An Oshkosh Corporation Company

Service and Maintenance Manual

Model

530LRT

PVC 2004

31217177

March 6, 2020 - Rev A

ANSI

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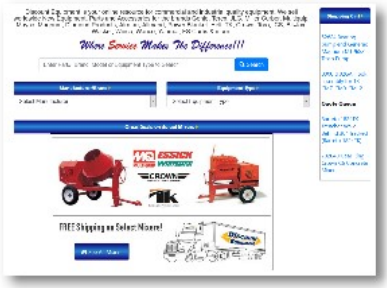

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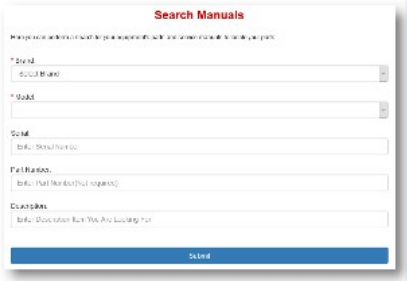

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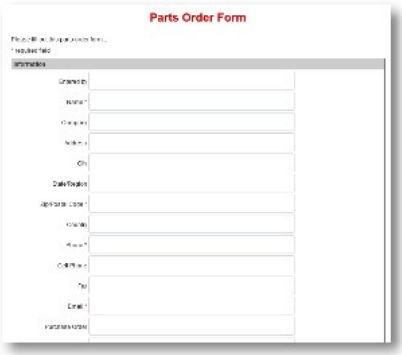

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INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

GENERAL

This section contains the general safety precautions which must be observed during maintenance of the Mobile Elevating Work Platform (MEWP). 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.

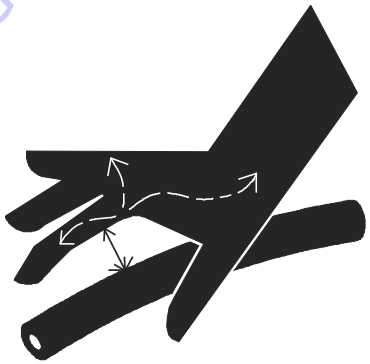
Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the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

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.



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 platform until it has been safely restrained from any movement by blocking or overhead sling, or the 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.

REVISION LOG

Original Issue	A - March 6, 2020

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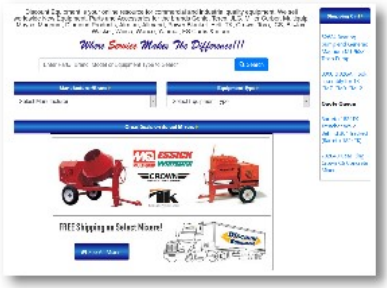

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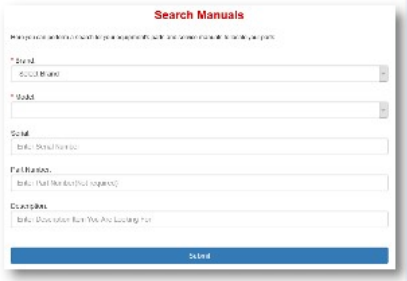

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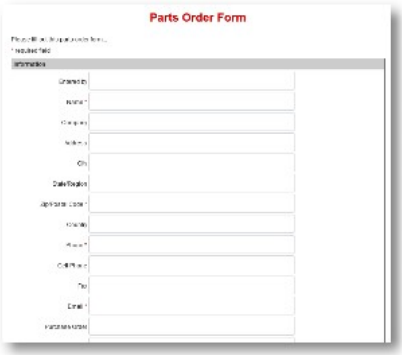

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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, 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 1. SPECIFICATIONS

1.1 GENERAL SPECIFICATIONS

Operating Specifications

Model	530LRT
Maximum Occupants	6
Maximum Workload (Capacity): Main Platform: Max. on Extension (Each):	 1500 lb (680 kg) 500 lb (227 kg)
Maximum Stowed Travel Grade - Gradeability:	40% (22°)
Maximum Stowed Travel Grade - Side slope:	5°
Maximum Platform Working Height	53 ft. (16.15 m)
Maximum Allowable Operating Slope (Platform Fully Elevated) Front to Back: Side to Side:	 1.25° 1.25°
Maximum Drive Height	32 ft. (9.8 m)
Maximum Drive Speed Platform Lowered: High Mid Low Platform Elevated (> 14 ft.)	 3.5 mph (5.6 kph) 1.5 mph (2.4 kph) 0.7 mph (1.1 kph) 0.5 mph (0.8 kph)
Lift Up Speed (No Load) (Stowed to Full Height)	65 seconds
Lift Down Speed (No Load) (Full Height to Stowed)	60 seconds
Maximum Wind Speed	28 mph (12.5 m/s)
Maximum Horizontal Manual Side Force: ANSI/ANSI EXPORT: CE:	 300 lb (1335 N) 90 lb (400 N)
Maximum Tire Load (Each)	5500 lb (2500 kg)
Ground Bearing Pressure w/Standard tires	26.5 psi (1.86 kg/cm^2)
Leveling Jack Bearing Pressure	70 psi (4.92 kg/cm^2)
Hydraulic System Pressure Main Relief: Steer Relief:	 2700 psi (186 bar) 2500 psi (172 bar)
Electrical System Voltage	12 Volt
Inside Turning Radius	109.7 in (2.79 m)

Model	530LRT
Outside Turning Radius	19.76 ft. (6.023 m)
Gross Vehicle Weight Dual Fuel/Diesel - ANSI/ANSI Export/CSA/CE w/One Extension: w/Two Extensions: w/MegaDeck: *Note: Certain options or country standards increase weight.*	 17,000 lb (7711 kg) 17,300 lb (7847 kg) 17,800 lb (8074 kg)

Generator Specifications (If Equipped)

Table 1-1. 7500W Generator Specifications

Type:	Brush Type, Synchronous, Revolving Field
Regulation: 3 Phase: 1 Phase: 1 Phase: Peak:	 240 Volt, 7.5 Kw, 18.3 Amps, 1.0 pf 240 Volt, 6 Kw, 26 Amps, 1.0 pf 120 Volt, 6 Kw, 50 Amps, 1.0 pf 3 Phase - 8.5 Kw, - 1 Phase - 6.0 Kw
Max Rated Temperature:	104 F (40C)

Table 1-2. 4000W Generator Specifications

Type:	Brush Type, Synchronous, Revolving Field
Regulation: 1 Phase: Peak:	 120/240 Volt, 4 Kw, 20 Amps, 1.0 pf 4.0 Kw
Max Rated Temperature:	104 F (40C)

Dimensional Data

Component	530LRT
Wheelbase	117 in. (297 cm)
Ground Clearance (center/platform stowed)	14.1 in (35.7 cm)
Machine Height (top of rails/platform stowed)	125 in. (317.5 cm)
Machine Width	90.8 in. (230 cm)
Machine Length (leveling jack to leveling jack)	192.2 in. (488.3 cm)

Capacities

Fuel Tank	Diesel: Gasoline: LP Tank:	22 gal (83.3 L) 22 gal (83.3 L) 43.5 lb (20 kg)
Hydraulic Tank		32.3 gal (122.2 L)
Engine Oil	Diesel: Dual Fuel:	6 qt (5.7 L) 3.6 qt (3.4 L)
Engine Coolant		7 qt (6.67 L)
Drive Brake (Each)		2.7 oz (0.08 L)
Drive Hub (Each)		17 oz (0.5 L)

Drive Information

Model	530LRT
High Drive, Forward, Range	4-5 (sec/25ft)
High Drive, Reverse, Range	4-5 (sec/25ft)
Elevation Drive, Platform Height	32 ft. (9.75 m)
Elevated Drive, F/R, Range	34 (sec/25ft)
Gradeability Requirement	40%

Steering Information

Model	530LRT
Toe In / Out, (+/-) Max	0.8 in. (20.32 mm)
Steer Angle, Inside Tire	42-46 degrees
Steer Angle, Outside Tire	32-34 degrees

Tires

Size	Ply Rating	Foam Fill Tire Assembly Rating	Wheel Nut Torque
12 x 16.5 Foam Filled (Non-Marking)	10	90 PSI @ 8,000 lb (3700 kg) - Static Load	170 ft. lb. (230 Nm)
12 x 16.5 Foam Filled	10	90 PSI @ 8,000 lb (3700 kg) - Static Load	170 ft. lb. (230 Nm)
IN395/45/D20 Foam Filled (Non-Marking)	14	90 PSI @ 14,740 lb (6700 kg) - Static Load	170 ft. lb. (230 Nm)
IN395/45/D20 Foam Filled	14	90 PSI @ 14,740 lb (6700 kg) - Static Load	170 ft. lb. (230 Nm)

Critical Stability Weights

⚠ WARNING

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

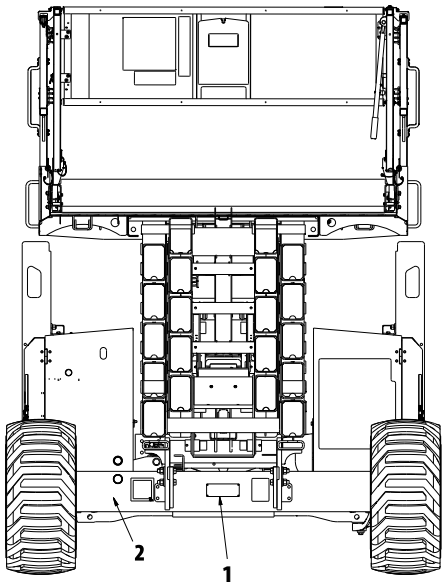
Component	530LRT
Wheel and Tire (each) 12x16.5 - Foam Filled 395/45/D20 - Foam Filled	 328 lb (149 kg) 381 lb (173 kg)
Engine Only (Kubota - Diesel)	209 lb (95.1 kg)
Engine Only (Kubota - Gas/LP)	171 lb (77.7 kg)
Battery	66 lb (30 kg)

Major Component Weights

Component	Weight
Platform Single Ext: Dual Ext: Mega:	 993.6 lb (450.7 kg) 993.6 lb (450.7 kg) 1,172.2 lb (531.7 kg)
Platform Extension (all)	300 lb (136.1 kg)
Arms (with cylinders):	9,892.1 lb (4491 kg)
Chassis:	3628 lb (1645.7 kg)
Chassis Counterweight:	1000 lb (456 kg)
Chassis with Foam Filled Tires:	5152 lb (2337 kg)

1.2 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the machine. The plate is located at the rear of the machine on the center of the axle. In addition, should the serial number plate be damaged or missing, the machine serial number is stamped onto the lip of the rear axle.



1. Serial Number Plate
2. Stamped Serial Number

Figure 1-1. Serial Number Location

1.3 LUBRICATION

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

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

KEY	SPECIFICATIONS
MPG	Multipurpose Grease - Having a minimum dripping point of 350°F. Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) - Meeting API service classification GL-5 or MIL-Spec MIL-L-2105.
EO	Engine Oil (crankcase)
HO	Hydraulic Oil

Hydraulic Oil Specifications

Table 1-3. Mobilfluid 424

Inspection Data	Recommended	Optional
SAE Grade	10W-30	10W-20
Gravity, API	29.0	29.3
Density, LB/GAL, 60° F	7.35	7.3
Flash Point, °F(°C)	442(228)	380(193)
Pour Point, °F(°C)	-46 (-43)	-30(-34)
Viscosity		
Brookfield, cP at -18°C	2700	
Brookfield, cP at 0°F		2500
Viscosity, cST at 40°C	55	52.1
Viscosity, cST at 100°C	9.3	8.95
Viscosity Index	152	152
Viscosity, Sus at 100°F		26.0
Viscosity, Sus at 210°F		56.8
Color, ASTM D 1500	3.0	

Table 1-4. Mobil DTE 10 Excel 32

ISO Viscosity Grade	32
Pour Point, °C Max.	-54
Flash Point, °C Min.	250
Viscosity	
cSt @ 40° C	32.7
cSt @ 100° C	6.63
cSt @ 100° F	32.7
cSt @ 212° F	6.63
Viscosity Index	164
Density (Kg/l) @ 15°C	0.8468
Density (lb/in^3) @ 60°F	0.0305

Table 1-5. UCon Hydrolube HP-5046

pH	9.1
Specific Gravity, 20/20°F	1.082
Pour Point, °C(°F)	<-50(<58)
Appearance	Red Liquid
Viscosity	
at 0°C (32°F)	340cST(1600SUS)
at 40°C (104°F)	46cST(215SUS)
at 65°C (150°F)	22cST(106SUS)
Viscosity Index	170

Table 1-6. Mobil EAL 224H

Type	Biodegradable Vegetable Oil
ISO Viscosity Grade	32/46
Specific Gravity	0.922
Pour Point °C(°F)	-32°(-25°)
Flash Point °C(°F)	220°(428°)
Rust Protection, ASTM D 665A & BB	Pass Color, ASTM D 1500 Max 2.0
Operating Temp -17°-162°C	(0-180°F) (Store above 14°C (32°F))
Viscosity	
ASTM D445 cST 40°C	37
ASTM D445 cST 100°C	8.4
Viscosity Index, ASTM D 2270	213

Table 1-7. Mobil SHC Hydraulic EAL 46

ISO Viscosity Grade	46
Density@15°C	0.93
Pour Point, °C (°F), ASTM D 97	-33(-27)
Flash Point, °C (°F), Min., ASTM D 97	298(568)
Operating Temp °C(°F)	-29°(-20) to 93(200)
Viscosity	
ASTM D 445 cST 40°C	43.3
ASTM D 445 cST 100°C	7.7
Viscosity Index	149

Table 1-8. Mobil EAL ENVIROSYN H 46

ISO Viscosity Grade	46
Density@15°C	0.874
Pour Point, °C (°F), ASTM D 97	-45°C(-49)
Flash Point, °C (°F), Min., ASTM D 97	260°C(500)
Operating Temp °C(°F)	-29°(-20) to 93(200)
Viscosity	
ASTM D 445 cST 40°C	48.8
ASTM D 445 cST 100°C	7.8
Viscosity Index	145

1.4 HYDRAULIC PRESSURE SETTINGS

Description	530LRT
Main Relief	2700 psi (186 bar)
Steer Relief	2500 psi (172 bar)

1.5 HYDRAULIC CYLINDER SPECIFICATIONS

Description	Bore	Stroke	Rod Dia
Lift Cylinders Upper: Lower:	 3.90 in. (100 mm) 4.70 in. (120 mm)	 84.125 in. (2137 mm) 84.125 in. (2137 mm)	 3.30 in. (85 mm) 3.5 in. (90 mm)
Leveling Jack Cylinder	2.5 in. (63 mm)	27 in. (685.8 mm)	2 in. (50 mm)
RAM Lockout Cylinder (Oscillating Axle)	3.62 in. (92 mm)	4 in. (101.6 mm)	3.5 in. (88.9 mm)
Steer Cylinder	2.75 in. (70 mm)	8.94 in. (227.1 mm)	1.97 in. (50 mm)

1.6 ENGINE SPECIFICATIONS

Table 1-9. Kubota Diesel (D1305-E4B)

Emissions	CARB, EPA Tier 4 Final, China Stage III and EU Stage V
Fuel Type:	Diesel: - Low Sulfur (<500 ppm) - Ultra Low Sulfur (15 ppm) *(Required to meet Stage V)* - up to 5% biodiesel
No. of Cylinders	3
Oil Pan Capacity	1.51 Gal. (5.7 L)
Engine RPM Control	Mechanical
Low RPM Set	1200 RPM
High RPM Set	2600 RPM
Alternator	60 Amp, 12V, Belt Drive
Battery	112 Amp-Hour, 950 Cold Cranking Amps, 12 VDC
Fuel Consumption: Low RPM High RPM	0.41 gal/hr (1.5 L/hr) 2.0 gal/hr (7.6 L/hr)
Displacement	1.261 L (77 cu. in.)
Gross Power	24.8 Hp (18.5 Kw) @ 2600 RPM
Gross Torque	59.1 Ft. lb. (80.1 Nm) @ 1700 RPM

Table 1-10. Kubota (WG972-GL-E4 - Dual Fuel)

Emissions	U.S. EPA Phase 3 and CARB SSI
Fuel Type:	Gasoline - 87 Octane minium - Ethanol/Gas Mix-10% max. - Methanol/Gas Mix-5% max. LP - Liquid Petrolium
No. of Cylinders	3
Oil Pan Capacity	0.90 Gal. (3.4 L)
Engine RPM Control	Electronic - ECM
Low RPM Set	1200 RPM
High RPM Set	3500 RPM
Alternator	60 Amp, 12V, Belt Drive
Battery	112 Amp-Hour, 950 Cold Cranking Amps, 12 VDC
Fuel Consumption: Low RPM High RPM	 0.38 gal/hr (1.45 L/hr) - Gas 2.07 lb/hr (0.94 kg/hr) - LP 1.76 gal/hr (6.66 L/hr) - Gas 9.77 lb/hr (4.43 kg/hr) - LP
Displacement	0.962L (58.7 cu. in.)
Gross Power	GAS - 30.6 Hp (22.8 Kw) @ 3500 RPM LP - 30.0 Hp (21.6 Kw) @ 3500 RPM
Gross Torque	GAS - 49.1 Ft.lb (66.6 Nm) @ 2400 RPM LP - 48.8 Ft.lb (66.2 Nm) @ 1800 RPM

1.7 PLATFORM HEIGHT/TILT LIMIT SETTINGS

The machine is equipped with the following limit switches:

Rotary Position Sensor - High drive speed is cut out when platform is raised above the preset heights listed in Table 1-21, Maximum Cutout Height.

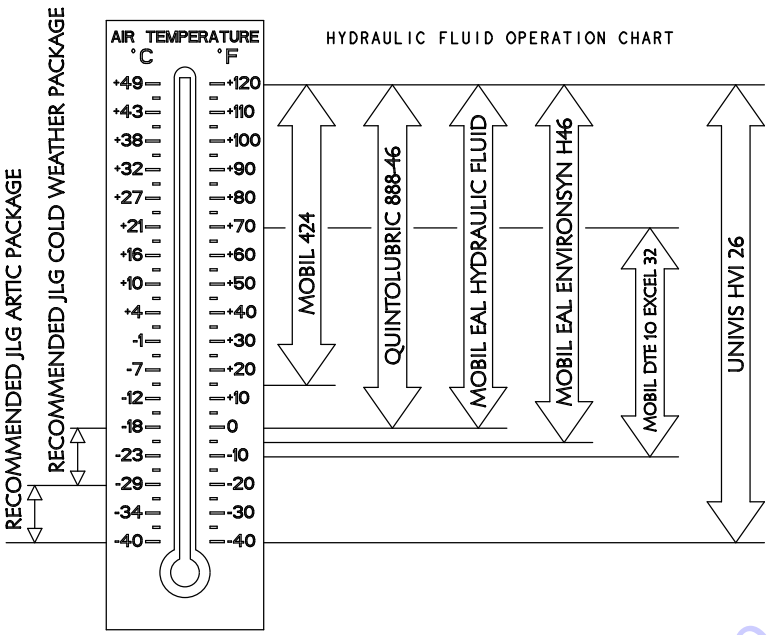
Model	High Drive Cutout
530LRT	14 ft (4.26 m)

Tilt Alarm - An alarm sounds and a warning light is illuminated when the machine is operated on a slope that exceeds the values in Table 1-11, Tilt Cutout Settings. The lift and drive functions will cut out at these set heights.

NOTE: *Alarm only sounds when above elevation. If the machine is operated beyond the specified slope, with the platform completely lowered, only the warning light is illuminated.*

Table 1-11. Tilt Cutout Settings

Market	Leveling Jacks Set		Leveling Jacks NOT Set		Drive is prevented when elevated beyond the following heights:	Lift Up is prevented when elevated beyond the following heights without leveling jacks set:
	Front to Back	Side to Side	Front to Back	Side to Side		
ANSI, ANSI Exp., CE, AUS, Korea	1.5° to 53 ft (16 m)	1.5° to 53 ft (16 m)	5° to 32 ft (9.75 m) 1.3° to 45 ft (13.7 m)	3° to 32 ft (9.75 m) 1.3° to 45 ft (13.7 m)	32 ft	45 ft
CSA	1.5° to 53 ft (16 m)	1.5° to 53 ft (16 m)	3° to 32 ft (9.75 m)	3° to 32 ft (9.75 m)	32 ft	32 ft



Fluid	Properties		Base				Classifications		
	Viscosity at 40°C (cSt, Typical)	Viscosity Index	Mineral Oils	Vegetable Oils	Synthetic	Synthetic Polyol Esters	Readily Biodegradeable *	Virtually Non-toxic **	Fire Resistant ***
Mobilfluid 424	55	145	X						
Mobil DTE 10 Excel 32	32	164	X					X	
Univis HVI 26	26	376	X						
Mobil EAL Hydraulic Oil	47	176		X			X	X	
Mobil EAL Envirosyn H 46	49	145			X		X	X	
Quintolubric 888-46	50	185				X	X	X	X

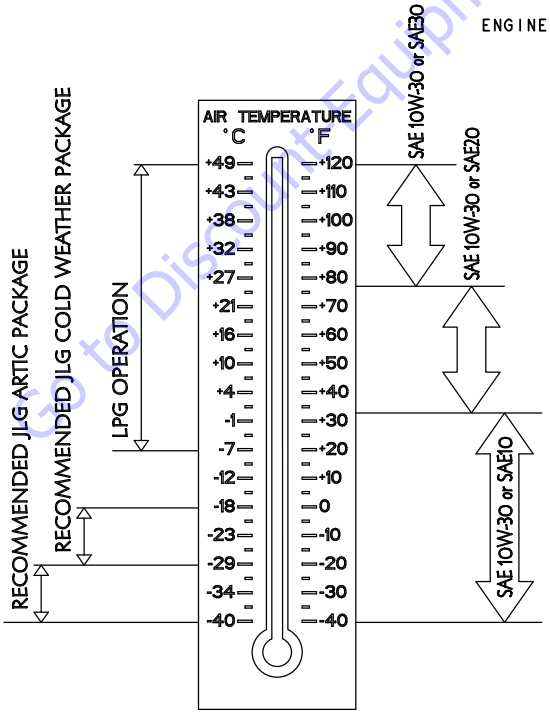
* Readily biodegradable classification indicates one of the following:
CO2 Conversion>60% per EPA 56016-82-003
CO2 Conversion>80% per CEC-L-33-A-93
** Virtually Non-toxic classification indicates an LC50>5000 ppm per OECD 203
*** Fire Resistent classification indicates Factory Mutual Research Corp. (FMRC) 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.

4150740_B_Hydraulic

Figure 1-2. Hydraulic Oil Operating Temperature Specifications



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1001204714_A_Dual Fuel

Figure 1-3. Engine Oil Operating Temperature Specifications - Kubota (Dual Fuel Engine)

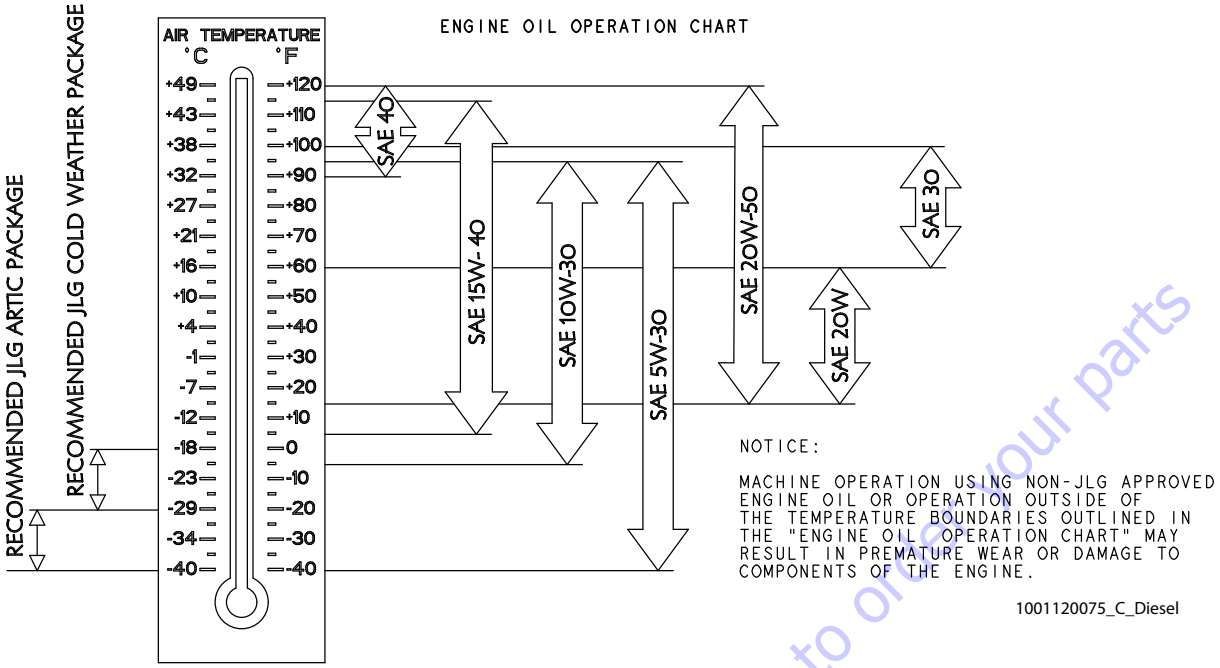

Figure 1-4. Engine Oil Operating Temperature Specifications - Kubota (Diesel Engine)

1.8 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.*

1.9 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

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

3. * ASSEMBLY USES HARDENED WASHER

5000059K

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
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

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

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

3. * ASSEMBLY USES HARDENED WASHER

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
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

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

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

3. * ASSEMBLY USES HARDENED WASHER

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

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

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

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Metric Fastener Torque Chart (Continued)

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

NOTES:

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

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

Metric Fastener Torque Chart (Continued)

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

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

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SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

This section provides the necessary information needed by those personnel that are responsible to place the machine in operation readiness and maintain its safe operating condition. For maximum service life and safe operation, ensure that all the necessary inspections and maintenance have been completed before placing the machine into service. With proper care, maintenance and inspections performed per JLG's recommendations 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 platforms. The frequency of inspections and maintenance must be increased as environment, severity and frequency of usage requires.

Pre-Start Inspection

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

Annual Machine Inspection

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE

The preventive maintenance and inspection checks are listed and defined in the following table. This table is divided into two basic parts, the “AREA” to be inspected and the “INTERVAL” at which the inspection is to take place. Under the “AREA” portion of the table, the various systems along with the components that make up that system are listed. The “INTERVAL” portion of the table is divided into two columns representing the various inspection time periods. The numbers listed within the interval column represent the applicable inspection code for which that component is to be checked.

The checks and services listed in this schedule are not intended to replace any local or regional regulations that may pertain to this type of equipment nor should the lists be considered as all inclusive. Variances in interval times may occur due to climate and/or conditions and depending on the location and use of the machine.

NOTICE

JLG INDUSTRIES REQUIRES THAT A COMPLETE ANNUAL INSPECTION BE PERFORMED IN ACCORDANCE WITH THE "ANNUAL MACHINE INSPECTION REPORT” FORM.

NOTE: *This machine requires periodic safety and maintenance inspections by a JLG Dealer. A decal located on the frame affords a place to record (stamp) inspection dates. Notify dealer if inspection is overdue.*

Maintenance and Inspection Schedule Codes

1. Check for proper and secure installation.
2. Visual inspection for damage, cracks, distortion, or excessive wear.
3. Check for proper adjustment.
4. Check for cracked or broken welds.
5. Operates properly.
6. Returns to neutral or “off” position when released.
7. Clean and free of debris.
8. Interlocks function properly.
9. Check for signs of leakage.
10. Decals installed and legible.
11. Check for proper fluid level.
12. Check for chafing and proper routing.
13. Check for proper tolerances.
14. Properly lubricated.
15. Torqued to proper specification.
16. No gouges, excessive wear, or cords showing.
17. Properly inflated and seated around rim.
18. Proper and authorized components.
19. Fully charged.
20. No loose connections, corrosion, or abrasions.
21. Verify.
22. Perform.
23. Sealed properly.
24. Overrides platform controls.
25. Remove pump motor cover and blow away any brush wear dust from cover, brushes, and brush holder assembly.
26. Replace.

Table 2-2. Preventive Maintenance & Inspection Schedule

AREA ON MACHINE	INTERVAL	
	PRE-DELIVERY (a) OR FREQUENT (b) INSPECTION	ANNUAL (c) (YEARLY) INSPECTION
FUNCTIONS/CONTROLS		
Platform Controls	5, 6, 7	5, 6, 7
Ground Controls	5, 6	5, 6
Function Control, Guards, or Detents	5	5
Function Enable System	5, 8	5, 8
Emergency Stop Switches (Ground & Platform)	5	5
Manual Descent or Auxiliary Power	5	5
PLATFORM ASSEMBLY		
Platform	1	1
Guard Rails	1, 2, 4	1, 2, 4
Gate	1, 5	1, 5
Floor	1, 2	1, 2
Lanyard Anchorage Point	1, 4, 10	1, 4, 10
SCISSOR ARMS		
Scissor Arms	1, 2, 4	1, 2, 4
Arm Safety Prop	1, 5	1, 5
Cylinder Pins, Pivot Pins & Attaching Hardware	1, 2	1, 2
Arm Pins, Wear Pads & Attaching Hardware	1, 2	1, 2
CHASSIS ASSEMBLY		
Side-Compartment Door Installation	1, 5, 7	1, 5, 7
Static Strap	1	1
Wheel and Tire Assemblies	2, 15, 16	2, 15, 16
Drive Motors	1, 7, 9	1, 7, 9
Platform Ladder	1, 7	1, 7
Drive Brakes	1, 7	1, 7
Drive Torque Hubs	1, 7	1, 7
Engine Mounts	1	1
Battery	9	18
Engine Oil	5	5
Exhaust System	1, 5	1, 5
Fuel Tank	1, 9	1, 9
Air Cleaner****	7	26

Table 2-2. Preventive Maintenance & Inspection Schedule (Continued)

AREA ON MACHINE	INTERVAL	
	PRE-DELIVERY (a) OR FREQUENT (b) INSPECTION	ANNUAL (c) (YEARLY) INSPECTION
HYDRAULIC/ELECTRIC SYSTEM		
Hydraulic Pump	1, 2, 9	1, 2, 9
Hydraulic Control Valves	1, 9	1, 9
Hydraulic Fluid***	11	11
Hydraulic Filter*	—	26
Hydraulic Hoses, Lines and Fittings	1, 9	1, 9
Hydraulic Oil Tank, Cap, and Breather	5, 7, 9	5, 7, 9
Hydraulic Cylinders (Steer and Lift)	2, 7, 9	2, 7, 9
GENERAL		
Operation & Safety Manual in Storage Box	21	21
ANSI Manual of Responsibilities and AEM Safety Manual in Storage Box (ANSI and ANSI Export Only)	21	21
Capacity Decals Installed, Secure, Legible	21	21
All Decals/Placards Installed, Secure, Legible	21	21
Annual Machine Inspection Due	—	21
No Unauthorized Modifications or Additions	21	21
All Relevant Safety Publications Incorporated	21	21, 22
General Structural Condition and Welds	2, 4	2, 4
All Fasteners, Pins, Shields, and Covers	1, 2	1, 2
Grease and Lubricate to Specifications	22	22
Function Test of All Systems	22	22
Paint and Appearance	7	7
Notify JLG of change in Machine Ownership		22

* Replace Annually - JLG PN - 70005423.
** Replace when system performance is degraded.
*** Every two years, drain and remove hydraulic oil reservoir, clean pick-up screen, refill with fresh hydraulic fluid.
**** Replace every six (6) months.

Footnotes

(a) Prior to each sale, lease, or delivery.

(b) In service for 3 months; or Out of service for 3 months or more; or Purchased used.

(c) Annually, no later than 13 months from the date of the prior inspection.

2.3 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

4. 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.
5. 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°.
6. If a part resists removal, check to see whether all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

Component Disassembly and Reassembly

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

Pressure-Fit Parts

When assembling pressure-fit parts, use an anti-seize or molybdenum disulfide base compound to lubricate the mating surface.

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

1. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.

2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Torque Chart Section 1.)

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.4 LUBRICATION AND INFORMATION

Hydraulic System

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

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

Changing Hydraulic Oil

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

Lubrication Specifications

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

2.5 SERVICE MAINTENANCE COMPONENTS

Setting Scissor Arm Safety Prop

⚠ CAUTION

THE SAFETY PROP MUST BE USED WHENEVER MAINTENANCE PERFORMED ON THE MACHINE REQUIRES THE SCISSOR ARMS TO BE RAISED.

1. To engage the safety props, raise the unloaded platform high enough to allow the safety props to rotate vertically into position. (See Figure 2-1.)
2. Rotate the rod keeper plate and release the safety prop actuator rod at the front of the machine. (See Figure 2-2.)
3. Lift the actuator rod (flat) up out of the slot in the keeper plate bracket and pull the actuator rod to align the safety props vertically with the scissor arm center pins above and below the safety prop mounting pins.
4. Set the actuator rod (flat at the set position) into the slot on the keeper plate bracket and rotate the keeper plate to lock the actuator rod in this position.
5. Lower the platform arms until the safety prop rests on the scissor arm center pin mounts above and below the safety prop.

Maintenance can now begin.

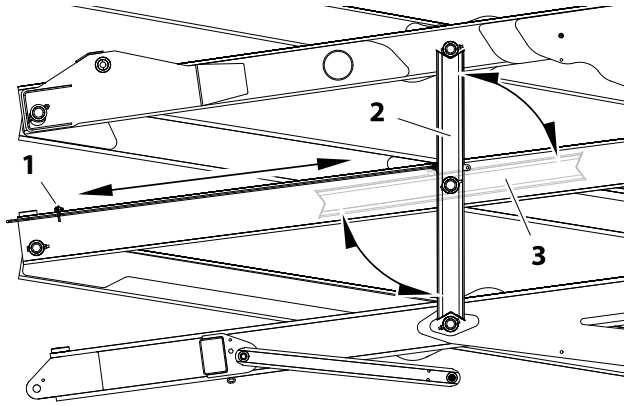


Figure 2-1. Scissor Arm - Safety Prop Assembly

1. Actuator Rod/Rod Keeper Plate.
2. Safety Prop in set position.
3. Safety Prop in stowed position.

To store the safety prop, raise the platform, release the actuator rod from the keeper plate bracket, push the safety prop rod so that the safety props are

restored back to its stowed position. Lock the actuator rod in place with the keeper plate till next use.

⚠ WARNING

TO AVOID PERSONAL INJURY, USE SAFETY PROP FOR ALL MAINTENANCE REQUIRING PLATFORM TO BE ELEVATED.

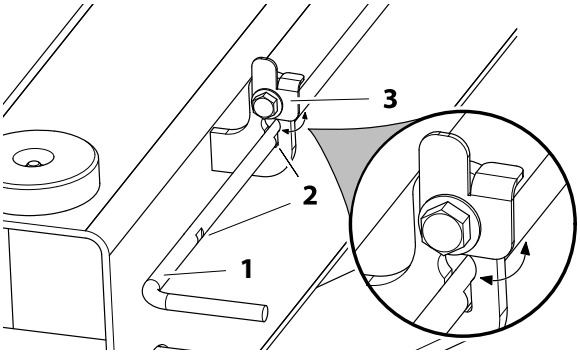


Figure 2-2. Safety Prop Actuator Rod

1. Safety Prop Actuator Rod
2. Notch Flats on Rod
3. Rod Keeper Plate

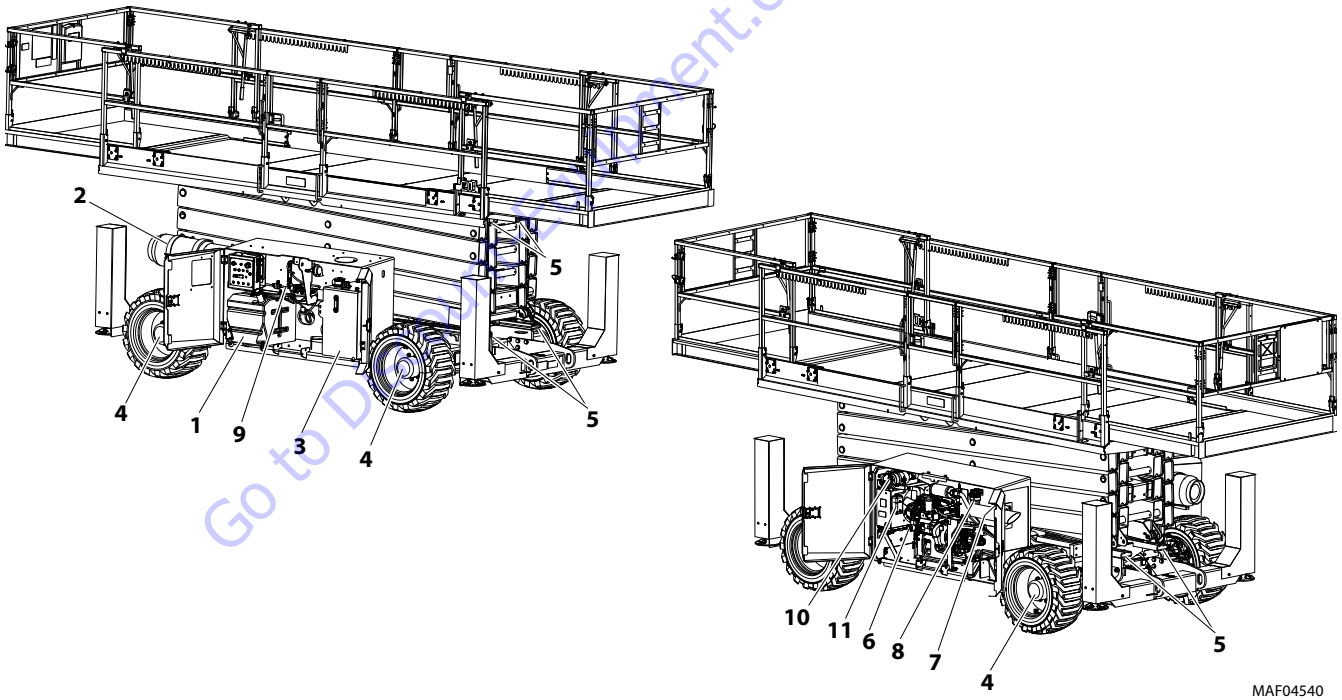
General Maintenance Tips

NOTE: *Be sure to lubricate like items on each side of machine.*

NOTE: *Recommended lubricating intervals are based on machine operations under normal conditions. For machines used in multi-shift operations and/or exposed to hostile environments or conditions, lubrication frequencies must be increased accordingly.*

Operate hydraulic functions through one complete cycle before checking hydraulic oil level in tank. Oil should be visible in ADD sight window on hydraulic tank. If oil is not visible, add oil until oil is visible in both ADD and FULL sight windows on tank. Do not overfill tank.

Any time the pump coupling is removed, coat splines of coupling with Texaco Code 1912 grease prior to assembly.

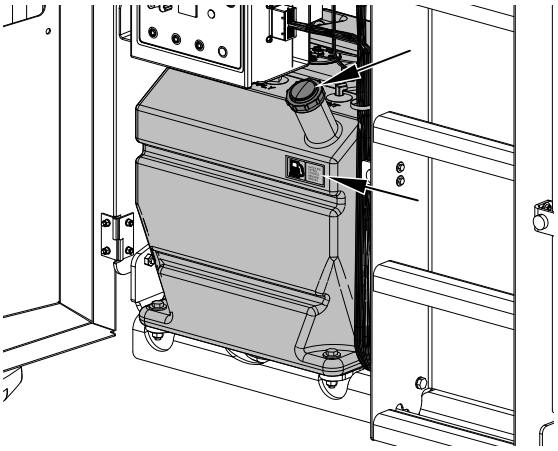


1. Fuel Tank - (Gasoline or Diesel)
2. Fuel Tank w/Shut-Off Valve - (LP Only)
3. Hydraulic Oil Tank
4. Drive Hubs
5. Scissor Arm - Sliding Wear Pads
6. Oil Change w/Filter - Kubota
7. Fuel/Water Separator Filter - Kubota- Diesel
8. Hydraulic Charge Filter - Kubota - Diesel
9. Fuel Filter/Fuel Pump - Kubota- Gasoline
10. Air Filter
11. Engine Coolant

Figure 2-3. Service Maintenance Components

NOTE: *Platform ladders removed for illustrative purposes only.*

Fuel Tank



- Fuel - Diesel or Gasoline (Per Engine Type - Reference Decal on Machine)
- Capacity - 22 gal (83.2 l)

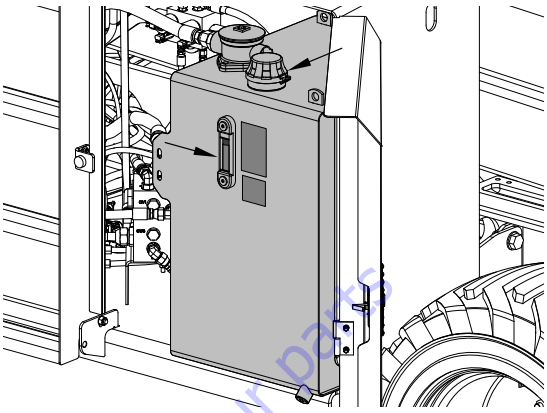
Drive Hub

- Lube Points - Fill Plugs (4)
- Lube - EPGL
- Interval - Every 2 years or 1200 hours
- Capacity - 24 oz (0.7 l)

Scissor Arms - Sliding Wear Pads

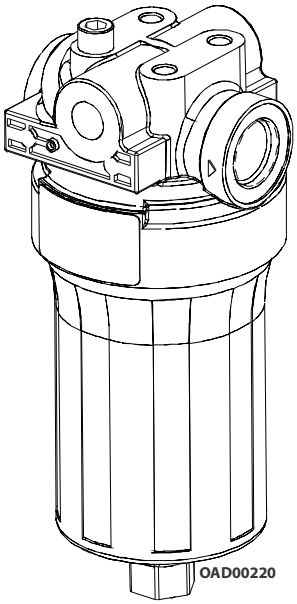
- Lube Points - 8 Sliding Wear Pads
- Lube - MPG
- Interval - Every month or 50 hours.

Hydraulic Oil Tank



- Lube Point - Fill Cap/Fill Level
- Lube - HO - API service classification GL-3, Reference - Figure 1-2., Hydraulic Oil Operating Temperature Specifications
- Interval - Check oil every 10 hours of operation; change oil every 2 years or 1200 hours of operation.
- Capacity - 32.3 gal (122.2 l)

Hydraulic Charge Filter



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

Oil Change with Filter

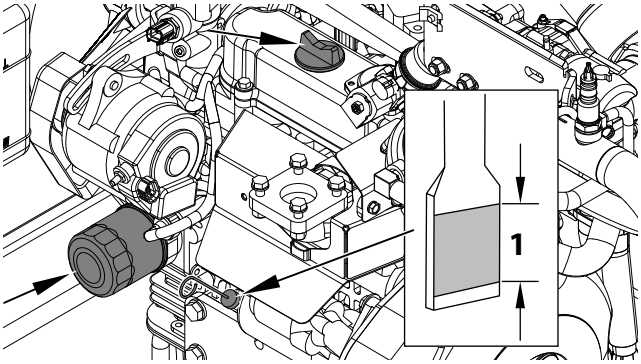


Figure 2-4. Kubota Dual Fuel (WG972-GL-E4)

NOTE: *Exhaust system shown removed for illustrative purposes only.*

- Lube Point(s) - Fill Cap/Spin-on Element
- Capacity - 0.9 Gal. (3.4 L) engine only
- Lube - EO - Minimum API SL, Viscosity - See Figure 1-3., Engine Oil Operating Temperature Specifications - Kubota (Dual Fuel Engine)
- Interval - Every Year or 200 hours of operation
- Check oil level daily, maintain within marked level (1)/Change in accordance with engine manual.

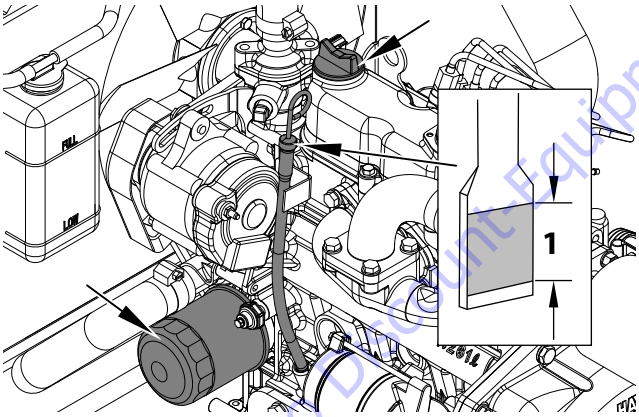
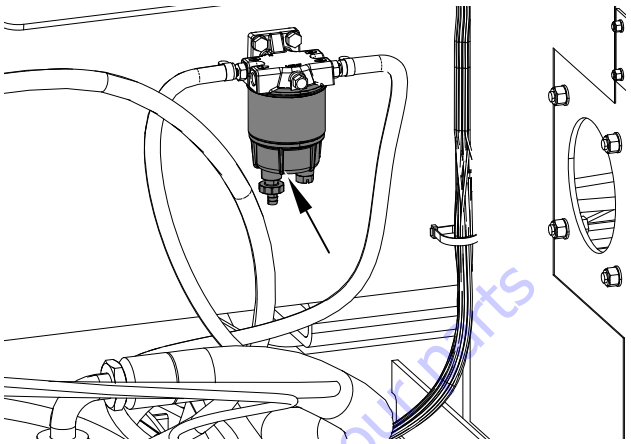


Figure 2-5. Kubota Diesel (D1305-E4B)

- Lube Point(s) - Fill Cap/Spin-on Element
- Capacity - 1.51 gal. (5.7 L) Engine Oil
- Lube - EO - Minimum API CF - Viscosity, See Figure 1-4., Engine Oil Operating Temperature Specifications - Kubota (Diesel Engine)
- Interval - Every Year or 200 hours of operation
- Check oil level daily, maintain within marked level (1)/Change in accordance with engine manual.

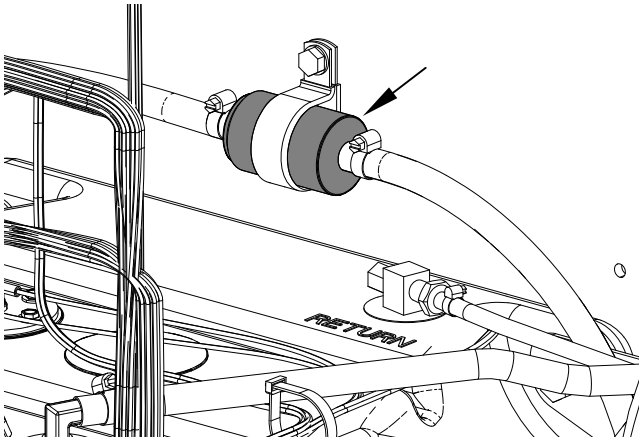
Fuel/Water Separator Filter (Diesel) - Kubota



NOTE: *Mounted inside engine cabinet on right-rear cabinet wall behind battery and exhaust pipe.*

- Lube Point(s) - Replaceable Element
- Interval (Filter) - Every Year or 600 hours of operation.
- Interval (Water Bowl) - Empty Daily. Loosen drain cock on underside of fuel filter and allow all water to drain into a container until clear fuel is visible. Tighten drain.

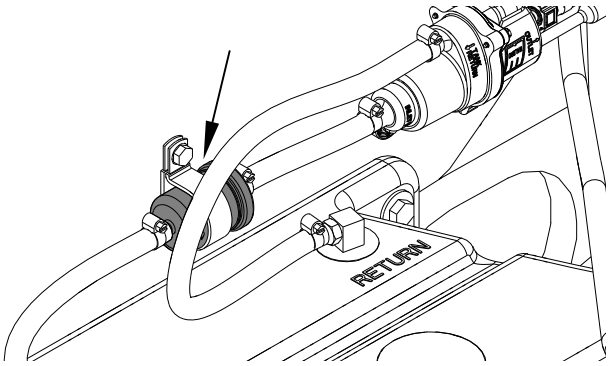
Fuel Strainer (Diesel) - Kubota



NOTE: *Mounted inside fuel/hydraulic cabinet on left-rear cabinet wall behind fuel tank.*

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

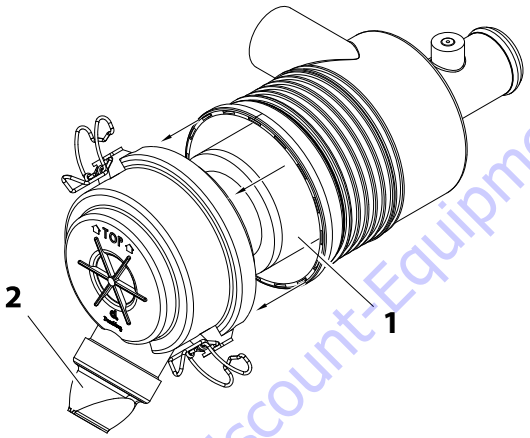
Fuel Filter (Gas) - Kubota



NOTE: *Mounted inside fuel/hydraulic cabinet on left-rear cabinet wall behind fuel tank.*

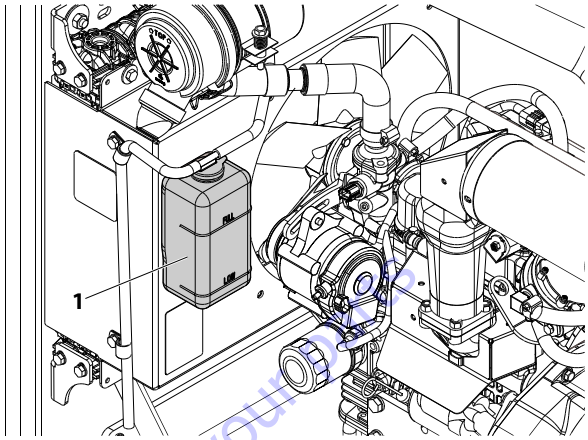
- Lube Point(s) - Replaceable Element
- Interval - Every 6 months or 300 hours of operation

Air Filter



- Lube Point(s) - Replaceable Primary Filter Element (1) (Dry Type)
- Interval - Every 6 months or 300 hours of operation. Under severe operating conditions (such as a very dusty work area) check condition of filter more often.
- Once a week, squeeze the evacuator valve (2) on bottom of air cleaner assembly to allow collected debris to fall out of the air cleaner.

Engine Coolant



- Lube Point - Fill Cap/Fill Level
- Interval - Check coolant level daily. Ensure it is between the “FULL” and “LOW” lines (1). If coolant level is low, allow fluid to cool, then add as required.

2.6 CYLINDER DRIFT TEST

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

Platform Drift

Measure the drift of the platform to the ground. Fully extend the scissor arms from stowed position with the rated load in the platform and power off. Maximum allowable drift is 2 in (5 cm) in 10 minutes. If the machine does not pass this test, proceed with the following.

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

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

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

If the cylinder passes this test, it is acceptable.

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

2.7 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.
   c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

PARTS FINDER

Search Website by Part Number

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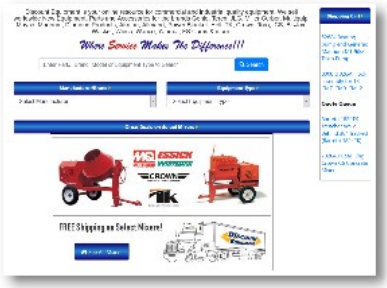

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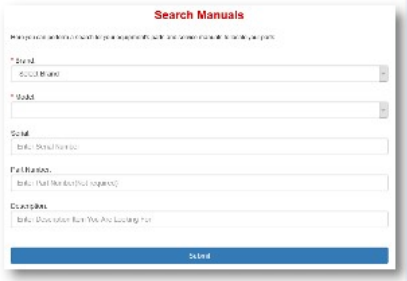

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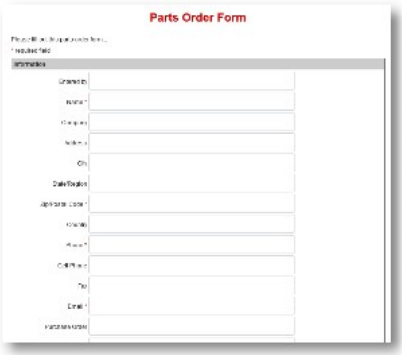

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SECTION 3. CHASSIS, PLATFORM & SCISSOR ARMS

3.1 OPERATING CHARACTERISTICS

Leveling Jacks

The machine is equipped with auto leveling jacks. These leveling jacks are operated through one switch unlike the traditional four switch system. The leveling jacks are operated by a bang bang valve.

1. Activate the leveling jack button located on the platform control box.
2. Extend the jacks by moving the joystick forward.

NOTE: *Once all four jacks make contact with the ground the system will go from set mode into level mode. At this point the engine will return to idle.*

3. The tilt indicator will go out once the machine is level.

NOTE: *If the machine is not level it will not lift. If you hit the end of stroke on any of the cylinders you cannot lift the machine.*

NOTE: *There is a limit switch on each cylinder that senses when the cylinder is fully retracted when all four are fully retracted, the stowed light in the platform control box will light.*

If you receive a 2/5 flash code through the system fault light at the platform control station the machine is unable to level. You must reposition and try again.

The jacks are operational (extend or retract) if the machine is in the stowed position. The armstack angle tilt sensor and rotary sensor together must sense that the machine is stowed. A failure of either sensor will prevent the jacks from being activated.

Generator

When the generator switch is activated, the engine RPM will increase to high idle.

When a function is selected for operation, which requires a higher engine speed than the generator, the generator will automatically shut off during the operation of the function. Once the function has stopped, the generator will be active again.

Lift

A proportional flow control valve allows for proportional control of the lift up function. Proportional valves on both the upper and lower cylinders allow for smooth control of the lift down function.

Drive

If driving at high drive up a grade and you hit an 8° incline, the drive function will cut back to mid drive speed. The drive pump will shift back into high drive once the incline decreases to 5°. There will be a 2 second delay before the machine goes back into high drive.

3.2 TIRES, WHEELS & DRIVE ASSEMBLY

Tire Inflation

The air pressure for pneumatic tires must be equal to the air pressure that is stenciled on the side of the JLG product or rim decal for safe and proper operational characteristics.

Tire Damage

For pneumatic tires, JLG Industries, Inc. recommends that when any cut, rip, or tear is discovered that exposes sidewall or tread area cords in the tire, measures must be taken to remove the JLG product from service immediately. Arrangements must be made for replacement of the tire or tire assembly.

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

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

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

Tire Replacement

JLG recommends a replacement tire be the same size, ply and brand as originally installed on the machine. Please refer to the JLG Parts Manual for the part number

of the approved tires for a particular machine model. If not using a JLG approved replacement tire, we recommend that replacement tires have the following characteristics:

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

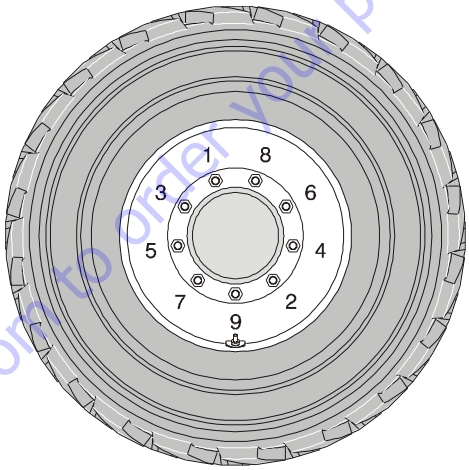
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ 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:



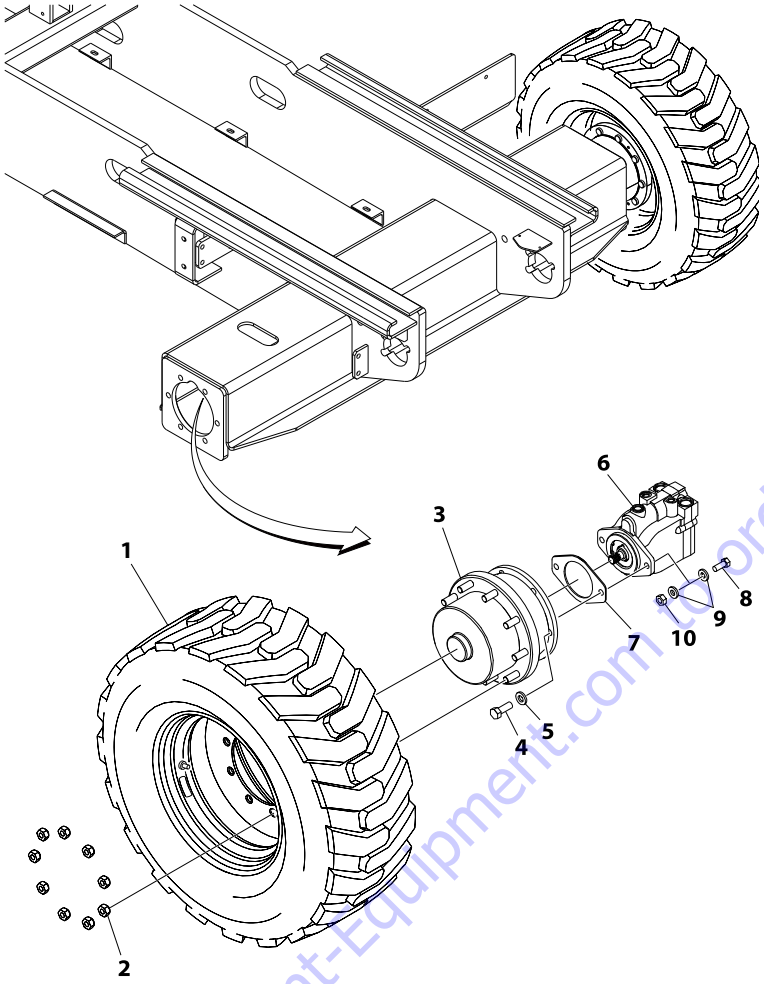
3. The tightening of the nuts should be done in stages. Following the recommended sequence, tighten nuts per wheel torque chart.

Table 3-1. Wheel Torque Chart

TORQUE SEQUENCE (DRY)		
1st Stage	2nd Stage	3rd Stage
40-50-ft. lb. (60-70 Nm)	90-105 ft. lb. (125-150 Nm)	170 ft. lb. (230 Nm)

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

Drive Assembly



1. Tire & Rim
2. Lugnut
3. Drive Hub
4. Bolt
5. Washer
6. Drive Motor (Sauer)
7. Gasket
8. Bolt
9. Washer
10. Nut

NOTE: *Rear axle shown.*

Figure 3-1. Drive Assembly (Fairfield/Sauer)

REMOVAL

⚠ WARNING

SHUT MACHINE OFF, BRACE AXLES AND CHALK WHEELS TO PREVENT MACHINE FROM MOVING DURING REPAIRS.

1. Disconnect, cap and label all hydraulic lines attached to Drive Motor (6). If applicable, disconnect all electrical wiring.
2. With axle raised and supported, remove the Tires (1) from the Drive Hub (3) by removing the 9 Lugnuts (2).
3. Remove the Drive Hub (3) and Drive Motor (6) from the axle by removing the 6 Bolts (4) and Washers (5).
4. The Drive Motor (6) can be removed from the Drive Hub (3) by removing the 2 Bolts (8), Nuts (10) and Washers (9).

INSTALLATION

1. Follow "Removal" procedures in reverse order.
2. Refer to Table 3-1, Wheel Torque Chart when torqueing Lugnuts (2).

NOTE: *For detailed information on the Drive Hub and Drive Motor, refer to Section 3.3, Drive Hub and Section 3.4, Drive Motor (Sauer).*

3.3 DRIVE HUB

Roll and Leak Testing

Always roll and leak test Drive-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.

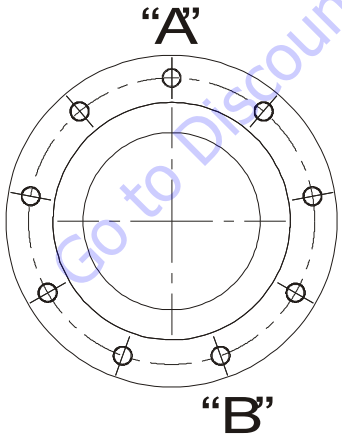
THE ROLL TEST

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

THE LEAK TEST

The purpose of a leak test is to make sure the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your air checker starts to fall once you have pressurized the unit. Leaks will most likely occur at the main seal or wherever o-rings or gaskets are located. Usually you can detect the exact location of a leak by brushing a soap and water solution around the main seal and where o-rings or gaskets meet the exterior of the unit, then checking for air bubbles. If you detect a leak in a seal, o-ring, or gasket, replace the part immediately.

Tightening and Torquing Bolts



If you use an air impact wrench to tighten bolts, take extreme care to ensure that you do NOT tighten the bolts beyond their indicated torque specification. Never use an impact wrench to tighten shoulder bolts. Always tighten all shoulder bolts by hand.

The following steps describe the proper procedure for tightening and torquing bolts or socket head **cap screws** in a bolt circle.

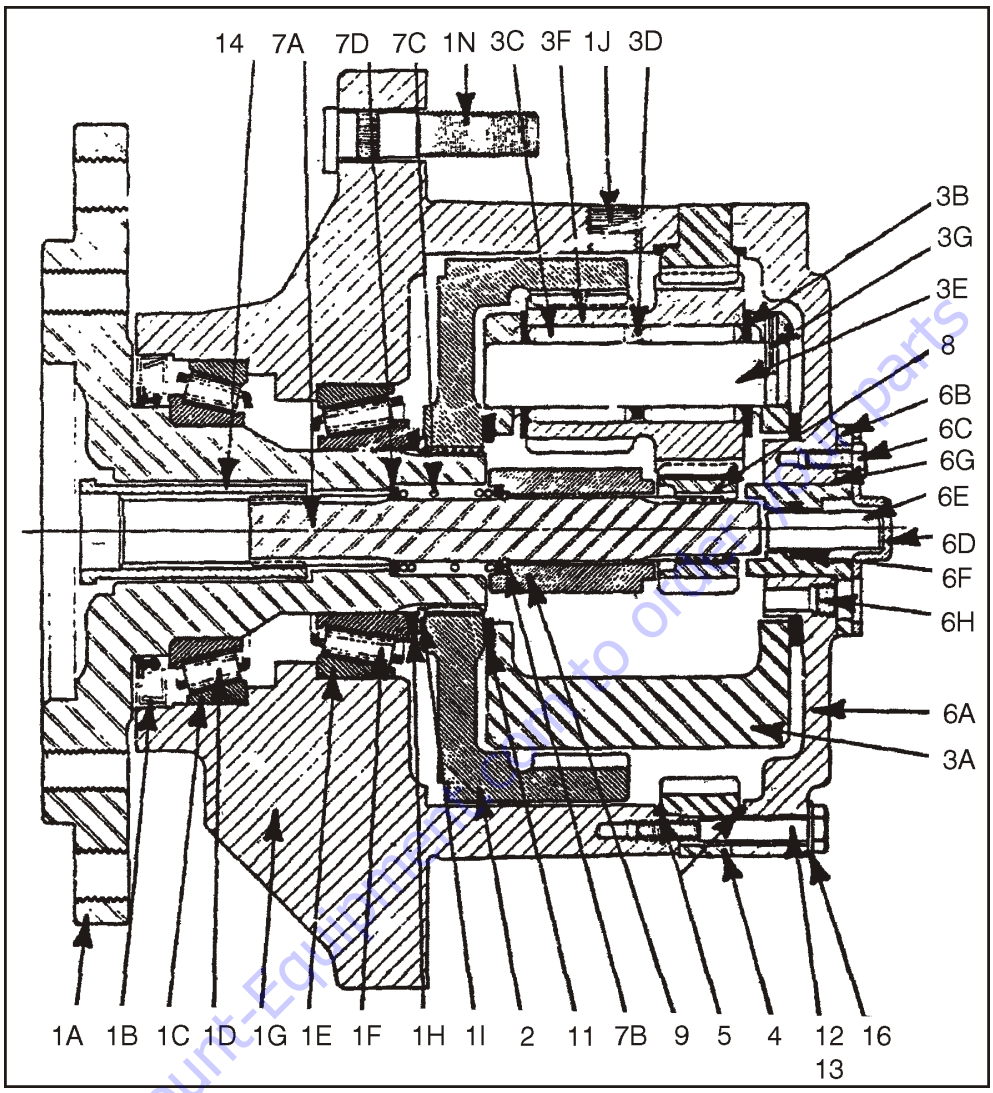
1. Tighten (but do not torque) bolt "A" until snug.
2. Go to the opposite side of the bolt circle and tighten bolt "B" until equally snug.
3. Continue around the bolt circle and tighten the remaining bolts.
4. Now use a torque wrench to apply the specified torque to bolt "A".
5. Continue around the bolt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

Oil Information

1. TYPE – EP90
   On normal applications, use EP90. On applications where the lubricant must meet special requirements, the O.E.M. should be able to recommend a suitable substitute.
2. OIL TEMPERATURE
   Continuous – 160°F [70°C] Intermittent – 200°F [95°C]
3. OIL CHANGE
   Initial – After 50 hours or 50,000 revolutions of operation. Subsequent – After 1000 hours or (1) year, whichever comes first.

NOTE: *Higher temperatures make it necessary to change oil more frequently.*

4. OIL FILL LEVEL AND VOLUME
   Unit mounted horizontal – half full
   Approximate volume - 17 oz. (0.5 ltr)
5. REAR BRAKES
   Rear brakes require 2.7 oz. (0.08 ltr) of DTE 13M hydraulic fluid each to function properly.



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
   - N. Stud
2. Internal Gear
3. Carrier 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
7. Input Shaft Sub Assembly
   - A. Input Shaft
   - B. Retaining Ring
   - C. Spring
   - D. Spacer
8. Input Gear
9. Thrust Spacer
10. Bolt
11. Shoulder Bolt
12. Coupling
13. Flat Washer

Figure 3-2. Drive Hub (Cross-Section)

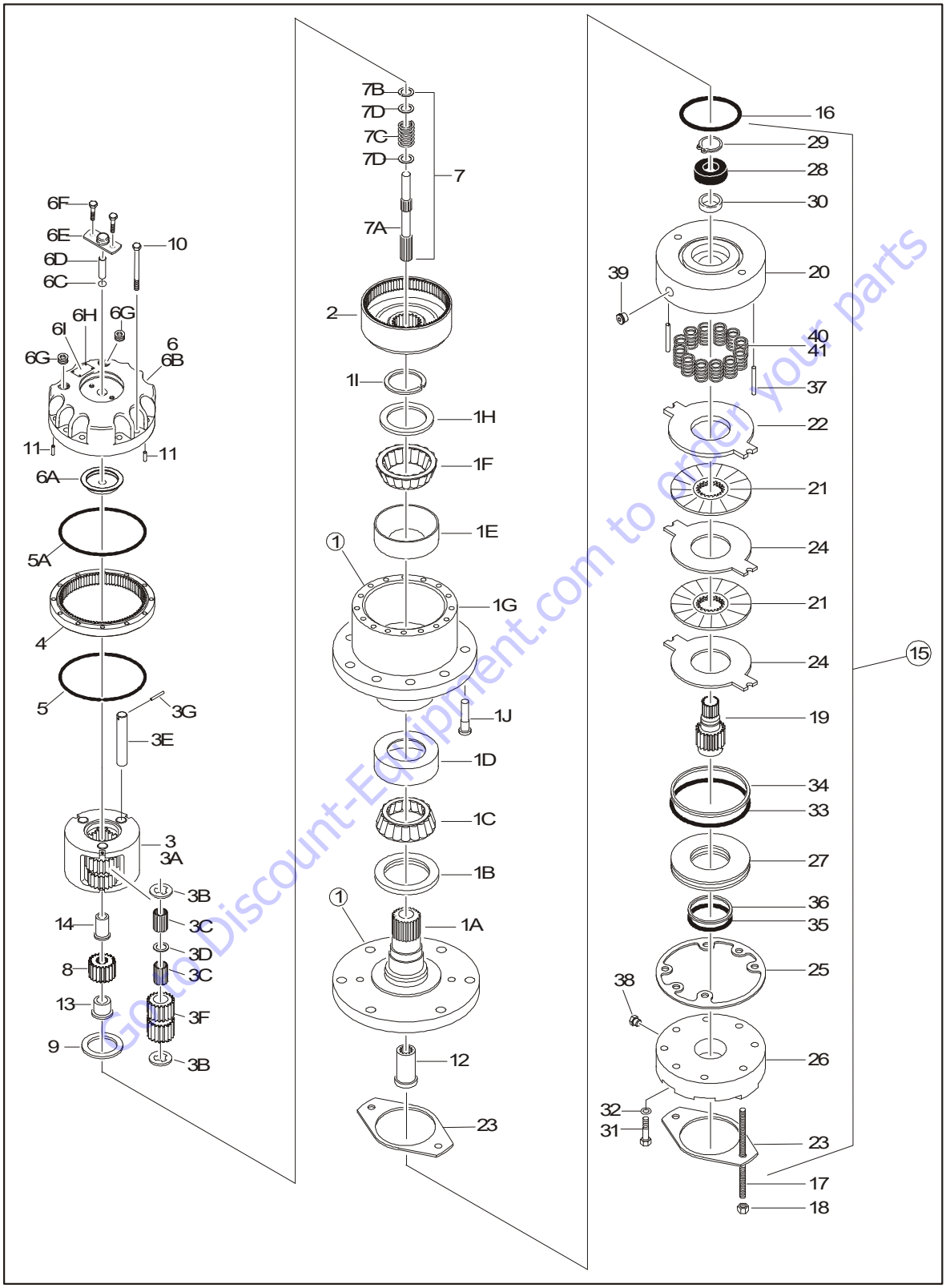


Figure 3-3. Drive Hub

NOTE: *Refer to Figure 3-3., Drive Hub.*

Table 3-2. Drive Hub Part Description

Item #	Description
1	Spindle/Housing Assembly
1A	Spindle
1B	Seal
1C	Bearing Cone
1D	Bearing Cup
1E	Bearing Cup
1F	Bearing Cone
1G	Housing/Ring Gear
1H	Thrust Washer
1I	Retaining Ring
1J	Wheel Stud
2	Internal Gear
3	Carrier Assembly
3A	Carrier
3B	Retaining Ring
3C	Needle Bearing
3D	Thrust Washer
3E	Planet Shaft
3F	Planet Gear
3G	Rollpin
4	Ring Gear
5	O-Ring
5A	O-Ring
6	Cover Assembly
6A	Thrust Spacer
6B	Cover Plate
6C	O-Ring
6D	Disconnect Rod
6E	Disengage Cap
6F	Bolt 1/2"-20NC x 1/2"
6G	Pipe Plug
6H	Rivet
6I	ID Plate
7	Input Shaft Assembly
7A	Shaft
7B	Retaining Ring
7C	Spring
7D	Thrust Spacer

Table 3-2. Drive Hub Part Description

Item #	Description
8	Sun Gear
9	Thrust Washer
10	Bolt
11	Dowell Pin
12	Coupling
13	Input Spacer
14	Input Spacer
15	Brake Assembly
16	O-Ring
17	Threaded Rod
18	Nut 1/2"-13NC
	BRAKE ASSEMBLY
19	Shaft
20	Housing
21	Friction Plate
22	Pressure Plate
23	Gasket
24	Outer Plate
25	Gasket
26	Cylinder
27	Piston
28	Ball Bearing
29	Retaining Ring
30	Shaft Seal
31	Capscrew
32	Lockwasher
33	O-Ring
34	Backup Ring
35	O-Ring
36	Backup Ring
37	Dowel Pin
38	Plug
39	Plug
40	Spring Kit (Natural)
41	Spring Kit (Blue)

Main Disassembly for Drive Hub

NOTE: *Refer to Figure 3-2. for part location and listing.*

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

⚠ CAUTION

CAUTION: BEWARE OF SHARP EDGES IN THE COUNTERBORE WHEN YOU REMOVE THE O-RING.

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

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

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

⚠ CAUTION

WEAR SAFETY GLASSES DURING THIS STEP, AND BE AWARE THAT SPRING AND SPACERS COMPRESSED BY RETAINING RING MAY POP SUDDENLY OFF SHAFT WHEN YOU REMOVE THE RETAINING RING.

12. Using retaining ring pliers, remove retaining ring (7B) from the 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).

⚠ CAUTION

BEWARE OF SHARP EDGES IN COUNTERBORE WHEN YOU REMOVE THE O-RING.

16. Remove o-ring (5) from the counterbore in hub (1G). Discard the o-ring.
17. At this point the main disassembly for drive hub is complete.

Hub-Spindle Disassembly

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

⚠ CAUTION

WEAR SAFETY GLASSES DURING THIS STEP.

1. Remove retaining ring (1I) from around spindle (1A) in hub (1G).
2. Remove spacer (1H) from around spindle (1A) in hub (1G).
3. Set hub (1G), small end/spindle facing down, up 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 the spindle and set them aside. Discard the seal.*

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

NOTE: *If you use a punch and hammer, make sure you do not strike the counterbore with the punch when you remove the bearing cup.*

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

NOTE: *If using a punch and hammer, make sure to not strike the counterbore with the punch when removing the bearing cup.*

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

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

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

Cover Disassembly

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

Carrier Disassembly

NOTE: *When removing the needle rollers from the cluster gears, discard the old needle rollers and use new ones during re-assembly.*

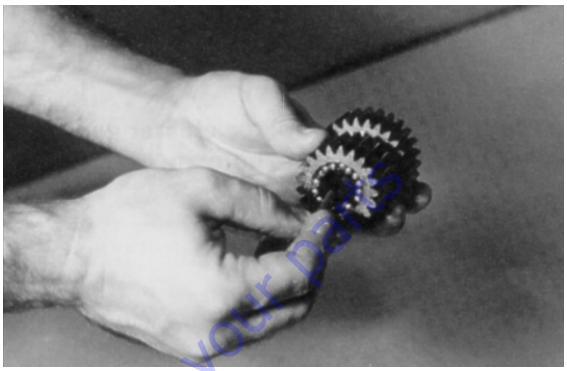
1. Using a punch and hammer, drive roll pin (3G) into planet shaft (3E).

NOTE: *Be sure to drive the roll pin all the way into the planet shaft. Failure to do so could result in damage to the carrier when removing the planet shaft from the carrier.*

2. Using a punch and hammer, drive the planet shaft (3E) out of the planet shaft hole in the carrier housing (3A).
3. When removing the planet shaft (3E) from the carrier housing, one thrust washer (38), one cluster gear (3F), and one more thrust washer will come off of the planet shaft and come to rest inside the carrier. Remove these parts from inside the carrier.
4. Remove 16 needle rollers (3C) from inside one end of cluster gear (3F). Discard the needle rollers.
5. Remove one spacer (3D) from inside cluster gear (3F).
6. Remove the remaining 16 needle rollers (3C) from the other side of cluster gear (3F). Discard the needle rollers.
7. Repeat steps 1-6 to remove and disassemble the two remaining cluster gears.
8. At this point the carrier disassembly is complete.

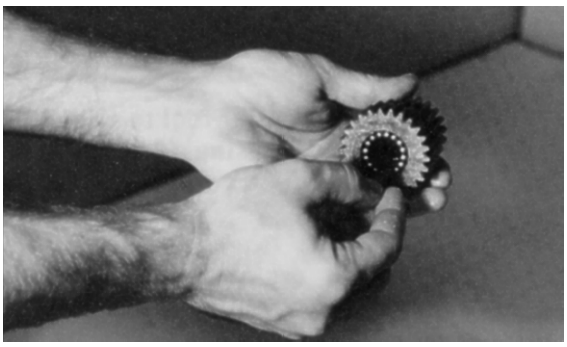
Carrier Assembly

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

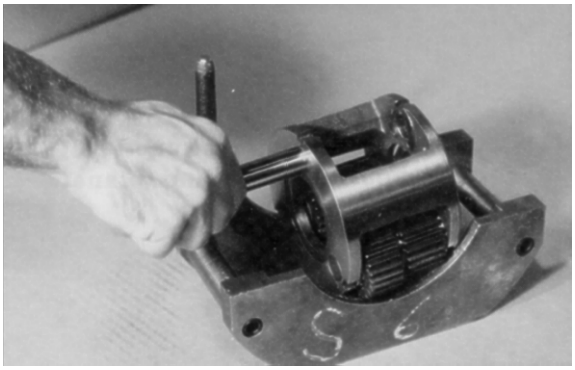


2. Place one spacer (3D) inside cluster gear (3F) so that it rests on top of the needle rollers.

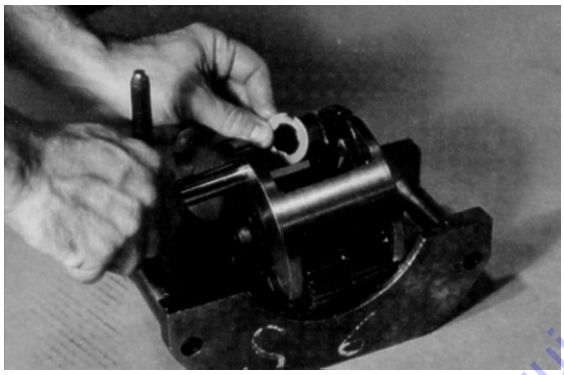
3. Line the remaining half of cluster gear (3F) with 16 needle rollers.



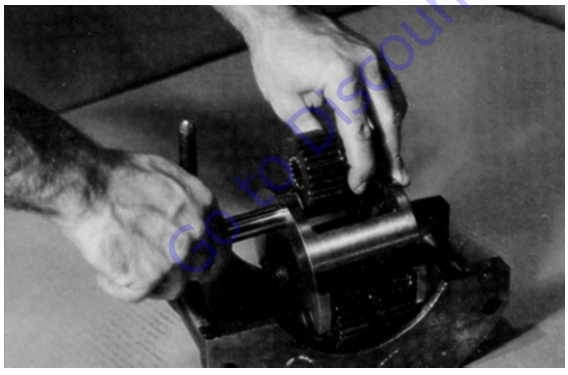
4. Set carrier housing (3A) sideways on a table. Insert a planet shaft (3E), roll pin hole last, into one of the planet shaft holes from roll-pin-holed side of carrier housing.



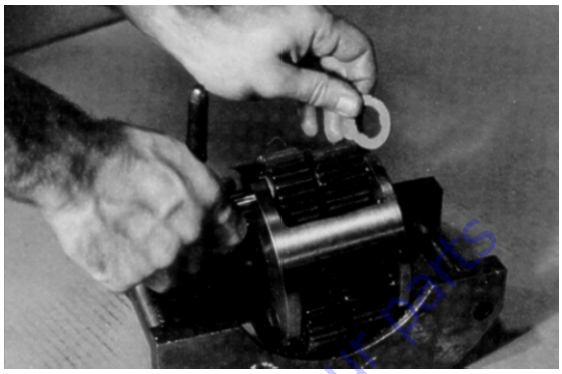
5. Place one thrust washer (3B) onto the end of planet shaft (3E) inside carrier. Fit tang of thrust washer into the slot on the inside edge of the planet shaft hole.



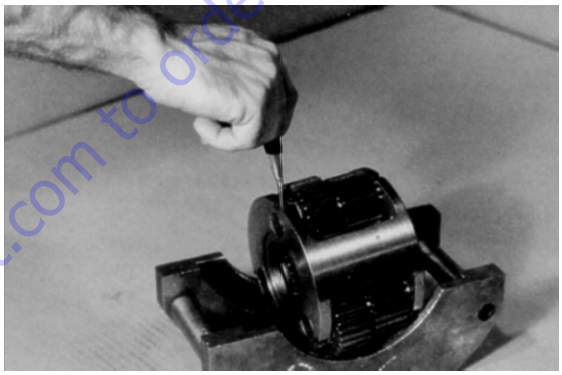
6. Following the thrust washer, place the cluster gear (3F), large end toward roll pin hole in carrier housing, onto the planet shaft (3E).



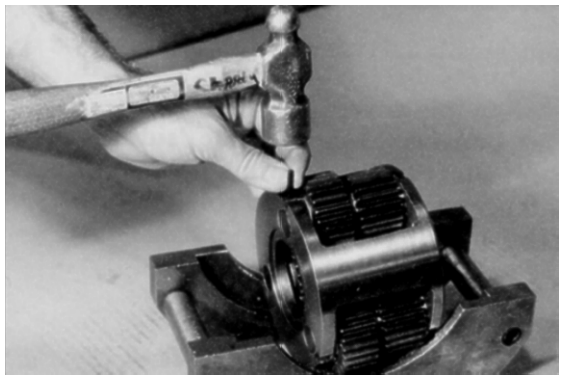
7. Following the cluster gear, place one more thrust washer (3B) onto planet shaft (3E) through the opposite planet shaft hole in carrier housing (3A).



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



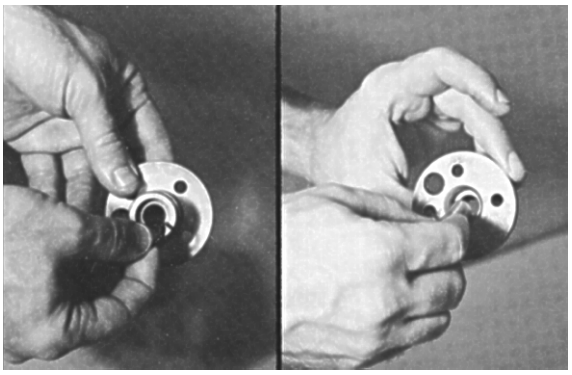
9. Drive roll pin (3G) down into the aligned roll pin holes in carrier housing (3A) and planet shaft (3E).



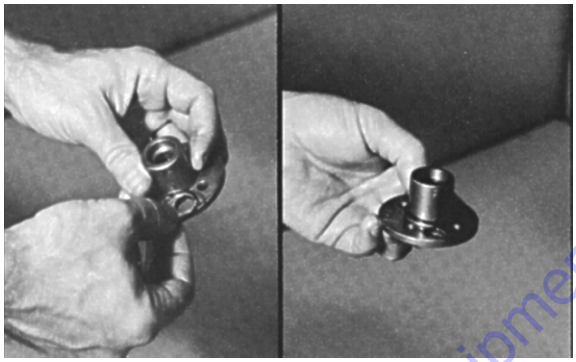
10. Repeat steps 1 thru 9 to assemble and install the two remaining cluster gears.
11. Carrier sub-assembly is complete.

Cover Sub-Assembly

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

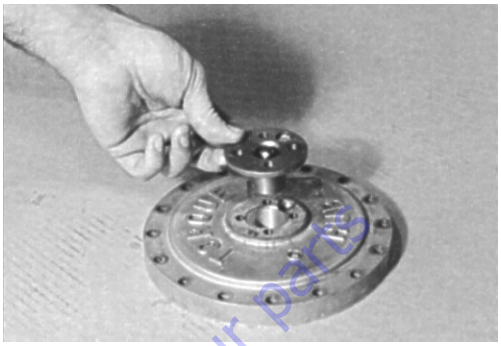


2. Place the o-ring (6G) onto the cover cap (6B) so that it rests against the flange of the cover cap.



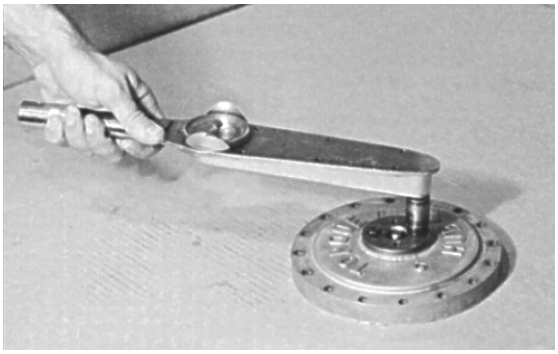
3. Insert disconnect rod (6E) into cover cap (6B).

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

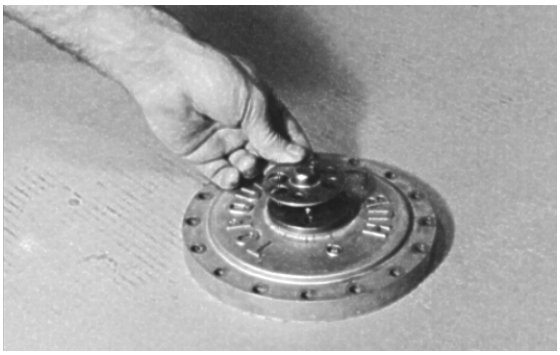


5. Place two of the cover cap bolts (6C) into any two bolt holes that are 180° apart on the cover cap (6B) and tighten bolts.

6. Using a torque wrench, apply 2.95 to 3.69 ft. lb. (4 to 5 Nm) of torque to both bolts (6C).

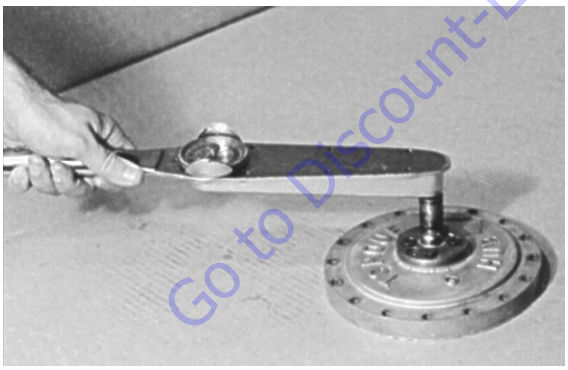


7. With the large end down, place the disconnect cap (6D) onto the cover cap (6B), aligning the pipe plug hole in the disconnect cap over the pipe plug hole in the cover cap.

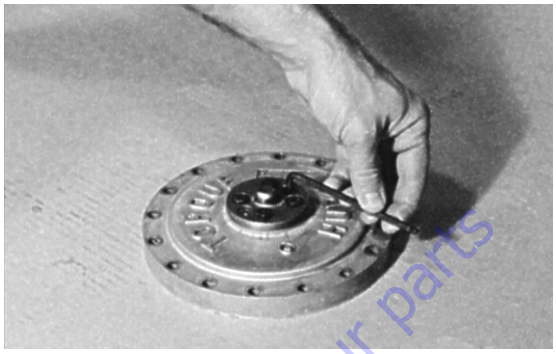


8. Place the two remaining bolts (6C) into the bolt holes in the disconnect cap (6D), and tighten the bolts.

9. Using a torque wrench, apply 2.95 to 3.69 ft. lb. (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 into the pipe plug hole in the cover (6A).

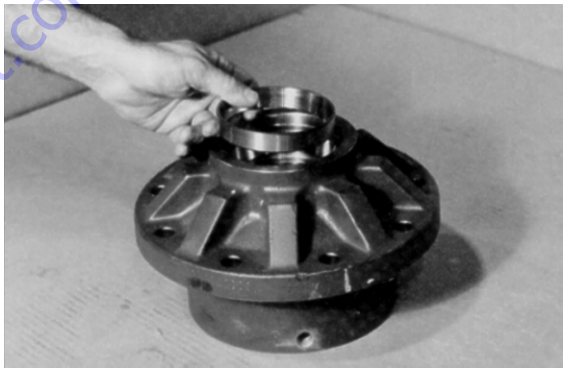


11. Cover sub-assembly is complete.

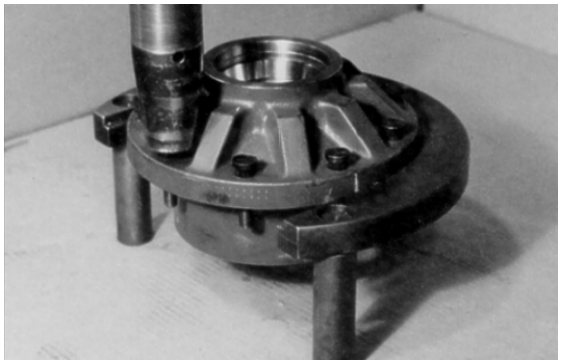
Hub-Spindle Sub-Assembly

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

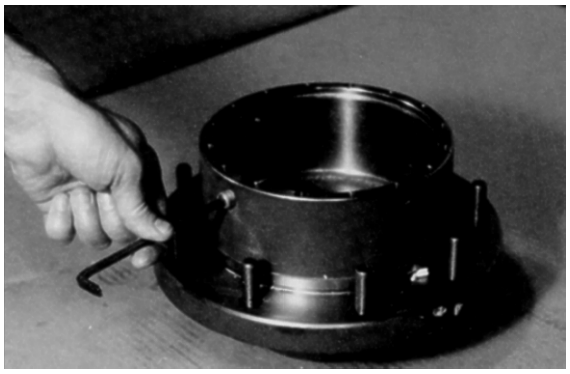
1. Set hub (1G) onto its large end. Press bearing cup (1C) into the counterbore in the small end of the hub (1G).



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

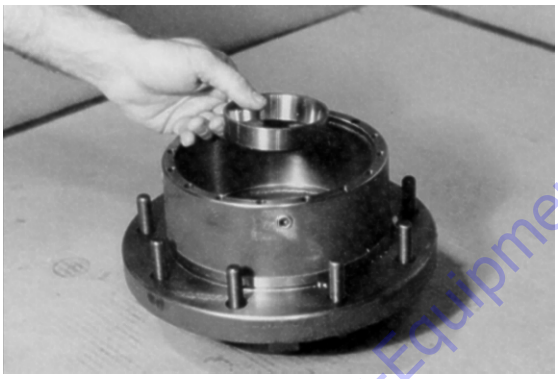


3. Apply a light coat of "Never-Seize" to two pipe plugs (1J) and tighten them into the two pipe plug holes in the side of the hub (1G).

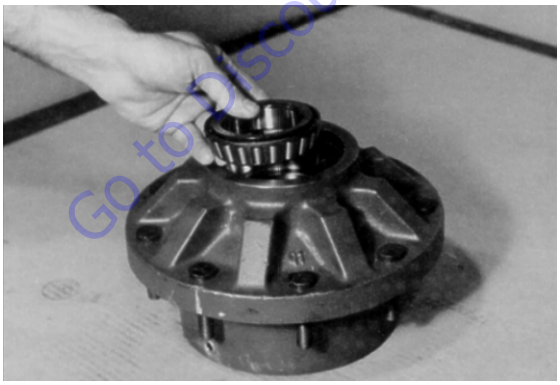


NOTE: *Make sure the cup sits square with the counterbore before pressing.*

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



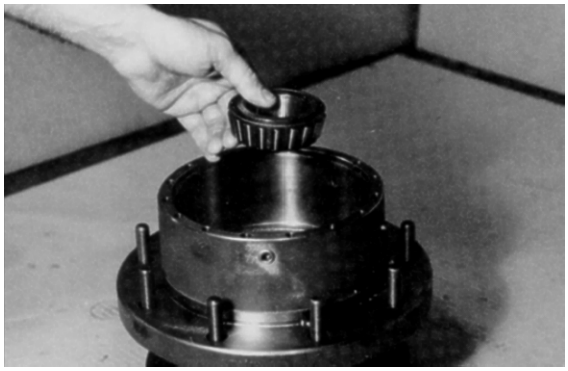
5. Set hub (1G) onto its large end. Place bearing cone (1D) into bearing cup (1C).



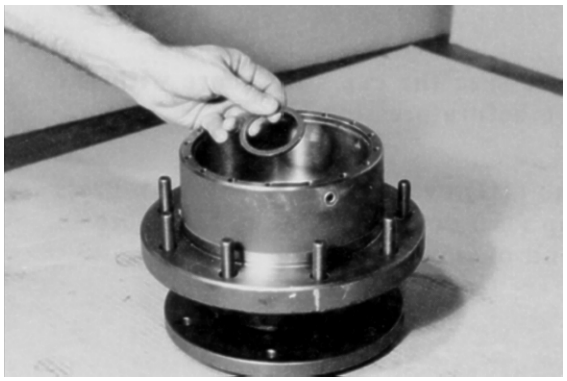
6. Press seal (1B) into the small end of hub (1G).

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

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



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



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

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

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

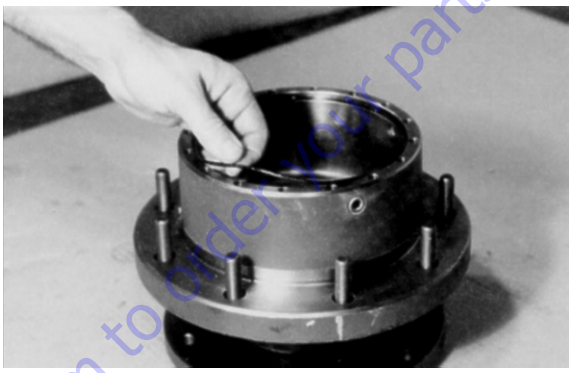
Main Assembly

⚠ WARNING

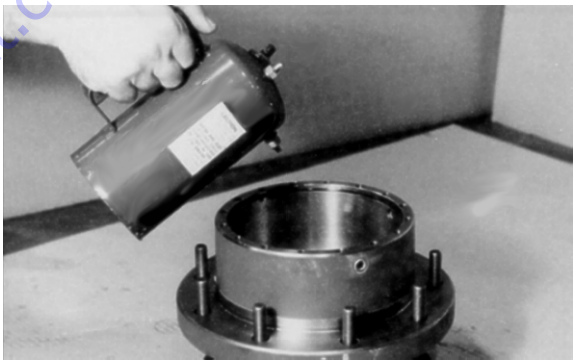
BEWARE OF SHARP EDGES IN COUNTERBORE WHEN INSTALLING THE O-RING

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

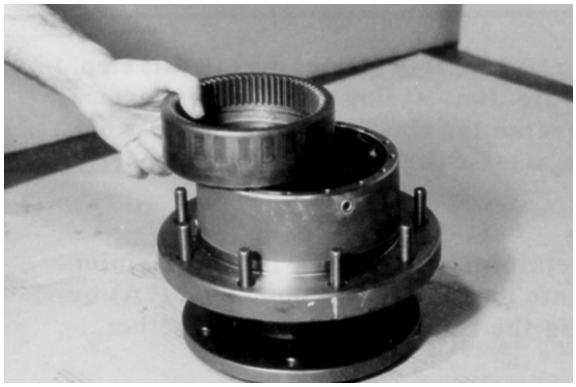
NOTE: *O-ring may be stretched or pinched together to make it fit the counterbore exactly.*



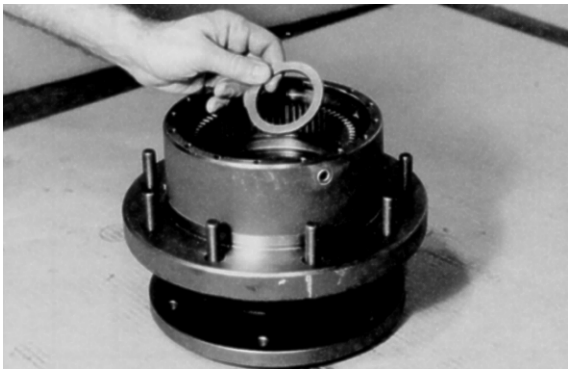
2. Oil all exposed surfaces inside hub (1G).



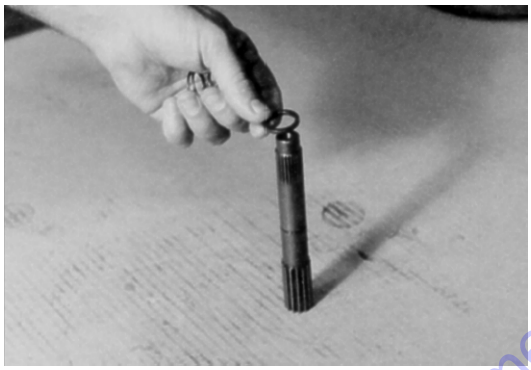
3. Place internal gear (2) into hub (1G) so that its internal splines mesh with the external splines of spindle (1A). Oil internal gear (2).



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

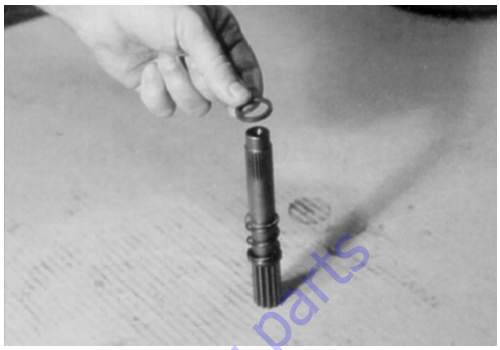


5. Stand input shaft (7A) on its splined end. Place one spacer (7D) onto the smooth end of input shaft (7A).



6. Place one spring (7C) onto the smooth end of input shaft (7A).

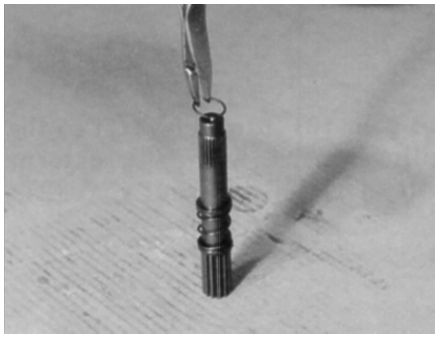
7. Place other spacer (7D) onto the smooth end of input shaft (7A).



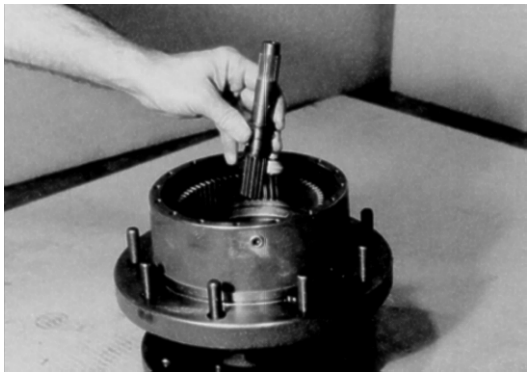
⚠ WARNING

WEAR SAFETY GLASSES DURING THIS STEP, AND BE AWARE THAT SPRING AND SPACERS, COMPRESSED BY RETAINING RING, MAY POP SUDDENLY OFF SHAFT IF THE RING IS RELEASED BEFORE IT IS PROPERLY IN PLACE.

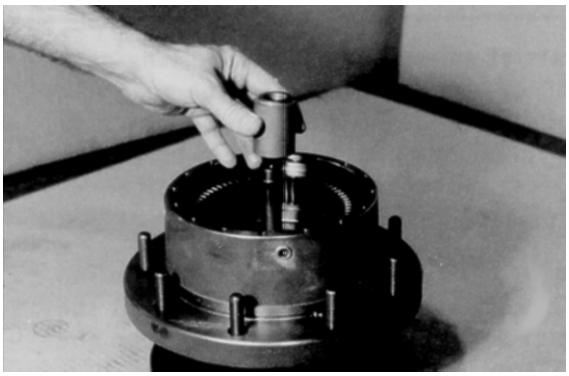
8. Using retaining ring pliers, insert retaining ring (7B) into the groove on input shaft (7A) by compressing the spring and spacers together.



9. With large splined end down, place input shaft subassembly (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 the large ends of cluster gears (3F) face up. Locate the punch marks on the face of each cluster gear (3F) and position them at 12 o'clock.

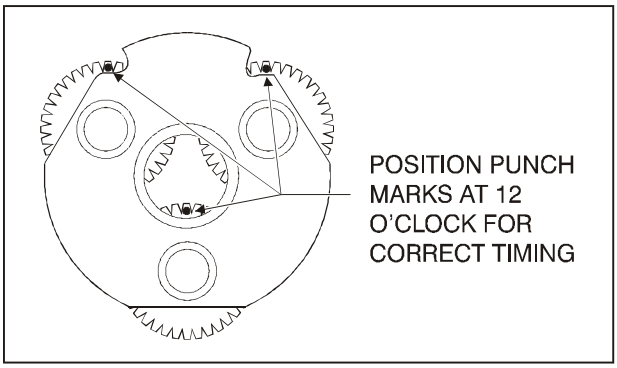
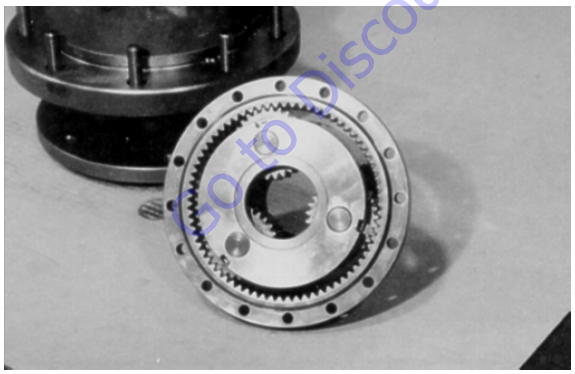


Figure 3-4. Cluster Gear Punch Marks

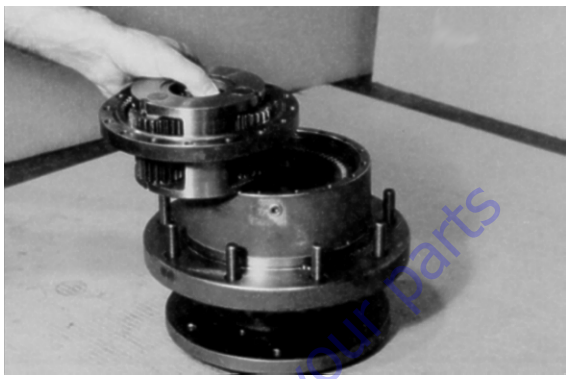
12. With "X" marked side facing up, place the ring gear (4) around cluster gears (3F).

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

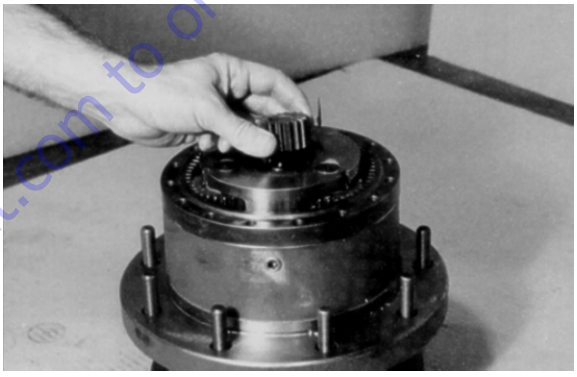


13. Place the carrier sub assembly (3) and ring gear (4) together into mesh with internal gear (2), aligning the "X" marked shoulder bolt hole in the ring gear (4) over one of the shoulder bolt holes in the hub. Mark the location of shoulder bolt holes on the outside of ring gear and hub.

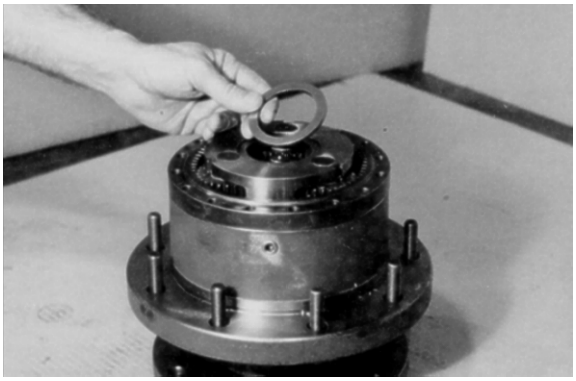
NOTE: *You may lift the ring gear off the hub to align the shoulder bolt holes. The ring gear and carrier are installed together only to keep the punch marks on the carrier in place.*



14. With the 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 the hub (1G). Place thrust washer (11) into the counterbore in top of the carrier.

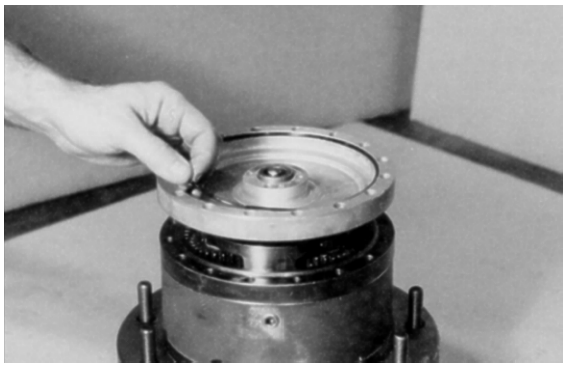


⚠ WARNING

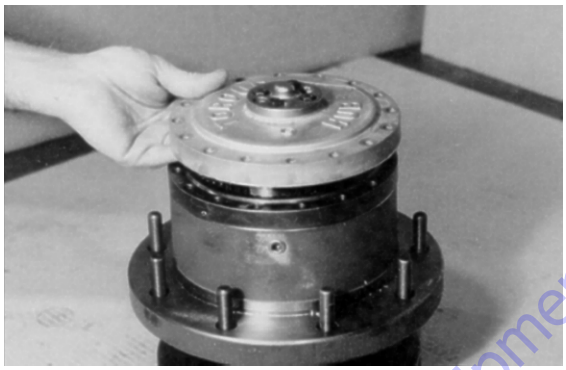
BEWARE OF SHARP EDGES IN THE COUNTERBORE WHEN YOU INSTALL THE O-RING.

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

NOTE: *The o-ring may be stretched or pinched together to make it fit the counterbore exactly.*

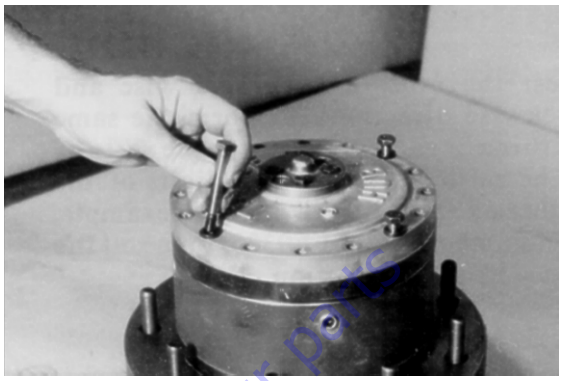


17. Place cover sub-assembly (6) onto ring gear (4), aligning the pipe plug holes according to the alignment prior to disassembly.

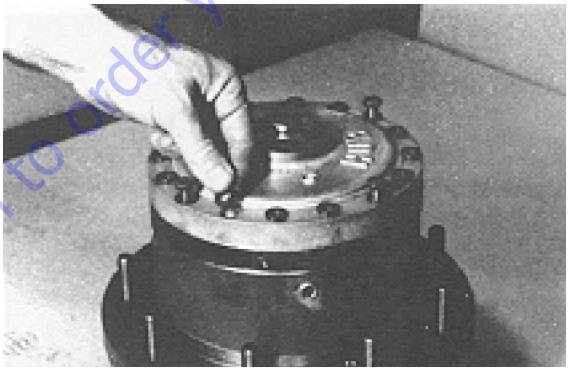


18. Place four flat washers (16) on top of the bolt holes in the cover sub-assembly.

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

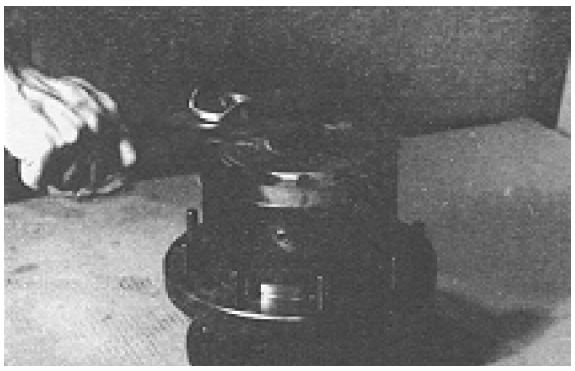


20. Place the remaining 12 flat washers (16) onto the remaining bolt holes in cover (6).

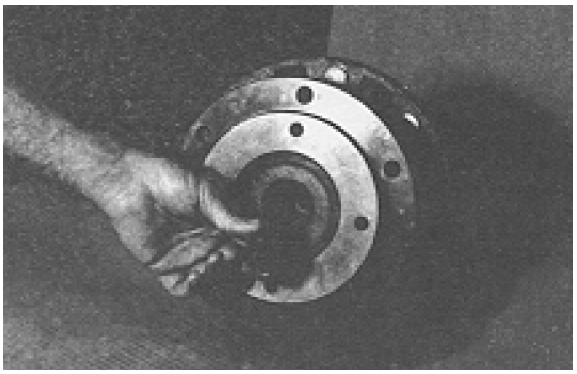


21. Place the 12 bolts into the remaining bolt holes in cover (6) and tighten.

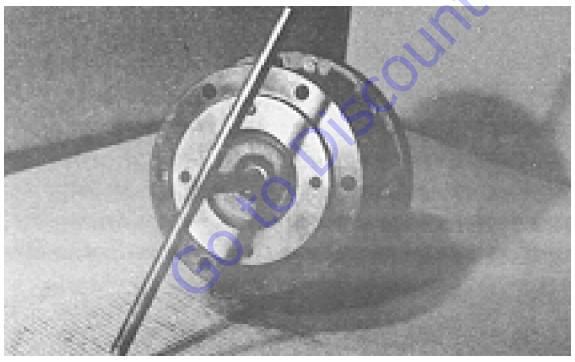
22. Torque the shoulder bolts (13) 18 to 25 ft. lb. (25 to 34 Nm). Torque bolts (12) 18 to 25 ft. lb. (25 to 34 Nm).



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

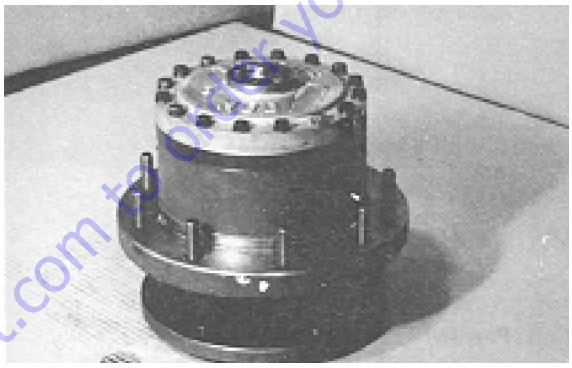


24. Roll test the unit in both clockwise and counterclockwise directions. Perform the same number of turns in each direction as the ratio of the unit. The ratio is the last two digits of the model number on the unit's ID tag.



25. Leak test the unit at a pressure of 5 psi (0.34 bar) for 2 to 3 minutes.

26. At this point the main assembly is complete.

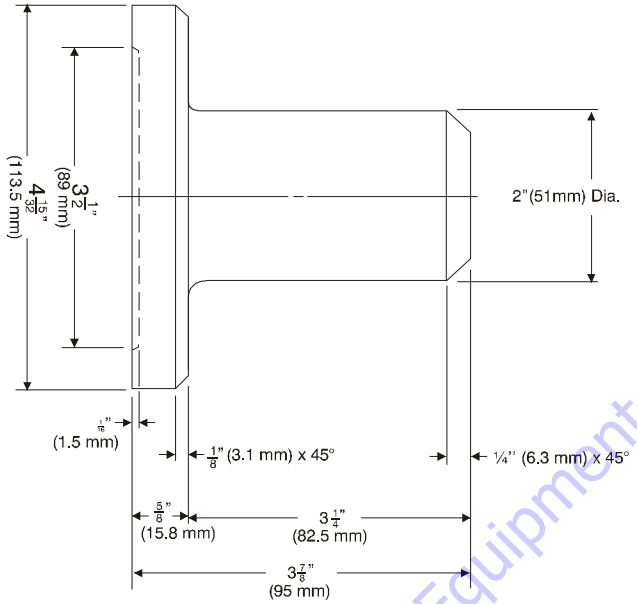


Tool List

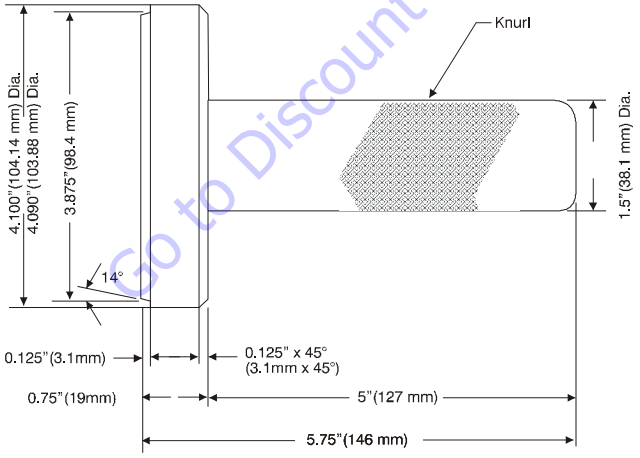
The following specialized tools are used to assemble this unit. The tool diagrams included in this manual are intended for the customer who may wish to have a tool made. All tools exist as one piece and must be made from mild steel All dimensions are given in inches.

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

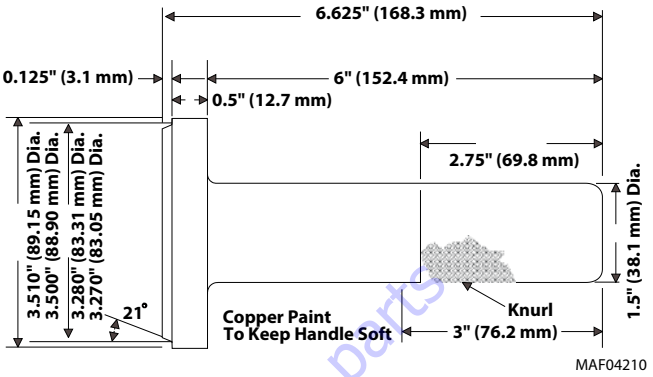
1. T-118126 SEAL PRESSING TOOL for SEAL (1B).



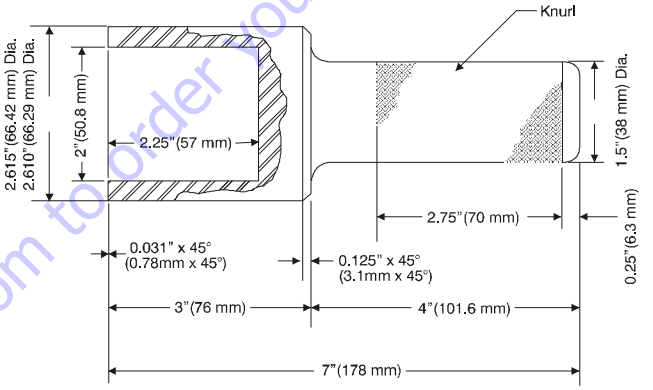
2. T-138903 ASSEMBLY PRESSING TOOL for CUP (1C)



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



4. T-109691 ASSEMSLY PRESSING TOOL for CONE (1F)



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

Re-Aligning Torque Hub Input Coupling

The following 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 the hydraulic power supply to the brake port.
2. Pressurize the brake release port 155 to 200 psi (10.6 to 13.8 bar) to release the brake.
3. Verify that the brake is released by rotating the input coupling or hub spindle.
4. Once the brake is released, the input coupling will be free to re-align with the drive motor.
5. Install the drive motor on the hub, then release the hydraulic pressure at the brake release port. The coupling will remain in position.
6. Disconnect the hydraulic power supply and reconnect the line going into the brake release port.

3.4 DRIVE MOTOR (SAUER)

Description

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

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

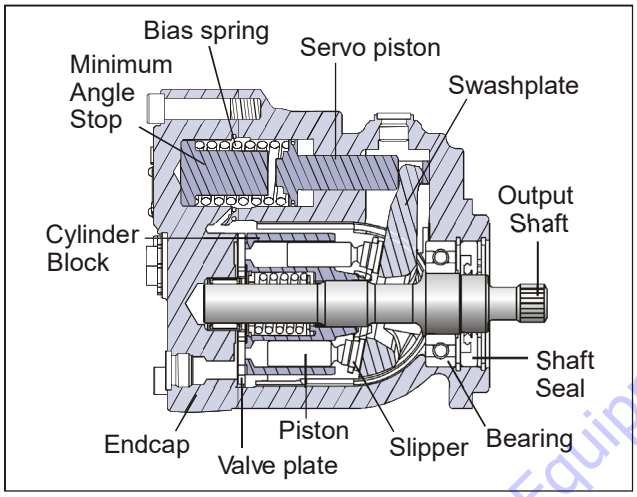
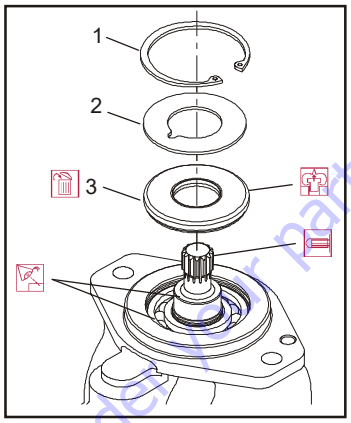


Figure 3-5. Drive Motor Cross Section

Shaft Seal Replacement

REMOVAL

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



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

Figure 3-6. Removing the Shaft Seal

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

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

INSPECT THE COMPONENTS

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

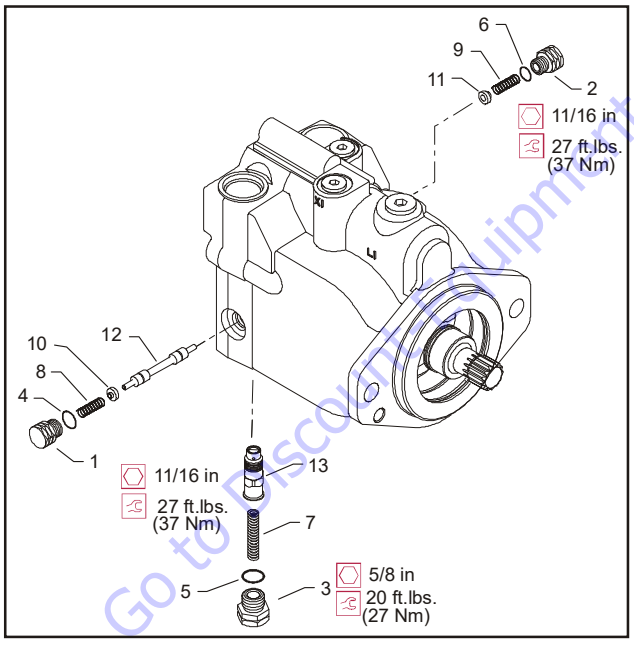
INSTALLATION

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

Loop Flushing Valve

REMOVAL

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



1. Plug
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 3-7. Loop Flushing Spool

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

INSPECT THE COMPONENTS

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

INSTALLATION

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

Troubleshooting

Table 3-3. Excessive Noise and/or Vibration

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

Table 3-4. System Operating Hot

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

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

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

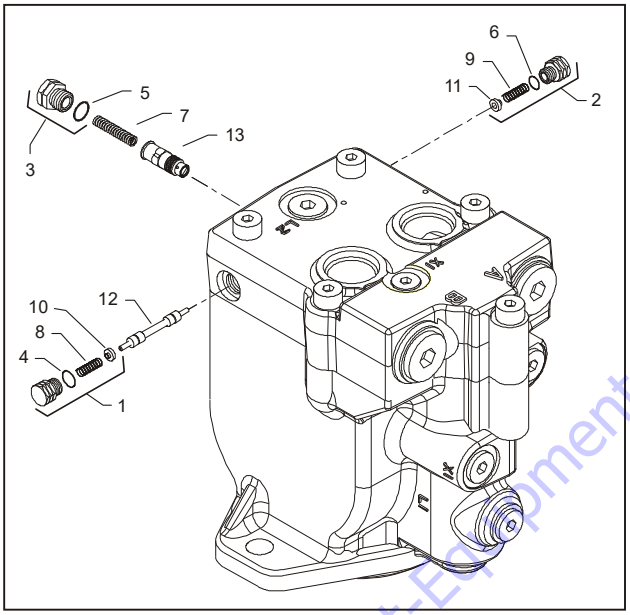
Disassembly

NOTE: *Removal of the endcap voids warranty.*

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

Replace all O-Rings and gaskets.

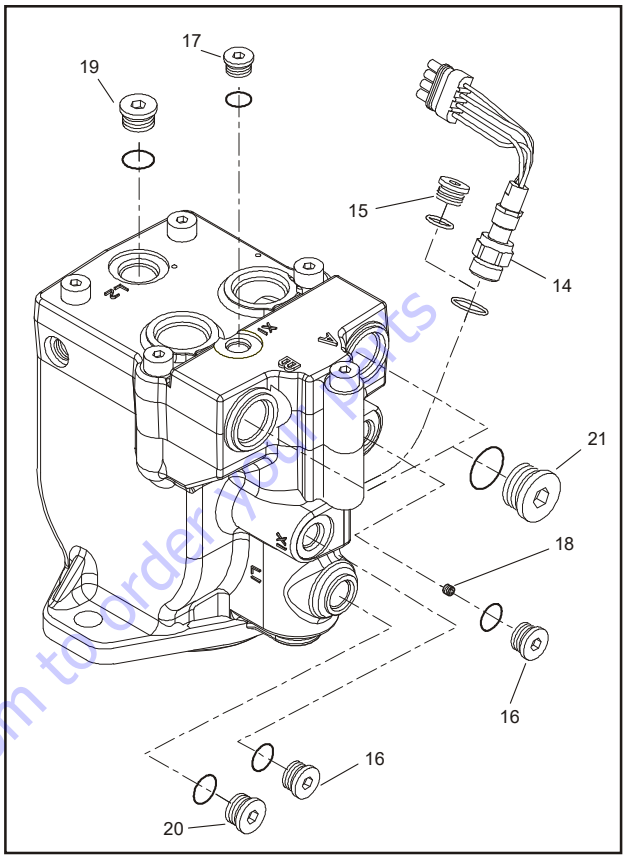
It is recommended that all O-rings be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.



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

Figure 3-8. Loop Flushing Spool

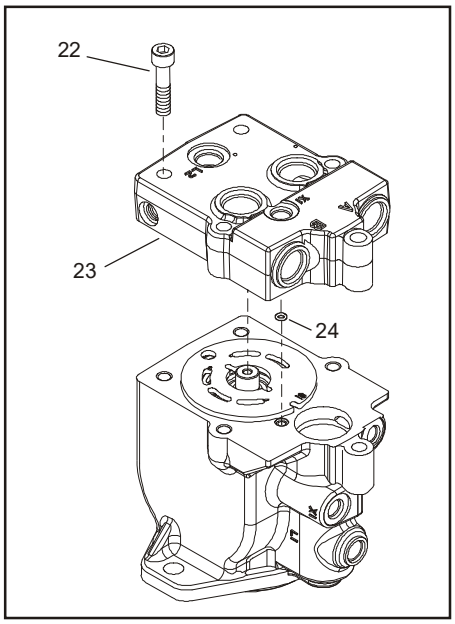
1. Using a 11/16 in wrench, remove plug (1) and (2).
2. Using a 5/8 in hex wrench, remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Using pliers, remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).



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 3-9. Plugs, Fittings, and Speed Sensor

8. Remove all fittings from the unit. Discard any O-rings on the fittings.
9. Using an 11/16 in hex wrench, loosen the speed sensor lock nut (14) if equipped. Then remove the speed sensor using a 1/2 inch hex wrench. Units without speed sensor have an O-ring plug (15) installed in that location; remove it with a 1/4 inch 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. Using a 9/16 in internal hex wrench, remove work port plugs (21, if equipped with axial ports). Discard O-rings.

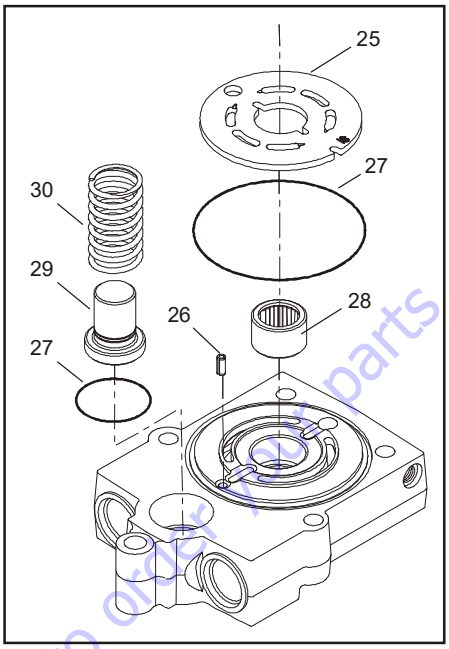


22. Screw
23. End Cap
24. O-ring

Figure 3-10. End Cap

13. Using an 8 mm internal hex wrench, remove the endcap screws (22).
14. Remove the endcap (23). Remove O-ring (24) from the housing or endcap.

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



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

Figure 3-11. Valve Plate & Rear Shaft Bearing

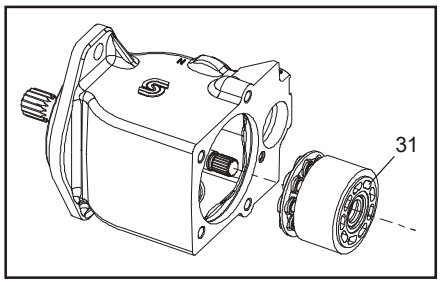
⚠ CAUTION

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

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

    Each displacement has a unique valve plate. For identification, the last two digits of the valve plate part number are stamped on its surface.
16. Remove and discard the O-rings (27).
17. Remove the rear shaft bearing (28) from the endcap with a bearing puller.

    The bearing may be difficult to remove with a puller. Try this as an alternative: Pack the bearing cavity with heavy grease. After the shaft is removed, insert it into the bearing cavity and tap lightly with a soft mallet on the splined end. The grease will force the bearing out. Use caution not to drive the bearing past the rear shaft journal as the bearing may become trapped on the shaft and damaged.
18. Remove minimum angle stop (29) and servo spring (30) from the housing.



31. Cylinder Kit Assembly

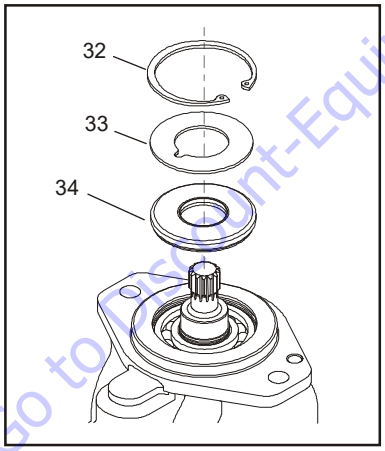
Figure 3-12. Cylinder Kit

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

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

Table 3-6. Displacement Identifiers

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

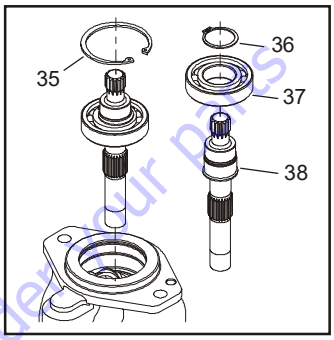


32. Snap Ring
33. Support Washer
34. Shaft Seal

Figure 3-13. Shaft Seal

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

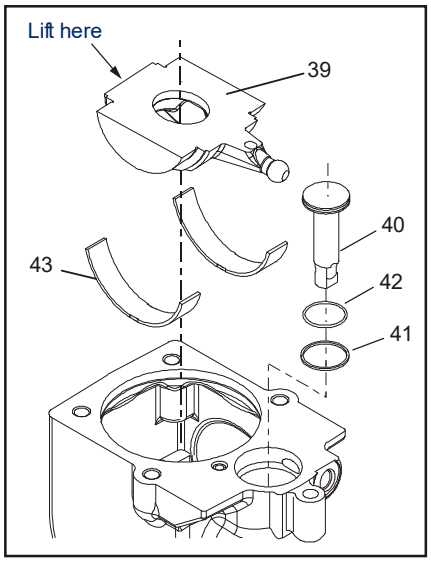
    To avoid damaging the shaft during seal removal, install a large sheet metal screw into the chuck of a slide hammer. Drive the screw into the seal surface and use the slide hammer to pull the seal.



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

Figure 3-14. Shaft & Front Bearing

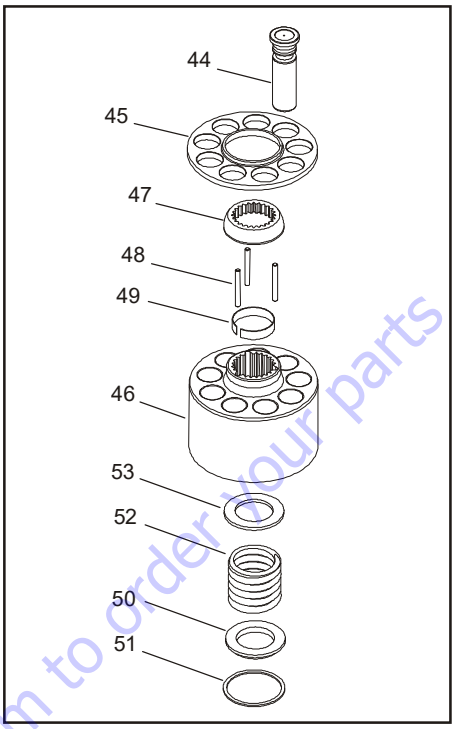
21. Remove the inner snap ring (35) and the shaft / bearing assembly.
22. Remove the snap-ring (36) retaining the shaft front bearing. Pull the bearing (37) off of the shaft (38).



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

Figure 3-15. Swash Plate & Servo Piston

23. Turn housing over and remove the swashplate (39) by lifting on the end opposite the servo lever.
24. Remove the servo piston (40). Remove the piston seal (41) and O-ring (42) from the servo piston. Discard the seal and O-ring.
25. Remove the journal bearings (43) from the housing. If the bearings are to be reused, note the location and orientation of each bearing for reassembly.



44. Piston
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 3-16. Cylinder Kit Disassembly

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

    The pistons are not selectively fitted, however units with high hourly usage may develop wear patterns. Number the pistons and bores for reassembly if they are to be reused.
27. Remove the ball guide (47), hold-down pins (48), and retaining ring (49) from the cylinder block.

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

⚠ WARNING

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

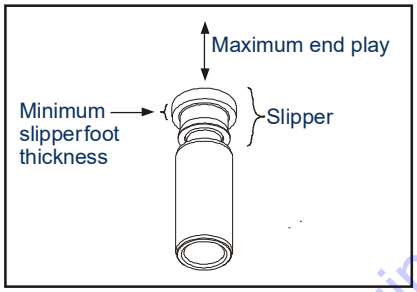
28. Turn the block over. Using a press, apply pressure on the block spring washer (50) to compress the block spring. Compress the spring enough to safely remove the spiral retaining ring (51). While maintaining pressure, unwind the spiral retaining ring (51). Carefully release the pressure and remove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

Inspection

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

PISTON

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



SLIPPERS

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

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

Table 3-7. Slipper Foot Thickness & End Play

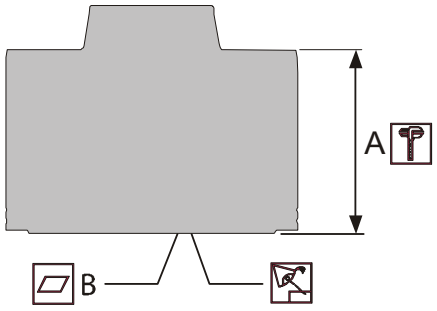
Measurement		L Frame	K Frame
Slipper Foot Thickness	mm (in.)	2.71 (0.11)	4.07 (0.16)
Piston/Slipper End Play		0.15 (0.006)	

CYLINDER BLOCK

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

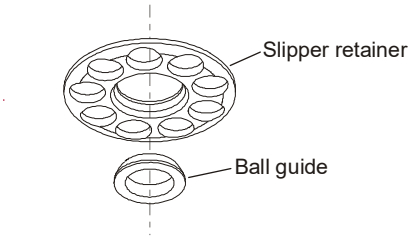
Table 3-8. Cylinder Block Measurements

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



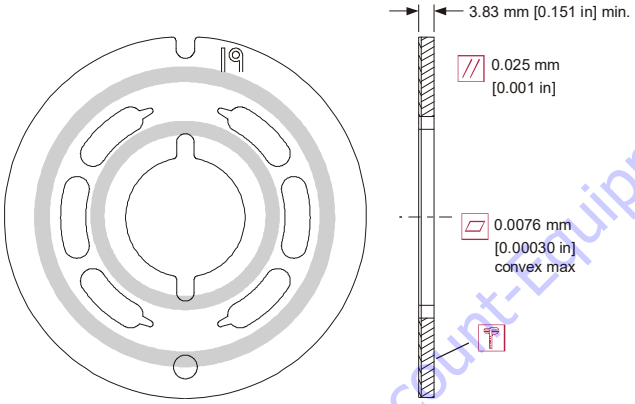
BALL GUIDE AND SLIPPER RETAINER

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



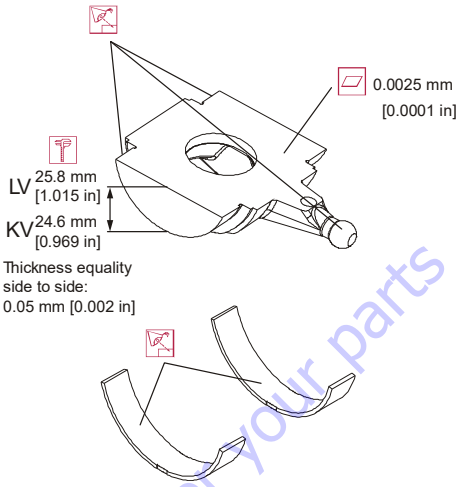
VALVE PLATE

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



SWASHPLATE AND JOURNAL BEARINGS

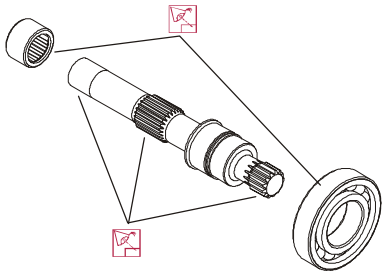
Inspect the running face, servo ball-joint, and swashplate journal surfaces for damage or excessive wear. Some material transfer may appear on these surfaces and is acceptable providing the surface condition meets specifications shown. Measure the swashplate thickness from the journals to the running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



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

SHAFT BEARINGS

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

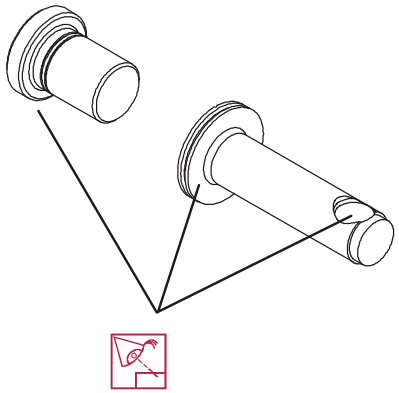


SHAFT

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

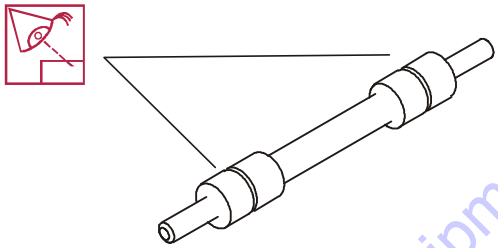
SERVO PISTON AND MINIMUM ANGLE STOP

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



LOOP FLUSHING SPOOL

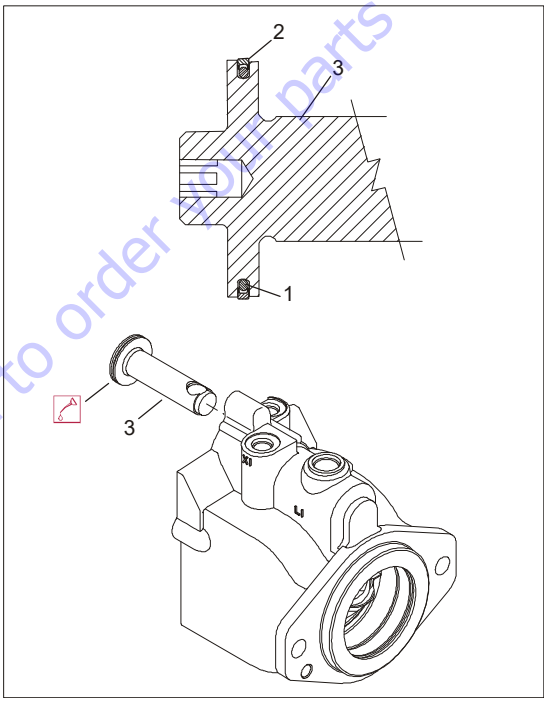
Inspect the loop flushing spool. Check for cracks or damage. Replace if necessary.



Assembly

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

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



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

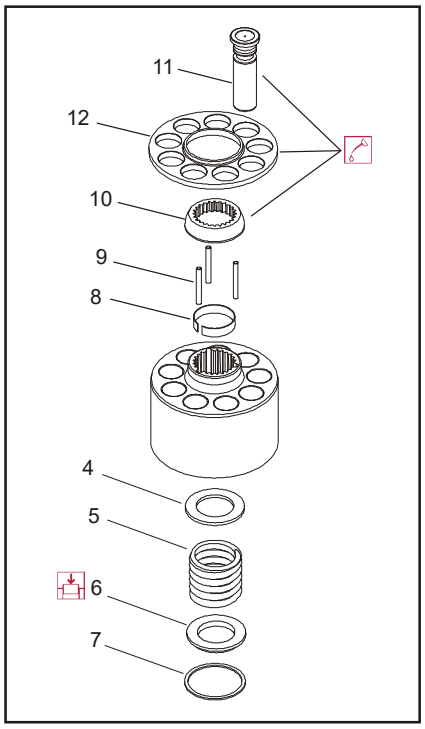
Figure 3-17. Servo Piston

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

⚠ WARNING

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

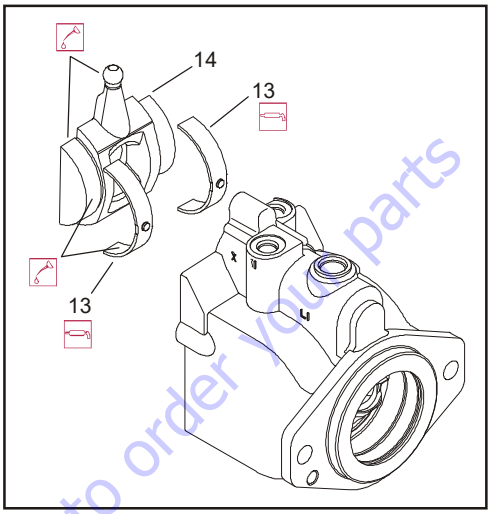
3. Install the inner block spring washer (4), block spring (5), and outer washer (6) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (7) into the groove in the cylinder block.



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

Figure 3-18. Cylinder Kit Assembly

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

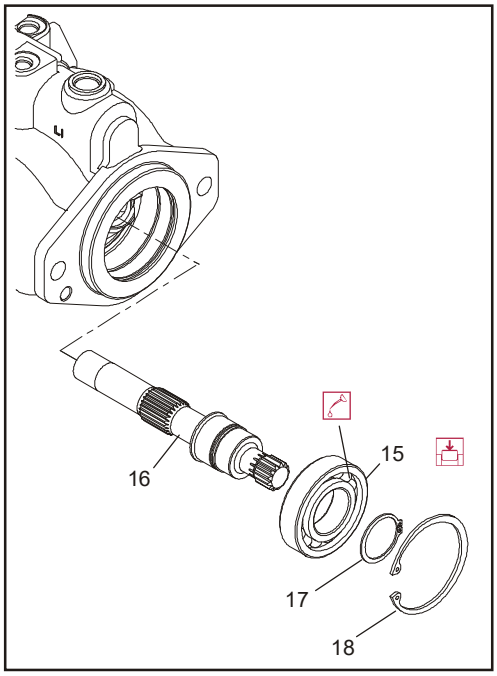


13. Journal Bearings
14. Swash Plate

Figure 3-19. Swash Plate and Journal Bearing

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

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

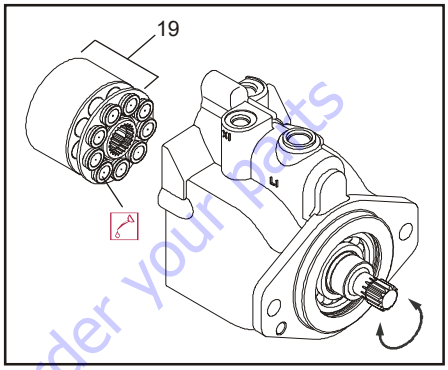


15. Front Shaft Bearing
16. Shaft
17. Snap Ring
18. Snap Ring

Figure 3-20. Shaft and Front Bearing

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

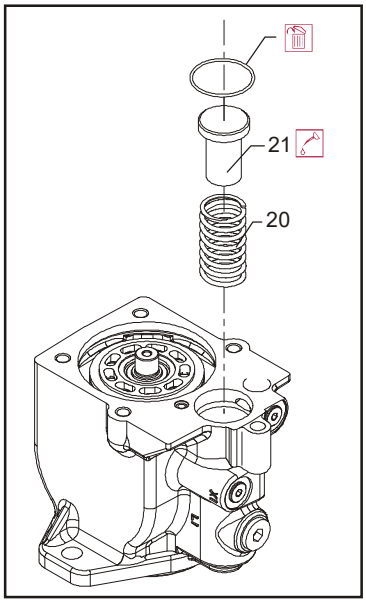
10. Verify swashplate and bearings are properly seated. Install the cylinder kit (19) onto the shaft. Install with the slippers facing the swashplate. Rock the shaft to align the block splines and slide the cylinder kit into place. Orient the motor with the shaft pointing downward and verify the cylinder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



19. Cylinder Kit

Figure 3-21. Cylinder Kit Installation

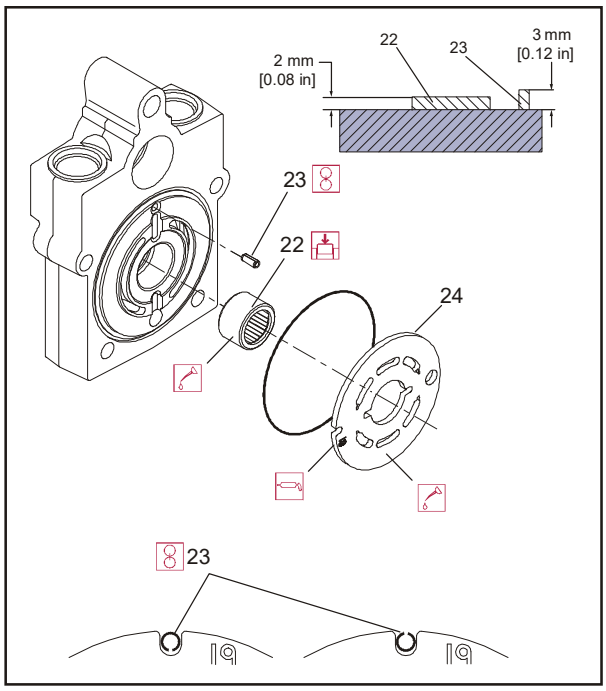
11. Lubricate and install the servo spring (20), and minimum angle stop (21) into the housing bore.



20. Servo Spring
21. Minimum Angle Stop

Figure 3-22. Servo Spring and Minimum Angle Stop

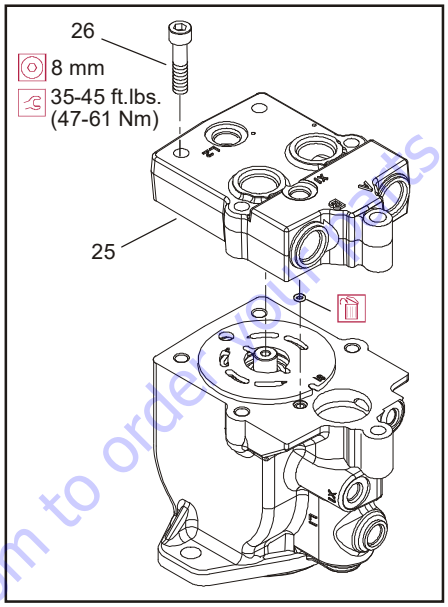
12. Press the rear shaft bearing (22) into the endcap. Install the bearing with letters facing out. Press until bearing surface is 0.08 ±0.01 in (2 ±0.25 mm) above endcap surface.



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

Figure 3-23. Valve Plate and Rear Bearing

13. Install timing pin (23) into its bore in the endcap. Install the pin with its groove facing toward or away from the shaft. Press the pin until the end protrudes 0.12 ±0.01 in (3 ±0.25 mm) above endcap surface.
14. Install the valve plate (24) onto the endcap. Install the valve plate with the yellow surface toward the cylinder block. Align the slot in the valve plate with the timing pin. Apply a liberal coat of assembly grease to the endcap side of the valve plate to keep it in place during installation.
15. Install the endcap (25) onto the housing with the endcap screws (26). Check to ensure the endcap will properly seat onto the housing without interference. Improper assembly of the internal components may prevent the endcap from seating properly. Ensure the O-rings seat properly when installing the endcap.

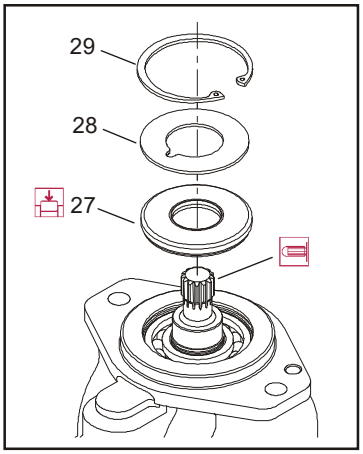


25. End Cap
26. Screw

Figure 3-24. End Cap

16. Using an 8 mm internal hex wrench, tighten the endcap screws. Tighten the screws in opposite corners slowly and evenly to compress the servo spring and properly seat the endcap. Torque endcap screws 35-45 ft. lb. (47-61 Nm).
17. Before installing the shaft seal, ensure the shaft turns smoothly with less than 120 in.lbs. (13.5 Nm) of force. If the shaft does not turn smoothly within the specified maximum force, disassemble and check the unit.

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



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

Figure 3-25. Shaft Seal

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

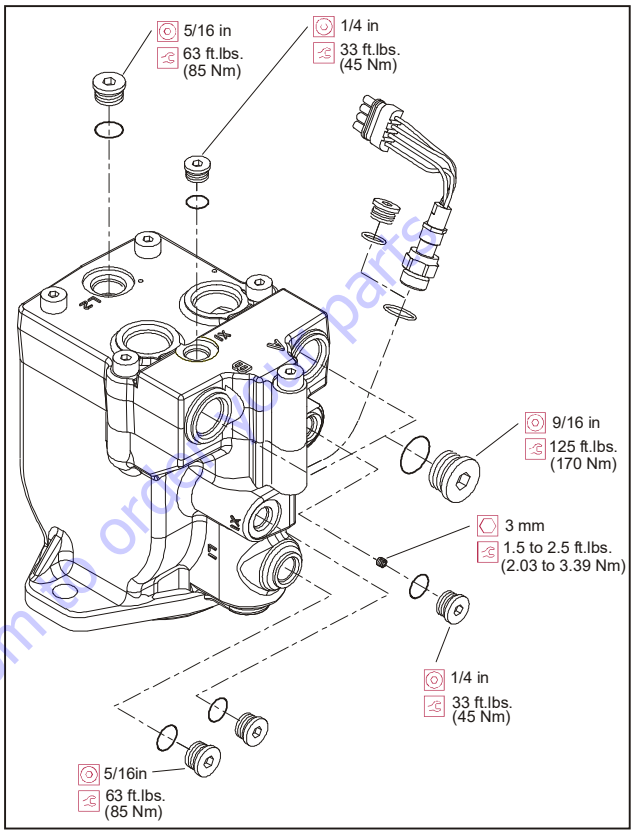
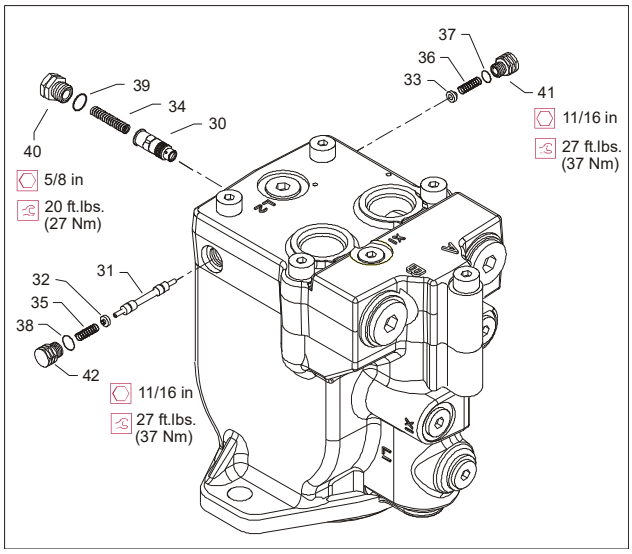


Figure 3-26. Plugs and Fittings Installation

20. Install orifice poppet (30).



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

Figure 3-27. Loop Flushing Spool

21. Install shift spool (31).
22. Install spring retaining washers onto springs (32 and 33).
23. Carefully install centering springs (34, 35, and 36).
24. Install new O-rings (37, 38, and 39).
25. Using a 5/8 in wrench torque plug (40) to 20 ft. lb. (27 Nm).
26. Using a 11/16 in wrench, torque plugs (41 and 42) to 27 ft. lb. (37 Nm).

Initial Start-Up Procedures

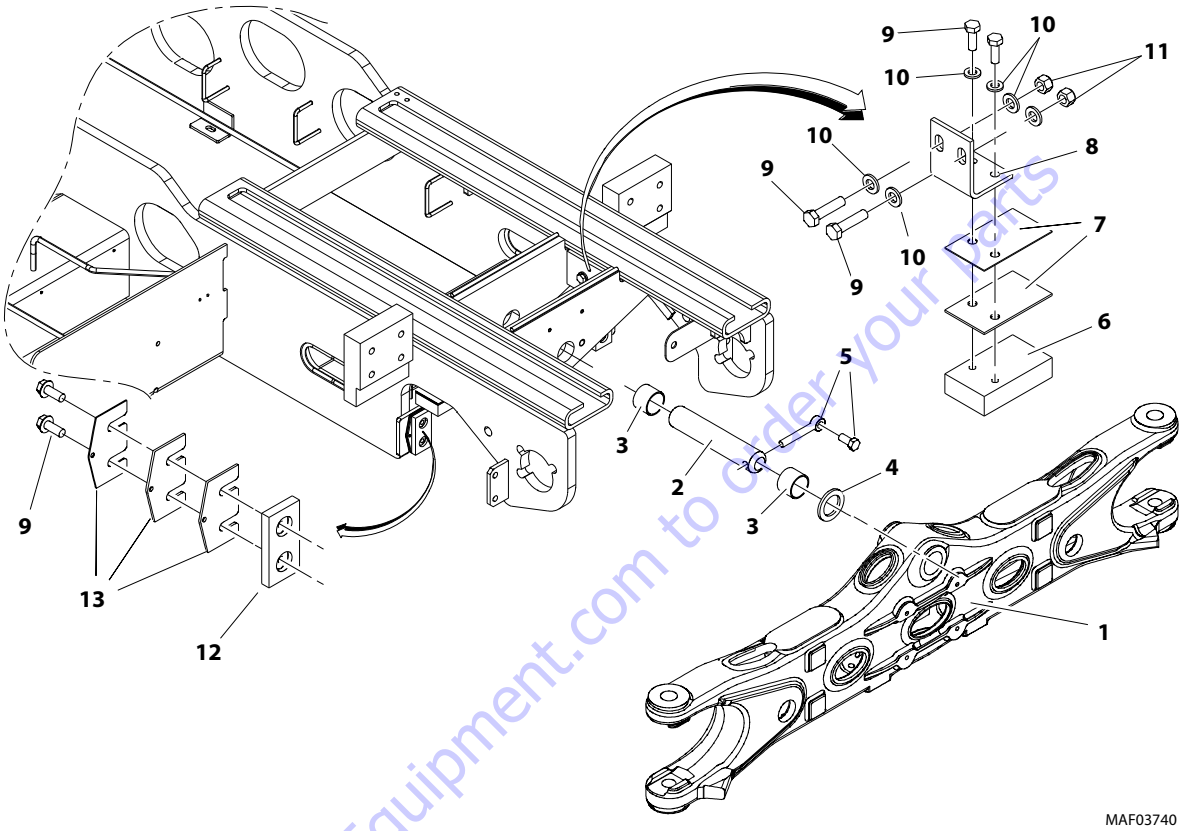
Follow this procedure when starting-up a new motor or when installing a motor that has been removed.

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

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

3.5 AXLE INSTALLATION

Front Axle Assembly (Fixed)



1. Front Axle
2. Pivot Pin
3. Pivot Pin Bushing
4. Thrust Washer
5. Pin Keeper and Screw
6. Stop Block Pad
7. Stop Block Shims
8. Stop Block Pad Bracket
9. Hex Head Screws
10. Washers
11. Nuts
12. Wear Pad
13. Wear Pad Shims

REMOVAL

⚠ CAUTION

SUPPORT THE FRAME AND AXLE BEFORE ATTEMPTING ANY REMOVAL AND/OR ASSEMBLY PROCEDURES.

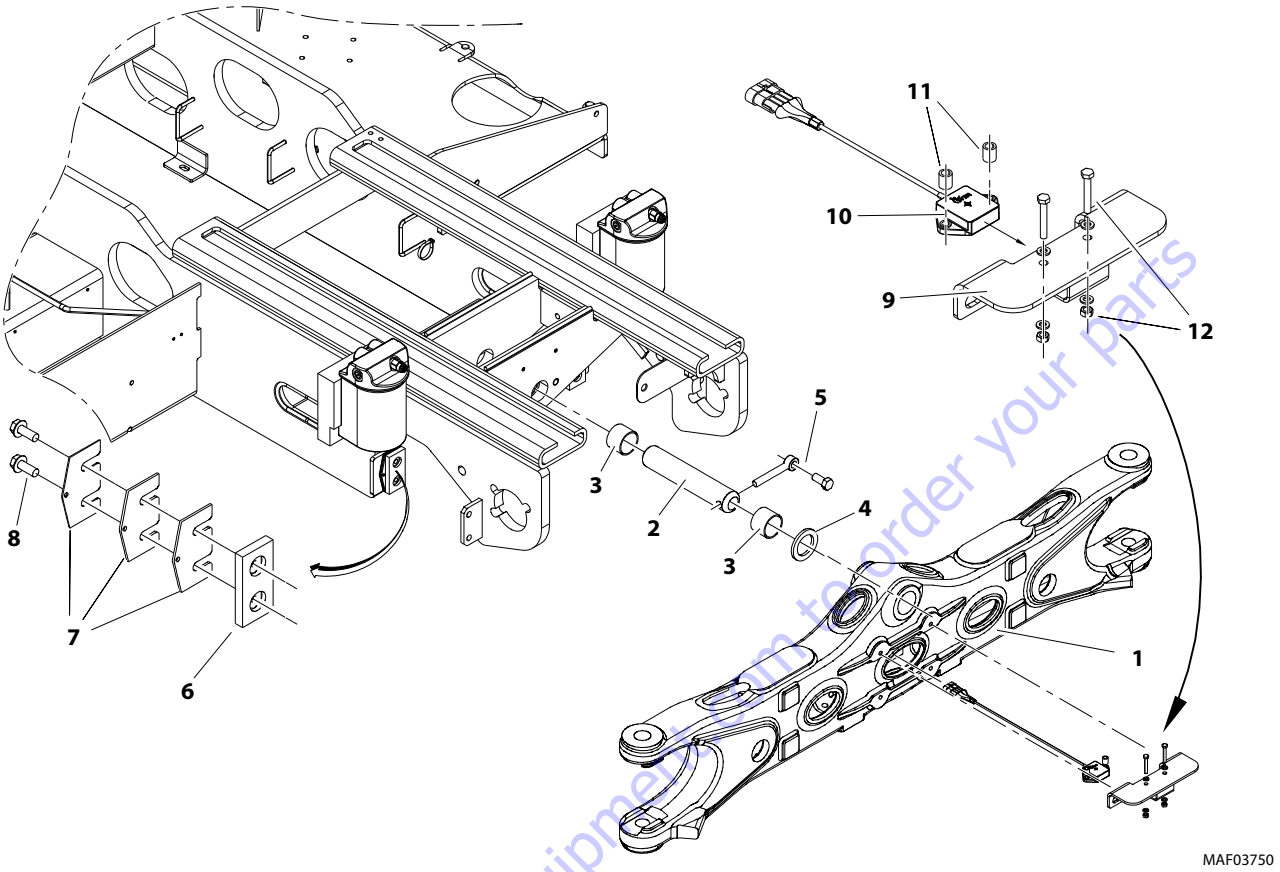
1. Disable machine operation. Remove wheel and drive assemblies.
2. Remove the bolt and pin keeper (5).
3. Push the axle pivot pin (1) out and remove the thrust washer (4) and bearings (3).
4. Front axle (1) can now be moved away from the frame.

ASSEMBLY

1. When installing the axle assembly, follow Removal Steps in reverse.
2. Shim both the stop block pad and the wear pad to achieve a maximum gap of 1/16 in. (1.5 mm) between the pad and the axle machined surface.

NOTE: *Apply Medium Strength Threadlocking Compound to bolts (9) attaching stop block pad (6), and wear pad (12).*

Front Axle Assembly (Oscillating)



1. Front Axle
2. Pivot Pin
3. Pivot Pin Bushing
4. Thrust Washer
5. Pin Keeper and Screw
6. Wear Pad
7. Wear Pad Shims
8. Hex Head Screws
9. Osc. Axle Tilt Sensor Bracket
10. Osc. Axle Tilt Sensor
11. Spacers
12. Mounting Bolts/Washers/Nuts

REMOVAL

⚠ CAUTION

SUPPORT THE FRAME AND AXLE BEFORE ATTEMPTING ANY REMOVAL AND/OR ASSEMBLY PROCEDURES.

1. Disable machine operation. Remove wheel and drive assemblies.
2. Unplug the axle tilt sensor electrical connection.
3. Remove the bolt and pin keeper (5).
4. Push the axle pivot pin (1) out and remove the thrust washer (4) and bearings (3).
5. Front axle (1) can now be moved away from the frame.

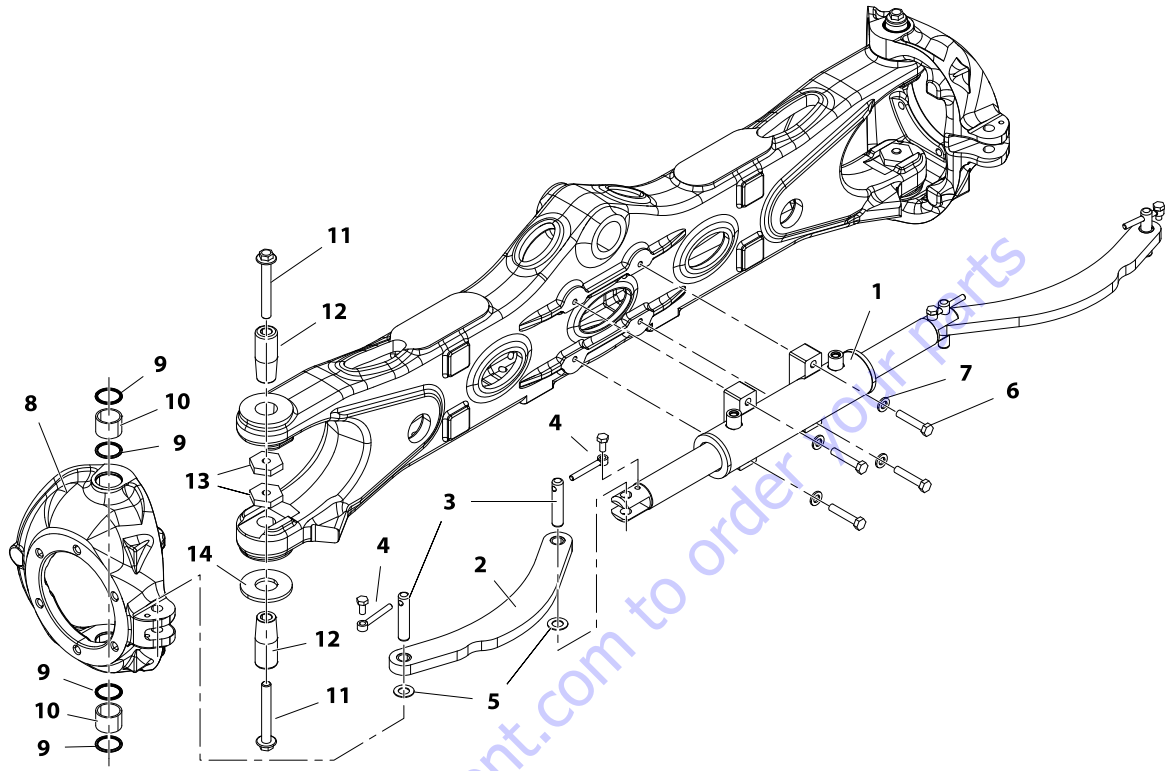
ASSEMBLY

1. When installing the axle assembly, follow Removal Steps in reverse.
2. If removed, shim the wear pad to achieve a maximum gap of 1/16 in. (1.5 mm) between the pad and the axle machined surface.

NOTE: *Apply Medium Strength Threadlocking Compound to bolts (8) attaching wear pad (6) to the frame.*

- **Oscillating Axle Tilt Sensor - (item 10)** If this sensor is not wired correctly or if you have the wrong part number you will get CANBUS FAILURE - OSCILLATING AXLE TILT SENSOR

Steering Assembly



1. Steer Cylinder Assembly
2. Tie-Rod Link
3. Pivot Pins
4. Pin Keeper and Screw
5. Thrust Washer
6. Cyl. Attach Screws
7. Washer
8. Spindle Assembly
9. Bushing Seal
10. Spindle Bushing
11. Hex Flange Bolt
12. Tapered Kingpin Pin
13. Hex Nut
14. Thrust Washer

STEER CYLINDER REMOVAL

1. Disable machine operation and block all wheels. Disconnect, cap and label all hydraulic lines on steer cylinder (1).
2. Remove the screws and pin keeper (4), and pin (3) connecting cylinder rod to tie rod (2). Slide the tie rod out of the cylinder rod, capture the thrust washer (5) on bottom of tie rod.
3. Support steer cylinder. Remove 4 bolts (6) and washers (7) connecting cylinder to axle. Carefully remove cylinder.

SPINDLE REMOVAL

4. Remove wheel and drive assembly prior to spindle (8) removal.
5. Disconnect tie rod (2) from spindle by removing screw and pin keeper (4), and pin (3).
6. Support spindle. Remove spindle from axle by removing flange bolts (11), from nuts (13). Remove the 2 tapered king pins (12), from the tapered king-pin bores on the axle, and thrust washer (14) from lower axle. Remove spindle from axle.

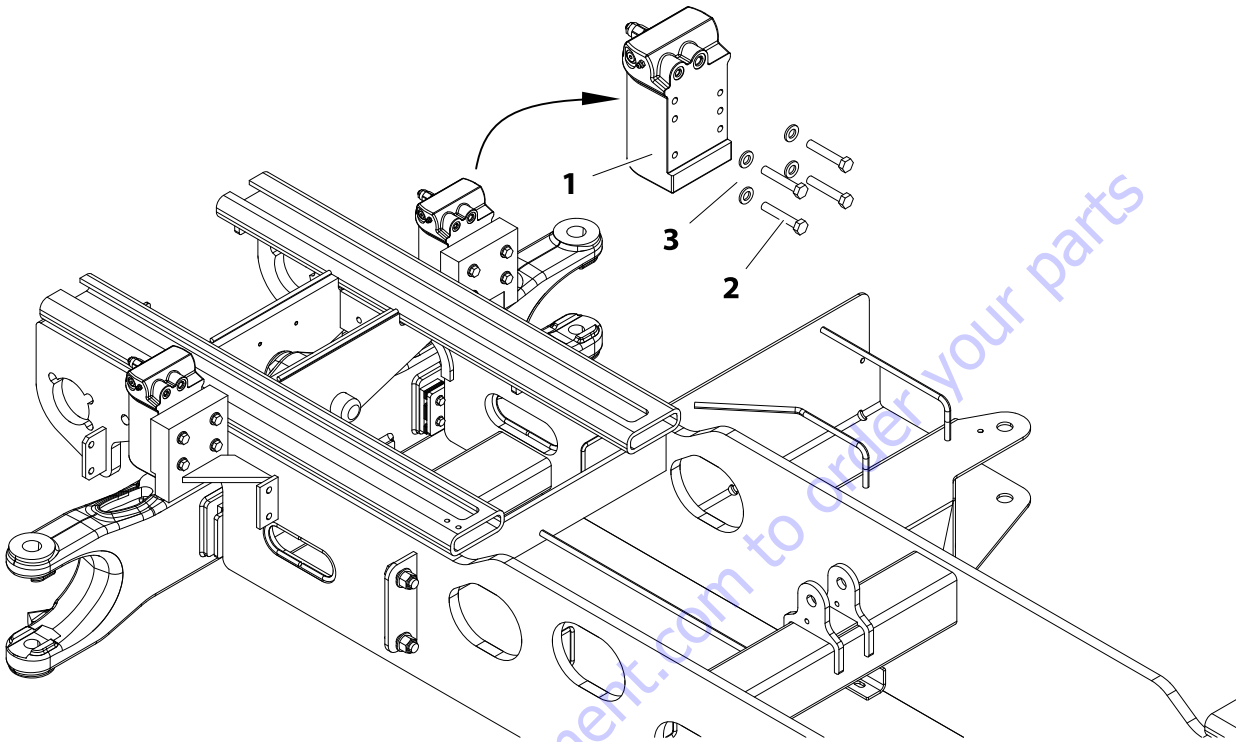
ASSEMBLY

1. When assembling steer cylinder and spindle, follow Removal Steps in reverse.

NOTE: *Apply Medium Strength Threadlocking Compound to bolts (4, 6, 11).*

Torque flange bolt (11) to 108 ft. lb. (147 Nm).
Inspect spindle bushing seals (9), replace if damaged.
Ensure large thrust washer (14) is installed between spindle (8) and bottom of axle.
Be certain spindle nut (13) is aligned and seated in the machined groove on the axle before tightening.

Axle Lockout Cylinder



1. Axle Lockout Cylinder
2. Bolt
3. Washers

REMOVAL

1. Disable machine operation.
2. Disconnect, cap and label hydraulic lines on the axle lockout cylinder (1).
3. Remove the four bolts (2) and washers (3) connecting the cylinder to the frame.
4. Carefully remove cylinder from the frame.

INSTALLATION

1. Attach cylinder to frame using four bolts (2) and washers (3).

NOTE: *Make sure the shoulder on the lockout cylinder is firmly against the bottom of the mounting plates on the frame before torquing bolts.*
Apply Medium Strength Threadlocking Compound and Threadlocking Compound to bolts (2).

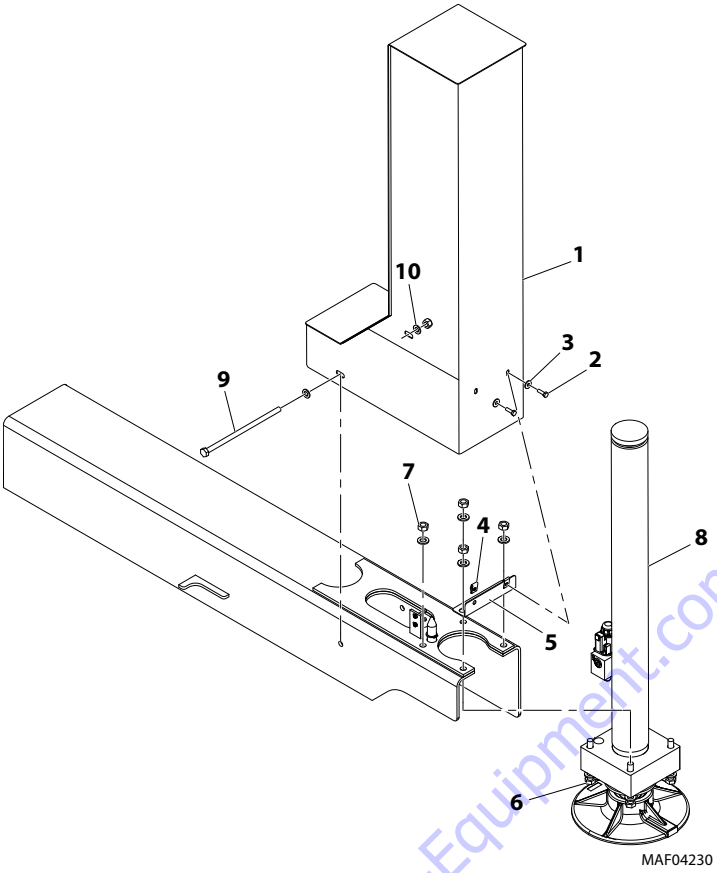
2. Uncap and reconnect hydraulic lines to cylinder.

NOTE: *Refer to Section 4.14, Cylinder Assemblies for axle lockout cylinder breakdown and bleeding procedure.*

3. Operate axle lockout cylinder function to ensure proper functioning.

3.6 LEVELING JACKS

Cylinder Removal



1. Cover
2. Bolt
3. Flat washer
4. Tinnerman Nut
5. Jack Cover Attach Bracket
6. Bolt
7. Nut/Washer
8. Leveling Jack Cylinder
9. Bolt
10. Nut/Washer

Figure 3-28. Leveling Jack Cylinder Removal

REMOVAL

1. Disable machine operation.
2. Remove the three bolts (2 and 9), flat washers (3 and 10) and from cover (1). Carefully lift cover up and off of machine.
3. Disconnect, cap and label all hydraulic lines and wires connected to the leveling jack cylinder (8).
4. Support cylinder. Remove the four bolts (6) and nuts and washers (7) attaching cylinder to cylinder mount. Remove jack cover attach bracket (5).
5. Carefully remove cylinder from mount.

INSTALLATION

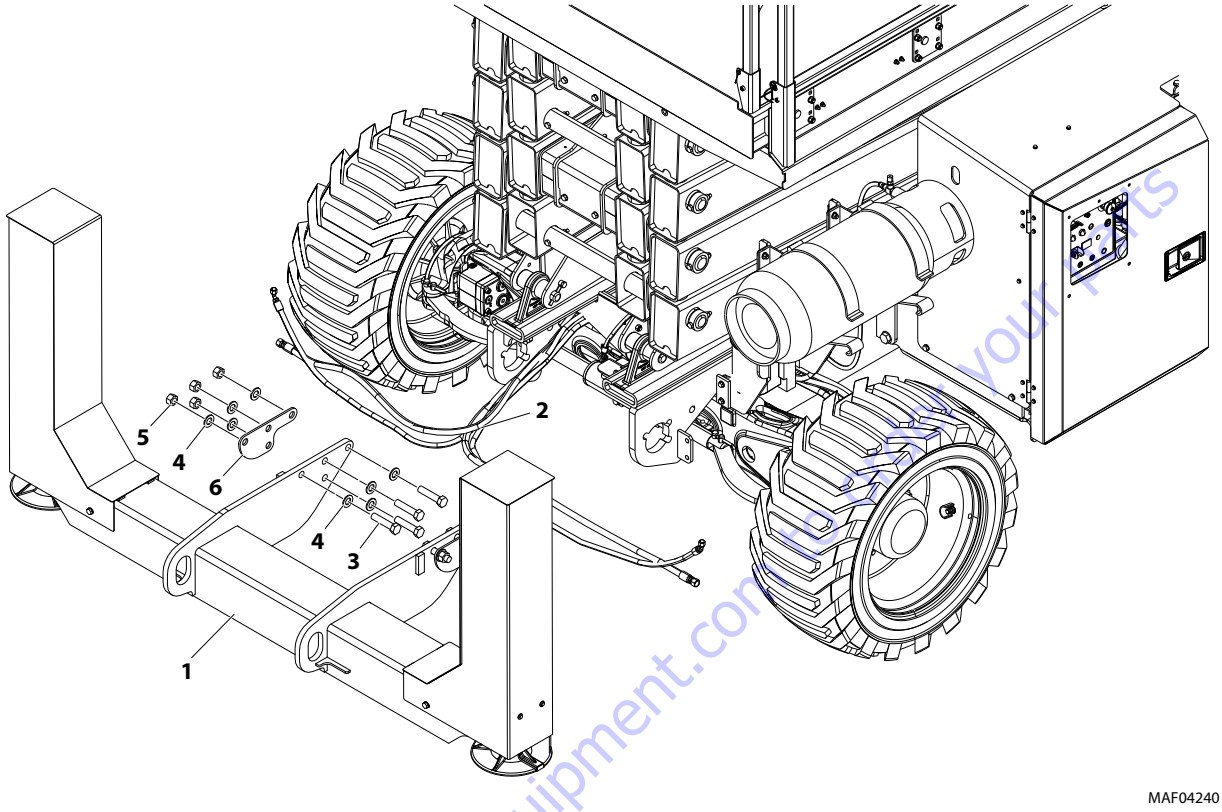
1. Follow Removal Steps in reverse.

NOTE: *Refer to Figure 4-30., Leveling Jack Cylinder for cylinder breakdown.*

2. Operate leveling jacks to ensure proper operation.

Assembly Removal

NOTE: *Applies to both front and rear of machine.*



1. Leveling Jacks Assembly
2. Hydraulic Lines/Electrical Wiring
3. Bolt
4. Washers (Hardened)
5. Nut
6. Doubler Plate

Figure 3-29. Leveling Jacks Assembly

REMOVAL

⚠ CAUTION

SUPPORT THE LEVELING JACKS ASSEMBLY BEFORE ATTEMPTING ANY REMOVAL AND/OR ASSEMBLY PROCEDURES.

1. Disable machine operation and block all wheels.
2. Remove covers from leveling jack cylinders (refer to Figure 3-28., Leveling Jack Cylinder Removal).
3. Disconnect, cap and label hydraulic lines (2) connected to leveling jack cylinders. Disconnect and label all electrical wiring attached to cylinder and switches. Remove hoses and wiring from the leveling jack tube assembly.
4. Remove the eight bolts (3), washers (4), nuts (5) and doubler plate (6) through the frame.
5. Carefully lower assembly from the frame.

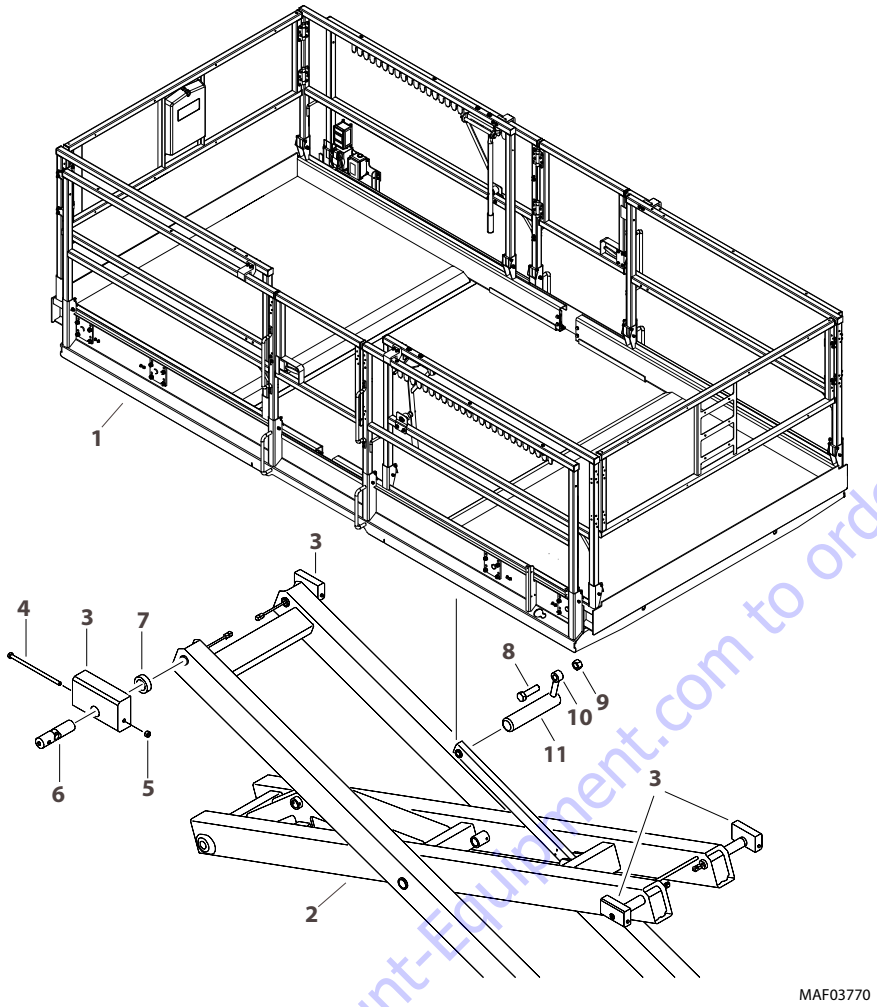
INSTALLATION

1. Follow Removal Steps in reverse.

NOTE: *Mount doubler plate on outside of frame rail.*

2. Insert hoses and wiring into the leveling jack tube assembly. Uncap and reconnect hydraulic lines and electrical wires to cylinders and switches.
3. Enable machine and unblock all wheels.
4. Operate leveling jacks to ensure proper operation.

3.7 PLATFORM



1. Platform
2. Scissor Arms
3. Slide Block
4. Bolt
5. Locknut
6. Pin
7. Spacer Tube
8. Bolt
9. Locknut
10. Pin Keeper
11. Pin

Figure 3-30. Platform Removal

⚠ CAUTION

NEVER WORK UNDER ELEVATED PLATFORM WITHOUT FIRST PROPERLY SUPPORTING THE PLATFORM AND BRACING/BLOCKING SCISSOR ARM ASSEMBLY.

REMOVAL

1. Disable machine operation.
2. Place lifting straps at each end of the platform (1). Using an overhead crane lift platform.

NOTE: *Use lifting straps and overhead crane capable of lifting at least 6000 lb (2722 kg).*

3. Disconnect, cap and label hydraulic lines on deck extension cylinders. Disconnect and label all electrical wires going to platform.
4. Detach the center attach link from the platform by removing the bolt (8), locknut (9) pin keeper (10) and pin (11).
5. With scissor arm assembly (2) braced, remove the slide block (3) at each corner of the platform by removing the bolt (4), locknut (5), pin (6) and spacer tube (7).
6. Lift platform away from the machine.

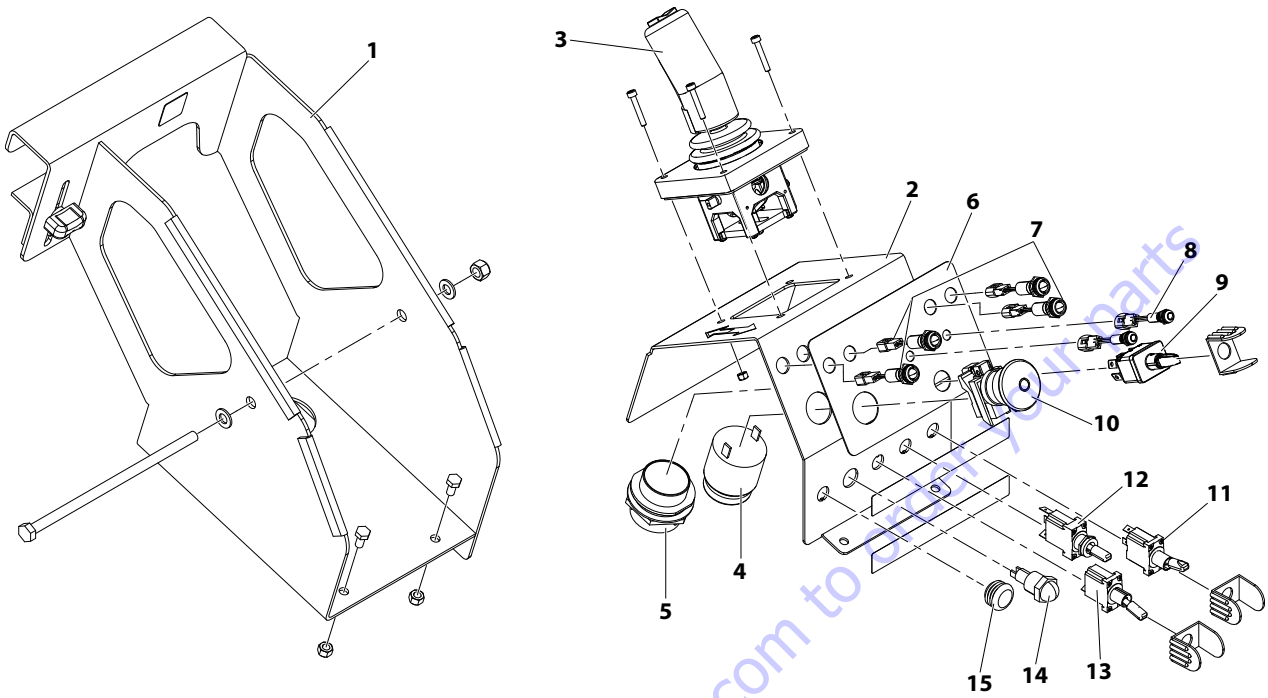
INSTALLATION

1. Follow Removal Steps in reverse.

NOTICE

TIGHTEN BOLTS (4) AND LOCKNUTS (5) TO JUST MAKE CONTACT WITH THE SLIDE BLOCKS (3). DO NOT OVERTIGHTEN.

Platform Control Station



1. Mounting Bracket
2. Control Box Plate
3. Joystick Controller
4. Alarm Speaker
5. Wiring Harness Connector
6. Function Decal
7. LED Indicator
8. Leveling Jack Switch/ LEDS
9. Select Switch/Guard
10. Stop Switch
11. Fuel Select or Glow Plug Switch/Guard
12. Speed Select Switch
13. Engine Start Switch
14. Horn Switch
15. Blank Plug

NOTICE

DO NOT SWITCH PLATFORM CONTROL BOXES FROM ONE MACHINE TO ANOTHER. IF BOXES ARE SWITCHED, THE MACHINE WILL NOT POWER UP IN PLATFORM MODE, AND THE SYSTEM DISTRESS INDICATOR ON THE PLATFORM CONTROL BOX WILL REMAIN LIT.

DISASSEMBLY

1. Disconnect the cable from the harness connector (5) on the underside of the platform control station.
2. Remove the control box plate (2) from the mounting bracket (1) by removing the three bolts and washers.
3. Once loaded control box plate is removed, switches, buttons and bulbs can be removed for replacement.
4. Remove the four screws and nuts to remove the joystick controller (3).
5. The harness can be removed from the box by removing the harness connector terminal nut, and disconnecting all the wiring inside the control box.

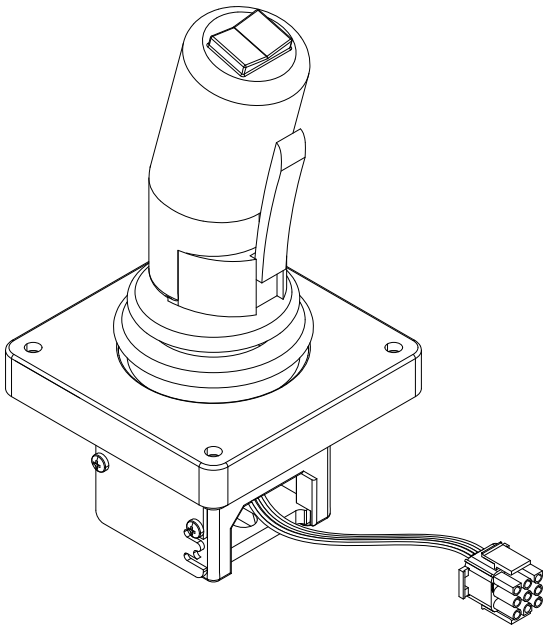
ASSEMBLY

1. Follow Disassembly Procedures in reverse.
2. Ensure electrical wires are properly and securely attached to switches, buttons and bulbs.

NOTE: *Ensure wires are not pinched when installing the loaded control box plate back onto the mounting bracket.*

3. Reattach wiring cable to harness connector (4) on underside of platform control station.
4. Mount control station to platform rail.
5. Operate functions with platform control console to ensure proper operation.

Joystick Controller



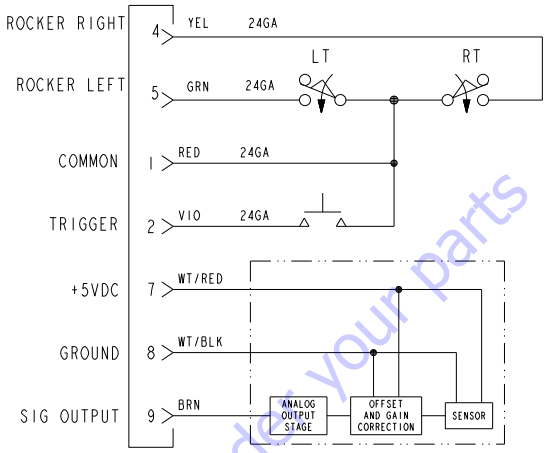


Table 3-9. Joystick Specifications

Type	Single Axis (Y Axis Only)
Input Voltage	5V
Current Consumption	10mA @ 12VDC
Centered Output Voltage	2.50VDC
Reverse Voltage	4.0VDC
Forward Voltage	1.0VDC

Table 3-10. Joystick Plug Loading Chart

Terminal	Color	Function
1	RED	Handle COM
2	VIOLET	Trigger N.O.
3		Spare
4	YELLOW	Rocker Right
5	GREEN	Rocker Left
6		Spare
7	White/RED	+5VDC
8	White/BLACK	Ground
9	BROWN	SIG Output

3.8 SCISSOR ARMS

Lift Cylinder Removal

REMOVAL

⚠ CAUTION

NEVER WORK UNDER ELEVATED SCISSOR ARMS WITHOUT FIRST PROPERLY BRACING/BLOCKING SCISSOR ARM ASSEMBLY.

1. Remove platform (refer to Figure 3-30.).
2. Elevate the scissor arm assembly enough to gain access to the upper and lower connection pins. Block/brace scissor arms and disable machine.
3. Disconnect, cap and label all hydraulic lines connected to the lift cylinder. Disconnect and label all electrical wires connected to lift cylinder.
4. Attach lifting straps to overhead crane and lift cylinder and support cylinder before attempting to remove from arm assembly.
5. Remove the cylinder upper pin by removing the bolt, nut and collar. Push pin out.
6. Remove the lower pin by removing the bolt and nut. Push pin out.
7. Carefully lift cylinder up and out of arm assembly.

INSTALLATION

1. Follow Removal Steps in reverse.
2. After assembly, operate lift cylinder to ensure proper operation.

NOTE: *Refer to Figure 4-28., Lift Cylinder for cylinder breakdown.*

Scissor Arms Removal

⚠ CAUTION

NEVER WORK UNDER ELEVATED SCISSOR ARMS WITHOUT FIRST PROPERLY BRACING/BLOCKING SCISSOR ARM ASSEMBLY.

NOTE: *Scissor arms can be removed individually or as an entire assembly.*

ARM REMOVAL

1. Remove platform (refer to Figure 3-30.) and lift cylinder (refer to Figure 3-32.).
2. Disconnect, cap and label all hydraulic hoses and wiring attached to scissor arms.
3. Support the scissor arm(s) being removed.
4. Remove the pin from the scissor arm by removing the two bolts, nuts and collar.
5. Push pin and bearing out from scissor arms.
6. Repeat at each connecting pin.

INSTALLATION

1. Follow Removal Steps in reverse.

Scissor Arm Assembly Removal

⚠ CAUTION

NEVER WORK UNDER ELEVATED SCISSOR ARMS WITHOUT FIRST PROPERLY BRACING/BLOCKING SCISSOR ARM ASSEMBLY.

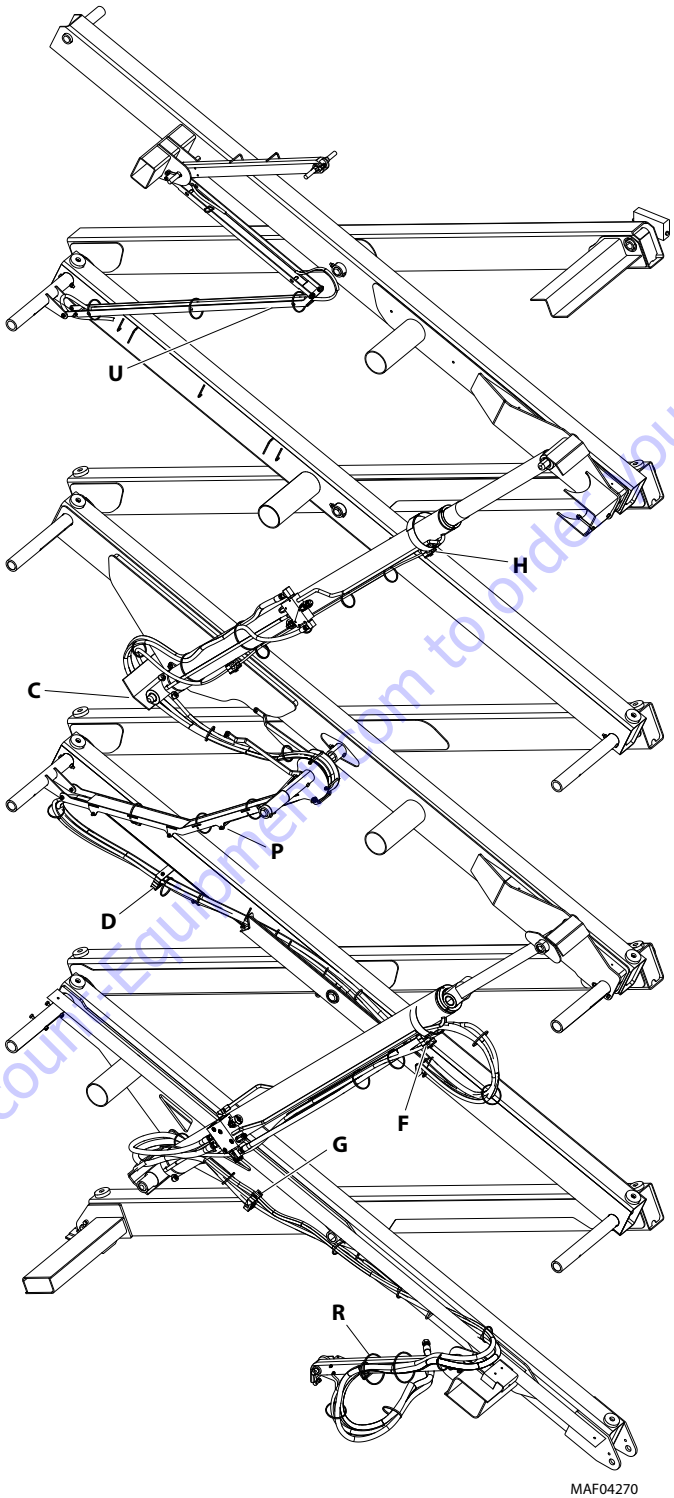
REMOVAL

NOTE: *Applies to all four corners.*

1. Remove platform (refer to Figure 3-30., Platform Removal).
2. Disconnect, cap and label all hydraulic hoses and wiring attached to scissor arms and lift cylinder.
3. Support the scissor arm assembly with appropriate lifting straps and overhead crane.
4. Disconnect the scissor arm assembly from the four sliders by removing the bolts and nuts.
5. Push pins out.
6. Carefully lift arm assembly up and away from chassis.

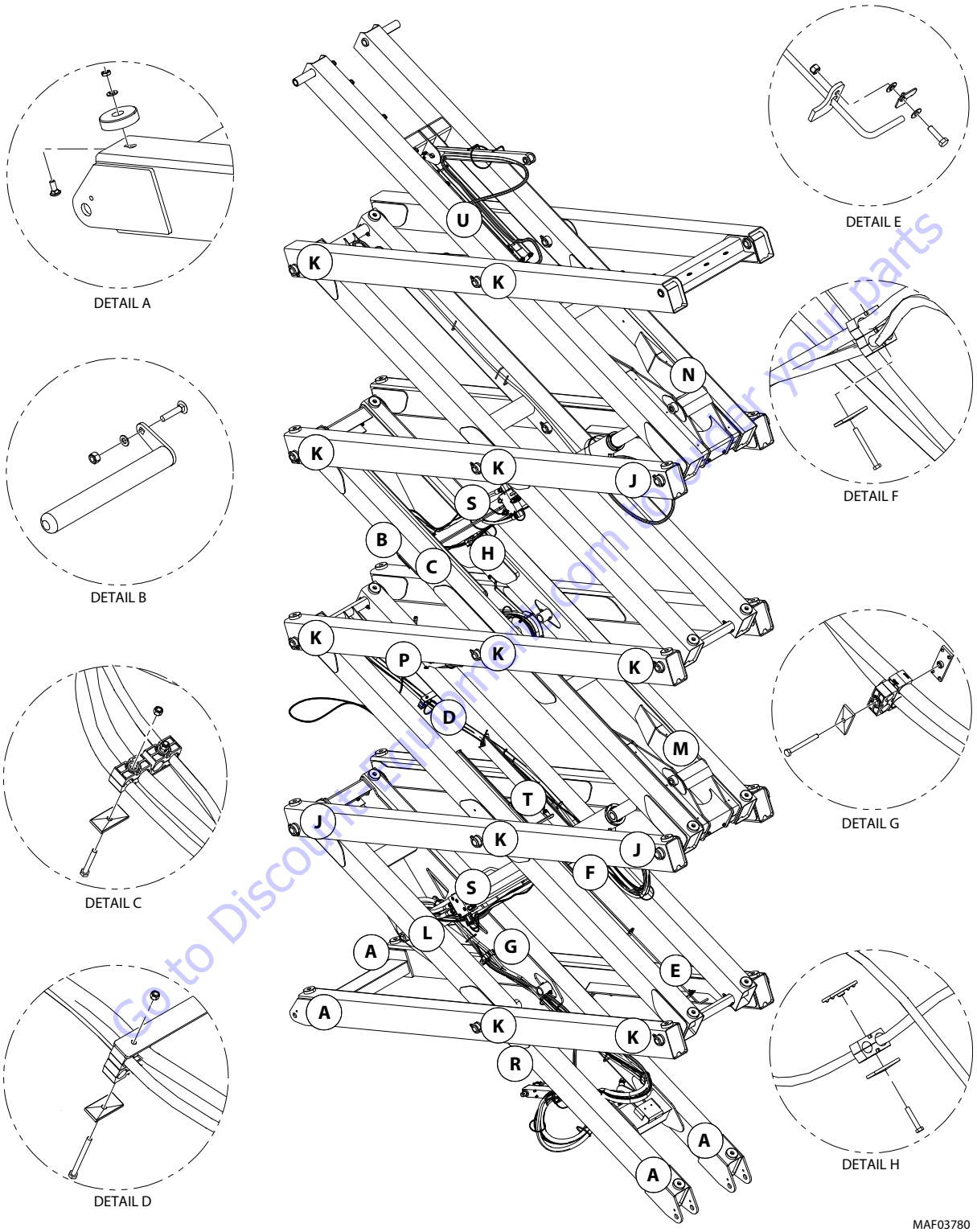
INSTALLATION

Follow Removal Steps in reverse.



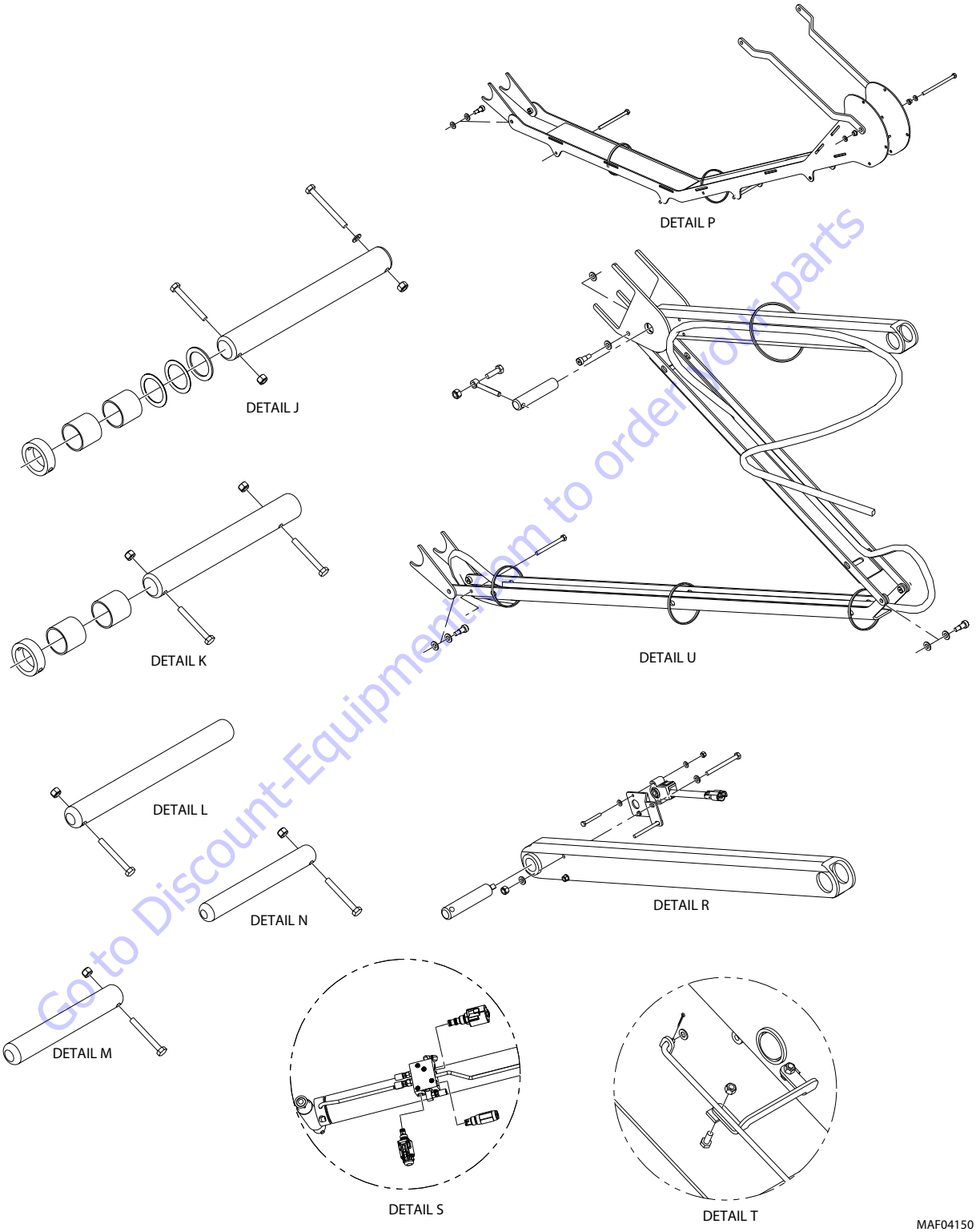
NOTE: *See Figure 3-32. and Figure 3-33. for letter detail views. Route hoses/wiring through wire rod on arm, behind safety prop.*

Figure 3-31. Scissor Arm - Hose and Wiring Routing



NOTE: *Detail H - Do not overtighten safety rod keeper plate, it must rotate freely.*
Detail A, C, D, F, G, and H - Apply Medium Strength Threadlocking Compound to threads.

Figure 3-32. Scissor Arm Component Assembly 1 of 2



NOTE: *Coat all pins (Detail: B, J, K, L, M, and V) with moly paste lubricant before assembly.*

Figure 3-33. Scissor Arm Component Assembly 2 of 2

3.9 SIDE COMPARTMENT COVERS

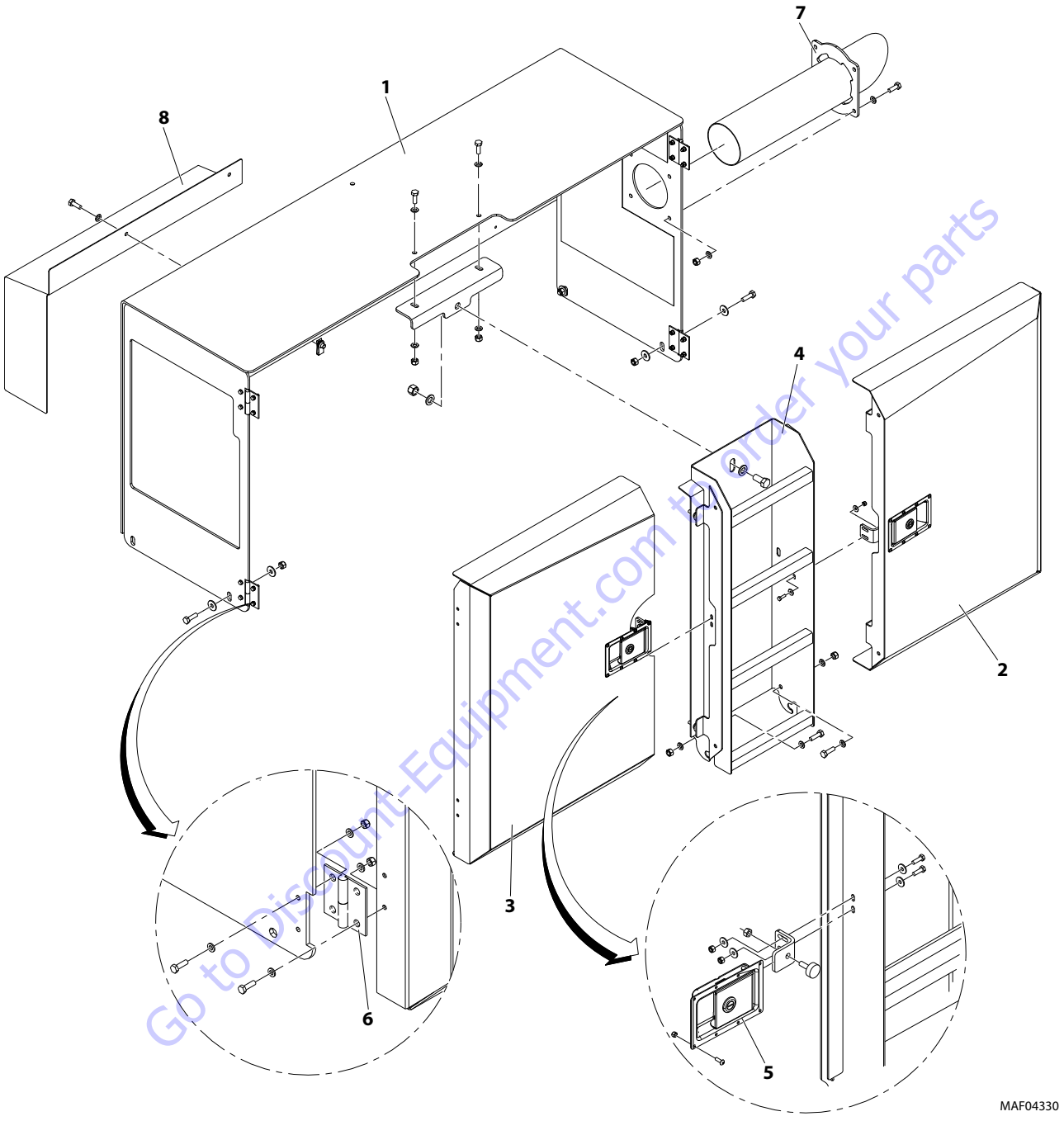


Figure 3-34. Left Side - Engine Compartment Covers

1. Engine Main Compartment Cover
2. Front Engine Door
3. Rear Engine Door
4. Ladder Assembly
5. Door Latch Assembly
6. Door Hinge Assembly
7. Engine Exhaust Tube
8. Generator Shield

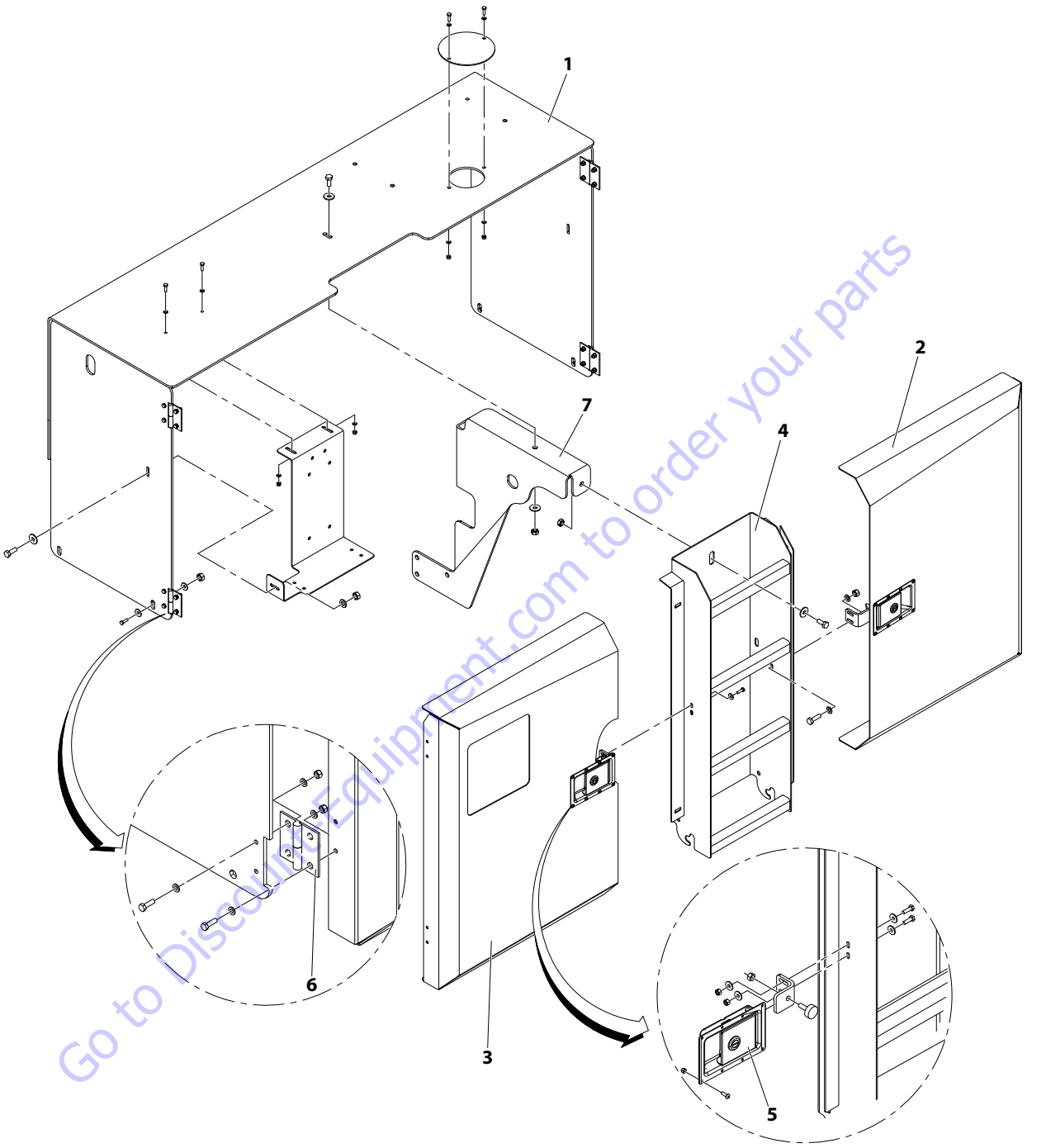


Figure 3-35. Right Side - Hydraulic/Fuel Compartment Covers

1. Hydraulic/Fuel Main Compartment Cover
2. Hydraulic Tank Door
3. Fuel Tank Door
4. Ladder Assembly
5. Door Latch Assembly
6. Door Hinge Assembly
7. Bracket Ladder Support

Cover Removal

NOTE: *Procedures apply to both left and right side compartment hoods.*

1. Elevate the platform to a height where, when removed and lifted, the compartment covers clear the underside of the platform. Engage the arm safety prop and/or block the scissor arms to prevent lowering.
2. Disable machine operation.
3. If removing the main compartment cover, the hinged cover and any outer covers/doors must be removed first.
4. Attach lifting straps to each end of the large compartment cover and support with an overhead lifting device.
5. Remove the bolts on the hinges to remove the door from the cover.
6. Remove the bolts and washers, from the front covers or doors, remove and lay aside.
7. Remove the ladder from the support bracket by removing the bolts, washers and nuts.
8. Remove the bolts and washers, from the front, top and back of the large compartment cover.

NOTE: *On engine side only, remove the exhaust pipe shield from the cover by removing the bolts, washers, and nuts.*

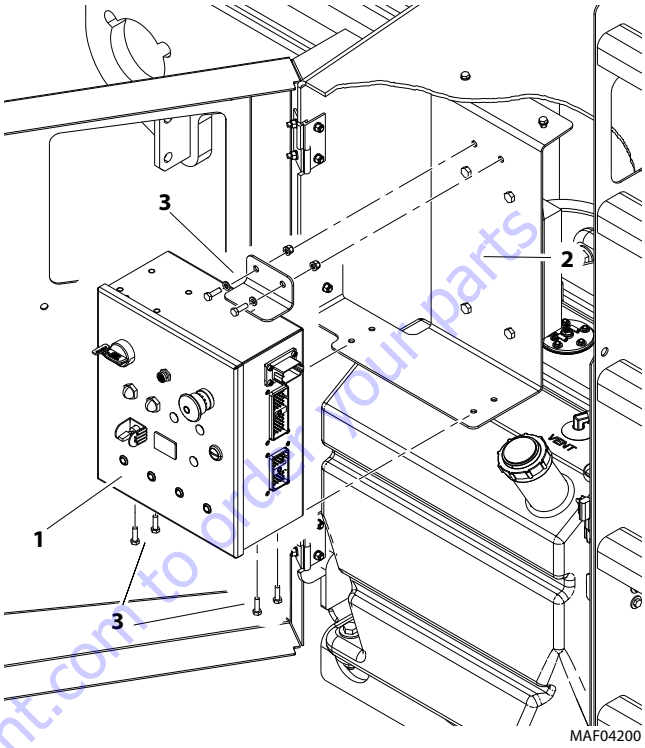
9. Carefully lift the main compartment cover up and away from the machine.

Cover installation

1. Follow Removal Steps in reverse.

3.10 GROUND CONTROL STATION

Control Station Removal



1. Ground Control Box
2. Control Box Mount
3. Mounting Bolts, Nuts and Washers

Figure 3-36. Ground Control Station Removal

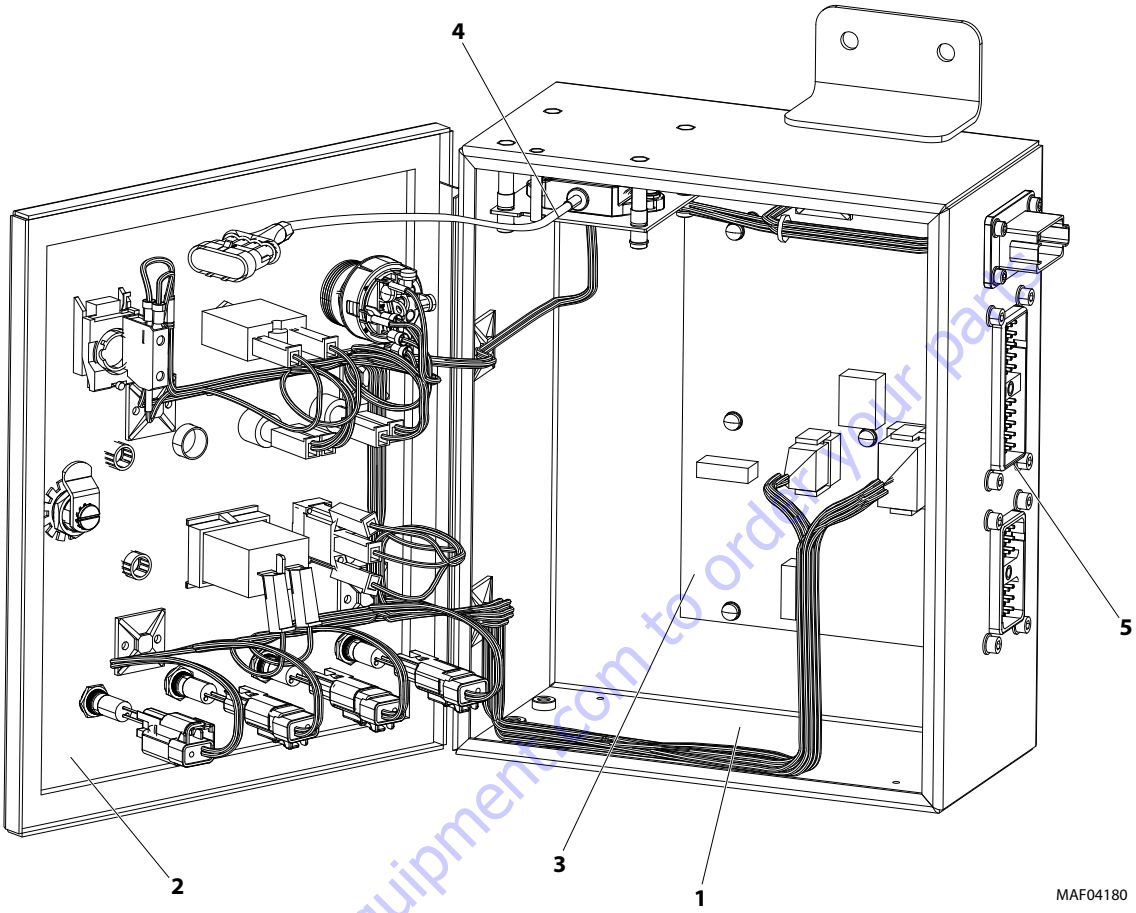
REMOVAL

1. Disconnect and label the harnesses from the ground control box (1).
2. Remove the ground control box from the control box mount (2) by removing the four lower and two upper bolts, nuts and washers (3).

INSTALLATION

1. Follow Removal Steps in reverse.

Ground Control Station Components



1. Ground Control Box
2. Lid
3. Circuit Board
4. Chassis Tilt Sensor
5. Machine Harness Connectors

DISASSEMBLY

1. Disconnect the harnesses from the ground control box (1).
2. Open the lid (2) to gain access to components inside the ground control box.
3. Disconnect any wires and/or plugs from damaged components (3 or 4).
4. Remove and replace components if necessary.

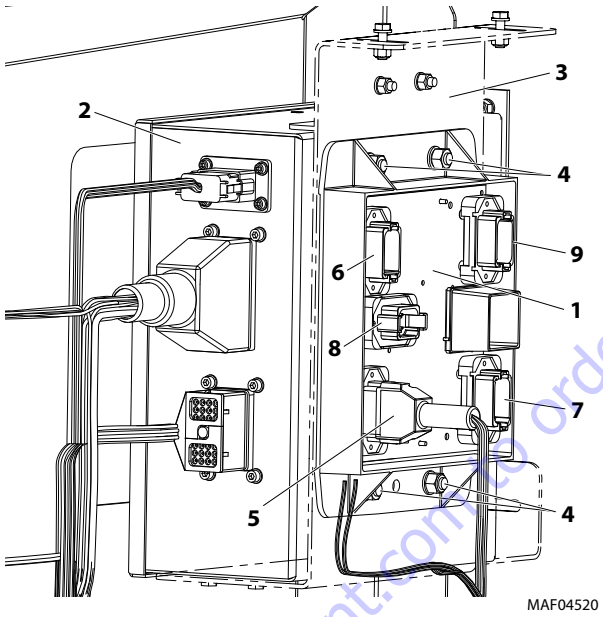
ASSEMBLY

1. Reattach any wires and/or plugs.
2. Close lid (2) and secure.
3. Reattach machine harnesses to the ground control box (5).

NOTE: *If Chassis tilt sensor or the ground control station box is remo.ved and replaced, the Chassis tilt sensor must be calibrated (refer to Section 5.4, Location Of Additional Sensors).*

Options Control Module

The Options Control Module provides additional machine harness connections for additional machine components such as the Leveling Jacks and LSS control system. If determined faulty, this module is only replaceable and not serviceable.



1. Option Control Module
2. Ground Control Station
3. Station/Module Mounting Plate
4. Module Mounting Bolts/Nuts/Washers
5. J1-Connector
6. J2-Connector
7. J3-Connector
8. J4-Connector
9. J5-Connector

Figure 3-37. Optional Control Module

REMOVAL

1. Tag and Disconnect the wiring harness(s) from the J-Connectors on the module.
2. Remove the four nuts and washers (4) from the mounting bolts.
3. Remove the module from the mounting plate.

INSTALLATION

1. Mount new module to the mounting plate using the four bolts, nuts and washers (4)
2. Reconnect the J-Connector wiring harness(s).
3. Power up machine and operate functions to check proper operation.

3.11 BATTERY

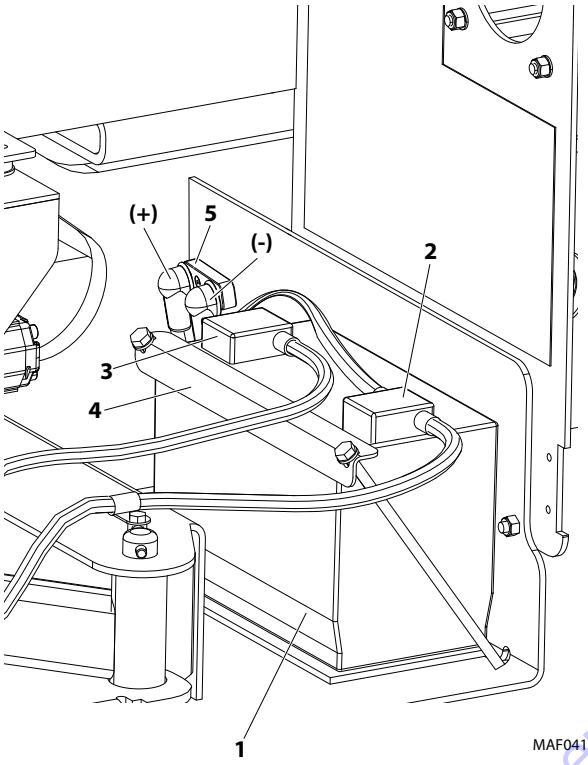


Figure 3-38. Battery Removal

1. Battery
2. Battery Terminal (-)
3. Battery Terminal (+)
4. Bracket, Bolt, Nut & Washers
5. Auxiliary Power Block

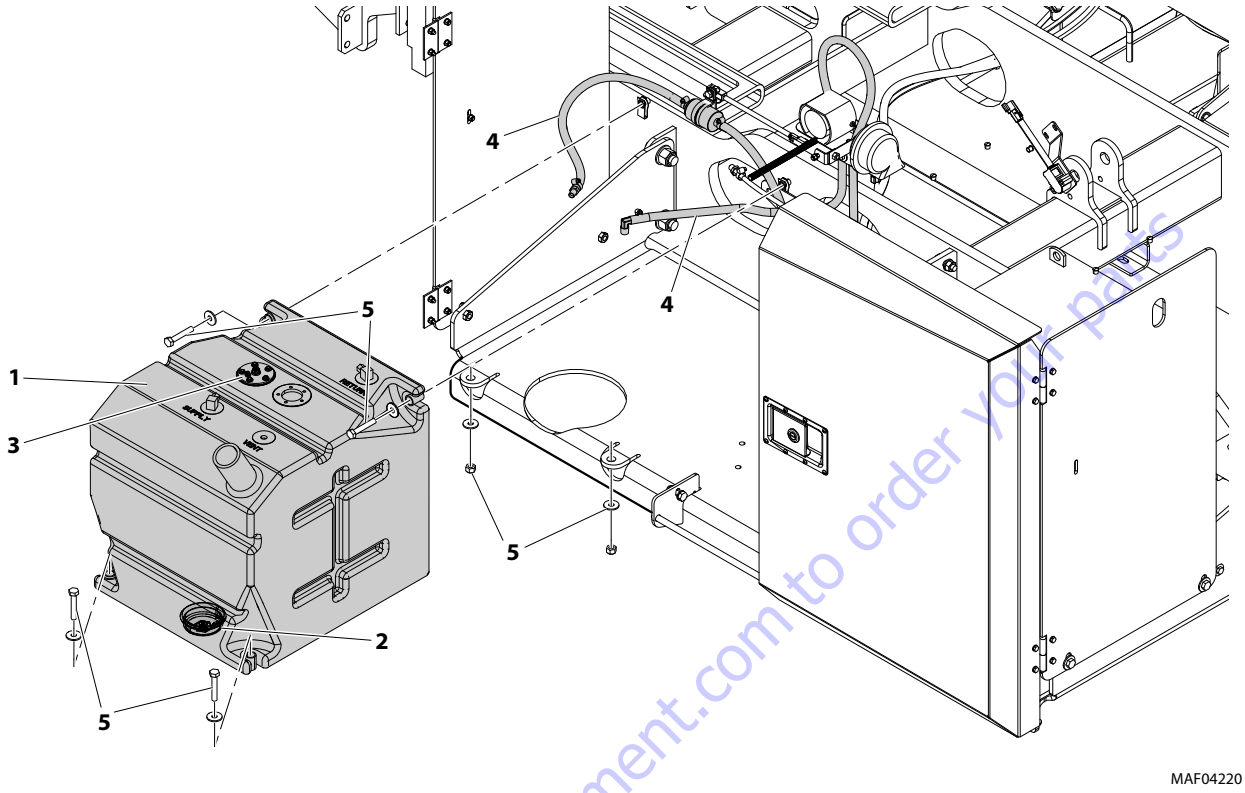
REMOVAL

1. Disconnect the red battery cable from the positive battery terminal (3).
2. Disconnect the black battery cable from the negative (2) battery terminal.
3. Remove the bolts, nuts, and washers to remove the hold-down bracket (4) securing the battery in place. Remove battery.
4. With the positive battery cable disconnected, if necessary, the auxiliary power block (5) can be removed by first disconnecting the cables from the block. Remove the bolts, washers and nuts securing the block to the machine compartment cover.

INSTALLATION

1. Place battery in the seat. Negative battery terminal (2) should be closest to outside of machine.
2. Secure battery in place with the hold-down bracket, bolt, nut and washers (4).
3. Reconnect red battery cable to positive battery terminal (3). Secure terminal cover in place over terminal.
4. Reconnect black battery cable to negative battery terminal (2).
5. If removed, secure auxiliary power block (5) to machine using two bolts, nuts and washers. Reconnect cables.

3.12 FUEL TANK



1. Fuel Tank
2. Tank Drain (on bottom of tank)
3. Tank Sending Unit
4. Fuel Feed/Return and Vent Lines
5. Tank Mounting Bolts/Nuts and Washers

Figure 3-39. Fuel Tank Installation

REMOVAL

NOTE: *Outer cabinet, ladder and door shown removed for illustrative clarity only.*

1. Disable machine operation.
2. Drain fuel from the fuel tank (1, 2). Store fuel in appropriate receptacle.
3. Disconnect and cap the fuel and vent lines (4) attached to the fuel tank.
4. Remove the bolts, washers and nuts (5) from the bottom front and top rear of the fuel tank.
5. Remove the fuel tank from the hydraulic compartment.
6. If necessary, remove the tank sending unit (3) from the tank.

INSTALLATION

1. Follow Removal Steps in reverse.

NOTE: *If removed, reuse or replace sending unit gasket, as necessary. Before reinstalling, apply Low Strength Threadlocking Compound to threads of tank sending unit bolts.*
If removed, before reinstalling into tank insert apply pipe sealant (High Strength Threadlocking compound) to fuel and vent line fittings on the fuel tank (1).
Apply (High Strength Threadlocking compound thread sealant) to threads of tank aluminum drain plug before installing. Do not over tighten.

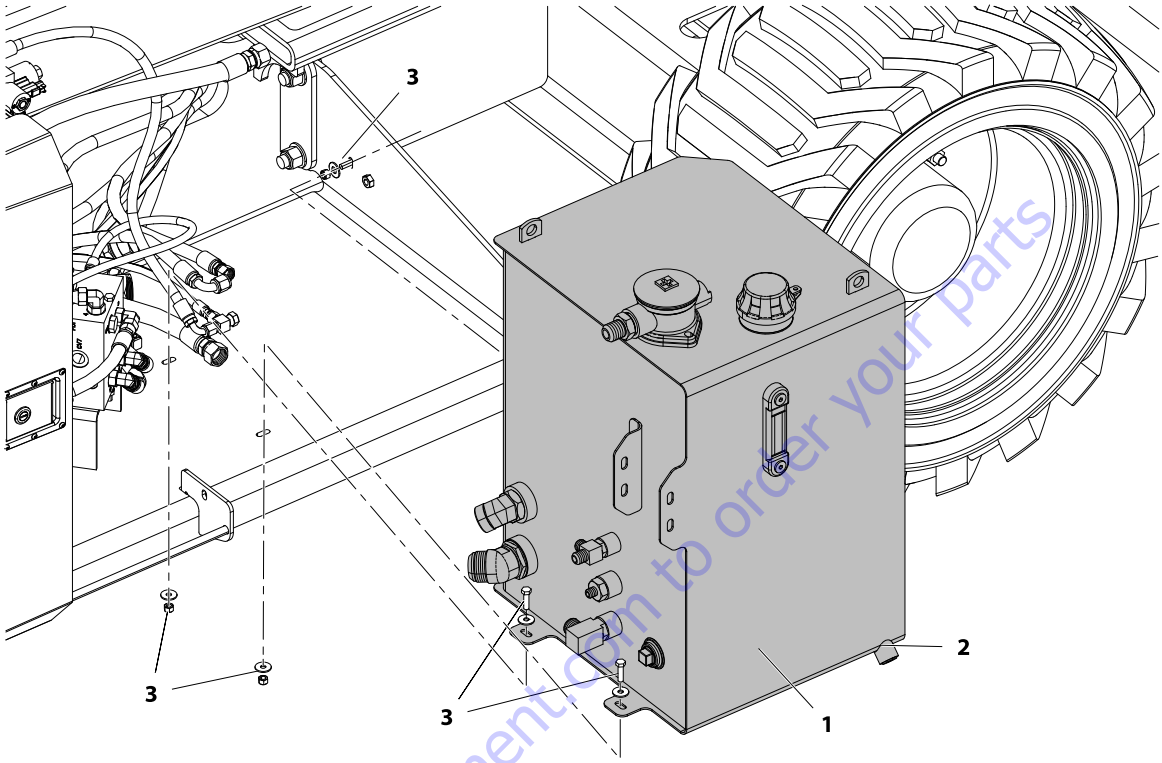
2. Refill fuel tank with proper fuel.

NOTICE

ENSURE PROPER FUEL LINES ARE ATTACHED TO PROPER FITTING ON FUEL TANK. FUEL TANK IS LABELED WITH RETURN LINE, SUPPLY LINE AND VENT LINE.

3. Ensure there is no fuel leakage.

3.13 HYDRAULIC TANK



1. Hydraulic Tank
2. Tank Drain
3. Tank Mounting Bolts/Nuts and Washers

Figure 3-40. Hydraulic Tank Removal

REMOVAL

NOTE: *It is recommended to remove the side compartment cover before attempting to remove the hydraulic tank (refer to Section 3.9, Side Compartment Covers).*

1. Disable machine operation.
2. Drain hydraulic fluid from hydraulic tank (1) by opening the drain plug (2). Store hydraulic fluid in appropriate receptacle.
3. Disconnect, cap and label all hoses connected to tank.
4. Remove the bolts, washers, and nuts (3) attaching the hydraulic tank to the machine. Remove tank from machine.

NOTE: *Hydraulic tank has two lifting lugs on the top corners for lifting.*
Empty tank weighs approximately 105 lb (47.6 kg).

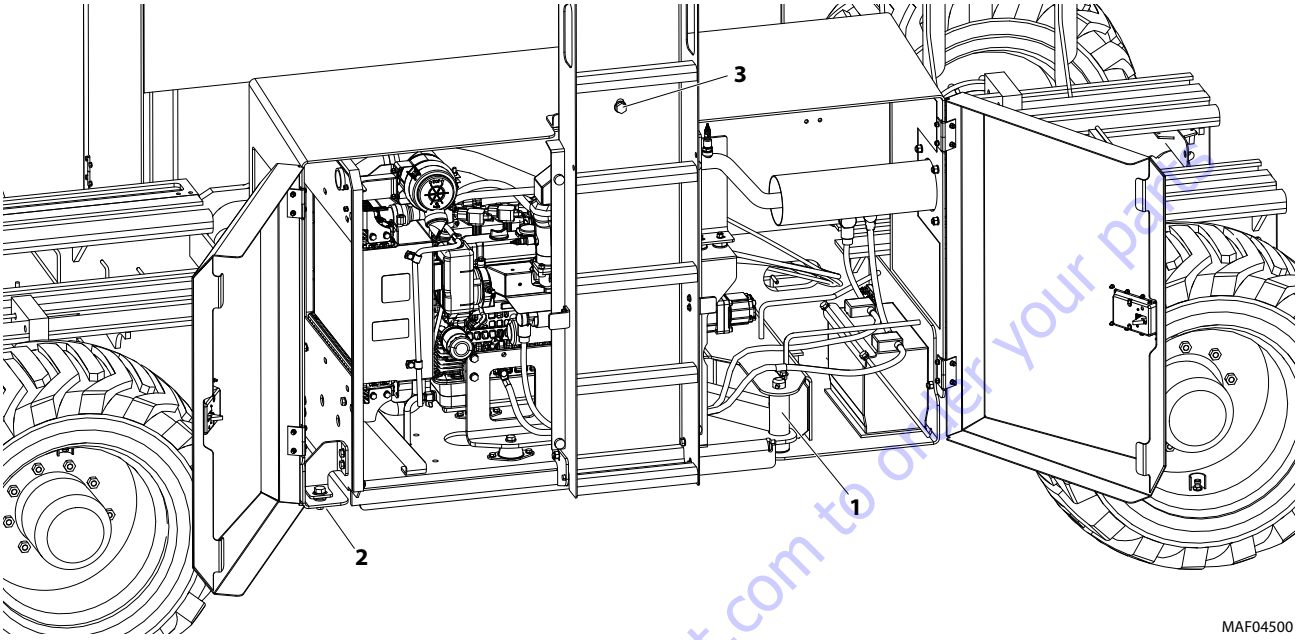
INSTALLATION

1. Follow Removal Steps in reverse.
2. Ensure drain plug (2) is tight. Refill hydraulic tank (1) with 34 gal (128.7 l) hydraulic fluid.

3.14 KUBOTA ENGINE

Engine Tray - Swing Out

NOTE: *When servicing components on the back side of the engine, remove the tray (2) and ladder (3), bolts, nuts and washers to swing the engine tray out for better access (as shown below).*



1. Tray Pivot Pin
2. Tray to Frame - Bolt, Nut and Washer
3. Ladder To Cabinet - Bolt, Nut, and Washer

Figure 3-41. Engine Swing Out Tray Components

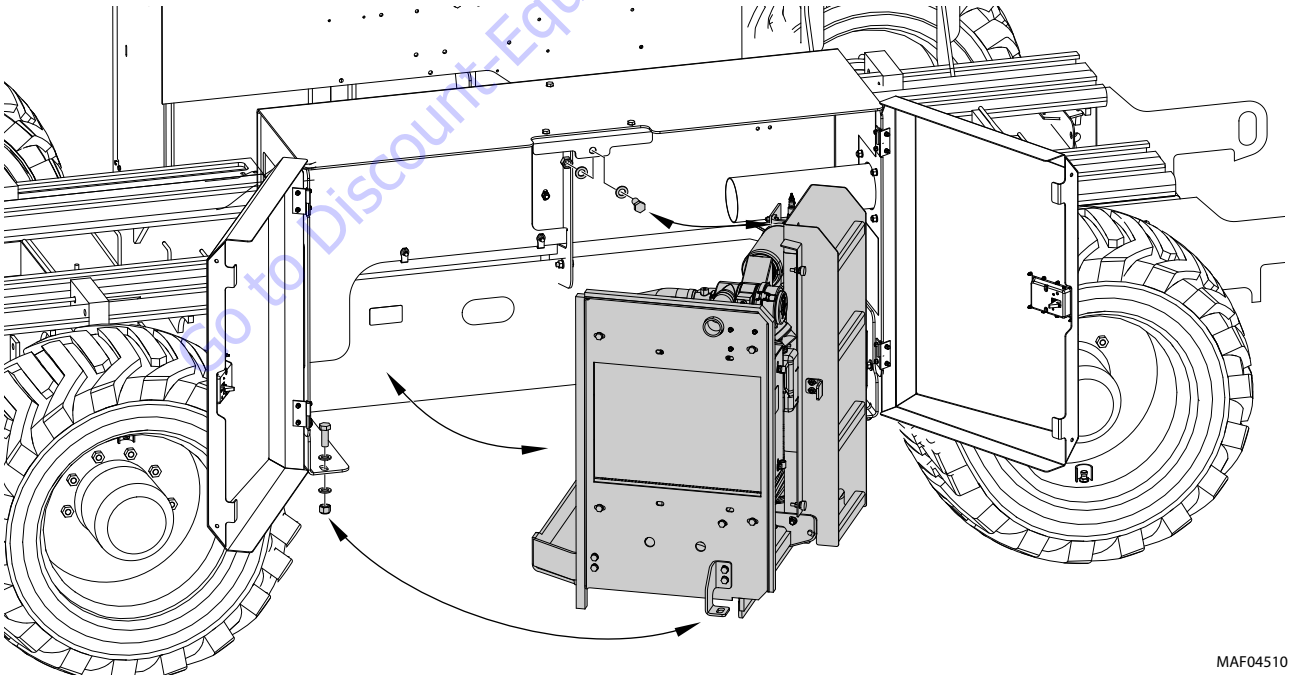
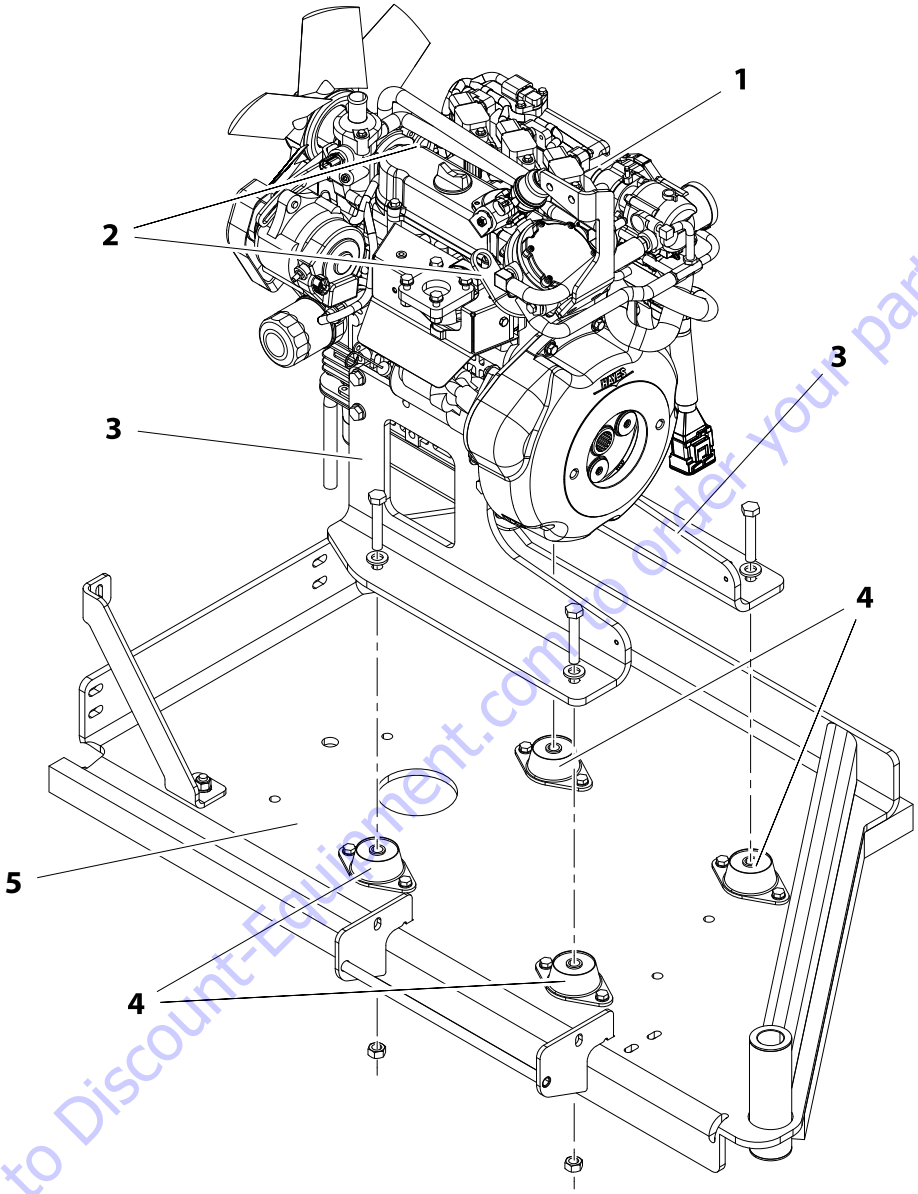


Figure 3-42. Engine Tray In Swing Out Position

Engine Removal



1. Kubota Engine
2. Engine Lifting Lugs
3. Left/Right Side Engine Mounting Brackets
4. Engine Isolator Mount
5. Swinging Engine Tray

Figure 3-43. Engine Removal (All Engines)

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

REMOVAL

1. Disable machine operation. Disconnect battery positive (+) terminal. Swing engine tray (5) out for access to both sides of engine.
2. Remove platform ladder and brackets, exhaust system, air cleaner system, hydraulic pumps and radiator cooling system, as necessary.
3. Disconnect, cap and label all hoses connected to engine (1). Disconnect and label all electrical wiring connected to engine.
4. Using the lifting lugs (2) at the front and rear corners of the engine, support engine (1) with lifting device capable of lifting 500 lb (227 kg) (refer to engine manual for proper lifting information).
5. Remove the four large bolts, nuts, and washers securing the left/right side engine mounting brackets (3) to the isolator mounts (4) and tray.
6. Slowly lift the engine up and out of the engine compartment.

NOTICE

IF NOT REMOVED, BE CAREFUL NOT TO DAMAGE THE RADIATOR FAN ON THE RADIATOR HOUSING WHEN LIFTING THE ENGINE.

INSTALLATION

1. Follow Removal Steps in reverse.

Apply Medium Strength Threadlocking Compound to the engine mount bolts.

Dual Fuel/LPG System

⚠ CAUTION

IT IS POSSIBLE TO SWITCH FROM ONE FUEL SOURCE TO THE OTHER WITHOUT ALLOWING THE ENGINE TO STOP. THE FOLLOWING INSTRUCTIONS MUST BE FOLLOWED.

Changing From Gasoline to LP Gas

NOTE: *Before climbing onto the platform, open hand valve on LP gas supply tank by turning valve counterclockwise.*

1. Start engine from platform control station.
2. While engine is operating, place the dual fuel switch at platform control station to the LPG position. Allow engine to operate, without load, until engine begins to "stumble" from lack of gasoline. At this time the machine is allowing the LP fuel to be sent to the fuel regulator.

Changing From LP Gas to Gasoline

1. With engine operating on LP under a no-load condition, throw LPG/GASOLINE switch at platform control station to GASOLINE position.
2. If engine "stumbles" because of lack of gasoline, place switch to LPG position until engine regains smoothness, then return switch to GASOLINE position.
3. Close hand valve on LP gas supply by turning clockwise.

Using Liquid Petroleum (LP) Gas

⚠ WARNING

CLOSE FUEL VALVE ON TANK WHEN PARKING SCISSOR LIFT MORE THAN MOMENTARILY.

WHEN REFUELING LPG POWERED SCISSOR LIFTS, ALWAYS FOLLOW MANUFACTURERS SPECIFICATIONS AND/OR APPLICABLE REGULATIONS.

1. If machine is to be left overnight or longer, it must be parked outside or the LPG tank removed and stored outside.
2. LPG is extremely flammable. No smoking.
3. Only trained and authorized personnel are permitted to operate filling equipment.
4. Fill LPG tanks outdoors. Stay at least 50 ft (15 m) from buildings, motor vehicles, electrical equipment or other ignition sources. Stay at least 15 ft (5 m) from LPG storage tanks.
5. During transfer of LPG, metal components can become very cold. Always wear gloves when refilling or changing tanks to prevent “freeze burns” to skin.
6. Do not store LPG tanks near heat or open flame. For complete instructions on the storage of LPG fuels, refer to ANSI/NFPA 58 & 505 or applicable standards.

⚠ WARNING

DO NOT USE AN LPG TANK THAT IS DAMAGED. A DAMAGED TANK MUST BE REMOVED FROM SERVICE. FROST ON THE SURFACE OF A TANK, VALVES, OR FITTINGS INDICATES LEAKAGE. A STRONG ODOR OF LPG FUEL CAN INDICATE A LEAK.

Propane Fuel System Pressure Relief

⚠ CAUTION

THE PROPANE FUEL SYSTEM OPERATES AT PRESSURES UP TO 312 PSI (21.5 BAR). TO MINIMIZE THE RISK OF FIRE AND PERSONAL INJURY, RELIEVE THE PROPANE FUEL SYSTEM PRESSURE (WHERE APPLICABLE) BEFORE SERVICING THE PROPANE FUEL SYSTEM COMPONENTS.

To relieve propane fuel system pressure:

1. Close the manual shut-off valve on the propane fuel tank.
2. Start and run the vehicle until the engine stalls.
3. Turn the ignition switch OFF.

⚠ CAUTION

RESIDUAL VAPOR PRESSURE WILL BE PRESENT IN THE FUEL SYSTEM. ENSURE THE WORK AREA IS WELL VENTILATED BEFORE DISCONNECTING ANY FUEL LINE.

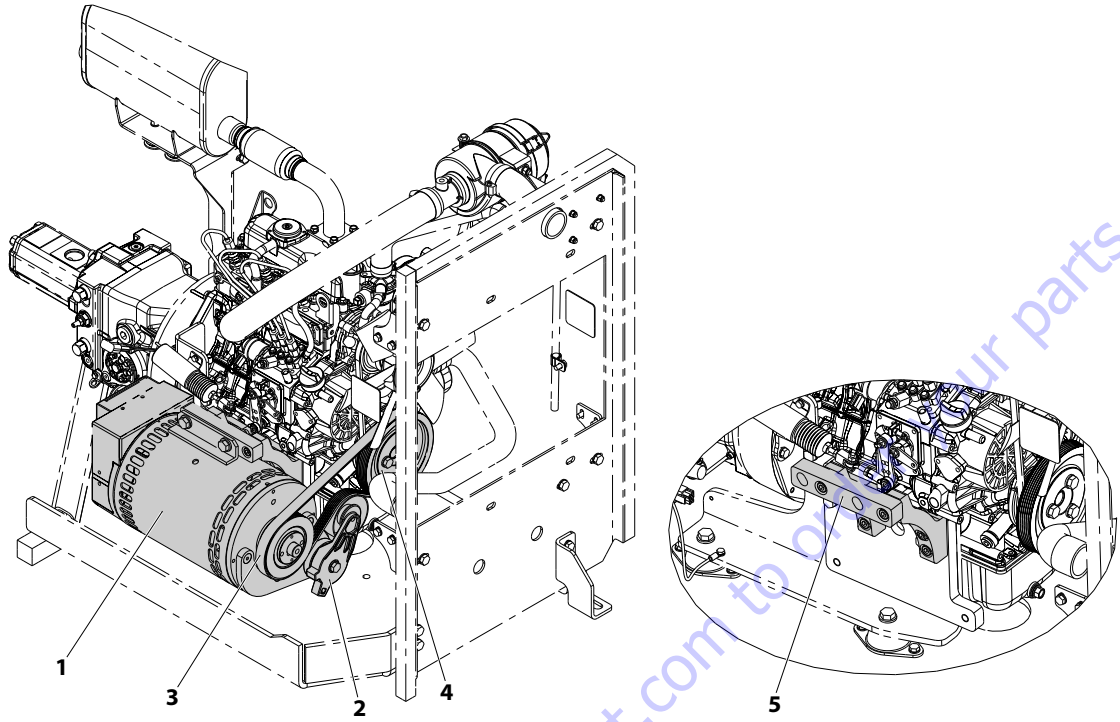
Propane Fuel System Leak Test

⚠ CAUTION

NEVER USE AN OPEN FLAME OF ANY TYPE TO CHECK FOR PROPANE FUEL SYSTEM LEAKS.

Always inspect the propane fuel system for leaks after performing service. Check for leaks at the fittings of the serviced or replaced component. Use a commercially available liquid leak detector or an electronic leak detector. When using both methods, use the electronic leak detector first to avoid contamination by the liquid leak detector.

Generator (if equipped)



1. Generator
2. Belt Tensioner
3. Drive Belt
4. Drive Pulley
5. Bracket Assembly

Figure 3-44. AC Generator Installation

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

REMOVAL

1. Disable machine operation. Rotate engine tray to access back of engine.
2. Disconnect and label electrical wires attached to generator (1).
3. Remove drive belt tension using the belt tensioner and remove belt from generator pulley.
4. Remove the generator from the engine by removing the two upper bracket (5) bolts, nuts, and washers. And the lower pivot, belt tensioner bolt, nut, and washer.
5. Replace belt if damaged.

INSTALLATION

1. Follow Removal Steps in reverse. Ensure belt is tight before securing generator with the bolts.

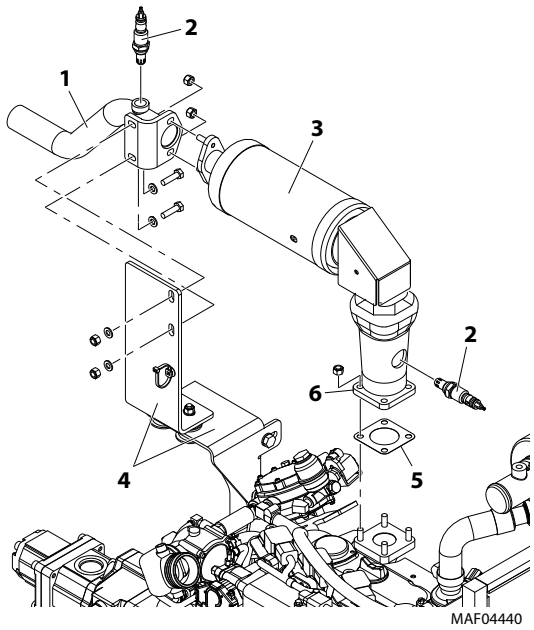
NOTE: *Apply Medium Strength Threadlocking Compound to the threads of the generator mounting bolts.*

Table 3-11. AC Generator Specifications

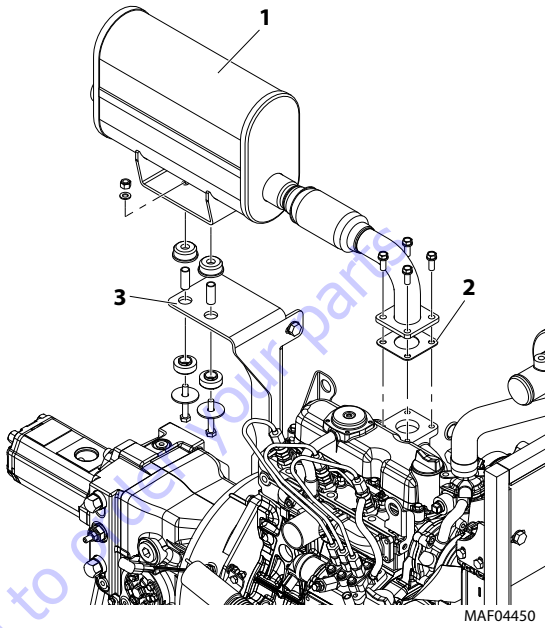
DESCRIPTION	7500 KW	4000 KW
Voltage	120/240V AC±10%	120/240 V AC±10% - 60Hz 110/230V AC±5% - 50Hz
Continuous	7.5 KW - 240V - 3 Phase 6.0 KW - 240V - 1 Phase 6.0 KW - 120V - 1 Phase	4.0 KW - 1 Phase
Peak	8.5 KW - 3 Phase 6.0 KW - 1 Phase	4.0 KW
Amps Peak	18.3 Amps - 3 Phase 26 Amps - 1 Phase 50 Amps - 1 Phase	20 Amps

NOTE: *The generator control box is mounted on the rear wall of the Hydraulic/Fuel Tank cabinet just behind the ground control station.*
The platform junction box is mounted under the platform deck on the Hydraulic/Fuel Tank cabinet side of the machine.
See Section 6, Electrical Schematics generator electrical configuration.

Exhaust System



Dual Fuel - Gas/LPG



Diesel

Figure 3-45. Exhaust System (Kubota Engine)

1. Tail Pipe
2. O2 Sensor
3. Muffler
4. Mounting Bracket
5. Gasket
6. Exhaust Pipe

1. Muffler
2. Gasket
3. Mounting Bracket

Dual Fuel - Gas/lpg

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

REMOVAL

1. Disable machine operation.
2. Disconnect the O2 Sensor (2) wiring. Disassemble the tail pipe (1) from the muffler (3) by removing the two attaching bolts, washers, nuts, and gasket.
3. Disassemble the muffler (3) from the exhaust pipe (6) removing by the four attaching bolts, nuts, washers and gasket. Also remove the two bolts and washers attaching the muffler to the mounting bracket (4).
4. Disconnect the O2 Sensor (2) wiring. Disassemble the exhaust pipe (6) from the engine exhaust manifold by removing the four bolts, nuts, washers and gasket at the exhaust manifold.

INSTALLATION

1. Follow Removal Steps in reverse.

NOTE: *Torque on O2 Sensors is 32±3.6 ft. lb. (44±4.9 Nm).*

Diesel

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

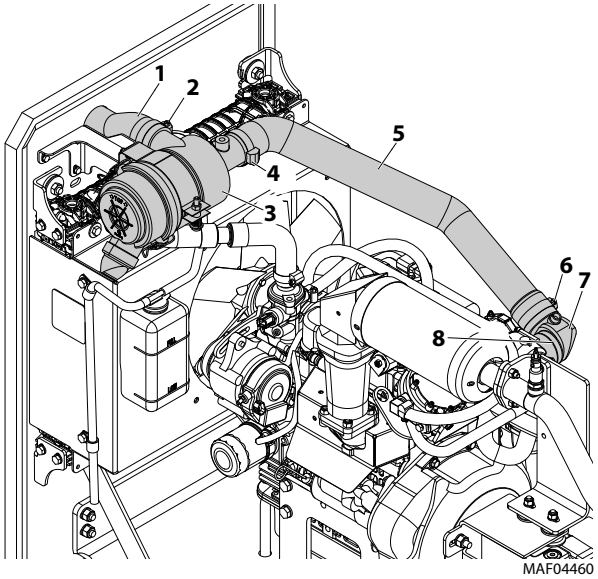
REMOVAL

1. Disable machine operation.
2. Unbolt the muffler (1) from the mounting bracket (3), by removing the bolts, nuts, and washers from the rubber isolating mounts.
3. Disassemble the muffler (1) from the exhaust manifold by removing the four bolts, washers, and gasket (2) attaching it to the manifold.

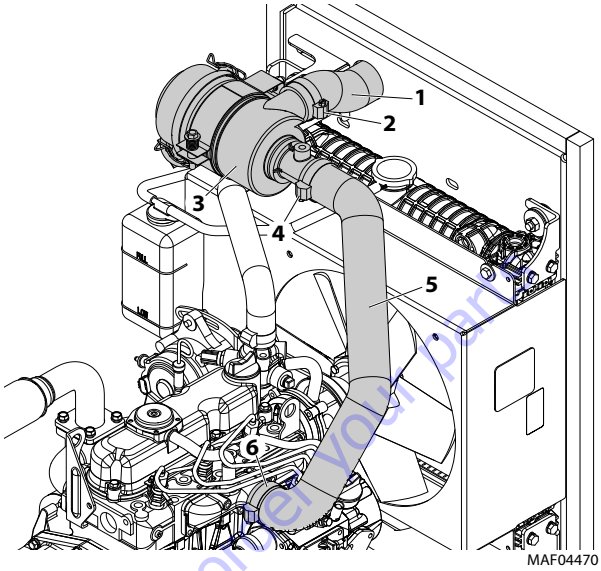
INSTALLATION

1. Follow Removal Steps in reverse.

Air Cleaner System



Dual Fuel - Gas/LPG



Diesel

Figure 3-46. Air Cleaner System (Kobota Engine)

1. Inlet Hose
2. Clamp
3. Air Cleaner Assy.
4. Clamp
5. Intake Pipe
6. Clamp
7. 90° Elbow
8. Clamp

1. Inlet Hose
2. Clamp
3. Air Cleaner Assy.
4. Clamp
5. Intake Pipe
6. Clamp

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

REMOVAL

1. Disable machine operation. If necessary, swing engine tray out for better access to components.
2. Loosen the clamp (4) and (8) attaching the intake pipe to the air cleaner assembly (3) and engine intake manifold. Disconnect the intake pipe from the air cleaner assembly and remove the complete intake pipe from the engine assembly.
3. To remove the air cleaner assembly (3) from the air cleaner bracket clamp, Unscrew the main clamp screw on the clamp until the air cleaner is loose in the bracket. Release the latches on the end and remove the end cap from the air cleaner assembly. Slide the air cleaner assembly with inlet hose out of the bracket clamp.

NOTE: *The filter element can be removed from the air cleaner by releasing the latches on the end of the air cleaner. Replace filter element as needed. See Section 1.8, Service Maintenance,*

INSTALLATION

1. Follow Removal Steps in reverse.

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

REMOVAL

1. Disable machine operation. If necessary, swing engine tray out for better access to components.
2. Loosen the clamp (4) and (6) attaching the intake pipe to the air cleaner assembly (3) and engine intake manifold. Disconnect the intake pipe from the air cleaner assembly and remove the complete intake pipe from the engine assembly.
3. To remove the air cleaner assembly (3) from the air cleaner bracket clamp, Unscrew the main clamp screw on the clamp until the air cleaner is loose in the bracket. Release the latches on the end and remove the end cap from the air cleaner assembly. Slide the air cleaner assembly with inlet hose out of the bracket clamp.

NOTE: *The filter element can be removed from the air cleaner by releasing the latches on the end of the air cleaner. Replace filter element as needed. See Section 1.8, Service Maintenance,*

INSTALLATION

1. Follow Removal Steps in reverse.

Radiator

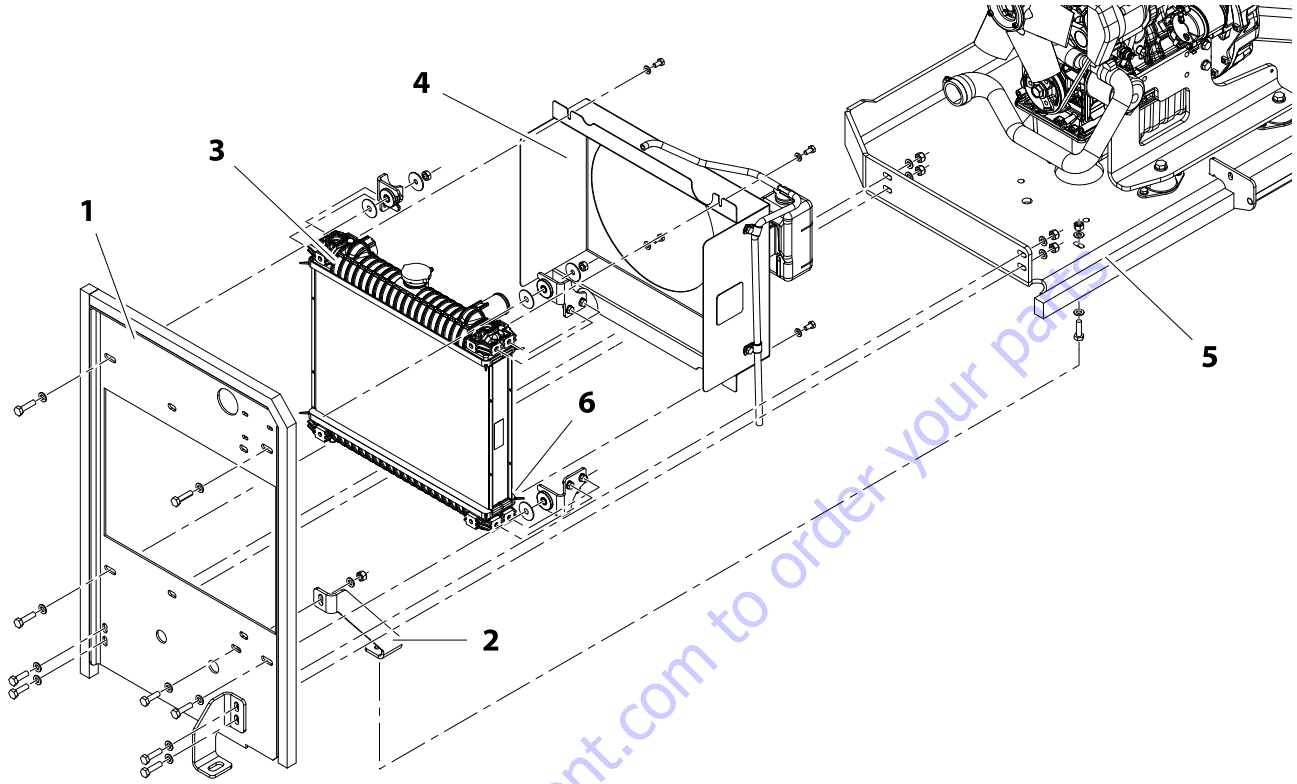


Figure 3-47. Radiator Installation (All Engines)

1. Radiator Mounting Plate
2. Mounting Plate Lower Support
3. Radiator Assembly
4. Fan Shroud Assembly
5. Engine Tray
6. Radiator Petcock Location

⚠ WARNING

ALLOW RADIATOR TO COOL DOWN BEFORE SERVICING.

REMOVAL

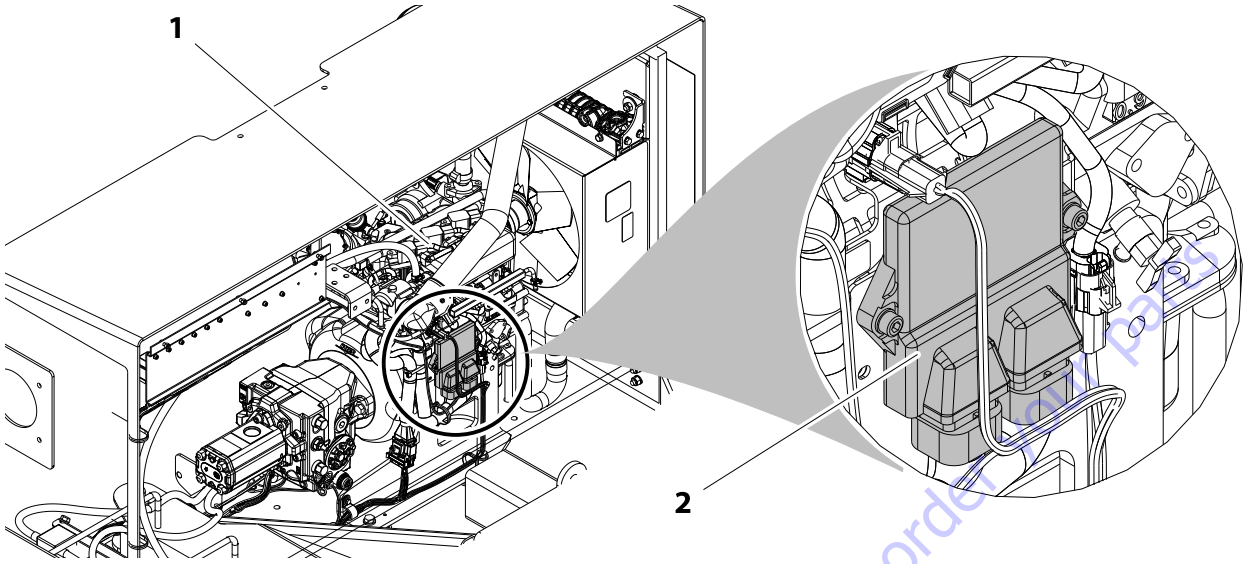
1. Disable machine operation. Swing engine tray out for better access to components.
2. Drain the coolant from the radiator into a suitable container by opening the petcock (6) on the bottom left corner of the radiator.
3. Disconnect the:
   - upper and lower radiator hoses from the radiator.
   - if necessary remove the air cleaner or disconnect the intake pipe hose connector at the radiator mounting plate
4. Support the radiator mounting plate assembly (1) and remove the four large bolts holding the mounting plate to the engine swivel tray (4), and the lower support bracket (2)
5. Re-check that all connections, hoses, etc. are disconnected and remove complete radiator mounting plate (1) assembly from the engine tray.
6. Dissemble the radiator shroud (3), and radiator assembly (2) from the radiator mounting plate assembly (1).

INSTALLATION

1. Follow Removal Steps in reverse.

NOTE: *Refill with fresh clean coolant properly balanced.*

Engine Electrical Component Locations



1. Dual Fuel Engine
2. ECM Module

Figure 3-48. Duel Fuel Engine - Control Module Location

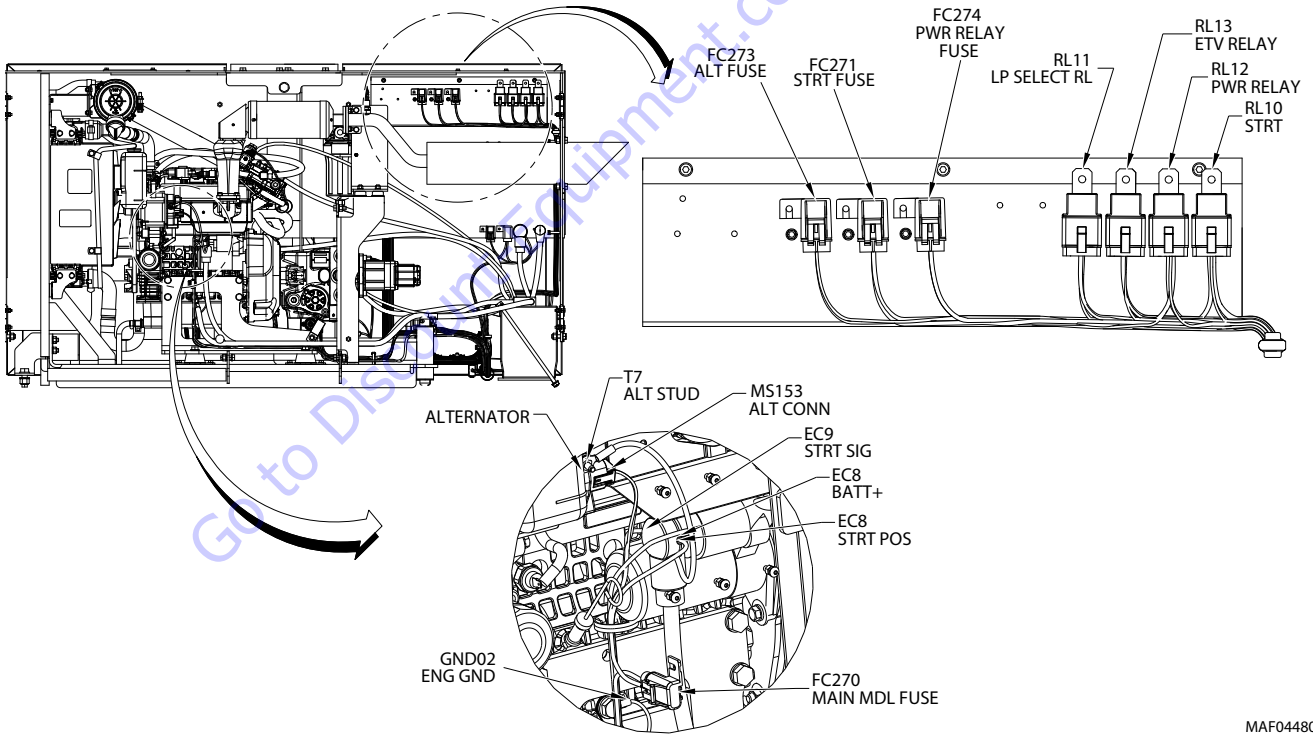


Figure 3-49. Duel Fuel Engine Compartment - Electrical Component Locations

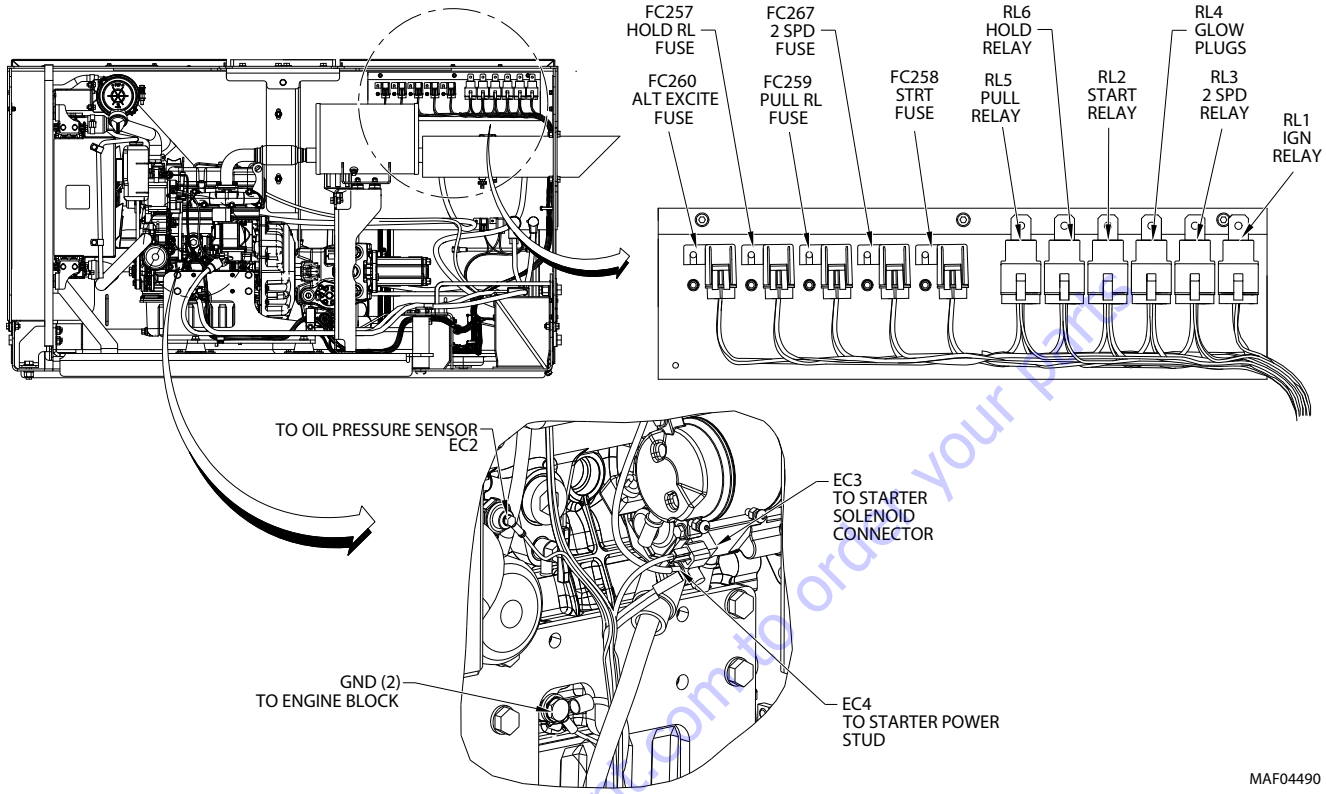
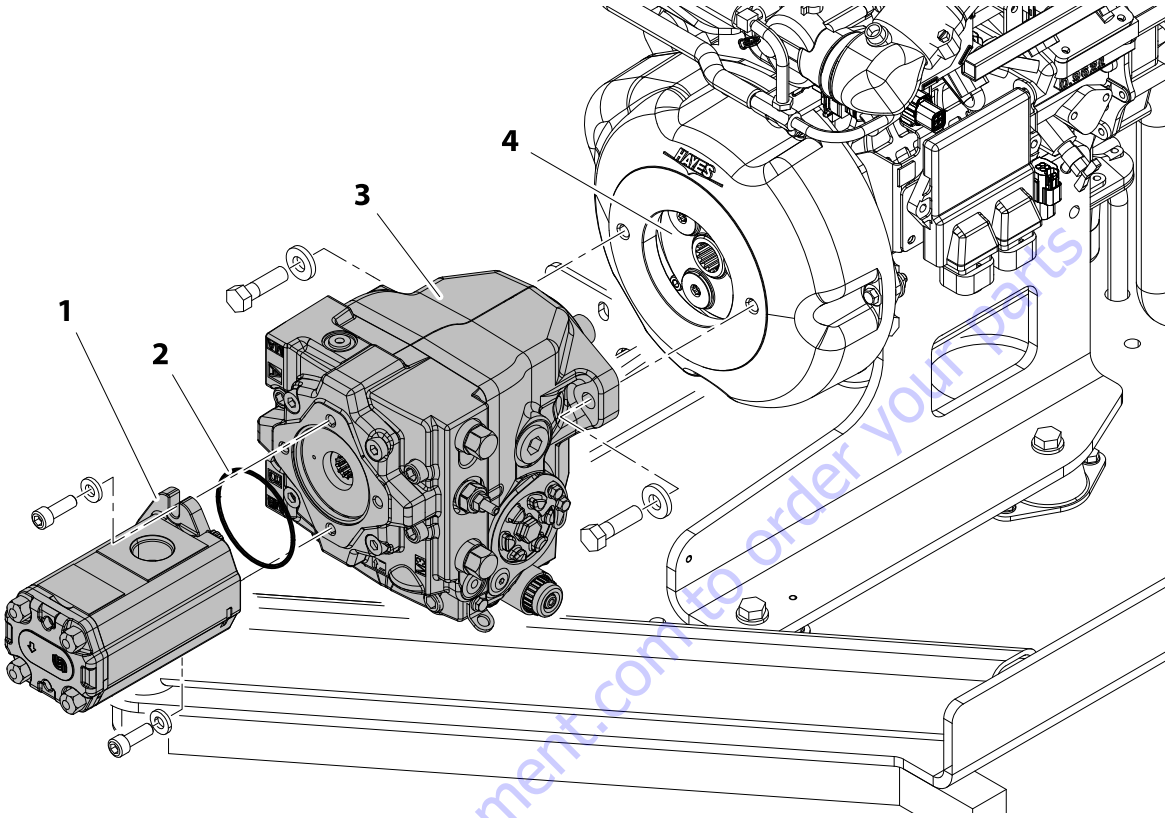


Figure 3-50. Diesel Engine Compartment - Electrical Component Locations (CE)

Hydraulic Pump Installation



1. Tandem Gear Pump
2. O-Ring
3. Axial Hi 45 Pump
4. Pump Coupling

Figure 3-51. Hydraulic Pump Assembly

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

REMOVAL

1. Disable machine operation. Disconnect, cap and label all hydraulic hoses connected to pumps (1, 3). Disconnect and label all wiring connected to pumps.
2. Remove the two bolts and washers attaching the gear pump (1) to the axial pump (3). Carefully remove the gear pump.
3. Remove and discard the o-ring (2).
4. Remove the two bolts and washers attaching the axial pump (3) to the coupling (4) of the motor. Carefully remove the axial pump.

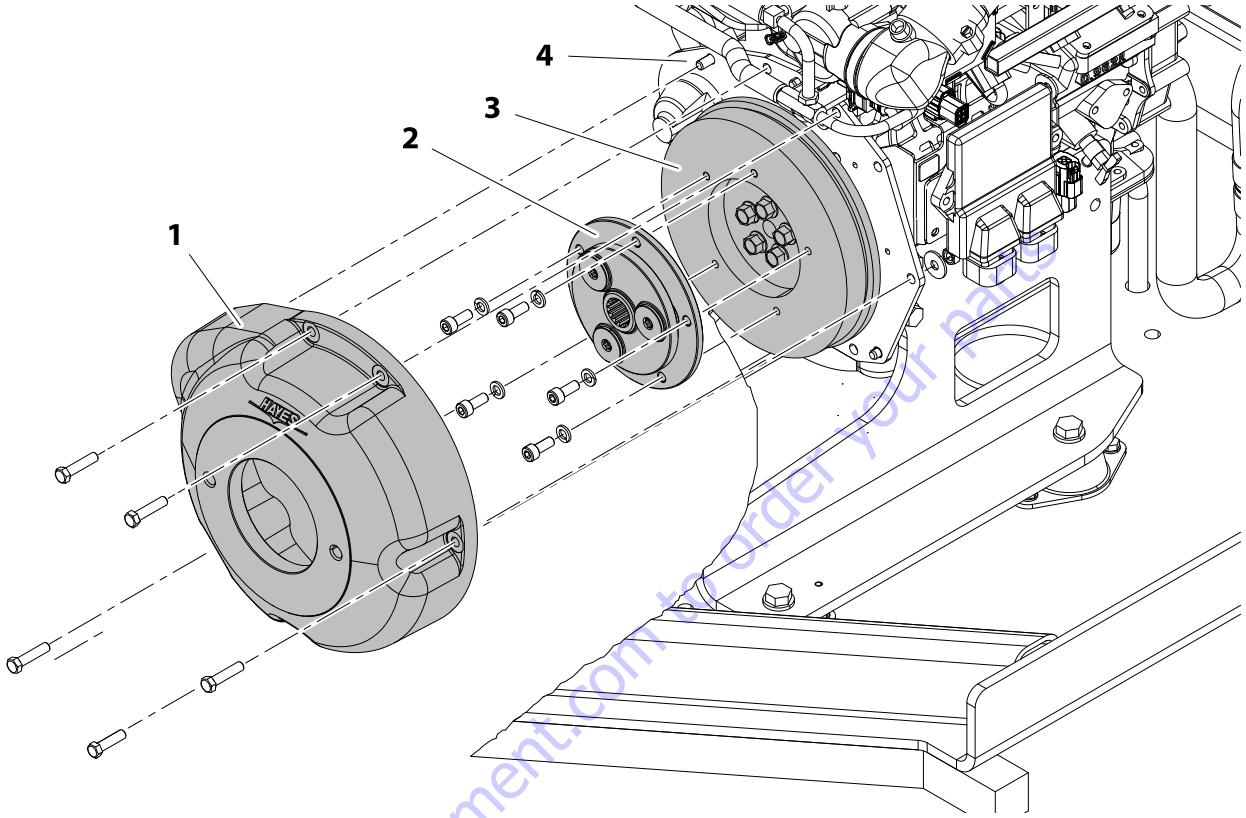
INSTALLATION

1. Follow Removal Steps in reverse.

NOTE: *Apply grease to internal splines of pump coupling (1) and external splines of axial pump (3) shaft prior to installing pump.*
Install a new o-ring (2) during installation.
Apply Medium Strength Threadlocking Compound to bolts.
Torque mounting bolts to 50 - 55 ft. lb. (68 - 75 Nm) for axial pump (3).

NOTE: *Refer to Section 4.10, Gear Pump and Section 4.11, Axial HI 45 Pump for more information on pumps.*

Pump Coupling Assembly



1. Coupler Housing
2. Pump Coupler
3. Engine Flywheel/Coupler Mounting Plate
4. Starter Bolts

Figure 3-52. Pump Coupling Assembly (All Engines)

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

REMOVAL

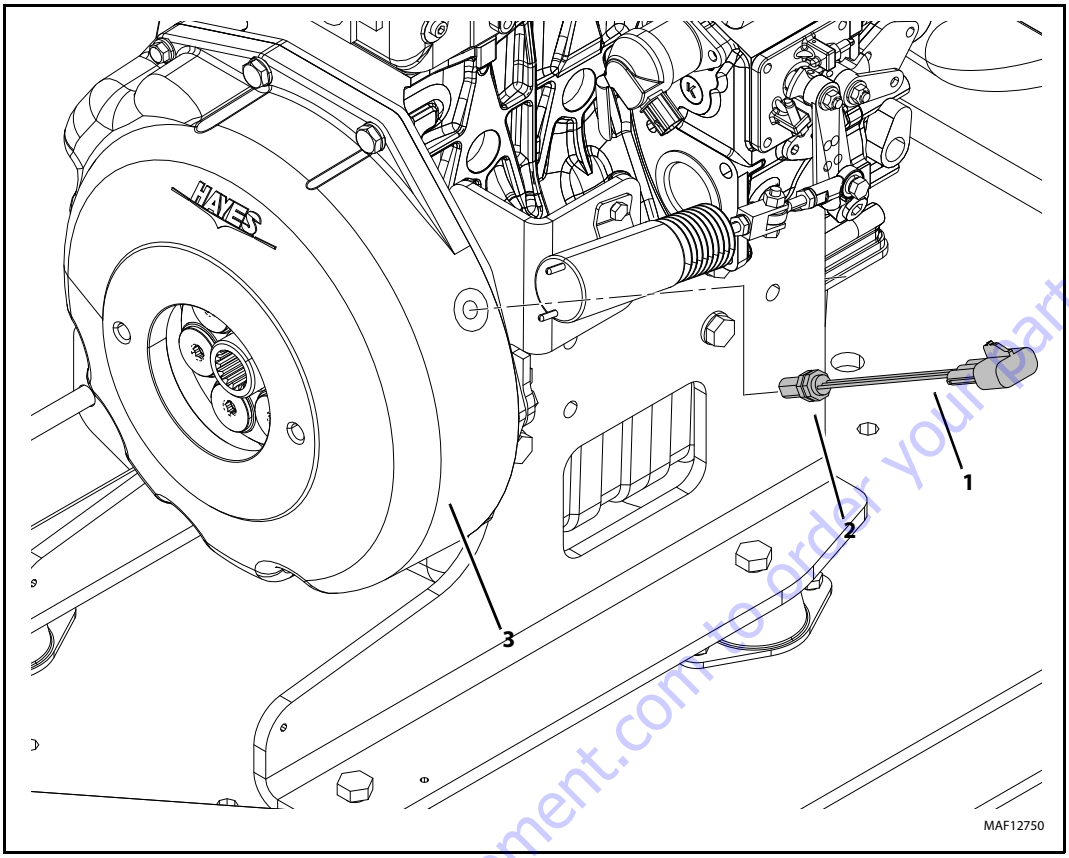
1. Disable machine operation. Disconnect the battery positive (+) terminal.
2. Remove exhaust system and pump assemblies, as necessary.
3. Remove the five bolts, washers and nuts, plus the two starter bolts holding the coupler housing (1) to the engine block plate. Support starter, do not hang by electrical wiring. Remove the coupler housing 1).
4. Remove the five pump coupler bolts to remove the pump coupling from the engine flywheel/mounting plate (3). Remove coupling plate (2).

INSTALLATION

1. Follow Removal Steps in reverse.

NOTE: *Apply Medium strength Threadlocking compound to bolts.*
Torque coupling to flywheel bolts to 20 - 25 ft. lb. (27.1 - 33.8 Nm).
Torque coupler housing to engine bolts to 13 - 15 ft. lb. (17.6 - 20.3 Nm).

Engine Speed Sensor (Kubota Diesel Engine)



1. Speed Sensor
2. Nut
3. Coupler Housing

Figure 3-53. Engine Speed Sensor Installation

⚠ CAUTION

ALLOW ENGINE AND COMPONENTS TO COOL DOWN BEFORE SERVICING.

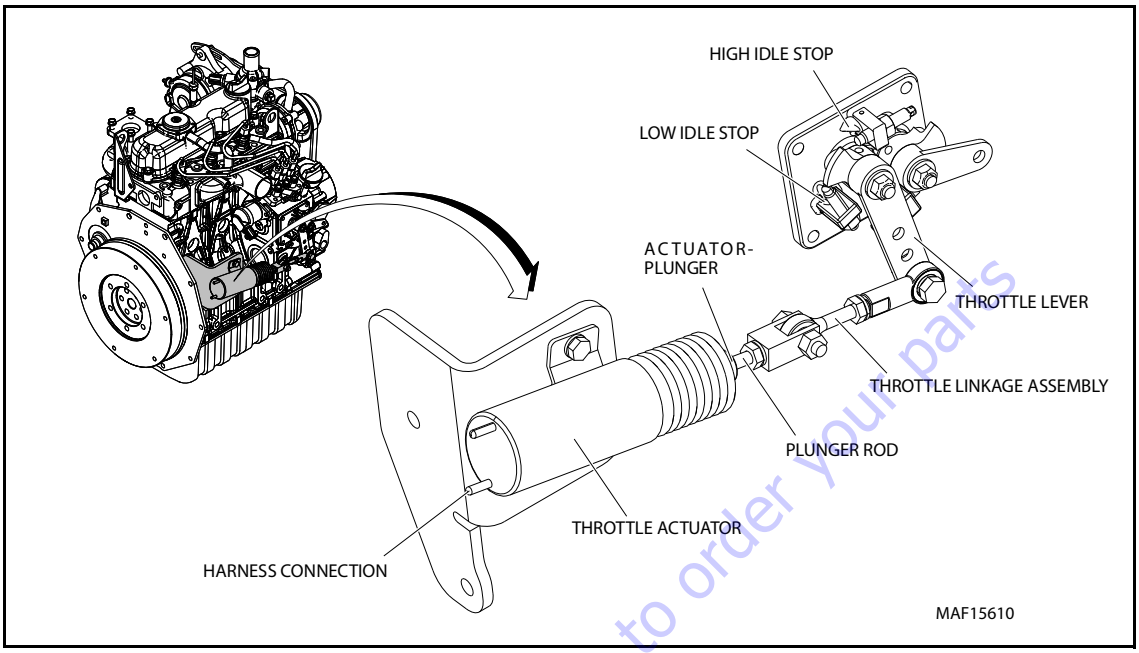
REMOVAL

1. Park the machine on firm and level surface.
2. Shut the engine OFF and disconnect the battery power from the machine.
3. Open Engine side compartment doors and disconnect ground wire from battery.
4. Swing out the engine tray by removing the hardware at the following locations: engine tray stay bracket, top ladder bolt.
5. Loosen the nut (2) on the engine sensor and remove the engine speed sensor (1) from the Coupler Housing (3).

INSTALLATION

1. Install engine speed sensor (1) into the coupler housing (3) until the sensor contact the flywheel.
2. Back out the engine speed sensor (1) by hand, 0.5 to 1 turns. Ensure the flats on the engine speed sensor are vertical.
3. Tighten the nut on the speed sensor (2) using a spanner to the required torque specification (106 in. lbs (12 Nm)).
4. Swing engine tray back into position by installing the hardware at the following locations: engine tray stay bracket, top ladder bolt.
5. Reconnect ground wire to battery terminal and close engine side compartment doors.

Throttle Actuator Adjustment



NOTE: *Illustration shows actuator in de-energized state.*

Figure 3-54. Throttle Assembly and Linkages

Air Gap Setting

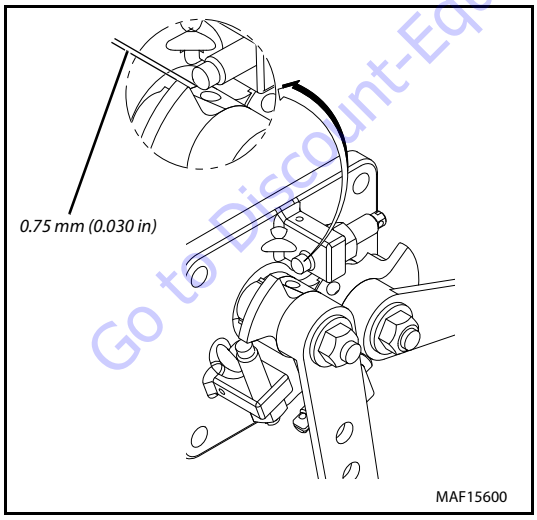


Figure 3-55. Air Gap Setting

AIR GAP SETTING PROCEDURE

1. The distance between the throttle arm and the high idle stop must be 0.75 mm (0.030 in) when the actuator is energized.

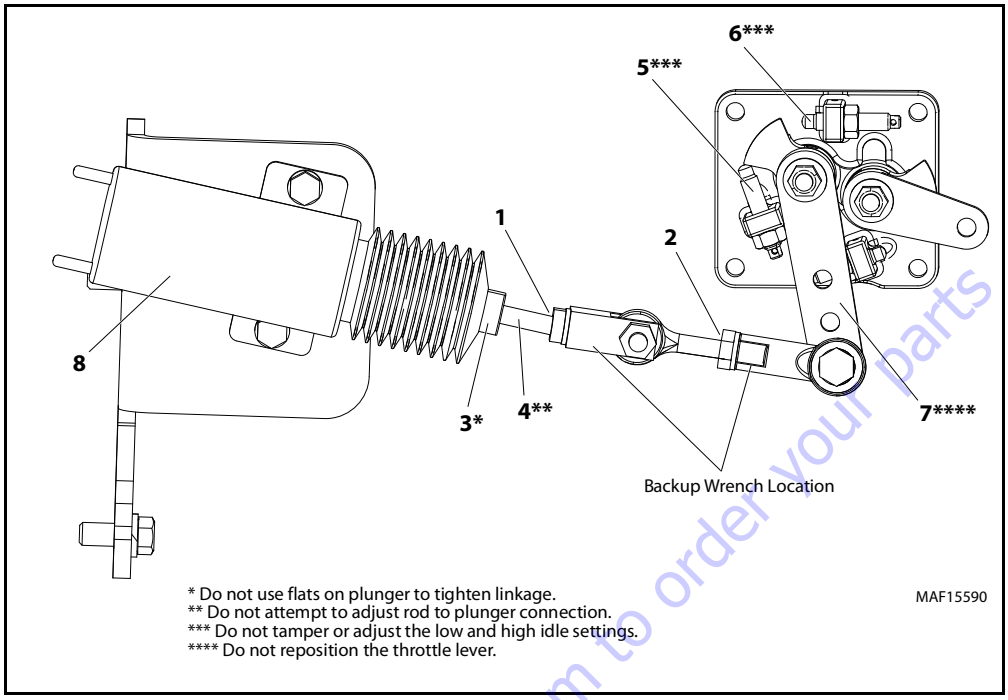
NOTE: *When the actuator solenoid is energized, the actuator plunger must be fully seated to prevent coil burnout.*

Diagnosis of Actuator

The common failure modes that are found in the actuator are as follows.

Description	Item Check List	Action
Throttle actuator plunger or rod separation	Inspect the actuator. Check if the plunger and threaded rod have separated or if the threaded rod spins in the plunger.	Replace the actuator
Ground fault	Make sure that the actuator harness is not damaged.	Replace the harness if damage is found.
	Inspect the ground wire connection.	If necessary remove the ground or chassis connection and clean the paint or oil from the connection location.
Blown fuse	Examine the respective 30 Amp fuse to confirm if it is still good. Blown fuse can indicate coil burnout.	If the fuse has been overloaded/ burned-out, replace the respective fuses.
Throttle actuator coil burnout	Coil burnout will result if the plunger is not able to fully retract or if the machine switches between high idle and low idle multiple times in less than a minute.	If the actuator coil is burned-out, replace the actuator
	The actuator coil becomes burned-out due to the following reasons: • Repeated blown fuses • The distance between the throttle arm and high idle stop is not maintained as 0.75 mm (0.030 in) • If the resistance in de-energized state and energized state is outside limit	

Adjustment of The Actuator



1. Clevis Adjustment Connection
2. Eyebolt Adjustment Connection
3. Actuator Plunger
4. Plunger Rod
5. Low Idle Stop
6. High Idle Stop
7. Throttle Lever
8. Throttle Actuator

Figure 3-56. Adjustment of the Actuator

ADJUSTMENT OF THE ACTUATOR PROCEDURE

1. Adjust the nuts at the clevis connection or at the eye bolt connection to maintain the proper air gap between the throttle arm and the high idle stop, if necessary.

NOTE: *Make sure that the plunger rod does not rub the eye-bolt.*

2. Make sure that the linkage and clevis is correctly adjusted before tightening of linkage assembly.
3. Use lockwasher and jam nut to tighten the linkage assembly.

Adjustment Verification of Actuator

1. Measure the plunger travel distance from energized to de-energized position. The travel distance must not be more than 1 in.
2. Verify plunger moves freely without binding.
3. If binding occurs, check the plunger rod. It should not come into contact with the eye bolt. Also verify the spacer is installed on the correct side of lever arm.
4. Use digital multimeter to measure de-energized state (0 to 1 ohms) and energized state (14 to 17 ohms) of actuator.

Figure 3-57. Adjustment Verification of Actuator

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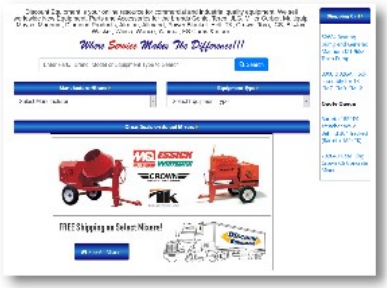

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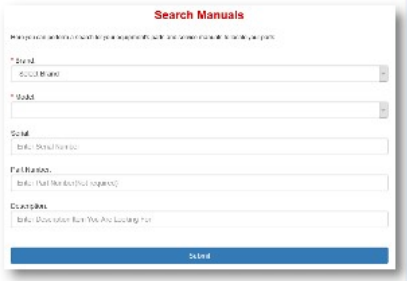

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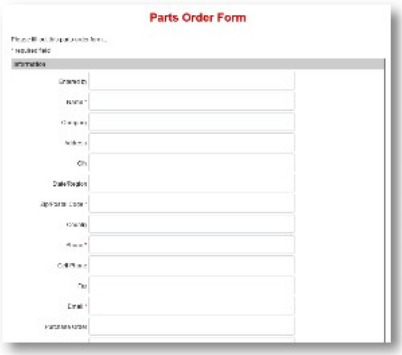

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SECTION 4. BASIC HYDRAULIC INFORMATION & SCHEMATICS

4.1 CYLINDERS - THEORY OF OPERATION

Cylinders are of the double acting type. The steer system incorporates a double acting cylinder. A double acting cylinder is one that requires oil flow to operate the cylinder rod in both directions. Directing oil (by actuating the corresponding control valve to the piston side of the cylinder) forces the piston to travel toward the rod end of the barrel, extending the cylinder rod (piston attached to rod). When the oil flow is stopped, movement of the rod will stop. By directing oil to the rod side of the cylinder, the piston will be forced in the opposite direction and the cylinder rod will retract.

NOTE: *The lift cylinder is a single acting cylinder which takes hydraulic pressure to extend and gravity to retract.*

A holding valve is used in the lift circuit to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

4.2 VALVES - THEORY OF OPERATION

Solenoid Control Valves (Bang-Bang)

Control valves used are four-way three-position solenoid valves of the sliding spool design. When a circuit is activated and the control valve solenoid energizes, the spool is shifted and the corresponding work port opens to permit oil flow to the component in the selected circuit, with the opposite work port opening to reservoir. Once the circuit is deactivated (control returned to neutral), the valve spool returns to neutral (center) and oil flow is then directed through the valve body and returns to reservoir. A typical control valve consists of the valve body, sliding spool, and two solenoid assemblies. The spool is machine fitted in the bore of the valve body. Lands on the spool divide the bore into various chambers, which, when the spool is shifted, align with corresponding ports in the valve body open to common flow. At the same time other ports would be blocked to flow. The spool is spring-loaded to center position, therefore when the control is released, the spool automatically returns to neutral, prohibiting any flow through the circuit.

Relief Valves

Main relief valves are installed at various points within the hydraulic system to protect associated systems and components against excessive pressure. Excessive pressure can be developed when a cylinder reaches its limit of travel and the flow of pressurized fluid continues from the system control. The relief valve provides an alternate path for the continuing flow from the pump, thus preventing rupture of the cylinder, hydraulic line or fitting. Complete failure of the system pump is also avoided by relieving circuit pressure. The relief valve is installed in the circuit between the pump outlet (pressure line) and the cylinder of the circuit, generally as an integral part of the system valve bank. Relief pressures are set slightly higher than the load requirement, with the valve diverting excess pump delivery back to the reservoir when operating pressure of the component is reached.

Crossover Relief Valves

Crossover relief valves are used in circuits where the actuator requires an operating pressure lower than that supplied to the system. When the circuit is activated and the required pressure at the actuator is developed, the crossover relief diverts excess pump flow to the reservoir. Individual, integral relief's are provided for each side of the circuit.

4.3 CYLINDER CHECKING PROCEDURE

NOTE: *Cylinder check must be performed anytime a system component is replaced or when improper system operation is suspected.*

Cylinders Without Counterbalance Valves

1. Using all applicable safety precautions, activate engine and fully extend cylinder to be checked. Shut down engine.
2. Carefully disconnect hydraulic hoses from retract port of cylinder. There will be some initial weeping of hydraulic fluid which can be caught in a suitable container. After the initial discharge, there should be no further drainage from the retract port.
3. Activate engine and extend cylinder.
4. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to port and retract cylinder. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repair must be made.
5. With cylinder fully retracted, shut down engine and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate engine and retract cylinder. Check extend port for leakage.
7. If extend port leakage is less than 6-8 drops per minute, carefully reconnect hose to extend port, than activate cylinder through one complete cycle and check for leaks. If leakage continues at a rate of 6-8

drops per minute or more, cylinder repairs must be made.

Cylinders With Single Counterbalance Valve

NOTICE

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.
2. Shut down hydraulic system and allow machine to sit for 10-15 minutes. If machine is equipped with bang-bang or proportional control valves, turn ignition switch to on, move control switch or lever for applicable cylinder in each direction, then turn ignition switch to off. If machine is equipped with hydraulic control valves, move control lever for applicable cylinder in each direction. This is done to relieve pressure in the hydraulic lines.
   Carefully remove hydraulic hoses from appropriate cylinder port block.
3. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the counterbalance valve is defective and must be replaced.
4. To check piston seals, carefully remove the counterbalance valve from the retract port. After initial discharge, there should be no further leakage from the ports. If leakage occurs at a rate of 6-8 drops per minute or more, the piston seals are defective and must be replaced.
5. If no repairs are necessary or when repairs have been made, replace counterbalance valve and carefully connect hydraulic hoses to cylinder port block.
6. If used, remove lifting device supporting platform or release and stow safety prop, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

4.4 OSCILLATING AXLE - LOCKOUT CYLINDER TEST (IF EQUIPPED)

NOTICE

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

NOTE: *Ensure platform is fully lowered prior to beginning lockout cylinder test, and that the surface used to approach the ramp is flat and level.*

Left Side Wheel Test

1. Place a 4 inch (10.16 cm) high block with ascension ramp in front of left wheel of the oscillating axle.
2. From platform control station, select LOW drive speed.
3. Set the DRIVE control switch into position and carefully drive the machine up ascension ramp until left oscillating axle wheel is on top of block.
4. Verify the axle oscillates to maintain contact with the ground/ramp. (All four wheels on the ground).
5. Raise machine platform above stowed position approximately 14 ft (4.26 m) on the 530LRT.
6. Carefully drive the machine back off the block and ramp.
7. Have an assistant check to see that the left oscillating axle wheel that was on the block is in position on the ground. The axle should oscillate so that all four wheels maintain contact with the ground.
8. In the current position (platform raised and all four tires on flat and level surface), carefully drive machine up the ramp block again.
9. Have an assistant check to verify that the axle did not oscillate and remained locked (one wheel is off of the ground).
10. Carefully drive the machine back off the block and ramp.
11. Lower the machine platform; the lockout cylinder should then release and allow wheel to rest on the ground. It may be necessary to activate DRIVE to release cylinders.
12. If the lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

Right Side Wheel Test

1. Place a 4 inch (10.16 cm) high block with ascension ramp in front of right wheel of the oscillating axle.
2. From platform control station, select LOW drive speed.
3. Set the DRIVE control switch into position and carefully drive the machine up ascension ramp until right oscillating axle wheel is on top of block.
4. Verify the axle oscillates to maintain contact with the ground/ramp. (All four wheels on the ground).
5. Raise machine platform above stowed position approximately 14 ft (4.26 m) on the 530LRT.
6. Carefully drive the machine back off the block and ramp.
7. Have an assistant check to see that the right oscillating axle wheel that was on the block is in position on the ground. The axle should oscillate so that all four wheels maintain contact with the ground.
8. In the current position (platform raised and all four tires on flat and level surface), carefully drive machine up the ramp block again.
9. Have an assistant check to verify that the axle did not oscillate and remained locked (one wheel is off of the ground).
10. Carefully drive the machine back off the block and ramp.
11. Lower the machine platform; the lockout cylinder should then release and allow the axle to oscillate. It may be necessary to activate DRIVE to release cylinders.
12. If the lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

4.5 DRIVE PUMP PRE-FILL PROCEDURE

The drive pump should be pre-filled with recommended hydraulic fluid prior to machine start up.

Before starting this procedure inspect the unit for any damage incurred during shipping and handling. Make certain all components are clean prior to filling with hydraulic fluid.

The methods to pre-fill pump is as follows:

Pre-Fill of the Drive Pump Housing Without HOC

These types of pumps should never be dry started. Pre-fill the pump as follows:

1. The drive pump has 2 case drain ports. Both are SAE #12 ports. The lower port has a 3/4 in. hose going back to tank. The other port has an SAE #12 plug in. Using a 9/16 Allen wrench remove the plug.
2. Fill the hydraulic tank.
3. Fluid from the hydraulic tank will back flush into the pump housing through the 3/4 in. case drain hose. Air will be forced out of the open port on the pump. When oil starts flowing out of the open port, reinstall and tighten the plug. The pump case is now pre-filled.

Pre-Fill of the Drive Pump Housing With HOC

4. The drive pump has both case drain ports filled by hoses due to the HOC.
5. Repeat steps 1 to 3 as above, except instead of loosening the SAE #12 plug, loosen the hose on the bottom of the case drain manifold, located near the hydraulic tank. This is the hose connected to the pump L2 port.

Priming the Gear Pump

1. Fill the hydraulic tank to the full mark.
2. Using a 2 in. wrench, loosen the pressure hose small section of the gear pump (steering section). The hose fitting does not need to be removed, just loosened enough to let the air escape.
3. When oil leaks at the hose end, re-torque the hose end. The pump is primed and the pumps are ready to start.

4.6 DRIVE PUMP START-UP PROCEDURE

NOTICE

THE FOLLOWING PROCEDURE SHOULD ALWAYS BE PERFORMED WHEN STARTING A NEW PUMP OR WHEN RESTARTING AN INSTALLATION IN WHICH EITHER THE PUMP OR MOTOR HAVE BEEN REMOVED FROM THE SYSTEM.

NOTICE

THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, DRIVE FUNCTION DISCONNECTED, ETC.) WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY TO TECHNICIAN AND OTHER PERSONNEL. TAKE NECESSARY SAFETY PRECAUTIONS BEFORE MOVING THE MACHINE.

Prior to installing pump and/or motor, inspect unit(s) for damage incurred during shipping and handling. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with hydraulic fluid.

Fill reservoir with recommended hydraulic fluid, which should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to components, which may result in unexpected machine movement.

The inlet line leading from the reservoir to the pump should be filled prior to start-up. Check inlet line for properly tightened fittings and make sure it is free of restrictions and air leaks.

Be certain to fill pump and/or motor housing with clean hydraulic fluid prior to start-up. Fill housing by pouring filtered oil into upper case drain port.

Install a 0 to 500 psi (0 to 35 bar) pressure gauge in the charge pressure gauge port to monitor charge pressure during start-up.

It is recommended that the external control input signal electrical connections be disconnected at the pump control until after initial start-up. This will allow the pump to remain in its neutral position.

"Jog" or slowly rotate prime mover until charge pressure starts to rise. Start prime mover and run at the lowest possible RPM until charge pressure has been established. Excess air may be bled from high pressure lines through high pressure gauge ports.

⚠ WARNING

DO NOT START PRIME MOVER UNLESS PUMP IS IN NEUTRAL POSITION (0 DEGREES SWASHPLATE ANGLE). TAKE PRECAUTIONS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be approximately 220 psi (15.5 bar) minimum. If charge pressure is incorrect, shut down and determine cause for improper pressure.

⚠ WARNING

INADEQUATE CHARGE PRESSURE WILL AFFECT THE OPERATOR'S ABILITY TO CONTROL THE MACHINE.

Shut down prime mover and connect external control input signal. Start prime mover, checking to ensure pump remains in neutral. With prime mover at normal operating speed, slowly check for forward and reverse machine operation.

Charge pressure should remain at 220 psi to 240 psi (15.5 bar to 16.9 bar) minimum during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

Shut down prime mover, remove gauges, and plug ports. Check reservoir level and add fluid if necessary.

4.7 HYDRAULIC COMPONENT START-UP PROCEDURES & RECOMMENDATIONS

From a hydrostatic component standpoint, the goal at system start up is to put into functional operation, the hydrostatic system in such a way as to preserve the designed life span of the system. The following start-up procedure should be adhered to whenever a new pump or motor is initially installed into a machine, or a system is restarted after either a pump or motor has been removed and/or replaced.

⚠ WARNING

THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, WORK FUNCTIONS DISCONNECTED, ETC.) WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY. TAKE NECESSARY SAFETY PRECAUTIONS BEFORE MOVING THE VEHICLE/MACHINE.

Prior to installing the pump and/or motor, inspect the unit(s) for damage that may have been incurred during shipping and handling. Ensure all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Fill the reservoir with recommended hydraulic fluid. This fluid should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components, which may result in unexpected vehicle/machine movement.

NOTE: *If a pump or motor is being replaced due to internal damage, the remaining units (pump or motors) need to be inspected for damage and contamination, and the entire hydraulic system will need to be flushed and the fluid replaced. Failure to do so may cause considerable damage to the entire system.*

The inlet line leading from the reservoir to the pump must be filled prior to start-up. Check the inlet line for property tightened fittings and make sure it is free of restrictions and air leaks.

NOTE: *In most cases, the reservoir is above the pump inlet so that the pressure head created by the higher oil level helps to keep the inlet pressures within an acceptable range and prevent high vacuum levels. However, due to hose routing or low reservoir locations, there may be air trapped within this line. It is important to ensure that the air is bled from this line. This can be accomplished by loosening the hose at the fitting closest to the pump. When oil begins to flow, the line is full, the air has been purged, and the fitting can be retightened to its specified torque. If the tank needs to be pressurized in order to start the flow of oil, a vacuum reading should be taken at the inlet of the pump during operation in order to verify that the pump is not being asked to draw an inlet vacuum higher than it is capable of.*

Be certain to fill the pump and/or motor housing with clean hydraulic fluid prior to start up. Fill the housing by pouring filtered oil into the upper case drain port.

NOTE: *It is highly recommended to use the highest possible case drain port, this ensures that the housing contains as much oil as possible and offers the greatest amount of lubrication to the internal components.*

In initial start-up conditions, it may be convenient to fill the housing, just prior to installing the case drain line. Component, (especially motor), location may be such that access to the case drain port after installation is not realistic.

Make certain that the oil being used to fill the component housing is as clean as possible. Store the fill container in such a way as to prevent it from becoming contaminated.

Install a 60 bar (or 1000 psi) pressure gauge in the charge pressure gauge port in order to monitor the charge pressure during start-up.

It is recommended that the external control input signal, (electrical connections for EDC), be disconnected at the pump control until after initial start-up. This will ensure that the pump remains in its neutral position.

⚠ WARNING

DO NOT START THE ENGINE UNLESS PUMP IS IN THE NEUTRAL POSITION (0 DEGREES SWASHPLATE ANGLE). TAKE PRECAUTIONS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.

"Jog" or slowly rotate the engine until charge pressure starts to rise. Start the engine and run at the lowest possible RPM until charge pressure has been established. Excess air should be bled from the system lines as close to the motors as possible.

NOTE: *With the engine on low idle, "crack", (loosen-don't remove), the system lines at the motor(s). Continue to run the engine at low idle and tighten the system lines as soon as oil is observed to leak from them. When oil is observed to "leak" at the motor, the line is full, the air has been purged, and the system hoses should be retightened to their specified torque.*

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be as indicated in the pump model code. If charge pressure is inadequate, shut down and determine the cause for improper pressure.

⚠ WARNING

INADEQUATE CHARGE PRESSURE WILL AFFECT THE OPERATOR'S ABILITY TO CONTROL THE MACHINE.

Shut down the engine and connect the external control input signal. Also reconnect the machine function(s), if disconnected earlier. Start the engine, checking to be certain the pump remains in neutral. With the engine at normal operating RPM, slowly check for forward and reverse machine operation.

Charge pressure may slightly decrease during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

Shut down engine, remove gauges, and plug ports. Check reservoir level and add filtered fluid if needed.

The machine is now ready for operation.

4.8 HYDRAULIC CONNECTION ASSEMBLY AND TORQUE SPECIFICATION

Tapered Thread Types

NPTF = national tapered fuel (Dry Seal) per SAE J476/J512

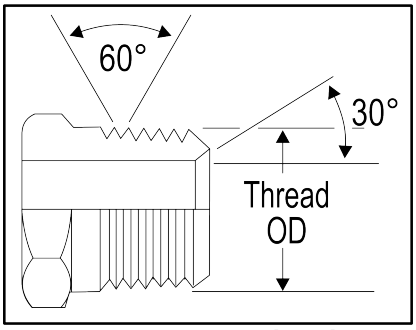


Figure 4-1. NPTF thread

BSPT = British standard pipe tapered per ISO7-1

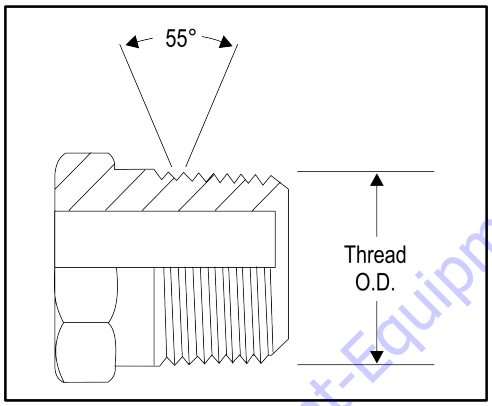


Figure 4-2. BSPT thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

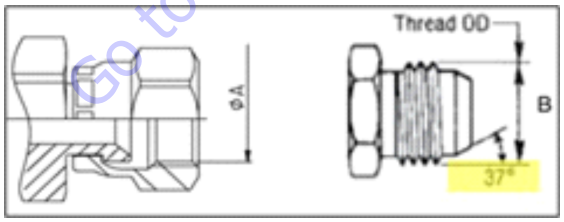


Figure 4-3. JIC Thread

SAE = 45° flare per SAE J512

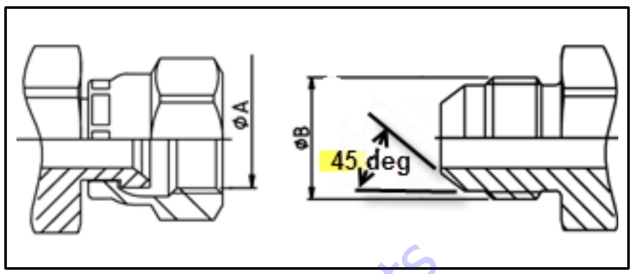


Figure 4-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

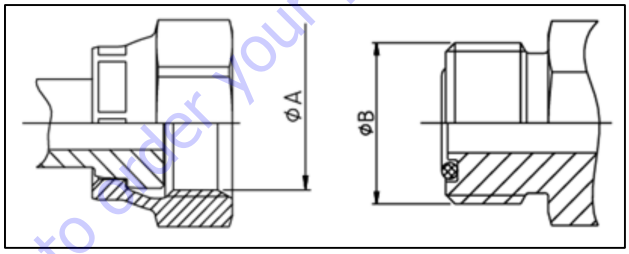


Figure 4-5. ORFS Thread

MBTL = metric flareless bite type fitting, pressure rating L (medium) per ISO 8434, DIN 2353

MBTS = metric flareless bite type fitting, pressure rating S (high) per ISO 8434, DIN 2353

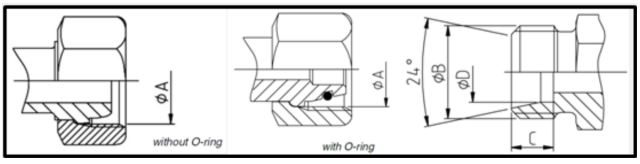


Figure 4-6. MTBL-MBTS Thread

BH = bulkhead connection – JIC, ORFS, MBTL, or MBTS types

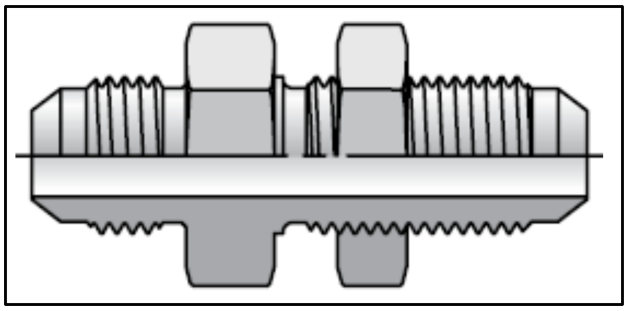
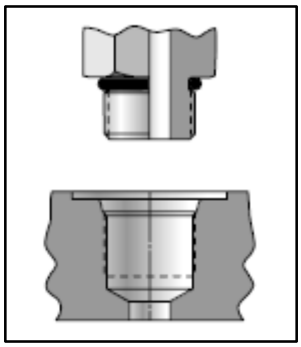


Figure 4-7. Bulkhead Thread

Straight Thread Types, Port Connections

ORB = o-ring boss per SAE J1926, ISO 11926

MPP = metric pipe parallel o-ring boss per SAE J2244, ISO 6149, DIN 3852



MFF = metric flat face port per ISO 9974-1

BSPP = British standard parallel pipe per ISO 1179-1, DIN 3852-2

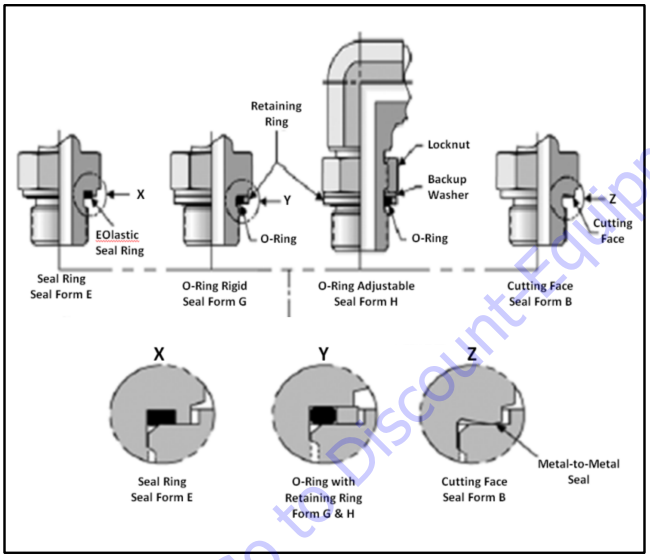


Figure 4-8. MFF-BSPP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

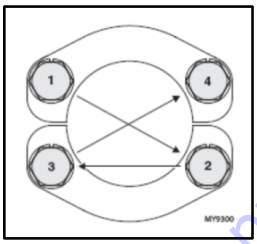


Figure 4-9. ORB-MPP Thread

Tightening Methods

Torque = Application of a twisting force to the applicable connection by use of a precise measurement instrument (i.e. torque wrench).

Finger Tight = The point where the connector will no longer thread onto the mating part when tightened by hand or fingers. Finger Tight is relative to user strength and will have some variance. The average torque applied by this method is 3 ft. lb. (4 Nm). Also referred to as 'Hand Tight.'

TFFT = Turns From Finger Tight; Application of a preload to a connection by first tightening the connection by hand (fingers) and applying an additional rotation counted by a defined number of turns by use of a tool.

FFWR = Flats From Wrench Resistance; Application of a preload to a connection by tightening to the point of initial wrench resistance and turning the nut a described number of 'flats'. A 'flat' is one side of the hexagonal tube nut and equates to 1/6 of a turn. Also referred to as the 'Flats Method.'

Assembly And Torque Specifications

Prior to selecting the appropriate torque from the tables within this section, it is necessary to properly identify the connector being installed. Refer to the Figures and Tables in this section.

GENERAL TUBE TYPE FITTING ASSEMBLY INSTRUCTIONS

1. Take precautions to ensure that fittings and mating components are not damaged during storage, handling or assembly. Nicks and scratches in sealing surfaces can create a path for leaks which could lead to component contamination and/or failure.
2. When making a connection to tubing, compression or flare, inspect the tube in the area of the fitting attachment to ensure that the tube has not been damaged.
3. The assembly process is one of the leading causes for contamination in air and hydraulic systems. Contamination can prevent proper tightening of fittings and adapters from occurring.
   - **a.** Avoid using dirty or oily rags when handling fittings.
   - **b.** If fittings are disassembled, they should be cleaned and inspected for damage. Replace fittings as necessary before re-installing.
   - **c.** Sealing compounds should be applied where specified; however, care should be taken not to introduce sealant into the system.
   - **d.** Avoid applying sealant to the area of the threads where the sealant will be forced into the system. This is generally the first two threads of a fitting.
   - **e.** Sealant should only be applied to the male threads.
   - **f.** Straight thread fittings do not require sealants. O-rings or washers are provided for sealing.
   - **g.** When replacing or installing an o-ring, care is to be taken while transferring the o-ring over the threads as it may become nicked or torn. When replacing an o-ring on a fitting, the use of a thread protector is recommended.
   - **h.** When installing fittings with o-rings, lubrication shall be used to prevent scuffing or tearing of the o-ring. See o-ring Installation (Replacement) in this section.
4. Take care to identify the material of parts to apply the correct torque values.
   - **a.** Verify the material designation in the table headings.
   - **b.** If specifications are given only for steel fittings and components, the values for alternate materials shall be as follows: Aluminum and Brass- reduce steel values by 35%; Stainless Steel- Use the upper limit for steel.
5. To achieve the specified torque, the torque wrench is to be held perpendicular to the axis of rotation.

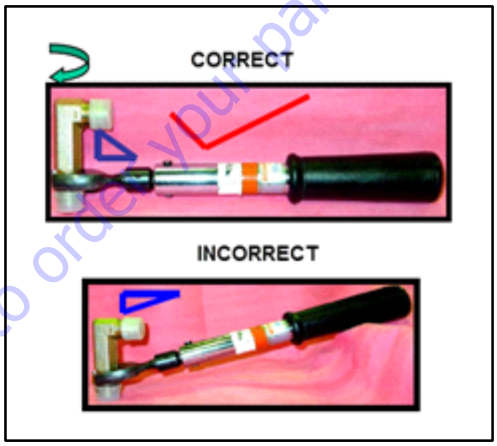


Figure 4-10. Torque Wrench Angle

6. Refer to the appropriate section in this manual for more specific instructions and procedures for each type of fitting connection.

Assembly Instructions for American Standard Pipe Thread Tapered (NPTF) Connections.

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as High Strength Threadlocking Compound, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

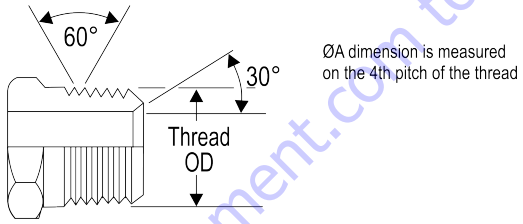
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 4-1, NPTF Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 4-1, NPTF Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 4-1. NPTF Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
Material	Dash Size	Thread Size	ØA*		
		(UNF)	(in)	(mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH **STEEL, ALUMINUM, OR BRASS** MATING COMPONENTS	2	1/8-27	0.40	10.24	2 to 3
	4	1/4-18	0.54	13.61	2 to 3
	6	3/8-18	0.67	17.05	2 to 3
	8	1/2-14	0.84	21.22	2 to 3
	12	3/4-14	1.05	26.56	2 to 3
	16	1-11 1/2	1.31	33.22	1.5 to 2.5
	20	1 1/4-11 1/2	1.65	41.98	1.5 to 2.5
	24	1 1/2-11 1/2	1.89	48.05	1.5 to 2.5
	32	2-11 1/2	2.37	60.09	1.5 to 2.5

*ØA thread dimension for reference only.

**See FFWR and TFFT Methods subsection for TFFT procedure requirements.

Assembly Instructions for British Standard Pipe Thread Tapered (BSPT) Connections

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as High Strength Threadlocking Compound, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

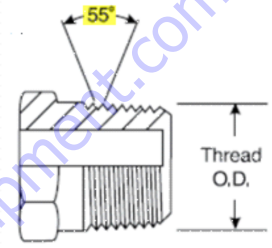
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 4-2, BSPT Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 4-2, BSPT Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 4-2. BSPT Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
MATERIAL	Dash Size	Thread Size (BSPT)	ØA* (in)	ØA* (mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH **STEEL, ALUMINUM, OR BRASS** MATING COMPONENTS	2	1/8-28	0.38	9.73	2 to 3
	4	1/4-19	0.52	13.16	2 to 3
	6	3/8-19	0.66	16.66	2 to 3
	8	1/2-14	0.83	20.96	2 to 3
	12	3/4-14	1.04	26.44	2 to 3
	16	1-11	1.31	33.25	1.5 to 2.5
	20	1 1/4-11	1.65	41.91	1.5 to 2.5
	24	1 1/2-11	1.88	47.80	1.5 to 2.5
	32	2-11	2.35	59.61	1.5 to 2.5

* ØA thread dimension for reference only.

** See Appendix B for TFFT procedure requirements.

Assembly Instructions for 37° (JIC) Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting and start threads by hand.

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

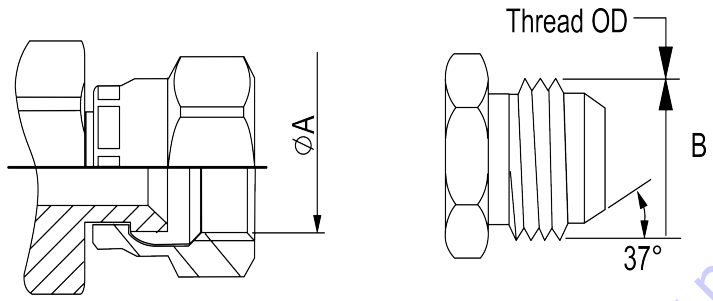
3. Torque assembly to value listed in Table 4-3, 37° Flare (JIC)Thread - Steel or Table 4-4, 37° Flare (JIC)Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

NOTE: *Torque values provided in Table Table 4-3, 37° Flare (JIC)Thread - Steel and Table 4-4, 37° Flare (JIC)Thread - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 4-3. 37° Flare (JIC)Thread - Steel

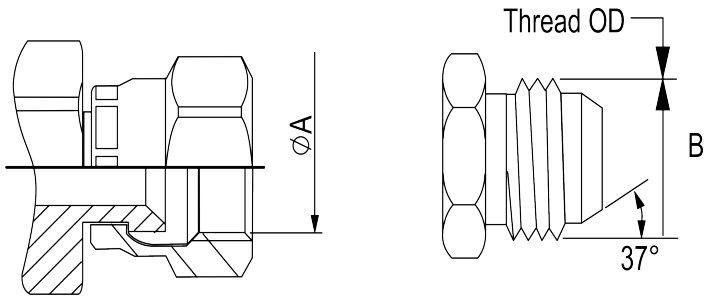


Type/Fitting Identification							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[ft. lb.]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	7	8	9	10	--
	3	3/8-24	0.34	8.60	0.37	9.50	8	9	10	11	12	14	--
	4	7/16-20	0.39	10.00	0.44	11.10	13	14	14	18	19	19	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	14	15	15	19	20	21	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	22	23	24	30	31	33	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	42	44	46	57	60	63	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	60	63	66	81	85	89	1 to 1-1/2
	12	11/16-12	0.97	24.60	1.06	27.00	84	88	92	114	120	125	1 to 1-1/2
	14	13/16-12	1.11	28.30	1.19	30.10	100	105	110	136	142	149	1 to 1-1/2
	16	15/16-12	1.23	31.30	1.31	33.30	118	124	130	160	168	176	3/4 to 1
	20	15/8-12	1.54	39.20	1.63	41.30	168	176	185	228	239	251	3/4 to 1
	24	17/8-12	1.80	45.60	1.87	47.60	195	205	215	264	278	291	3/4 to 1
	32	21/2-12	2.42	61.50	2.50	63.50	265	278	292	359	377	395	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Table 4-4. 37° Flare (JIC)Thread - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[ft. lb.]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	4	4	5	5	6	7	--
	3	3/8-24	0.34	8.60	0.37	9.50	5	6	7	7	8	9	--
	4	7/16-20	0.39	10.00	0.44	11.10	8	9	9	11	12	13	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	9	10	10	12	13	14	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	14	15	16	19	20	21	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	27	29	30	37	39	41	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	39	41	43	53	56	58	1 to 1-1/2
	12	1 1/16-12	0.97	24.60	1.06	27.00	55	57	60	74	78	81	1 to 1-1/2
	14	1 3/16-12	1.11	28.30	1.19	30.10	65	68	72	88	93	97	1 to 1-1/2
	16	1 5/16-12	1.23	31.30	1.31	33.30	77	81	84	104	109	114	3/4 to 1
	20	1 5/8-12	1.54	39.20	1.63	41.30	109	115	120	148	155	163	3/4 to 1
	24	1 7/8-12	1.80	45.60	1.87	47.60	127	133	139	172	180	189	3/4 to 1
	32	2 1/2-12	2.42	61.50	2.50	63.50	172	181	189	234	245	257	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Assembly Instructions for 45° SAE Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting.
3. Tighten fitting by hand until hand tight.

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

Torque fitting to value listed in Table 4-5, 45° Flare (SAE) - Steel and Table 4-6, 45° Flare (SAE) - Aluminum/Brass while using the Double Wrench Method outlined in this section. Refer to FFWR and TFFT Methods for procedure requirements if using the TFFT method.

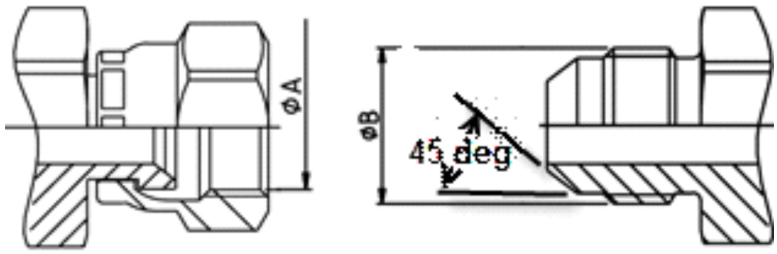
NOTE: *Torque values provided in Table 4-5, 45° Flare (SAE) - Steel and Table 4-6, 45° Flare (SAE) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS

mating components.

Table 4-5. 45° Flare (SAE) - Steel

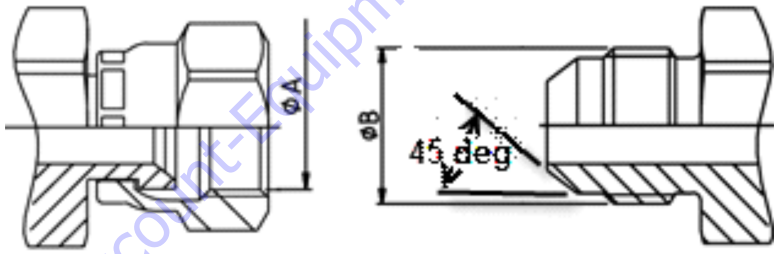


TYPE/FITTING IDENTIFICATION							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[ft. lb.]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	13	14	14	18	19	19
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89
	12	11/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Table 4-6. 45° Flare (SAE) - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[ft. lb.]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	8	9	9	11	12	12
	6	5/8-18	0.56	14.30	0.63	15.90	14	15	15	19	20	20
	8	3/4-16	0.69	17.50	0.75	19.10	27	29	30	37	39	41
	10	7/8-14	0.81	20.60	0.87	22.20	39	41	43	53	56	58
	12	11/16-14	0.98	25.00	1.06	27.00	55	58	61	75	79	83

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for TFFT procedure requirements.