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An Oshkosh Corporation Company

Service and Maintenance Manual

Models

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31215022

December 19, 2019 - Rev A

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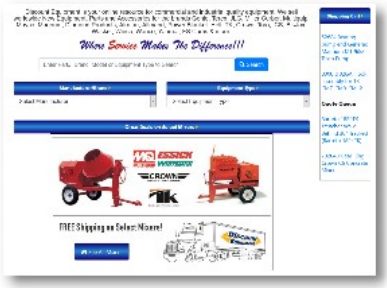

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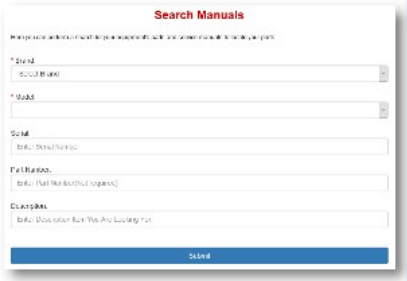

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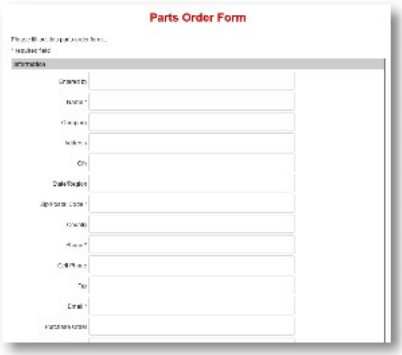

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

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

Original Issue	December 19, 2019 - Rev A

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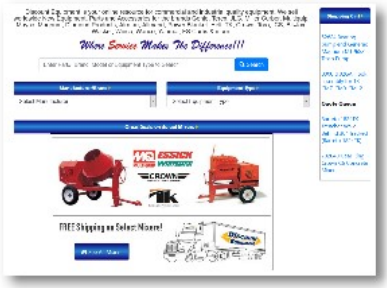

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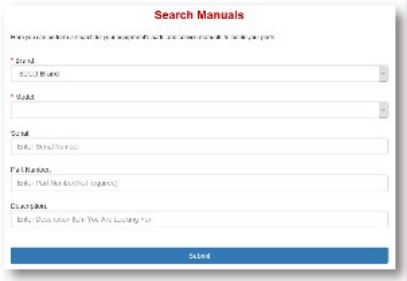

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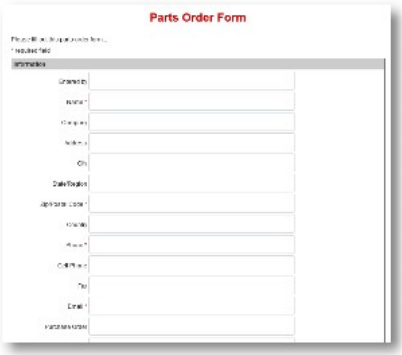

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Capacity Unrestricted	550 lb (249.5 kg)
Maximum Operating Slope	5°
Maximum Travel Grade, stowed Position (Gradeability)	45%
Maximum Travel Grade, stowed Position (Side Slope)	5°
Drive Speed - Stowed	4.25 mph (6.8 km/h)
Gross Machine Weight - Approximate	13,250 lb (6010 kg)
Maximum Ground Bearing Pressure	65 psi (4.6 kg/cm^2)
Maximum Wind Speed	28 mph (12.5 m/s)
Max. Tire Load	7200 lb (3266 kg)
System Voltage	12V DC
Maximum Main Relief Hyd. Pressure	4060 psi (280 Bar)
Average Fuel Consumption	0.85 gph (3.2 lph)

1.2 DIMENSIONAL DATA

Turning Radius (Inside)	6 ft. 9in. (2.06 m)
Turning Radius (Outside)	15 ft. 8in. (4.78 m)
Machine Height (stowed)	89.3 in. (2269 mm)
Machine Length (stowed)	258.9 in. (6576 mm)
Up and Over Platform Height	24 ft. (7.3 m)
Horizontal Reach	25 ft. (7.62 m)
Machine Width	92.6 in. (2353 mm)
Wheel Base	93 in. (2362 mm)
Platform Height	45 ft.9 in (13.72 m)
Ground Clearance	16.4 in. (417 mm)

1.3 CAPACITIES

Hydraulic System	38 gal. (143.8 L)
Hydraulic Oil Tank (to Full Level)	31.7 gal. (119.9 L)
Drive Hub	24 oz. (0.7 L)
Drive Brake	27 oz. (0.8 L)
Engine Coolant Deutz 2.9L Kubota	 2.9 gal. (11.3L) 2.25 gal. (8.5 L)

1.4 TIRES

Size	Type	Pressure	Weight
33/1550x16.5	Foam-Filled	N/A	395 lb (179 kg)
12 x 16.5	Foam-Filled	N/A	328 lb (149 kg)
315/55 D20	Foam-Filled	N/A	286 lb (130 kg)
	Solid	N/A	286 lb (130 kg)
33x12-20	Solid	N/A	285 lb (129 kg)

1.5 ENGINE DATA

Table 1-1. Deutz D2011L03

Fuel	Diesel
No. of Cylinders	3
Bore	3.7 in. (94 mm)
Stroke	4.4 in. (112 mm)
Displacement	142 cu. in. (2331 cm^3)
Oil Capacity crankcase cooler total capacity	 6.3 qts. (6 L) 3.7 qts. (3.5 L) 10 qts. (9.5 L)
Low RPM	1200
Mid RPM Tower Lift, Upper Lift, Tele Swing, Basket Level, Basket Rotate, Jib Lift	 1800 1500
High RPM	2800

Table 1-2. Deutz D2.9L4

Type	Diesel
Number of Cylinders	4
Bore	3.6 in. (92 mm)
Stroke	4.3 in. (110 mm)
Total Displacement	178 cu. in. (2925 cm^3)
Firing Order	1-3-4-2
Output	49 hp (36.5 kW)
Oil Capacity	2.4 gal. (8.9 L)
Coolant Capacity (System)	3.2 gal. (12.1 L)
Average Fuel Consumption	1.2 gph (4.1 Lph)
Min. Low Engine RPM	1200
Mid Engine RPM	1800
Max. High Engine RPM	2500

Table 1-3. Kubota WG 2503

Fuel	Gasoline or Gasoline/LP Gas
BHP Gasoline LP	 45.5 kW @ 2700 rpm 46 Kw @ 2700 rpm
Bore	3.46 in. (88 mm)
Stroke	4.03 in. (102.4 mm)
Displacement	153 cu. in (2.5L)
Oil Capacity w/filter	2.5 gal. (9.5L)
Max. High RPM	2700
Coolant Capacity (Engine only)	1.4 gal. (5.4 L)
Fuel Consumption - Gasoline In Drive @Idle	 2.35 gal/hr (8.92 L/hr) 0.48 gal/hr (1.83 L/hr)
Fuel Consumption - LP In Drive @Idle	 2.56 gal/hr (9.72 L/hr)/(5.64 Kg/hr) 0.62 gal/hr (2.36 L/hr)/(1.37 kg/hr)

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, 10W-30
+50° to + 210° F (+10° to +99° C)	20W-20

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

NOTE: *Machines may be equipped with Standard UTTO biodegradable and non-toxic hydraulic oil. This is a fully synthetic hydraulic oil that possesses the same anti-wear and rust protection characteristics as mineral oils, but will not adversely affect the ground water or the environment when spilled or leaked in small amounts.*

NOTE: *Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. If use of hydraulic oil other than Standard UTTO is desired refer contact JLG Industries for proper recommendations..*

Table 1-4. Mobilfluid 424 Specs

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

Table 1-5. 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	4.1cSt
at 100° F	15.8 cSt
at 212° F	4.1 cSt
Viscosity Index	168

Table 1-6. Quintolubric 888-46

Density	0.91 @ 15°C (59°F)
Pour Point	<-20°C (<-4°F)
Flash Point	275°C (527°F)
Fire Point	325°C (617°F)
Auto ignition Temperature	450°C (842°F)
Viscosity	
at 0° C (32°F)	360 cSt
at 20° C (68°F)	102 cSt
at 40° C (104°F)	46 cSt
at 100° C (212°F)	10 cSt
Viscosity Index	220

Table 1-7. Mobil EAL 224H Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	32/46
Specific Gravity	0.922
Pour Point, Max	-25°F (-32°C)
Flash Point, Min.	428°F (220°C)
Operating Temp.	0 to 180°F (-17 to 162°C)
Weight	7.64 lb. per gal. (0.9 kg per liter)
Viscosity	
at 40° C	37 cSt
at 100° C	8.4 cSt
Viscosity Index	213
NOTE: *Must be stored above 32°F (14°C)*	

Table 1-8. Exxon Univis HVI 26 Specs

Specific Gravity	32.1
Pour Point	-76°F (-60°C)
Flash Point	217°F (103°C)
Viscosity	
at 40° C	25.8 cSt
at 100° C	9.3 cSt
Viscosity Index	376
NOTE: *Mobil/Exxon recommends that this oil be checked on a yearly basis for viscosity.*	

1.7 MAJOR COMPONENT WEIGHT

⚠ WARNING

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

Components	LB	KG.
Counterweight	1875 ± 75	850.5 ± 34
Tire and Wheel - 20x9 Foam-Filled	220	99.8
Tire and Wheel - 18x7	230	104.3
Platform & Console - 30x60	242.5	110
Platform & Console - 30x48	216	98
Battery	66	30

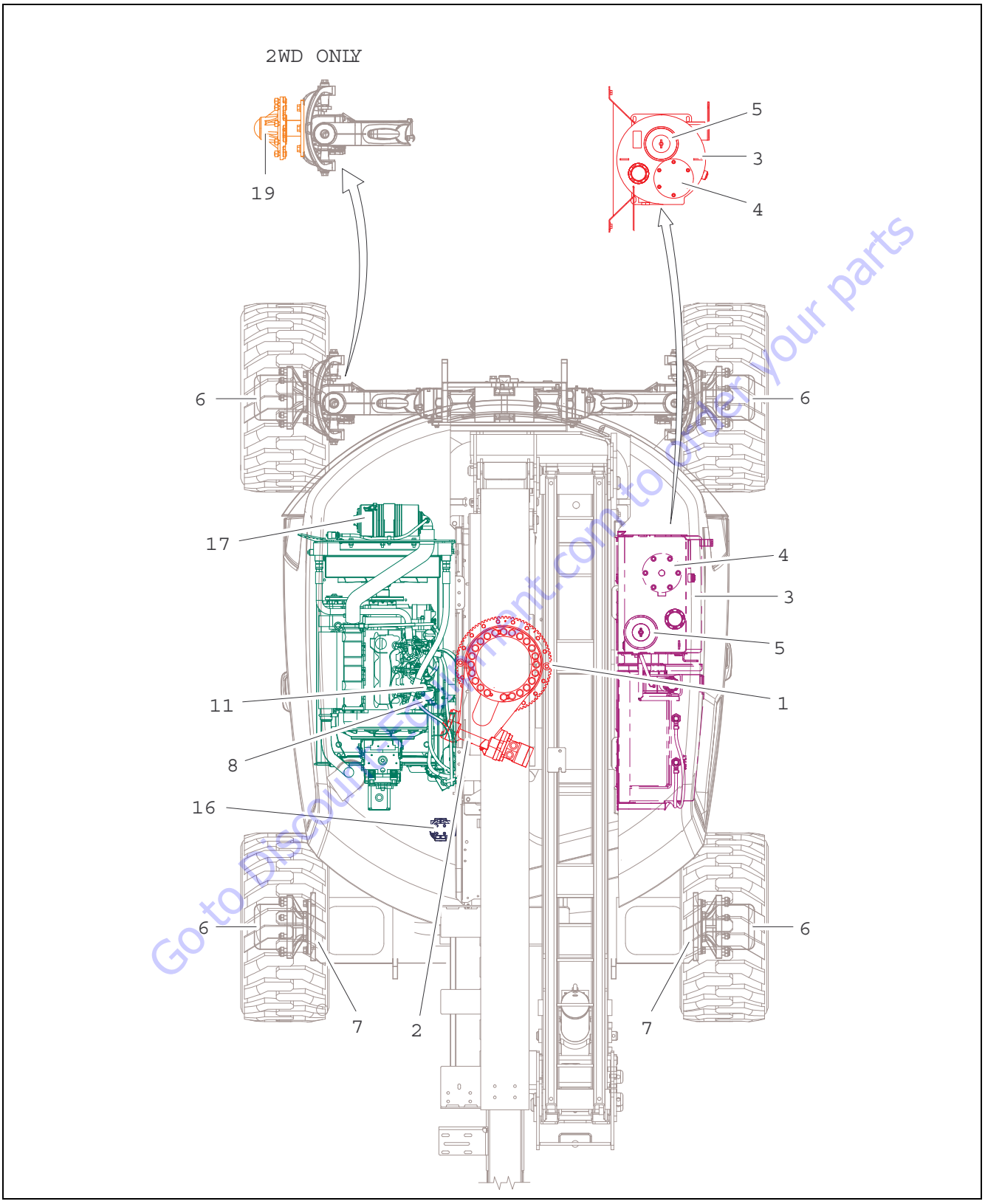


Figure 1-1. Maintenance and Lubrication Diagram - Deutz 2.3L Engine

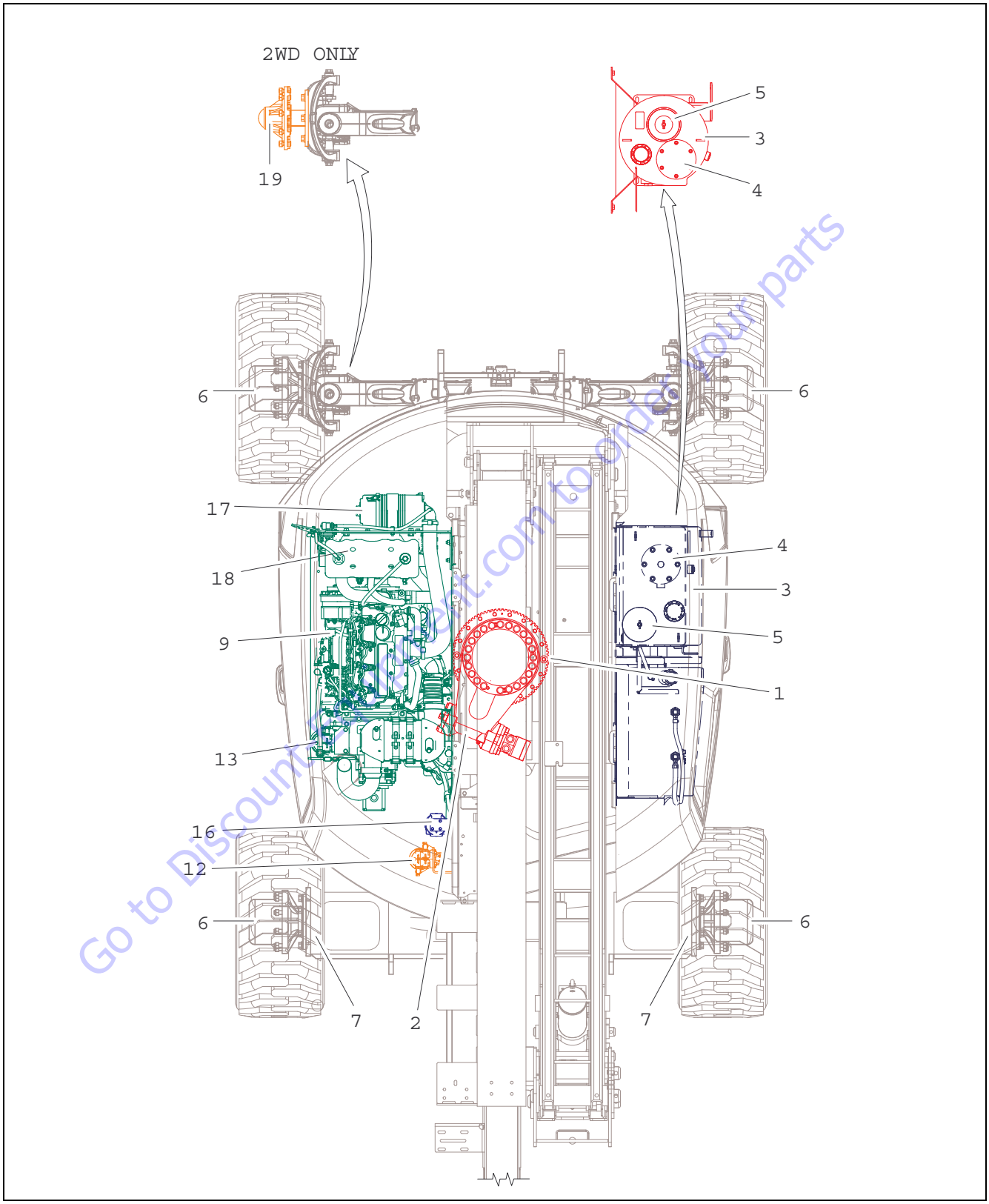


Figure 1-2. Maintenance and Lubrication Diagram - Deutz 2.9L Engine

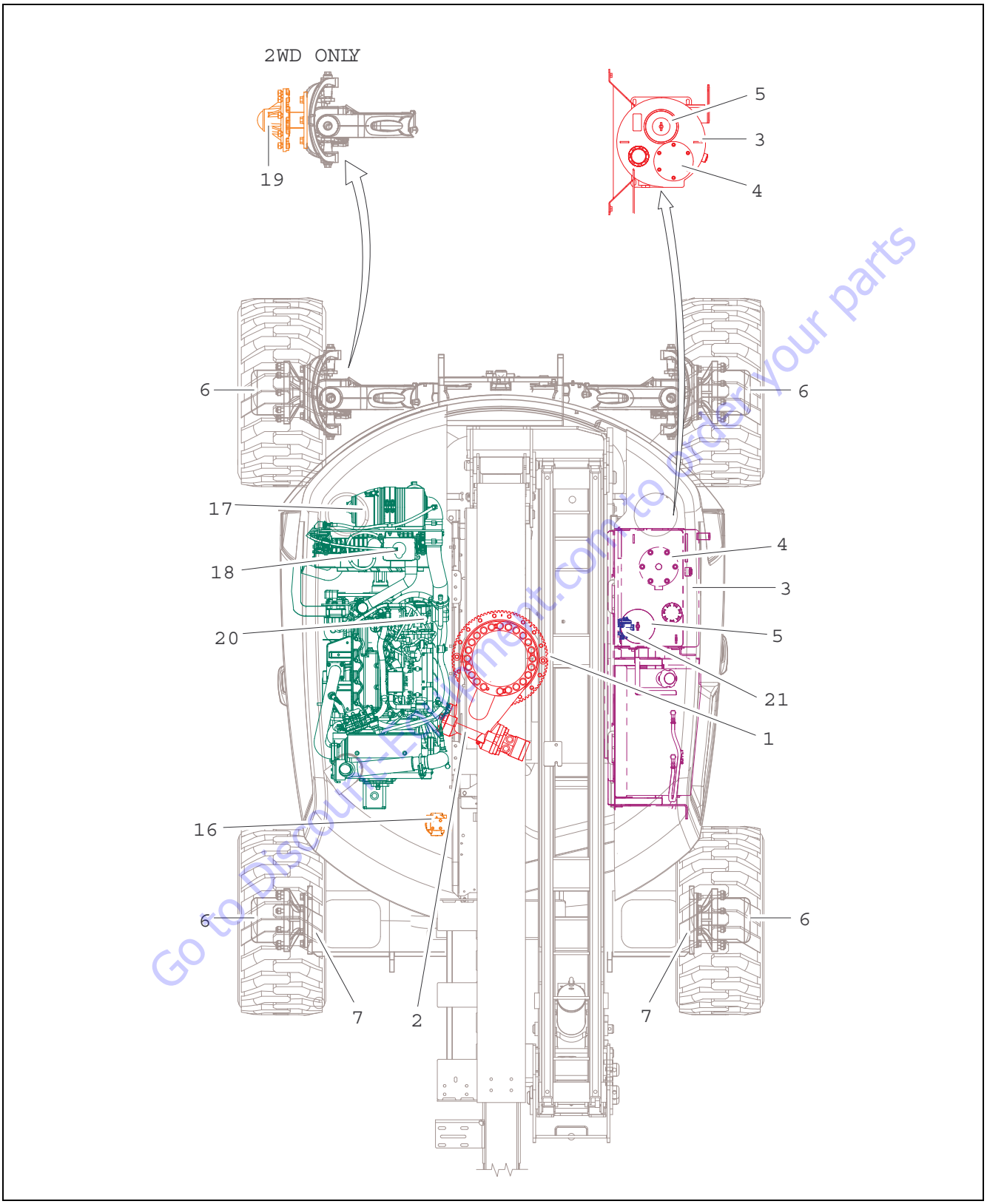


Figure 1-3. Maintenance and Lubrication Diagram - Kubotas Engine

1.8 MAINTENANCE AND LUBRICATION

NOTE: *The following numbers correspond to those in Figure 1-1., Maintenance and Lubrication Diagram - Deutz 2.3L Engine, Figure 1-2., Maintenance and Lubrication Diagram - Deutz 2.9L Engine, and Figure 1-3., Maintenance and Lubrication Diagram - Kubotas Engine.*

Table 1-9. Lubrication Specifications.

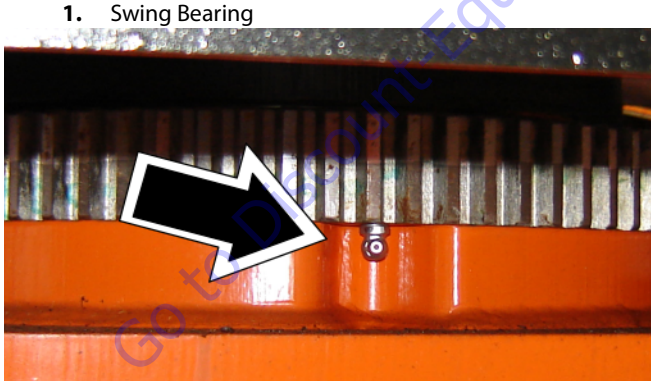
KEY	SPECIFICATIONS
BG*	Bearing Grease (JLG Part No. 3020029) Mobilith SHC 460.
HO	Hydraulic Oil. API service classification GL-4, e.g. Mobilfluid 424
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
MPG	Multipurpose Grease having a minimum dripping point of 350° F (177° C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EO	Engine (crankcase). Gas (5W30) - API SN, -Arctic ACEA AI/BI, A5/B5 - API SM, SL, SJ, EC, CF, CD - ILSAC GF-4. Diesel (15W40, 5W30 Arctic) - API CJ-4.

*MPG may be substituted for these lubricants, if necessary, but service intervals will be reduced.

NOTICE

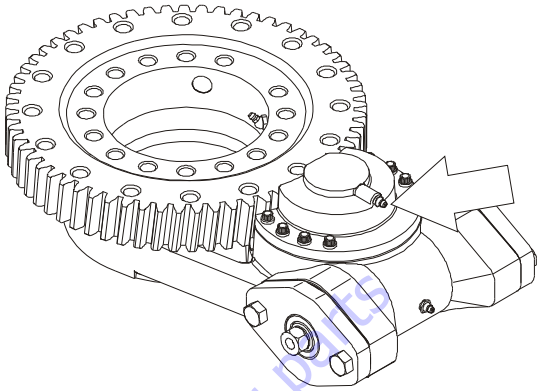
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

1. Swing Bearing

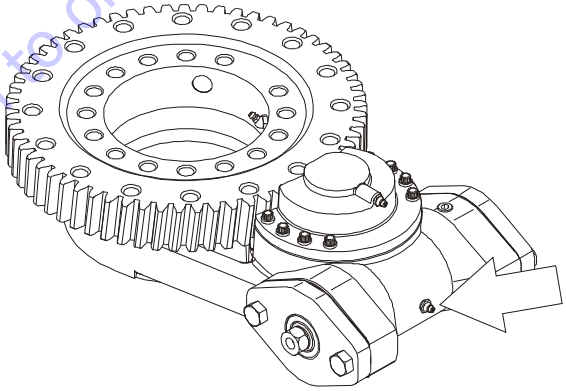


Lube Point(s) - Fitting
Capacity - A/R
Lube - BG
Interval - Every 3 months or 150 hrs of operation
Comments - Apply grease and rotate in 90 degree intervals until bearing is completely lubricated

2. Swing Bearing/Worm Gear Teeth



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

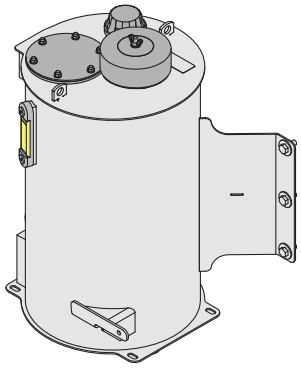


Lube Point(s) - Grease Fitting
Capacity - A/R
Lube - Mobil SHC 007
Interval - A/R

⚠ CAUTION

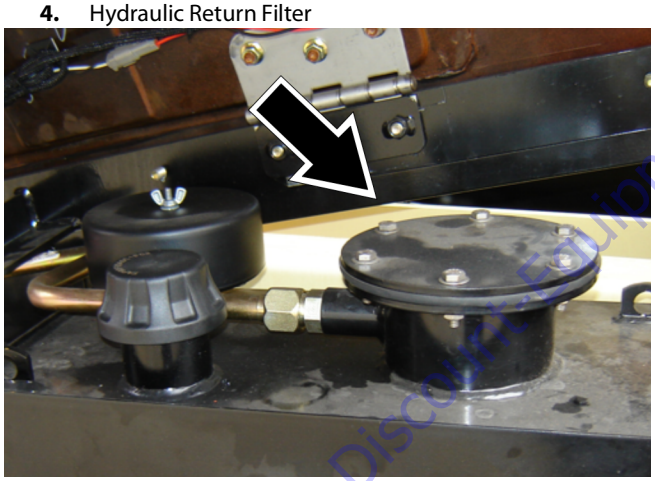
DO NOT OVERGREASE BEARINGS. OVERGREASING BEARINGS WILL RESULT IN DAMAGE TO OUTER SEAL IN HOUSING.

3. Hydraulic Tank



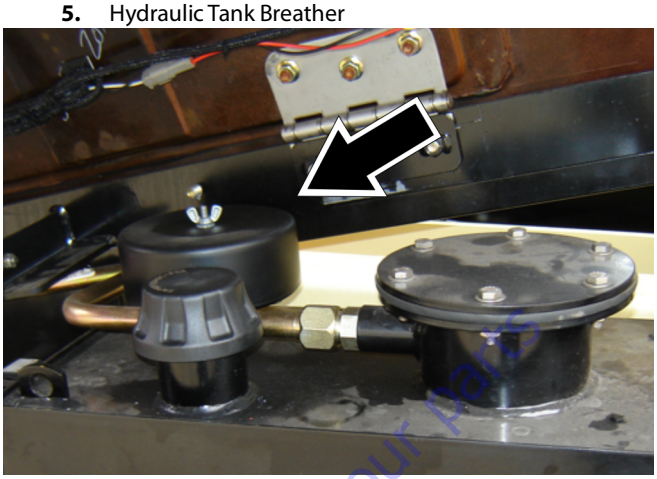
Lube Point(s) - Fill Cap
Total Capacity - 24.8 Gal. (93.9 L) to Full Level
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.
Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate all systems a minimum of two complete cycles and recheck oil level in reservoir.

4. Hydraulic Return Filter



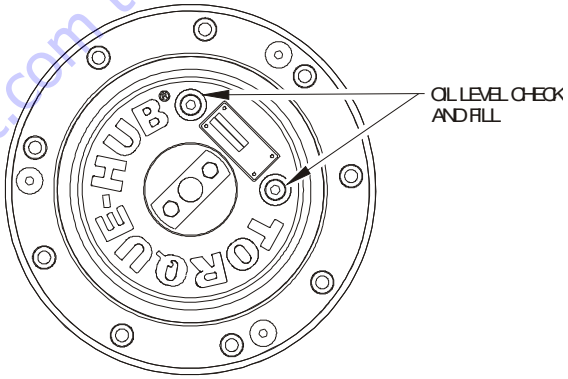
Lube Point(s) - Replaceable Element
Interval - Change after first 50 hours and every 6 months or 300 hours thereafter.

5. Hydraulic Tank Breather



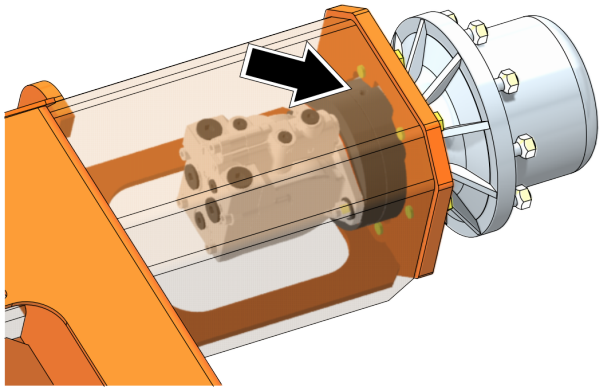
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.
Comments - Remove wing nut and cover to replace. Under certain conditions, it may be necessary to replace on a more frequent basis.

6. Wheel Drive Hub



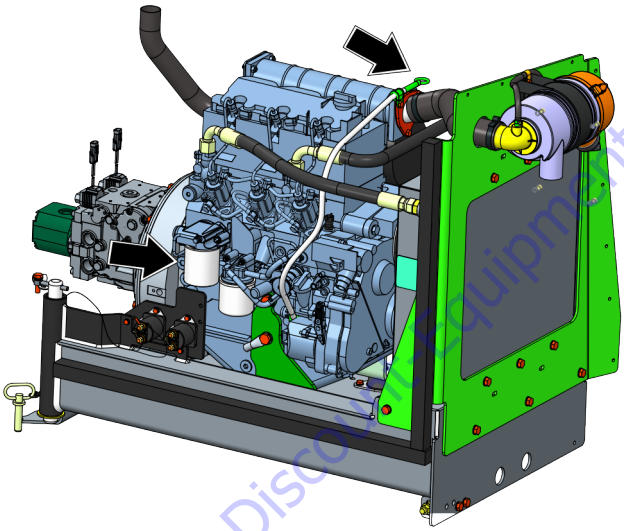
Lube Point(s) - Level/Fill Plug
Capacity - 24 oz. (0.8 L)(1/2 Full)
Lube - EPGL
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

7. Drive Brake



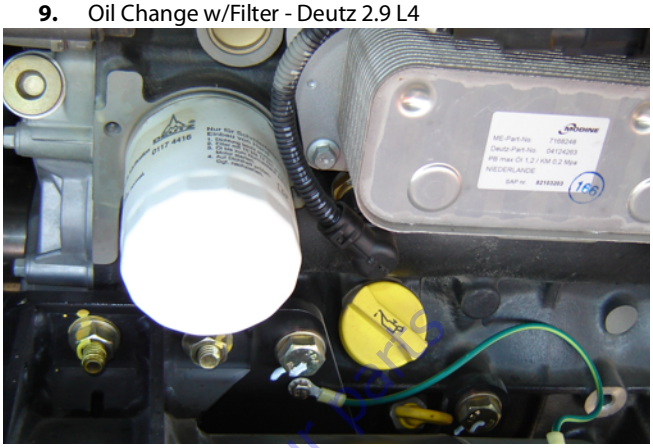
Lube Point(s) - Fill Plug
Capacity - 2.7 oz. (89 mL)
Lube - Premium Hydraulic Fluid
Interval - Change as necessary

8. Oil Change with Filter - Deutz 2.3 L3



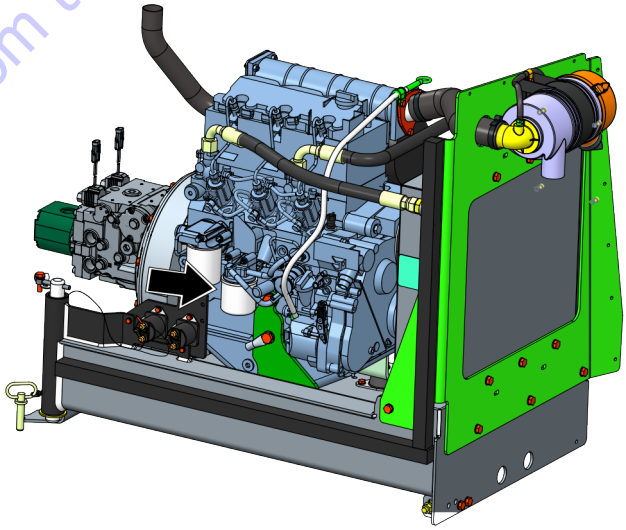
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 10 Quarts (9.5 L) w/Filter
Lube - EO
Interval - Check level daily; change every 500 hours or six months, whichever comes first. Adjust final oil level by mark on dipstick.

9. Oil Change w/Filter - Deutz 2.9 L4



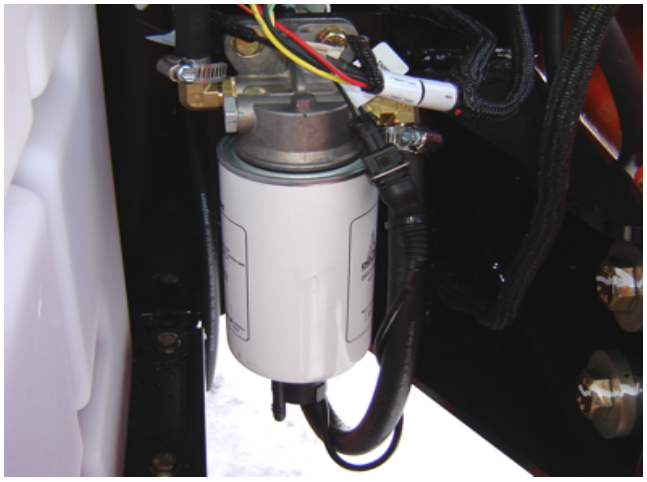
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 2.4 gal (8.9 L)
Lube - EO
Interval - Every Year or 600 hours of operation
Comments - Check level daily/Change in accordance with engine manual

10. Fuel Filter/Water Separator - Deutz 2.3 L3



Lube Point(s) - Replaceable Element
Interval - Every year or 500 hours of operation

11. Fuel Pre-Filter - Deutz D2.9L

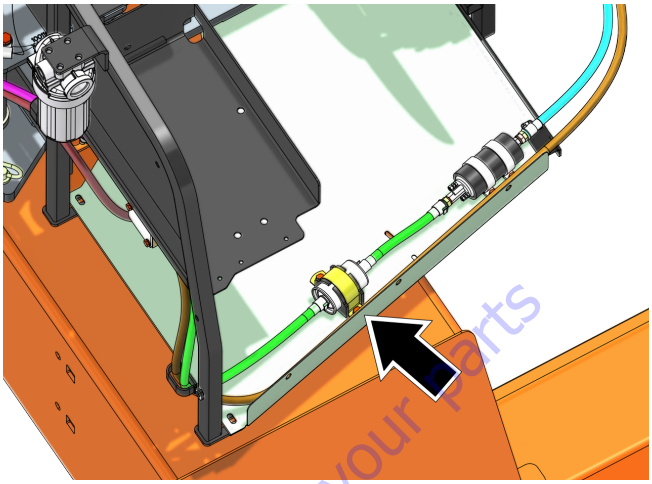


Lube Point(s) - Replaceable Element
Interval - Drain water daily; Every year or 600 hours of operation

12. Fuel Filter - Deutz D2.9

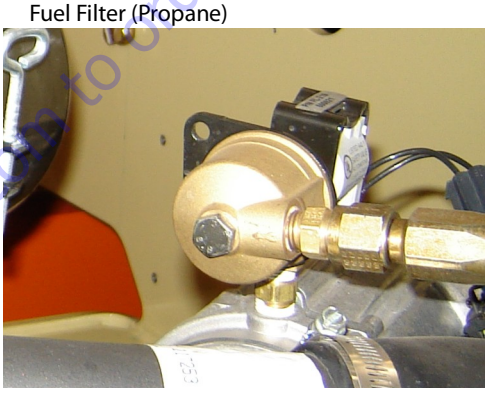
Lube Point(s) - Replaceable Element
Interval - Every year or 600 hours of operation

13. Fuel Filter (Gasoline)



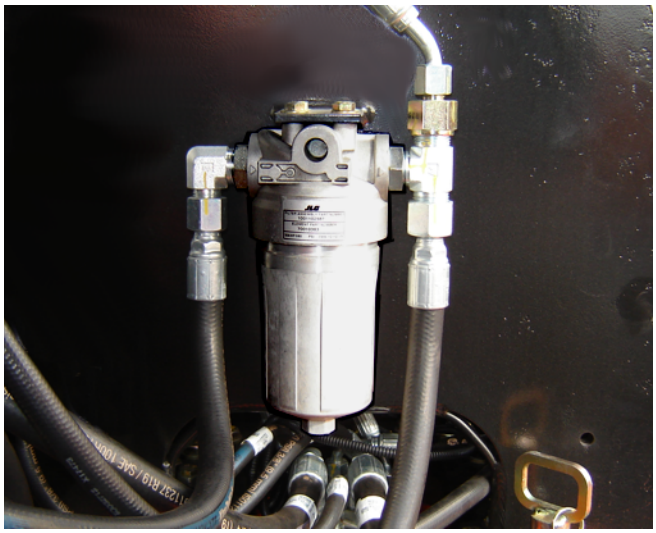
Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation

14. Fuel Filter (Propane)



Interval - 3 Months or 150 hours of operation
Comments - Replace filter.

15. Charge Filter

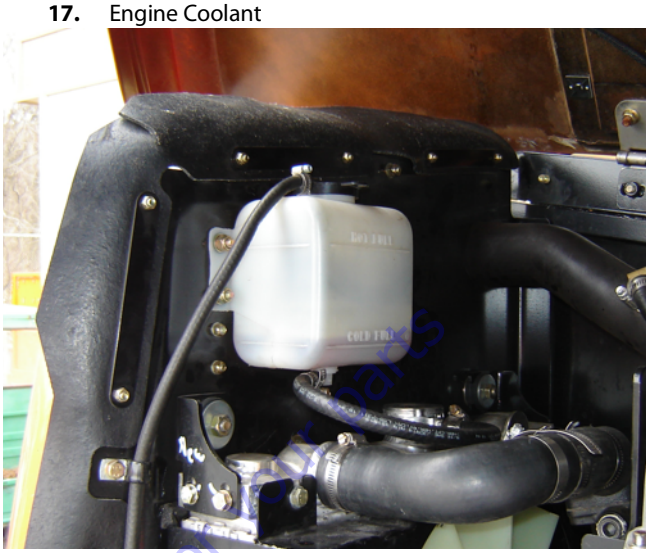


Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.
Comments - Remove the engine tray retaining bolt and pull out engine tray to gain access.

16. Air Filter

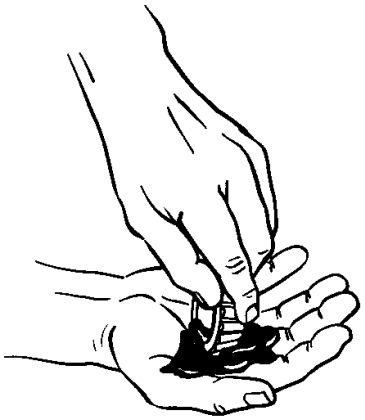
Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation or as indicated by the condition indicator
Comments - Check Dust Valve daily

17. Engine Coolant



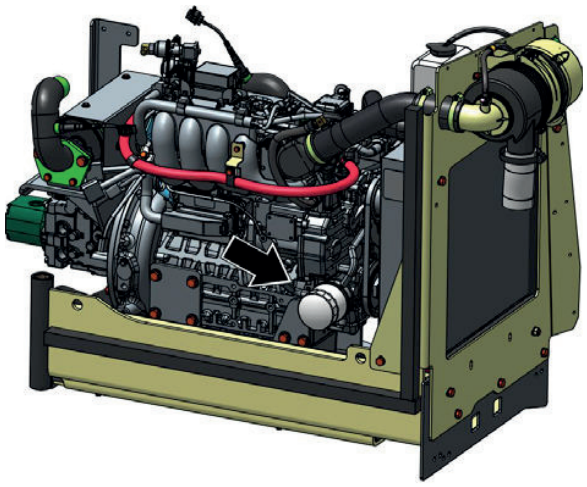
Lube Point(s) - Fill Cap
Capacity (Deutz 2.9L)- 2.9 gal. (11.3L)
Capacity (Kubota)- 2.25 gal. (8.5L)
Lube - Anti-Freeze
Interval - Check level daily; change every 1000 hours or two years, whichever comes first.

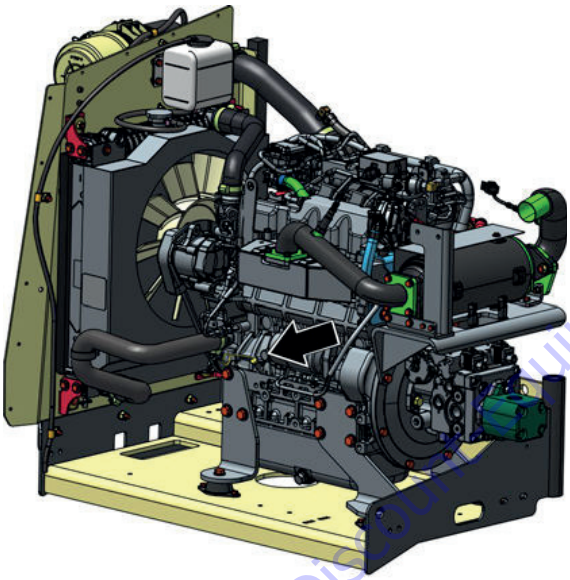
18. Wheel Bearings



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

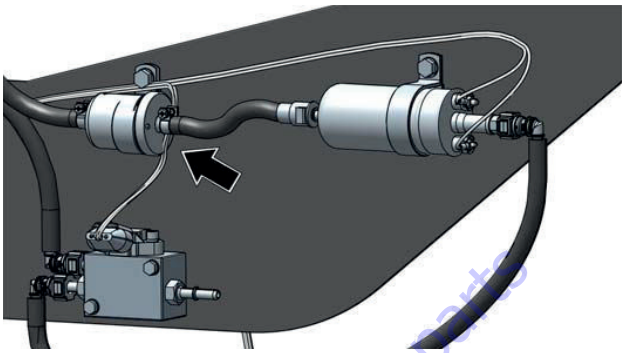
19. Oil Change w/Filter - Kubota





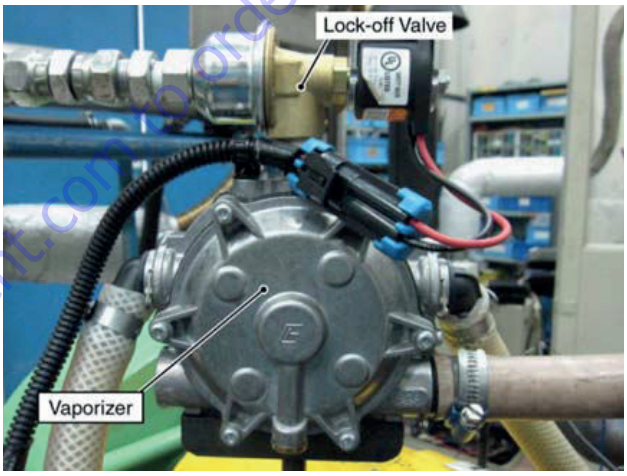
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 2.5 gal. (9.5 L) w/filter
Lube - EO
Interval - 3 Months or 150 hours of operation
Comments - Check level daily/Change in accordance with engine manual

20. Fuel Filter - Kubota



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

21. Fuel Filter (Propane) - Kubota



Interval - Every year or 1000 hours of operation
Comments - Replace filter.

1.9 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.*

1.10 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

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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

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
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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 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:

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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:

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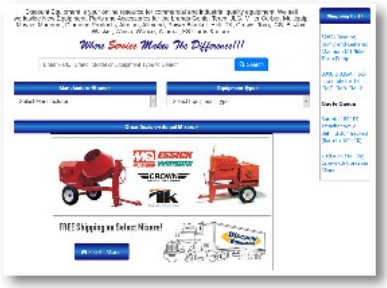

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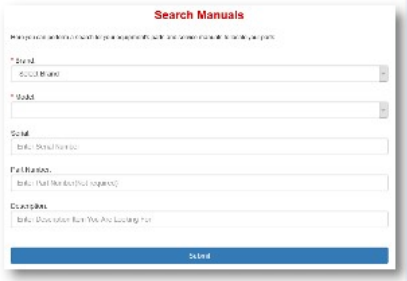

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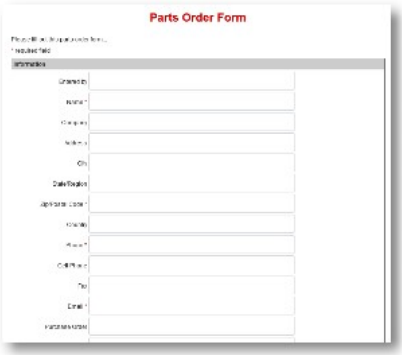

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SECTION 2. GENERAL

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 Operation and Safety Manual for completion procedures for the Pre-Start Inspection. The Operation and Safety Manual must be read in its entirety and understood prior to performing the Pre-Start Inspection.

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventive Maintenance

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

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

Table 2-1. Inspection and Maintenance

Type	Frequency	Primary Responsibility	Service Qualification	Reference
Pre-Start Inspection (See Note)	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 (See Note)	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 (See Note)	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

NOTE: *Inspections forms are available from JLG. Use the Service and Maintenance Manual to perform inspections.*

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

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

Cleanliness

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

Components Removal and Installation

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

Component Disassembly and Reassembly

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

Pressure-Fit Parts

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

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

NOTICE

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

1. Always use new replacement hardware when installing locking fasteners. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Torque Chart Section 1.
3. 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 Table 1-9, "Lubrication Specifications.," on page 7. 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 Mobilfluid 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

NOTE: *Start-up of hydraulic system with oil temperatures below -15°F (-26°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 -15°F (-26°C).*

3. The only exception to the above is to drain and fill the system with Mobil DTE 13 oil or its equivalent. This will allow start up at temperatures down to -20°F (-29°C). However, use of this oil will give poor performance at temperatures above 120°F (49°C). Systems using DTE 13 oil should not be operated at temperatures above 200°F (94°C) under any condition.

Changing Hydraulic Oil

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

Lubrication Specifications

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

2.4 CYLINDER DRIFT TEST

Theory

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

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

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

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

Cylinder Leakage Test

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

Measure drift at cylinder rod with a calibrated dial indicator.

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

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

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

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

Cylinder Thermal Drift

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

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

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

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

Do NOT Do the Following When Welding on JLG Equipment

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

NOTICE

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

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Footnotes:

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

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

[3] Annually, no later than 13 months from the date of the prior inspection, Includes all daily and quarterly inspections, mandated by regulating body

[50] Indicates a 50 hour interval required to perform task after initial use of machine. This only occurs once in machine life

[250] Indicates a 250 hour interval required to perform task after initial use of machine. This only occurs once in machine life

Performance Codes:

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

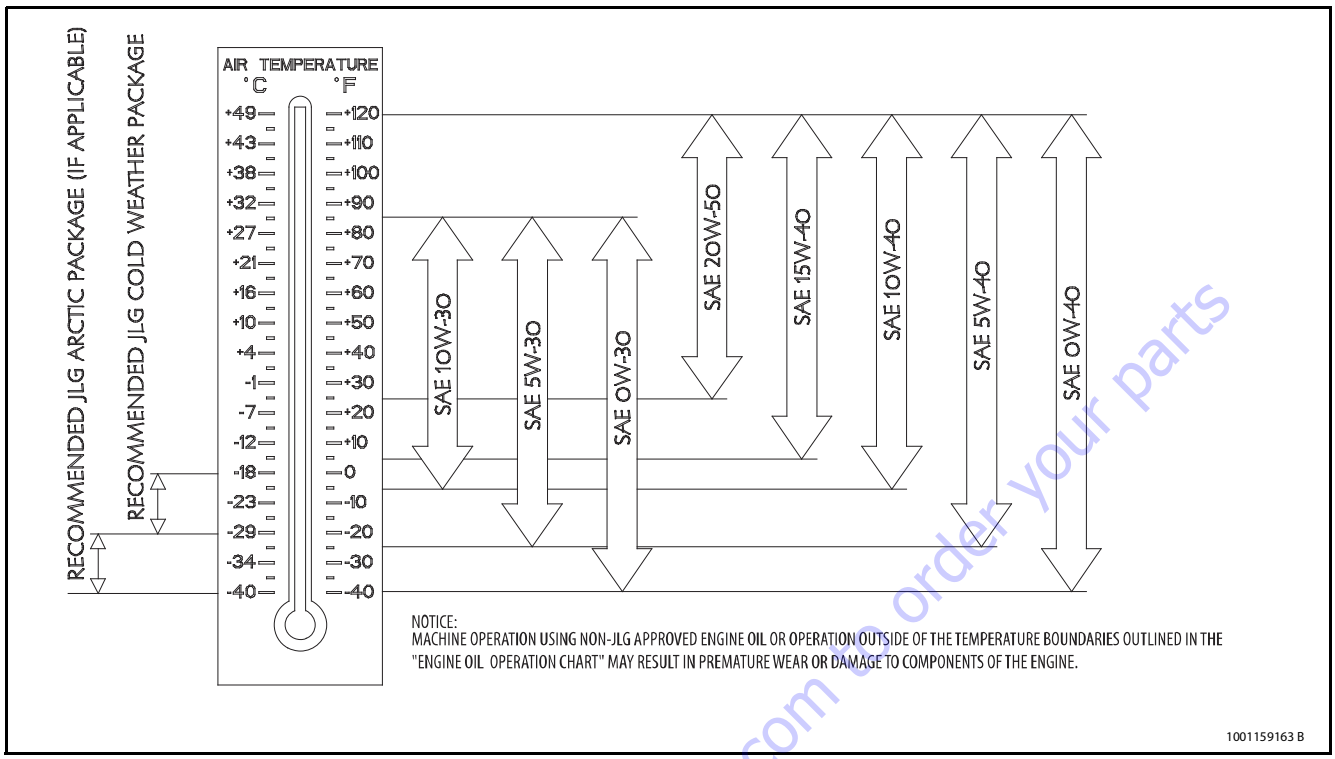
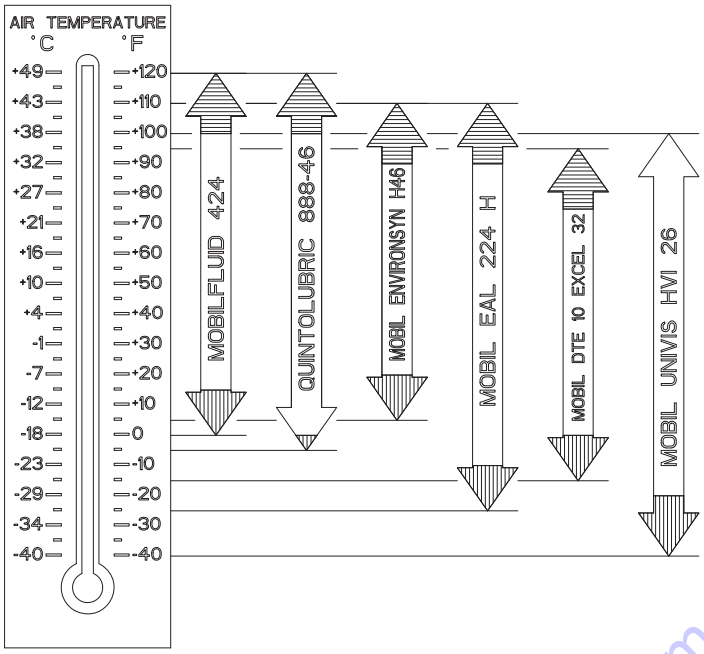


Figure 2-1. Engine Operating Temperature Specifications - Deutz 2.9



THE ADDITION OF A HYDRAULIC OIL-COOLER IS HIGHLY RECOMMENDED FOR PROLONGED OPERATION IN THIS TEMPERATURE RANGE (CONSULT JLG SERVICE)

OPERATION IN THIS TEMPERATURE RANGE SHOULD INCLUDE THE USE OF HYDRAULIC SYSTEM HEATING AIDS (CONSULT JLG SERVICE)

THE ADDITION OF A HYDRAULIC OIL-COOLER IS NOT RECOMMENDED FOR OPERATION IN THIS TEMPERATURE RANGE

Fluid	Properties		Base				Classifications		
Description	Viscosity at 40° C (cSt, Typical)	Viscosity Index	Mineral Oils	Vegetable Oils	Synthetic	Synthetic Polyol Esters	Readily Biodegradable*	Virtually Non-toxic**	Fire Resistant***
Mobilfluid 424	55	145	X						
Mobil DTE 10 Excel 32	32	141	X						
Univis HVI 26	26	376	X						
Mobil EAL 224 H	47	212		X			X	X	
Mobil Envirosyn H 46	49	145			X		X	X	
Quintolubric 888-46	50	185				X	X	X	X

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

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

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

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

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Figure 2-2. Hydraulic Oil Operating Temperature Specifications

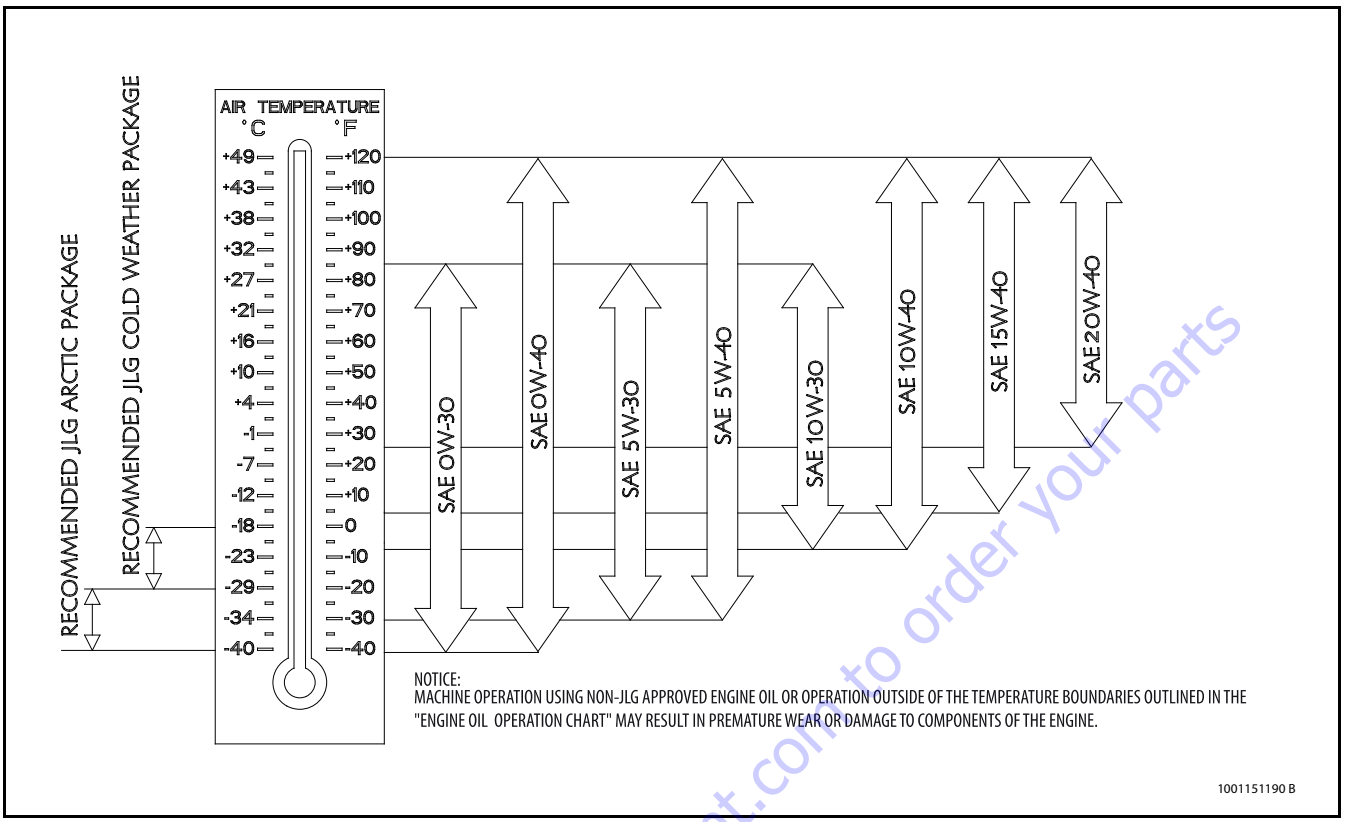


Figure 2-3. Engine Oil Operating Temperature Specifications - Deutz 2011

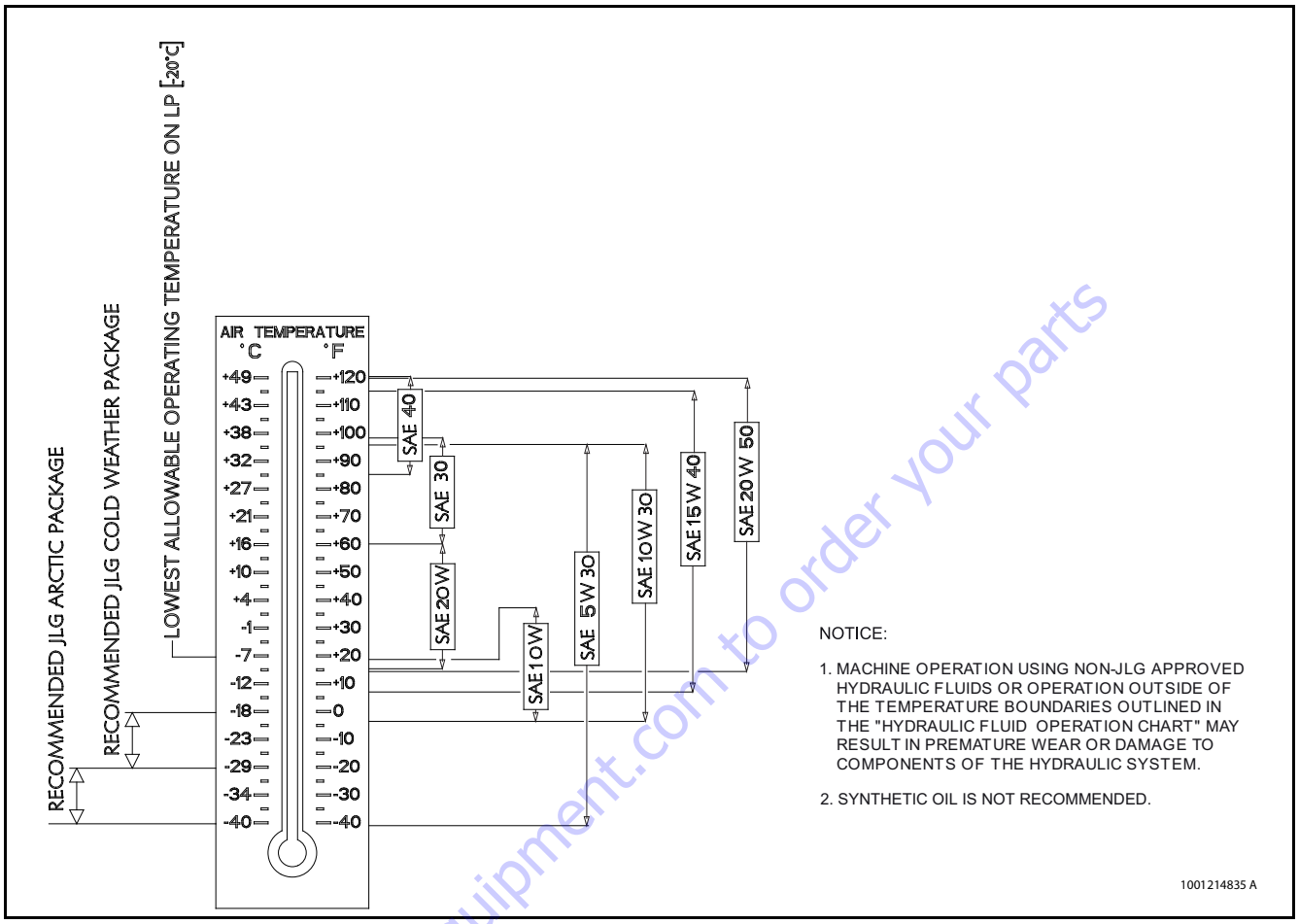
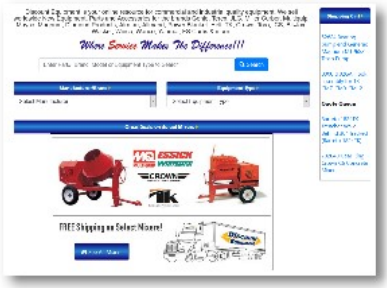


Figure 2-4. Engine Operating Temperature Specifications - Kubota

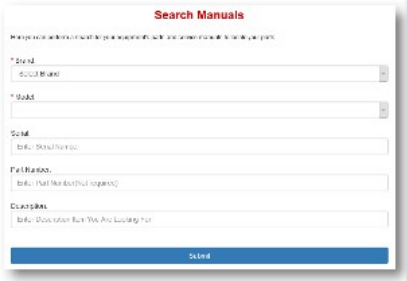
PARTS FINDER

Search Website by Part Number

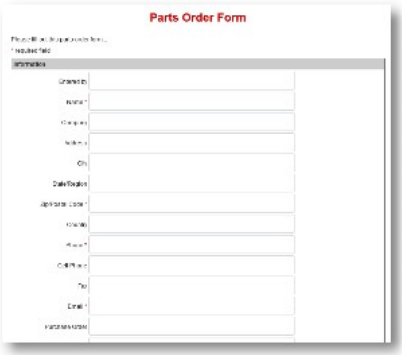
Discount Equipment



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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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 AND 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 in. (7.5 cm) in total length
- any tears or rips (ragged edges) in the cord plies which exceeds 1 in. (2.5 cm) in any direction
- any punctures which exceed 1 in. 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 hasn't propagated beyond the allowable criteria.

Tire Replacement

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

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

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

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.

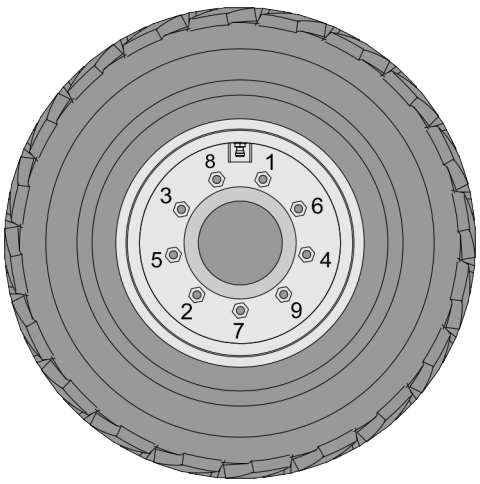
⚠ WARNING

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)	95 ft. lbs. (130 Nm)	170 ft. lbs. (230 Nm)

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

3.2 OSCILLATING AXLE SYSTEM

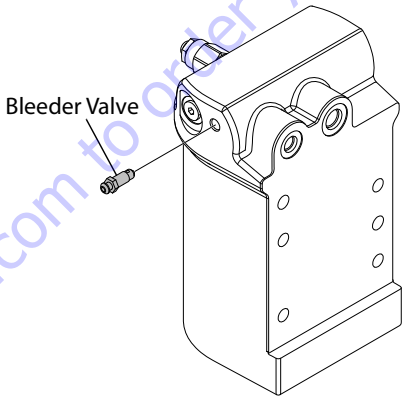
The oscillating front axle is attached to the frame by a pivot pin, which allows all four wheels to remain on the ground when traveling on rough terrain. There are two lockout cylinders connected to the frame. The lockout cylinders permit axle oscillation when the main boom is in Transport Position refer to "Transport Position Sensing System" , and when the boom is oriented between the rear tires, refer to Section 3.6, Drive Orientation System.

The lockout cylinders will lock and hold the axle when the Main boom is above horizontal or swung beyond the rear tires. Pilot pressure is supplied through Drive Pump charge pressure. The cylinders unlock when pilot pressure is applied to the holding valves mounted on the cylinders and lock when pilot pressure is removed.

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

3.3 LOCKOUT CYLINDER BLEEDING

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

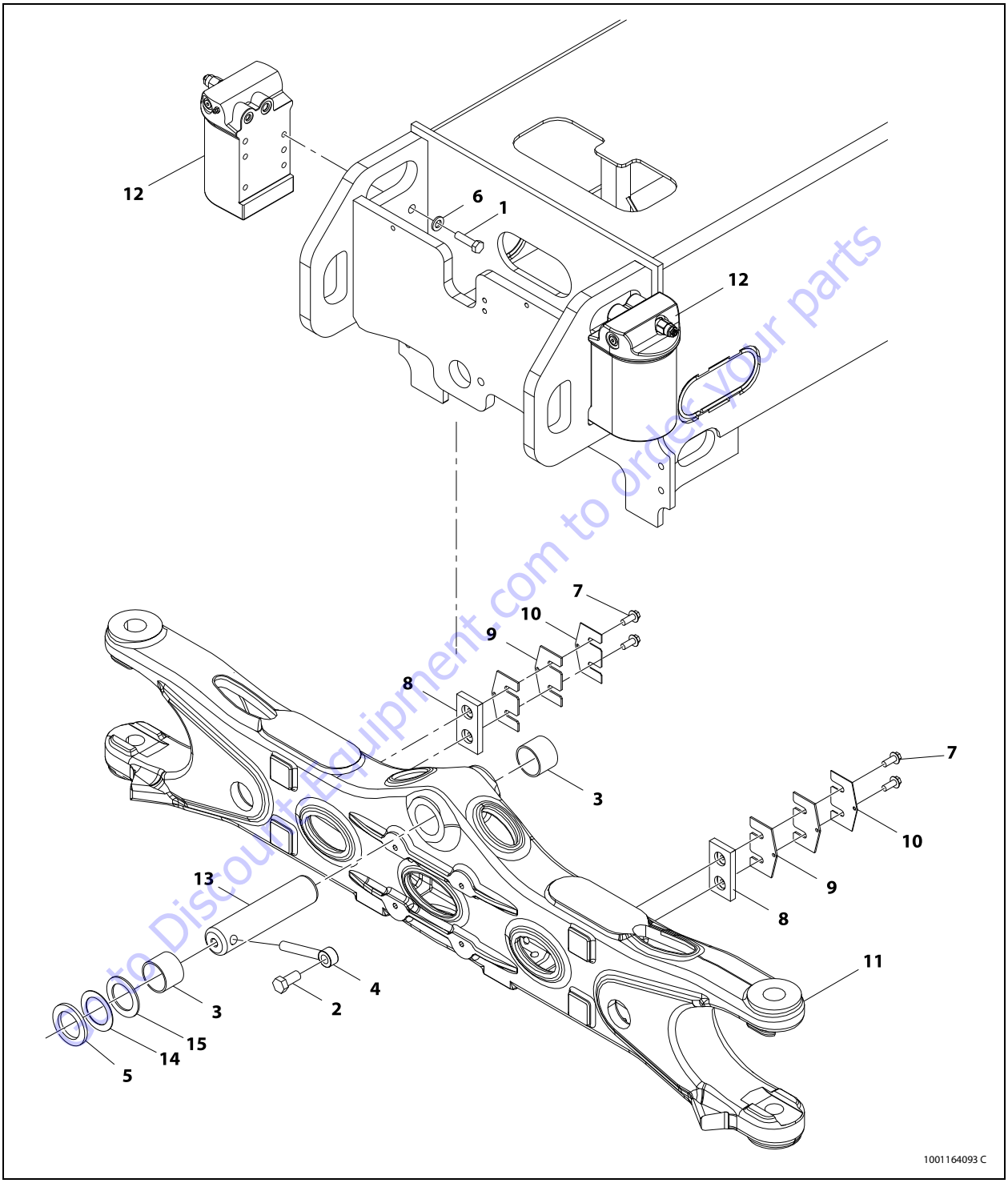


3.4 CHASSIS TILT INDICATOR SYSTEM

The Chassis Tilt Indicator System measures the turntable angle with respect to level ground. The tilt sensor is mounted to the turntable base plate. For location of tilt sensor refer Figure 6-2., Tilt Sensor Location.

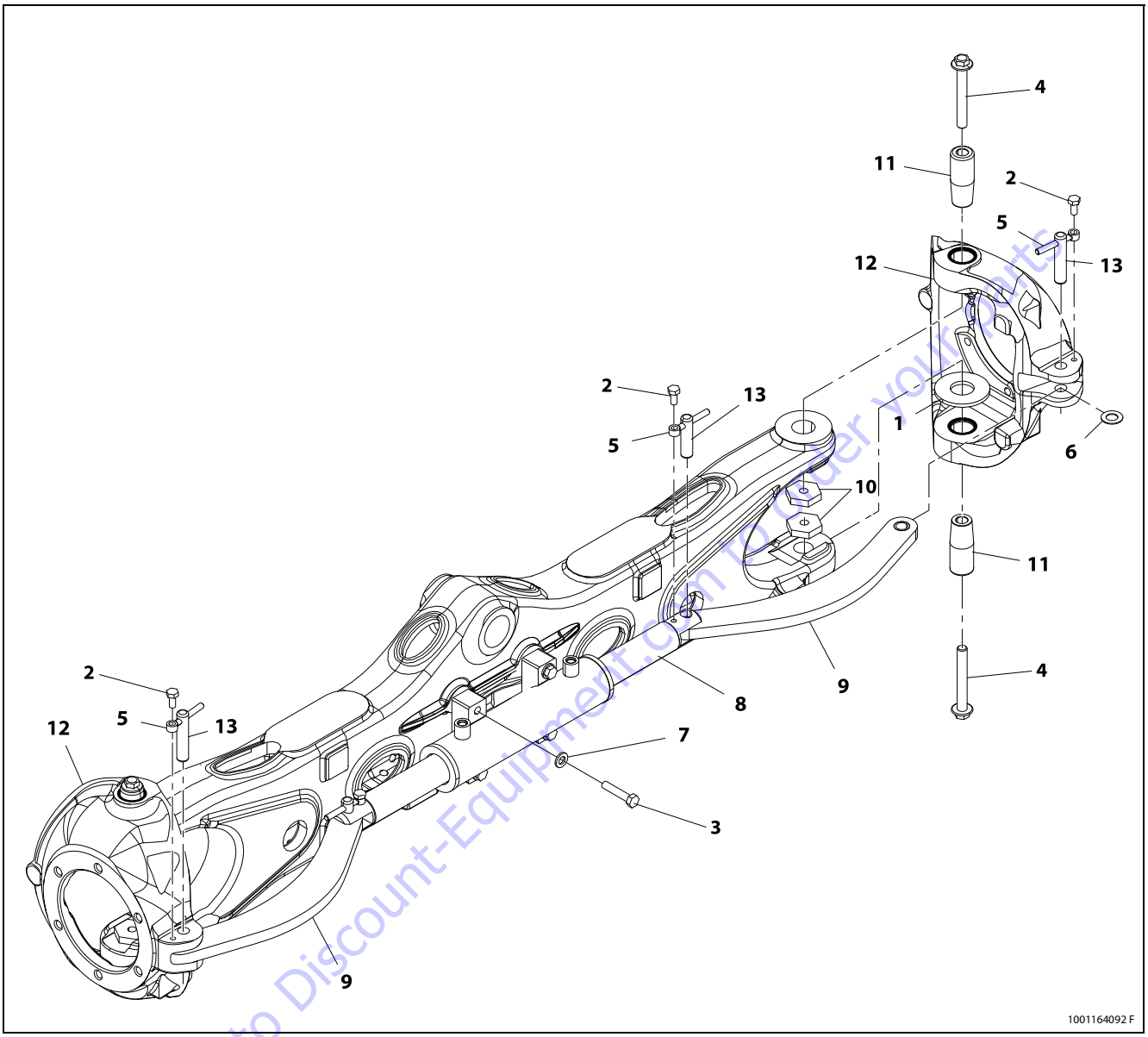
The chassis tilt angle is used for the purpose of warning the operator by means of the chassis tilt light in the platform display panel. The tilt angle is dependent on market, Refer Table 6-2, Machine Configuration Programming Information (Software Version P2.7). Additionally when used in conjunction with the Beyond Transport - Drive Speed Cutback System, the tilt sensor will cause an alarm to sound, and automatically put all functions in the creep speed mode. The operator is responsible for preventing the machine from attaining an unstable position.

The 8° angle is used exclusively for the purpose of automatically slowing drive speed when this angle is reached and the boom is in Transport position. When the boom is in Transport Position, and the chassis is at or above 8°, the drive system will automatically switch into Max Torque mode.



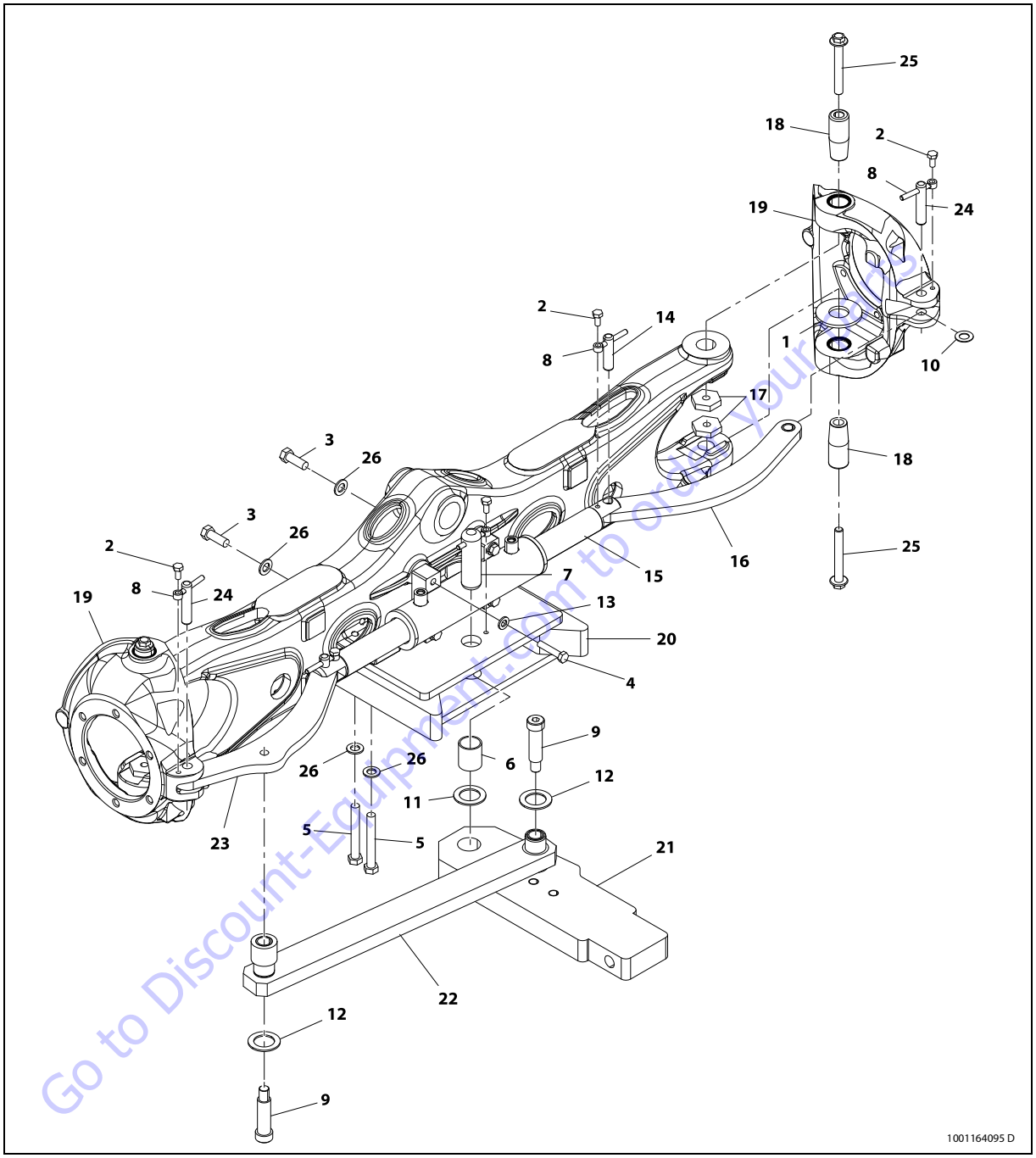
1. Bolt
2. Bolt
3. Bearing
4. Keeper Pin
5. Washer
6. Washer
7. Bolt
8. Wear Pad
9. Shim
10. Shim
11. Axle
12. Axle Lockout Cylinder
13. Pin
14. Shim
15. Washer

Figure 3-1. Axle Installation



1. Thrust Bearing
2. Bolt
3. Bolt
4. Bolt
5. Keeper Pin
6. Washer
7. Washer
8. Steer Cylinder
9. Link
10. Nut
11. Kingpin
12. Spindle
13. Pin

Figure 3-2. Steer Installation (Without Tow Package)



1.	Thrust Bearing	6.	Bearing	11.	Washer	15.	Steer Cylinder	19.	Spindle	23.	Link
2.	Bolt	7.	Pin	12.	Washer	16.	Link	20.	Bracket	24.	Pin
3.	Bolt	8.	Keeper Pin	13.	Washer	17.	Nut	21.	Pivot Plate	25.	Bolt
4.	Bolt	9.	Bolt	14.	Pin	18.	Kingpin	22.	Link	26.	Washer
5.	Bolt	10.	Washer								

Figure 3-3. Steer Installation (With Tow Package)

3.5 OSCILLATING AXLE LOCKOUT TEST

NOTICE

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

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

1. Place a 6 in. (15.2 cm) high block with ascension ramp in front of left front wheel.
2. From platform control console, 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 or raise the main boom enough to get it out of the transport position.
5. 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 return boom to stowed position (centered between rear wheels if swung or fully lowered if raised). When boom reaches 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 in. (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. Repeat steps 4 through 7 to check the opposite side of the oscillating axle.
11. If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

3.6 DRIVE ORIENTATION SYSTEM

The Drive Orientation System (DOS) is intended to indicate to the operator conditions that could make the direction of movement of the chassis different than the direction of movement of the drive/steer control handle. The system indicates to the operator the need to match the black and white directional arrows on the platform control panel to the arrows on the chassis. The system uses a limit switch mounted on the underside of the turntable, an indicator light and an override switch on the platform display panel. The limit switch trips roughly when the boom is swung past a rear tire. When the turntable is in the normal drive position with the boom between the rear tires, no indications or interlocks are made. When the machine is actively driving and the turntable is swung past the switch point, the system is ignored until drive/steer is released. When drive is initiated with the boom swung past the switch point, the DOS indicator will flash and the drive/steer functions will be disabled. The operator must engage the DOS override switch to enable drive/steer (High Speed drive will remain disabled). When the DOS is enabled, the DOS indicator will be illuminated continuously and a 3 second enable timer will be started and will continue for 3 seconds after the end the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

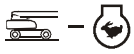
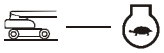
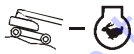
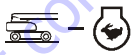
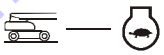
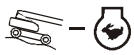
3.7 DRIVE SYSTEM

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

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

Drive speed is varied by a combination of drive pump displacement, engine speed, and motor displacement. Traction control is full-time and is present in all drive modes. There are three drive modes that can be selected at the platform console. The functionality of the drive system is dependent on the position of the boom. The following chart describes how the system works in each drive mode.

Table 3-2. Drive System Mode Chart

Boom Position	Drive Selection		Engine Speed when Drive is Actuated	Max. Speed MPH (kph)
In Transport	Max Speed		High-2600 RPM	4.5(7.2)
	Mid-Engine		Mid-1800 RPM	3(4.8)
	Max Torque		High-2600 RPM	1.25(2.01)
Out of Transport	Max Speed		High-2600 RPM	0.5(0.8)
	Mid-Engine		Mid-1800 RPM	0.5(0.8)
	Max Torque		High-2600 RPM	0.5(0.8)

3.8 WHEEL DRIVE ASSEMBLY

Removal

NOTE: *The drive motors can be removed through the axle flange as part of the wheel drive assembly or they can be removed separately through the bottom of the frame while leaving the drive hub bolted to the axle.*

1. Use a jack to lift the frame enough so the tire and wheel assembly is off the ground. Place blocking strong enough to support the weight of the machine under the frame and remove the jack.

NOTE: *The foam-filled tire & wheel assembly weighs approximately 395 lb (179 kg). The solid tire & wheel assembly weighs approximately 286 lb (130 kg).*

2. Remove hardware securing wheel and remove tire and wheel assembly. Using suitable lifting device lift the tire and wheel assembly and place in a suitable area.

3. Tag and disconnect the hydraulic lines running to the drive motor. Cap or plug all openings to ensure no dirt enters the hydraulic system.

NOTE: *The drive hub and drive motor assembly weighs approximately 149 lb (68 kg).*

4. Use a supporting device capable of handling the weight of the drive hub and drive motor, and unbolt the drive hub from the frame. Remove the entire assembly from the machine.

5. Remove the capscrews and washers that secure the drive motor to the drive hub and remove the drive motor. Remove and discard the brake gasket between the drive motor and drive hub.

Installation

1. Install a new brake gasket between the drive motor and drive hub. Apply a coat of Medium Strength Threadlocking Compound on capscrews. Install the washers and capscrews to secure the drive hub and drive motor, and torque to 70 ft. lbs. (95 Nm).

2. Place the drive hub flange against the mounting flange on the axle and fasten it in place with the bolts and washers. Torque the bolts to 190 ft. lbs. (260 Nm).

3. Using adequate support, install wheel into wheel assembly and secure with bolts and washers. See "Wheel Installation" for torque details.

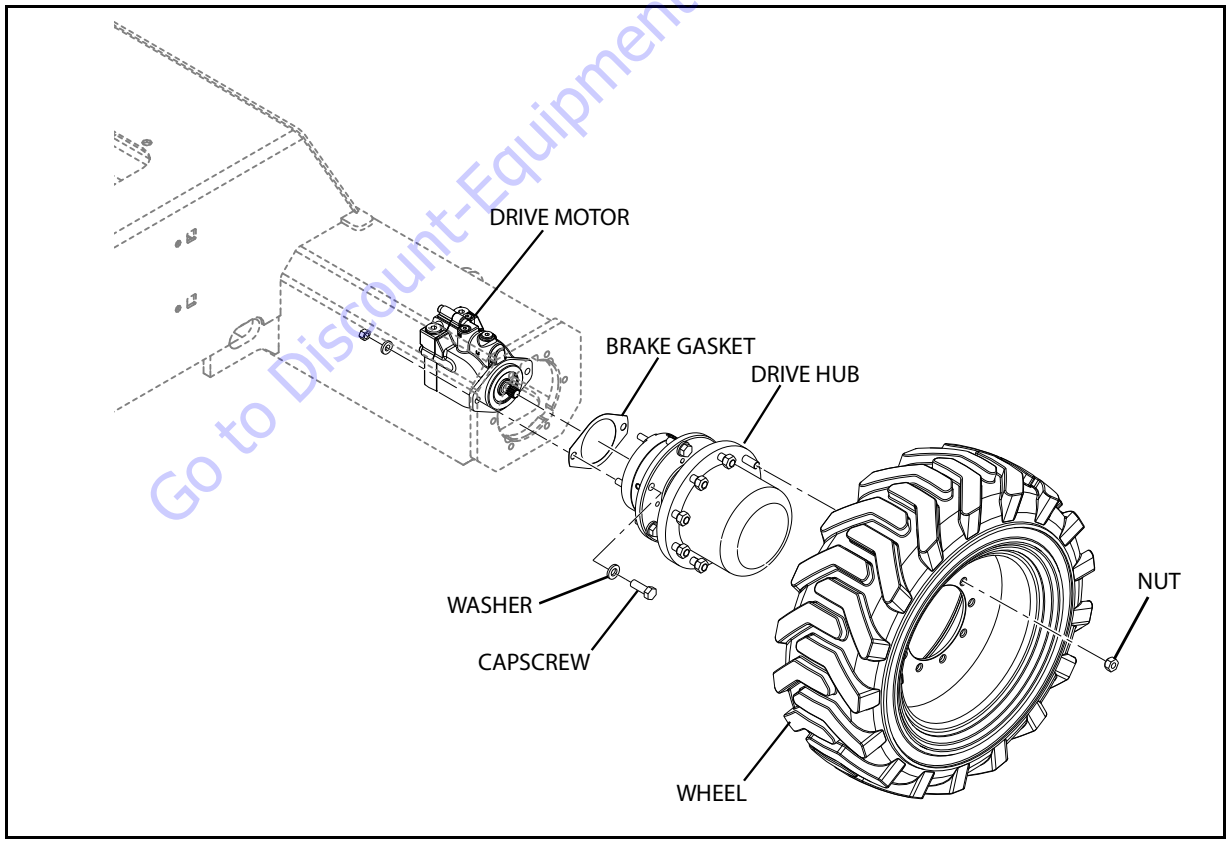


Figure 3-4. Wheel Drive Installation

3.9 TORQUE HUB

Roll and Leak Testing

Always roll and leak test Torque-Hubs after assembly to make sure that the unit's gears and sealants are working properly. The following information briefly outlines what to look for when performing these tests.

ROLL TEST

The roll test determines if the unit's gears rotate freely and properly. You should be able to rotate gears by applying a *constant* force to the roll checker. If you feel *more* drag in gears only at certain points, gears are not rolling freely. Examine them for improper installation or defects.

Some gear packages roll with more difficulty than others. Do not be concerned if gears seem to roll hard as long as they roll with *consistency*.

LEAK TEST

The purpose of a leak test is to make sure unit is air tight. You can tell if your unit has a leak if pressure gauge test reading starts to fall once you have pressurized the unit.

Leaks usually occur at the main seal or wherever O-rings or gaskets are located. You can usually detect location of a leak by brushing a soap and water solution around main seal and where O-rings or gaskets meet unit exterior, then checking for air bubbles. Replace part immediately if you detect a leak in a seal, O-ring, or gasket.

Tightening and Torquing Bolts

NOTICE

USE EXTREME CARE WHEN USING AN AIR IMPACT WRENCH. DO NOT TIGHTEN BOLTS BEYOND THEIR TORQUE SPECIFICATION. NEVER USE AN IMPACT WRENCH TO TIGHTEN SHOULDER BOLTS. TIGHTEN ALL SHOULDER BOLTS BY HAND.

1. Tighten (but do not torque) bolt "A" until snug.
2. Go to opposite side of bolt circle and tighten bolt "B" until equally snug.
3. Continue around bolt circle and tighten remaining bolts.
4. Apply specified torque to bolt "A".
5. Continue around bolt circle and apply equal torque to remaining bolts.

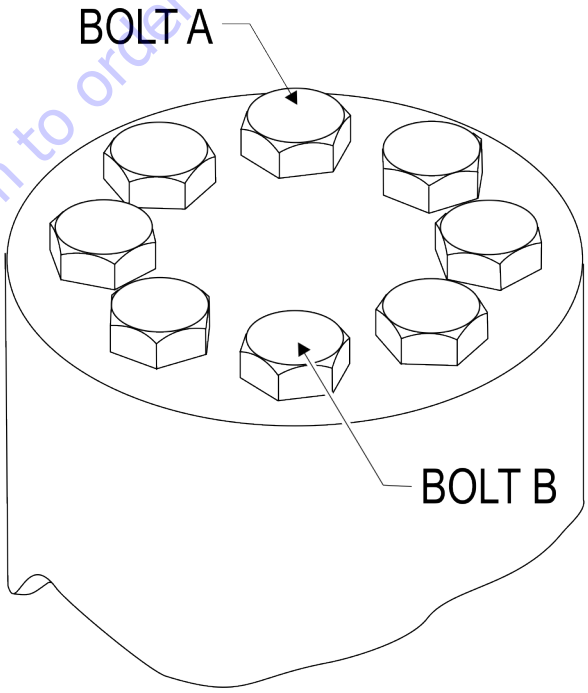


Figure 3-5. Bolt Tightening Sequence

Main Disassembly for "B" Drives

1. Turn hub (1G) on side, Remove coupling (14) from wide end of spindle (1A).
2. Mark location of shoulder bolt holes on outside of ring gear and hub for easy realignment when rebuilding. Remove four shoulder bolts (13) and 12 bolts (12) from cover (6).
3. Remove 16 flat washers (16) from cover (6).
4. Lift cover sub-assembly (6) off ring gear (4). Set cover on table with interior side facing up.

⚠ CAUTION

SHARP EDGES CAN CUT AND CAUSE SERIOUS INJURY. BEWARE OF SHARP EDGES IN COUNTERBORE WHEN REMOVING O-RING.

5. Remove O-ring (5) from counterbore around edge of cover (6A). Discard O-ring.

NOTE: *If O-ring is not in cover counterbore, it is in ring gear counterbore. Remove it from hub and discard.*

6. Remove thrust washer (11) from counterbore in top of carrier (3A).
7. Remove input gear (8) from middle of carrier sub-assembly (3).
8. Lift ring gear (4) off hub (1G).
9. Lift carrier sub-assembly (3) out of hub (1G).
10. Remove thrust spacer (9) from input shaft (7) in middle of spindle (1A).
11. Lift input shaft sub-assembly (7) out of middle of spindle (1A). Stand input shaft (7A) on splined end.

⚠ CAUTION

UNCONTROLLED OBJECTS CAN CAUSE EYE DAMAGE OR SERIOUS INJURY. ALWAYS WEAR EYE PROTECTION.

12. Using retaining ring pliers, remove retaining ring (7B) from groove on input shaft (7A).
13. Remove one spacer (7D), one spring (7C), and other spacer (7D) from input shaft (7A).
14. Remove thrust washer (11) from around spindle (1A).
15. Lift internal gear (2) out of hub (1G).
16. Remove O-ring (5) from counterbore in hub (1G). Discard O-ring.
17. Main disassembly for "B" drives is complete.

Hub-Spindle Disassembly

NOTE: *Start with large end of hub facing up and large end of spindle facing down.*

⚠ CAUTION

UNCONTROLLED OBJECTS CAN CAUSE EYE DAMAGE OR SERIOUS INJURY. ALWAYS WEAR EYE PROTECTION.

1. Remove retaining ring (1I) from around spindle (1A) ia hub (1G).
2. Remove spacer (1H) from around spindle (1A) in hub (1G).
3. Set hub (1G), with small end/spindle facing down, on something that will support the hub's flange while it lifts hub up so spindle is not resting on anything. Carefully press or hammer spindle (1A) down and out of hub (1G).

NOTE: *If seal (1B) and bearing cone (1D) come out of hub and rest on spindle, remove these parts from spindle and set them aside. Discard seal.*

4. If seal and bearing cone did not come out of small end of hub (1G) when you pressed spindle out of hub, remove seal (1B) and bearing cone (1D) from small end of hub (1G). Discard seal.
5. Bearing cone (1F) should be lying loose in wide end of hub (1G). Remove bearing cone (1F) from inside hub (1G).

NOTE: *Do not strike counterbore with punch if using a punch and hammer when removing bearing cup.*

6. Remove bearing cup (1C) from counterbore in small end of hub (1G).

NOTE: *Do not strike counterbore with punch if using a punch and hammer when removing bearing cup.*

7. Turn hub (1G) over and lift it out of flange-support. Remove bearing cup (1E) from counterbore in wide end of hub (1G).
8. Turn hub (1G) over onto its small end. Remove two pipe plugs (1J) from side of hub (1G).

NOTE: *If your unit does not have studs, skip this step.*

9. Press nine studs (1N) out of stud holes in hub (1G).
10. Hub-spindle disassembly is complete.

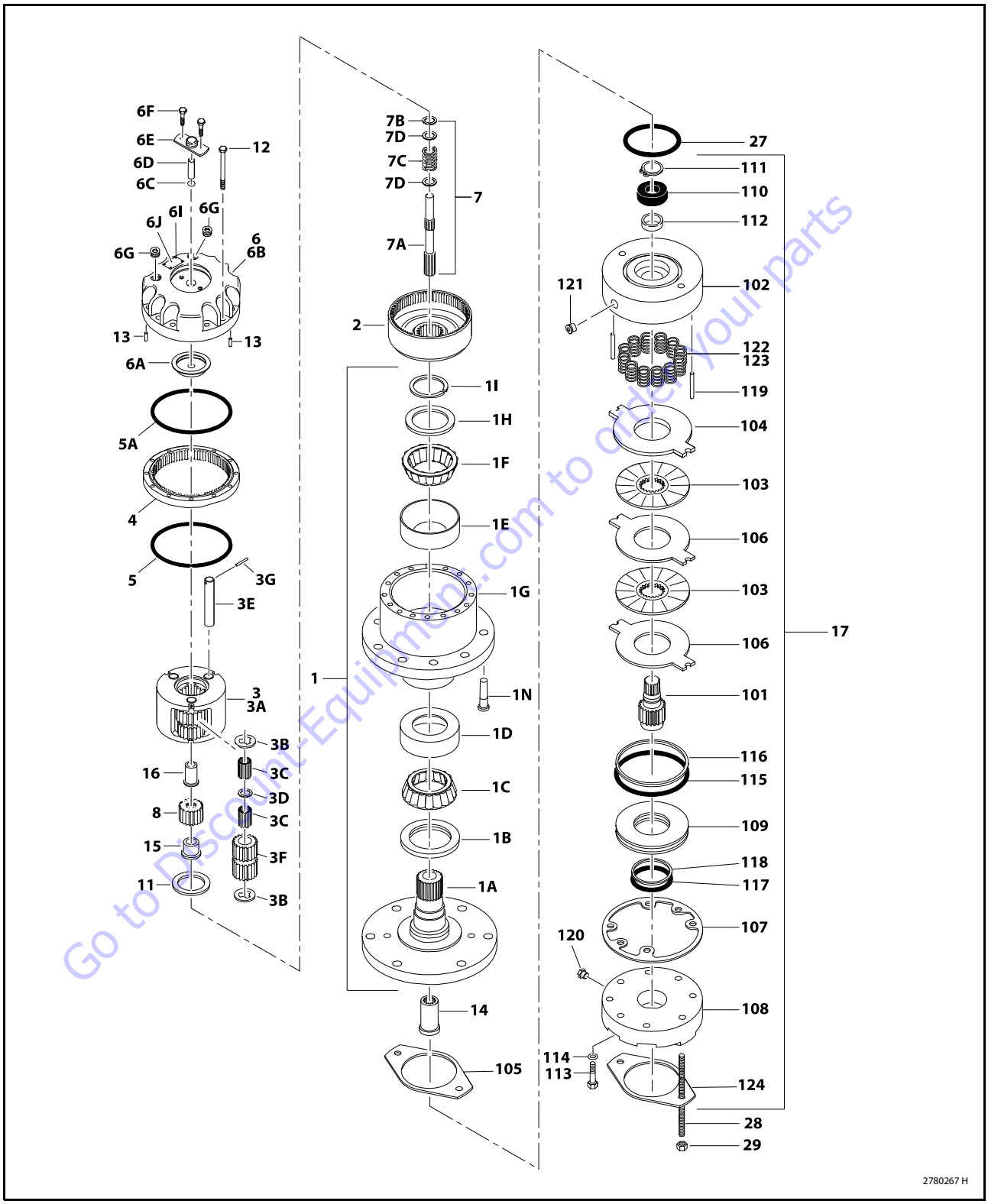


Figure 3-6. Drive Hub and Brake Assembly (2WD and 4WD) - Sheet 1 of 2

1	Spindle/Housing Assembly	3G	Roll Pin	7D	Thrust Spacer	107	Gasket
1A	Spindle	4	Ring Gear	8	Sun Gear	108	Cylinder
1B	Seal	5	O-Ring	11	Thrust Washer	109	Piston
1C	Bearing Cone	5A	O-Ring	12	Bolt	110	Ball Bearing
1D	Bearing Cup	6	Cover Assembly	13	Dowel Pin	111	Retaining Ring
1E	Bearing Cup	6A	Thrust Spacer	14	Coupling	112	Shaft Seal
1F	Bearing Cone	6B	Cover Plate	15	Input Spacer	113	Capscrew
1G	Housing/Ring Gear	6C	O-Ring	16	Input Spacer	114	Lockwasher
1H	Thrust Washer	6D	Disconnect Rod	17	Brake Assembly	115	O-Ring
1I	Retaining Ring	6E	Disengage Cap	27	O-Ring	116	Backup Ring
1N	Wheel Stud	6F	Bolt	28	Threaded Rod	117	O-Ring
2	Internal Gear	6G	Pipe Plug	29	Nut, 1/2in-13NC	118	Backup Ring
3	Carrier Assembly	6I	Rivet	101	Shaft	119	Dowel Pin
3A	Carrier	6J	I.D. Plate	102	Housing	120	Plug
3B	Retaining Ring	7	Input Shaft Assembly	103	Friction Plate	121	Plug
3C	Needle Bearing	7A	Shaft	104	Pressure Plate	122	Spring (Natural)
3D	Thrust Washer	7B	Retaining Ring	105	Gasket	123	Spring (Blue)
3E	Planet Shaft	7C	Spring	106	Outer Plate	124	Gasket
3F	Planet Gear						

Figure 3-7. Drive Hub and Brake Assembly (2WD and 4WD) - Sheet 2 of 2

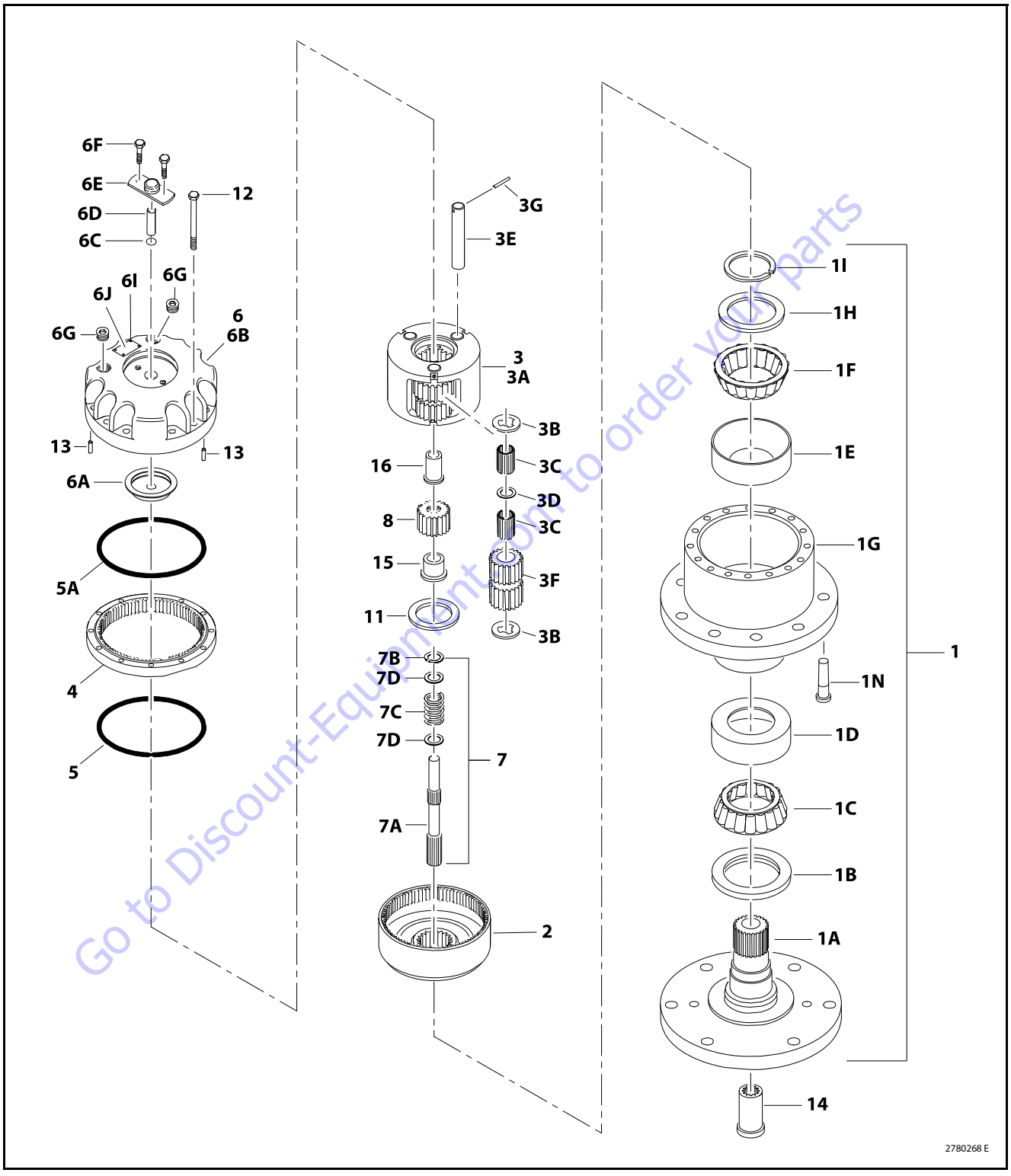
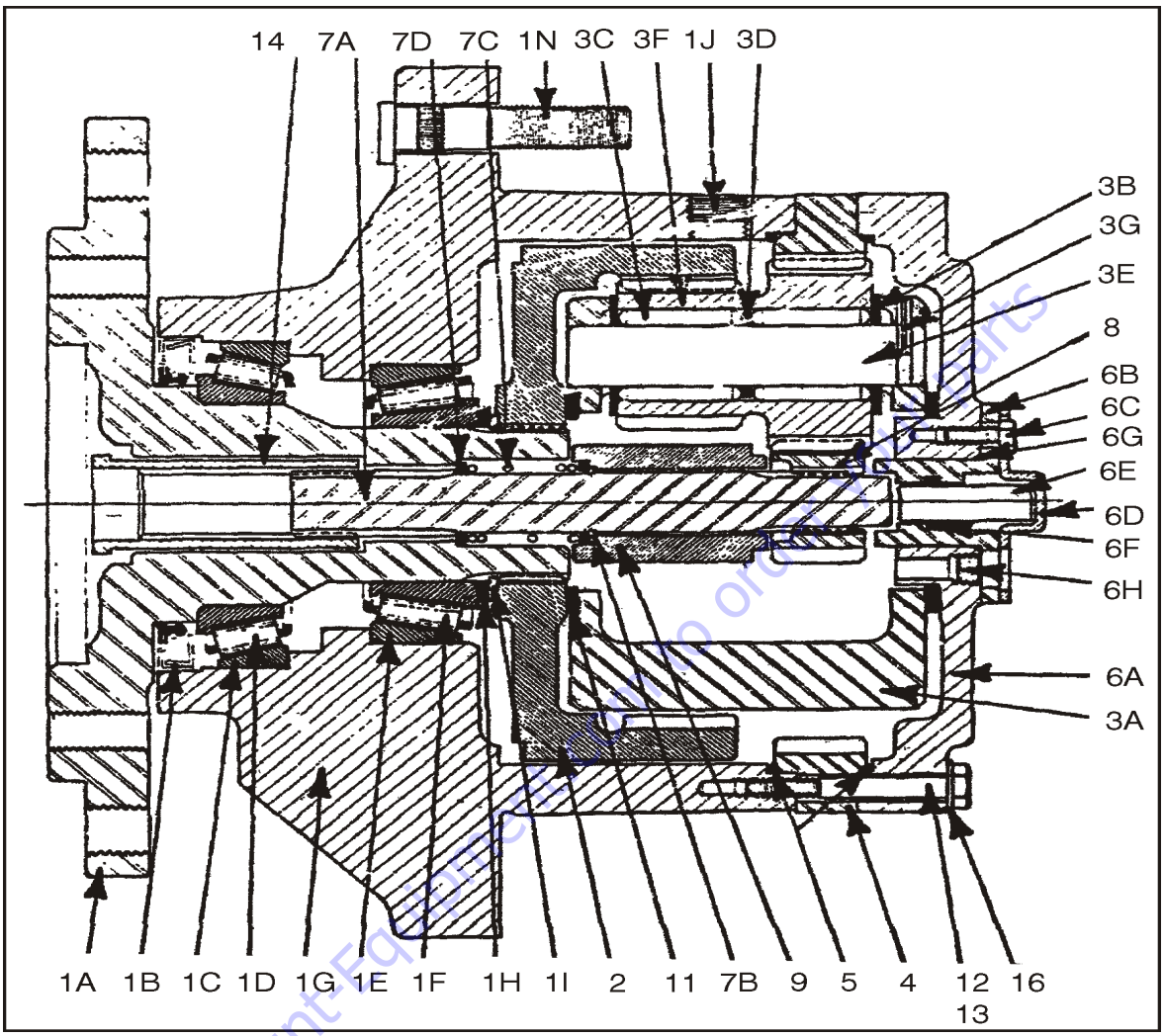


Figure 3-8. Drive Hub (4WD Front Only) -Sheet 1 of 2

1	Spindle/Housing Assembly	3	Carrier Assembly	6	Cover Assembly	7A	Shaft
1A	Spindle	3A	Carrier	6A	Thrust Spacer	7B	Retaining Ring
1B	Seal	3B	Retaining Ring	6B	Cover Plate	7C	Spring
1C	Bearing Cone	3C	Needle Bearing	6C	O-Ring	7D	Thrust Spacer
1D	Bearing Cup	3D	Thrust Washer	6D	Disconnect Rod	8	Gear, Sun
1E	Bearing Cup	3E	Planet Shaft	6E	Disengage Cap	11	Thrust Washer
1F	Bearing Cone	3F	Planet Gear	6F	Bolt	12	Bolt
1G	Housing/Ring Gear	3G	Roll Pin	6G	Plug, Pipe	13	Pin, Dowel
1H	Thrust Washer	4	Ring Gear	6I	Rivet	14	Coupling
1I	Retaining Ring	5	O-Ring	6J	I.D. Plate	15	Input Spacer
1N	Wheel Stud	5A	O-Ring	7	Input Shaft Assembly	16	Input Spacer
2	Internal Gear						

Figure 3-9. Drive Hub (4WD Front Only) -Sheet 2 of 2



1. Hub-Spindle Sub-Assembly
   - A. Spindle
   - B. Seal
   - C. Bearing Cup
   - D. Bearing Cone
   - E. Bearing Cup
   - F. Bearing Cone
   - G. Hub
   - H. Spacer
   - I. Retaining Ring
   - J. Pipe Plug
   - K. Stud
2. Internal Gear
3. Carier Sub-Assembly
   - A. Carrier Housing
   - B. Thrust Washer
   - C. Needle Roller
   - D. Spacer
   - E. Planet Shaft
   - F. Cluster Gear
   - G. Roll Pin
4. Ring Gear
5. O Ring
6. Cover Sub-Assembly
   - A. Cover
   - B. Cover Cap
   - C. Bolt
   - D. Disconnect Cap
   - E. Disconnect Rod
   - F. O Ring
   - G. O Ring
   - H. Pipe Plug
   - I. ID Plate
7. Input Shaft Sub Assembly
   - A. Seal
   - B. Retaining Ring
   - C. Spring
   - D. Spacer
8. Input Gear
9. Thrust Spacer
11. Thrust Spacer
12. Bolt
13. Shoulder Bolt
14. Coupling
16. Flat Washer

Figure 3-10. Drive Hub (Cross-Section)

Cover Disassembly

1. Remove two bolts (6C) holding disconnect cap (6D) to cover (6A).
2. Remove disconnect cap (6D) from on top of cover cap (6B) and cover (6A).
3. Remove two bolts (6C) holding cover cap (6B) to cover (6A).
4. Remove cover cap (6B) from cover (6A).
5. Remove disconnect rod (6E) from cover cap (6B).
6. Pry O-ring (6F) out of groove inside cover cap (6B). Discard O-ring.
7. Remove O-ring (6G) from flange of cover cap (6B). Discard O-ring.
8. Remove pipe plug (6H) from cover (6A).
9. Cover disassembly is complete.

Carrier Disassembly

NOTE: *Discard old needle rollers and use new ones during reassembly.*

1. Using a punch and hammer, drive roll pin (3G) into planet shaft (3E).

NOTICE

DRIVE ROLL PIN ALL THE WAY INTO PLANET SHAFT OR CARRIER WILL BE DAMAGED WHEN PLANET SHAFT IS REMOVED.

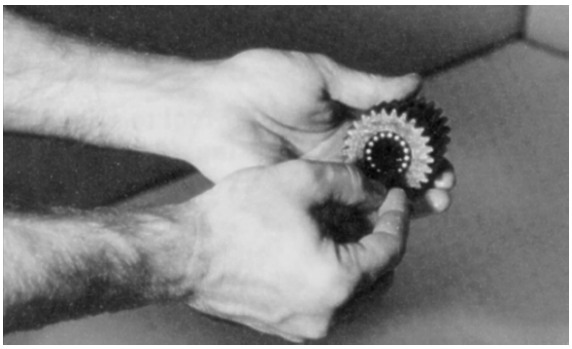
2. Using a punch and hammer, drive planet shaft (3E) out of planet shaft hole in carrier housing (3A).
3. When you remove planet shaft (3E) from carrier housing, one thrust washer (3B), one cluster gear (3F), and one more thrust washer (3B) will come off planet shaft and come to rest inside carrier. Remove these parts from inside carrier.
4. Remove 16 needle rollers (3C) from inside one end of cluster gear (3F). Discard needle rollers.
5. Remove one spacer (3D) from inside cluster gear (3F).
6. Remove remaining 16 needle rollers (3C) from other side of cluster gear (3F). Discard needle rollers.
7. Repeat steps 1-6 to remove and disassemble two remaining cluster gears.
8. At this point carrier disassembly is complete.

Assemble Carrier

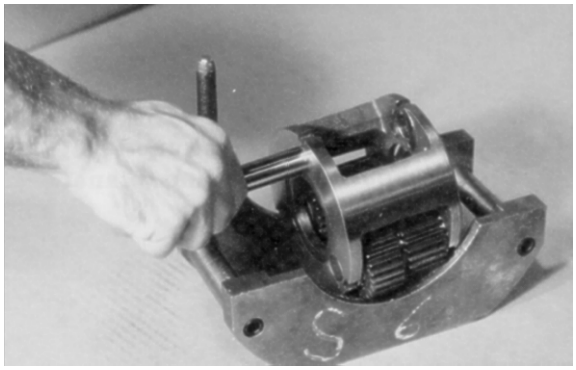
1. Apply grease to inside of one cluster gear (3F) and line one half of cluster gear with 16 needle rollers (3C).

2. Place spacer (3D) inside cluster gear (3F) so it rests on top of needle rollers.

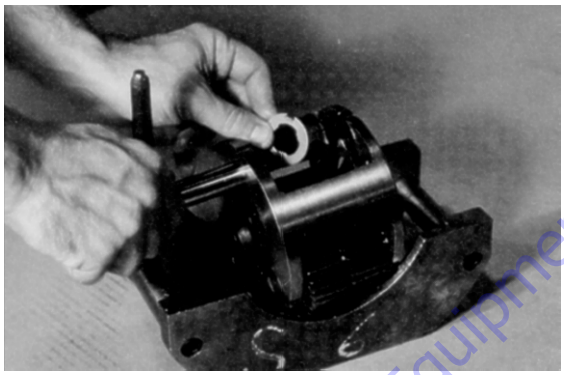
3. Line remaining half of cluster gear (3F) with 16 needle rollers (3C).



4. Set carrier housing (3A) on table, sideways. Insert a planet shaft (3E), roll pin hole last, into one of the planet shaft holes from roll-pin-holed side of carrier housing (3A).

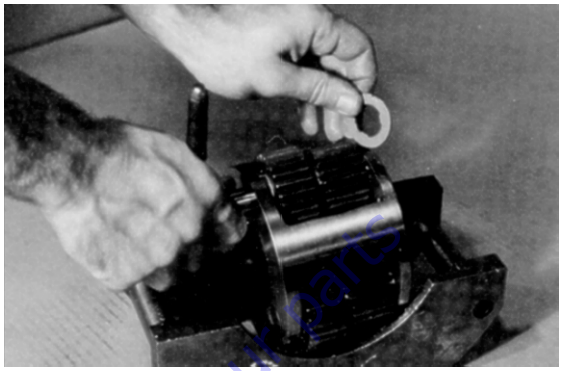


5. Place thrust washer (3B) on end of planet shaft (3E) inside carrier. Fit tang of thrust washer into slot on inside edge of planet shaft hole.

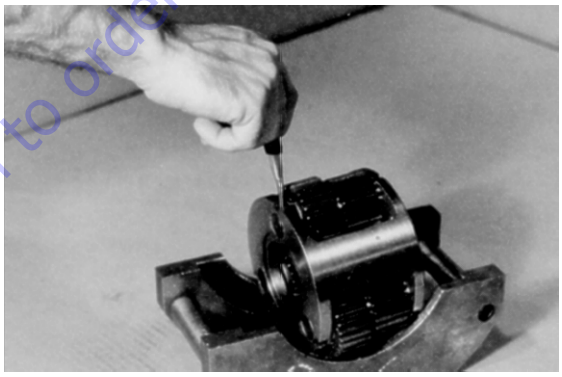


6. Following thrust washer, place cluster gear (3F), large end toward roll pin hole in carrier housing, on planet shaft (3E).

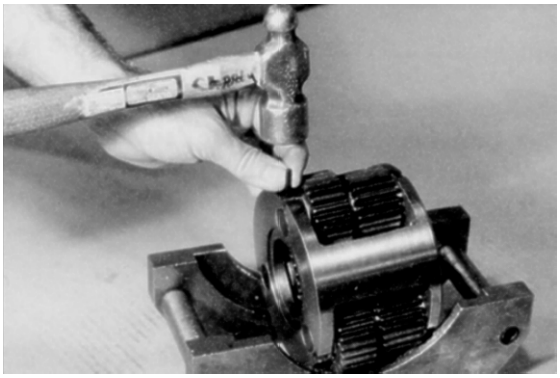
7. Following cluster gear, place one more thrust washer (3B) onto planet shaft (3E) through opposite planet shaft hole in carrier housing (3A).



8. Use an alignment punch or similar tool to align roll pin holes in carrier housing (3A) and planet shaft (3E).



9. Drive roll pin (3G) into aligned roll pin holes in carrier housing (3A) and planet shaft (3E).

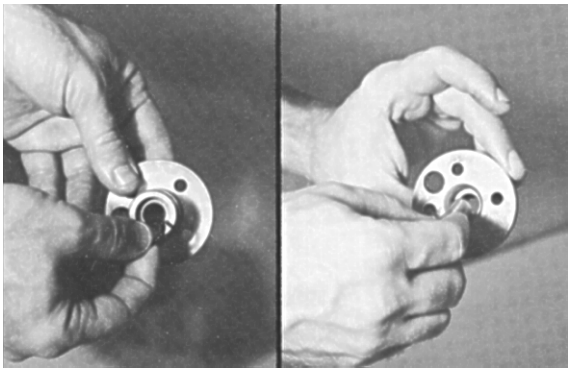


10. Repeat steps 1-9 to assemble and install two remaining cluster gears.

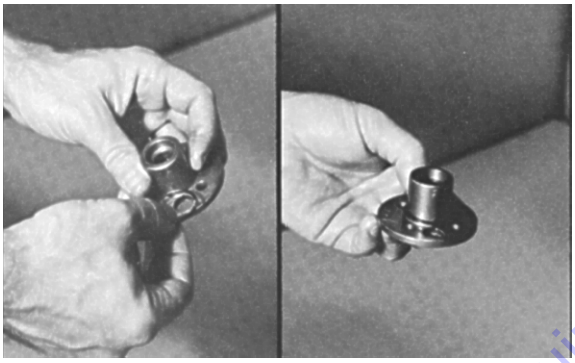
11. At this point carrier sub-assembly is complete.

Cover Sub-Assembly

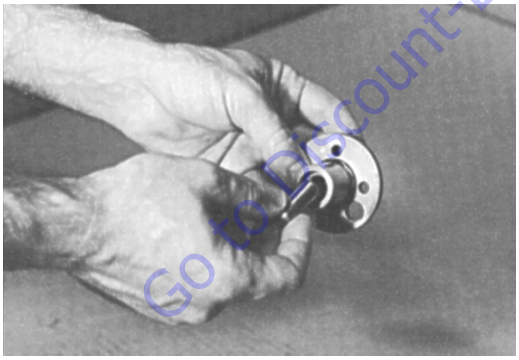
1. Using disconnect rod, push O-ring (6F) into groove inside cover cap (6B).



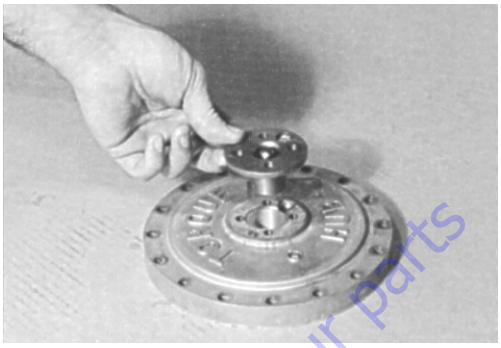
2. Place O-ring (6G) onto cover cap (6B) so it rests against flange of cover cap.



3. Insert disconnect rod (6E) into cover cap (6B).

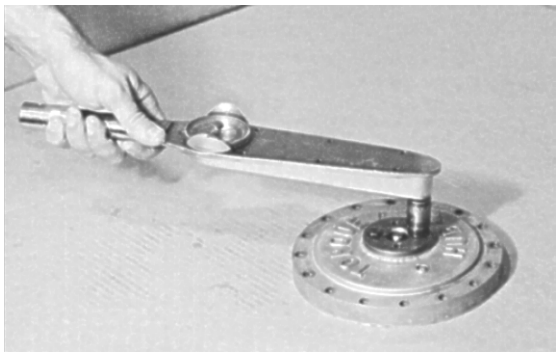


4. Set cover (6A) on table, exterior side up. Place cover cap (6B) on cover (6A). Align pipe plug hole in cover cap over pipe plug hole in cover.

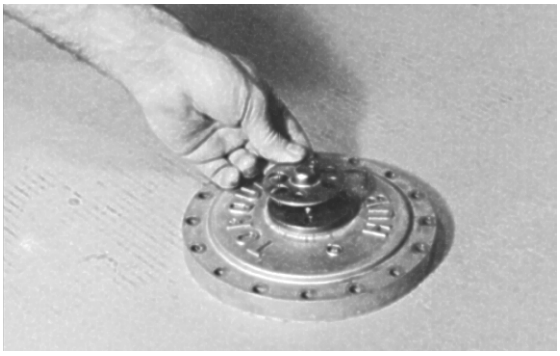


5. Place two cover cap bolts (6C) in any two bolt holes 180° apart on cover cap (6B) and tighten bolts.

6. Using a torque wrench, apply 36 to 49 in. lbs. (4 to 5 Nm) of torque to both bolts (6C).

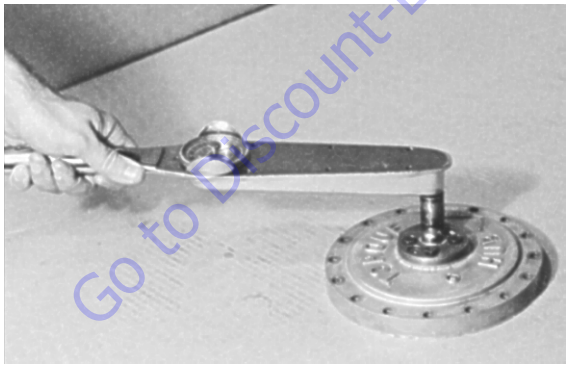


7. With large end down, place disconnect cap (6D) on cover cap (6B), aligning pipe plug hole in disconnect cap over pipe plug hole in cover cap.

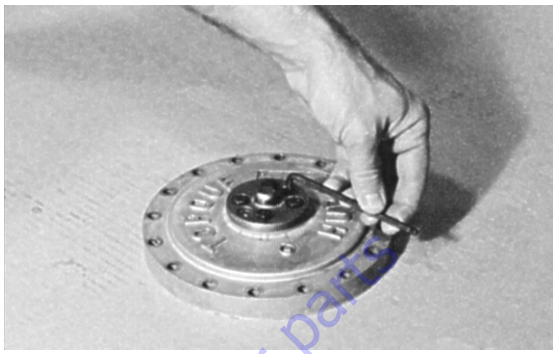


8. Place two remaining bolts (6C) in bolt holes in disconnect cap (6D) and tighten bolts.

9. Using a torque wrench, apply 36 to 49 in. lbs. (4 to 5 Nm) of torque to both bolts (6C).



10. Apply a light coat of "Never-Seize" to pipe plug (6H) and tighten it in pipe plug hole in cover (6A).

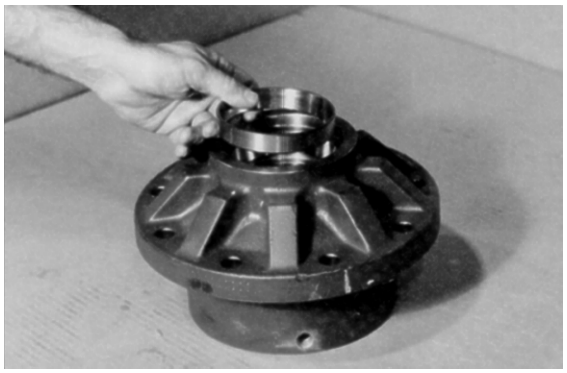


11. At this point cover sub-assembly is complete.

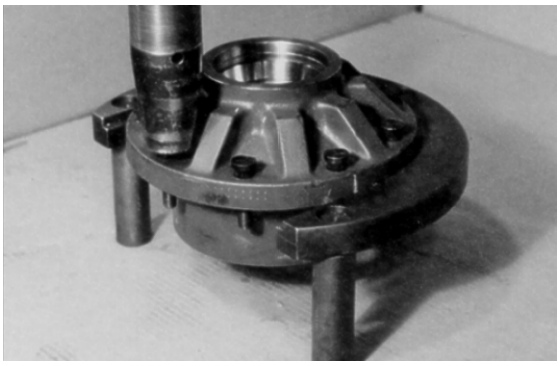
Hub-Spindle Sub-Assembly

NOTE: *Make sure cup sits square with counterbore before pressing.*

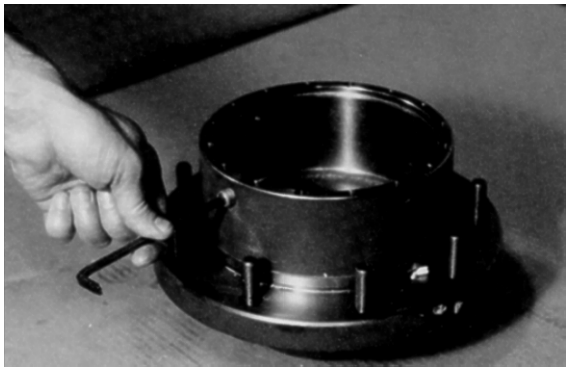
1. Set hub (1G) on large end. Press bearing cup (1C) into counterbore in small end of hub (1G).



2. Press nine studs (1N) in stud holes in hub (1G).

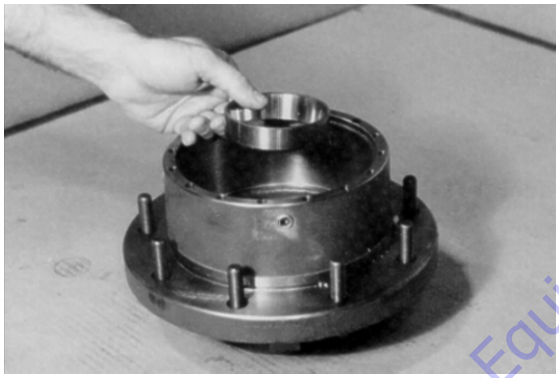


3. Apply a light coat of "Never-Seize" to two pipe plugs (1J) and tighten them in two pipe plug holes in side of hub (1G).

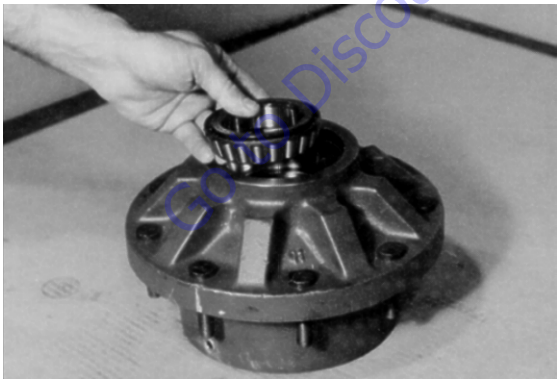


NOTE: *Make sure cup sits square with counterbore before pressing.*

4. Turn hub (1G) over to small end. Press bearing cup (1E) into counterbore in deep end of hub (1G).



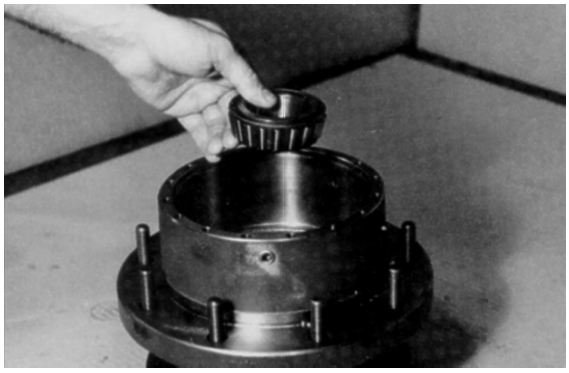
5. Set hub (1G) on large end. Place bearing cone (1D) into bearing cup (1C).



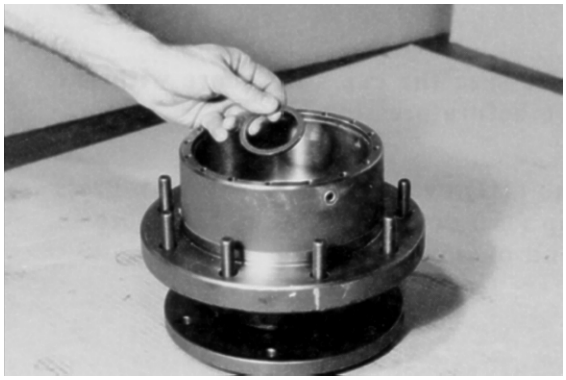
6. Press seal (1B) in small end of hub (1G).

7. Oil spindle, then lower hub (1G) small end down, onto spindle (1A).

8. Press bearing cone (1F) on spindle (1A) in hub (1G).



9. Place spacer (1H) on spindle (1A) in hub (1G).



NOTE: *Make sure retaining ring is securely seated in groove.*

10. Place retaining ring (1I) over spacer onto spindle (1A) in hub (1G).

11. At this point hub-spindle sub-assembly is complete.

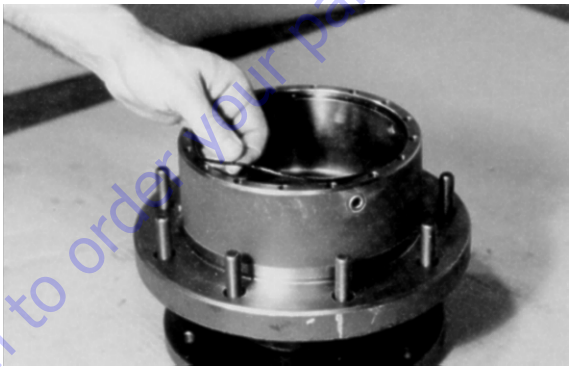
Main Assembly

⚠ CAUTION

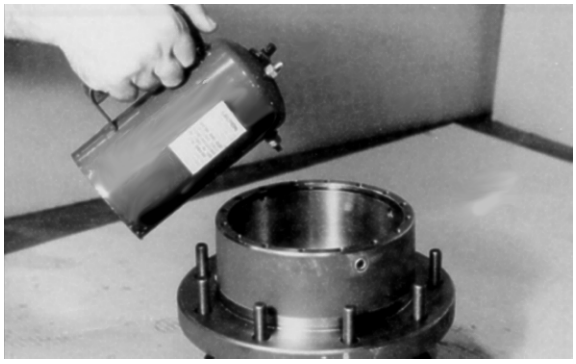
SHARP EDGES CAN CUT AND CAUSE SERIOUS INJURY. BEWARE OF SHARP EDGES IN COUNTERBORE WHEN REMOVING O-RING.

1. Grease O-ring (5) and place it into counterbore in hub (1G).

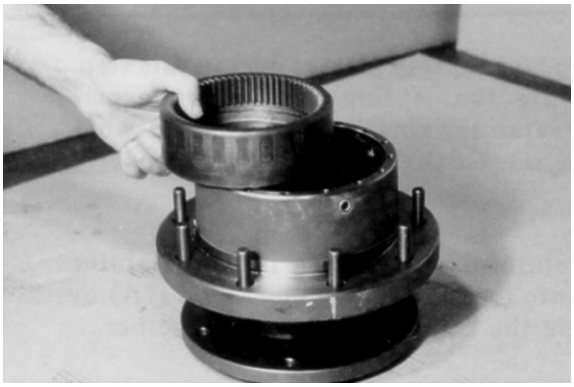
NOTE: *O-ring may be stretched or pinched together to make it fit into counterbore.*



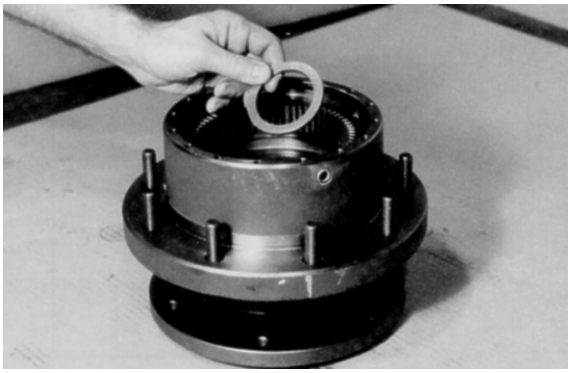
2. Oil exposed surfaces inside hub (1G).



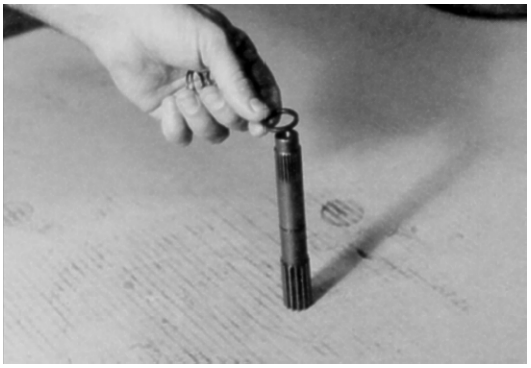
3. Place internal gear (2) in hub (1G) so its internal splines mesh with external splines of spindle (1A). Oil internal gear (2).



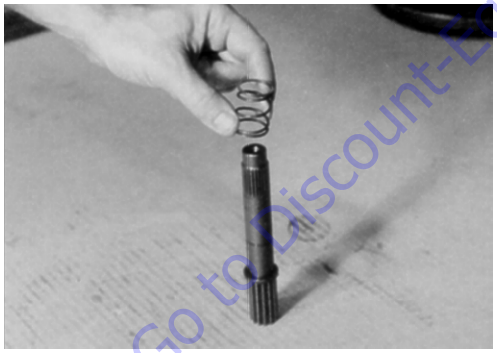
4. Place thrust washer (11) around spindle (1A) so it rests on bottom of internal gear (2).



5. Stand input shaft (7A) on splined end. Place one spacer (7D) on smooth end of input shaft (7A).



6. Place spring (7C) on smooth end of input shaft (7A).

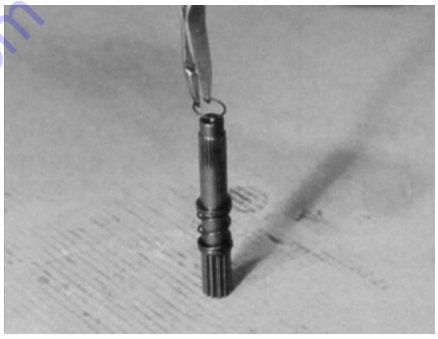


7. Place other spacer (7D) on smooth end of input shaft (7A).

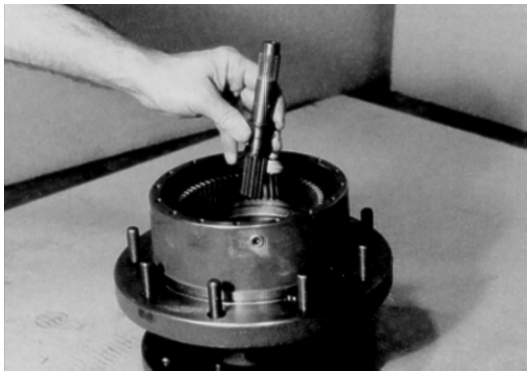
⚠ CAUTION

UNCONTROLLED OBJECTS CAN CAUSE EYE DAMAGE OR SERIOUS INJURY. ALWAYS WEAR EYE PROTECTION.

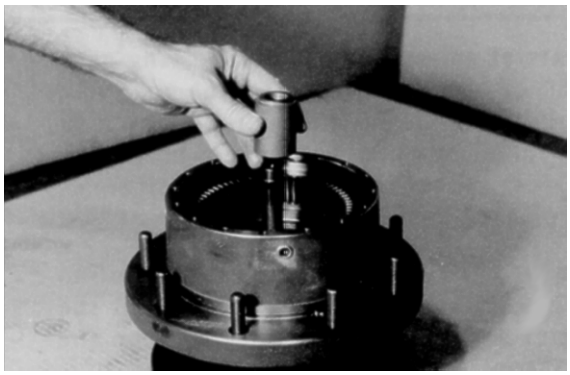
8. Using retaining ring pliers, insert retaining ring (7B) in groove on input shaft (7A) by compressing spring and spacers together.



9. With large splined end down, place input shaft sub-assembly (7) into spindle (1A).



10. Place thrust spacer (9) onto input shaft (7).



11. Set carrier sub-assembly (3) on a flat work surface so large ends of cluster gears (3F) face up. Locate punch marks on face of each cluster gear (3F) and position them at 12 o'clock.

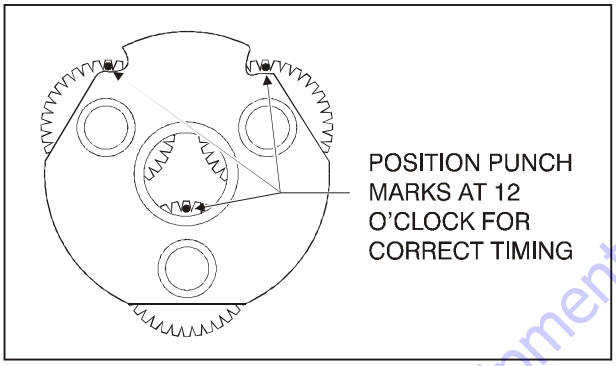
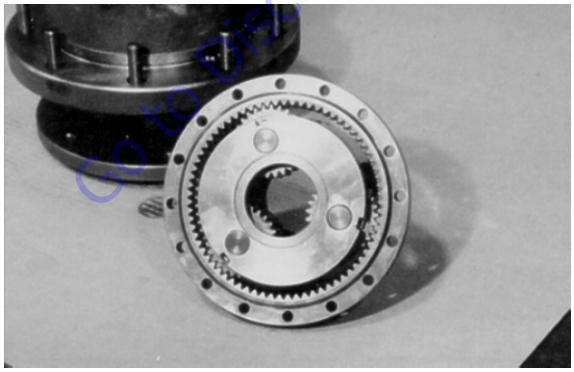


Figure 3-11. Cluster Gear Punch Marks

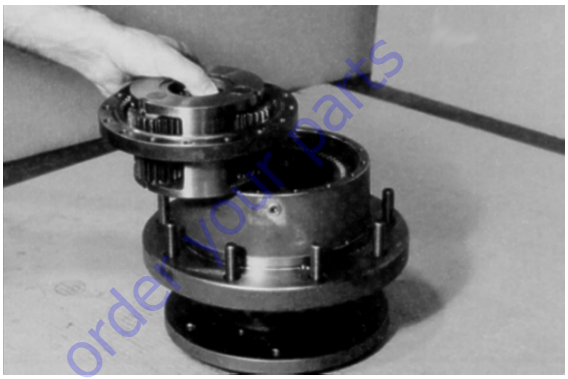
12. With "X" marked side facing up, place ring gear (4) around cluster gears (3F).

NOTE: *This will hold punch marks in position while installing carrier into hub.*

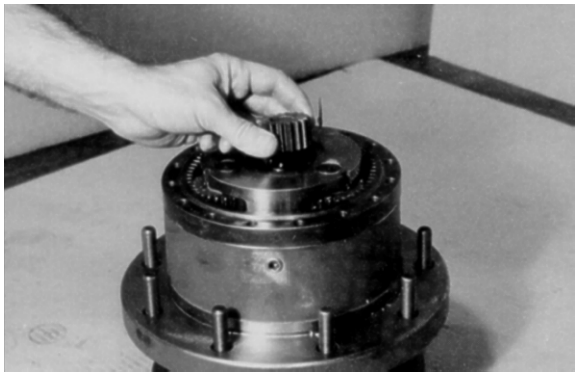


13. Place carrier sub assembly (3) and ring gear (4) together into mesh with internal gear (2), aligning "X" marked shoulder bolt hole in ring gear (4) over one of the shoulder bolt holes in hub. Mark location of shoulder bolt holes on outside of ring gear and hub.

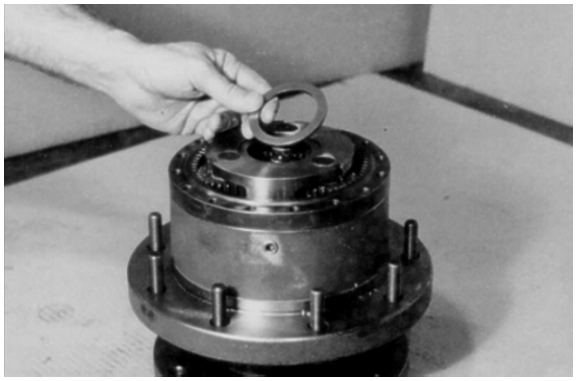
NOTE: *You may lift ring gear off hub to align shoulder bolt holes. Ring gear and carrier are installed together only to keep punch marks on carrier in place.*



14. With internal splines facing up (counterbore end facing down), place input gear (8) into mesh with carrier sub-assembly (3).



15. Oil all exposed surfaces inside hub (1G). Place thrust washer (11) into counterbore in top of carrier.

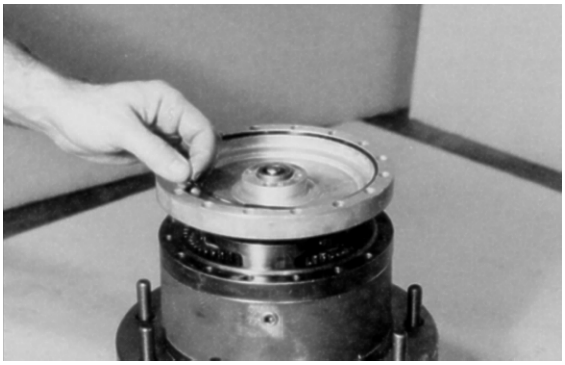


⚠ CAUTION

SHARP EDGES IN COUNTERBORE CAN CUT AND CAUSE INJURY WHEN INSTALLING O-RING.

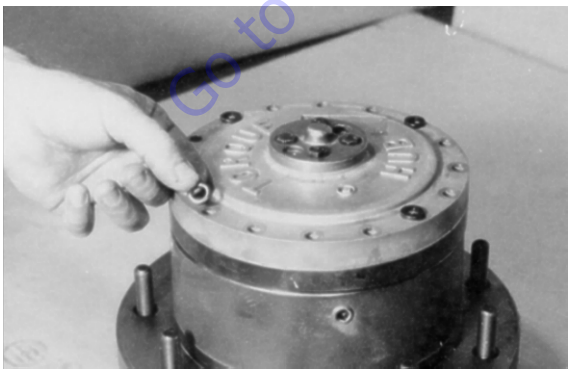
16. Set cover (6A) on table, interior side up. Grease O-ring (5) and place in counterbore around edge of cover (6A).

NOTE: *O-ring may be stretched or pinched together to make it fit counterbore.*

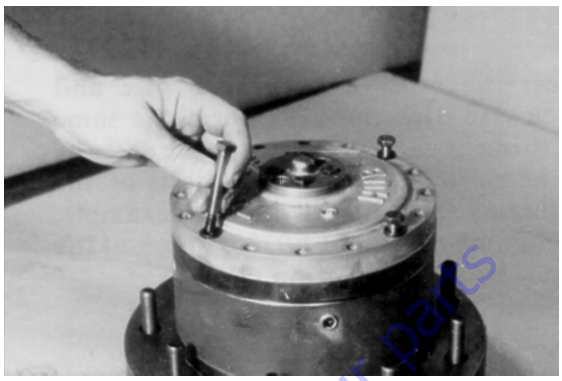


17. Place cover sub-assembly (6) on ring gear (4). Align pipe plug holes before disassembly.

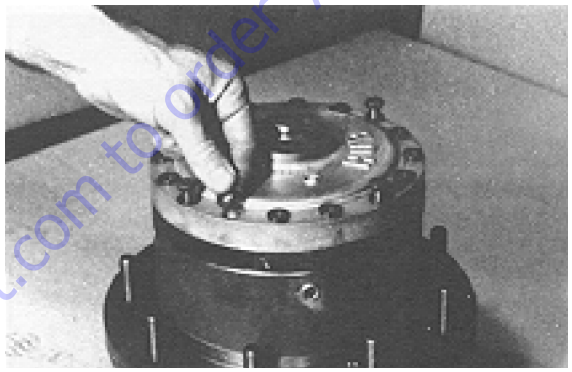
18. Place four flat washers (16) on top of bolt holes in cover sub-assembly.



19. Place shoulder bolts (13) in four shoulder bolt holes in cover (6) and hand-tighten.

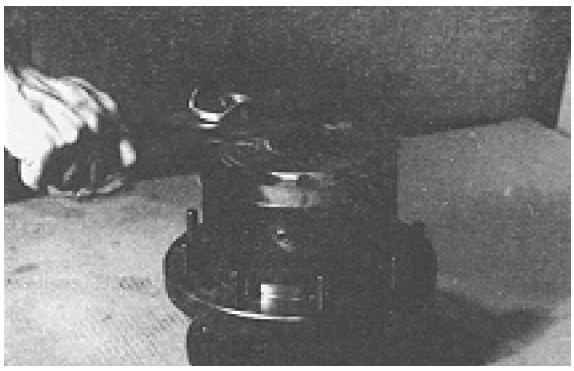


20. Place remaining 12 flat washers (16) on remaining bolt holes in cover (6).

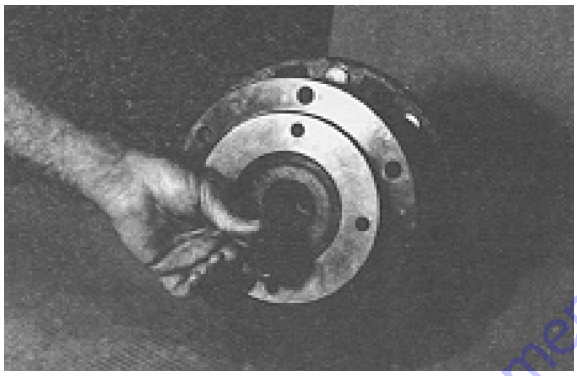


21. Place 12 bolts in remaining bolt holes in cover (6) and tighten.

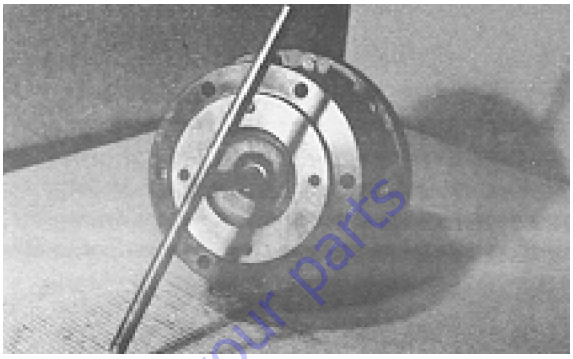
22. Torque shoulder bolts (13) 18 to 25 ft. lbs. (25 to 34 Nm). Torque bolts (12) 18 to 25 ft. lbs. (25 to 34 Nm).



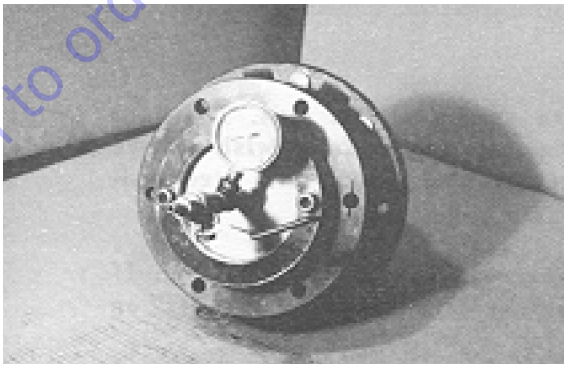
23. Turn hub (1G) on its side. Insert coupling (14) into end of spindle (1A).



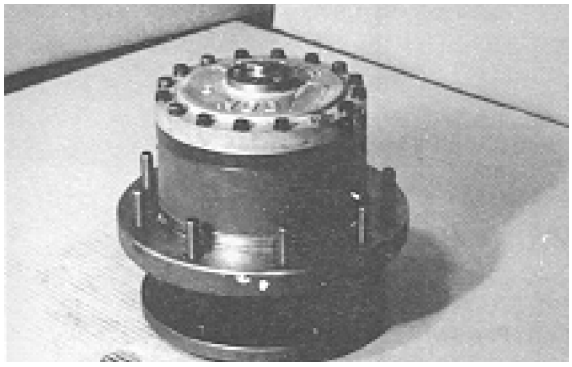
24. Roll test unit in clockwise and counterclockwise directions. Perform same number of turns in each direction as the ratio of the unit. The ratio is the last two digits of the model number on the unit's ID tag.



25. Leak test unit at a pressure of 5 psi (34.47 kPa) for 2 to 3 minutes.



26. At this point main assembly is complete.

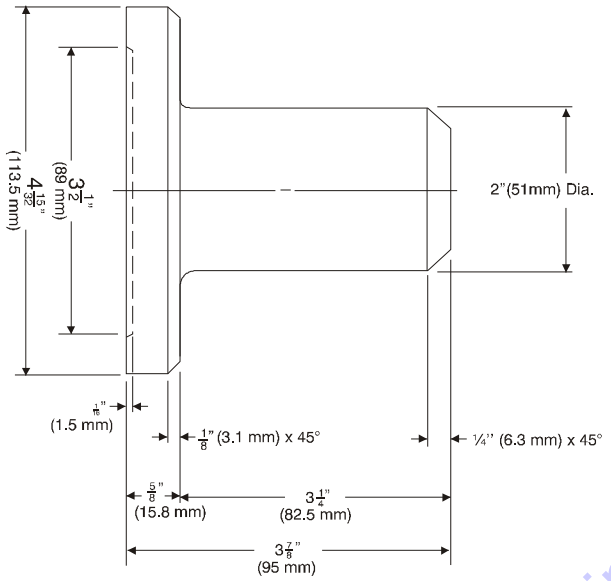


Tool List

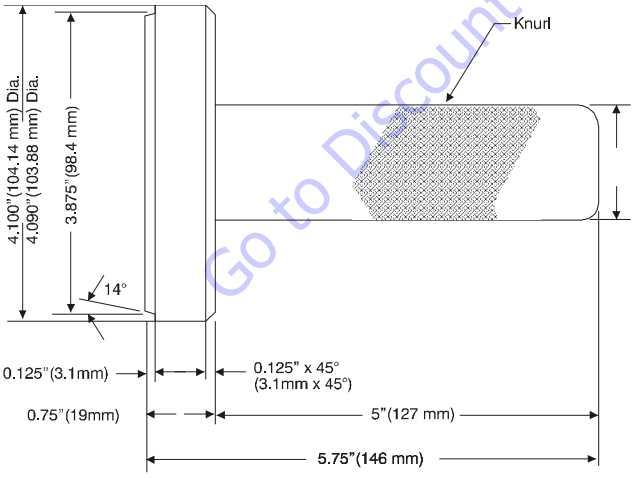
The following specialized tools are used to assemble this unit. Tool diagrams in this manual are intended for the customer who may wish to have a tool made. All tools are one piece and must be made from mild steel. All dimensions are in inches.

NOTE: *Tools may be carburized and hardened to improve tool life. If this is done, tools must be ground on all surfaces labeled with a "G" on the tool diagram.*

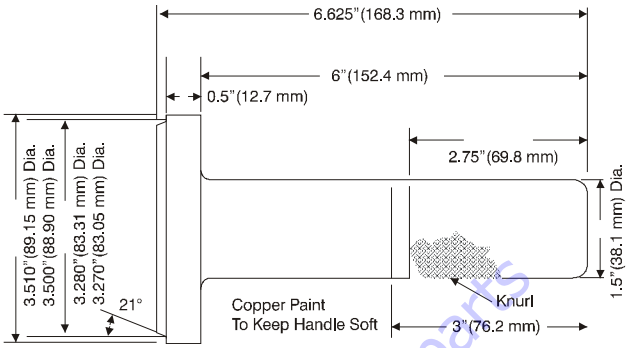
1. T-118126 SEAL PRESSING TOOL FOR SEAL (1B).



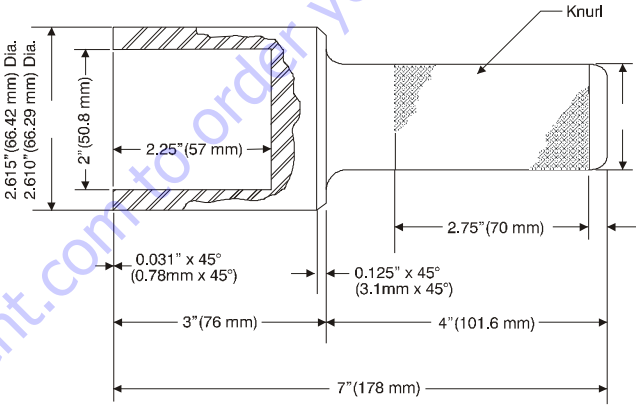
2. T-138903 ASSEMBLY PRESSING TOOL FOR CUP (1C).



3. T-140433 ASSEMBLY PRESSING TOOL FOR CUP (1E).



4. T-109691 ASSEMBLY PRESSING TOOL FOR CONE (1F).



* These tools are for specific seals, cups or cones. There is a specific tool for each cup and cone.

3.10 RE-ALIGN TORQUE HUB INPUT COUPLING

This procedure applies to torque hubs with integral brakes:

Equipment Required

1. Hydraulic power supply (hand pump) capable of producing 200 psi (13.8 bar).
2. Hydraulic fittings to adapt hydraulic supply to brake release port on hub.

Procedure

1. Using appropriate fittings, connect a line from hydraulic power supply to brake port.
2. Pressurize brake release port to 155 - 200 psi (10.6 - 13.8 bar) to release brake.
3. Verify brake is released by rotating input coupling or hub spindle. Once brake is released, input coupling is free to re-align with drive motor.
4. Install drive motor on hub. Release hydraulic pressure at brake release port. Coupling remains in position.
5. Disconnect hydraulic power supply and reconnect line to brake release port.

3.11 DRIVE MOTOR

Description

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

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

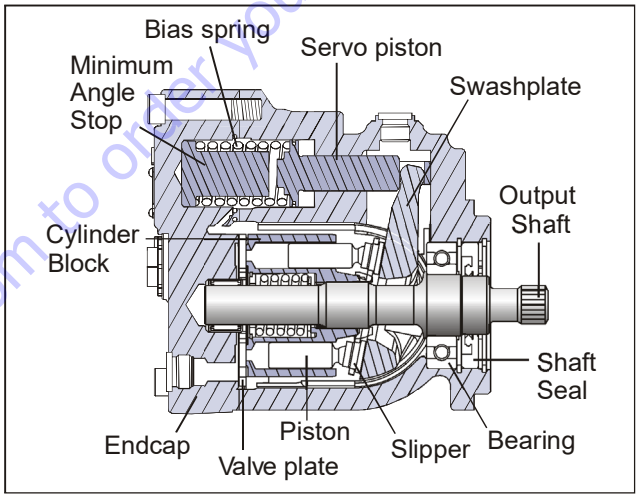
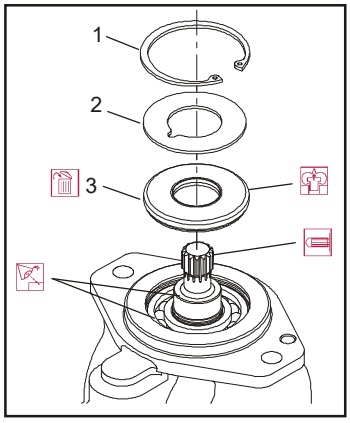


Figure 3-12. Drive Motor Cross Section

Shaft Seal Replacement

REMOVAL

1. Remove snap ring (1) and support washer (2).



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

Figure 3-13. Removing Shaft Seal

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

2. Carefully pry out and discard shaft seal (3).

INSPECT COMPONENTS

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

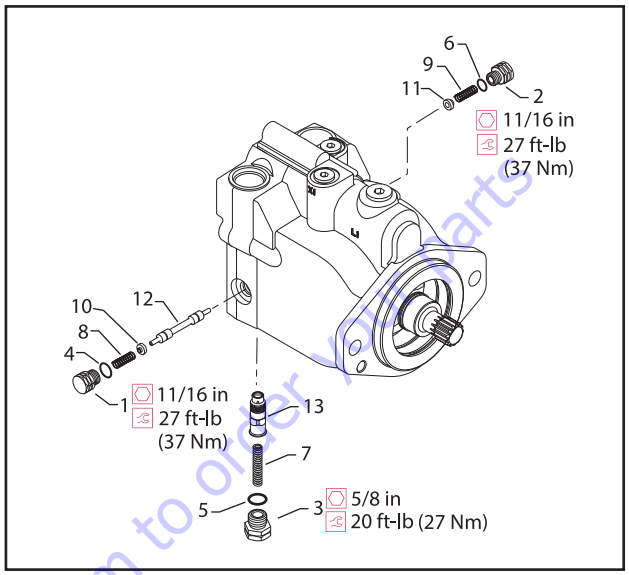
INSTALLATION

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

Loop Flushing Valve

REMOVAL

1. Remove plug (1) and (2) with 11/16 in. internal hex wrench.



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

Figure 3-14. Loop Flushing Spool

2. Use 1/4 in. in hex wrench to remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Use pliers to remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).
8. Inspect new O-rings and sealing area for rust, wear, or contamination. Check springs and poppet for wear.

INSTALLATION

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

Troubleshooting

Table 3-3. Excessive Noise and/or Vibration

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

Table 3-4. System Operating Hot

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

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

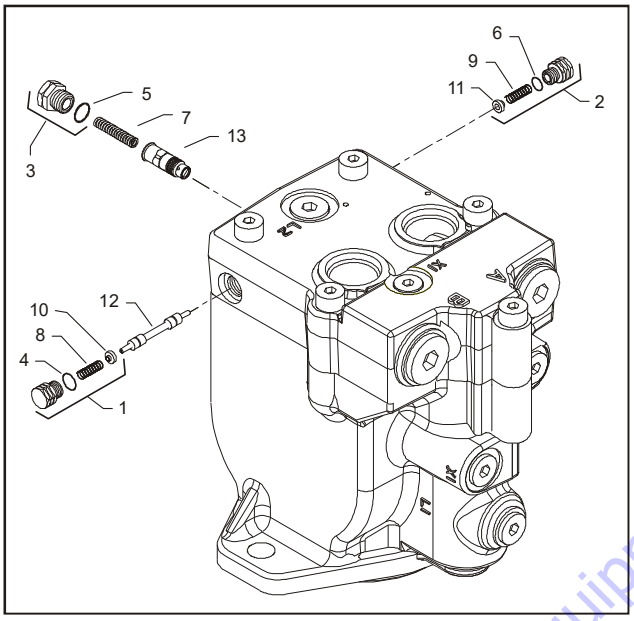
Item	Description	Action
Check signal line to servo control port.	Obstructed or restricted flow through the servo control signal lines could result in slow shift or no shift conditions within the motor.	Ensure signal lines are not obstructed or restricted and that signal pressure is adequate to shift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

Disassembly

NOTE: *Removal of endcap voids warranty.*

During assembly, coat all moving parts with a film of clean hydraulic oil. This ensures parts are lubricated during start-up.

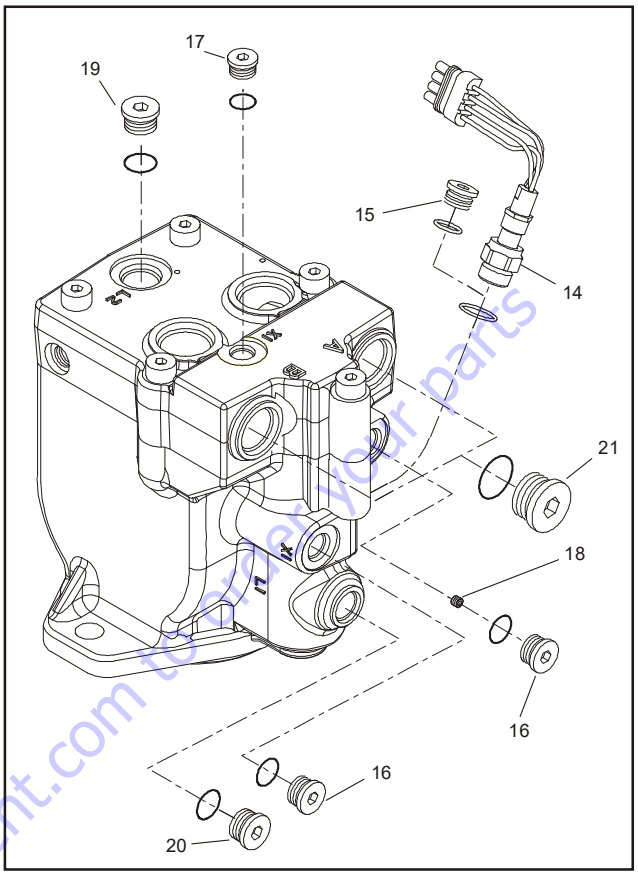
Replace all O-Rings and gaskets. Lightly lubricate O-rings with clean petroleum jelly prior to assembly.



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

Figure 3-15. Loop Flushing Spool

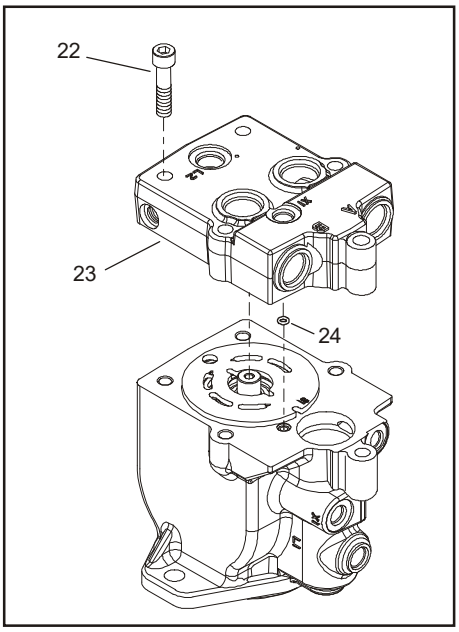
1. Using a 11/16 in. wrench, remove plug (1) and (2).
2. Using a 5/8 in. hex wrench, remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Using pliers, remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).



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

Figure 3-16. Plugs, Fittings, and Speed Sensor

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



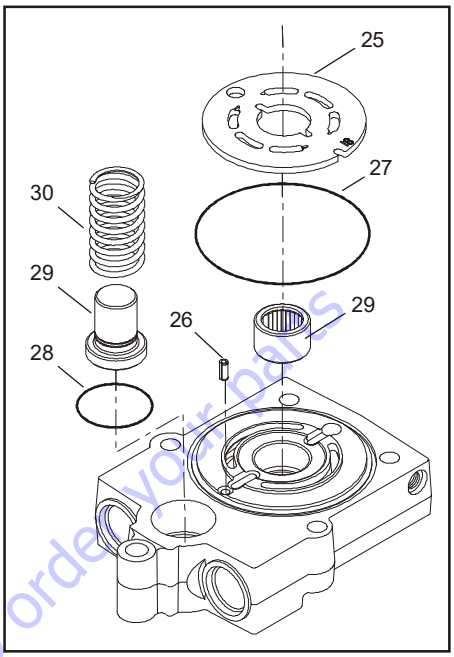
22. Screw
23. End Cap
24. O-ring

Figure 3-17. End Cap

13. Using an 8 mm internal hex wrench, remove endcap screws (22).

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

NOTE: *When endcap screws are removed, pressure from servo spring will cause endcap to bind on shaft. Press down on portion of endcap covering servo piston and hold endcap level while removing.*



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

Figure 3-18. Valve Plate & Rear Shaft Bearing

NOTICE

DO NOT SCRATCH VALVE PLATE SURFACE.

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

NOTE: *Each displacement has a unique valve plate. The last two digits of the part number are stamped on its surface.*

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

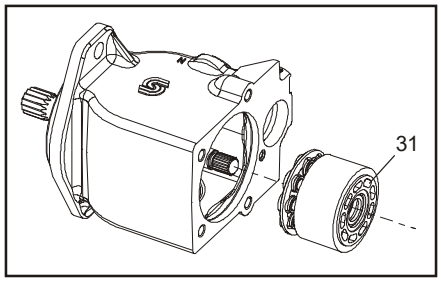
17. Remove rear shaft bearing (29) from endcap with a bearing puller.

NOTICE

DO NOT DRIVE BEARING PAST REAR SHAFT JOURNAL. BEARING MAY BECOME TRAPPED ON SHAFT AND DAMAGED.

NOTE: *Bearing may be difficult to remove with a puller. Try this as an alternative: Pack bearing cavity with heavy grease. After shaft is removed, insert it into bearing cavity and tap lightly with a soft mallet on the splined end. Grease will force out bearing.*

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



31. Cylinder Kit Assembly

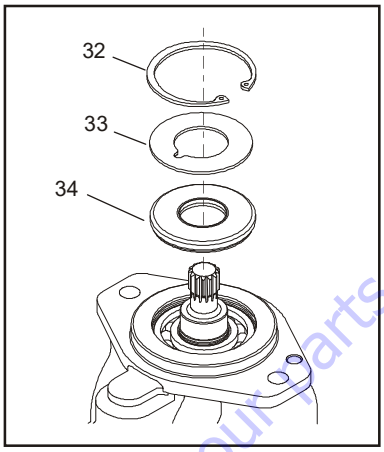
Figure 3-19. Cylinder Kit

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

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

Table 3-6. Displacement Identifiers

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

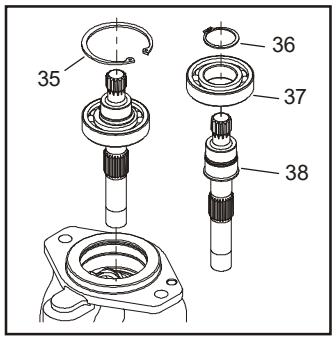


32. Snap Ring
33. Support Washer
34. Shaft Seal

Figure 3-20. Shaft Seal

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

NOTE: *To avoid damaging shaft during seal removal. Install a large sheet metal screw in chuck of a slide hammer. Drive screw into seal surface. Use slide hammer to pull seal.*

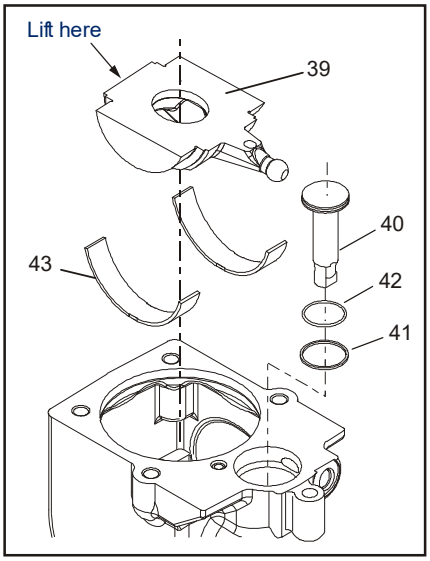


35. Inner Snap Ring
36. Snap Ring
37. Bearing
38. Shaft

Figure 3-21. Shaft & Front Bearing

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

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



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

Figure 3-22. Swash Plate & Servo Piston

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

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

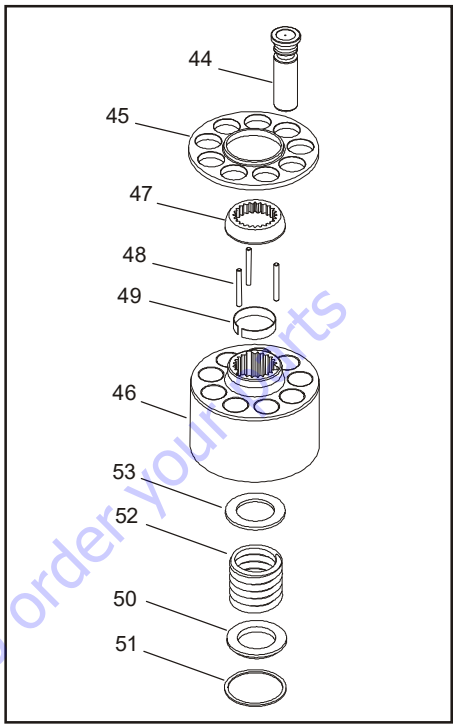
25. Remove journal bearings (43) from housing. If bearings will be reused, note location and orientation of each bearing for reassembly.

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

NOTE: *Pistons are not selectively fitted. Units with high hourly usage may develop wear patterns. Number pistons and bores for reassembly if they will be reused.*

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

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



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

Figure 3-23. Cylinder Kit Disassembly

⚠ WARNING

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

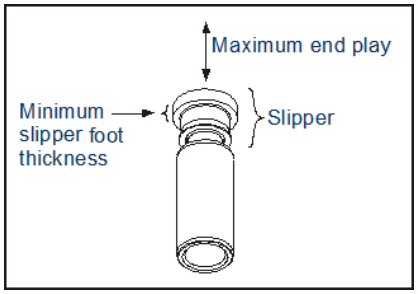
28. Turn block over. Using a press, apply pressure on block spring washer (50) to compress block spring enough to safely remove spiral retaining ring (51). Maintain pressure and unwind spiral retaining ring (51). Carefully release pressure and remove outer block spring washer (50), block spring (52),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

Inspection

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

PISTON

Inspect pistons for damage and discoloration. Discolored pistons may indicate excessive heat. Do not reuse.



SLIPPERS

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

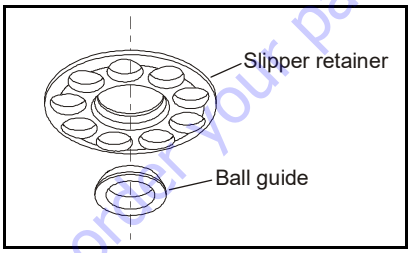
Minimum slipper foot thickness and maximum axial end-play are shown in table 3.6.

Table 3-7. Slipper Foot Thickness & End Play

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

BALL GUIDE AND SLIPPER RETAINER

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

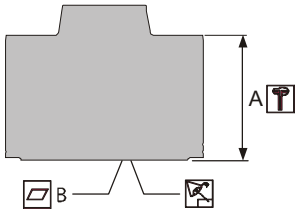


CYLINDER BLOCK

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

Table 3-8. Cylinder Block Measurements

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

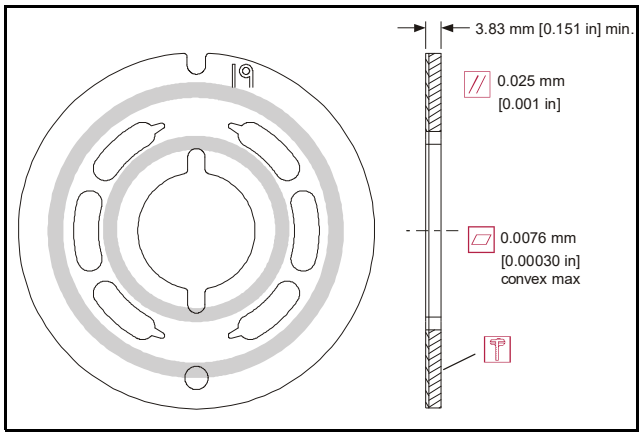


VALVE PLATE

Valve plate condition is critical to motor efficiency. Inspect valve plate surfaces for excessive wear, grooves, or scratches.

Replace or resurface grooved or scratched valve plates. Measure valve plate thickness and replace if worn beyond minimum specification.

Valve plate can be resurfaced if finished thickness is not below minimum specification shown in drawing.

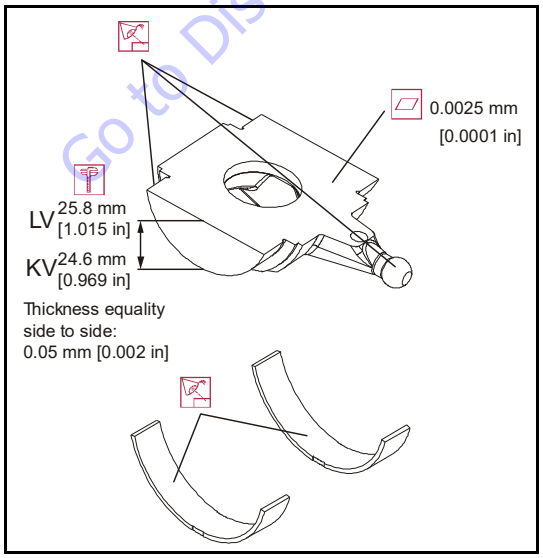


SWASHPLATE AND JOURNAL BEARINGS

Inspect running face, servo ball-joint, and swashplate journal surfaces for damage or excessive wear.

Some material transfer may appear on these surfaces and is acceptable providing surface condition meets specifications shown.

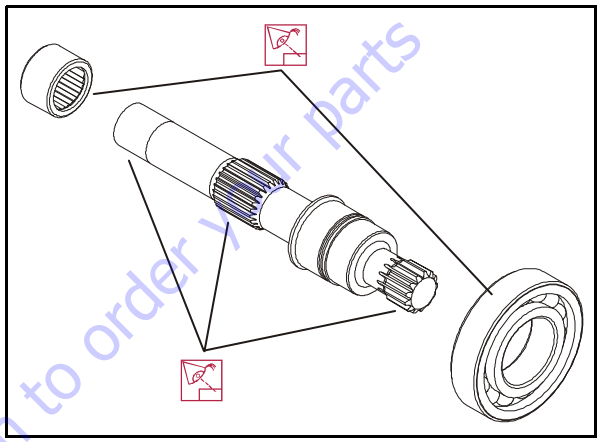
Measure swashplate thickness from journals to running face. Replace swashplate if damaged or worn beyond minimum specification.



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

SHAFT BEARINGS

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

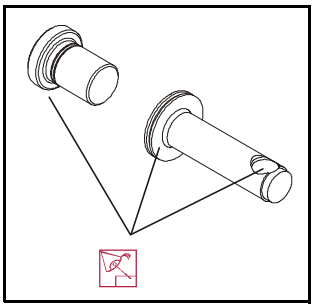


SHAFT

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

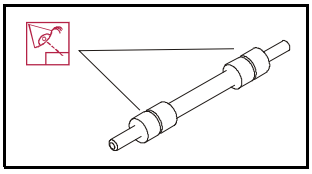
SERVO PISTON AND MINIMUM ANGLE STOP

Inspect minimum angle stop, servo piston head, and servo piston ball-socket for damage or excessive wear. Replace as needed.



LOOP FLUSHING SPOOL

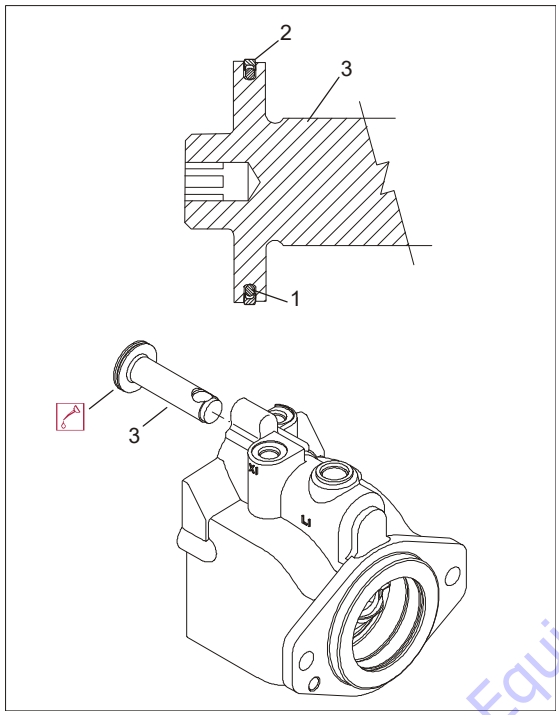
Inspect loop flushing spool. Check for cracks or damage. Replace as needed.



Assembly

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

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



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

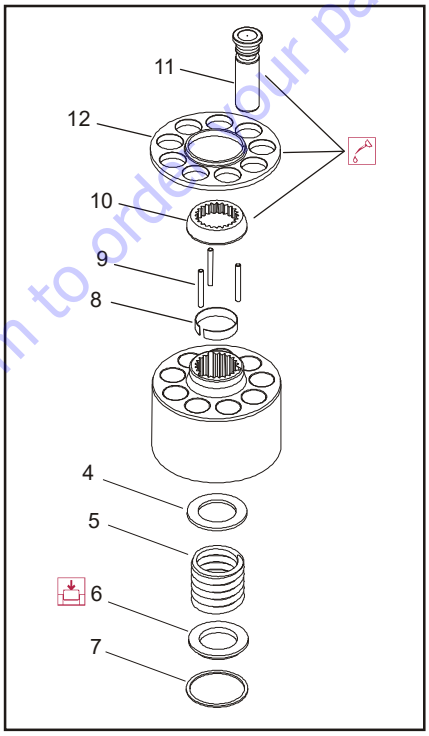
Figure 3-24. Servo Piston

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

⚠ WARNING

COMPRESSED SPRING MAY FLY OUT AND CAUSE SERIOUS INJURY. COMPRESSING BLOCK SPRING REQUIRES ABOUT 80 TO 90 LBF (350 TO 400 N) OF FORCE. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE SPRING IS SECURE BEFORE ATTEMPTING TO INSTALL SPIRAL RETAINING RING. RELEASE PRESSURE SLOWLY AFTER RETAINING RING IS INSTALLED.

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



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

Figure 3-25. Cylinder Kit Assembly

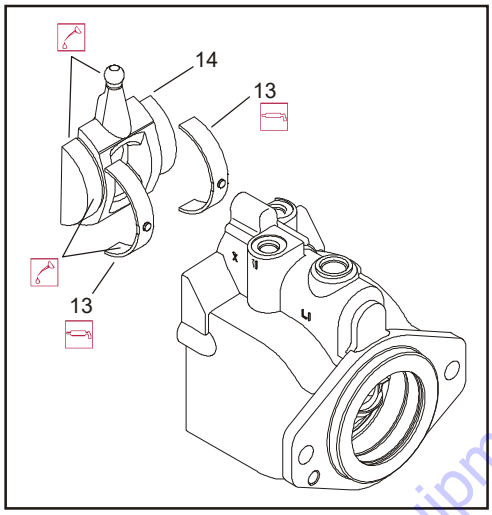
4. Turn block over and install retaining ring (8), hold-down pins (9), and ball guide (10) to cylinder block.

NOTICE

IF REUSING PISTONS, INSTALL THEM IN ORIGINAL BLOCK BORES.

5. Install pistons (11) to slipper retainer (12). Install piston/retainer assembly in cylinder block. Ensure concave surface of retainer seats on the ball guide. Lubricate pistons, slippers, retainer, and ball guide before assembly. Set cylinder kit aside on a clean surface until needed.

6. Install journal bearings (13) into housing seats. Use assembly grease to keep bearings seated during assembly. Ensure locating nubs drop into cavities in seats. If reusing bearings, install them in original location and orientation. Lubricate journal bearings.

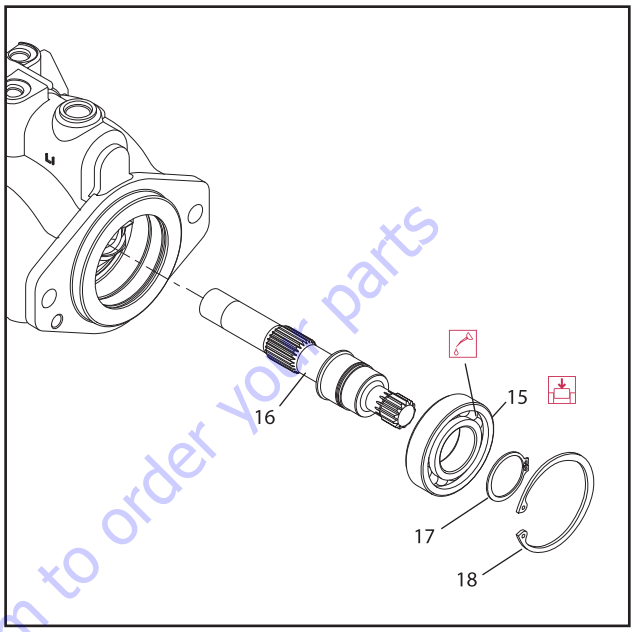


13. Journal Bearings
14. Swash Plate

Figure 3-26. Swash Plate and Journal Bearing

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

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

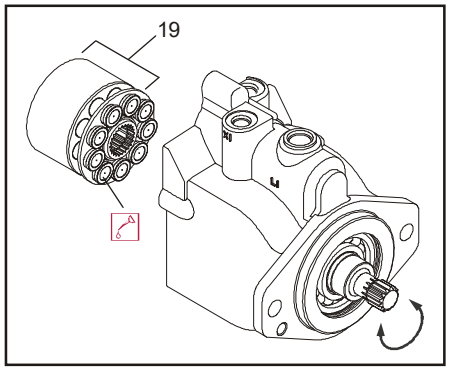


15. Front Shaft Bearing
16. Shaft
17. Snap Ring
18. Snap Ring

Figure 3-27. Shaft and Front Bearing

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

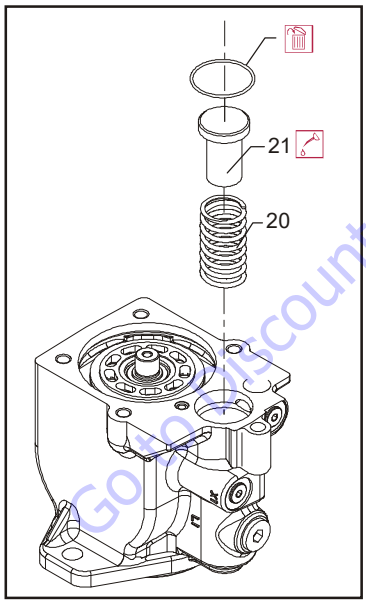
10. Verify swashplate and bearings are properly seated. Install cylinder kit (19) onto shaft. Install with slippers facing swashplate. Rock shaft to align block splines and slide cylinder kit into place. Orient motor with shaft pointing downward and verify cylinder kit, swashplate, journal bearings,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



19. Cylinder Kit

Figure 3-28. Cylinder Kit Installation

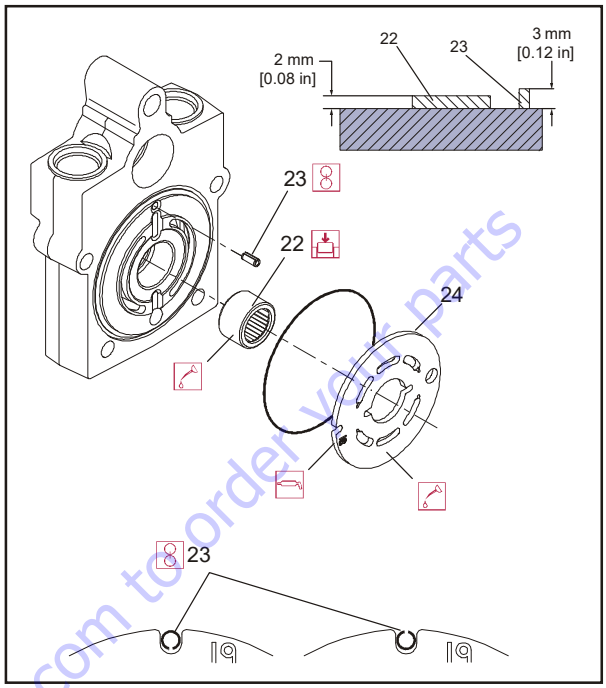
11. Lubricate and install servo spring (20), and minimum angle stop (21) into housing bore.



20. Servo Spring
21. Minimum Angle Stop

Figure 3-29. Servo Spring and Minimum Angle Stop

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



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

Figure 3-30. Valve Plate and Rear Bearing

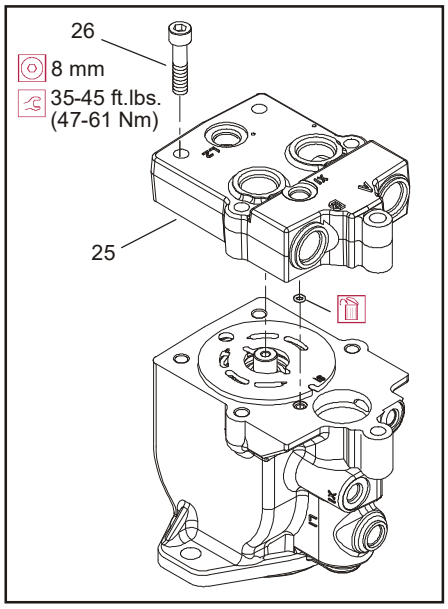
13. Install timing pin (23) into bore in endcap. Install pin with groove facing toward or away from shaft. Press pin until end protrudes 0.12 ±0.01 in (3 ±0.25 mm) above endcap surface.

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

15. Install endcap (25) on housing with endcap screws (26). Check endcap properly seats on housing without interference.

NOTICE

IMPROPER ASSEMBLY OF INTERNAL COMPONENTS MAY PREVENT ENDCAP FROM SEATING PROPERLY. ENSURE O-RINGS SEAT PROPERLY WHEN INSTALLING ENDCAP.



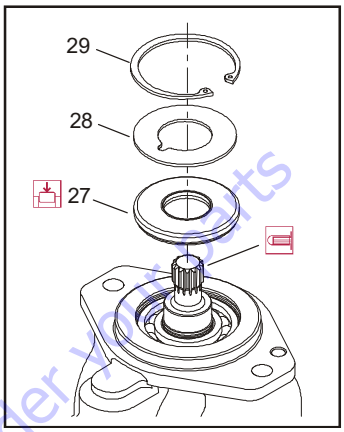
25. End Cap
26. Screw

Figure 3-31. End Cap

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

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

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



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

Figure 3-32. Shaft Seal

19. Install remaining plugs and fittings to housing. Refer to drawing below for wrench sizes and torque settings.

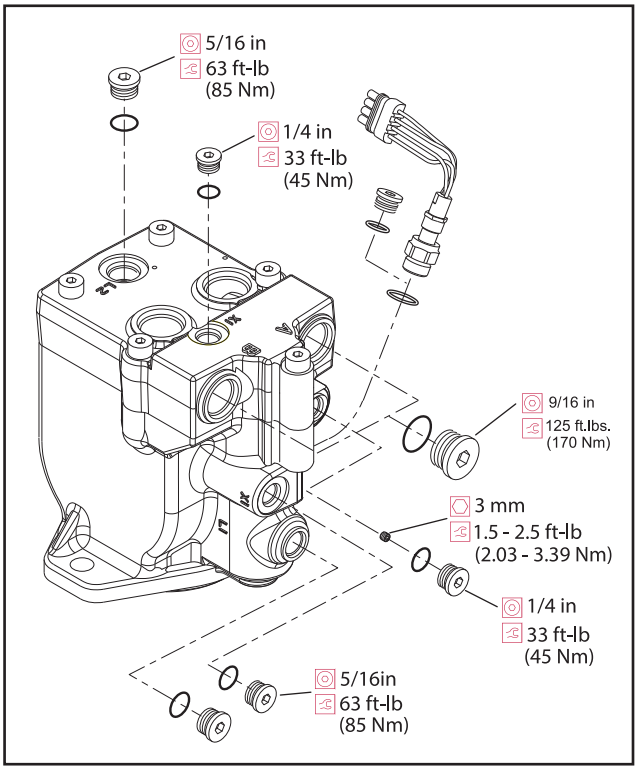


Figure 3-33. Plugs and Fittings Installation

20. Install orifice poppet (30).

21. Install shift spool (31).

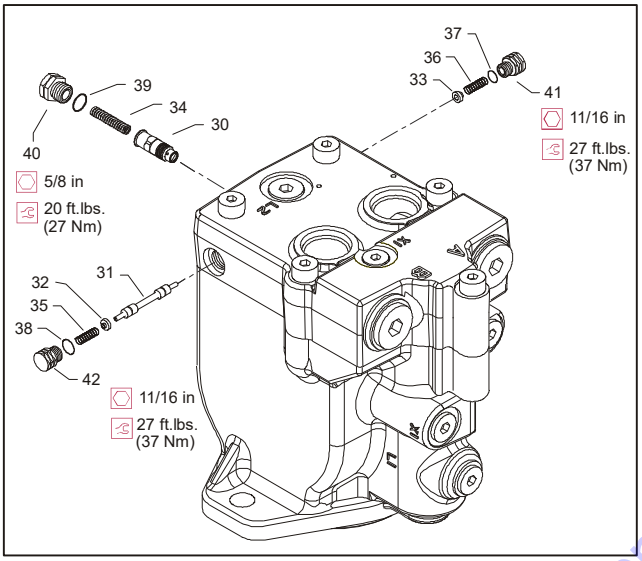
22. Install spring retaining washers on springs (32 and 33).

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

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

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

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



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

Figure 3-34. Loop Flushing Spool

Initial Start-Up Procedures

Follow this procedure when starting up a new motor or after reinstalling a motor.

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

1. Fill reservoir with recommended hydraulic fluid. Always filter fluid through a 10 micron filter when pouring into reservoir. Never reuse hydraulic fluid.

2. Fill inlet line leading from pump to reservoir. Check inlet line for properly tightened fittings and be certain it is free of restrictions and air leaks.

3. Fill pump and motor housing with clean hydraulic fluid. Pour filtered oil directly into upper most case drain port.

4. Install case drain lines into upper most case drain ports to ensure pump and motor stay filled with oil.

5. Install a 0 to 500 psi (0 to 35 bar) gauge in charge pressure gauge port of pump to monitor system pressure during start up.

6. Watch pressure gauge and run engine at lowest possible speed until system pressure builds to normal levels (minimum 160 psi (11 bar)). Once system pressure is established, increase to full operating speed. If system pressure is not maintained; shut down engine, determine cause, and take corrective action.

7. Operate hydraulic system at least fifteen minutes under light load conditions.

8. Check and adjust control settings as necessary after installation.

9. Shut down engine and remove pressure gauge. Replace plug at charge pressure gauge port.

10. Check fluid level in reservoir; add clean filtered fluid if necessary. Motor is now ready for operation.

3.12 DRIVE BRAKE

Refer to Figure 3-35., Drive Brake.

Disassembly

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

   If a press is available, the cylinder housing (8) can be secured on Face B while removing the capscrews and washers (13 & 14).

2. Remove the cylinder housing (8) and piston (9) subassembly and disassemble if necessary, removing O-ring seals (15 & 17) and backing rings (16 & 18) as necessary.

3. Remove the gasket (7) from the housing.

4. Remove the friction plates (3&6) and pressure plate (4).

5. Remove the dowel pins (19).

6. Remove the springs (22 & 23). Note the color and arrangement of the springs so they can be assembled in the same order.

7. If it's necessary to replace the ball bearing (10) or shaft seal (12), and reverse the brake position so it is supported on Face C of the housing (2).

8. Remove the internal retaining ring (11).

9. Using a press or similar device, remove the brake shaft (1) from the housing (2) and lay it aside.

10. Reverse the position of the housing (2) and press out the ball bearing (10). if necessary, the shaft seal (12) can be removed.

Inspection

1. Inspect the friction plates (3 & 6) and friction surface on the pressure plate (4) for wear or damage.

2. Examine the friction plates (3) and brake shaft (1) for wear or damage to the splines.

3. Examine the input and output splines of the brake shaft- for wear or damage.

4. Examine the compression springs (22 & 23) for damage or fatigue.

5. Check the ball bearing (10) for axial float or wear.

6. Examine O-ring seals (15 & 17) and backing rings (16 & 18) for damage.

Assembly

1. Lightly lubricate the rotary shaft seal (12) and assemble it to the housing (2) taking care not to damage the seal lip.

2. Apply a ring of Medium Strength Threadlocking Compound or equivalent adhesive to the outside diameter of bearing (10) and assemble fully in the housing (2). Secure the bearing in place with the retaining ring (11). Remove any excess adhesive with a clean cloth. Press the shaft (1) through the bearing (10), ensuring the bearing inner ring is adequately supported.

3. Assemble the springs into position as recorded during Disassembly.

4. Lubricate the)-rings (15 & 17) with Molykote 55M or equivalent silicone grease and assemble them, with the backing rings (16 & 18) to the piston (9). To ensure correct brake operation, it is important that the backing rings are assembled opposite to the pressurized side of the piston (9).

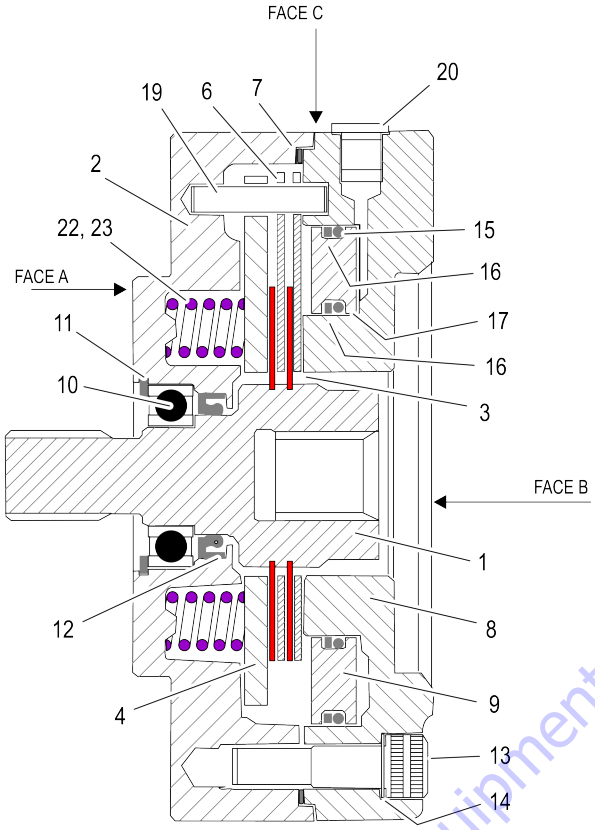
5. Correctly orient the piston aligning spaces with the two dowel pin holes and install into the cylinder housing (8) taking care not to damage the seals. Carefully lay these parts aside.

6. Install the dowel pins (19) in the housing (2) followed by the pressure plate (4) and friction plates. For example, in inner plate (3) followed by an outer plate (6) in the correct sequence.

7. Position the gasket (7) in the correct location.

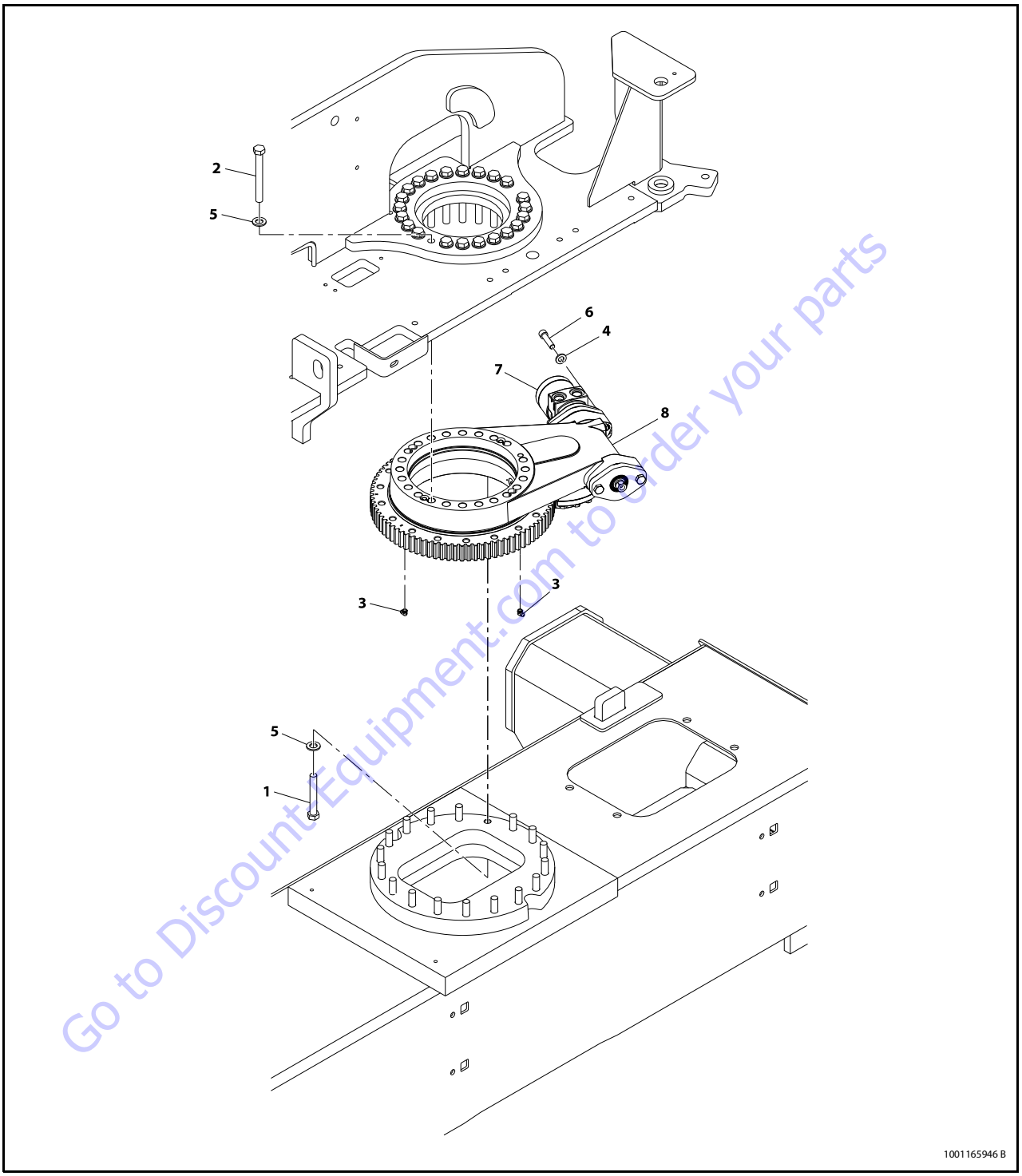
8. Align the two holes in the cylinder with the dowel pins (19) and assemble the piston and cylinder subassembly to the remainder of the brake. Secure in place with the capscrews and washers (13 & 14). Torque to 55 ft. lbs. (75 Nm).

NOTE: *The use of a suitable press on cylinder end Face B will ease installation of the capscrews (13).*



1. Brake Shaft
2. Housing
3. Inner Friction Plate
4. Pressure Plate
5. Gasket (Not Shown)
6. Outer Plate
7. Gasket
8. Cylinder
9. Piston
10. Ball Bearing
11. Retaining Ring
12. Rotary Shaft Seal
13. Socket Head Capscrew
14. Washer
15. O-ring
16. Backing Ring
17. O-ring
18. Backing Ring
19. Dowel Pin
20. Plug
21. Not Used
22. Spring
23. Spring

Figure 3-35. Drive Brake



1. Bolt
2. Bolt
3. Grease Fitting
4. Washer
5. Washer
6. Capscrew
7. Swing Motor
8. Turntable Bearing

Figure 3-36. Swing System

3.13 SWING BEARING

Removal

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. Remove the grease fittings attached to the frame and outer race of the swing bearing.
4. Attach suitable overhead lifting equipment to the base of turntable weldment.
5. 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.
6. 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.
7. Carefully place the turntable on a suitably supported trestle. 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.
8. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing and rotation box assembly from the frame; move to a clean, suitably supported work area.

Installation

1. Using an adequate lifting device, place the bearing assembly onto the frame. Align the 1/8 NPT holes in the bearing with the notches in the frame and install the grease fittings as shown in Figure 3-36., Swing System.
2. Coat the bearing bolts with High Strength Threadlocking Compound and secure the bearing assembly to the frame with the bolts. Following the torque sequence diagram in Figure 3-37., Swing Bearing Torque Sequence, tighten the bolts to torque of 206.5 ft. lbs. (280 Nm).
3. If any hydraulic hoses were disconnected to remove the swing bearing assembly, reconnect them as tagged during removal.

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

4. Using an adequate lifting device, lift the turntable assembly from the blocking it is resting on and lower it down onto the swing bearing assembly. Refer to the removal instructions for chain placement.
5. Install several bearing bolts snuggly to secure the turntable's position on the swing bearing assembly, but do not torque them at this time and keep the lifting device in place to support the weight of the turntable.
6. Coat the bearing bolts with High Strength Threadlocking Compound and install the remaining bolts securing the turntable to the swing bearing. Tighten the bolts snugly but do not torque them at this time. Remove the bolts installed to secure the turntable's position and apply threadlocker to them. Reinstall them in the same manner as the other bolts.
7. Following the torque sequence diagram in Figure 3-37., Swing Bearing Torque Sequence, tighten the bolts to torque of 206.5 ft. lbs. (280 Nm).
8. Remove the lifting equipment.
9. Route hydraulic lines through center of turntable and frame and connect as tagged prior to removal.
10. Using all applicable safety precautions, activate the hydraulic system and functionally check swing system for proper and safe operation.

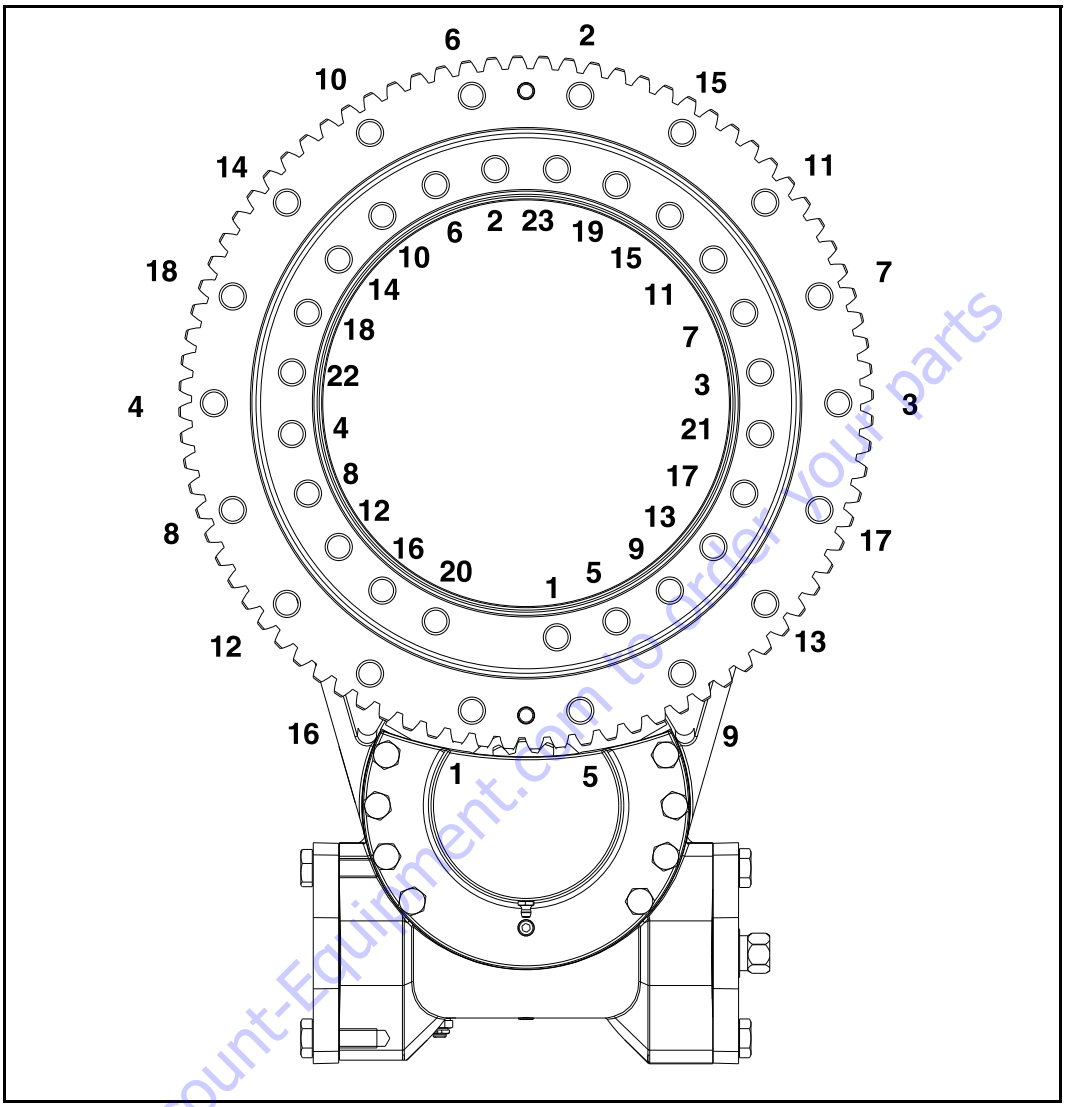


Figure 3-37. Swing Bearing Torque Sequence

Turntable Bearing Mounting Bolt Condition Check

NOTICE

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

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

1. Check the frame to bearing. Attach bolts as follows:
   - **a.** Elevate the fully extended main boom to horizontal as shown in Figure 3-41.
   - **b.** At the positions indicated on Figure 3-38. try and insert the 0.0015 in. feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   - **c.** Assure that the 0.0015 in. feeler gauge will not penetrate under the bolt head to the bolt shank.
   - **d.** Swing the turntable 90 degrees, and check some selected bolts at the new position.
   - **e.** Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.
2. Check the turntable to bearing. Attach bolts as follows:
   - **a.** Elevate the fully retracted main boom to full elevation as shown in Figure 3-40.
   - **b.** At the positions indicated on Figure 3-38. try and insert the 0.0015 in. feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   - **c.** Lower the boom to horizontal and fully extend the boom.
   - **d.** At the position indicated on Figure 3-38. try and insert the 0.0015 in. feeler gauge between the bolt head and hardened washer at the arrow indicated position.

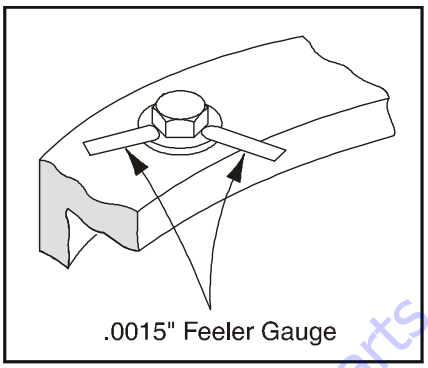


Figure 3-38. Swing Bolt Feeler Gauge Check

Wear Tolerance

1. With the boom positioned over the side of the machine, the Main Boom horizontal with telescope fully extended and Tower Boom stowed, (See Figure 3-41.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-39.)
2. At the same point, with the boom positioned over the side of the machine, the Main Boom fully elevated and the Tower Boom fully elevated, (See Figure 3-40.) using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-39.)
3. If a difference greater than 0.057 in. (1.40 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.057 in. (1.40 mm) is determined, and any of the following conditions exist, the bearing should be removed.
   - **a.** Metal particles in the grease.
   - **b.** Increased drive power.
   - **c.** Noise.
   - **d.** Rough rotation.
5. If bearing inspection shows no defects, reassemble bearing and return to service.

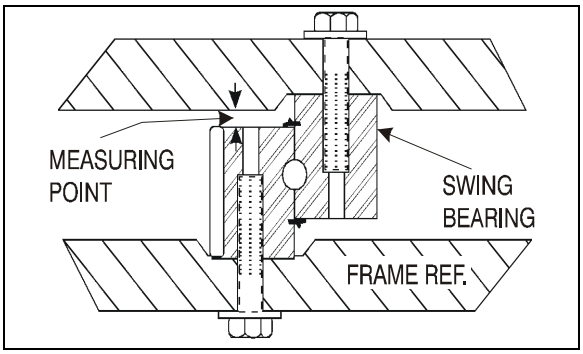


Figure 3-39. Swing Bearing Tolerance Measuring Point

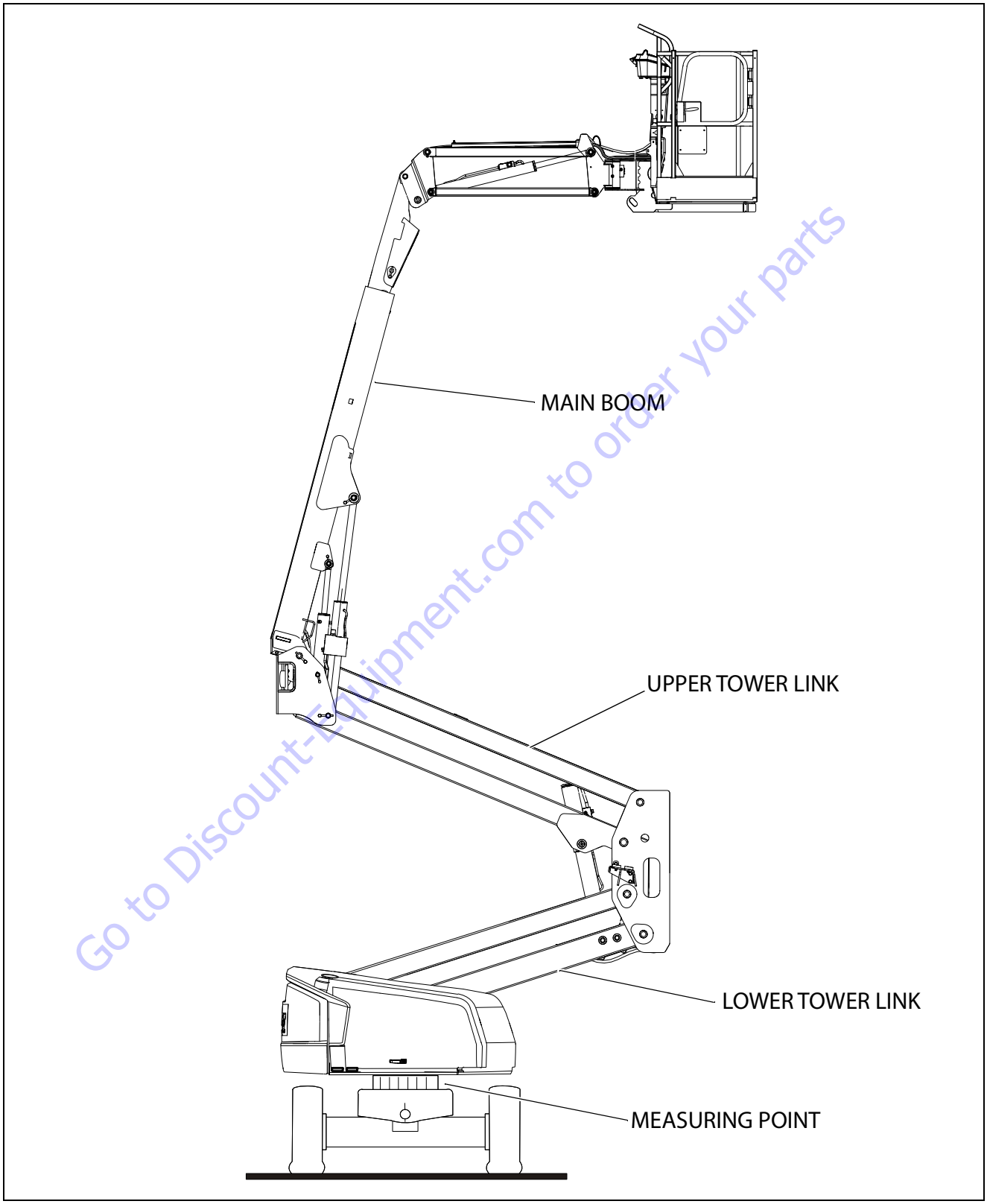


Figure 3-40. Swing Bearing Tolerance Boom Placement - Sheet 1 of 2

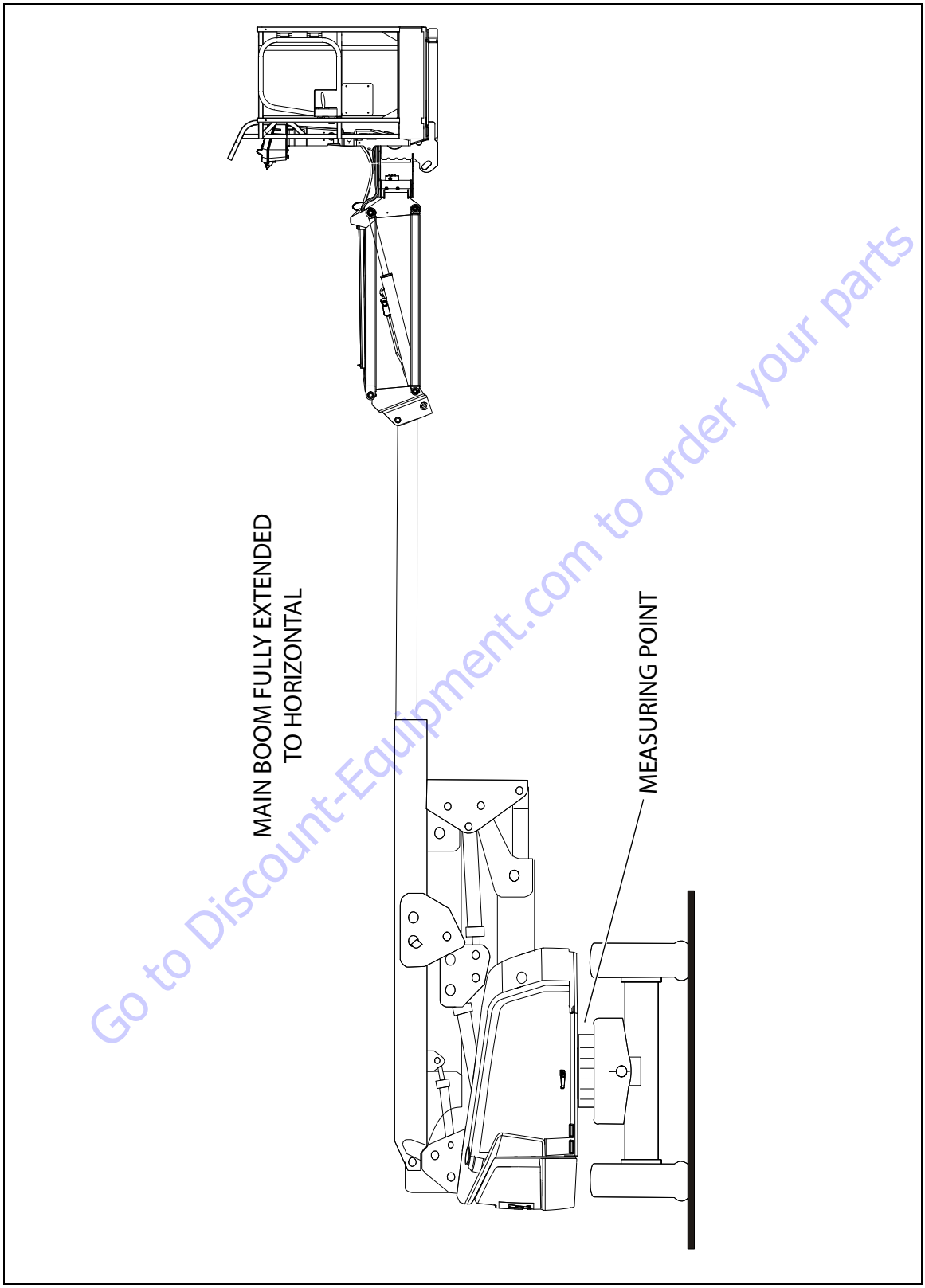


Figure 3-41. Swing Bearing Tolerance Boom Placement - Sheet 2 of 2

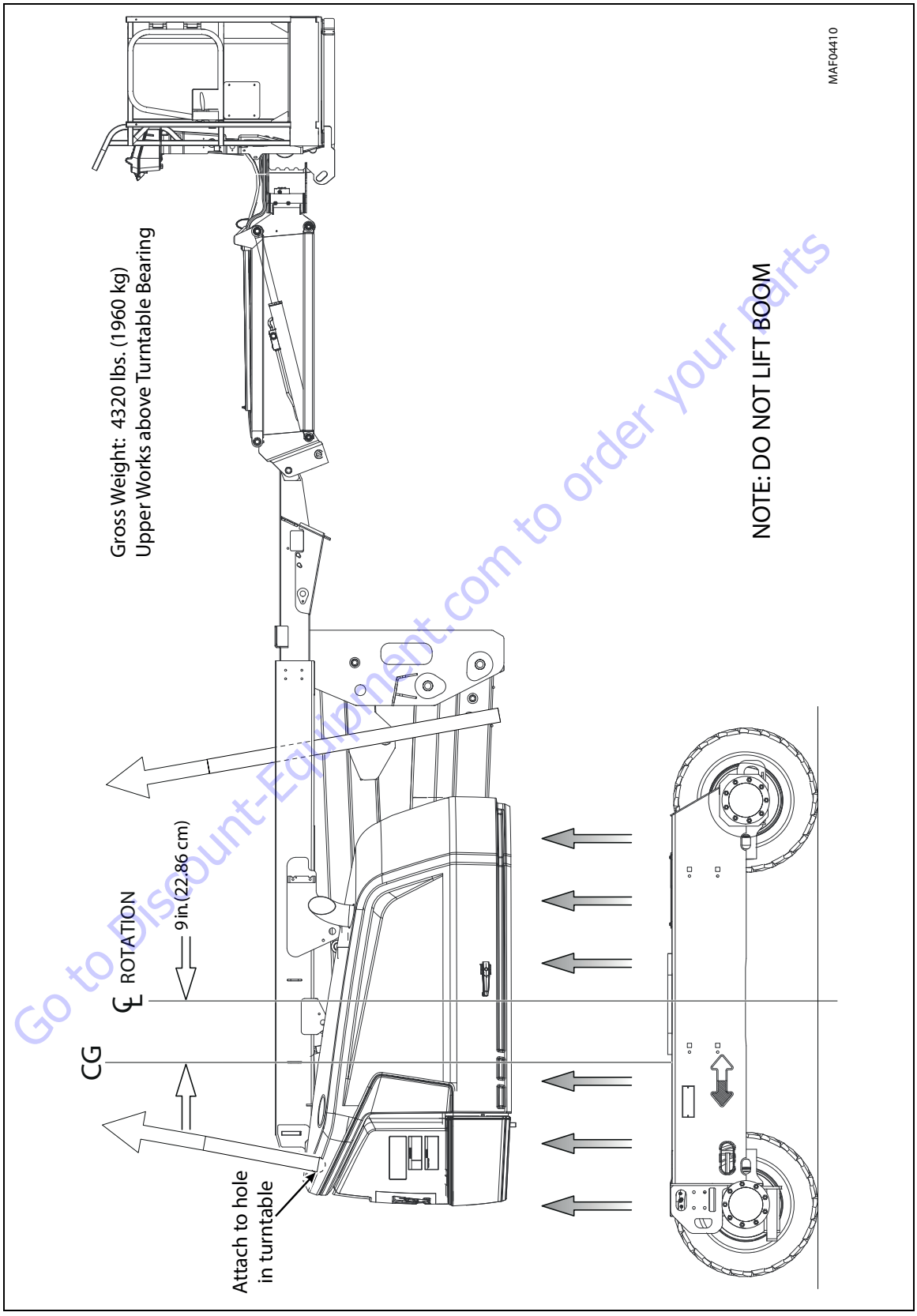


Figure 3-42. Swing Bearing Removal

3.14 SWING MOTOR

⚠ CAUTION

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

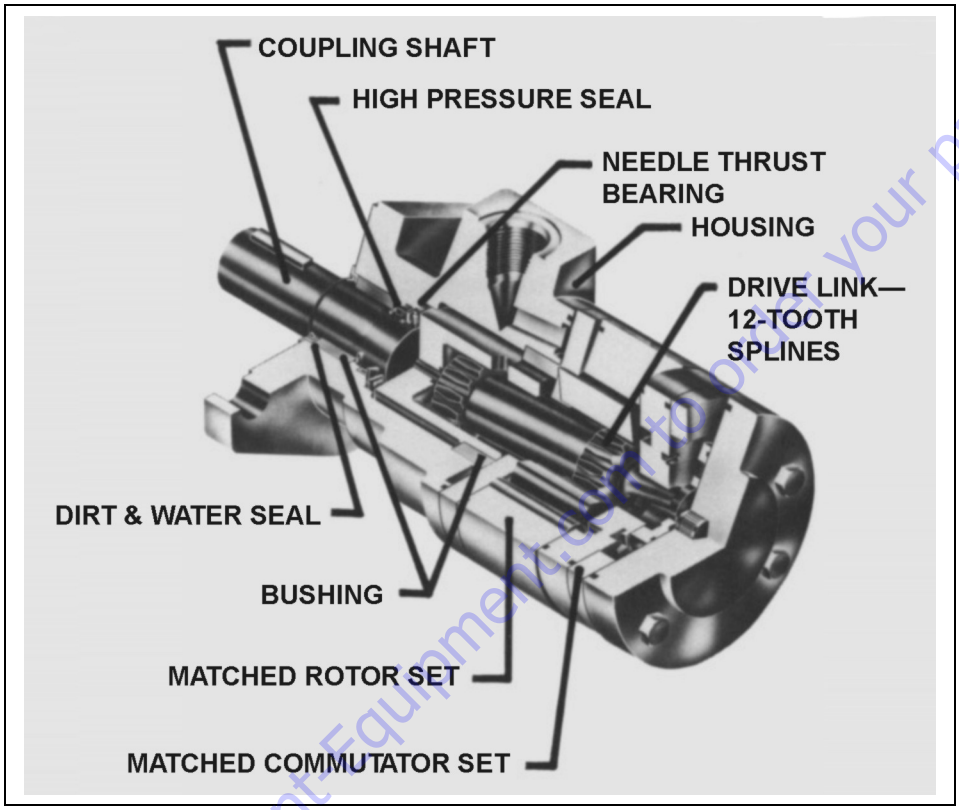


Figure 3-43. Swing Motor - Cutaway

Table 3-9. Swing Motor Troubleshooting

Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged.	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (4) deteriorated by excess heat.	Replace oil seal rings by disassembling unit.
	3. Special bolt (1, 1 A, 1B or 1C) loose or its sealing area deteriorated by corrosion.	(a) Loosen then tighten single bolt to torque specification. (b) Replace bolt.
	4. Internal shaft seal (16) worn or damaged.	Replace seal. Disassembly of motor unit necessary.
	5. Worn coupling shaft (12) and internal seal (16).	Replace coupling shaft and seal by disassembling unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(a) Check for faulty relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.
	2. High internal motor leakage	Replace worn rotor set by disassembling unit.
	3. Severely worn or damaged internal splines.	Replace rotor set, drive link and coupling shaft by disassembling unit.
	4. Excessive heat.	Locate excessive heat source (usually a restriction) in the system and correct the condition.
Low mechanical efficiency or undue high pressure required to operate unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble unit, identify and remedy cause and repair, replacing parts as necessary.
	3. Lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system external to motor unit.	Locate source and eliminate cause.

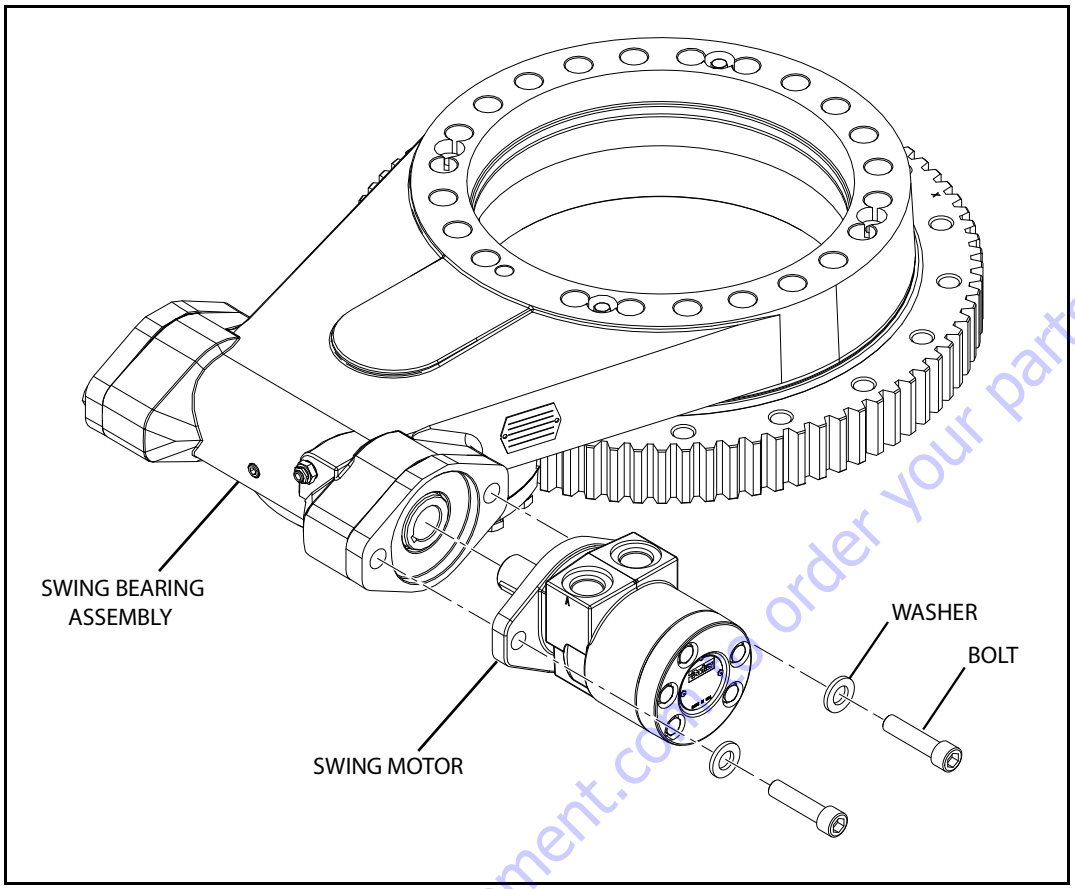
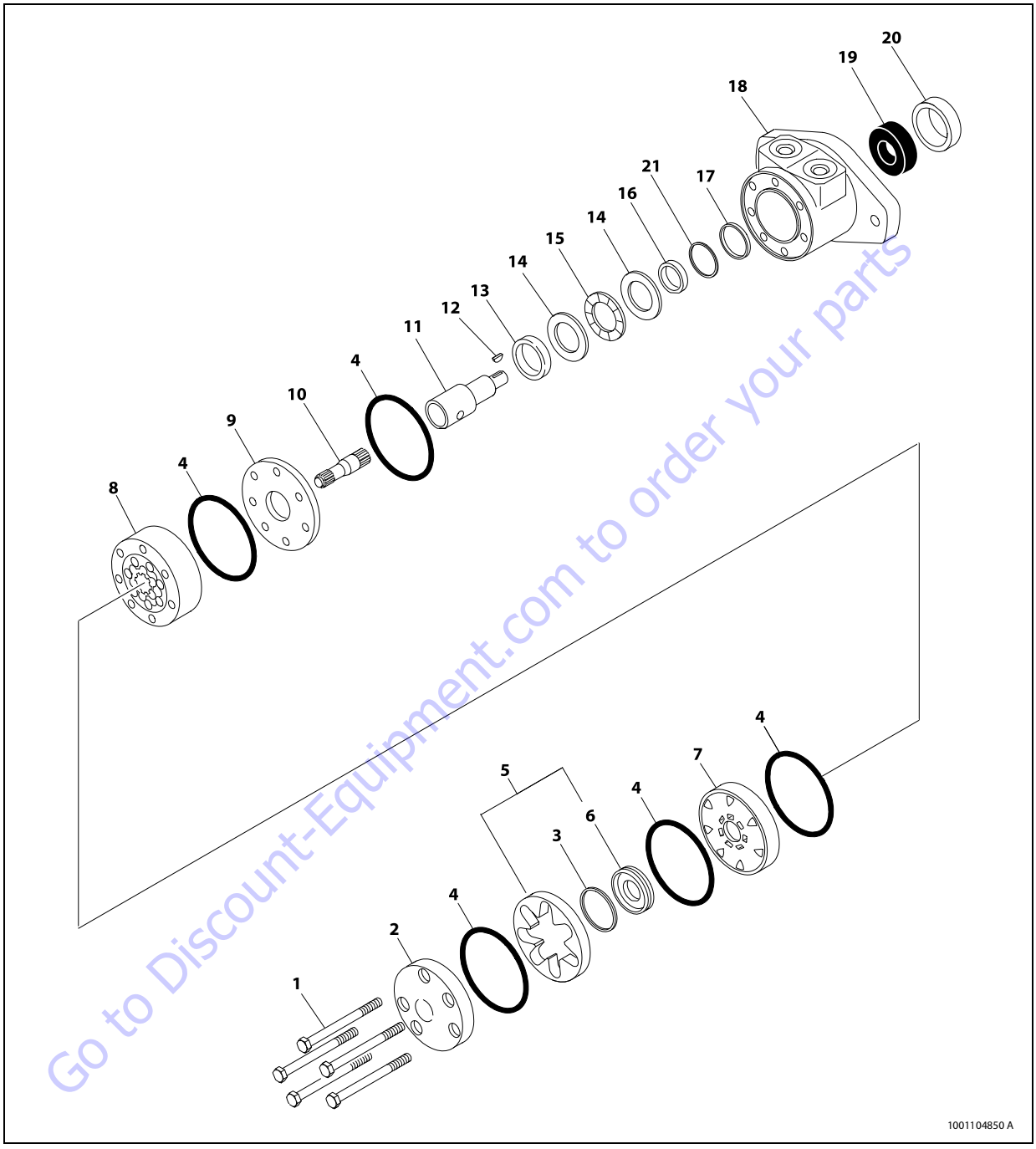


Figure 3-44. Swing Motor Removal and Installation

Removal

Refer to Figure 3-44., Swing Motor Removal and Installation

1. Thoroughly clean the area around the swing motor to prevent any dirt from entering the system.
2. Tag and disconnect the hydraulic lines running to the swing motor. Cap or plug all openings.
3. Secure the worm gear shaft so it does not pull out any when removing the swing motor. Failure to do so could damage the worm gear seals.
4. Remove the bolts securing the swing motor to the swing drive assembly.
5. Carefully pull the swing motor from the swing drive.



1. Bolt
2. End Cover
3. Commutator Seal
4. Seal Ring
5. Commutator and Ring Assembly
6. Ring
7. Manifold
8. Rotor Set
9. Wear Plate
10. Drive Link
11. Coupling Shaft
12. Woodruff Key
13. Bronze Bushing
14. Thrust Washer
15. Thrust Bearing
16. Inner Seal
17. Backup Washer
18. Housing
19. Bearing
20. Seal
21. Backup Washer

Figure 3-45. Swing Motor Assembly

Preparation Before Disassembly

- Before you disassemble the motor unit or any of its components read this entire section. It provides important information on parts and procedures you will need to know to service the motor.
- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the motor. Remove rust or corrosion from coupling shaft.
- Remove coupling shaft connections and hose fittings and immediately plug port holes and fluid lines.
- Remove the motor from system, drain it of fluid and take it to a clean work surface.
- Clean and dry the motor before you start to disassemble the unit.
- As you disassemble the motor clean all parts, except seals, in clean petroleum-based solvent, and blow them dry.

⚠ WARNING

PETROLEUM-BASE SOLVENTS ARE FLAMMABLE. BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

⚠ WARNING

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

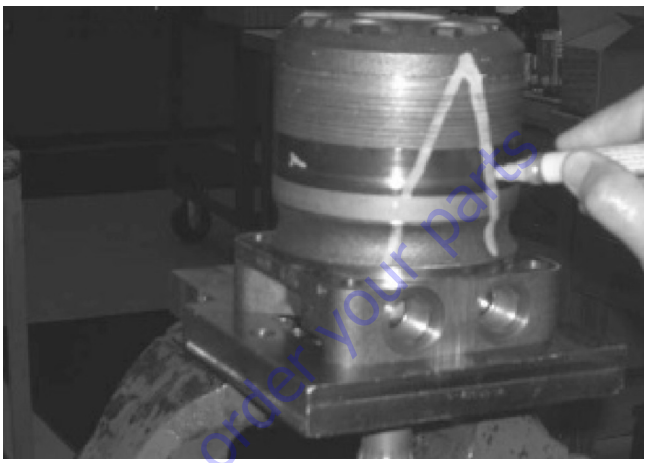
⚠ CAUTION

NEVER STEAM OR HIGH PRESSURE WASH HYDRAULIC COMPONENTS. DO NOT FORCE OR ABUSE CLOSELY FITTED PARTS.

- Keep parts separate to avoid nicks and burrs.
- Discard all seals and seal rings as they are removed from the motor. Replace all seals, seal rings and any damaged or worn parts with OEM approved service parts.

Disassembly and Inspection

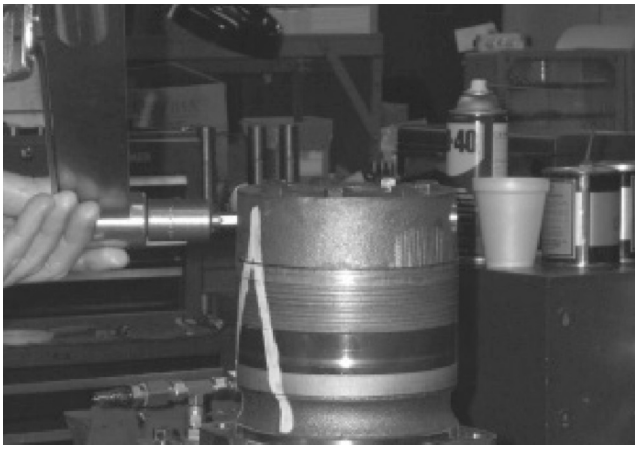
1. Place the motor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings if applicable.

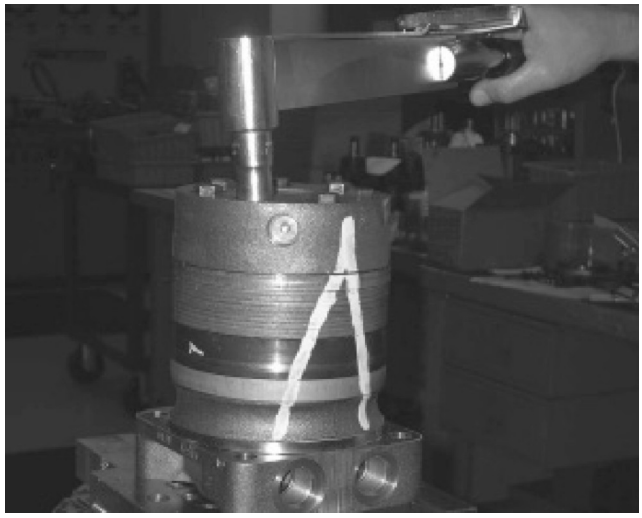


⚠ WARNING

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

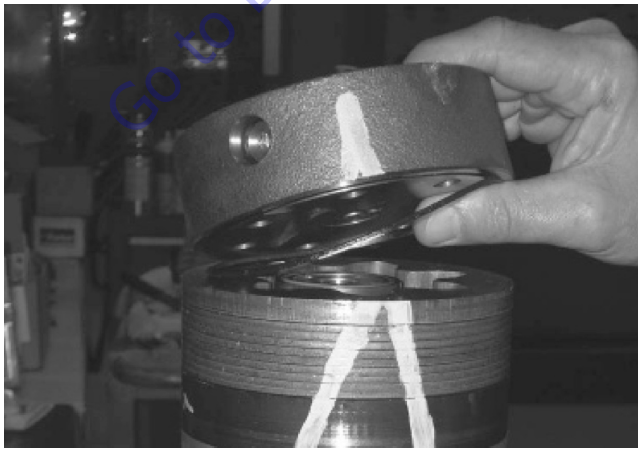
2. Scribe an alignment mark down and across the motor components from end cover (2) to housing (18) to facilitate reassembly orientation where required.



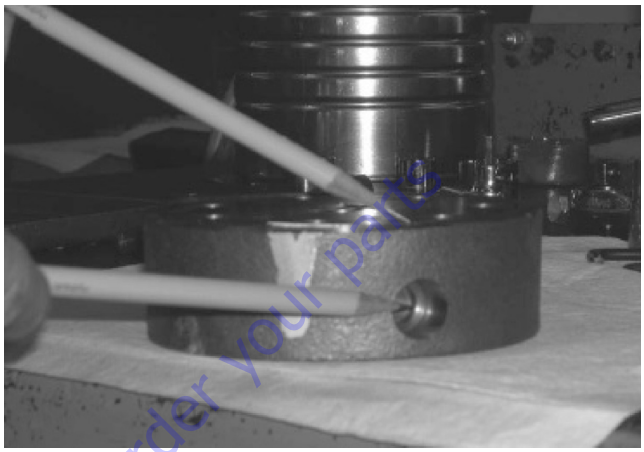


3. Remove the special ring head bolts (1) using an appropriate 1/2 or 9/16 in. size socket. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts.

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



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



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

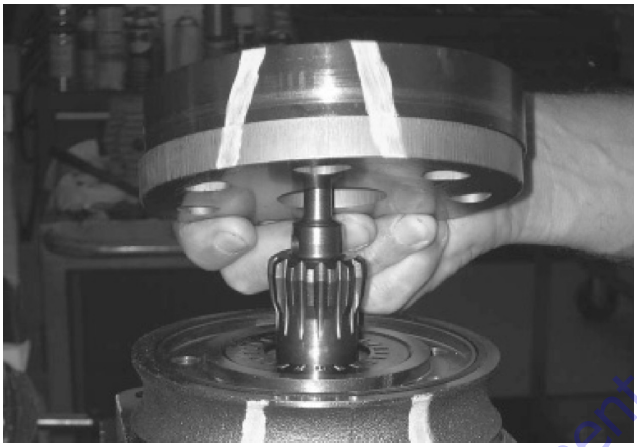
6. Remove commutator ring (6). Inspect commutator ring for cracks, or burrs.

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

8. Remove manifold (7) and inspect for cracks surface scoring, brinelling or spalling. Replace manifold if any of these conditions exist. A polished pattern on the ground surface from commutator or rotor rotation is normal. Remove and discard the seal rings (4) that are on both sides of the manifold.

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

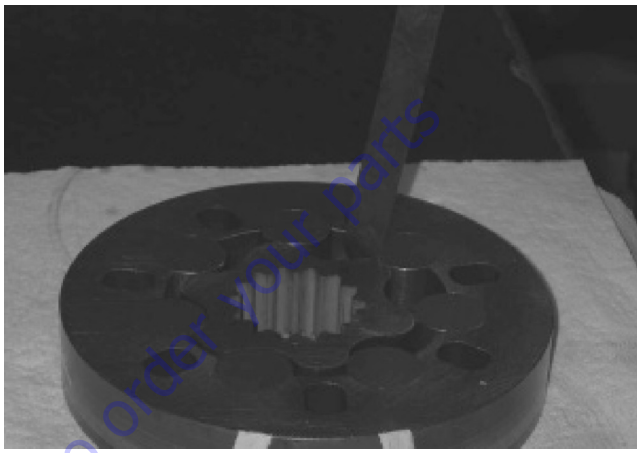
9. Remove rotor set (8) and wearplate (9), together to retain the rotor set in its assembled form, maintaining the same rotor vane to stator contact surfaces. The drive link (10) may come away from the coupling shaft (12) with the rotor set, and wearplate. You may have to shift the rotor set on the wearplate to work the drive link out of the rotor and wearplate. Inspect the rotor set in its assembled form for nicks, scoring, or spalling on any surface and for broken or worn splines. If the rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set. Inspect the wearplate for cracks, brinelling, or scoring. Discard seal ring (4) that is between the rotor set and wearplate.



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

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

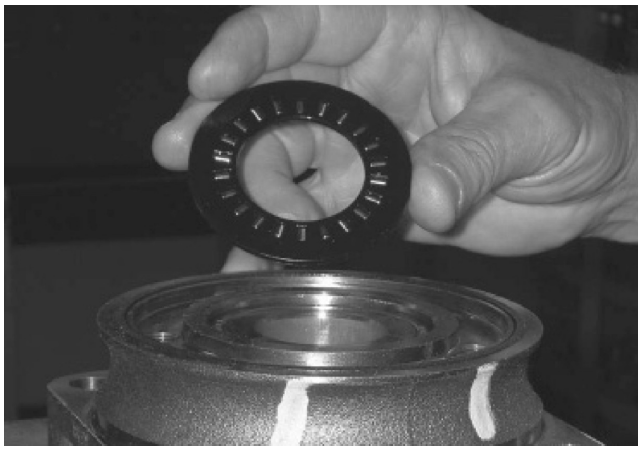
10. Place rotor set (8) and wear plate (9) on a flat surface and center rotor in stator such that two rotor lobes (180 degrees apart) and a roller vane centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is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



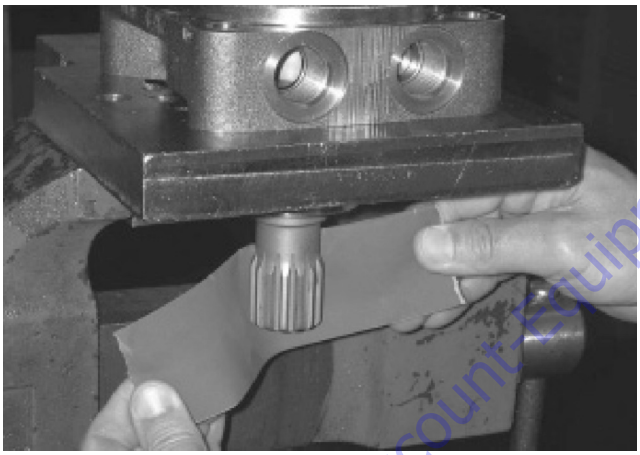
NOTE: *If rotor set (8) has two stator halves and two sets of seven vanes as shown, check the rotor lobe to roller vane clearance at both ends of rotor.*

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

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



13. Check exposed portion of coupling shaft (12) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the seal and bearing. Crocus cloth or fine emery paper may be used.



14. Remove coupling shaft (12), by pushing on the output end of shaft. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. Inspect for damaged or worn internal and external splines or keyway. Replace coupling shaft if any of these conditions exist.

NOTE: *Minor shaft wear in seal area is permissible. If wear exceeds 0.020 in. (0.51 mm) diametrically, replace coupling shaft.*

NOTE: *A slight "polish" is permissible in the shaft bearing areas. Anything more would require coupling shaft replacement.*

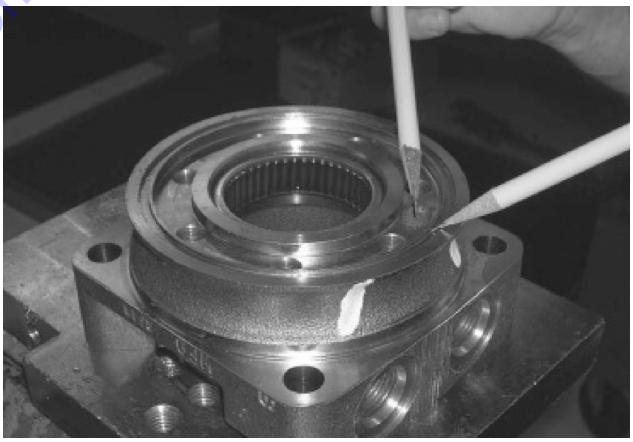
15. Remove and discard seal ring (4) from housing (18).

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

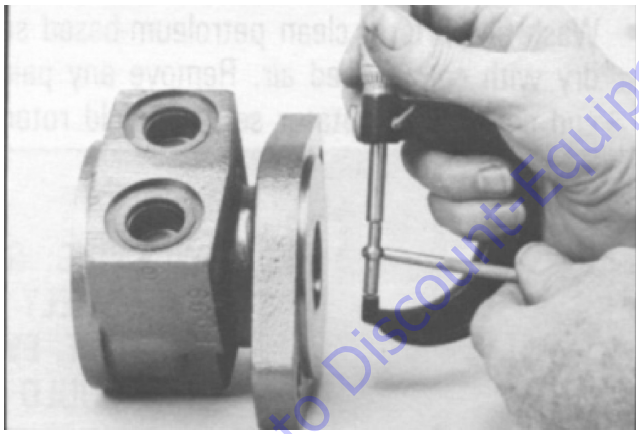
17. Remove seal (16) and backup ring (17) from housing (18) and backup washer (25). Discard both.

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

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



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



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

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

Assembly

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

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

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

⚠ WARNING

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

⚠ WARNING

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

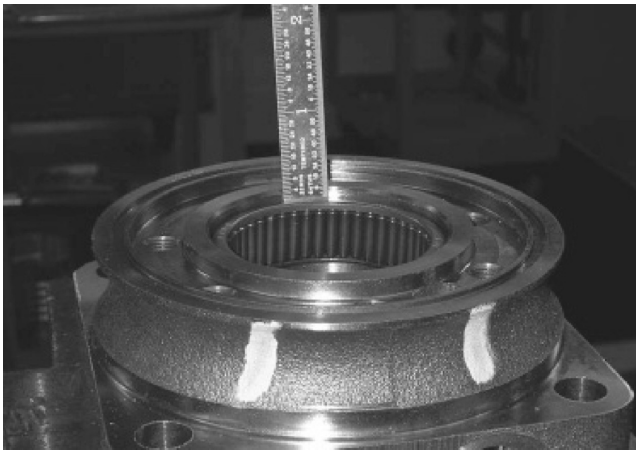
1. If the housing (18) bearing components were removed for replacement, thoroughly coat and pack a new outer bearing/bushing (19) with clean corrosion resistant grease recommended in the material section. Press the new bearing/bushing into the counterbore at the mounting flange end of the housing, using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

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

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

⚠ CAUTION

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

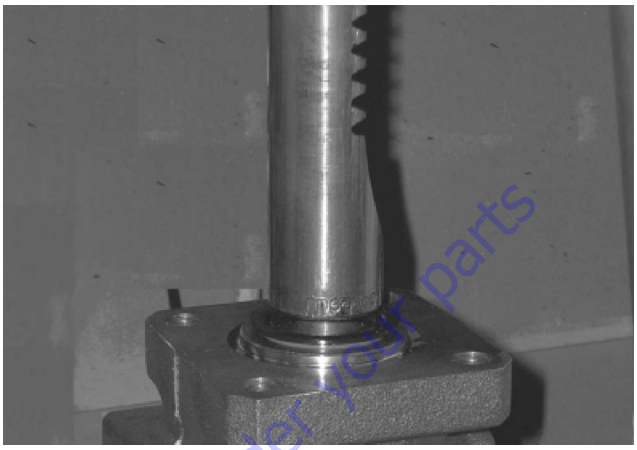


⚠ CAUTION

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

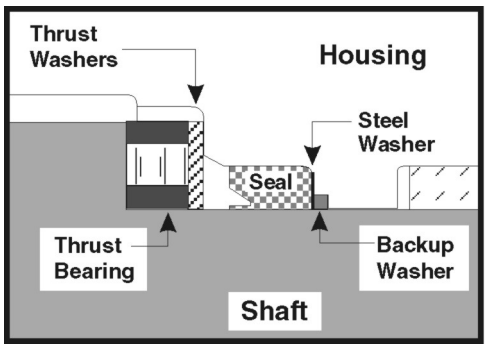
2. The inner housing bearing/bushing (13) can now be pressed into its counterbore in housing (18) flush to 0.03 in. (0.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19).

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



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

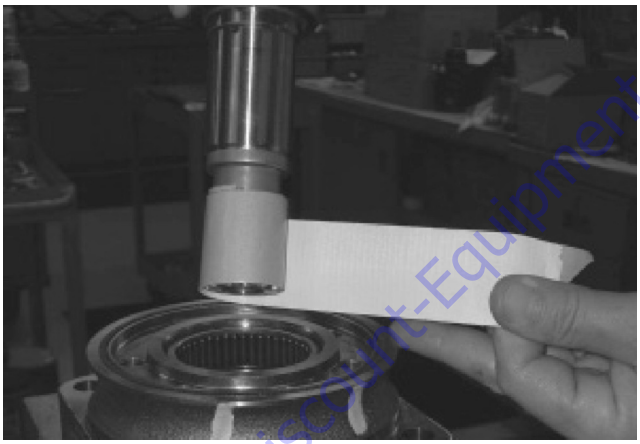
5. Assemble a new backup ring (17), new backup washer (25) and new seal (16) with the seal lip facing toward the inside of the motor, into their respective counterbores in housing (18).



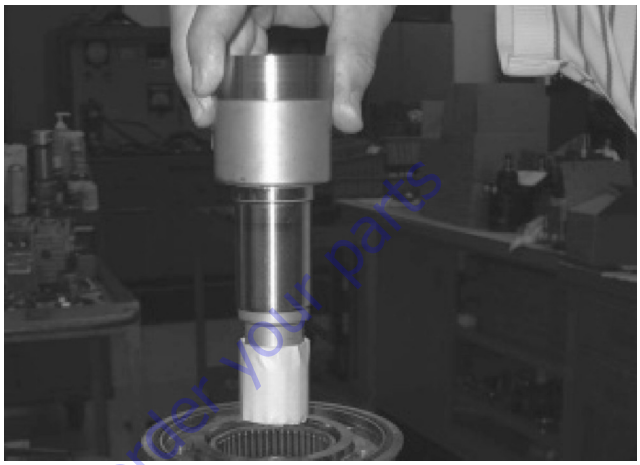
6. Assemble thrust washer (14) then thrust bearing (15) that was removed from the motor.

NOTE: *The motor requires one thrust washer (14) with thrust bearing (15). The coupling shaft will be seated directly against the thrust bearing.*

7. Apply masking tape around splines or keyway on shaft (12) to prevent damage to seal.



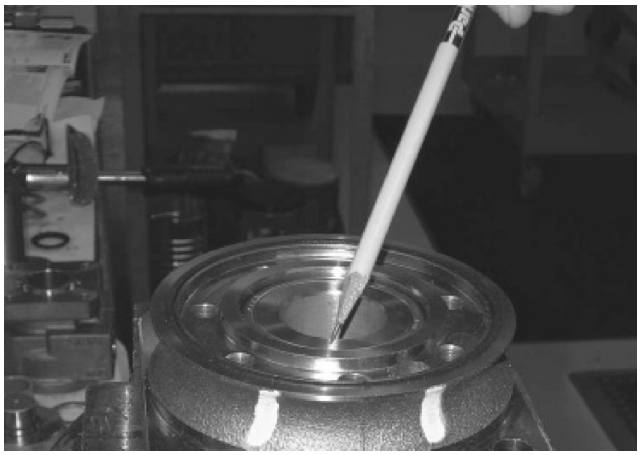
8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12) into housing (18), seating it against the thrust bearing (15).



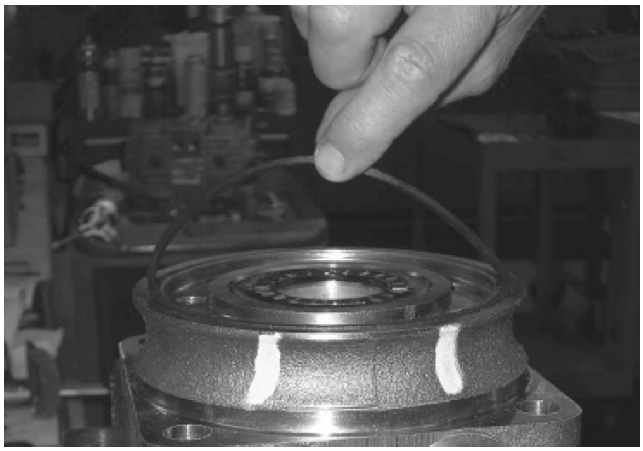
⚠ CAUTION

THE OUTER BEARING (19) IS NOT LUBRICATED BY THE SYSTEM'S HYDRAULIC FLUID. BE SURE IT IS THOROUGHLY PACKED WITH THE RECOMMENDED GREASE.

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



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



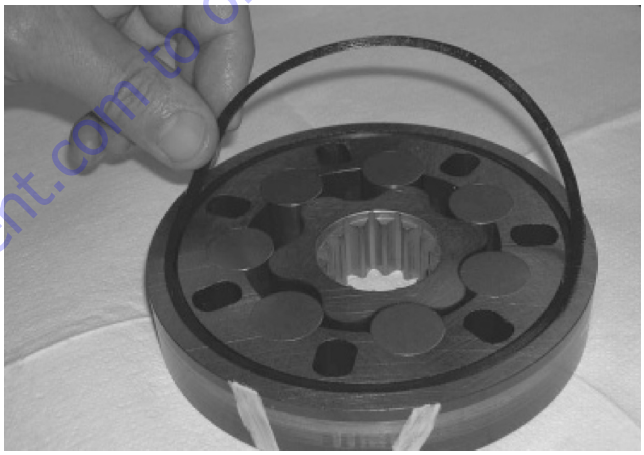
NOTE: *One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF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

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

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

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

12. Apply a small amount of clean grease to a new seal ring (4) and assemble it into the seal ring groove on the wear plate side of the rotor set stator.



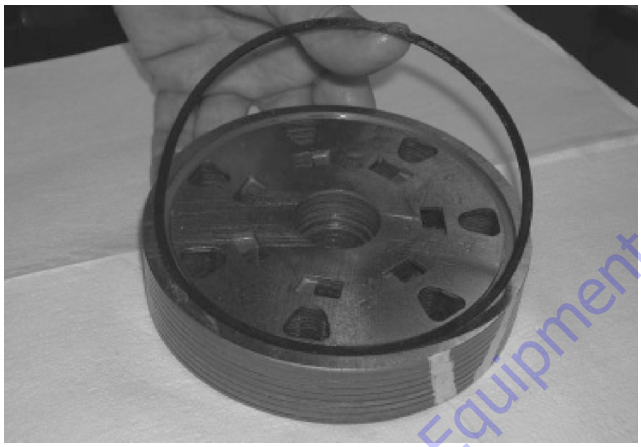
13. Install the assembled rotor set (8) onto wear plate (9) with rotor counterbore and seal ring side down and the splines into mesh with the drive link splines.

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

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

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

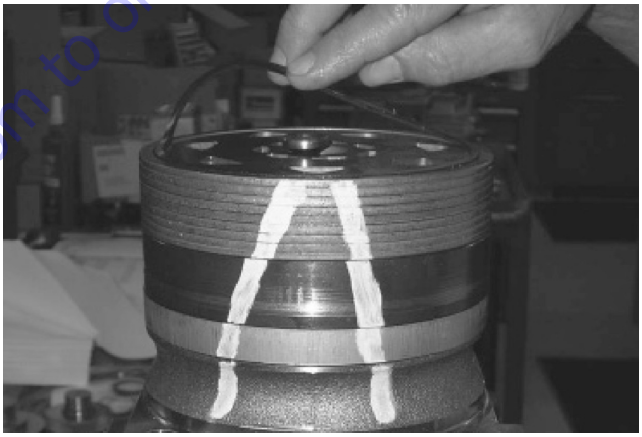
14. Apply clean grease to a new seal ring (4) and assemble it in the seal ring groove in the rotor set contact side of manifold (7).



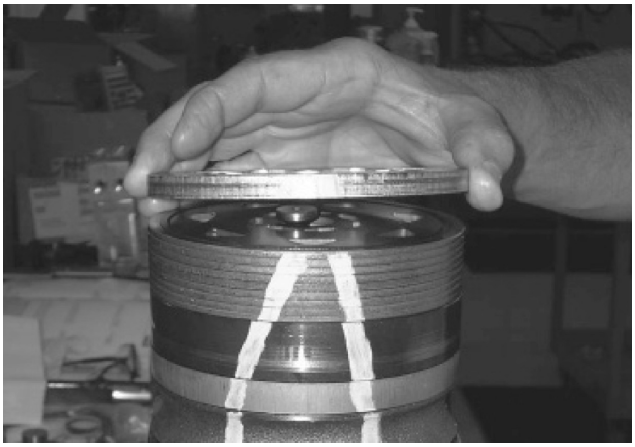
NOTE: *The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression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

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

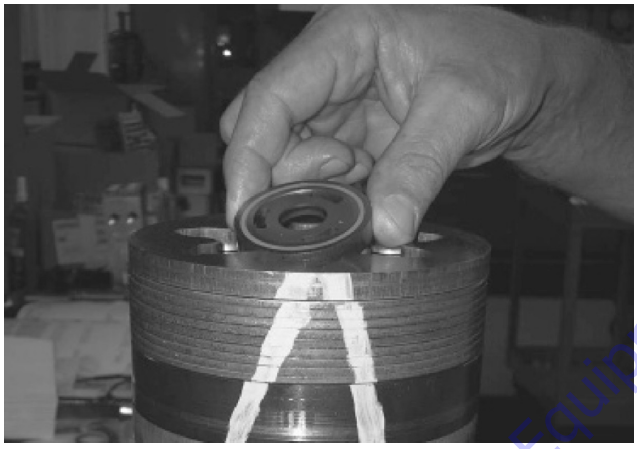
16. Apply grease to a new seal ring (4) and insert it in the seal ring groove exposed on the manifold.



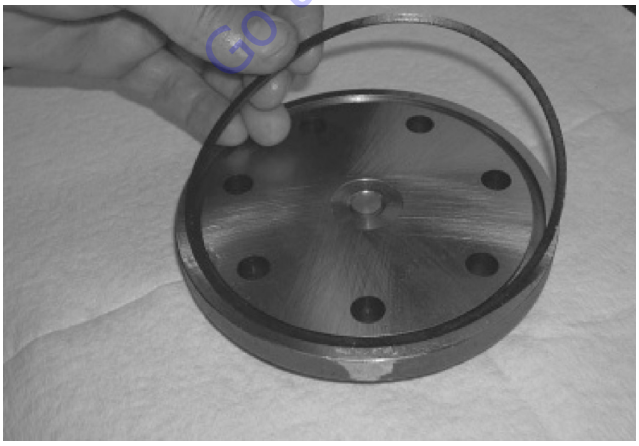
17. Assemble the commutator ring (6) over alignment studs onto the manifold.

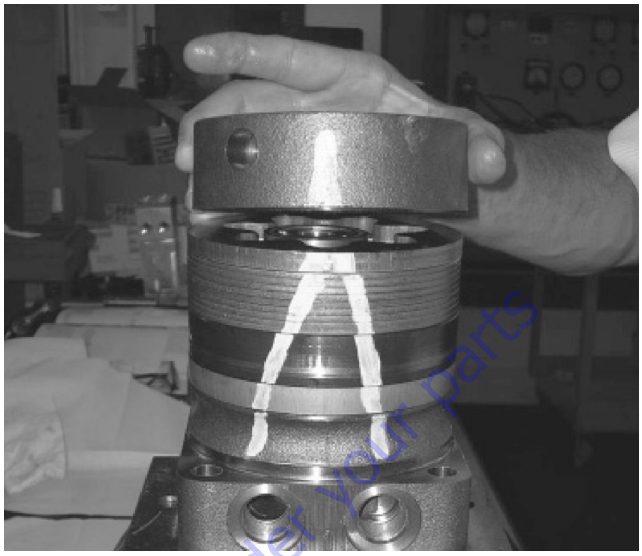


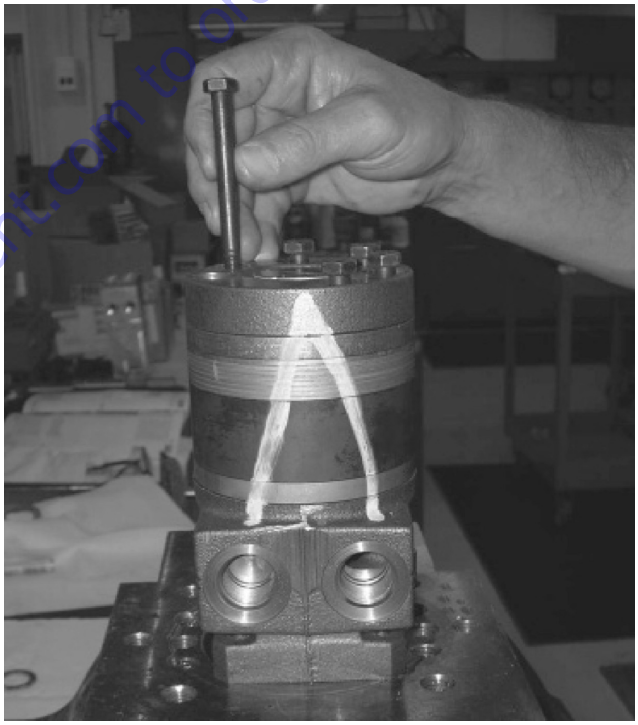
18. Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.



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

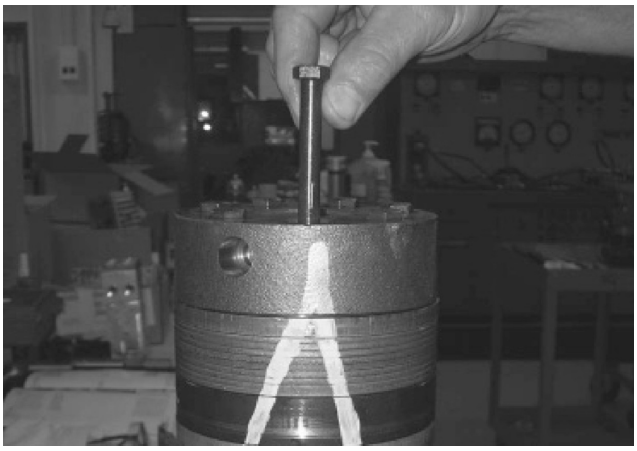


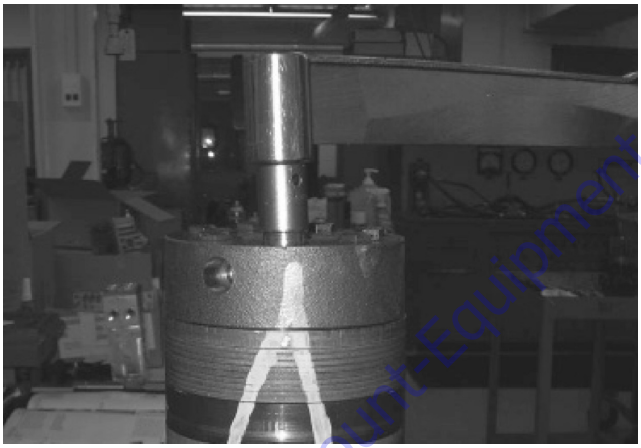


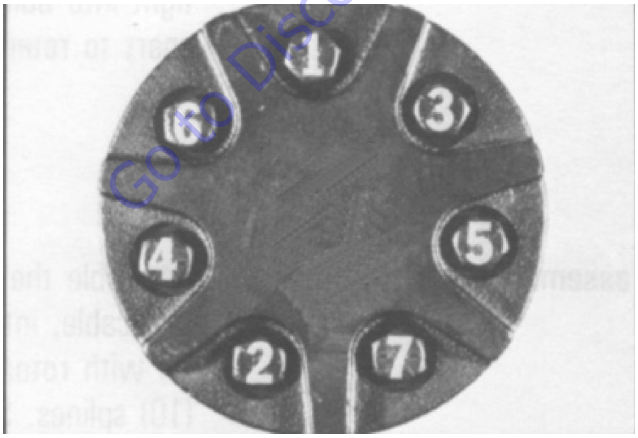


NOTE: *If the end cover has a valve (24) or has five bolt holes, use the line you previously scribed on the cover to radially align the end cover into its original position.*

20. Assemble the bolts (1) and screw in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 25-30 ft. lbs. (34-41 N m).







One Piece Stator Construction

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

1. Place stator onto wear plate (9) with seal ring (4) side down, after following assembly procedures 1 through 13. Be sure the seal ring is in place.

2. If assembly alignment studs are not being utilized, align stator bolt holes with wear plate and housing bolt holes and turn two bolts (1) finger tight into bolt holes approximately 180 degrees apart to retain stator and wear plate stationary.

3. Assemble the rotor, counterbore down if applicable, into stator, and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.

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

⚠ CAUTION

EXCESSIVE FORCE USED TO PUSH THE ROTOR VANES INTO PLACE COULD SHEAR OFF THE COATING APPLIED TO THE STATOR VANE POCKETS.

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes into stator, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

6. Remove the two assembled bolts (1) if used to retain stator and wear plate.

Go to assembly procedure #15, to continue assembly.

Two Piece Stator Construction

A disassembled rotor set (8) that cannot be readily assembled by hand and has a two piece stator can be assembled by the following procedures.

1. Place stator half onto wear plate (9) with seal ring (4) side down, after following motor assembly procedures 1 through 13. Be sure the seal ring is in place.

2. Align stator bolt holes with wear plate and housing bolts and turn two alignment studs finger tight into bolt holes approximately 180 degrees apart to retain stator half and wear plate stationary.

3. Assemble rotor, counterbore down if applicable, into stator half, and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.

NOTE: *Use any marking you applied to rotor set components to reassemble the components in their original relationship to ensure ultimate wear life and performance.*

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

⚠ CAUTION

EXCESSIVE FORCE USED TO PUSH THE ROTOR VANES INTO PLACE COULD SHEAR OFF THE COATING APPLIED TO THE STATOR VANE POCKETS.

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8C) into stator half, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

6. Place second stator half on a flat surface with seal ring groove up. Apply a small amount of grease to a new seal ring (4) and assemble it into stator half ring groove.

7. Assemble the second stator half over the two alignment studs and rotor with seal ring side down onto the first stator half aligning any timing marks applied for this purpose.

⚠ CAUTION

IF THE STATOR HALF (8B) IS A DIFFERENT HEIGHT (THICKNESS) THAN STATOR HALF (8D) THE STATOR VANES (8C) OR (8E)OF THE SAME LENGTH (HEIGHT) AS THE STATOR HALF MUST BE REASSEMBLED IN THEIR RESPECTIVE STATOR HALF FOR THE ROTOR SET TO FUNCTION PROPERLY.

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

9. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes into stator, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

   Go to assembly procedure #15, to continue assembly.

Final Checks

1. Pressurize the motor with 100 psi dry air or nitrogen and submerge in solvent to check for external leaks.
2. Check motor for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 Nm)
3. Pressure port with "A" cast under it on housing (18) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "B" cast under it is for counterclockwise coupling shaft rotation.
4. Use test stand if available, to check operation of the motor.

Installation

Refer to Figure 3-44., Swing Motor Removal and Installation.

1. Carefully insert the swing motor into the swing drive, making sure the swing motor shaft key is aligned correctly.
2. Secure the swing motor to the swing drive assembly with the retaining bolts. Apply High Strength Threadlocking Compound to the threads of the retaining bolts and torque to 73.75 ft. lbs. (100 Nm).
3. Connect the hydraulic lines running to the swing motor as tagged during removal.
4. Operate the swing function in both directions to ensure proper operation. Inspect the hose connections for any leakage.

3.15 GENERATOR

⚠ WARNING

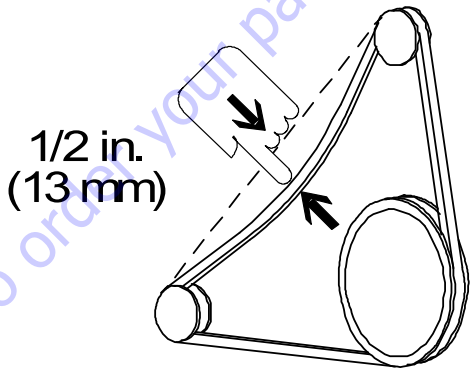
STOP ENGINE BEFORE CARRY OUT SCHEDULE MAINTENANCE.

NOTE: *Do often service, if operating in hostile environment.*

Maintenance Schedule

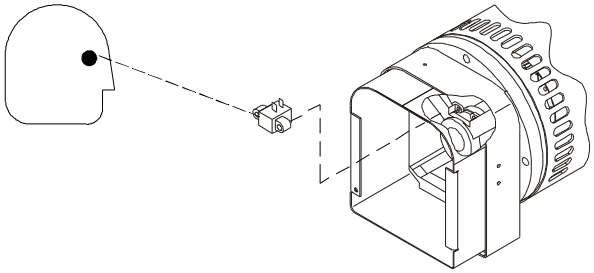
EVERY 250 HOURS

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

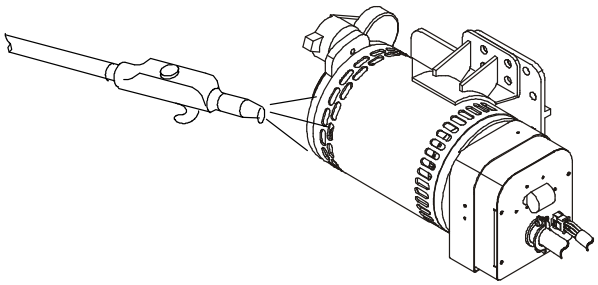


EVERY 500 HOURS

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



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

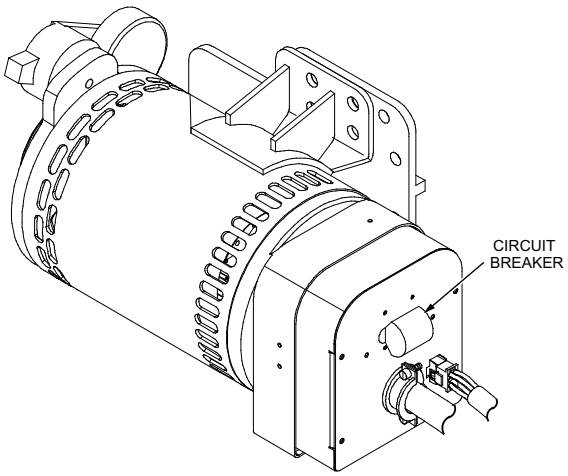


Overload Protection

⚠ WARNING

STOP THE ENGINE WHENEVER CHECKING OR INSPECTING THE CIRCUIT BREAKER.

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



Inspecting Brushes, Replacing Brushes and Cleaning Slip Rings

Refer to Figure 3-46., Inspecting Generator Brushes, Replacing Brushes and Cleaning Slip Rings.

INSPECTING BRUSH POSITION

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

INSPECTING BRUSHES

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

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

CLEANING SLIP RINGS

Visually inspect the slip rings. Under normal use, the rings turn dark brown.

If the slip rings are corroded or their surface is uneven, remove the belt to turn the shaft by hand for cleaning.

Clean the rings with 220 grit emery paper. Remove as little material as possible. If the rings are deeply pitted and do not clean up, consult generator factory service.

Reinstall the belt, brush holder assembly and end panel.

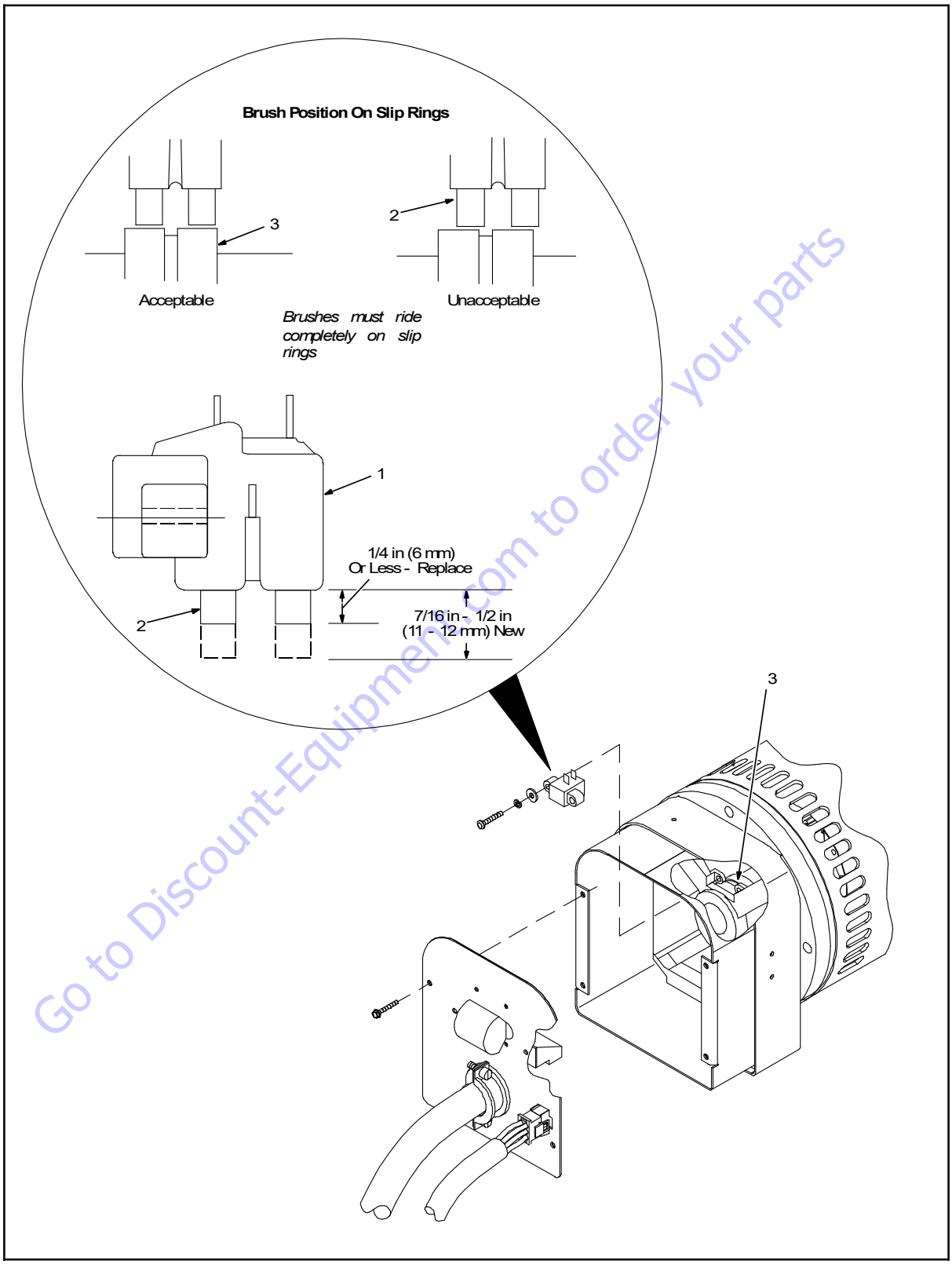


Figure 3-46. Inspecting Generator Brushes, Replacing Brushes and Cleaning Slip Rings

Generator Disassembly and Assembly

Refer to Figure 3-48. and Figure 3-49. to determine if trouble is in stator, rotor, control box, or combination of these components.

1. Rotor
2. Stator Assembly

⚠ CAUTION

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

DISASSEMBLY

1. Mark and disconnect all electrical leads, secure using cable ties.
2. Remove brush holder assembly.
3. Disassemble generator parts shown in Figure 3-47.
4. Clean all parts with approved solvent and dry with compressed air, If applicable.
5. Inspect all part for damage. Replace if necessary.

ASSEMBLY

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

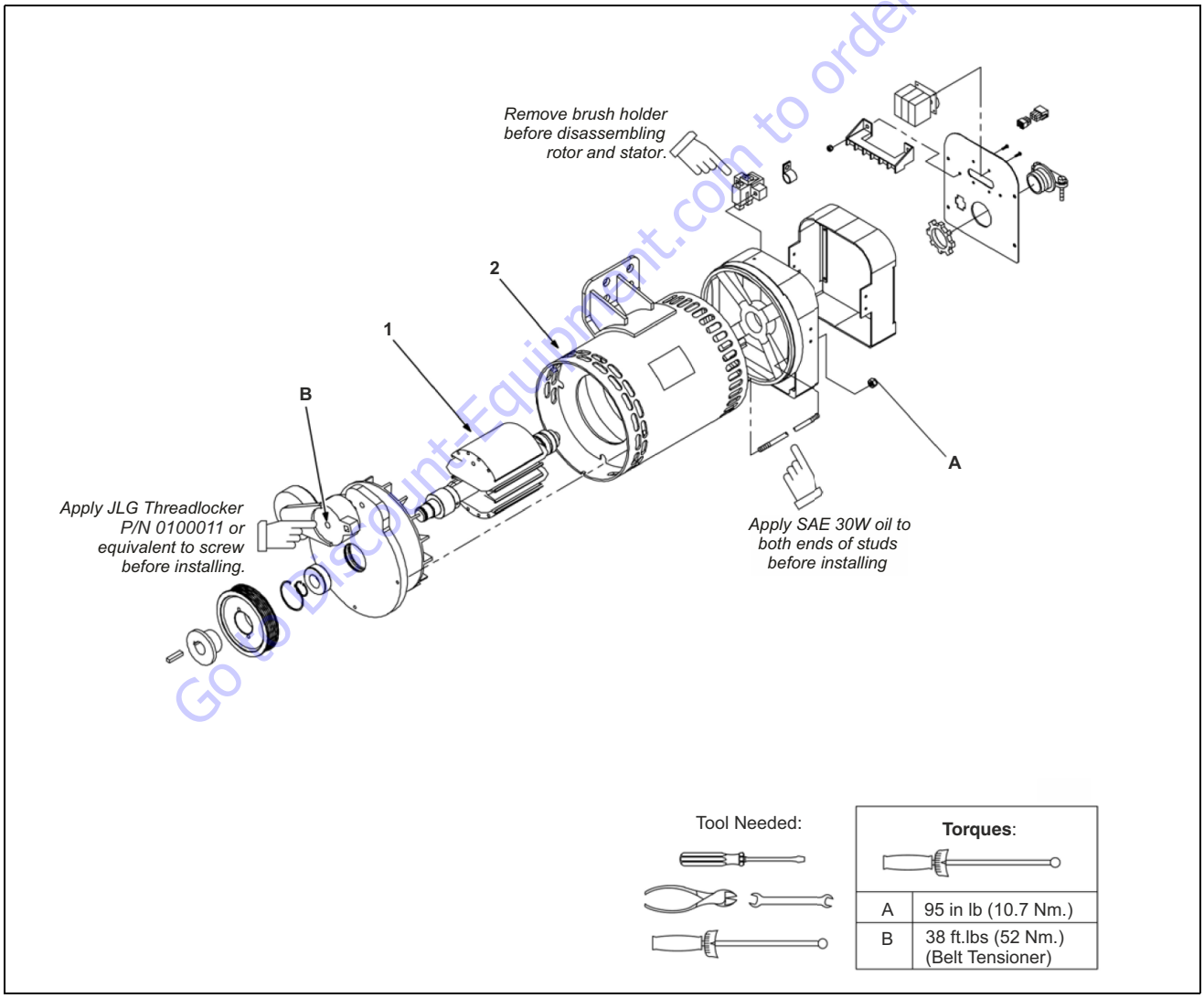


Figure 3-47. Generator Disassembly and Assembly

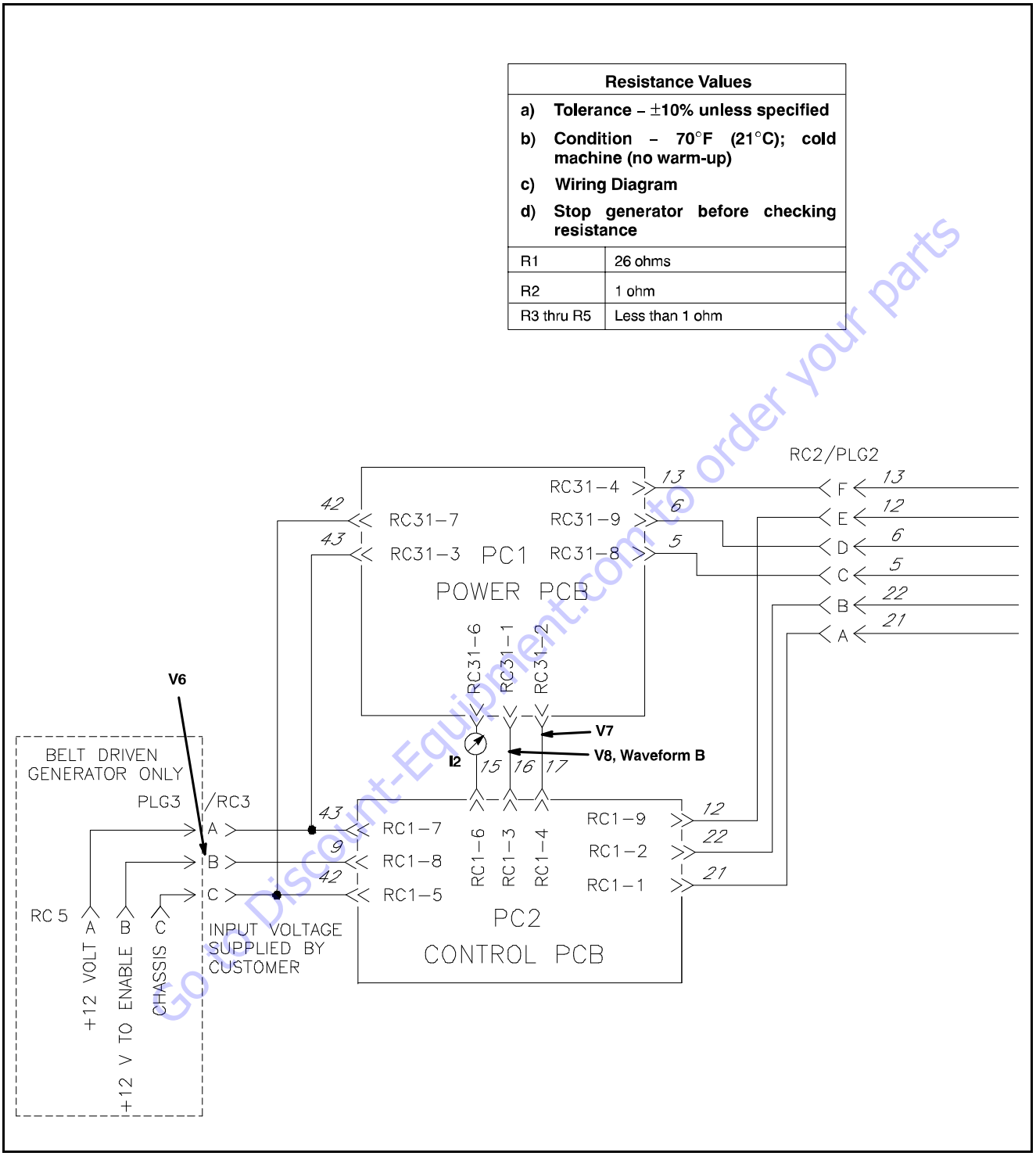
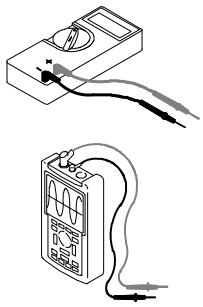


Figure 3-48. Generator Troubleshooting Circuit Diagram - Sheet 1 of 2

Test Equipment Needed:



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

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

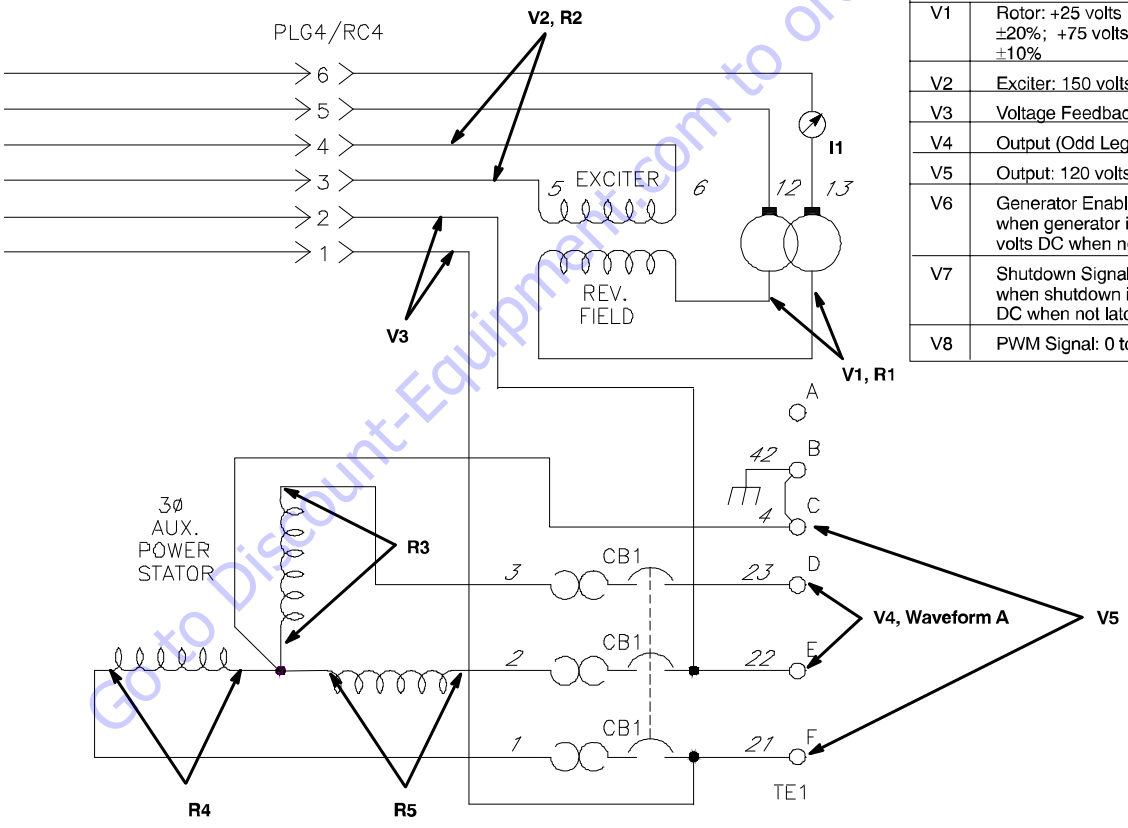


Figure 3-49. Generator Troubleshooting Circuit Diagram - Sheet 2 of 2

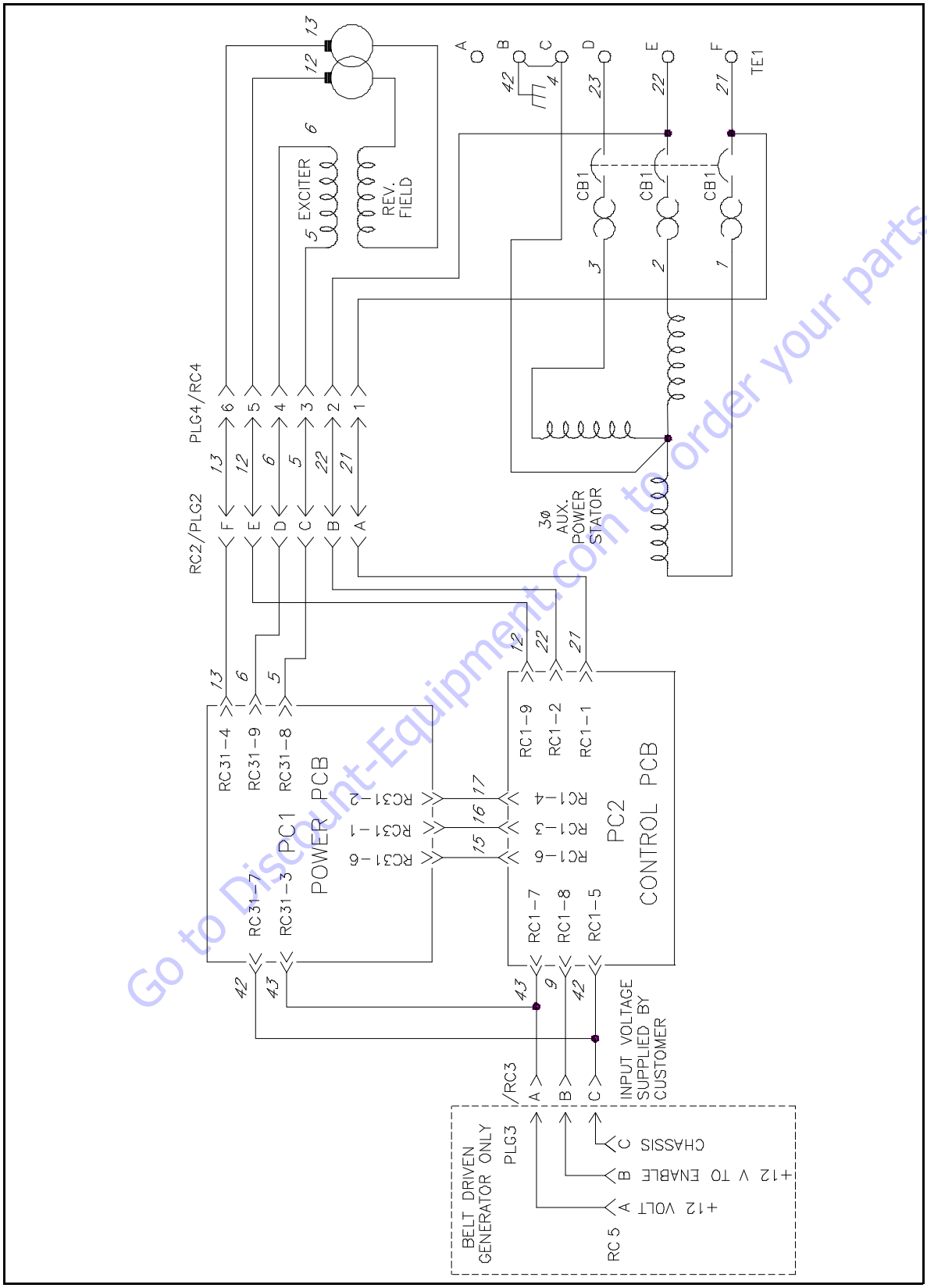


Figure 3-50. Generator Electrical Circuit Diagram

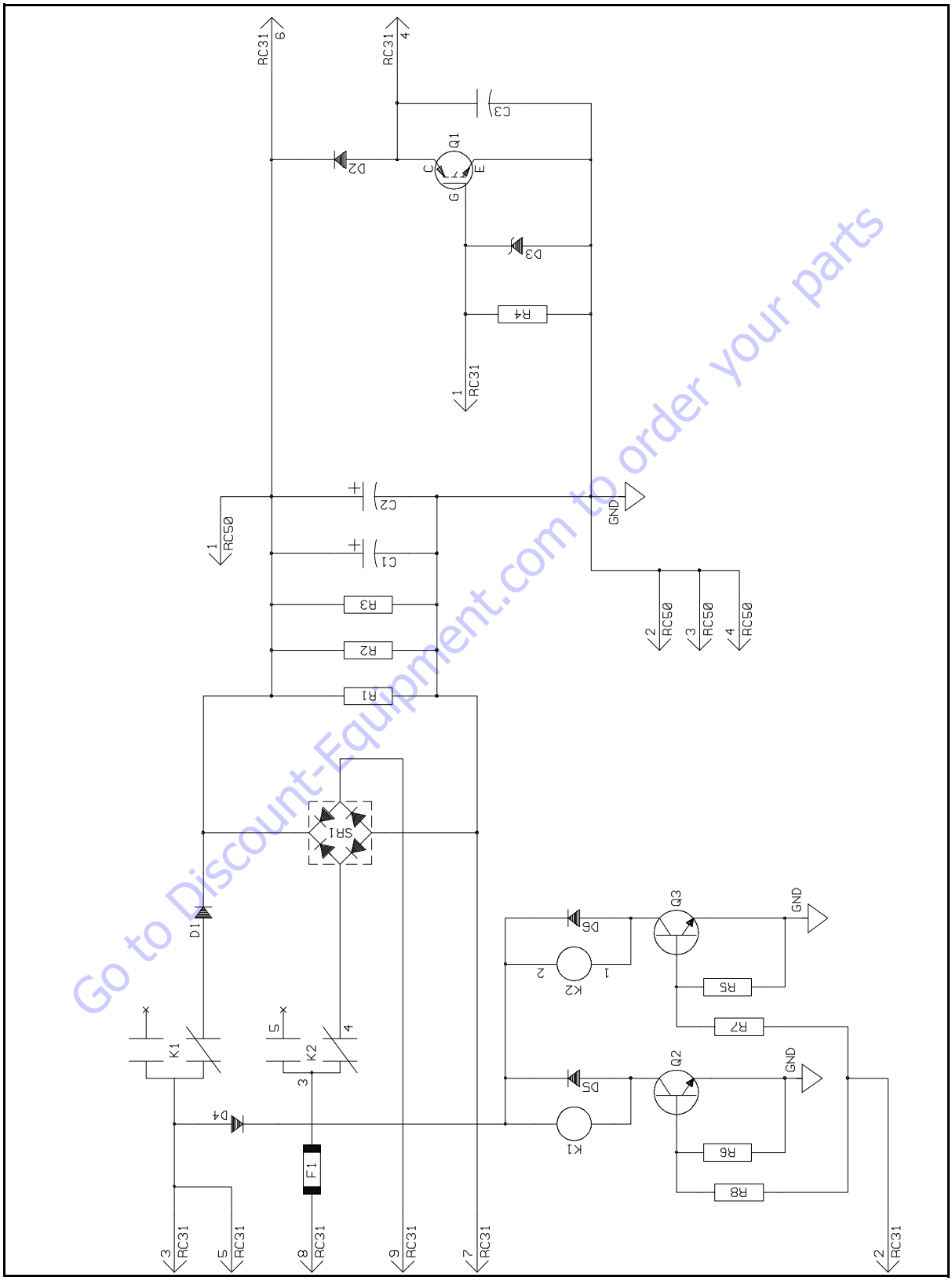


Figure 3-51. Power Board PC1 Electrical Circuit Diagram

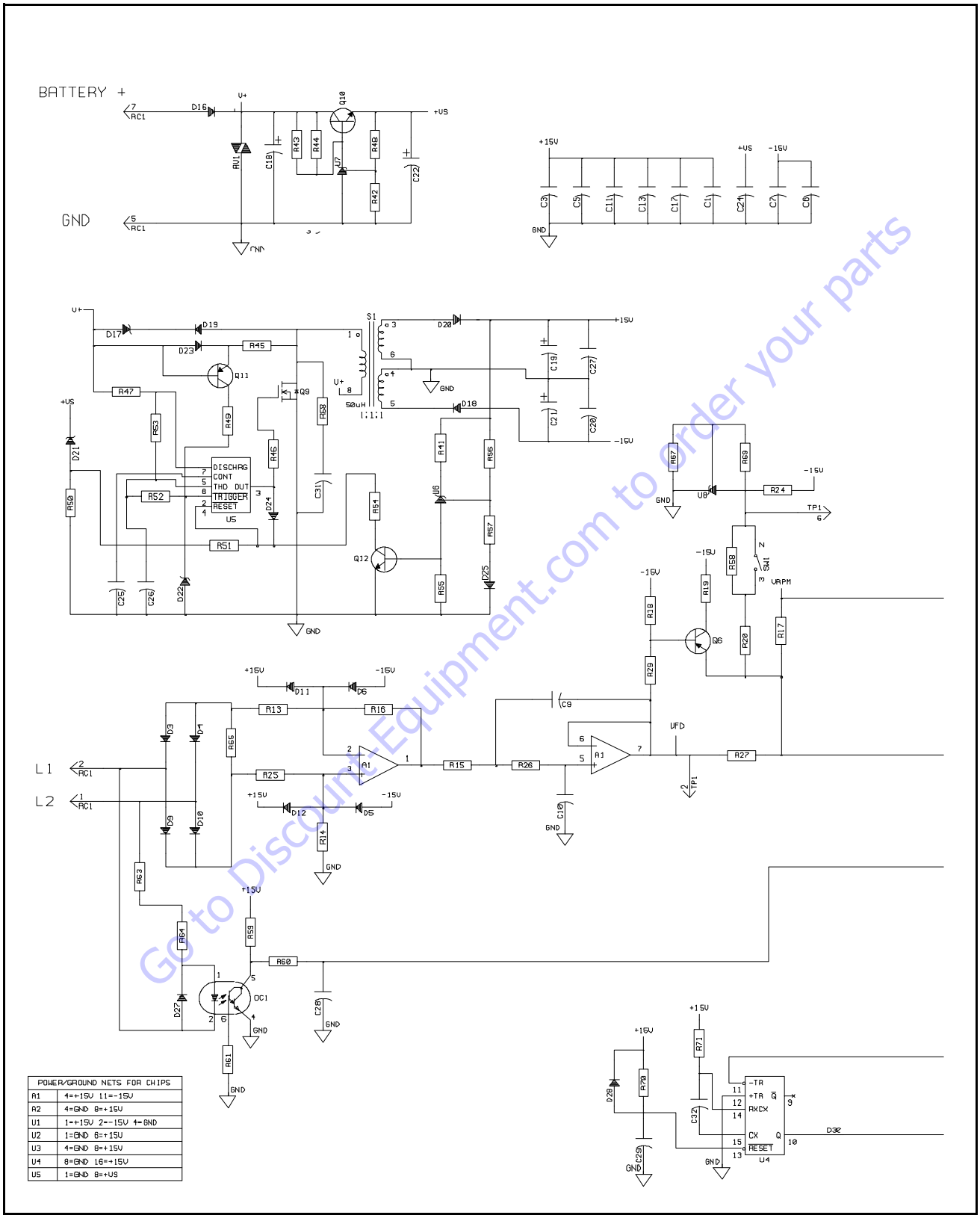


Figure 3-52. Power Board PC2 Electrical Circuit Diagram - Sheet 1 of 2

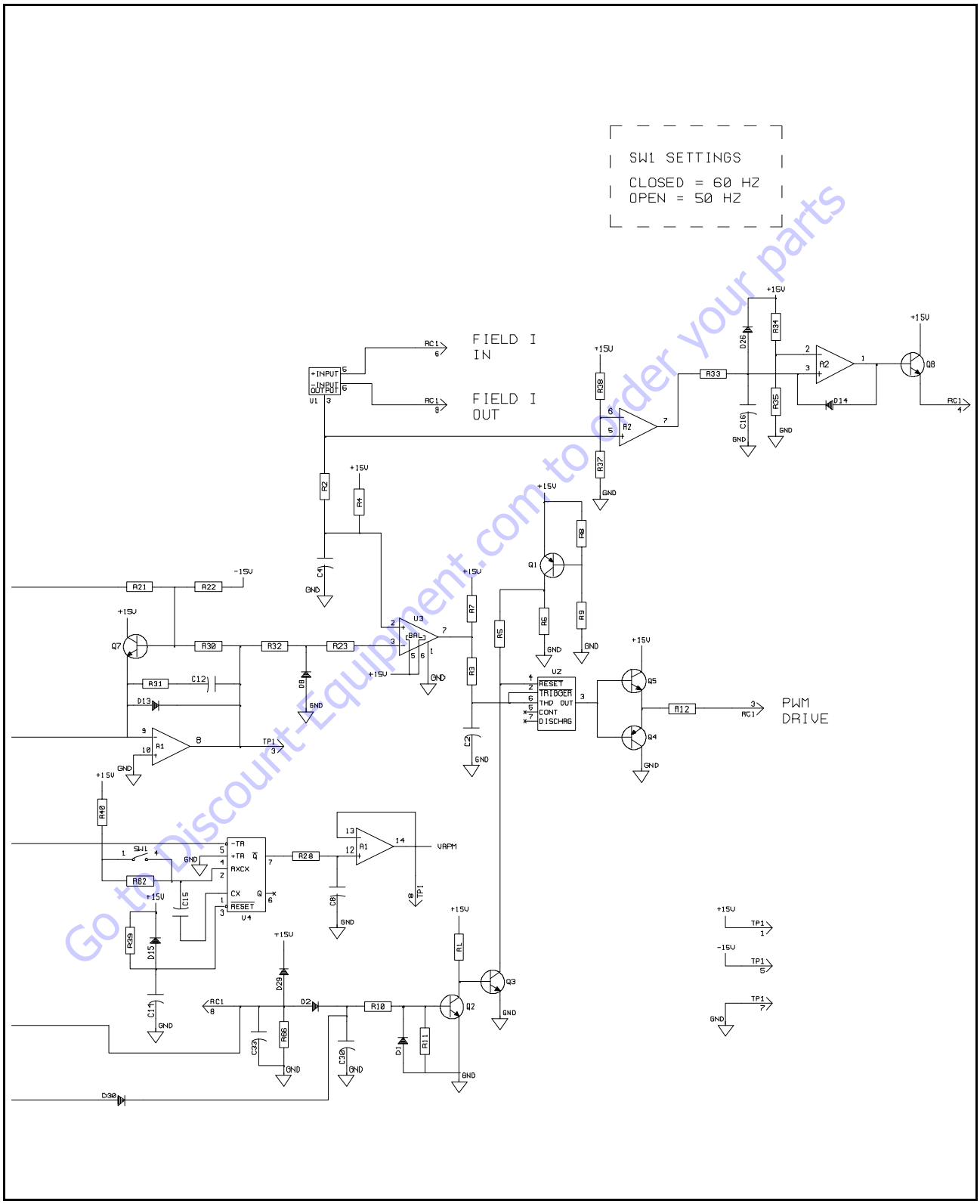


Figure 3-53. Power Board PC2 Electrical Circuit Diagram - Sheet 2 of 2

Lead Connection List for Generator

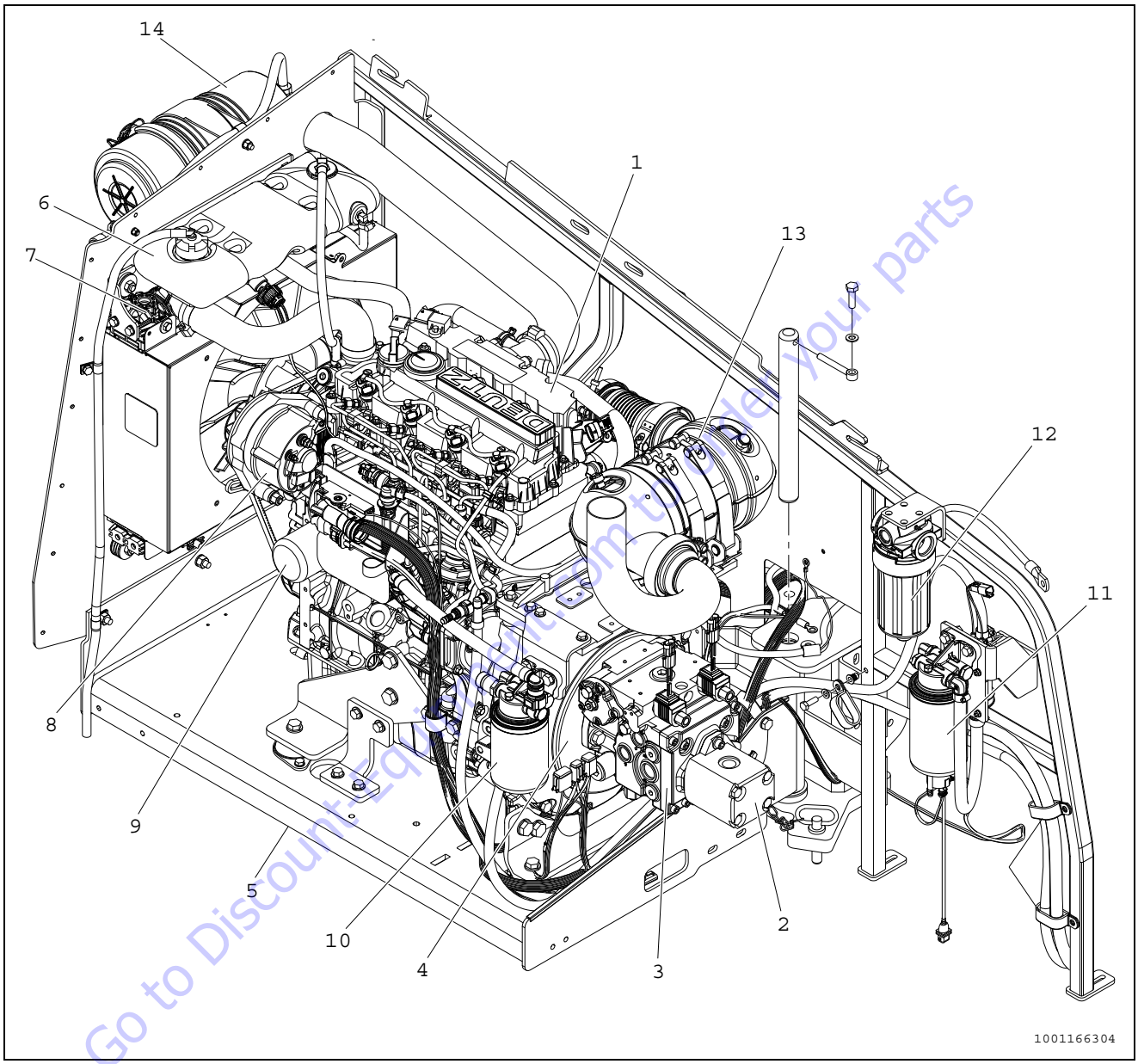
NOTE: *Table shows physical lead connections and should be used with circuit diagram (table replaces wiring diagram).*

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

Table 3-10. Lead Connection List for Generator

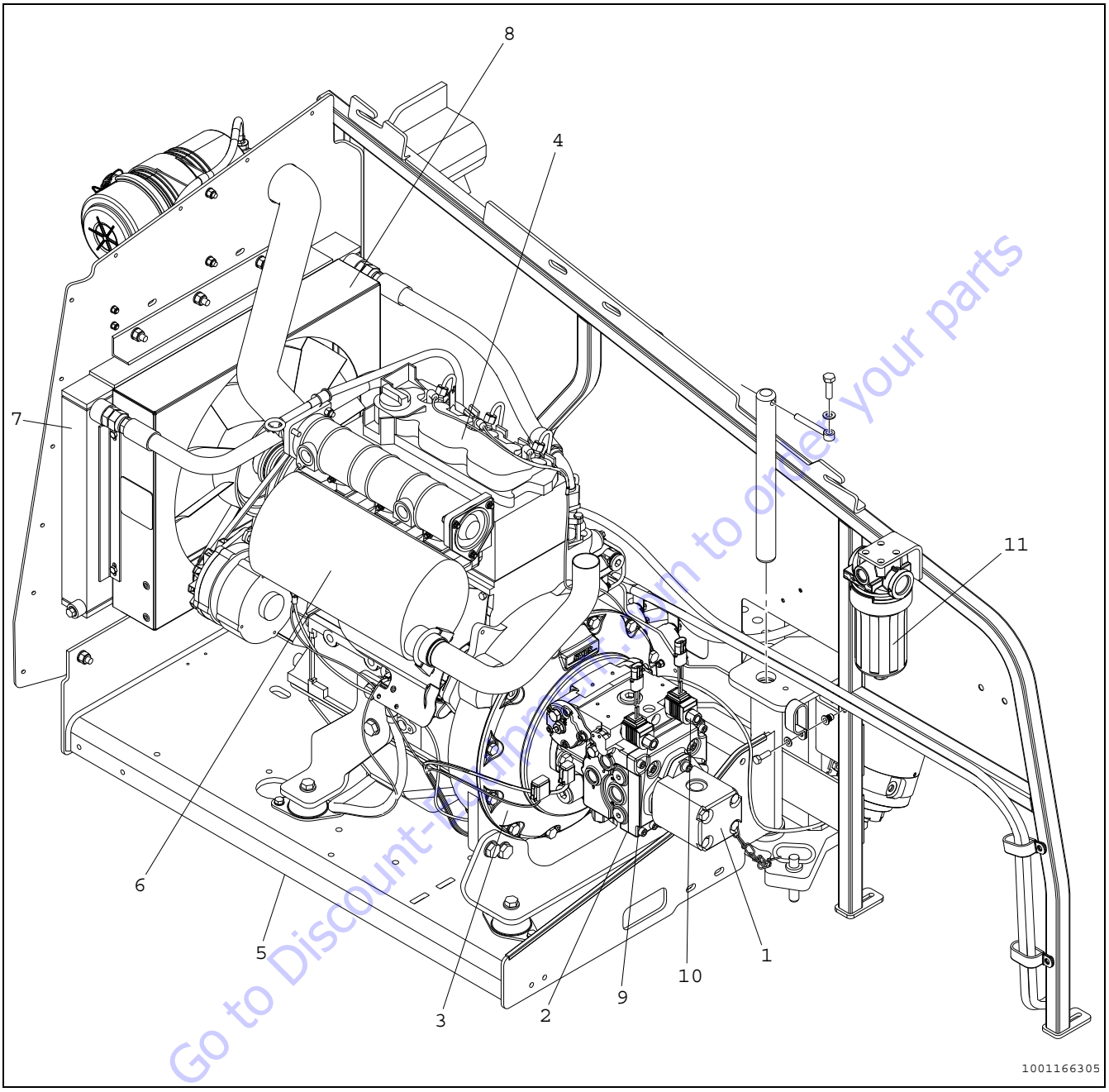
Leads	Connections
1A	STATOR TO CB1
2A	STATOR TO CB1
3A	STATOR TO CB1
4A	STATOR TO TE1 (C)
5A	STATOR TO RC4 (3)
5B	PLG2 (C) TO PLG4 (3)
5C	RC2 (C) PLG31 (8)
6A	STATOR TO RC4 (4)
6B	PLG2 (D) TO PLG4 (4)
6C	RC2 (D) PLG31 (9)
9A	RC5 (B) TO PLG3 (B) (Customer Supplied)
9B	RC3 (B) PLG1 (8)
12A	PLG2 (E) TO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

3.16 DEUTZ ENGINE



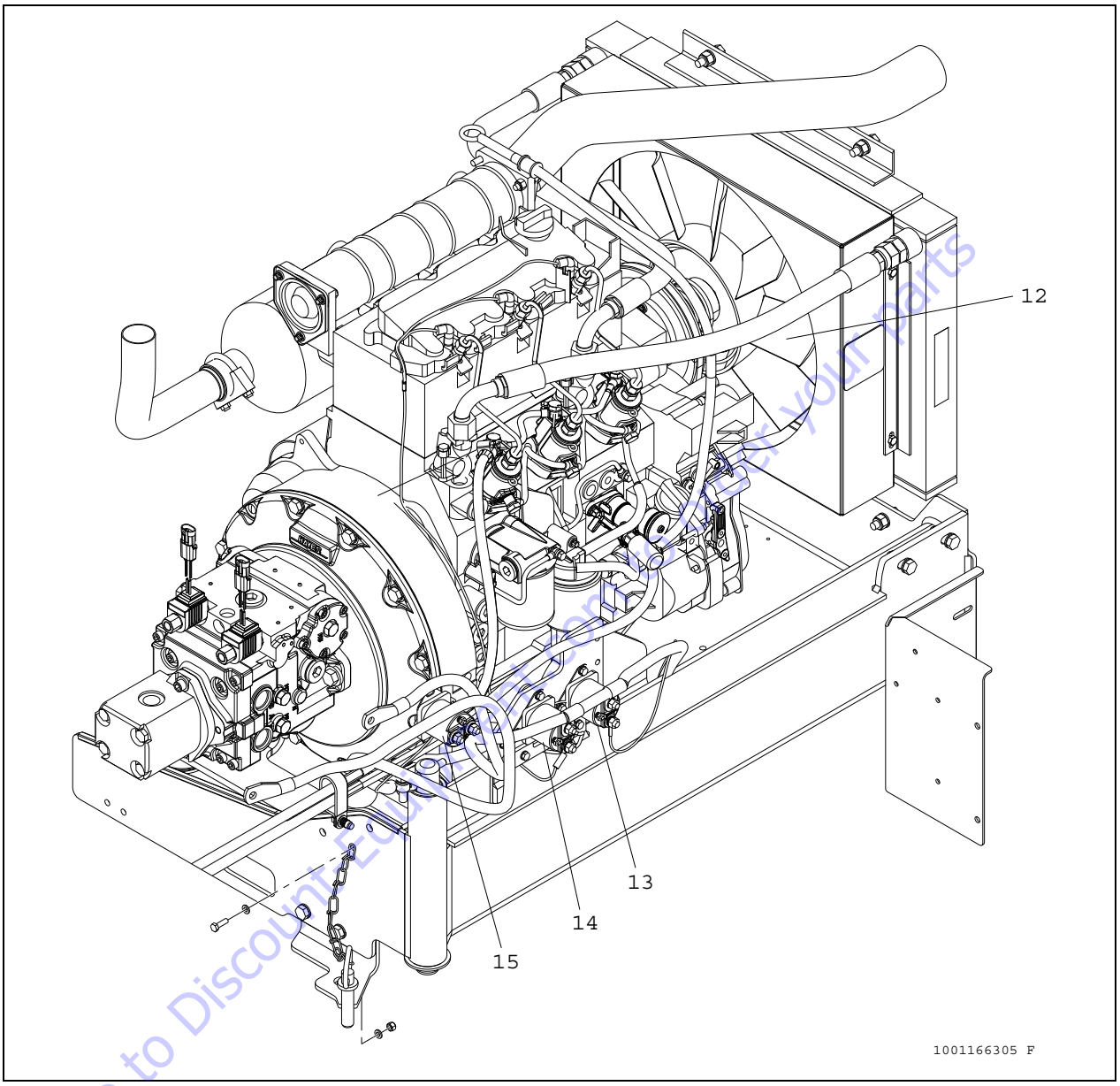
1. Engine
2. Gear Pump
3. Piston Pump
4. Pump Coupling
5. Engine Tray
6. Surge Tank
7. Radiator
8. Alternator
9. Oil Filter
10. Fuel Filter
11. Fuel Pre-Filter
12. Hydraulic Filter
13. Exhaust System
14. Air Cleaner

Figure 3-54. Deutz D2.9L4 Engine Components



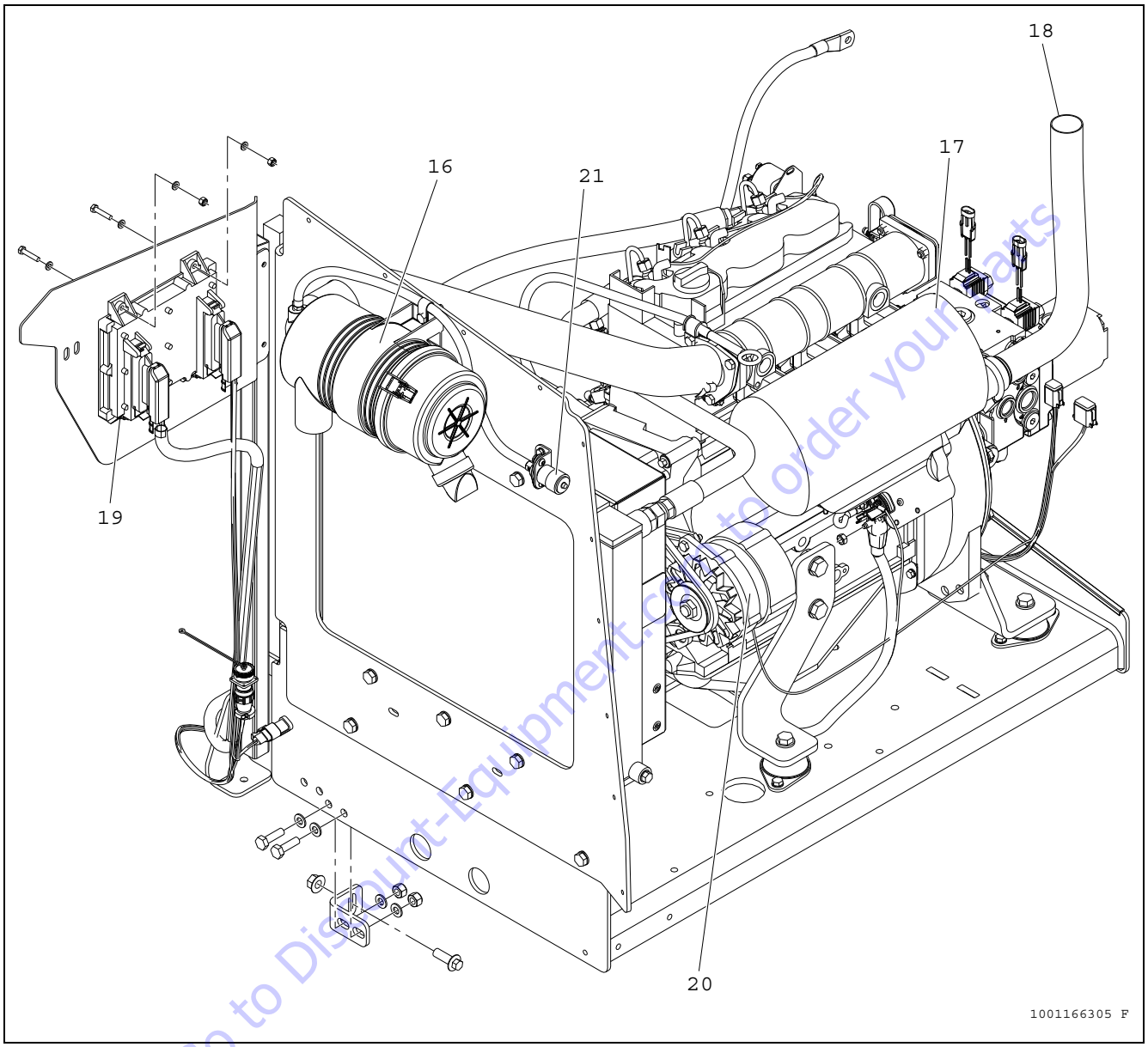
1. Gear Pump
2. Piston Pump
3. Pump Coupling Kit
4. Engine
5. Engine Tray
6. Muffler
7. Oil Cooler
8. Radiator
9. Forward Solenoid
10. Reverse Solenoid
11. Hydraulic Filter

Figure 3-55. Deutz D2011Engine Components - Sheet 1 of 3



12. Fan
13. Starter Relay
14. Glow Plug Relay
15. Auxiliary Pump Relay

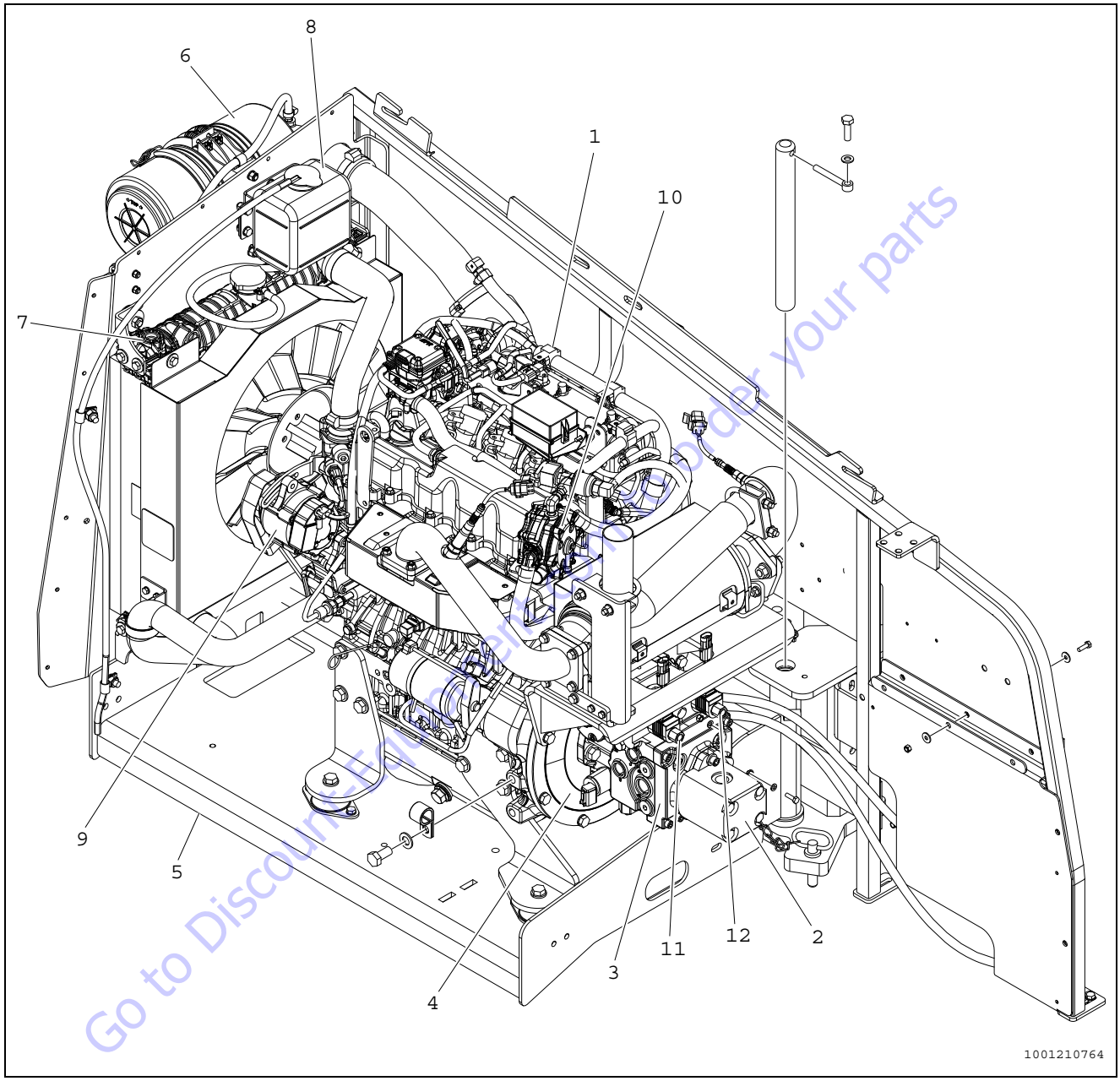
Figure 3-56. Deutz D2011Engine Components - Sheet 2 of 3



16. Air Cleaner
17. Muffler
18. Exhaust Pipe
19. ECM
20. Alternator
21. Air Intake Restriction Indicator

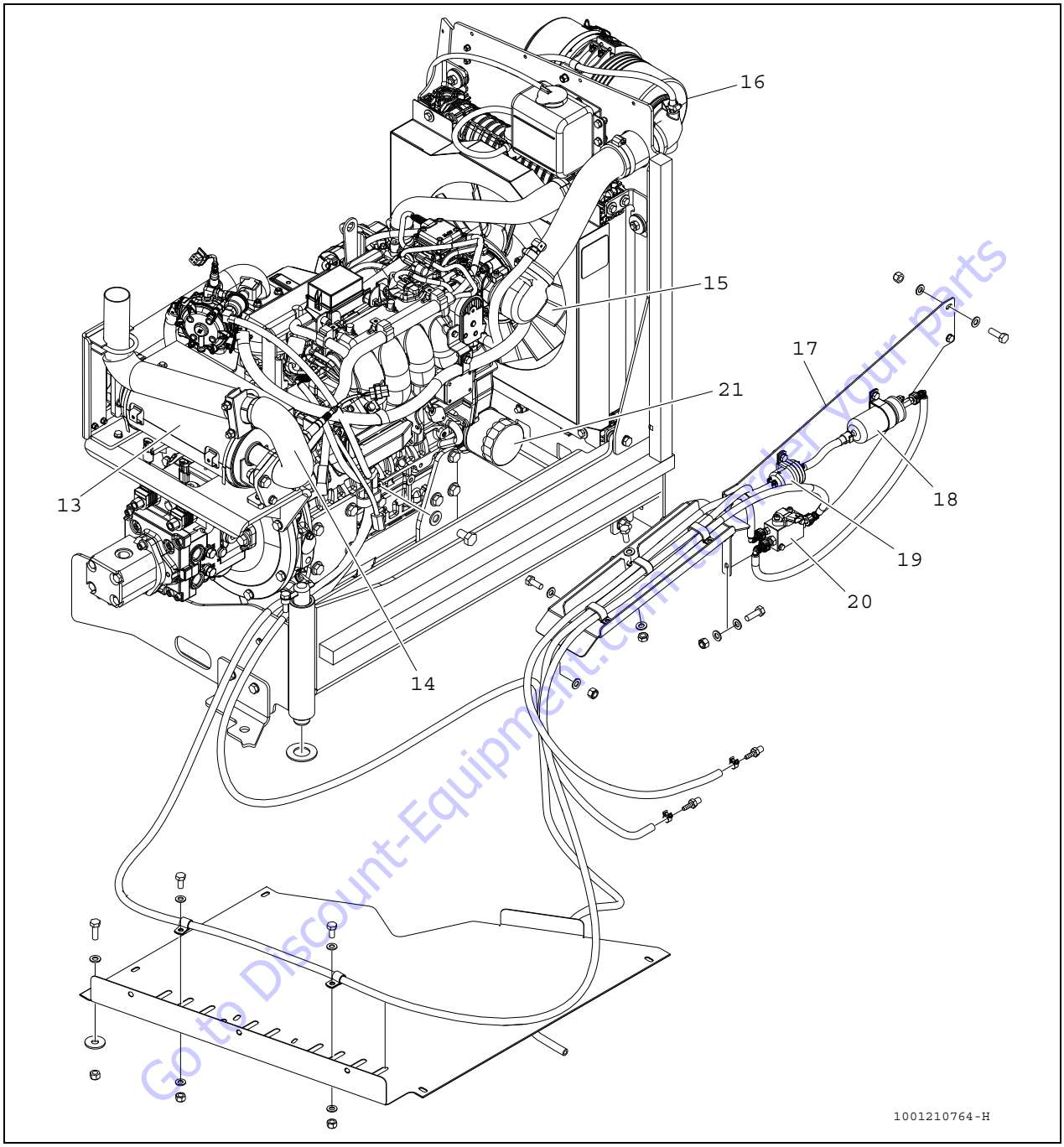
Figure 3-57. Deutz D2011Engine Components - Sheet 3 of 3

3.17 KUBOTA ENGINE



1. Engine
2. Gear Pump
3. Piston Pump
4. Pump Coupling
5. Engine Tray
6. Air Cleaner
7. Radiator
8. Coolant Overflow Container
9. Alternator
10. Regulator assembly
11. Forward Solenoid
12. Reverse Solenoid

Figure 3-58. Kubota Engine Components - Sheet 1 of 2



13. Muffler
14. Exhaust Pipe
15. Fan
16. Air Cleaner
17. Fuel System Mount
18. Fuel Pump
19. Fuel Filter
20. Fuel Manifold
21. Oil Filter

Figure 3-59. Kubota Engine Components - Sheet 2 of 2

3.18 DEUTZ ENGINE - D2.9L4

NOTE: *Refer to engine manufacturer's manual for detailed operating and maintenance instructions. Limited engine maintenance items are presented here for convenience but detailed engine maintenance items and schedule are included in the engine manufacturer's manual.*

Check Oil Level

1. Make sure machine and engine are level and switch engine OFF before checking oil level.
2. Remove oil dipstick and wipe with clean cloth.
3. Insert dipstick to the stop and remove again.
4. Check oil level. Top oil level as shown in figure below with an approved grade and type of oil outlined in engine manufacturer's operator's manual.
5. Replace dipstick until fully seated.

Replacing Engine Oil

1. Allow engine to warm up. Engine oil should reach approximately 176° F (80° C).
2. Make sure machine and engine are level.
3. Switch off engine.
4. Place oil tray under engine.

⚠ CAUTION

HOT ENGINE OIL CAN CAUSE BURNS. AVOID CONTACT WITH HOT OIL WHEN DRAINING.

NOTICE

COLLECT USED OIL IN A CONTAINER SUITABLE FOR DISPOSAL OR RECYCLING. DISPOSE OF USED ENGINE OIL IN ACCORDANCE WITH ENVIRONMENTAL REGULATIONS.

5. Open oil drain valve and drain oil.
6. Close oil drain valve.
7. Pour in new engine oil. Refer to Section 1 for capacity and Figure 3-60., Engine Oil Viscosity.

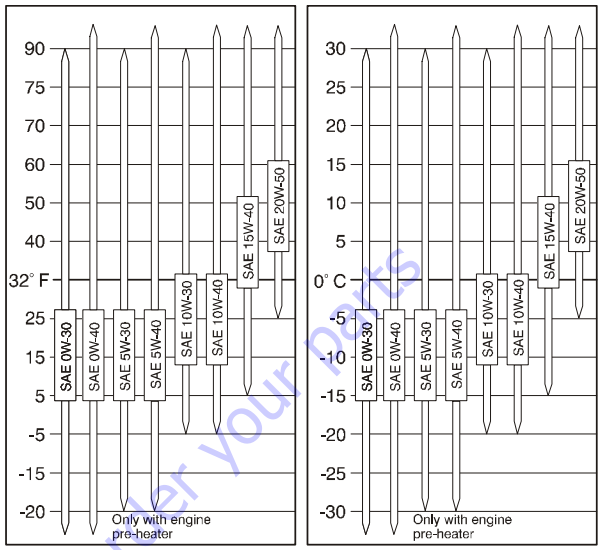
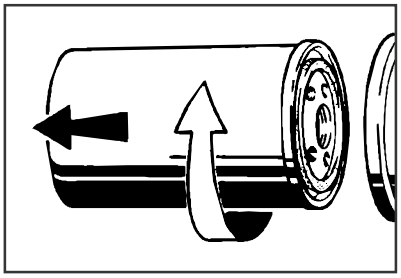


Figure 3-60. Engine Oil Viscosity

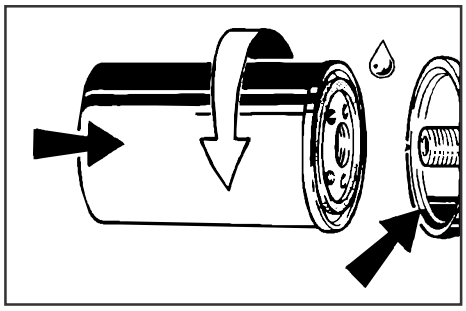
Replacing the Oil Filter

Figure 3-61. Location of the Oil Filter

1. Wipe area around filter to clean any dirt from area.
2. Using a suitable oil filter removal tool, loosen lube oil filter element and spin off.



3. Catch any escaping oil.
4. Clean any dirt from filter carrier sealing surface.
5. Lightly coat new oil filter rubber gasket with clean oil.
6. Screw in new filter by hand until gasket is flush.
7. Hand-tighten filter another half-turn.



8. Check oil level.
9. Check oil pressure.
10. Check oil filter cartridge for leaks.

Replacing the Fuel Filters

Figure 3-62. Location of the Fuel Filter

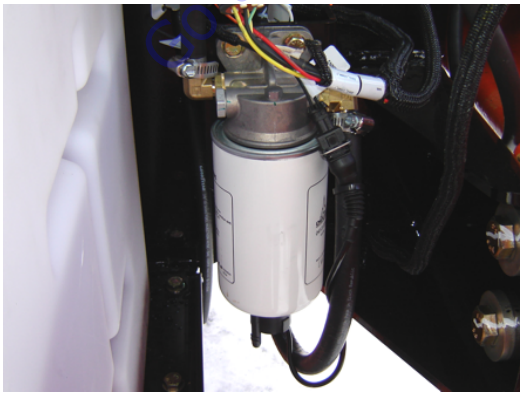
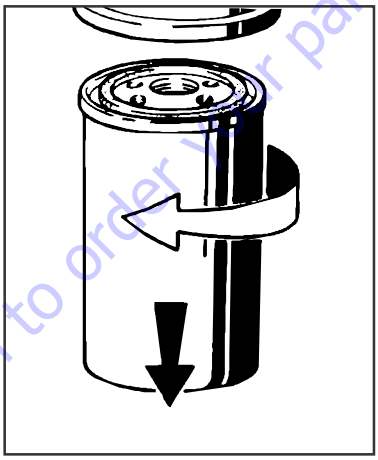


Figure 3-63. Location of the Fuel Pre-Filter

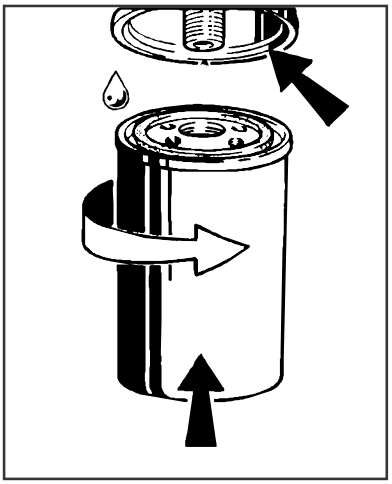
⚠ WARNING

FUEL IS FLAMMABLE AND CAN CAUSE DEATH OR SERIOUS INJURY. MAKE SURE NO OPEN FLAMES OR SPARKS ARE IN THE AREA WHEN WORKING ON FUEL SYSTEM. DO NOT SMOKE WHEN WORKING ON THE FUEL SYSTEMS.

1. Wipe area around filter to clean any dirt from area.
2. Fuel supply from the fuel tank may need to be blocked to prevent flow from the fuel tank.
3. Remove fuel filter cartridge.
4. Catch any escaping fuel.



5. Clean dirt from filter carrier sealing surface.
6. Apply light film of oil or diesel fuel to rubber gasket of new filter cartridge.
7. Screw in new filter by hand until gasket is flush. Hand-tighten filter another 3/4 turn.



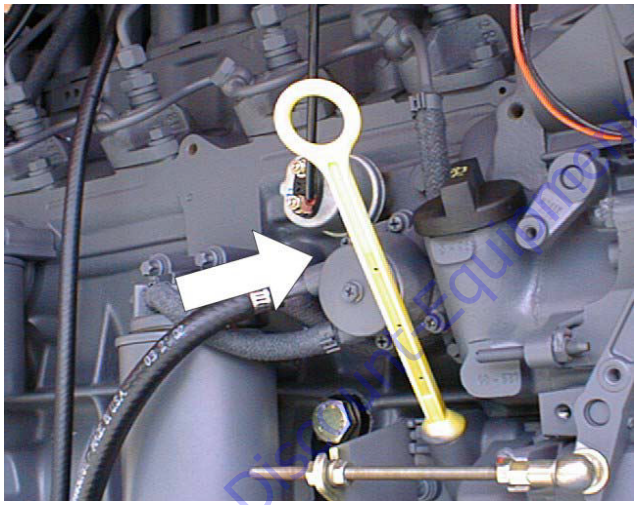
8. Check for leaks.

3.19 DEUTZ ENGINE - D2011

NOTE: *Refer to engine manufacturer's manual for detailed operating and maintenance instructions. Limited engine maintenance items are presented here for convenience but detailed engine maintenance items and schedule are included in the engine manufacturer's manual.*

Check Oil Level

1. Switch the engine off before checking oil level.
2. Make sure the machine and engine are level.
3. Remove the oil dipstick.
4. Wipe the dipstick with non-fibrous, clean cloth.
5. Insert the dipstick to the stop and remove again. Check the oil level, and if necessary, top the oil level up to the MAX mark with an approved grade and type of oil as outlined in the engine manufacturer's operator's manual. Refer to Figure 3-64., Deutz Engine Dipstick.



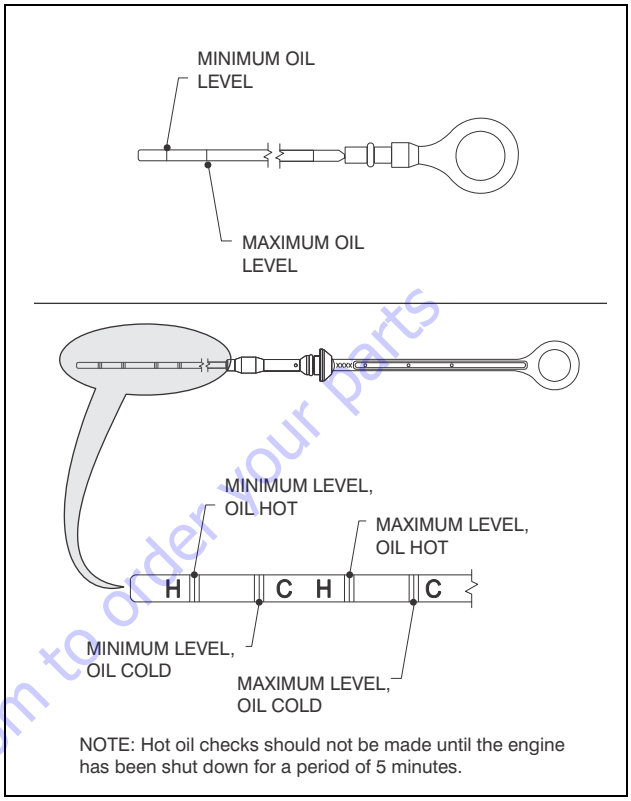


Figure 3-64. Deutz Engine Dipstick

6. Replace the dipstick making sure that it is fully seated in the dipstick tube to seal off the crankcase.

Replacing Engine Oil

1. Allow the engine to warm up. The engine oil should reach approximately 176° F (80° C).
2. Make sure the machine and engine are level.
3. Switch off the engine.
4. Place an oil tray under the engine.

⚠ CAUTION

HOT ENGINE OIL CAN CAUSE BURNS, AVOID CONTACT WITH HOT OIL WHEN DRAINING.

NOTICE

COLLECT USED OIL IN A CONTAINER SUITABLE FOR DISPOSAL OR RECYCLING. DISPOSE OF USED ENGINE OIL IN ACCORDANCE WITH ENVIRONMENTAL REGULATIONS.

5. Open the oil drain valve.
6. Drain the oil.
7. Close the oil drain valve.
8. Pour in new engine oil. Refer to Section 1 for capacity and refer to Figure 3-65., Engine Oil Viscosity for the proper grade.

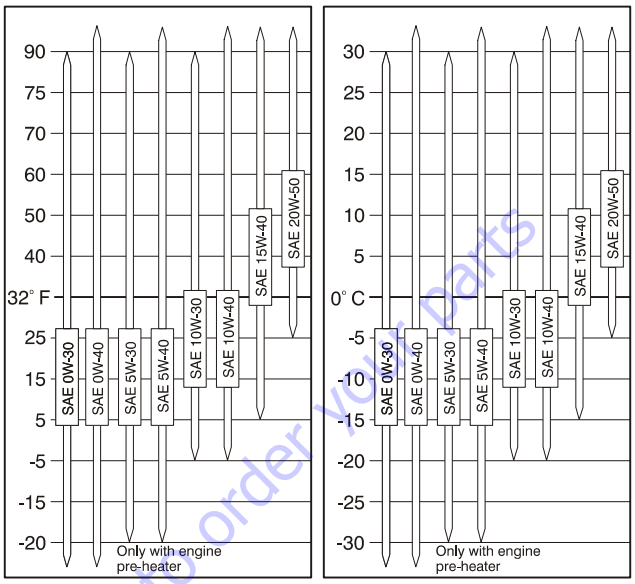
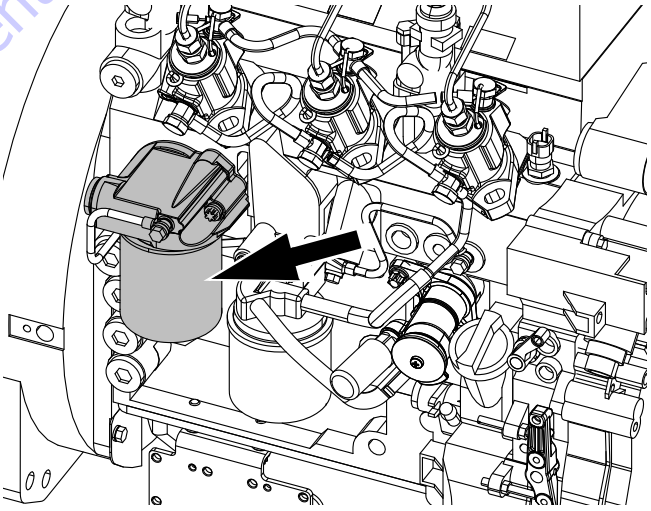


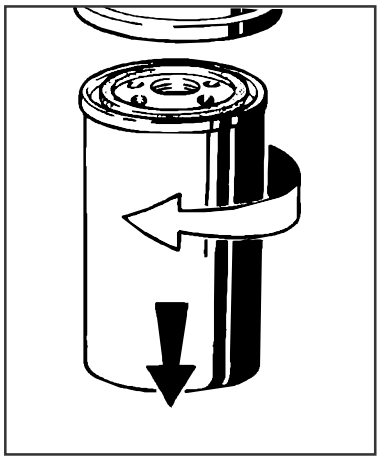
Figure 3-65. Engine Oil Viscosity

Replacing the Oil Filter

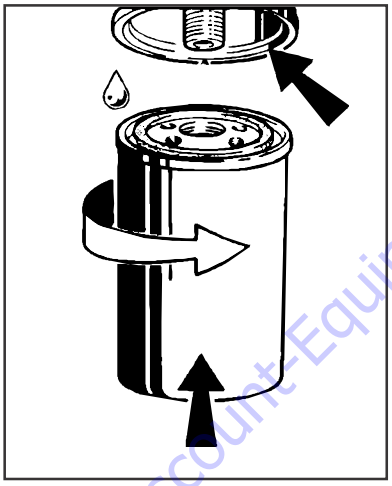


1. Wipe the area around the filter to clean any dirt from the area.

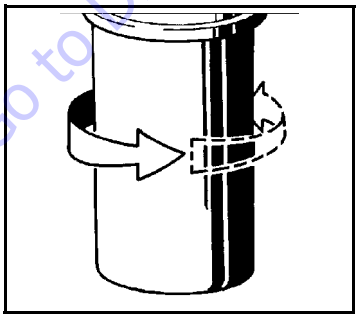
2. Using a suitable oil filter removal tool, loosen lube oil filter element and spin off.



3. Catch any escaping oil.
4. Clean any dirt from filter carrier sealing surface.
5. Lightly coat new oil filter rubber gasket with clean oil.

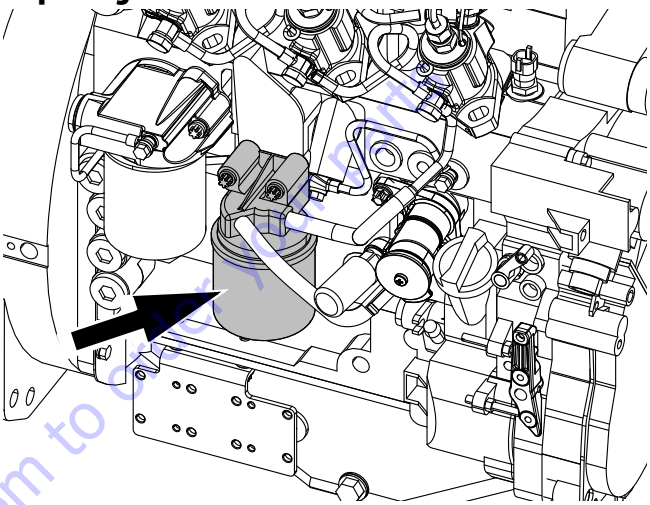


6. Manually screw in the new filter until the gasket is flush.



7. Hand-tighten filter another half-turn.
8. Check oil level.
9. Check oil pressure.
10. Check the oil filter cartridge and make sure there are no leaks.

Replacing the Fuel Filter



⚠ WARNING

FUEL IS FLAMMABLE AND CAN CAUSE DEATH OR SERIOUS INJURY. MAKE SURE NO OPEN FLAMES OR SPARKS ARE IN THE AREA WHEN WORKING ON FUEL SYSTEM. DO NOT SMOKE WHEN WORKING ON THE FUEL SYSTEMS.

1. Wipe the area around the filter to clean any dirt from the area.
2. Fuel supply from the fuel tank may need to be blocked to prevent fuel flow from the tank.
3. Undo the fuel filter cartridge and spin off.
4. Catch any escaping fuel.
5. Clean any dirt from the filter carrier sealing surface.
6. Apply a light film of oil or diesel fuel to the rubber gasket of the new filter cartridge.
7. Manually screw in the new filter until the gasket is flush.
8. Tighten the fuel filter cartridge with a final half-turn.
9. Check for leaks.