Cylinder
9. Steer Cylinder

Figure 5-1. Hydraulic Cylinder Location

Main Boom Telescope Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position.

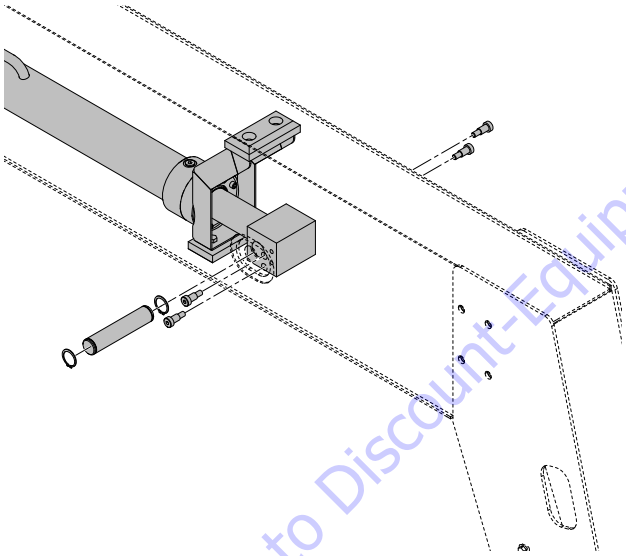
NOTE: *The main boom weighs* approximately *1816 lb (824 kg).*

2. Support platform end of the main boom with suitable lifting device.
3. Extend the boom to gain access to main fly boom telescope cylinder rod end pin.

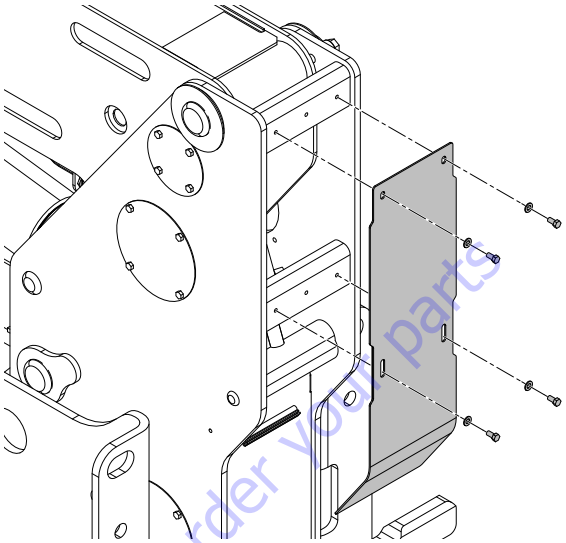
NOTICE

CAP HYDRAULIC LINES AND PORTS IMMEDIATELY AFTER DISCONNECTING LINES TO PREVENT SYSTEM CONTAMINATION.

4. Tag and disconnect hydraulic lines to telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic line and ports.
5. Remove bolt and keeper pin from cylinder rod pin.
6. Carefully drive out telescope cylinder rod pin from the fly boom using suitable brass drift.

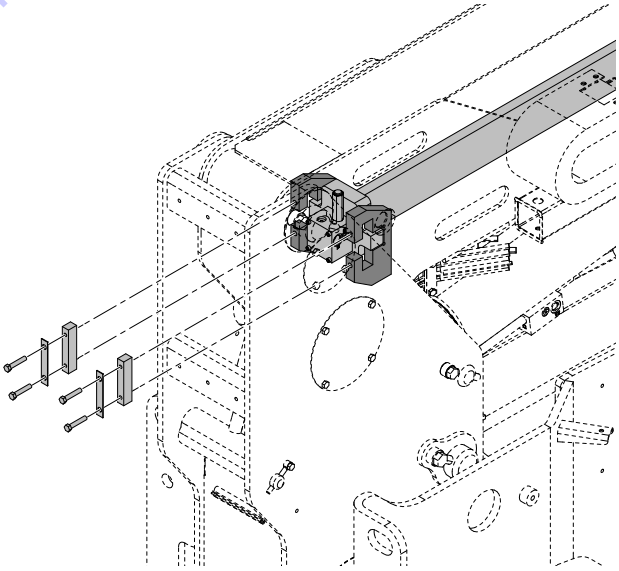


7. Remove four bolts which attach cover plate on the rear of the upright and remove upright cover plate.



NOTE: *First remove master cylinder from the upright then Remove main boom telescope cylinder. Refer "Main Boom Lift Cylinder Removal" on page 6.*

8. Remove four bolts, two blocks and shims from telescope cylinder barrel end support.



NOTE: *The main telescope cylinder weighs* approximately *370 lb (168 kg).*

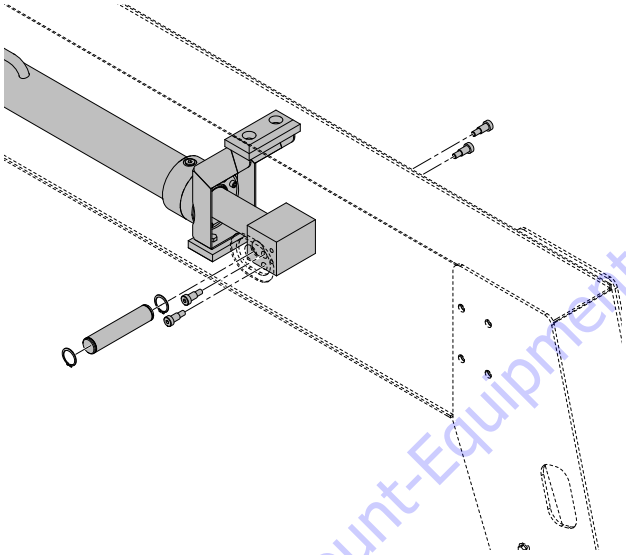
9. Attach a suitable sling to telescope cylinder. Attach suitable lifting device to sling and pull cylinder partially from the boom assembly.
10. Secure cylinder with a suitable sling and lifting device at approximate center of gravity.

Main Boom Telescope Cylinder Installation

1. Attach hydraulic power supply to telescope cylinder ports.
2. Using suitable supports or lifting devices at each end of cylinder, extend rod so cylinder pin holes are same distance apart as boom pin attach holes.

NOTE: *The main telescope cylinder weighs* approximately *370 lb (168 kg).*

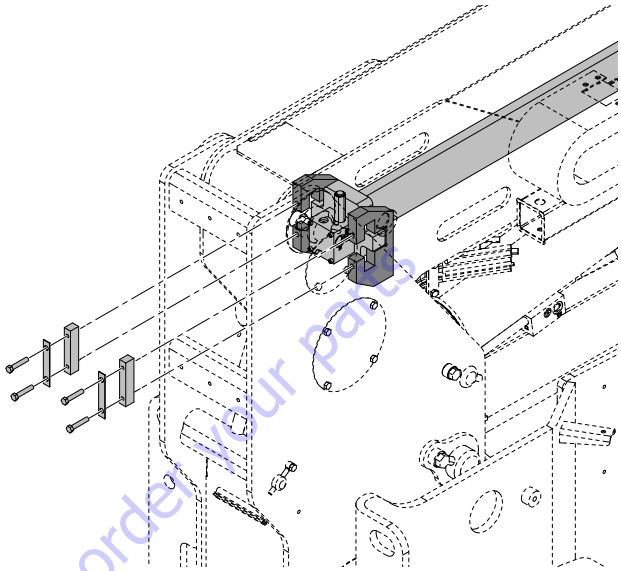
3. Using suitable lifting device, carefully lower the cylinder to boom assembly and place telescope cylinder into the boom assembly.
4. Remove lifting device from the telescope cylinder.
5. Install telescope cylinder rod pin in fly boom. Install keeper pin and bolt.



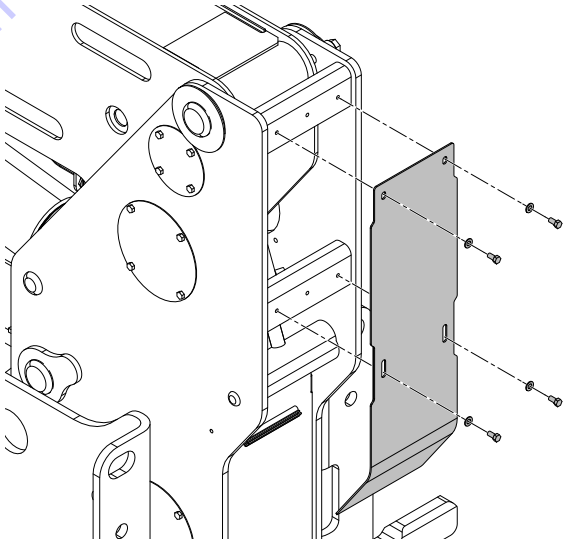
6. Install telescope cylinder barrel end support in slot in base boom.

NOTE: *Apply* Medium Strength Threadlocking Compound *to all bolts before installation.*

7. Install four bolts, two blocks and shims to attach telescope cylinder barrel ens support to boom assembly.



8. Install four bolts which attach cover plate on the rear of the upright.



9. Remove hydraulic line and port caps. Correctly route and connect hydraulic lines as tagged to the telescope cylinder.
10. Remove boom prop and suitable lifting device. Activate hydraulic system.
11. Using all applicable safety precautions, operate boom functions. Check for proper operation and hydraulic leaks. Secure as necessary.
12. Check fluid level of hydraulic tank. Refill if required.

Main Boom Lift Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position.

NOTE: *The main boom weighs* approximately *1816 lb (824 kg).*

2. Support platform end of the main boom with suitable lifting device.

NOTICE

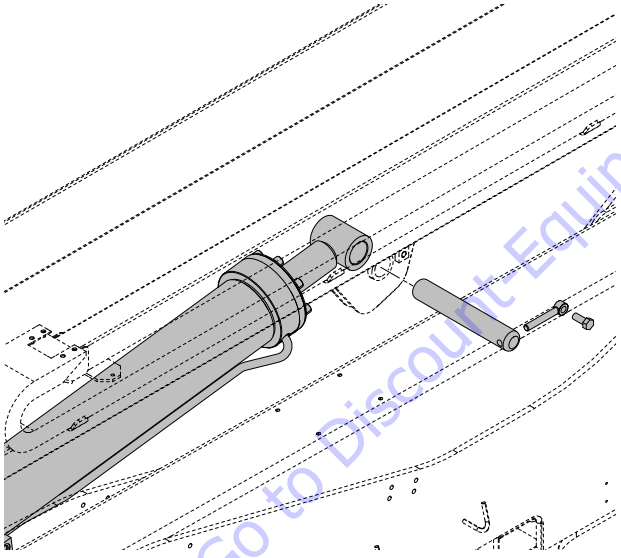
CAP HYDRAULIC LINES AND PORTS IMMEDIATELY AFTER DISCONNECTING LINES TO PREVENT SYSTEM CONTAMINATION.

3. Tag and disconnect hydraulic lines to lift cylinder. Use suitable container to retain residual hydraulic fluid. Cap hydraulic line and ports.

NOTE: *The main lift cylinder weighs* approximately *300 lb (136 kg).*

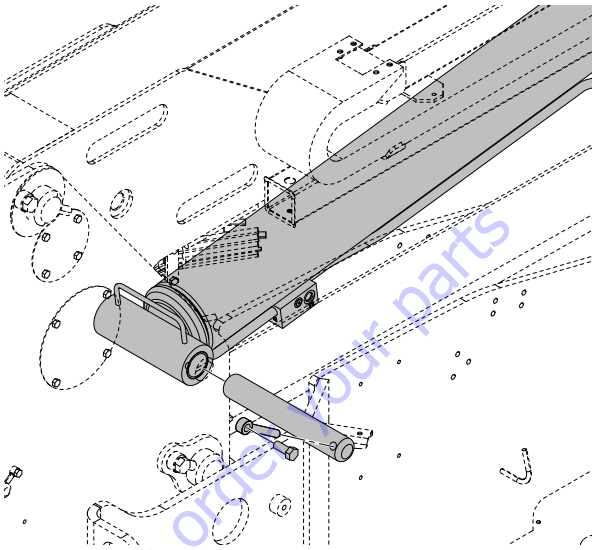
4. Attach a suitable lifting device to support main boom lift cylinder.

5. Remove bolt and keeper pin from cylinder rod pin. Carefully drive out pin using suitable brass drift.



6. Fully retract lift cylinder rod using auxiliary power.

7. Remove bolt and keeper pin from barrel end attach pin. Carefully drive out barrel end attach pin using suitable brass drift.



8. Remove cylinder from the machine and place in suitable work area.

Main Boom Lift Cylinder Installation

NOTE: *The main boom weighs* approximately *1816 lb (824 kg).*

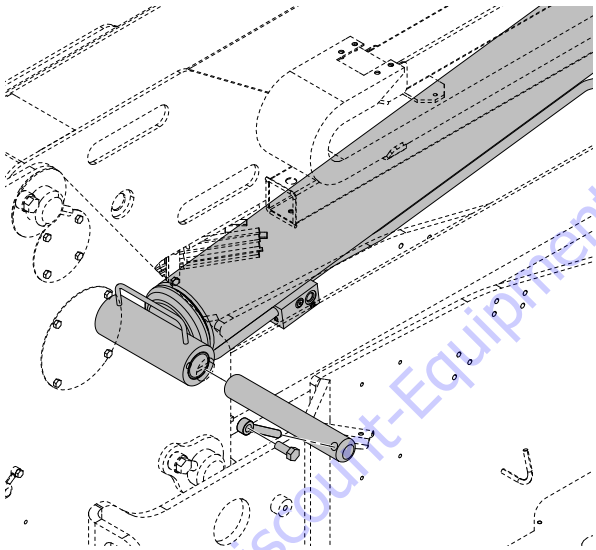
1. Support platform end of the main boom with suitable prop.

NOTE: *The main boom lift cylinder weighs* approximately *300 lb (136 kg).*

2. Install lift cylinder in place using suitable lifting device and support. Align attach pin mounting holes on upright.

NOTE: *Apply* Medium Strength Threadlocking Compound *to all bolt before installation.*

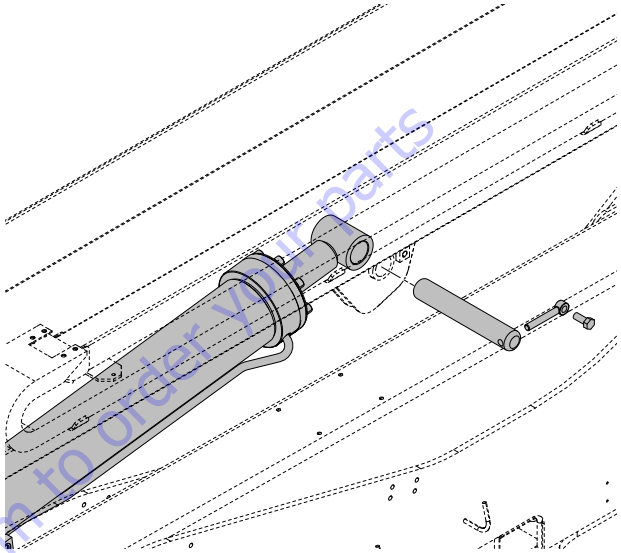
3. Use a suitable drift, drive barrel end attach pin through mounting holes in lift cylinder and upright. Install keeper pin and bolt and torque bolts to 110 ft. lbs. (149 Nm).



4. Remove cylinder port plugs and hydraulic line caps. Connect previously tagged lines to cylinder ports.

5. Use auxiliary power to extend cylinder rod until attach pin hole aligns with hole in the boom.

6. Use a suitable drift to drive cylinder rod attach pin through aligned holes, take care to align the grooved pin holes. Install keeper pin and bolt and torque bolts to 110 ft. lbs. (149 Nm).



7. Remove boom prop and lifting devices. Activate hydraulic system.

8. Using all applicable safety precautions, operate boom functions. Check for proper operation and hydraulic leaks. Secure as necessary.

9. Check fluid level of hydraulic tank and Refill if required.

Master Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position.

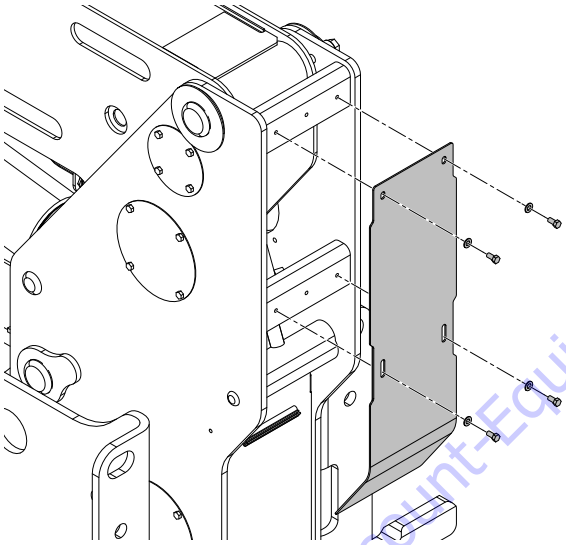
NOTE: *The main boom weighs* approximately *1816 lb (824 kg).*

2. Support platform end of the main boom with suitable prop.

NOTICE

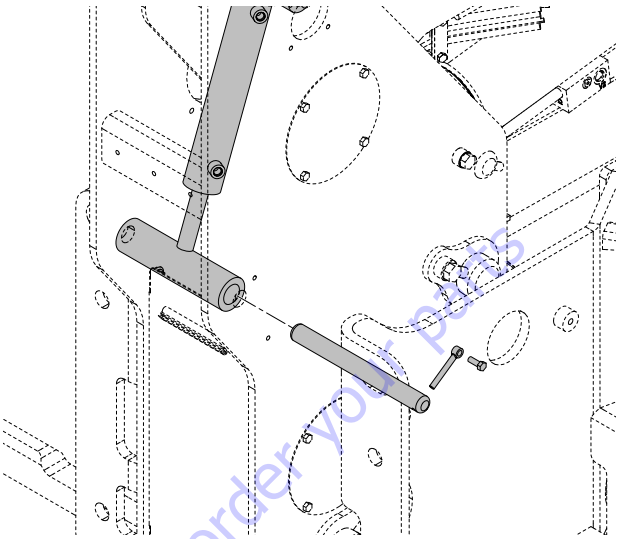
CAP HYDRAULIC LINES AND PORTS IMMEDIATELY AFTER DISCONNECTING LINES TO PREVENT SYSTEM CONTAMINATION.

3. Tag and disconnect hydraulic lines to lift cylinder. Use suitable container to retain residual hydraulic fluid. Cap hydraulic line and ports.
4. Remove four bolts which attach cover plate on the rear of the upright and remove upright cover plate.

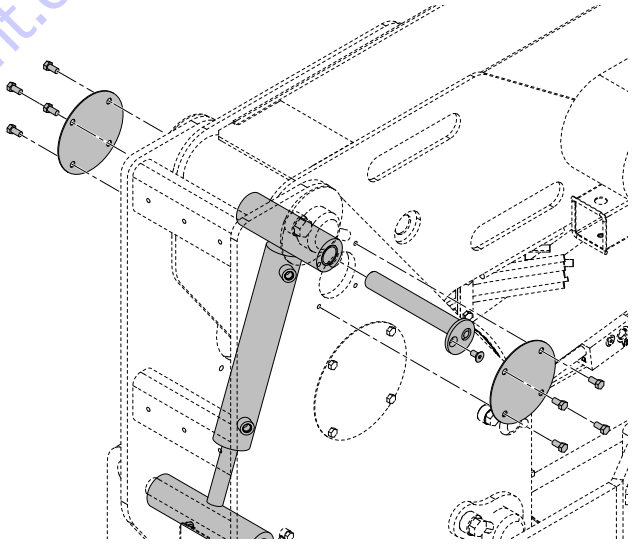


NOTE: *The master cylinder weighs* approximately *44 lb (20 kg).*

5. Use a suitable lifting device to support master cylinder.
6. Remove bolt and keeper pin from cylinder rod pin. Carefully drive out rod pin using suitable brass drift.



7. Remove four bolts which attach cover on top of the upright. Remove cover plate from both side.
8. Remove screw from barrel end attach pin. Carefully drive out barrel end attach pin using suitable brass drift.



9. Remove cylinder from the machine and place in suitable work area.

Master Cylinder Installation

NOTE: *The main boom weighs* approximately *1816 lb (824 kg).*

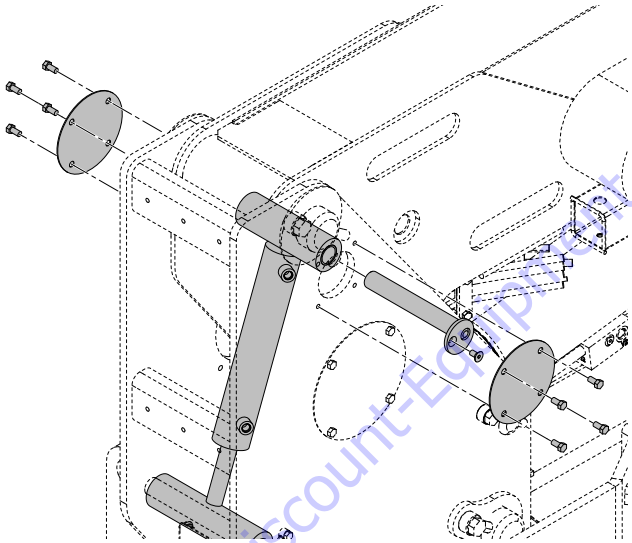
1. Support platform end of the main boom with suitable prop.

NOTE: *The master cylinder weighs approximately 44 lb (20 kg).*

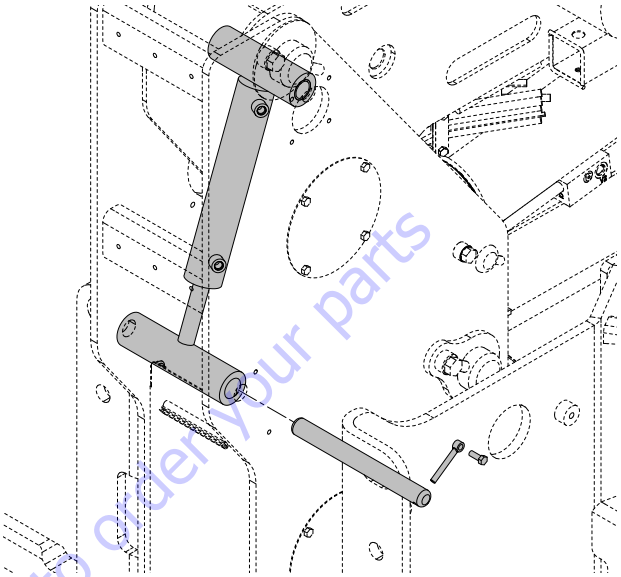
2. Install master cylinder in place using suitable lifting device and support. Align attach pin mounting holes on upright.

NOTE: *Apply* Medium Strength Threadlocking Compound *to all bolt before installation.*

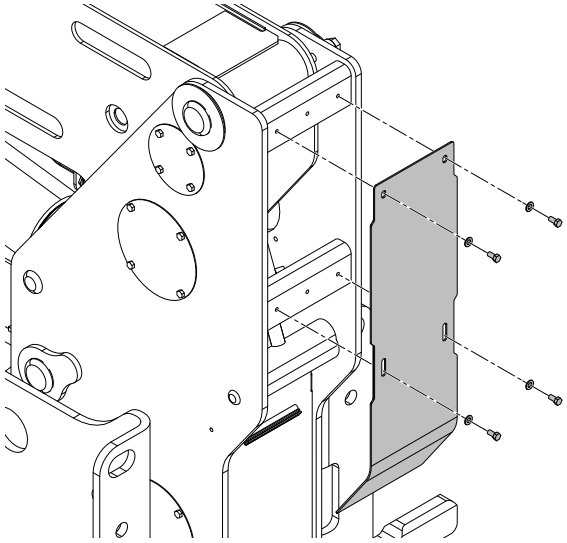
3. Use a suitable drift to drive barrel end attach pin through mounting holes in master cylinder and upright. Secure barrel end attach pin with screw.
4. Install cover plates to the upright using four bolt on both side.



5. Use a suitable drift to drive cylinder rod attach pin through aligned holes, take care to align the grooved pin holes. Install keeper pin and bolt.



6. Install cover plate on the rear of the upright using four bolts.



7. Remove cylinder port plugs and hydraulic line caps. Connect previously tagged lines to cylinder ports.
8. Remove boom prop and lifting devices. Activate hydraulic system.
9. Using all applicable safety precautions, operate boom functions. Check for proper operation and hydraulic leaks. Secure as necessary.
10. Check fluid level of hydraulic tank and refill if required.

Slave Cylinder Removal

1. Place machine on a flat and level surface, with main boom to the lowest position.
2. Use auxiliary power to retract the slave cylinder rod completely.

NOTE: *The main boom weighs* approximately *1816 lb (824 kg).*

3. Using a suitable lifting device, properly secure the platform to prevent the platform from tilting backward or forward during removal of the slave cylinder.

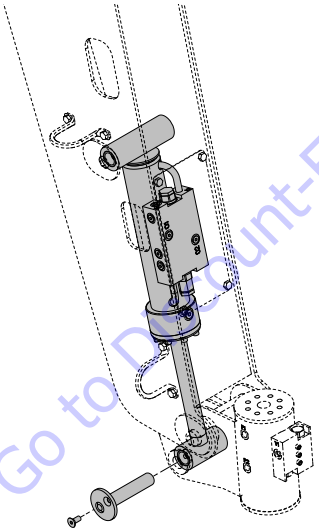
NOTICE

CAP HYDRAULIC LINES AND PORTS IMMEDIATELY AFTER DISCONNECTING LINES TO PREVENT SYSTEM CONTAMINATION.

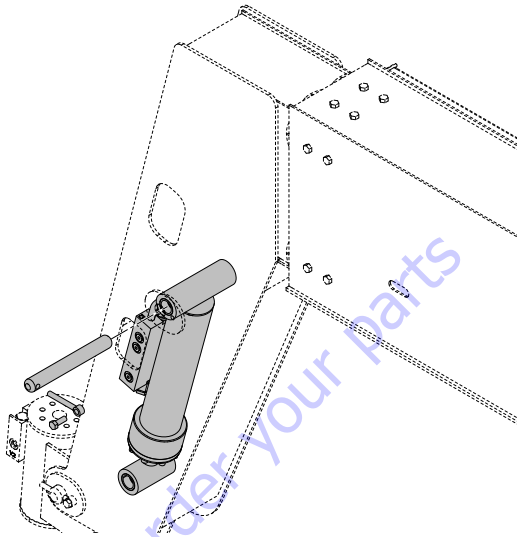
4. Tag and disconnect hydraulic lines to lift cylinder. Use suitable container to retain residual hydraulic fluid. Cap hydraulic line and ports.

NOTE: *The Slave cylinder weighs approximately 68 lb (31 kg).*

5. Use suitable sling and lifting device to support slave cylinder.
6. Remove screw from cylinder rod attach pin. Carefully drive out rod pin using suitable brass drift.



7. Remove bolt and keeper pin from cylinder barrel attach pin. Carefully drive out rod pin using suitable brass drift.



8. Remove cylinder from the machine and place in suitable work area.

Slave Cylinder Installation

NOTE: *The main boom weighs* approximately *1816 lb (824 kg).*

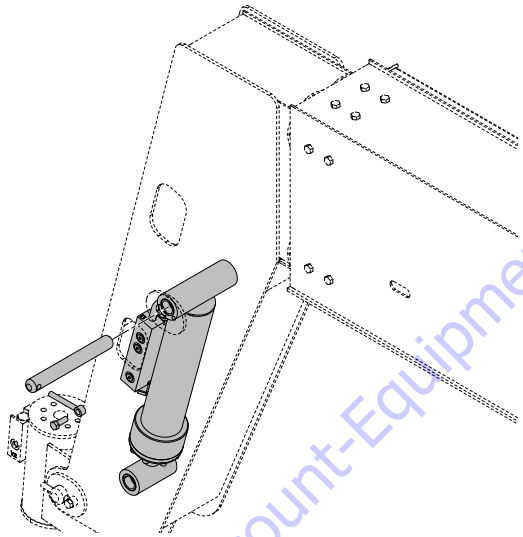
1. Using a suitable lifting device, properly secure the platform to prevent the platform from tilting backward or forward during removal of the slave cylinder.

NOTE: *The slave cylinder weighs approximately 68 lb (31 kg).*

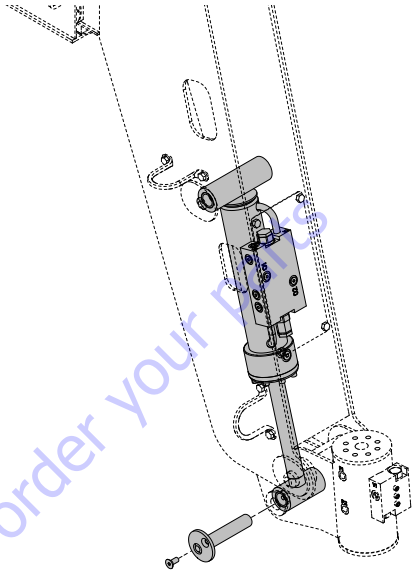
2. Install slave cylinder in place using suitable lifting device and support. Align attach pin mounting holes in fly boom.

NOTE: *Apply* Medium Strength Threadlocking Compound *to all bolt before installation.*

3. Use a suitable drift to drive barrel end attach pin through mounting holes in slave cylinder and fly boom. Install keeper pin and bolt.



4. Use a suitable drift to drive cylinder rod attach pin through aligned holes in slave cylinder and rotator. Secure rod end attach pin with screw.



5. Remove cylinder port plugs and hydraulic line caps. Connect previously tagged lines to cylinder ports.
6. Remove boom lifting devices. Activate hydraulic system.
7. Using all applicable safety precautions, operate boom functions. Check for proper operation and hydraulic leaks. Secure as necessary.
8. Check fluid level of hydraulic tank and refill if required.

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

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

1. Open bleeder valve. Rotate rod and remove from barrel.
2. Remove wiper seal. 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 and fitting from the cylinder port block.

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

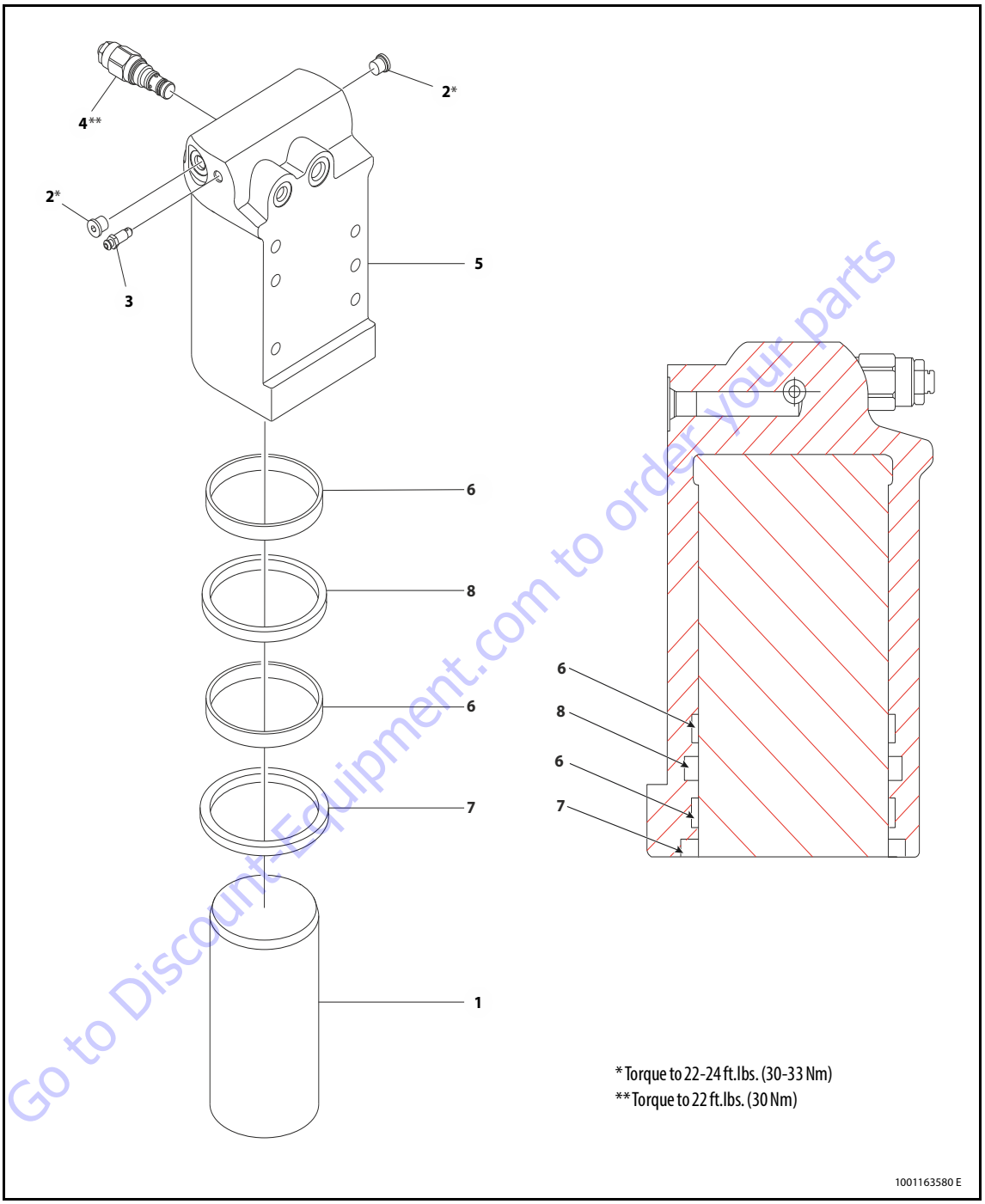
WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

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 the bleeder valve into the barrel.
6. Install counterbalance valve into the cylinder port block. Torque to 22 ft.lbs. (30 Nm).
7. Install the plugs into the cylinder. Torque to 22-24 ft.lbs. (30 -33 Nm).



1. Rod
2. O-ring Plug
3. Bleeder Valve
4. Cartridge Valve
5. Barrel
6. Wear Ring
7. Wiper Seal
8. Rod Seal

Figure 5-2. 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.
3. Remove the cartridge-type counterbalance valves and plugs from the cylinder port block and discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

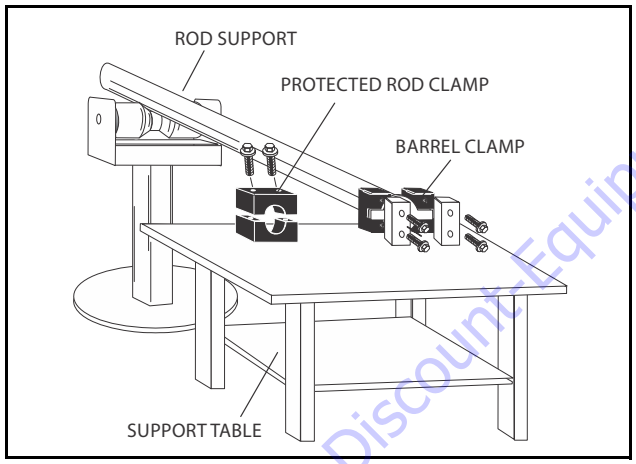


Figure 5-3. Cylinder Barrel Support

5. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

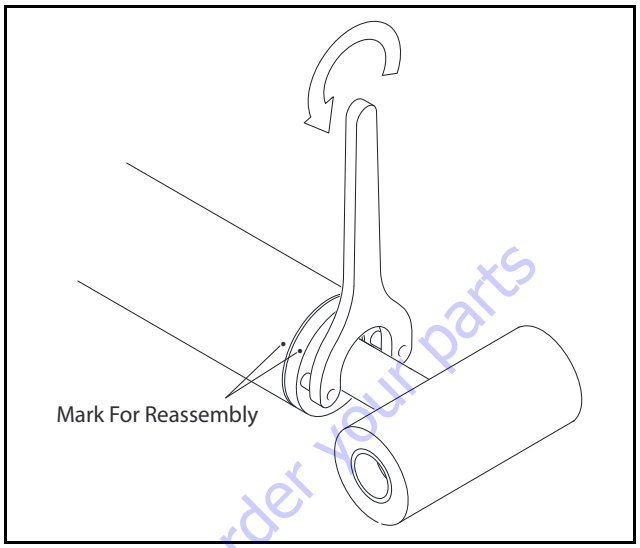


Figure 5-4. Cylinder Head Removal

6. Attach a suitable pulling device to the cylinder rod end.

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. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.

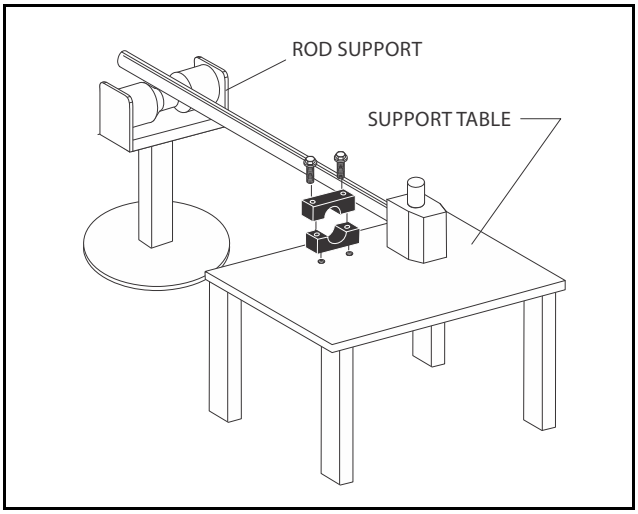
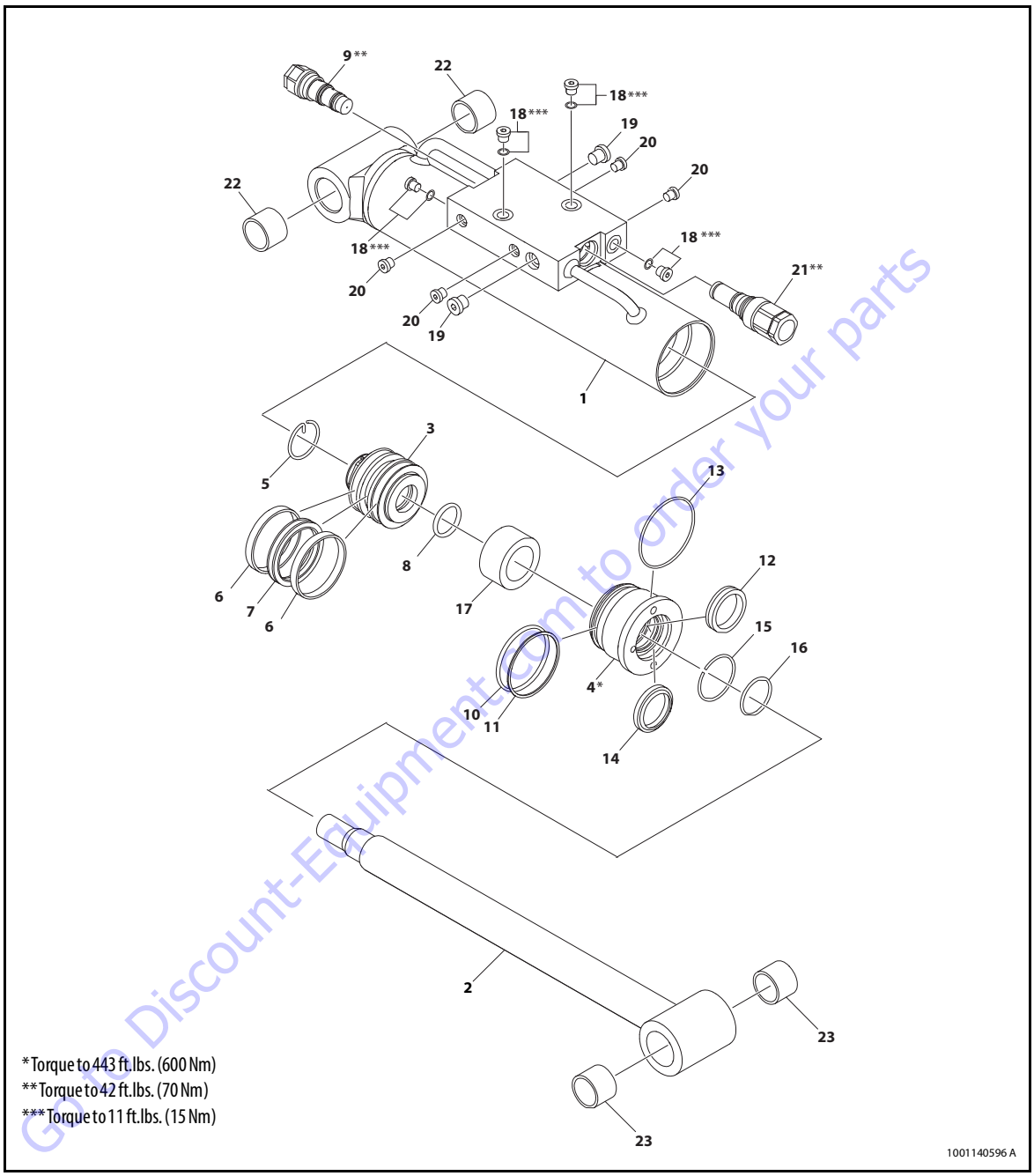


Figure 5-5. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Piston
5. Retainer
6. Wear Ring
7. Seal
8. O-ring
9. Counterbalance valve
10. O-ring
11. Backup Ring
12. Seal
13. O-ring
14. Wiper Seal
15. Retaining Ring
16. O-ring
17. Spacer
18. Plug
19. Plug
20. Plug
21. Counterbalance valve
22. Bushing
23. Bushing

Figure 5-6. Slave Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or holding fixture as close to the piston as possible.
9. Remove the retainer from rod end.
10. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.

NOTICE

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

11. Remove and discard the wear ring, seal from the outside groove of the piston. Remove and discard the o-ring from the inside groove of the piston.
12. Remove the spacer from the cylinder rod.
13. Remove the rod from the holding fixture. Remove the cylinder head.
14. Remove and discard the o-ring, backup ring from the outside groove of the cylinder head. Remove and discard rod seal, wiper seal, retaining ring, o-ring from the inside groove of the cylinder head.

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 threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. 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: *Lubrication is not required with nickel plated pins and bearings. Install pin into the composite bearing dry.*

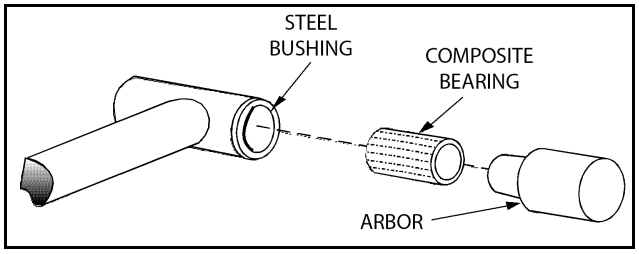


Figure 5-7. Composite Bearing Installation

14. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. Inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. Inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

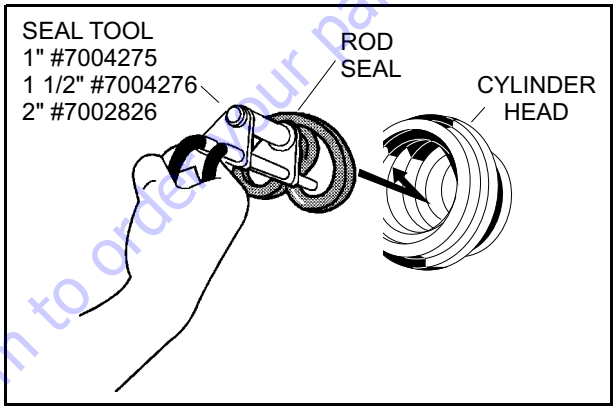


Figure 5-8. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

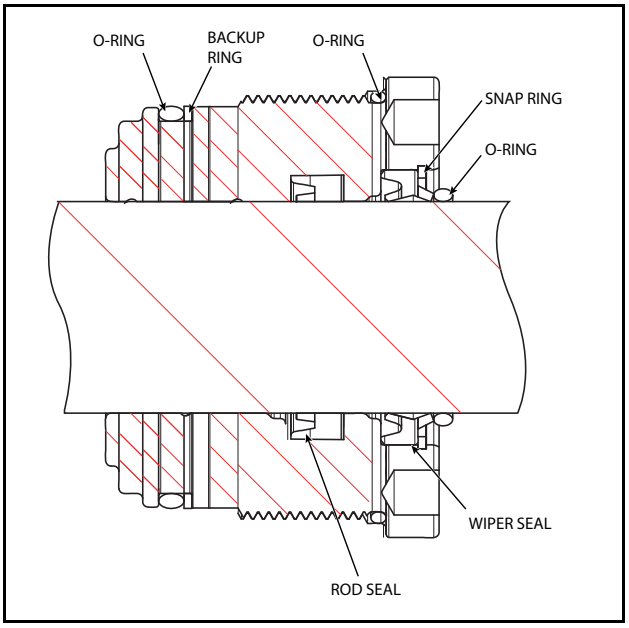
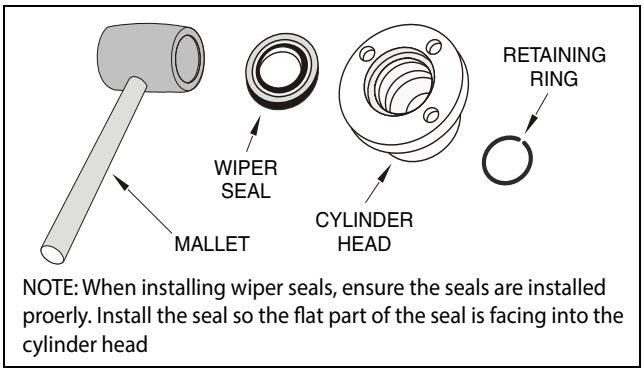


Figure 5-9. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install the new retaining ring into the applicable cylinder head gland groove.



NOTE: When installing wiper seals, ensure the seals are installed proerly. Install the seal so the flat part of the seal is facing into the cylinder head

Figure 5-10. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside groove of the cylinder head.

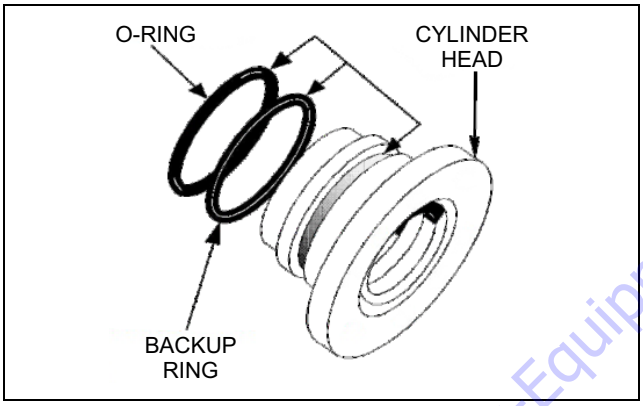


Figure 5-11. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head on the rod, ensuring that the wiper seal, retaining ring and rod seal are not damaged or dislodged. Push the head along the rod to the rod end.
5. Install the spacer tube onto the cylinder rod.
6. Place a new o-ring in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Remove the cylinder rod from the holding fixture.
10. Place new piston 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).

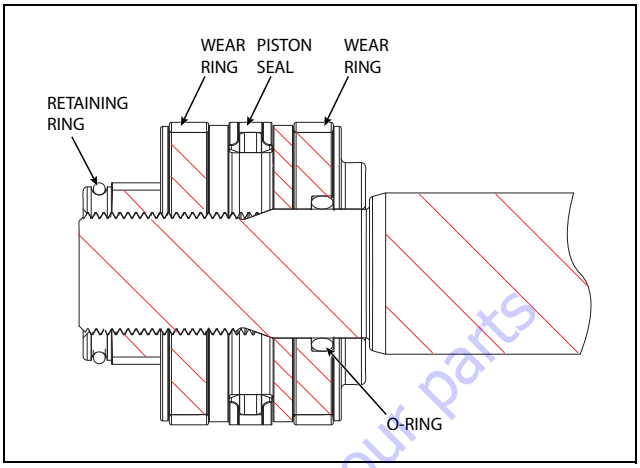


Figure 5-12. Piston Seal Kit Installation

11. 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.

12. 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.
13. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
14. Screw the cylinder head gland into the barrel using a pin-face spanner wrench and torque gland to 443 ft.lbs. (600 Nm).
15. 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.
16. Install the counterbalance valves in the rod port block. Torque to 70 ft.lbs. (52 Nm).
17. Install the new o-rings and plugs into the cylinder port block and torque plug to 11 ft.lbs. (11 Nm).

Jib 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 counterbalance valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

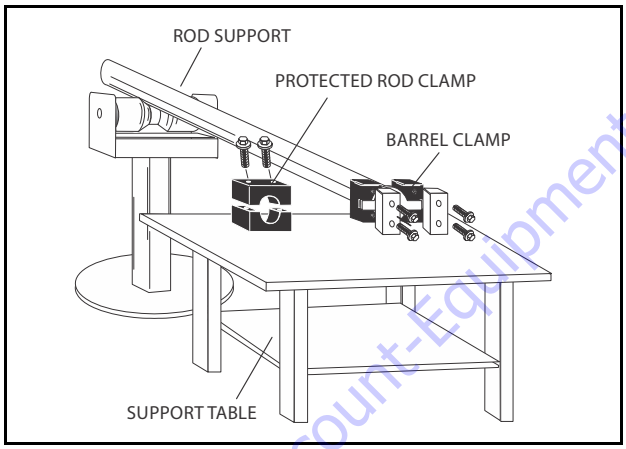


Figure 5-13. Cylinder Barrel Support

5. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

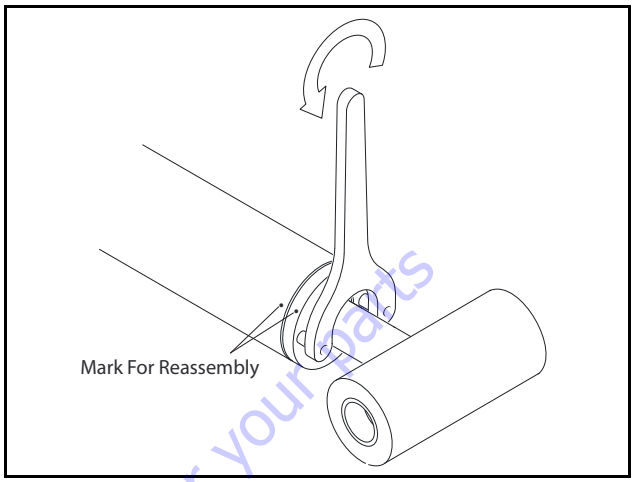


Figure 5-14. Cylinder Head Removal

6. Attach a suitable pulling device to the cylinder rod end.

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. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.

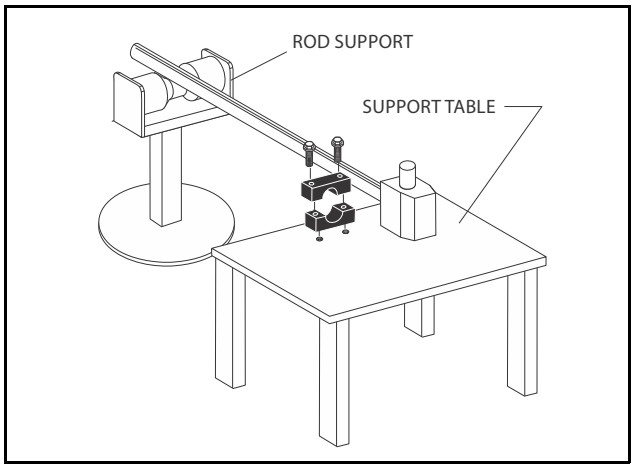
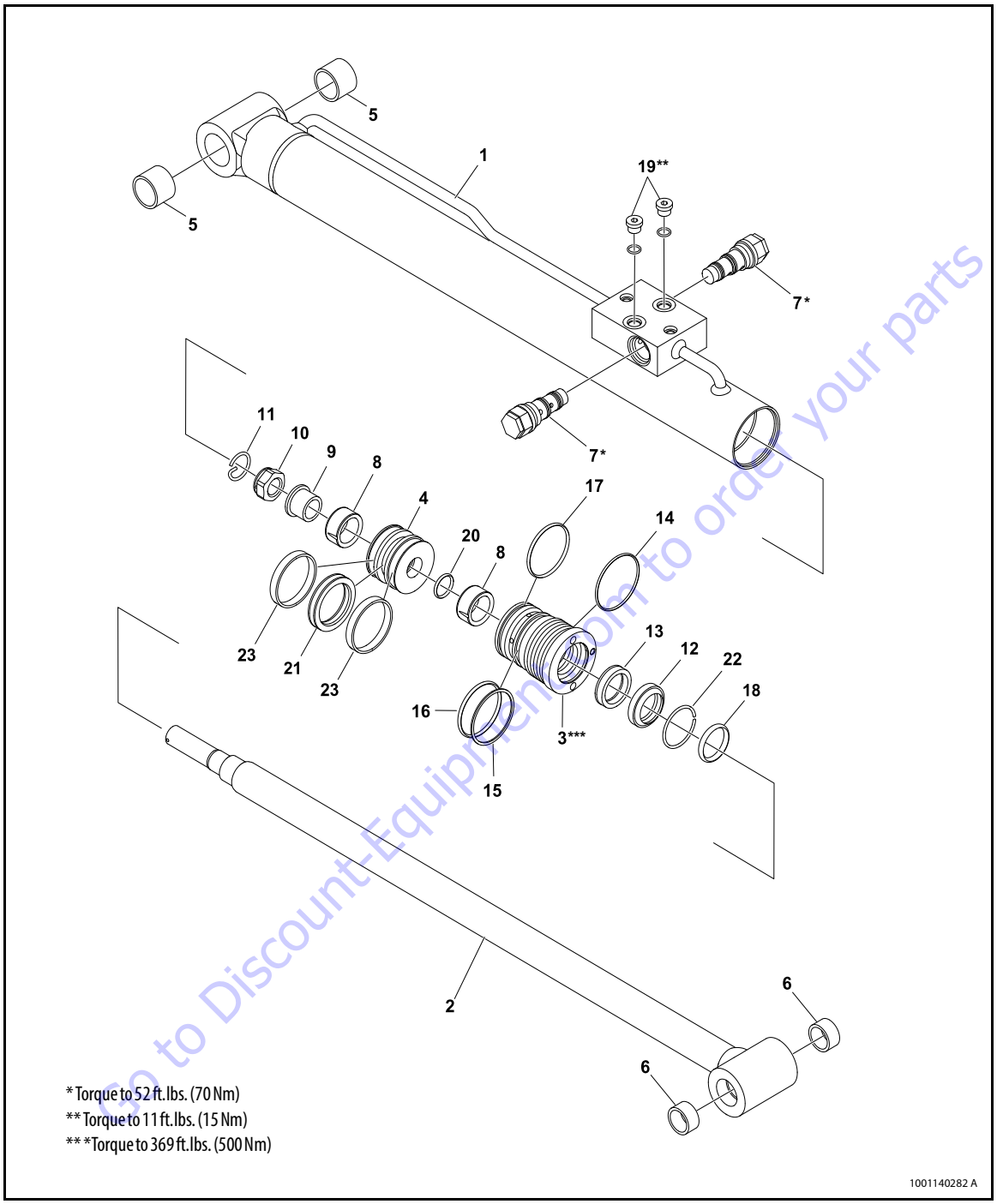


Figure 5-15. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Piston
5. Bushing
6. Bushing
7. Counterbalance Valve
8. Bushing
9. Sleeve
10. Hex Nut
11. Retainer
12. Wiper Seal
13. Rod Seal
14. O-ring
15. Backup Ring
16. O-ring
17. O-ring
18. O-ring
19. Plug
20. O-ring
21. Piston Seal
22. Retaining Ring
23. Wear Ring

Figure 5-16. Jib 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. Remove the retainer from the cylinder rod.
10. Loosen and remove the lock nut which attach the piston to the rod.
11. Remove the bushing and sleeve from the cylinder rod.
12. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.

NOTICE

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

13. Remove and discard the piston seal, wear ring from the outer groove of the piston. Remove and discard the o-ring from the inner groove of the piston.
14. Remove bushings from the cylinder rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland.
16. Remove and discard the o-ring, backup ring from the outer groove of the cylinder head. Remove and discard the retaining rings, rod seals, wiper seals, o-ring from the inner groove of the cylinder head.

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 threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. 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.*

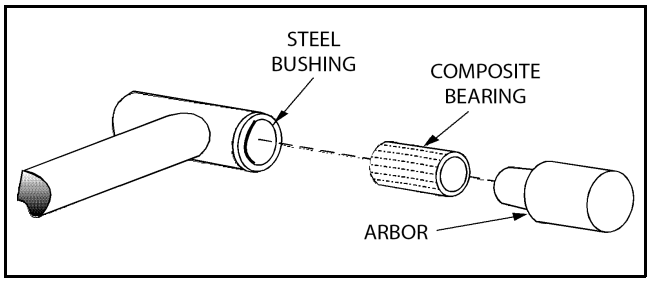


Figure 5-17. Composite Bearing Installation

14. Inspect port block fittings and holding valve. Replace as necessary.
15. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
16. 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.

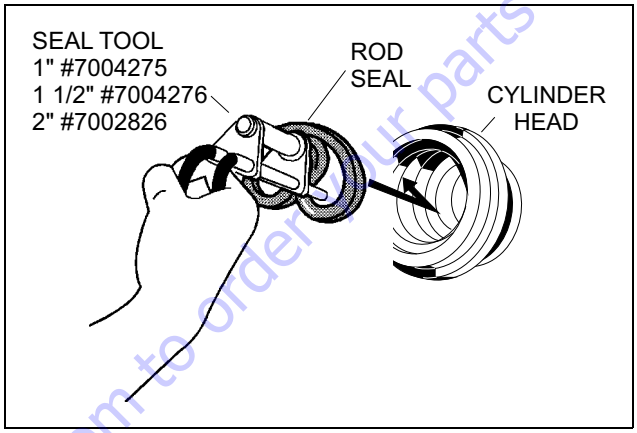


Figure 5-18. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

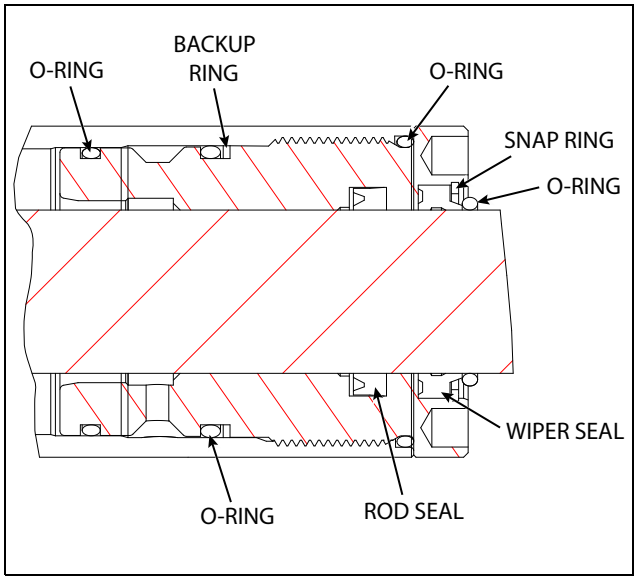
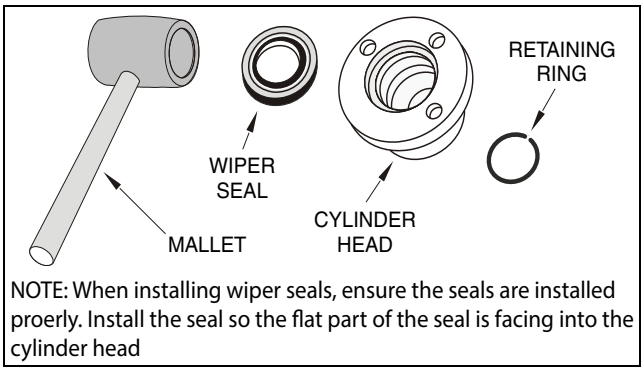


Figure 5-19. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install the new retaining ring into the applicable cylinder head gland groove.



NOTE: When installing wiper seals, ensure the seals are installed proerly. Install the seal so the flat part of the seal is facing into the cylinder head

Figure 5-20. Wiper Seal Installation

3. Place a new o-rings and backup seal in the applicable outside diameter groove of the cylinder head.

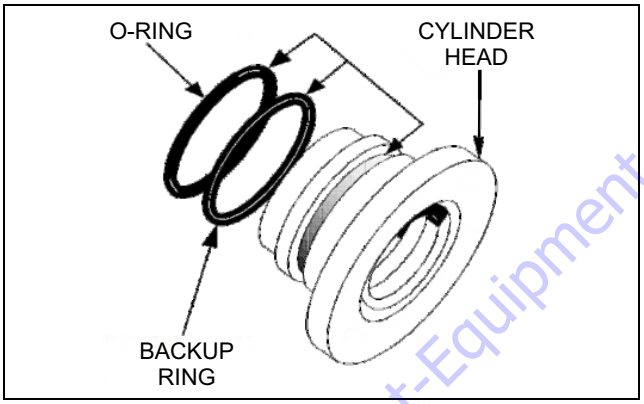


Figure 5-21. Installation of Head Seal Kit

4. Install o-ring onto the cylinder 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.
5. Push the bushing onto the cylinder rod.
6. Place a new o-ring in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer.
10. Remove the cylinder rod from the holding fixture.
11. Place new piston 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).

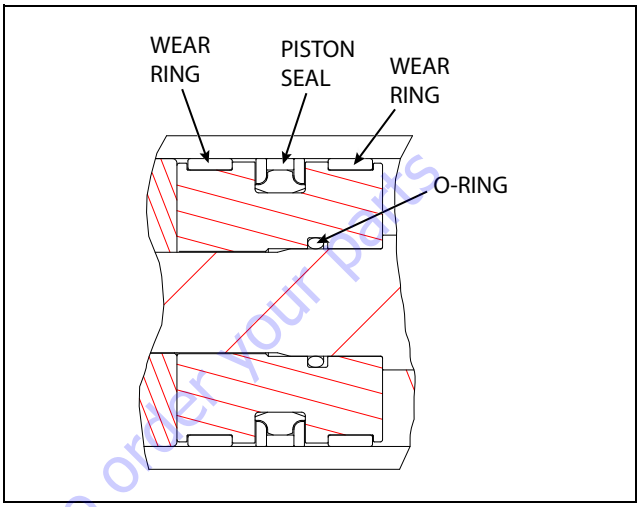


Figure 5-22. Piston Seal Kit Installation

12. Install the bushing and sleeve onto the cylinder rod.
13. Tighten the nut onto the cylinder rod and Install the retainer.
14. 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.

15. 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.
16. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
17. Screw the cylinder head gland into the barrel using a pin-face spanner wrench and torque gland to 369 ft.lbs. (500 Nm).
18. 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.
19. Install the counterbalance valves in the cylinder port block and torque to 52 ft.lbs. (70 Nm).
20. Install the o-ring and plugs in the cylinder port block and torque to 7 ft.lbs. (10 Nm).

Main 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.
3. Remove the cartridge-type counterbalance valves and plugs from the cylinder port block and discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

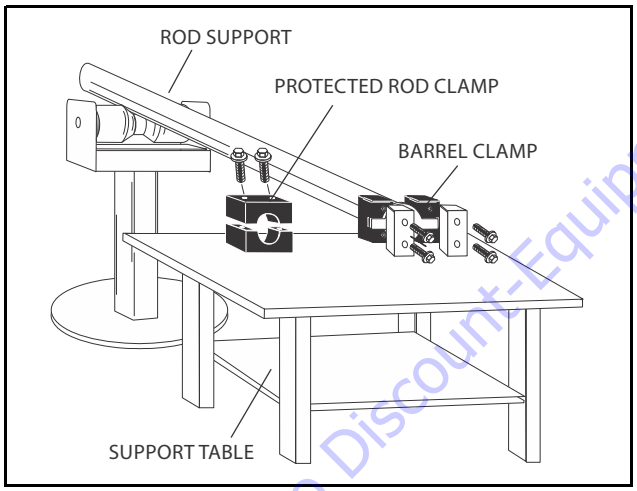


Figure 5-23. Cylinder Barrel Support

5. Unscrew cylinder head with hook spanner wrench.

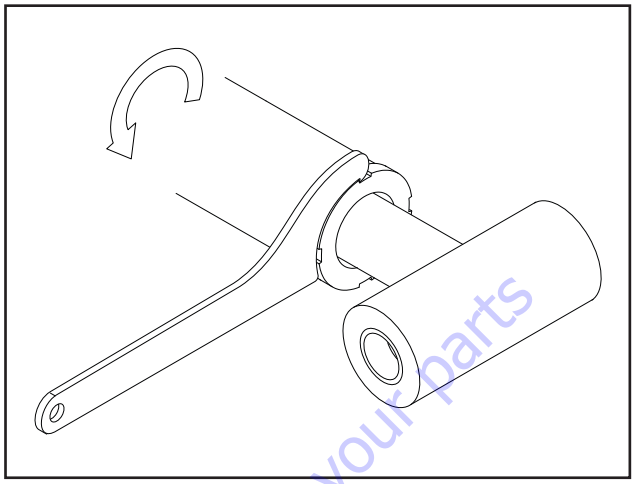


Figure 5-24. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod end.

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, carefully withdraw the complete rod assembly from the cylinder barrel.

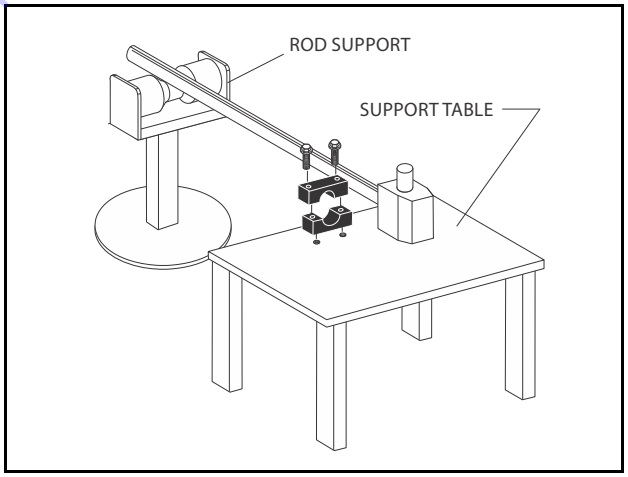
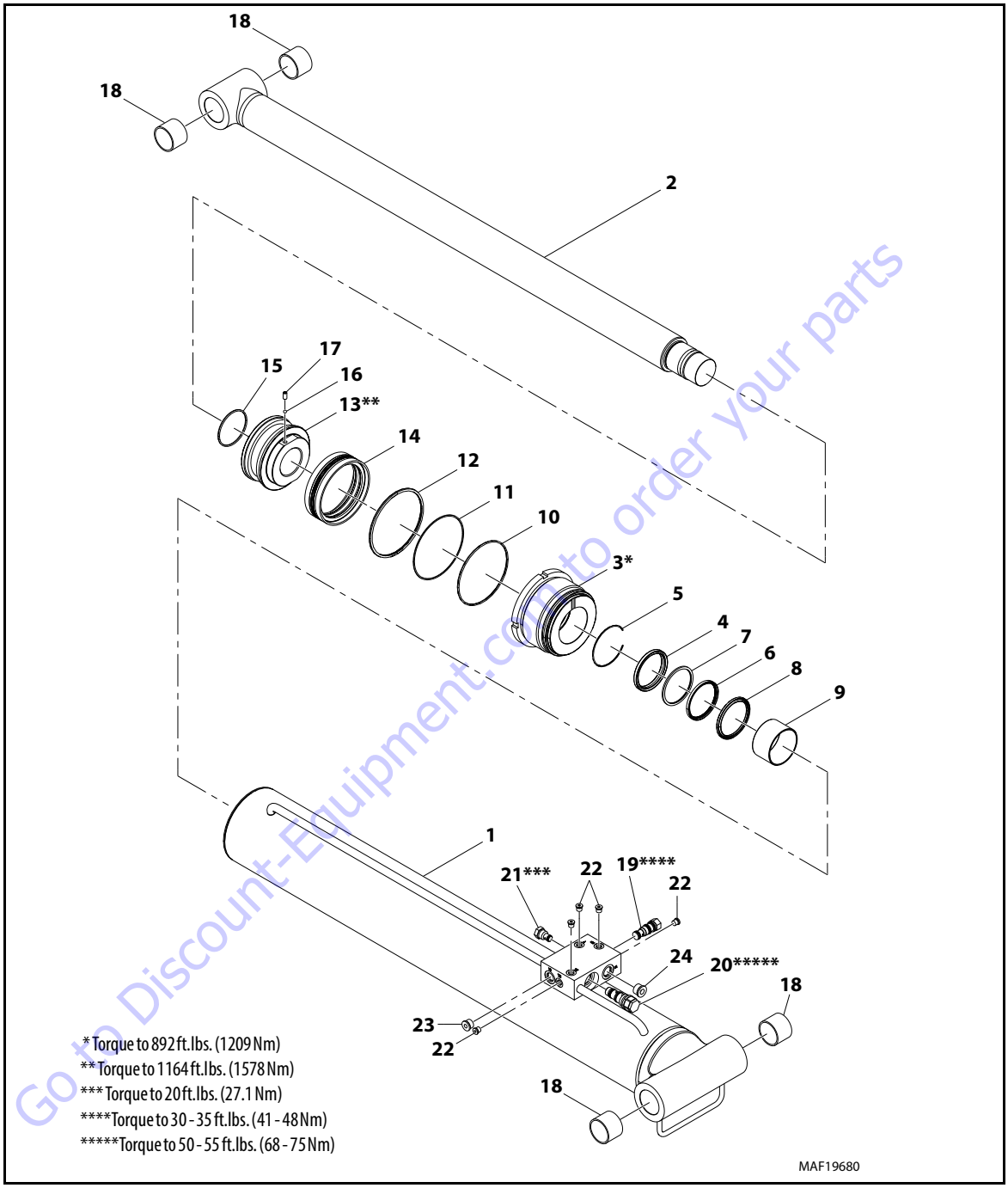


Figure 5-25. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Dust Wiper
5. Retainer
6. Rod Seal
7. Backup Ring
8. Buffer Ring
9. Bearing
10. O-ring
11. Backup Ring
12. O-ring
13. Piston
14. Piston Seal
15. O-ring
16. Steel Ball
17. Settscrew
18. Bearing
19. Check valve
20. Counterbalance Valve
21. Check valve
22. Plug
23. Plug
24. Plug

Figure 5-26. Main 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. Loosen and remove the setscrew and ball which attaches the piston to the rod.

10. Screw the piston counterclockwise and remove the piston from cylinder rod.

11. Remove and discard the piston seal and o-ring.

12. Remove spacer from the rod.

13. Remove the rod from the holding fixture. Remove the cylinder head. Discard the o-rings, backup rings, rod seal, bearing, retaining ring, and wiper seal.

Cleaning and Inspection

1. Clean parts thoroughly with approved cleaning solvent.

2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.

3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.

4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.

5. Inspect threaded portion of barrel for damage. Dress threads as necessary.

6. Inspect piston surface for damage, scoring, or distortion. Dress piston surface or replace piston as necessary.

7. Inspect threaded portion of piston for damage. Dress threads as necessary.

8. Inspect seal and O-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.

9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality and tapering. Replace as necessary.

10. Inspect threaded portion of head for damage. Dress threads as necessary.

11. Inspect seal and O-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.

12. Inspect cylinder head outside diameter for scoring, damage, ovality, and tapering. Replace as necessary.

13. Inspect rod and barrel bearings for signs of 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 with WD40 before 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.*

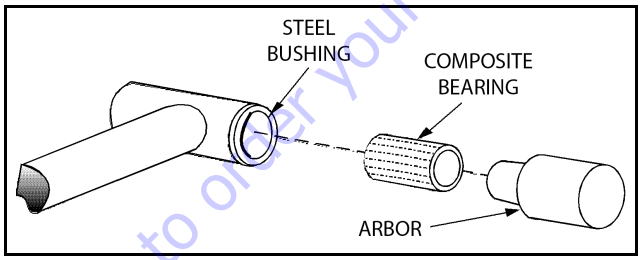


Figure 5-27. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.

15. Inspect oil ports for blockage or presence of dirt or other foreign material. Repair as necessary.

16. Inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

NOTICE

IMPROPER SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION.

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

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

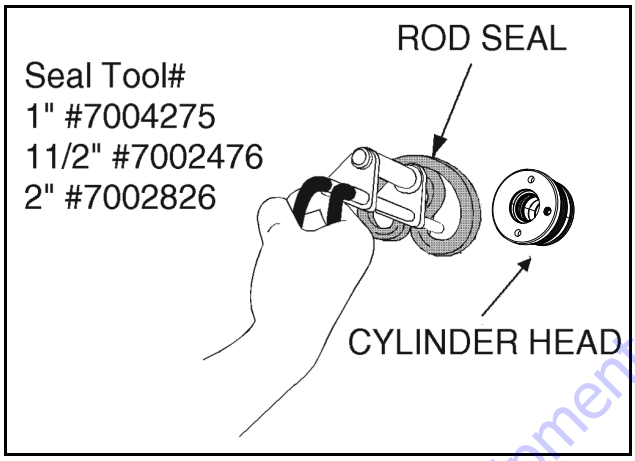


Figure 5-28. Road Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

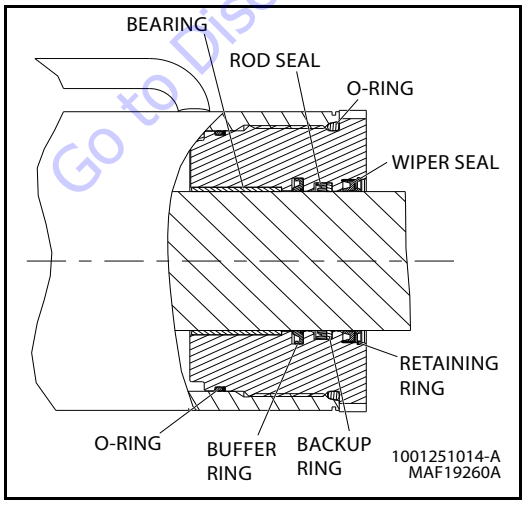


Figure 5-29. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head groove. Install a new bearing into the applicable inside diameter of the cylinder head groove.

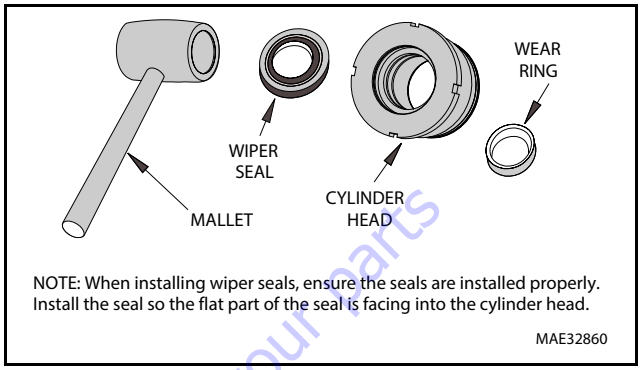


Figure 5-30. Wiper Seal Installation

3. Place new o-rings and backup ring in the applicable outside diameter groove of the cylinder head.

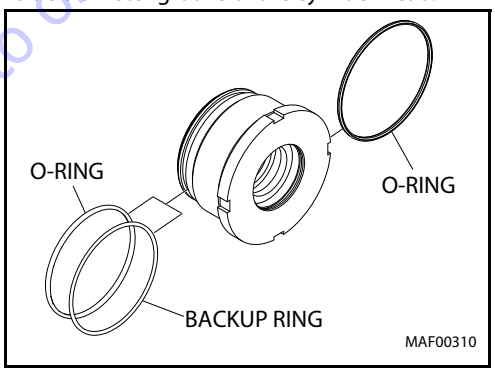


Figure 5-31. Installation of Head Seal Kit

4. Carefully install the cylinder head on the rod, ensuring that the wiper seal, bearing, retaining ring, backup ring 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. Install spacer onto the rod.

7. Place new o-ring in the applicable inside diameter of the piston.

8. Carefully thread the piston on the cylinder rod, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Install the setscrew and ball on the piston and attach the piston on the rod.

10. Remove the cylinder rod from the holding fixture.

11. Place new piston seal 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).

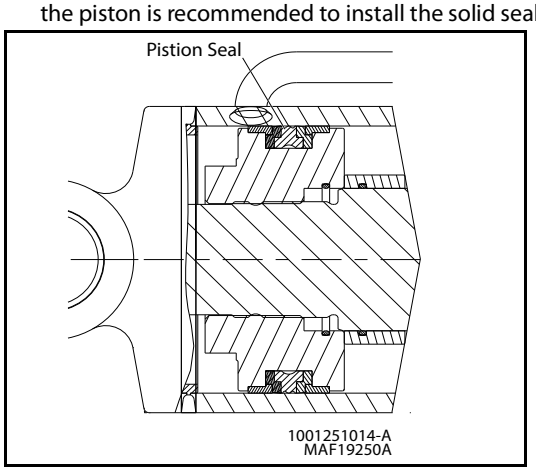


Figure 5-32. Piston Seal Installation

12. 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.

13. With barrel clamped secured and adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and piston seal is not damaged or dislodged.

14. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.

15. Screw the cylinder head into the barrel using a hook spanner wrench and torque cylinder head to 892 ft. lbs. (1209 Nm).

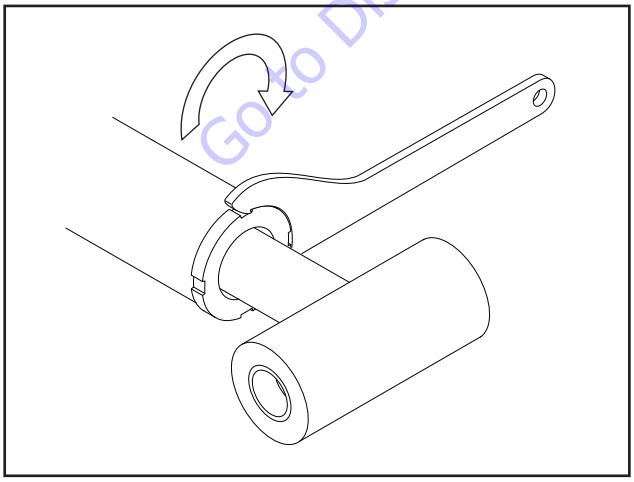


Figure 5-33. Cylinder Head Installation

16. Stake the machined area of the cylinder barrel end so that it locks the cylinder head in place and it does not unscrew from the barrel.

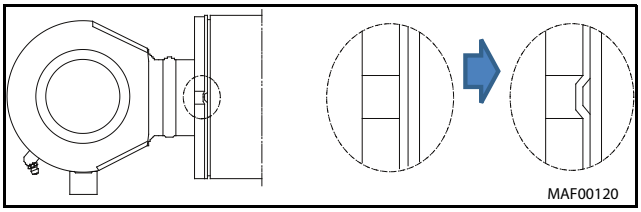


Figure 5-34. Staking

17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any plugs.

18. Install the plugs in the cylinder ports.

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. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

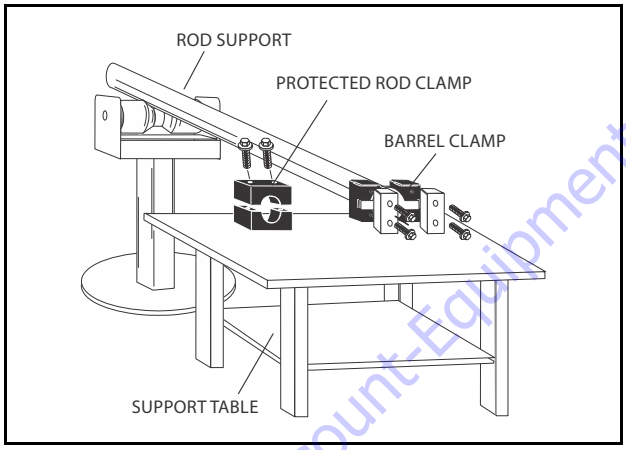


Figure 5-35. Cylinder Barrel Support

4. Using a hook spanner wrench, loosen the setscrew and remove setscrew from the cylinder barrel.

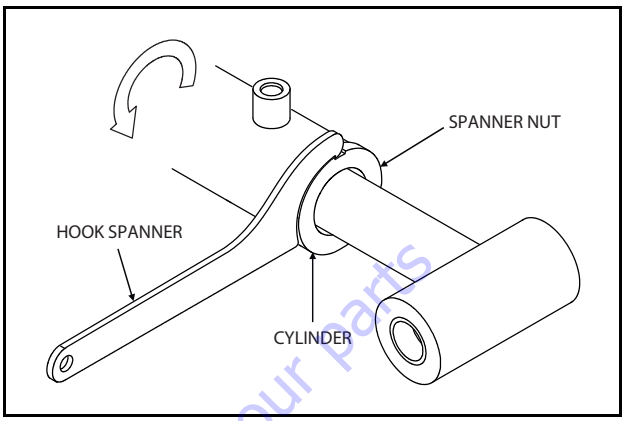


Figure 5-36. Cylinder Head Removal

5. Attach a suitable pulling device to the cylinder rod end.

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, carefully withdraw the complete rod assembly from the cylinder barrel.

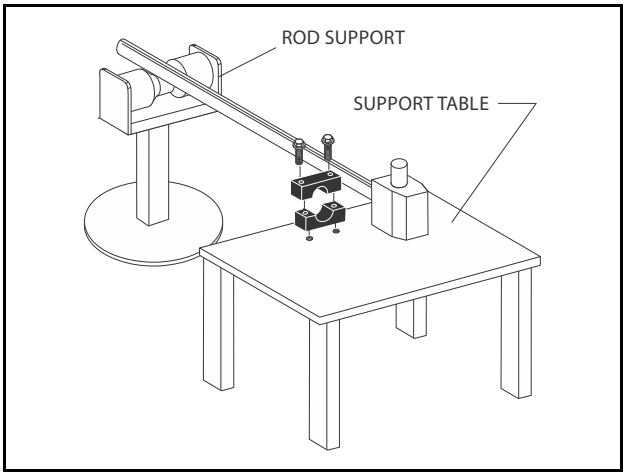
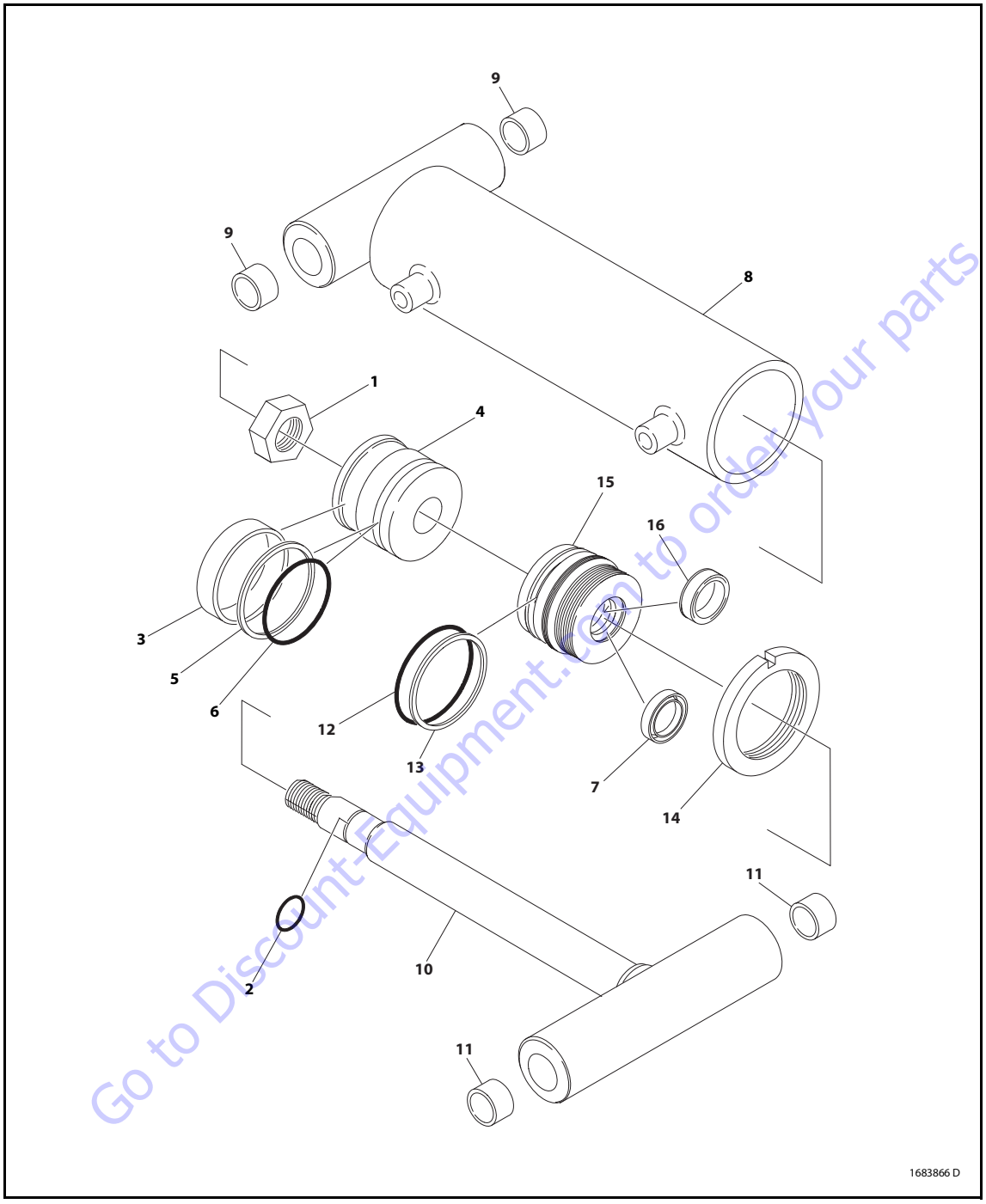


Figure 5-37. Cylinder Rod Support



1. Lock Nut
2. O-ring
3. Wear Ring
4. Piston
5. Piston Seal
6. O-ring
7. Wiper Seal
8. Barrel
9. Bushing
10. Rod
11. Bushing
12. O-ring
13. Backup Ring
14. Spanner Nut
15. Guide
16. Seal

Figure 5-38. 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. Loose and remove the nut from the cylinder rod.
9. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.

NOTICE

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

10. Remove and discard the piston seal, wear ring and o-ring from the outside groove of the piston.
11. Remove o-ring from the groove of the cylinder rod end.
12. Remove the rod from the holding fixture. Remove the cylinder head.
13. Remove and discard the o-ring and backup ring from the outer groove of the cylinder head. Remove and discard rod seal, wiper seal from the inner groove of the cylinder head.
14. Remove the spanner nut from the cylinder rod.

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 threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. 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.*

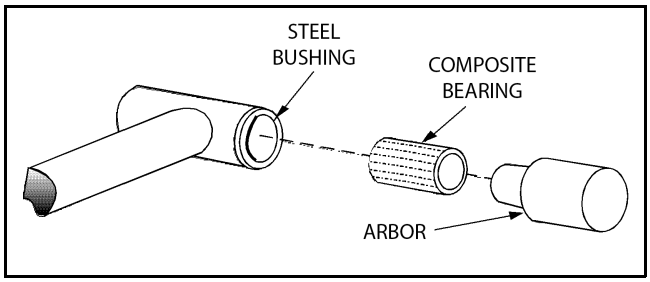


Figure 5-39. Composite Bearing Installation

14. Inspect port block fittings and holding valve. Replace as necessary.
15. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
16. 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.

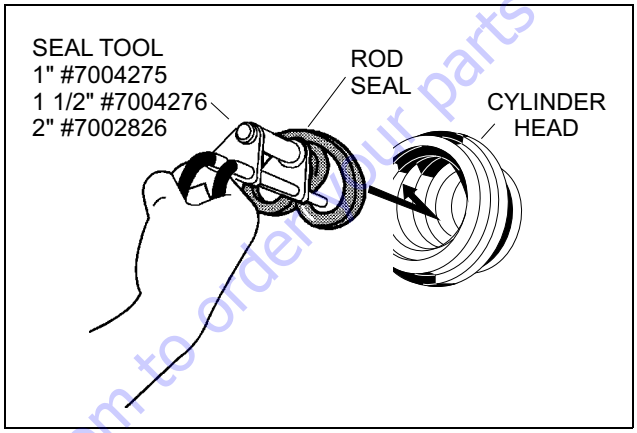


Figure 5-40. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

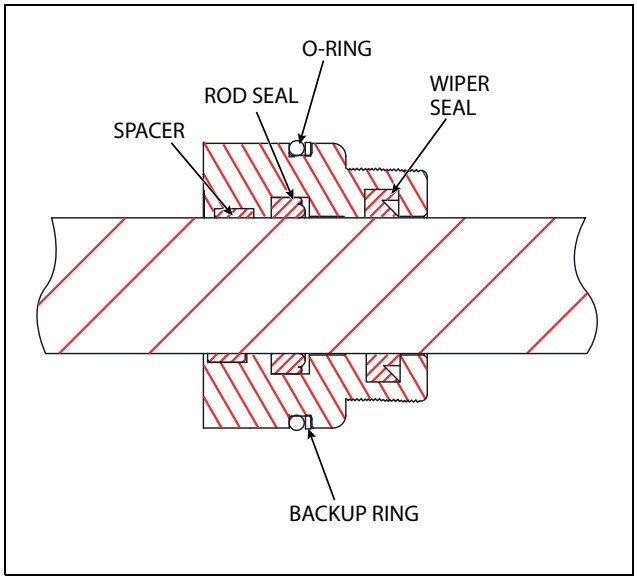


Figure 5-41. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove.

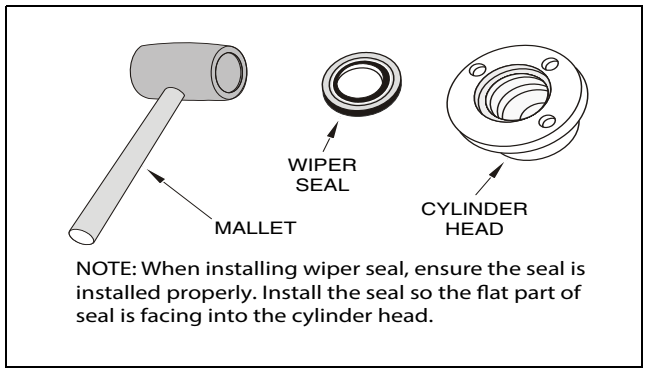


Figure 5-42. Wiper Seal Installation

3. Place a new o-rings and backup ring in the applicable outside diameter groove of the cylinder head.

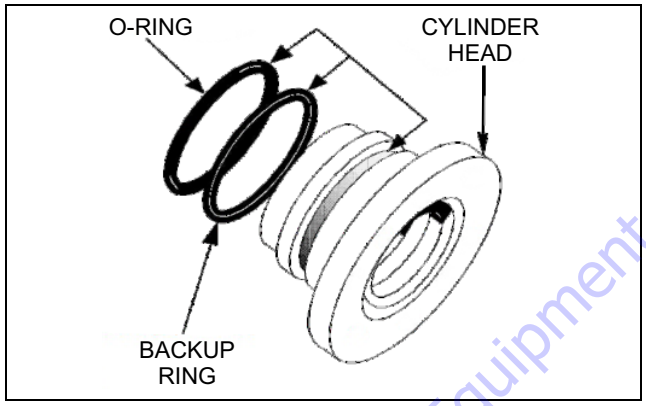


Figure 5-43. Installation of Head Seal Kit

4. Install the spanner nut onto the cylinder rod.
5. Carefully install the head on the rod, ensuring that the wiper seal and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
6. Install o-ring in the groove of the cylinder rod.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight.
9. Install and tighten the lock nut onto the cylinder rod.
10. Remove the cylinder rod from the holding fixture.
11. Place new piston seal, wear rings and o-ring in the outer and inner piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

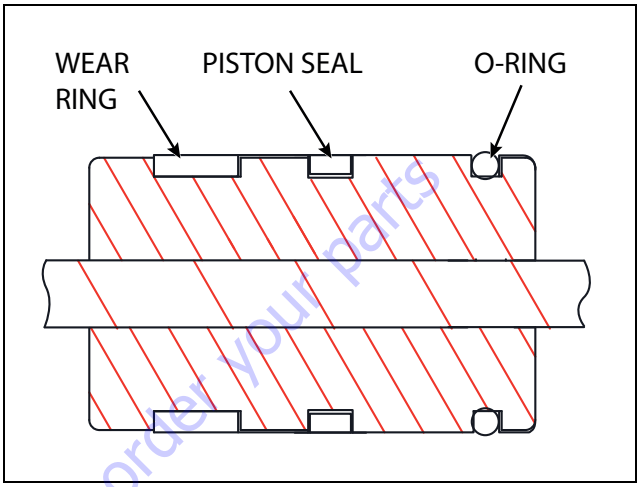


Figure 5-44. Piston Seal Kit Installation

12. 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.

13. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston wear ring and seal.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

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. Remove plugs from cylinder port.
4. Place the cylinder barrel into a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

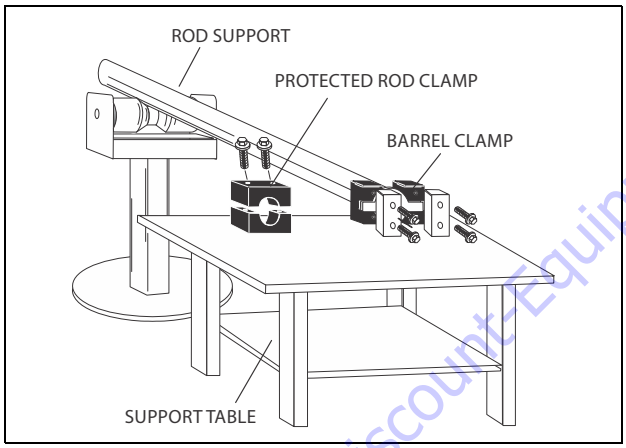


Figure 5-45. Cylinder Barrel Support

5. Using a pin-face spanner wrench, unscrew the cylinder head from both ends of the barrel.

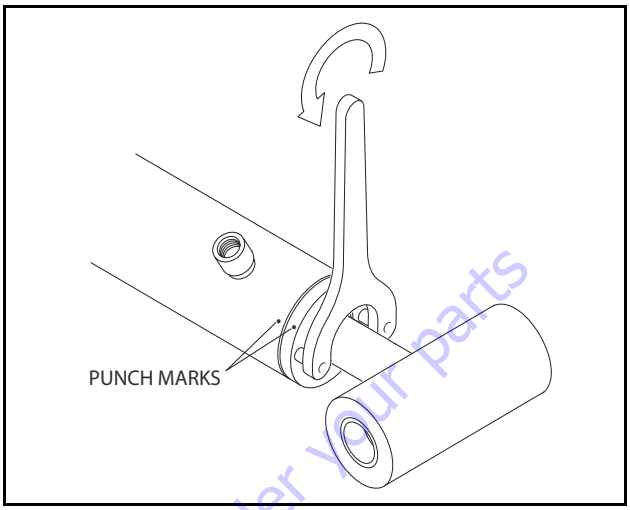


Figure 5-46. Cylinder Head Removal

6. Attach a suitable pulling device to the cylinder rod end.

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, carefully withdraw the complete rod assembly from the cylinder barrel.

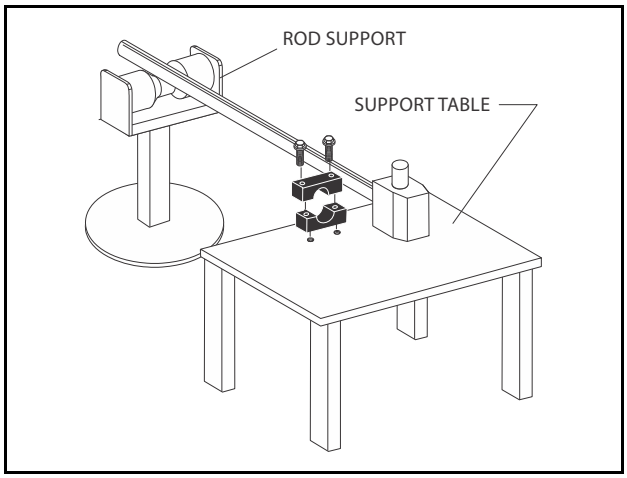


Figure 5-47. Cylinder Rod Support