JLG®

An Oshkosh Corporation Company

Service and Maintenance Manual

Models

600S

660SJ

PVC 2001

PN - 31215034

October 19, 2019 - Rev A

ANSI

CE

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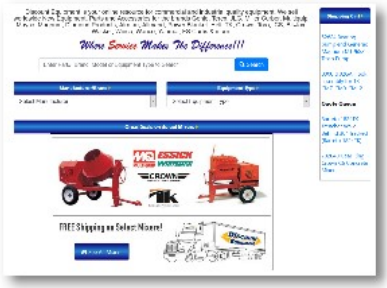

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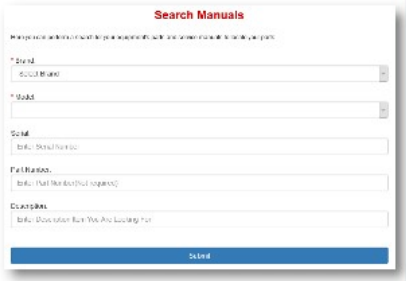

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

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

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

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

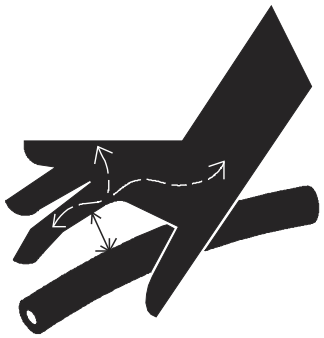
⚠ WARNING

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

B HYDRAULIC SYSTEM SAFETY

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

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



C MAINTENANCE

⚠ WARNING

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

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

REVISON LOG

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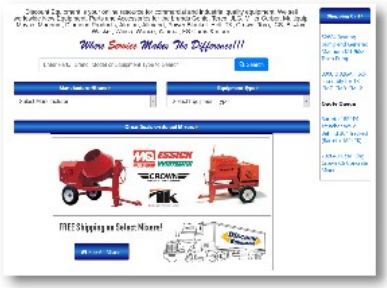

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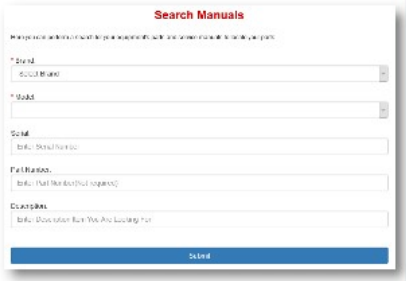

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Machine Specifications

Maximum Work Load (Capacity) - 600S Unrestricted: Restricted:	 600 lb (272 kg) 1000 lb (454 kg)
Maximum Work Load (Capacity) - 660SJ Unrestricted: Restricted:	 550 lb (250 kg) 750 lb (340 kg)
Maximum Travel Grade (Gradeability) 4WD	 45%
Maximum Travel Grade (Side Slope)	5°
Maximum Manual Force (600S)	90 lbs (400N)
Maximum Manual Force (660SJ)	90 lbs (400N)
Maximum Wind Speed	28 mph (12.5m/s)
Maximum Tire Load: 600S 660SJ	 12760lb (5788 kg) 14720lb (6677 kg)
Ground Bearing Pressure - 600S Foam Filled Pneumatic	 83.1 psi (5.84 kg/cm^2) 77.7 psi (5.46 kg/cm^2)
Ground Bearing Pressure - 660SJ Foam Filled Pneumatic	 86.4 psi (6.07 kg/cm^2) 85.1 psi (5.98 kg/cm^2)
Maximum Drive Speed (4WD)	3.8 mph (6.3 Km/hr.)
Electrical System	12V DC
Gross Machine Weight (Approximate) 600S - 2WS 600S - 4WS 660SJ - 2WS 660SJ - 4WS	 21,461 lb (9735 kg) 21,647 lb (9819 kg) 25,341 lb (11494 kg) 25,581 lb (11603 kg)

1.2 DIMENSIONAL DATA

Machine Dimensional Data

Machine Height (Stowed)	8 ft. 2.4 in. (2.5 m)
Machine Length (Stowed) 600S 660SJ	 28 ft. 7 in. (8.71 m) 35ft. 4.7 in. (10.79 m)
Machine Width	8 ft. 2 in. (2.48 m)
Turning Radius (Outside) 2WS 4WS	 19 ft. 7 in. (5.96 m) 12 ft. 8 in. (3.87 m)
Turning Radius (Inside) 2WS 4WS	 9 ft. 7 in. (2.92 m) 5 ft.3 in. (1.61 m)
Wheelbase	8 ft. 2.7 in. (2.51 m)
Total Axle Oscillation	8 in. (0.2 m)
Ground Clearance	11.3 in. (0.29 m)
Platform Height 600S 660SJ	 59 ft. 8 in. (18.18 m) 65 ft. 8 in. (20.02 m)
Horizontal Reach from center of rotation - 600S 600 lb (272 kg) Zone 1000 lb (454 kg) Zone	 50 ft. 2 in. (15.29 m) 41 ft. 1.2 in. (12.53 m)
Horizontal Reach over end - 600S 600 lb (272 kg) Zone 1000 lb (454 kg) Zone	 45 ft. 2.5 in. (13.78 m) 36 ft. 1.6 in. (11.01m)
Horizontal Reach over side - 600S 600 lb (272 kg) Zone 1000 lb (454 kg) Zone	 46 ft. 1.3 in. (14.05 m) 37 ft. 0.2 in. (11.28 m)
Horizontal Reach from center of rotation - 660SJ 550 lb (250 kg) Zone 750 lb (340 kg) Zone	 57 ft. 1 in. (17.4 m) 47 ft. 11 in. (14.60 m)
Horizontal Reach over end - 660SJ 550lb (250 kg) Zone 750 lb (340 kg) Zone	 52 ft. 1 in. (15.87 m) 42 ft. 11.4 in. (13.09 m)
Horizontal Reach over side - 660SJ 550 lb (250 kg) Zone 750 lb (340 kg) Zone	 52 ft. 11.6 in. (16.14 m) 43 ft. 10.2 in. (13.36 m)
Tail Swing	4 ft. (1.22 m)

1.3 CAPACITIES

Fuel Tank	
Diesel	31 Gallons (117 L)
Diesel (Steel Tank)	52 Gallons (200 L)
Gasoline	31 Gallons (117 L)
Hydraulic Oil Tank	34 Gallons (129 L)
Hydraulic System (Including Tank)	40 Gallons (121 L)
Engine Crankcase	
Deutz D2011L04	10quarts (9.4 L)
Deutz 2.9L	9.6 quarts (9.1 L)
Ford MSG425-DF	7 quarts (6.6 L)
Coolant System (Deutz 2.9)	13.2 quarts (12.5 L)
Coolant System (Ford MSG425-DF)	2 gal. (7.5 L)
Torque Hub, Drive*	24 ounces (0.7 L)
*Fill torque hubs half (1/2) full of lubricant.	

1.4 ENGINE DATA

Table 1-1. Deutz TD 2.9L4 (67hp) Specifications

Fuel	Ultra Low Sulfur Diesel (15 ppm)
Max Output (Power)	67 hp (50 kW) @ 2600 RPM
Max Output (Torque)	173 ft.lbs. (234 Nm) @ 1800 RPM
Oil Capacity (Crankcase)	2.4 gal (9.0 L)
Cooling System	3.3 gal (12.5 L)
Low RPM	1200 ± 50 RPM
High RPM	2600 ± 50 RPM
Alternator	12V,95 Amp
Fuel Consumption	1.06 GPH (4.02lph)
Battery	950 Cold Cranking Amps, 205 Minutes Reserve Capacity, 12 VDC

Table 1-2. Deutz D 2.9L4 (49hp) Specifications

Type	Liquid Cooled
Number of Cylinders	4
Bore	3.6 in (92 mm)
Stroke	4.3 in (110 mm)
Displacement	178 cu. in (2925 cm^3)
Fuel	Ultra Low Sulfur Diesel (15 ppm)
Max Output (Power)	49 hp (36.5 kW) @2600 RPM
Max Output (Torque)	108 ft.lbs. (147 Nm) @ 1600 RPM
Oil Capacity	2.4 gal (8.9 L)
Coolant Capacity (System)	3.2 gal (12.1 L)
Low RPM	1200 ± 50 RPM
High RPM	2600 ± 50 RPM
Alternator	12V, 95 Amp
Fuel Consumption	1.06 GPH (4.02lph)

Table 1-3. Deutz D2011L04 Specifications

Fuel	Diesel
Max Output (Power)	49 hp (36.4kW) @ 2500 RPM)
Oil Capacity	
Cooling System	5 Quarts (4.5 L)
Crankcase	11 Quarts (10.5 L) w/Filter
Total Capacity	16 Quarts (15.1 L)
Idle RPM	1000 ± 50 RPM
High RPM	2500 ± 50 RPM
Alternator	60 Amp
Battery	950 Cold Cranking Amps, 205 Minutes Reserve Capacity, 12 VDC
Fuel Consumption	0.79 GPH (2.99 lph)

Table 1-4. Ford MSG425-DF Specifications

Type	Liquid Cooled
Number of Cylinders	4
Displacement	2.5 L
Oil Capacity (Engine Only)	7 qt (6.6 L)
Coolant Capacity (Engine Only)	0.63 Gallon (2.4 L)
Coolant Capacity (System)	2 Gallon (7.5 L)
Low RPM	1000 ± 50 RPM
High RPM	3200 ± 50 RPM
Alternator	150 Amp
Starter	64.4 Amp @ 3574 RPM
Fan Ratio	1:3
Fuel Consumption	
Gas	1.05 GPH (3.98 lph)
LP	1.37 GPH (5.19 lph)
Max Output (Power)	
Gasoline	62.1 HP @ 2600
LP	62.7 HP @ 2600
Max Output (Torque)	
Gasoline	142 ft. lbs. (192 Nm) @ 2400 RPM
LP	145 ft. lbs. (197 Nm) @ 2400 RPM
Battery	950 Cold Cranking Amps, 205 Minutes Reserve Capacity, 12 VDC
Acceptable Fuel Grades	
Unleaded 87 or 89 Octane Gasoline	
Ethanol/Gasoline Mix: 10%	
HD-5 LPG	

1.5 TIRES

Table 1-5. Tire Specifications

Size	355/55D625
Load Range	G
Ply Rating	14
Fill Type	Foam/Crumb
Diameter	36.9 in.
Width	13.95 in.
Rim Size	11.75 x 24.5 in.
Tire & Wheel Weight	228 lbs (103.5 kg)
Max Tire Load	15,120 lbs (6858 kg)
Size	**355/55D625**
Load Range	G
Ply Rating	14
Fill Type	Pneumatic
Diameter	36.9 in.
Width	13.95 in.
Rim Size	11.75 x 24.5 in.
Tire & Wheel Weight	228 lbs (103.5 kg)
Max Tire Load	15,120 lbs (6858 kg) @ 100 psi (6.9 bar)
Size	**41/18LL x 22.5**
Load Range	G
Ply Rating	14
Fill Type	Soft Foam
Diameter	41in.
Width	18.4 in.
Rim Size	14 x 22.5 in.
Tire & Wheel Weight	700 lbs (318 kg)
Max Tire Load	19,000 lbs
Size	**41/18LL x 22.5**
Load Range	G
Ply Rating	14
Fill Type	Pneumatic
Diameter	41 in.
Width	18.4 in.
Rim Size	14 x 22.5 in.
Tire & Wheel Weight	265 lbs (120 kg)
Max Tire Load	19,000 lbs

1.6 CRITICAL STABILITY WEIGHTS

⚠ WARNING

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

Components		LB	KG.
Tire and Wheel	355/55D625(FF)	440	200
	41/18LLx22.5 (FF)	700	318
	355/55D625 (Pneumatic)	225	102
	355/55D625 (Pneumatic-Non Marking)	242.5	110
	41/18LLx22.5 (Pneumatic)	265	120
	355/55D625 (Pneumatic w/Sealant)	233	106
Engine (Complete tray including pump)	Deutz TD2.9L	1433	650
	Deutz D2.9L	1107	503
	Deutz D2011L04	983	445
	Ford	353	160
Counterweight	Chassis	453	205.5
	Turntable (600S)	4922	2233
	Turntable (660SJ)	5844	2653
Platform Only (No Control Box or Footswitch)	30x48	132	60
	30x60	145.5	66
	36x72	159	72
	36x96	230	84
	36x72 (Shipyard Gate)	247	112

1.7 HYDRAULIC OIL

Table 1-6. Hydraulic Oil

Hydraulic System Operating Temperature Range	S.A.E. Viscosity Grade
+0° to + 180° F (-18° to +83° C)	10W
+0° to + 210° F (-18° to +99° C)	10W-20, 10W-30
+50° to + 210° F (+10° to +99° C)	20W-20

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

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

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

Table 1-7. Mobilfluid 424

SAE Grade	10W-30
ISO Viscosity Grade	55
Gravity, API	29.0
Density, Lb/Gal. 60°F	7.35
Pour Point, Max	-46°F (-43°C)
Flash Point, Min.	442°F (228°C)
Viscosity	
Brookfield, cP at -18°C	2700
at 40° C (104° F)	55 cSt
at 100° C (212° F)	9.3 cSt
Viscosity Index	152

Table 1-8. Mobil DTE 10 Excel 32

ISO Viscosity Grade	#32
Specific Gravity	0.877
Pour Point, Max	-40°F (-40°C)
Flash Point, Min.	330°F (166°C)
Viscosity	
at 40° C (104° F)	33 cSt
at 100° C (212° F)	6.6 cSt
cp at -30° F	6200
Viscosity Index	140

Table 1-9. Quintolubric 888-46

Density	0.92 @ 15°C (59°F)
Pour Point	<-22°F (<-30°C)
Flash Point	572°F (300°C)
Fire Point	680°F (360°C)
Auto Ignition Temperature	>842°F(>450°C)
Viscosity	
at 0° C (32° F)	320 cSt
at 20° C (68° F)	109 cSt
at 40° C (104° F)	47.5 cSt
at 100° C (212° F)	9.5 cSt
Viscosity Index	190

Table 1-10. Mobil EAL 224 H

Type	Biodegradable Vegetable
ISO Viscosity Grade	32/46
Specific Gravity	0.922
Pour Point	-25°F (-32°C)
Flash Point	428°F (220°C)
Operating Temp.	0 to 180°F (-17 to 162°C)
Weight	7.64 lb. per gal. (0.9 kg per liter)
Viscosity	
at 40° C (104° F)	37 cSt
at 100° C (212° F)	8.4 cSt
Viscosity Index	213
NOTE: *Must be stored above 32°F (14°C)*	

Table 1-11. Mobil EAL Envirosyn H 46

Type	Synthetic Biodegradable
ISO Viscosity Grade	46
Specific Gravity	0.910
Density	0.874 @ 15°C (59°F)
Pour Point	-44°F (-42°C)
Flash Point	500°F (260°C)
Operating Temp.	0 to 180°F (-17 to 162°C)
Weight	7.64 lb. per gal. (0.9 kg per liter)
Viscosity	
at 40° C (104° F)	45 cSt
at 100° C (212° F)	8.0 cSt
Viscosity Index	153

Table 1-12. Exxon Univis HVI 26 (Arctic)

Specific Gravity	0.89
Pour Point	-76°F (-60°C)
Flash Point	217°F (103°C)
Viscosity	
at 40° C (104° F)	25.8 cSt
at 100° C (212° F)	9.3 cSt
Viscosity Index	376
NOTE: *Mobil/Exxon recommends this oil be checked on a yearly basis for viscosity.*	

1.8 TORQUE REQUIREMENTS

Table 1-13. Torque Requirements

Description	Torque Value (Dry)	Interval Hours
Bearing To Chassis	18X	
Bearing To Turntable	18X	
Wire Rope	15 ft. lbs (20 Nm)	150
Wheel Lugs	170 ft.lbs (230 Nm)	
Engine Mounting Bolt M12 M16	 84.8 ft.lbs (115 Nm) 206.5 ft.lbs (280 Nm)	
*Check swing bearing bolts after first 50 hours of operation and every 600 hours thereafter. (See Section 3.13, Swing Bearing.)		

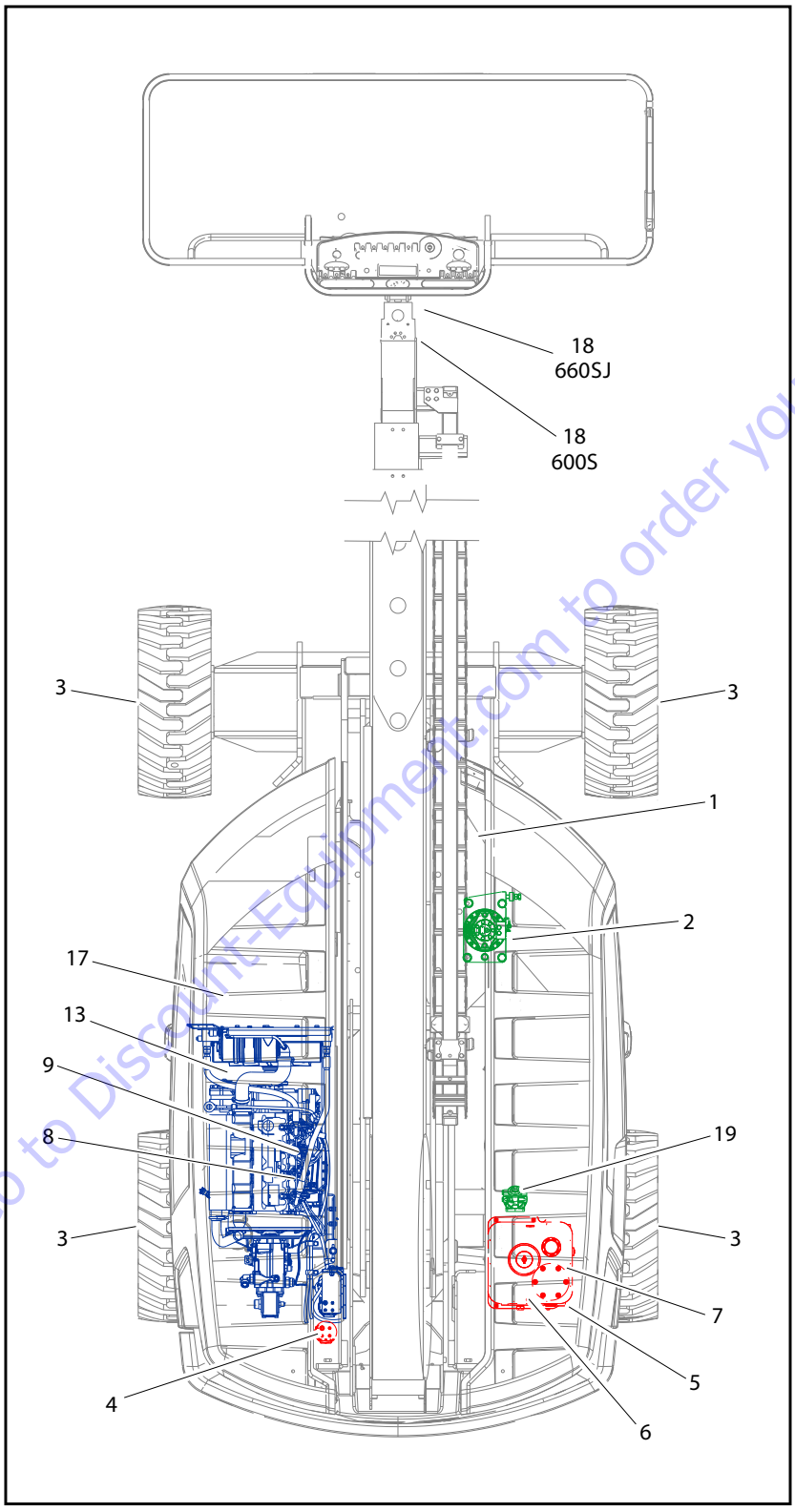


Figure 1-1. Maintenance and Lubrication Diagram - Deutz D2011L04

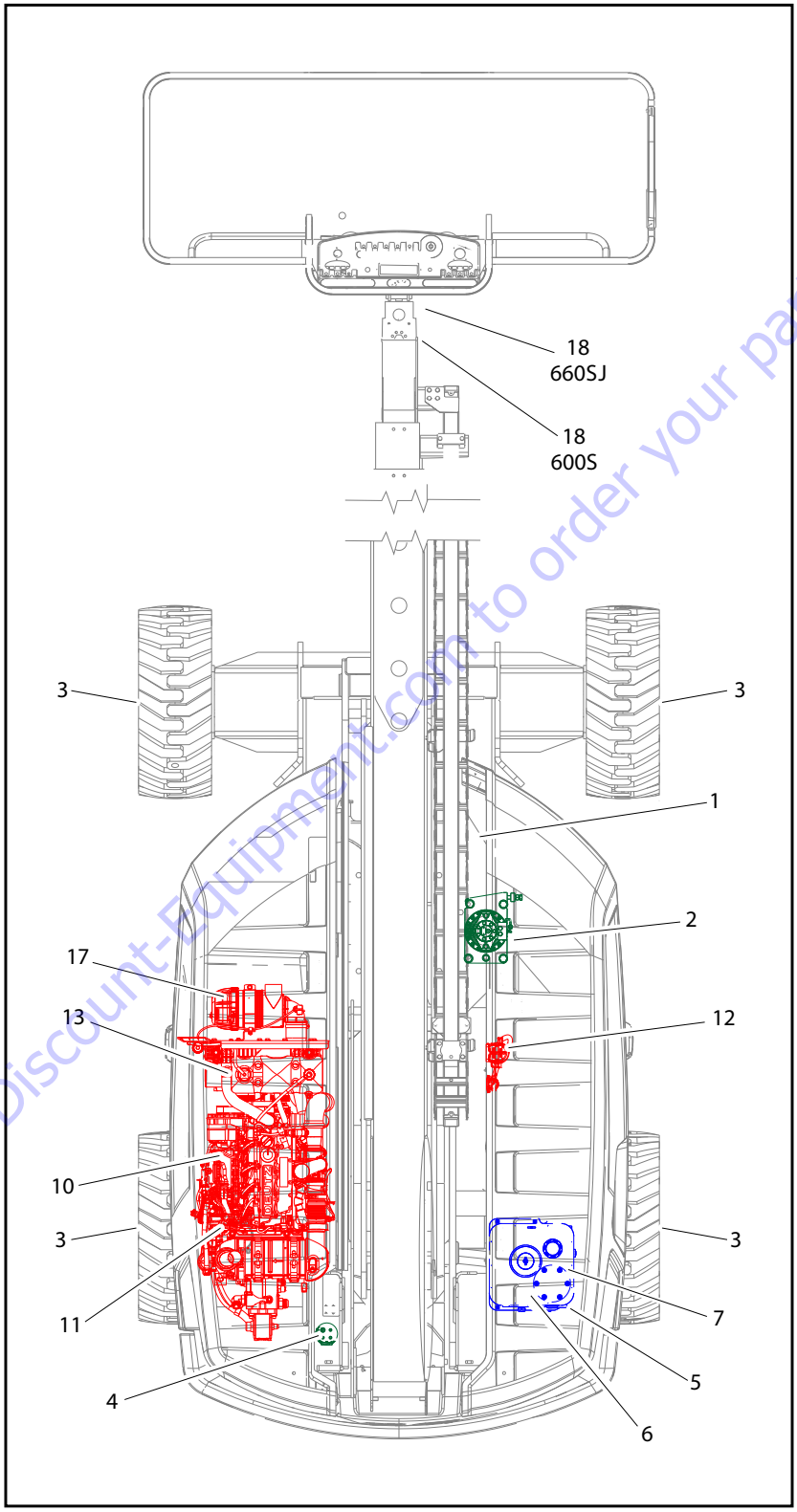


Figure 1-2. Maintenance and Lubrication Diagram - Deutz TD2.9/D2.9

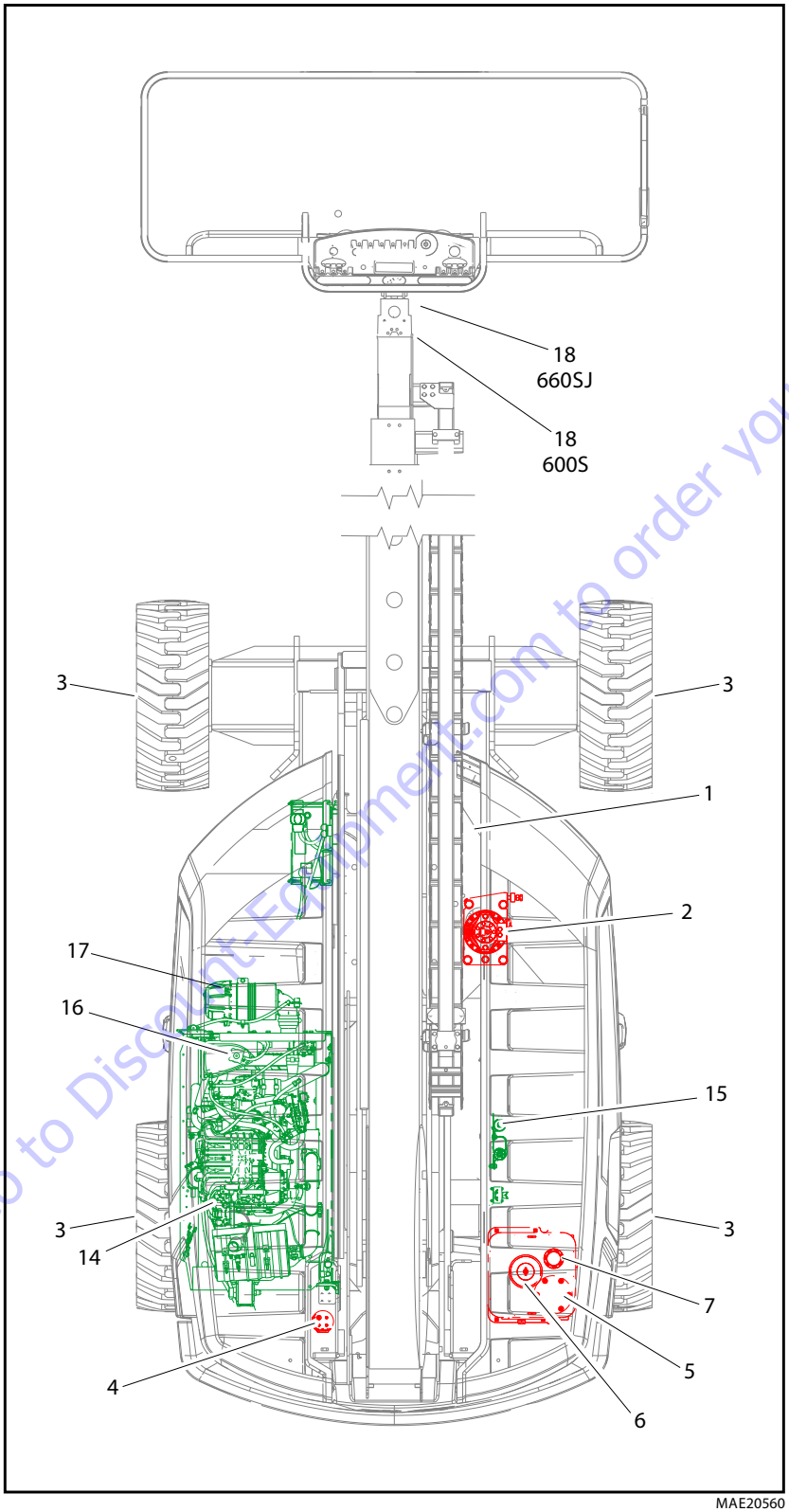


Figure 1-3. Maintenance and Lubrication Diagram - Ford MSG425

1.9 MAINTENANCE AND LUBRICATION

NOTE: *The following numbers correspond to those in Figure 1-1., Figure 1-2. and Figure 1-3.*

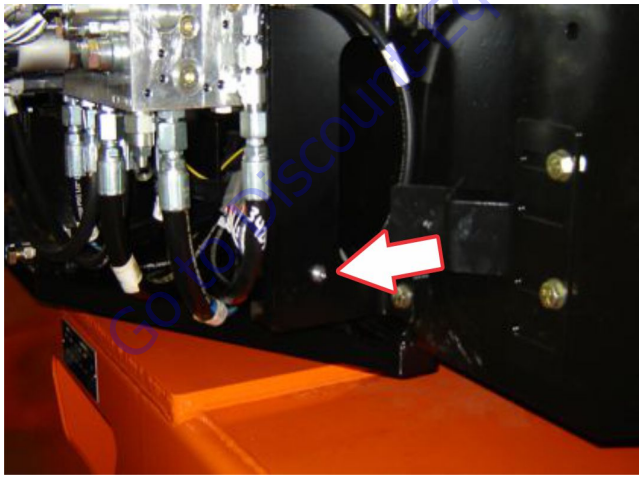
Table 1-14. Lubrication Specifications

KEY	SPECIFICATIONS
BG*	Bearing Grease (JLG Part No. 3020029) Mobilith SHC 460.
MPG	Multipurpose Grease having a minimum dripping point of 350° F (177° C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
HO	Hydraulic Oil. Refer Section 1.7, Hydraulic Oil.
EO	Engine (crankcase). Gas (5W30) - API SN, -Arctic ACEA AI/BI, A5/B5 - API SM, SL, SJ, EC, CF, CD - ILSAC GF-4. Diesel (15W40, 5W30 Arctic) - API CJ-4.
*MPG may be substituted for these lubricants, if necessary, but service intervals will be reduced.	

NOTICE

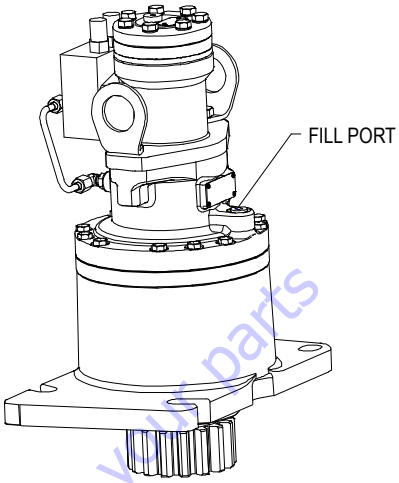
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

1. Swing Bearing



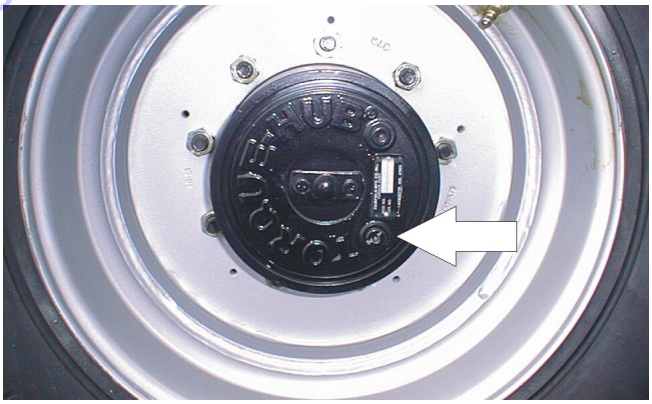
Lube Point(s) - 1 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Remote Access. Apply grease and rotate in 90 degree intervals until bearing is completely lubricated.

2. Swing Drive Hub



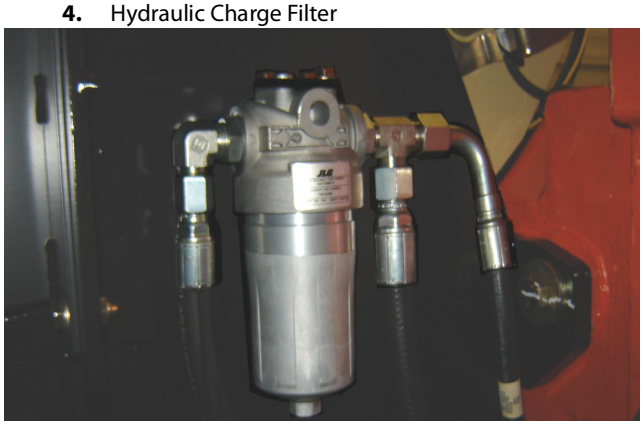
Lube Point(s) - Level/Fill Plug
Capacity - 32 oz. (0.95 L)
Lube - 80w90 Gear Oil
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation.

3. Wheel Drive Hub



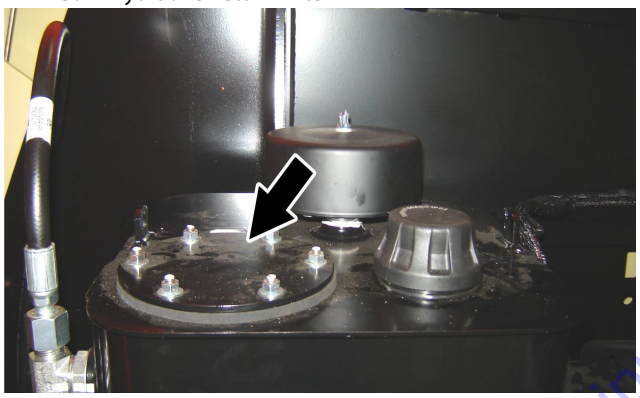
Lube Point(s) - Level/Fill Plug
Capacity - 24 oz. (0.7 L)
Lube - 80w90 Gear Oil
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation.

4. Hydraulic Charge Filter



Interval - Change after first 50 hrs. and every 6 months or 300 hrs.

5. Hydraulic Return Filter

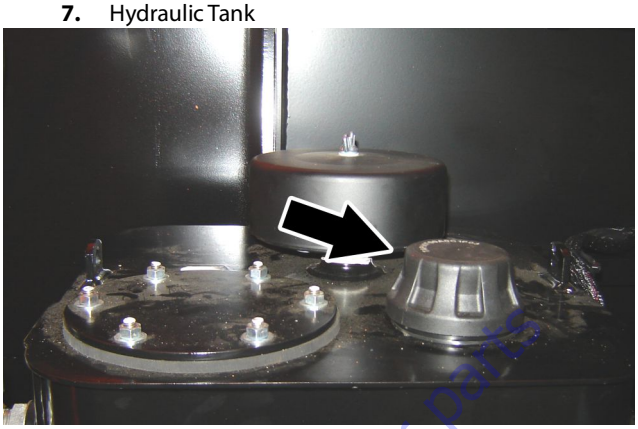


Interval - Change after first 50 hrs. and every 6 months or 300 hrs.

6. Hydraulic Tank Breather

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

7. Hydraulic Tank

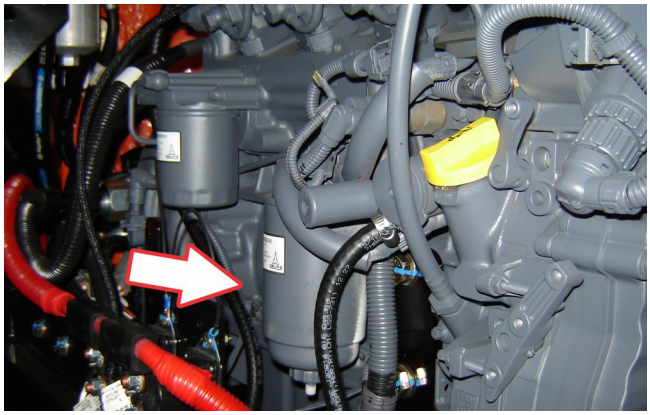


Lube Point(s) - Fill Cap
Capacity - 21 gal tank (79.5 L) 40.0 gal system (151 L)
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation
Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate all systems a minimum of two complete cycles and recheck oil level in reservoir.

8. Oil Change w/Filter - Deutz D2011

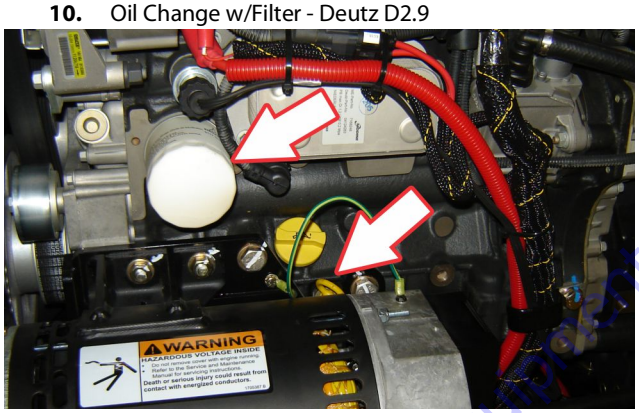
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 10 Quarts (9.4 L) Crankcase;
5 Quarts (4.8 L) Cooler
Type - Deutz approved engine oil.
Lube - EO
Interval - Every Year or 1200 hours of operation
Comments - Check level daily/Change in accordance with engine manual. Use Deutz approved engine oil type.

9. Fuel Filter - Deutz D2011



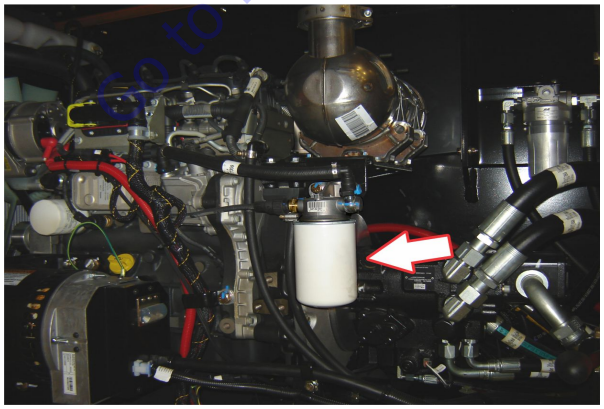
Lube Point(s) - Replaceable Element
Interval - Every Year or 600 hours of operation.

10. Oil Change w/Filter - Deutz D2.9



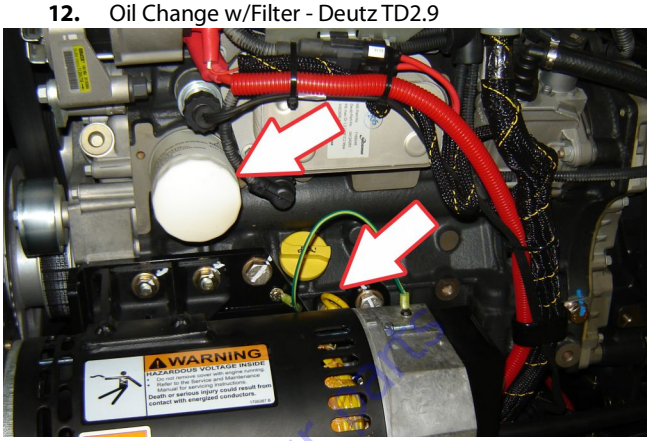
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 9.5 Quarts (9.0 L) Crankcase;
Lube - EO
Interval - Every Year or 1200 hours of operation
Comments - Check level daily/Change in accordance with engine manual.

11. Fuel Filter - Deutz D2.9



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

12. Oil Change w/Filter - Deutz TD2.9



Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 9.5 Quarts (9.0 L) Crankcase
Lube - EO
Interval - Every Year or 600 hours of operation (whichever comes first).
Comments - Check level daily/Change in accordance with engine manual.

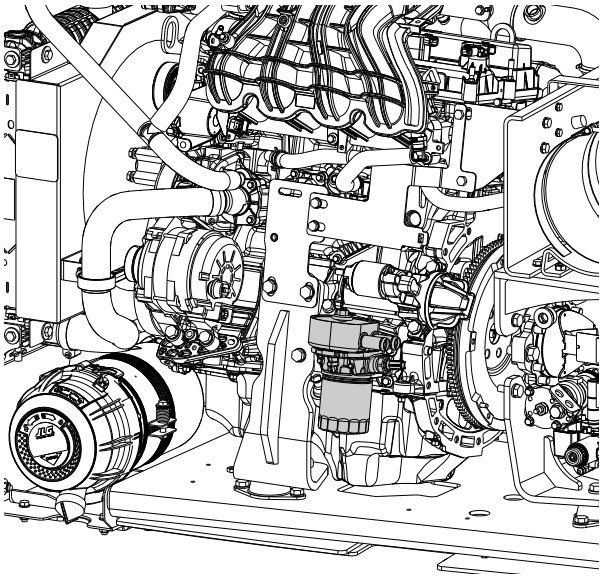
13. Fuel Pre-Filter - Deutz TD2.9/D2.9

Lube Point(s) - Replaceable Element
Interval - Drain water daily;
Filter must be replaced every year or 600 hours of operation (whichever comes first).

14. Engine Coolant - Deutz D2.9

Lube Point(s) - Fill Cap
Capacity - 13.2 quart (12.5 L)
Lube - Anti-Freeze
Interval - Check level daily; change every 1000 hours or two years, whichever comes first.

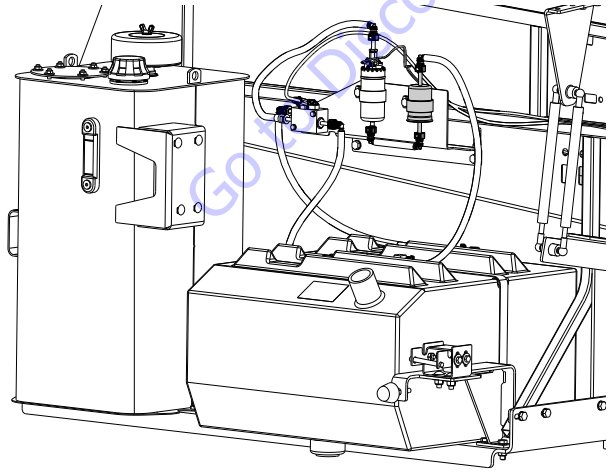
15. Oil Change w/Filter - Ford MSG425



MAE18190

Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 7 Quarts (6.6 L)
Lube - Ford-approved engine oil
Interval - Every Year or 300 hours of operation
Comments - Check level daily.

16. Fuel Filter - Ford MSG425



MAE21960

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

17. Engine Coolant - Ford MSG425

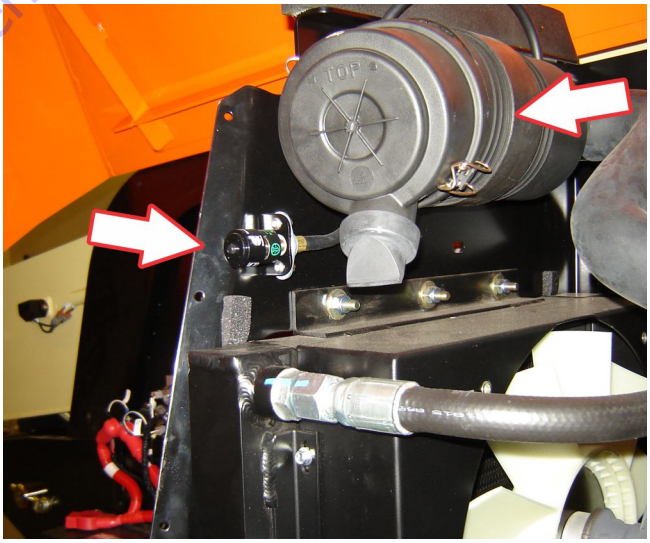
Lube Point(s) - Fill Cap
Capacity - 2 gal. (7.5 L)
Lube - Anti-Freeze
Interval - Check level daily; change every 1000 hours or two years, whichever comes first.

18. Air Filter Locations

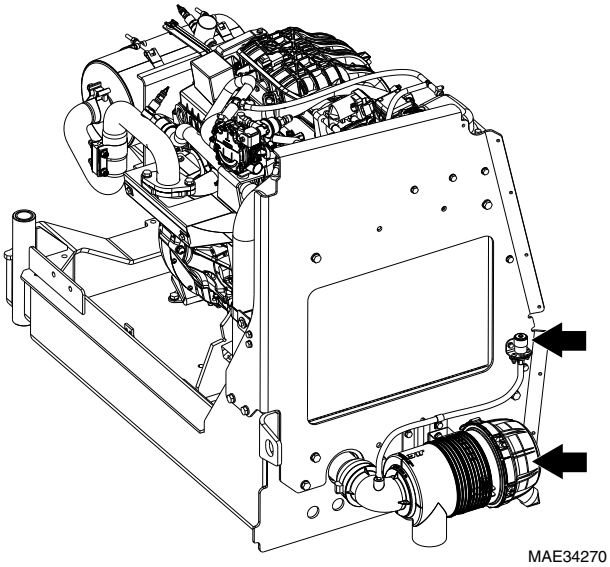
Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation or as indicated by the condition indicator.

A. Deutz D2.9L/TD2.9L

B. Deutz D2011

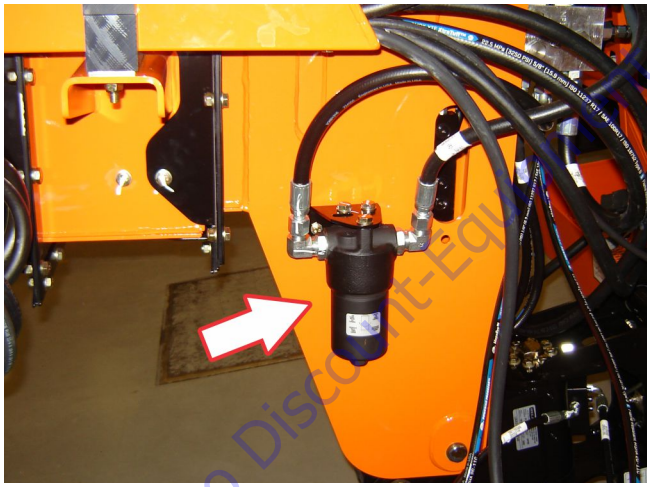


C. Air Filter - Ford MSG425

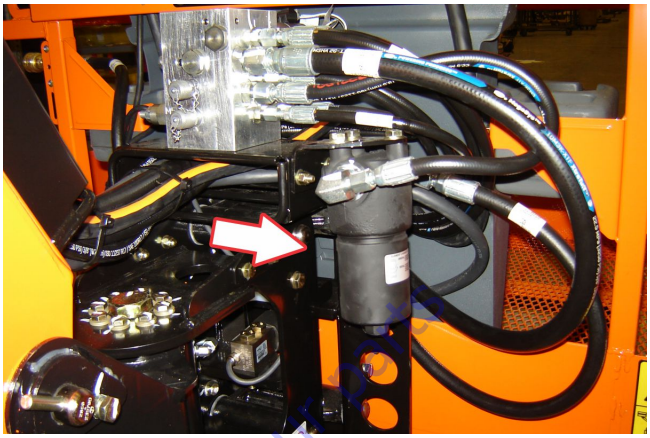


Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation or as indicated by the condition indicator.

19. A. Platform Filter - 600S

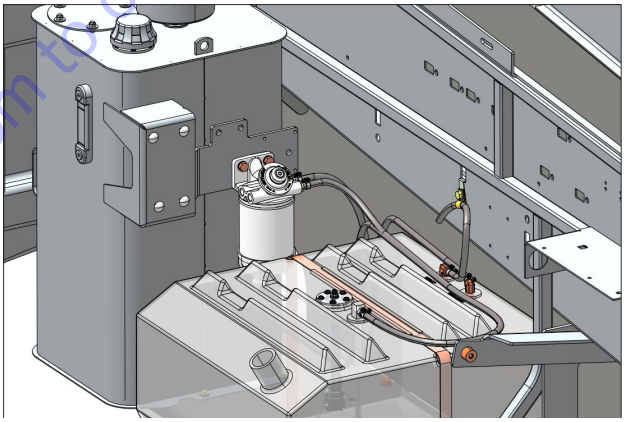


B. Platform Filter - 660SJ



Lube Point - Replaceable Element
Interval - Change after first 50 hours and then every year or 600 hours of operation, whichever comes first.

20. Optional Fuel Filter - Deutz D2011 - China Market



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

1.10 THREAD LOCKING 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.*

1.11 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

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
11/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
11/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
13/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
11/2	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

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

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

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.

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

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

Metric Fastener Torque Chart

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

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

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

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

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.

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

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.

SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

It is important to establish and conform to a comprehensive inspection and preventive maintenance program. The following table outlines periodic machine inspections and maintenance recommended by JLG Industries, Inc. Consult your national, regional, or local regulations for further requirements for mobile elevating work platform. 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 before use daily or at each change of operator. Reference the Operation and Safety Manual for Pre-Start Inspection procedures. The Operation and Safety Manual must be read and understood in its entirety before 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. 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 Inspection and Preventive Maintenance Schedule for items requiring inspection. Reference appropriate areas of this manual for servicing and maintenance procedures.

Annual Machine Inspection

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

Reference the JLG Annual Machine Inspection Form and Inspection and Preventive Maintenance Schedule for items requiring inspection. Reference 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 current machine ownership.

Preventive Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 SERVICE AND GUIDELINES

General

Following information is provided to assist you in using servicing and maintenance procedures in this manual.

Safety and Workmanship

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

Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and contamination out of vital components. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a schedule to function properly.
2. Any time air, fuel, or oil lines are disconnected, clean 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 contamination.
3. Clean and inspect all parts during servicing or maintenance. Ensure all passages and openings are unobstructed. Cover all parts to keep them clean. Make sure all parts are clean before they are installed. New parts should remain in their containers until ready to be used.

Components Removal and Installation

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

Component Disassembly and Reassembly

Complete procedural steps in sequence when disassembling or reassembling a component. Do not partially disassemble or assemble one part, then start on another. Always recheck your work to ensure nothing is overlooked. Do not make any adjustments, other than those recommended, without obtaining proper approval.

Pressure-Fit Parts

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

Bearings

1. When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used, but do not spin the bearing.
2. Discard bearings if 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 ready to install.
4. Lubricate new or used serviceable bearings before installation. Apply pressure to the outer race when pressing a bearing into a retainer or bore. Apply pressure to the inner race If bearing is installed on a shaft.

Gaskets

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

Bolt Usage and Torque Application

NOTICE

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

1. Always use new replacement hardware when installing locking fasteners. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
2. Unless specific torque requirements are given within the text, use standard torque values on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See "Torque Charts" on page 15.)

Hydraulic Lines and Electrical Wiring

Clearly mark or tag hydraulic lines and electrical wiring, and their receptacles, when disconnecting or removing them from the unit. This ensures correct re-installation.

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 needed to aid assembly.

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants can enter the system by using inadequate hydraulic oil; allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance; or allowing the pump to cavitate due to insufficient system warm-up or leaks in pump supply (suction) lines.

2. Design and manufacturing tolerances of component working parts are very close. The smallest amount of dirt or other contamination entering a system can cause wear or damage to components and faulty operation. Take every precaution to keep hydraulic oil clean - including reserve oil in storage. Check, clean, and replace hydraulic system filters as at intervals specified in the Lubrication Chart in Section 1. Always examine filters for metal particles.

3. Cloudy oils indicate high moisture content which permits organic growth and causes 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. They may not contain required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to ambient temperatures in which the machine is operating, are recommended for use.

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

Hydraulic Oil

1. Refer to Section 1 for viscosity ranges.

Changing Hydraulic Oil

1. Filter elements must be changed after the first 50 hours of operation and every 300 hours (unless specified otherwise) thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding specifications in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils.

2. Keep hydraulic oil clean. If oil must be poured from original container into another, clean all possible contaminants from the service container. Always clean filter mesh element and replace cartridge any time 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 machine back in service.

Lubrication Specifications

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

2.4 CYLINDER DRIFT

Theory

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

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

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

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

Cylinder Leakage Test

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

Measure drift at cylinder rod with a calibrated dial indicator.

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

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

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

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

Cylinder Thermal Drift

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
   - **a.** Excessive sloppiness in joints.
   - **b.** Noise originating from 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 (Clean pin before inspection):
   - **a.** Detectable bearing area wear.
   - **b.** Flaking, peeling, scoring, or scratches on pin surface.
   - **c.** Rusting of pin in bearing area.
4. Re-assembly of pinned joints using filament wound bearings:
   - **a.** Blow out housing using compressed air to remove all dirt and debris. Bearings and bearing housings must be free of all contamination.
   - **b.** Clean bearings and pins with solvent to remove all grease and oil.

NOTE: *Filament wound bearings are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).*

   - **c.** Inspect pin to ensure it is free of burrs, nicks, and scratches which can damage bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment:

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

Do Not Do The Following When Welding On Jlg Equipment:

- Do NOT ground on frame and weld on any other area than chassis.
- Do NOT ground on turntable and weld on any other area than turntable.
- Do NOT ground on platform/support and weld on any other area than platform/support.
- Do NOT ground on a specific boom section and weld on any other area than that specific boom section.
- Do NOT allow pins, wear pads, wire ropes, bearings, gearing, seals, valves, electrical wiring, or hoses to be between grounding position and welded area.

NOTICE

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Table 2-3. Inspection and Preventive Maintenance Schedule

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

Footnotes:

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

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

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

Performance Codes:

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

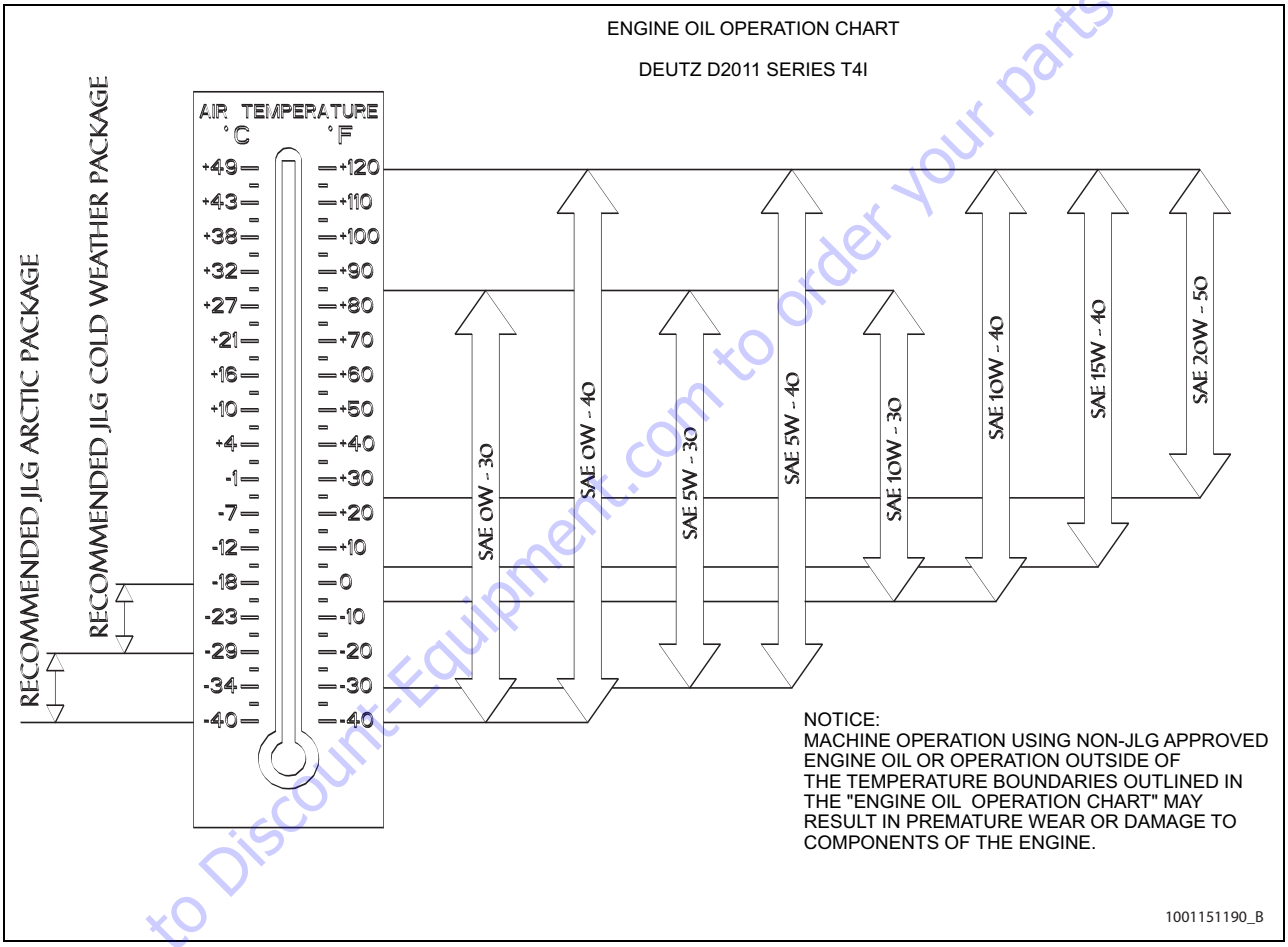


Figure 2-1. Engine Operating Temperature Specifications - Deutz D2011L04

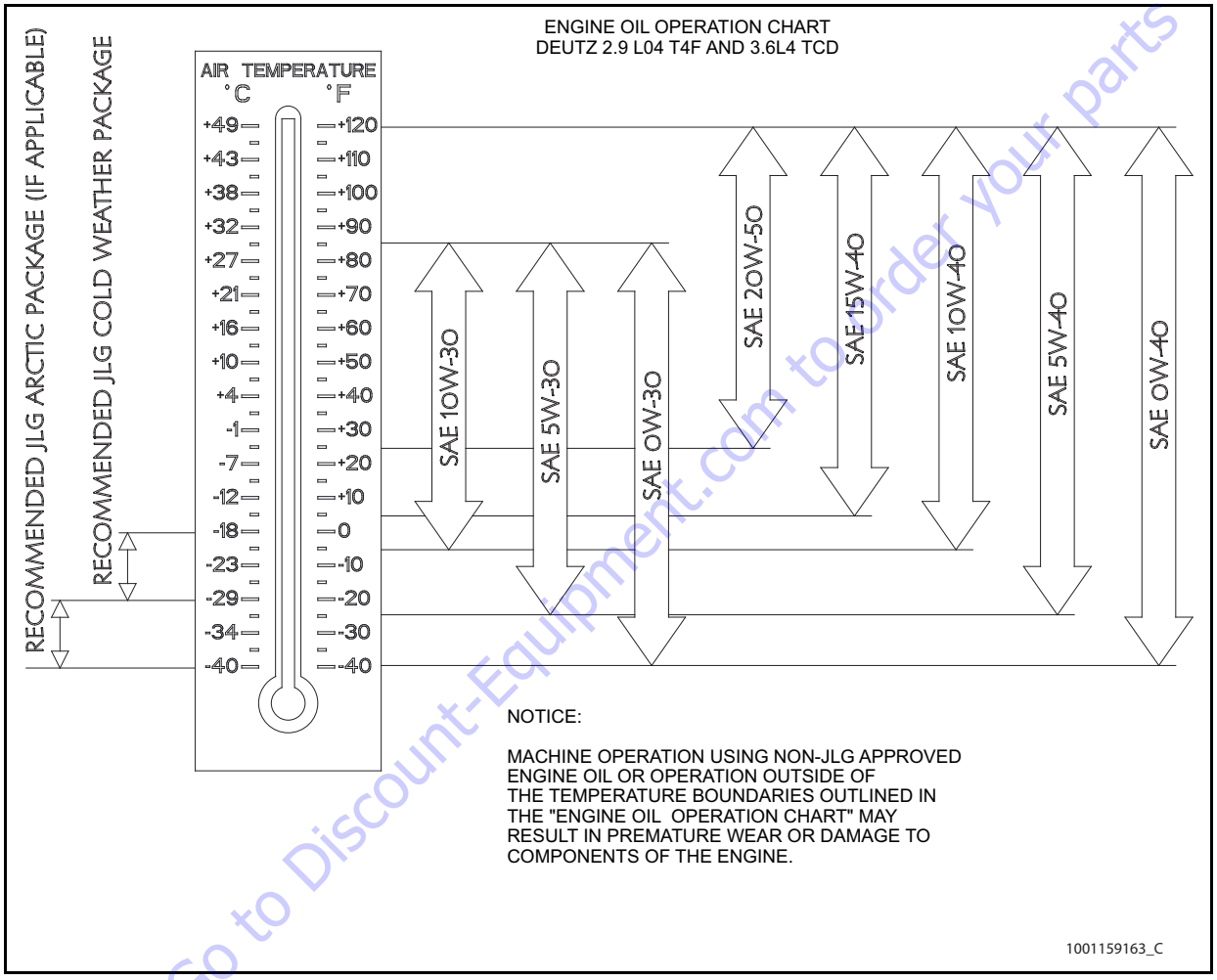


Figure 2-2. Engine Operating Temperature Specifications - Deutz TD2.9L4/D2.9L4

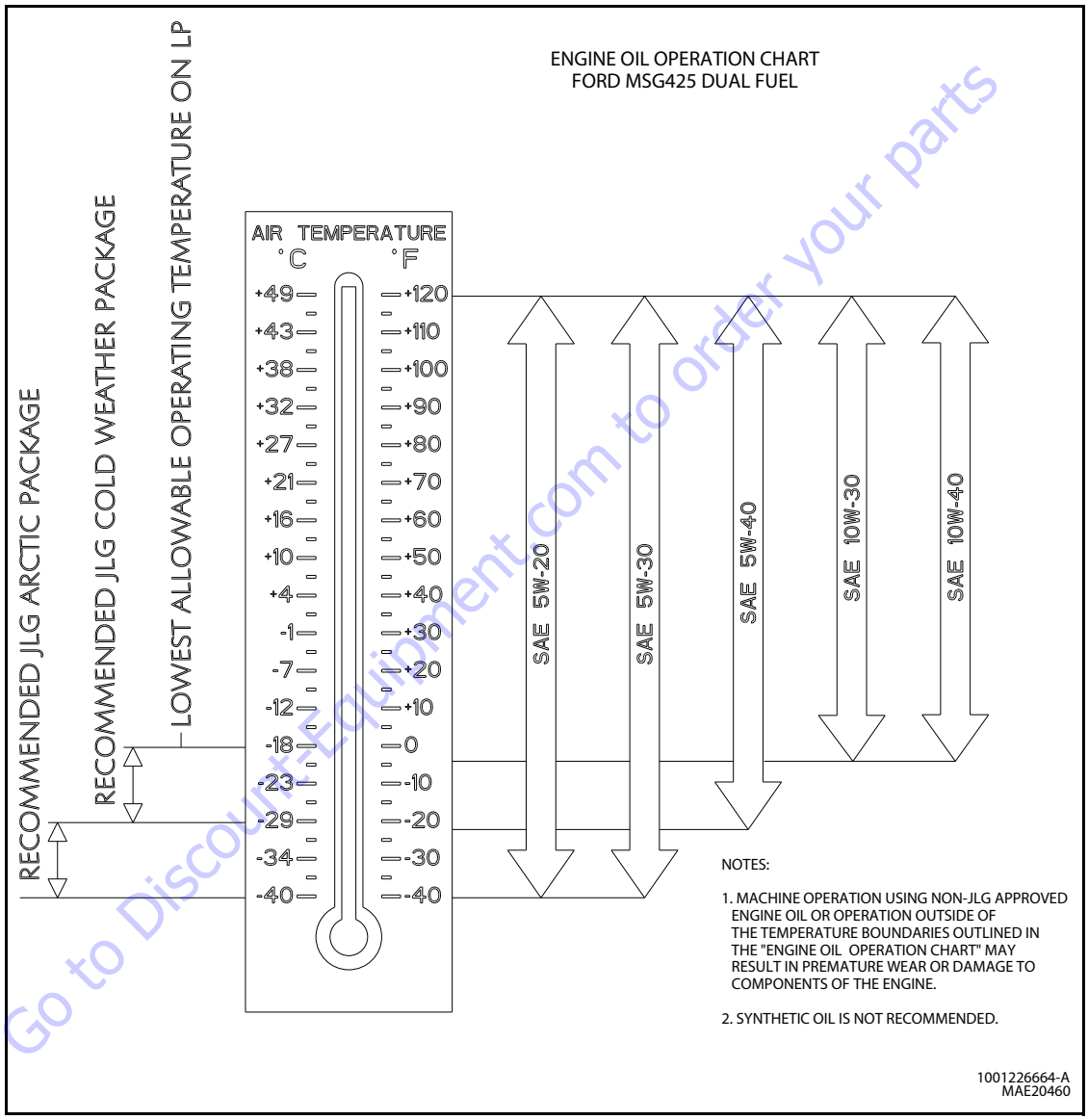
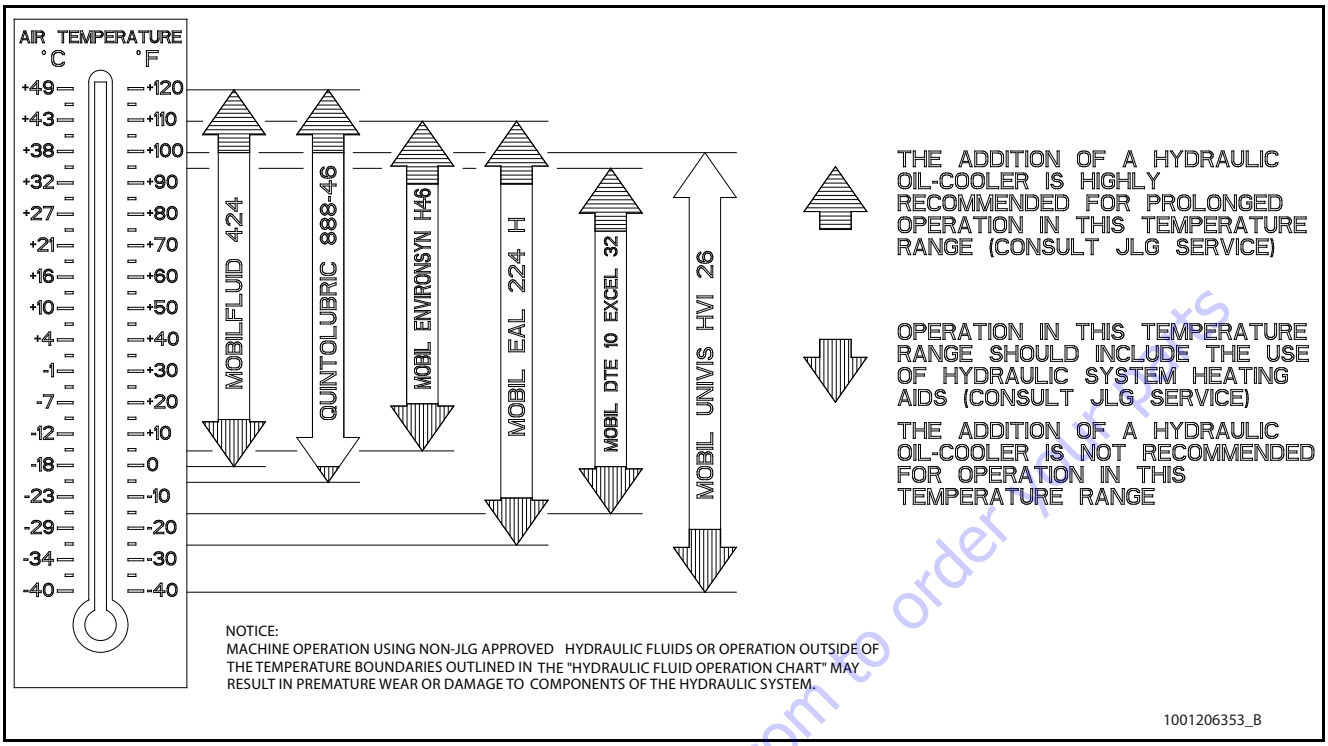


Figure 2-3. Engine Operating Temperature Specifications - Ford MSG425



Fluid	Properties		Base				Classifications		
Description	Viscosity at 40° C (cSt, Typical)	Viscosity Index	Mineral Oils	Vegetable Oils	Synthetic	Synthetic Polyol Esters	Readily Biodegradable*	Virtually Non-toxic**	Fire Resistant***
Mobilfluid 424	55	145	X						
Mobil DTE 10 Excel 32	32	141	X						
Univis HVI 26	26	376	X						
Mobil EAL 224 H	36	212		X			X	X	
Mobil Envirosyn H46	49	145			X		X	X	
Quintolubric 888-46	50	185				X	X	X	X

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

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

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

Figure 2-4. Hydraulic Oil Operating Temperature Specifications

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES & WHEELS

Tire Damage

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

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

If a tire is damaged but within above criteria, it must be inspected daily to ensure damage does not exceed 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 part number of 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. Due to size variations between tire brands, both tires on the same axle should be the same.

Wheel Replacement

Rims installed on each product model are 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 unsafe stability conditions.

Wheel Installation

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

⚠ WARNING

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

Tighten lug nuts to proper torque to prevent wheels from coming loose. Use a torque wrench to tighten fasteners. If you do not have a torque wrench, tighten fasteners with a lug wrench, then immediately have a service garage or dealer tighten lug nuts to proper torque.

Over-tightening will break studs or permanently deform mounting stud holes in wheels.

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:

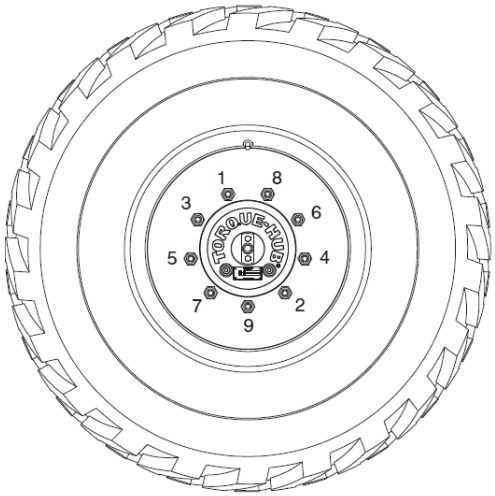


Figure 3-1. Wheel Lug Nut Tightening Sequence

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

Table 3-1. Wheel Torque Chart

TORQUE SEQUENCE		
1st Stage	2nd Stage	3rd Stage
40 ft-lbs. (55 Nm)	95 ft-lbs. (130 Nm)	170 ft-lbs. (230 Nm)

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

3.2 OSCILLATING AXLE BLEEDING PROCEDURE AND LOCKOUT TEST

Lockout Cylinder Bleeding

1. Start the engine.
2. Position the turntable to the normal stowed position.
3. Attach clear tubing to bleeder valve nipple.

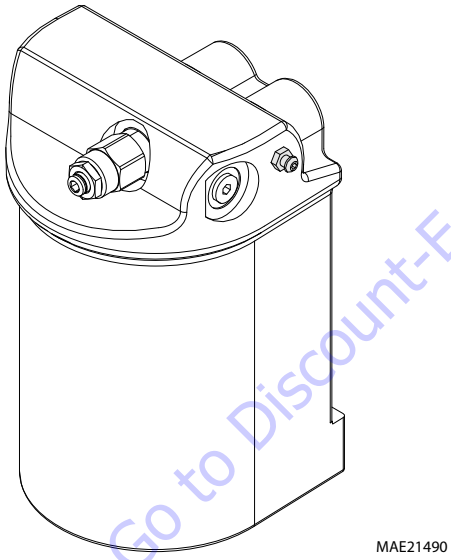


Figure 3-2. Bleeder Valve Location

4. Position a small bucket or bottle in front of the lockout cylinder bleeder valve and insert clear tubing.
5. Loosen the bleeder valve, turning counterclockwise slowly. Bleed air from the top of ram cylinder. Capture hydraulic oil until steady unbroken stream of hydraulic oil is viewed. Tighten or close the bleeder valve while stream of hydraulic oil is running.
6. Locate the bleeder valve on the opposite side lockout cylinder. Repeat the process.

Oscillating Axle Lockout Test

NOTICE

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

NOTE: *Ensure boom is fully retracted, lowered, and centered between drive wheels before starting lockout cylinder test.*

1. Place a 6 inch (15.2 cm) high block with ascension ramp in front of left front wheel.
2. From platform control station, start engine.
3. Place the Drive control lever to the forward position and carefully drive machine up ascension ramp until left front wheel is on top of block.
4. Carefully activate telescope and extend the boom at least 2 ft. (0.6 m).
5. Place Drive control lever to Reverse and drive machine off of block and ramp.
6. Have an assistant check to see that left front wheel remains locked in position off of ground.
7. Carefully activate telescope and return boom to stowed position. The lockout cylinders should release and allow wheel to rest on ground, it may be necessary to activate Drive to release cylinders.
8. Repeat the procedure for the right front wheel.
9. If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

3.3 CHASSIS TILT INDICATOR SYSTEM

The Chassis Tilt Indicator System measures the turntable angle with respect to level ground. The control system reads the reading and compares it to a pre-set turntable tilt angle value. When the machine is in transport position, it can travel at up to maximum speed until it tilts more than 8.0°, then the system will limit the drive speed to maximum displacement mode (slow drive speed). However, when the machine is out of transport position and the turntable tilts more than the pre-set value, the boom functions can only operate in creep speed mode, and the drive function is disabled. The operator has to return the machine into transport mode in order to continue to drive the machine. For machine setup see section 6.

3.4 COLD START SYSTEM (DIESEL)

The machine control system monitors the engine coolant and ambient temperature to make an assessment of cylinder pre-heating requirements. If the coolant temperature is below 50° C when control power is turned on, the glow plugs will be automatically fired for a duration that is based on the ambient temperature up to a maximum of 20 seconds. During this pre-heat period, the glow plug indicators will flash. The glow plugs will be turned off before the engine begins to crank.

3.5 AUXILIARY POWER SYSTEM

The Auxiliary Power System is intended as a secondary means to bring an operator from work height down to the ground in the event of primary power loss. This system uses an electric motor/pump unit powered by a 12V battery. It is not intended to be used as the main power source. All functions can be retracted or lowered and the jib can be lifted up. The auxiliary system levels the platform when lifting down. The drive function is excluded from the auxiliary system.

3.6 DRIVE ORIENTATION SYSTEM

The Drive Orientation System (DOS) indicates the conditions that could make the direction of movement of the chassis different than the direction of movement of the drive/steer control handle to the operator. The system indicates to the operator the need to match the black and white directional arrows on the platform control panel to the arrows on the chassis. The system uses a proximity switch mounted on the hydraulic swivel, an indicator light and a spring return override switch on the platform display panel. The proximity switch trips when the turntable is swung ± 45 degrees off center of the normal driving position. This occurs roughly when the main boom is swung past a rear tire. When the turntable is in the normal drive position with the boom between the rear tires, no indications or interlocks are made. When the machine is actively driving when the turntable is swung past the switch point, the system is ignored until drive/steer is released. When drive is initiated with the boom swung past the switch point, the DOS indicator will flash and the drive/steer functions will be disabled. The operator must engage the DOS override switch to enable Drive/steer (high drive will remain disabled). When the DOS is enabled, the DOS indicator will be illuminated continuously and a 3-second enable timer will be started and will continue for 3 seconds after the end of the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

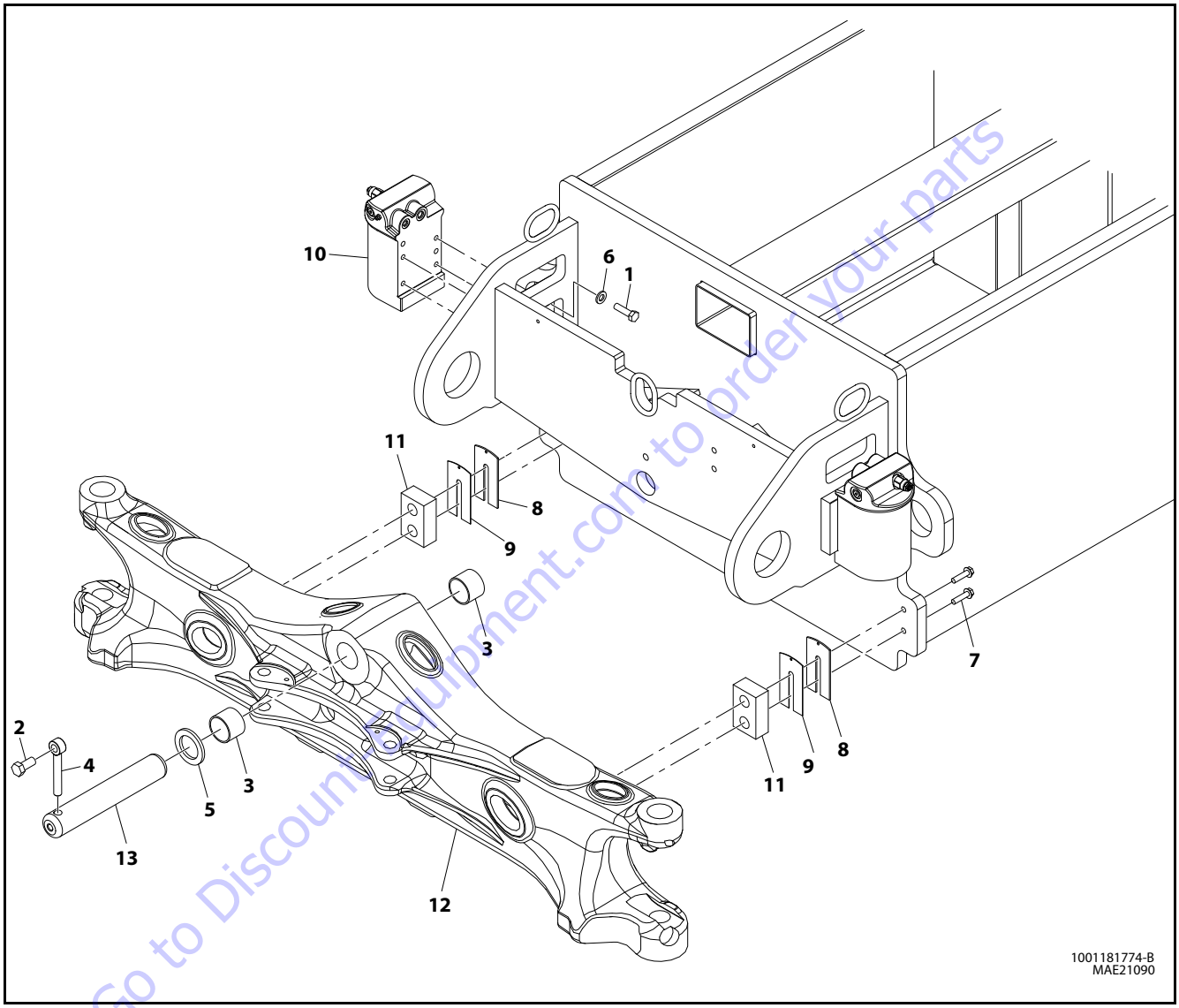
3.7 OSCILLATING AXLE SYSTEM

The oscillating front axle is attached to the frame by a pivot pin, which allows all four wheels to remain on the ground when traveling on rough terrain. The oscillating axle also incorporates two lockout cylinders connected between the frame and the axle. The lockout cylinders permit axle oscillation when the boom is in Transport Position as described in the Transport Position Sensing System and telescoped in. The lockout cylinders will hold down the oscillating axle to prevent its further movement if (1) the main boom arises more than 5° above horizontal (with respect to turntable); OR (2) the boom telescopes out 22.4 inches or more.

The UGM monitors the boom angle through the angular sensor mounted at the pin location that connects the main boom to the tension link and the boom telescope is monitored by two proxy switches mounted on the main boom side wall. When the UGM / Software determines the conditions to unlock the axle are met, electronic signals are sent to the 2-speed/lockout combination valve to supply hydraulic pilot pressures to the lockout cylinders. Pilot pressure is supplied via the Drive Pump charge pressure and the cylinders unlock when pilot pressure is applied to the holding valves mounted on the cylinders and lock when pilot pressure is removed. The first valve of the lockout combination valve is normally closed and opens when actuated to allow flow to the Lock-Out cylinders. The second valve (located between the first valve and the Lock-Out cylinders) is normally open to tank. This valve closes when actuated to block the tank path and force the flow to the Lock-Out cylinders. If either of these valves is in its normal state, the axle will be locked. The Ground Control Module supplies power and monitors the state of the boom elevation and extension sensors. If the sensor / switch states are not congruent, the Ground Control Module will remove power, thereby causing the oscillating axle to lock in the failsafe position until power is cycled.

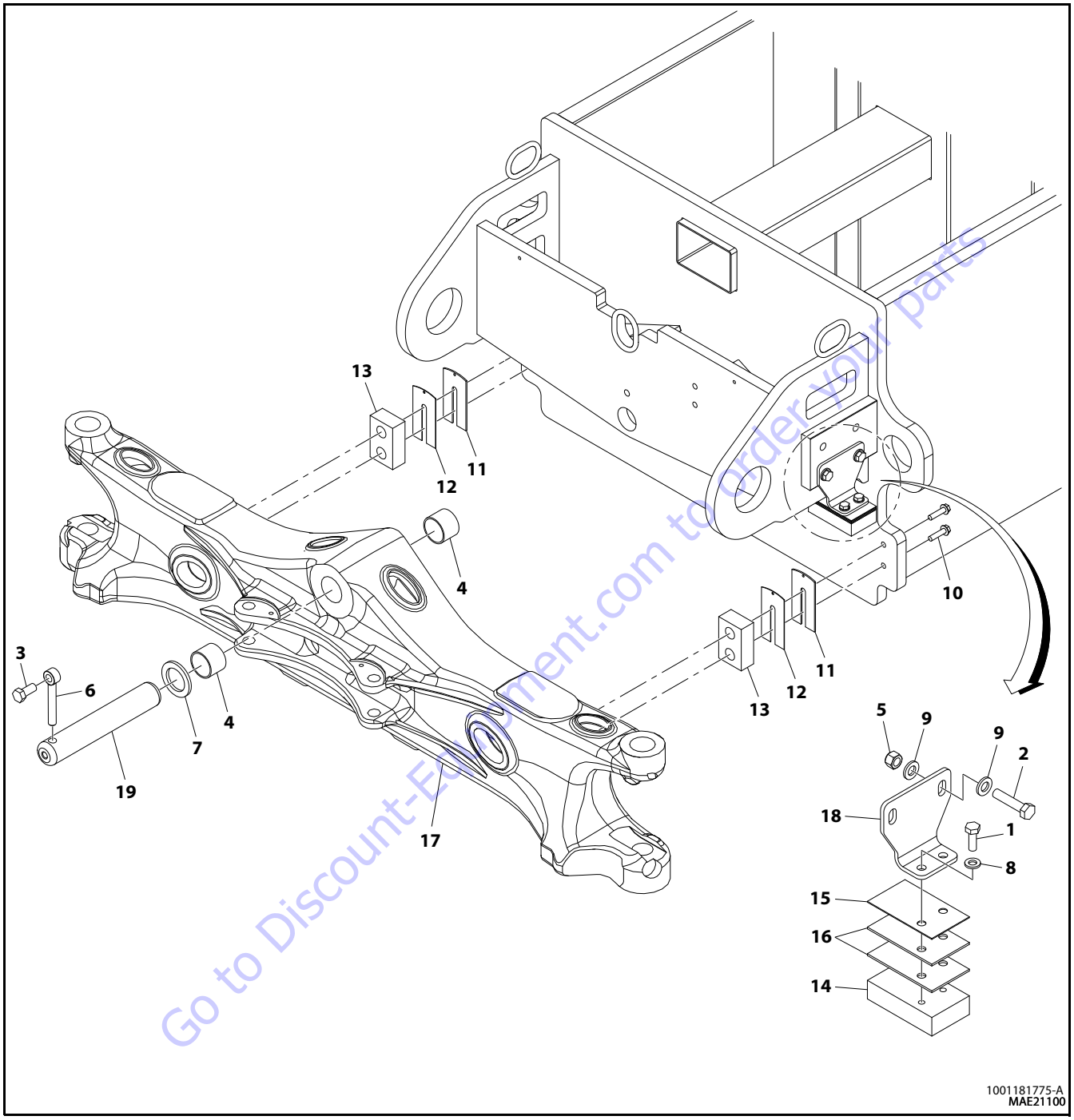
3.8 DRIVE SYSTEM

The four wheel drive system consists of one variable displacement closed loop pump, four variable displacement piston motors, gear reduction hubs and a traction control manifold that includes three flow dividers/combiners.
The two wheel drive system consists of one variable displacement closed loop pump, two variable displacement piston motors, gear reduction hubs and a traction control manifold that includes one flow dividers/combiner.
Drive speed is varied by a combination of drive pump displacement, engine speed, and motor displacement. Traction control is full time and is present in all drive modes. There are three drive modes that can be selected at the platform console. The functionality of the drive system is dependent on the position of the boom (In Transport or Out of Transport).



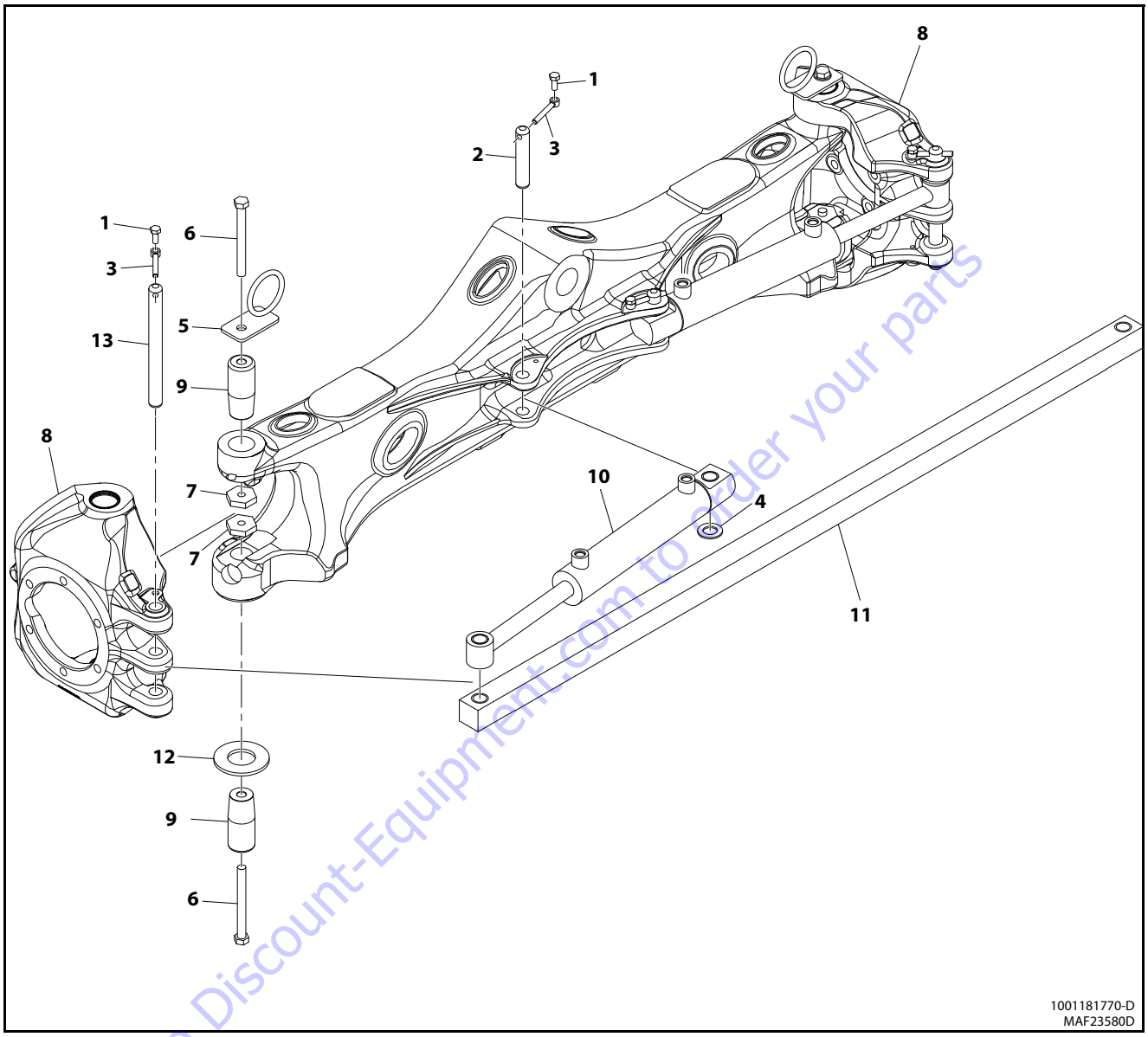
1. Bolt
2. Bolt
3. Bearing
4. Keeper Pin
5. Washer
6. Washer
7. Bolt
8. Shim
9. Shim
10. Axle Lockout Cylinder
11. Wear Pad
12. Axle
13. Pin

Figure 3-3. Axle Installation - Front



1. Bolt
2. Bolt
3. Bolt
4. Bearing
5. Nut
6. Keeper Pin
7. Washer
8. Washer
9. Washer
10. Bolt
11. Shim
12. Shim
13. Pad
14. Block
15. Shim
16. Shim
17. Axle
18. Bracket
19. Pin

Figure 3-4. Axle Installation - Rear



1. Bolt
2. Pin
3. Keeper Pin
4. Washer
5. Bracket
6. Bolt
7. Nut
8. Knuckle
9. Kingpin
10. Steer Cylinder Assembly
11. Tie-Rod
12. Bearing
13. Pin

Figure 3-5. Steering Installation

3.9 DRIVE HUB

Removal

NOTE: *Refer Figure 3-6., Drive Hub Installation*

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

NOTE: *The drive hub weighs approximately 110 lb (50 kg).*

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

Installation

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

NOTE: *The drive hub weighs approximately 110 lb (50 kg).*

2. Install the drive hub to the machine.
3. Use six bolts and attach the drive hub to the machine. Torque the bolts to 190 ft.lbs. (260 Nm).
4. Install previously removed hydraulic hoses to drive motor.

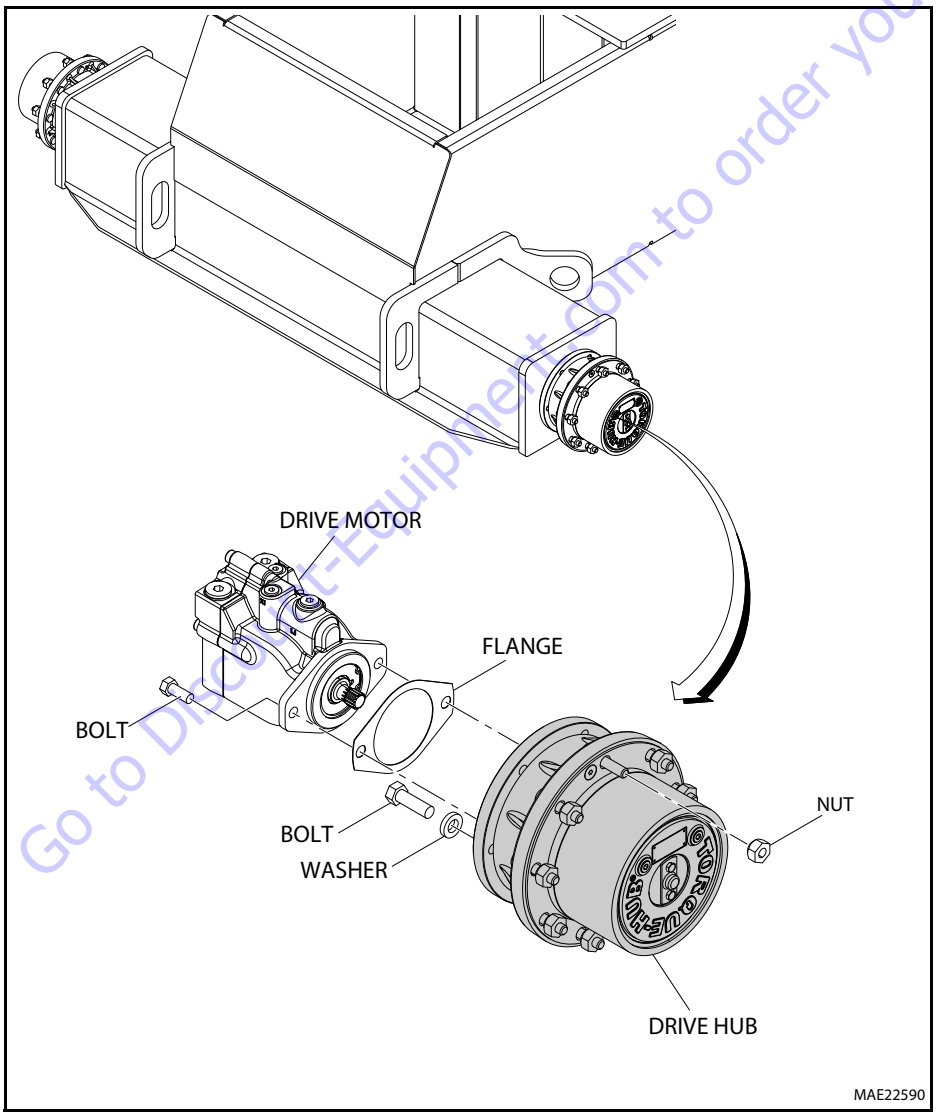


Figure 3-6. Drive Hub Installation

3.10 DRIVE MOTOR

Removal

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

1. Place machine on the firm level surface.
2. Tag and disconnect all hydraulic connections from the drive motor.
3. Use suitable lifting device to support the drive motor.

NOTE: *The drive motor weighs approximately 34 lb (15.4 kg).*

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

Assembly/Disassembly

For detail assembly/disassembly procedures, contact local JLG or local JLG dealer for information.

Installation

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

NOTE: *The drive motor weighs approximately 34 lb (15.4 kg).*

2. Install the drive motor to the machine.

⚠ CAUTION

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

3. Make sure that the pump shaft is properly aligned.
4. Use the two bolts and attach the drive motor to the machine. Tighten the bolts to torque 70 ft. lbs. (95 Nm).

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

5. Install drive brake on to the drive motor.
6. Remove tag from all disconnected hydraulic hoses.
7. Install Previously removed hydraulic hoses to the drive motor.
8. Start the machine and check the motor for proper functioning.

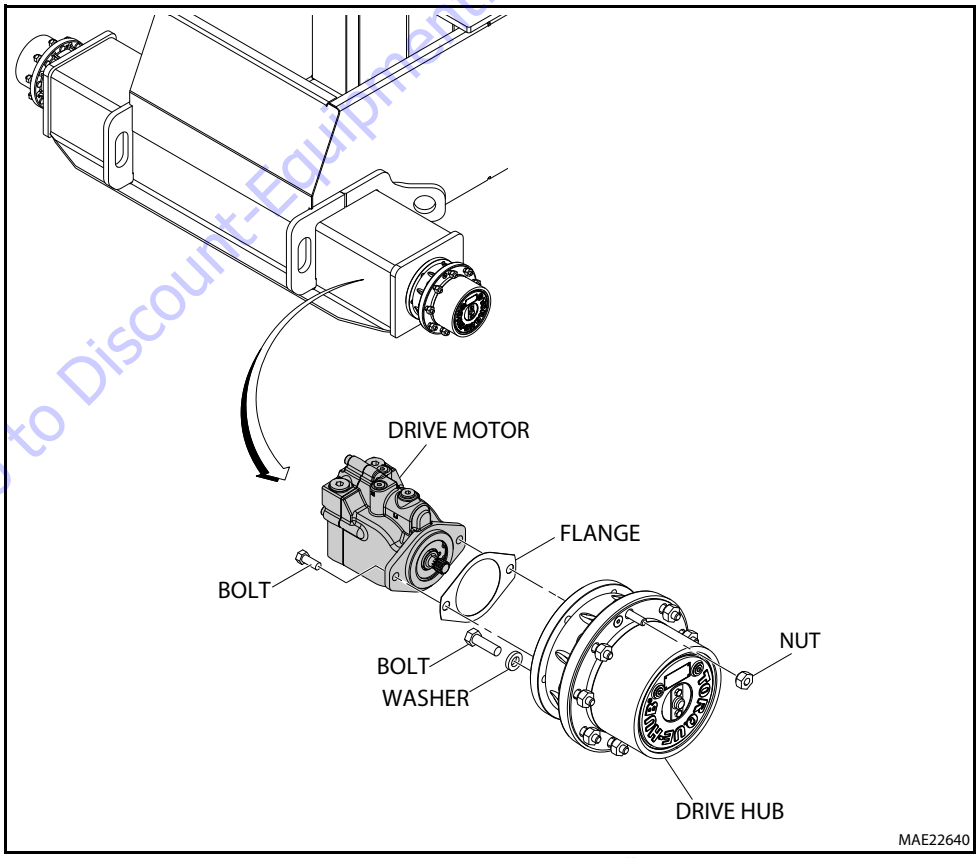


Figure 3-7. Drive Motor Installation

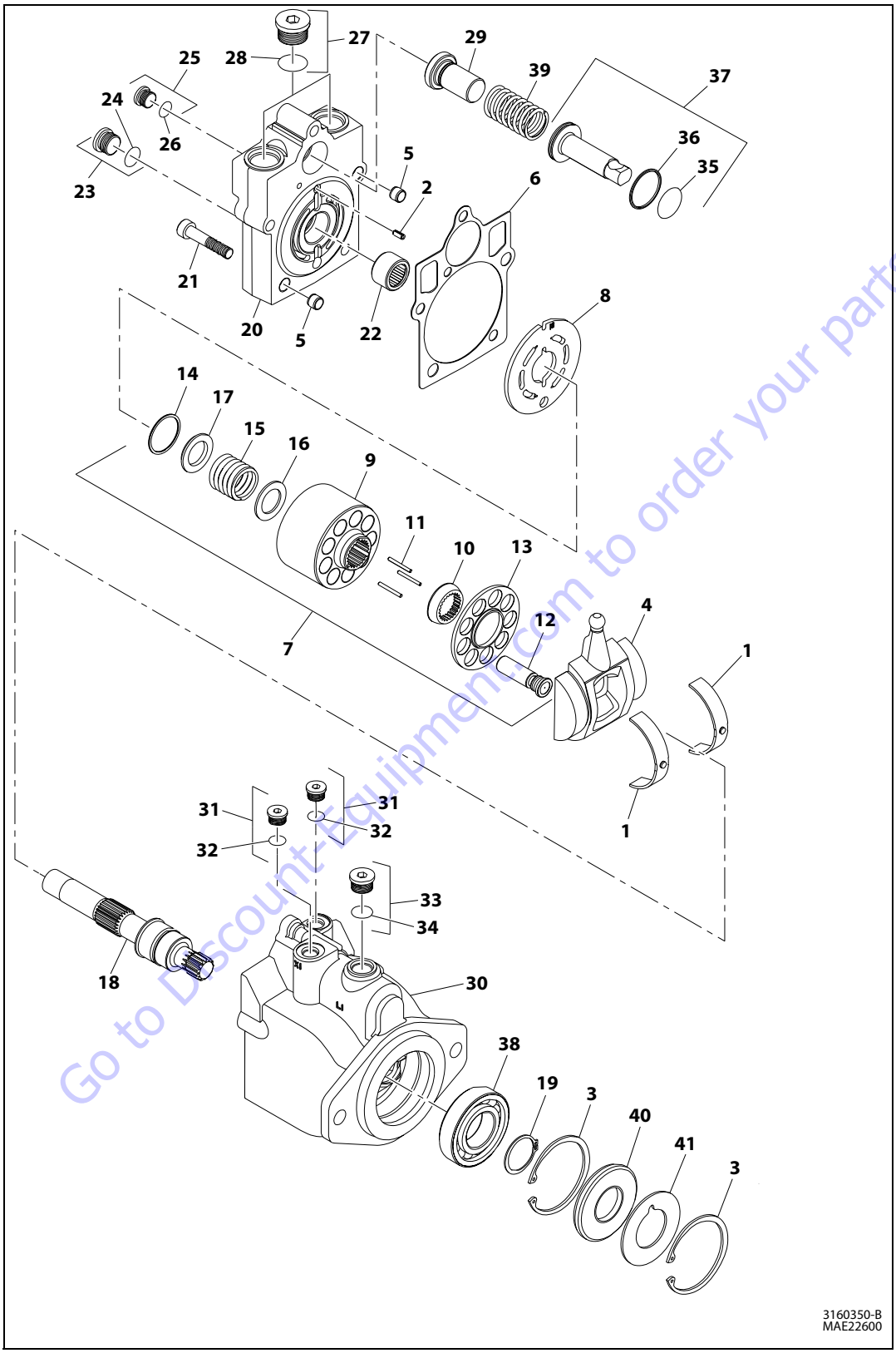


Figure 3-8. Drive Motor Assembly

1. Journal Bearing
2. Pin
3. Retaining Ring
4. Swash Plate
5. Pin
6. Gasket
7. Cylinder Block Kit
8. Valve Plate
9. Cylinder Block
10. Slipper Retainer Guide
11. Slipper Hold Down Pin
12. Piston Assembly
13. Slipper Retainer
14. Retaining Ring
15. Spring
16. Washer
17. Spring Retainer
18. Shaft
19. Retaining Ring
20. End - Axial Cap
21. Screw
22. Needle Bearing
23. Plug
24. O-Ring
25. Plug
26. O-Ring
27. Plug
28. O-Ring
29. Spring Seat
30. Housing
31. Plug
32. O-Ring
33. Plug
34. O-Ring
35. O-Ring
36. Seal Ring
37. Servo Piston
38. Bearing
39. Spring
40. Lip Seal
41. Support Washer

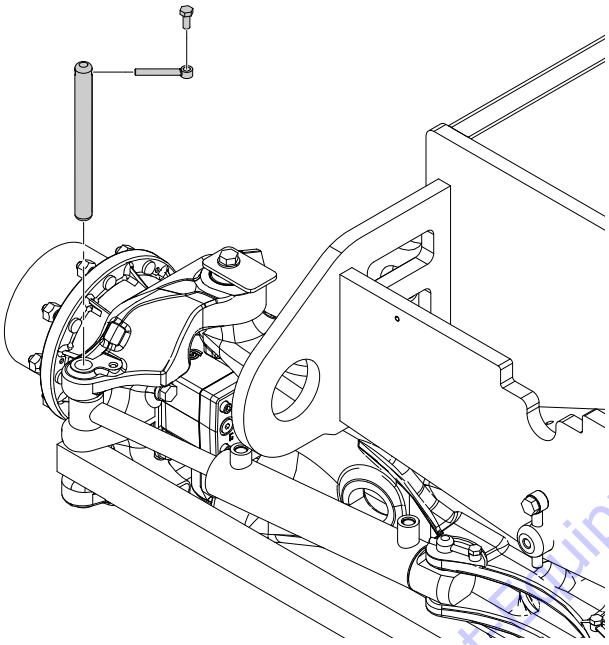
3.11 STEER CYLINDER

Removal

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

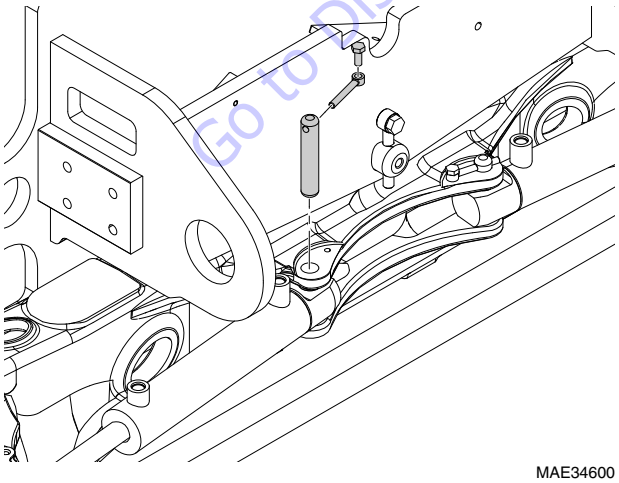
NOTE: *The steer cylinder weighs approximately 22 lb (10 kg).*

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



MAE34590

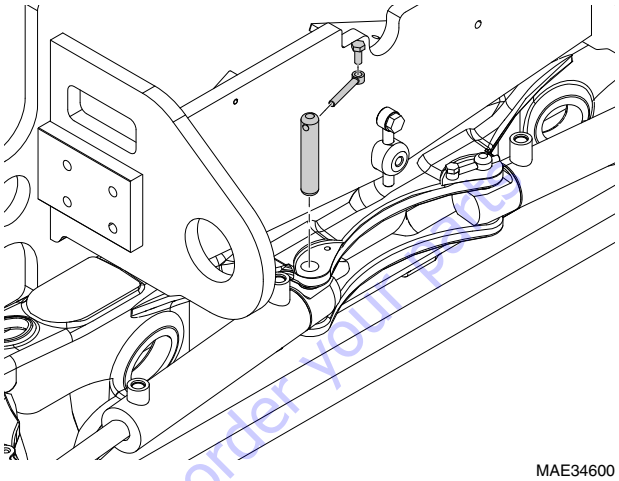
4. Remove the retaining pins and pivot pin from the barrel end of the cylinder and remove the cylinder from the machine.



MAE34600

Installation

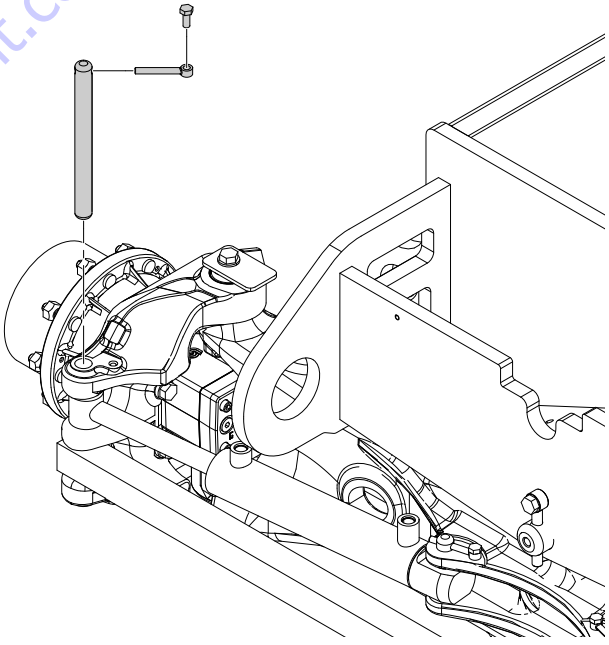
1. Using suitable lifting device, lift the steer cylinder into position and install the pivot pin and retaining pin into the barrel end of the cylinder.



MAE34600

NOTE: *The steer cylinder weighs approximately 22 lb (10 kg).*

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



MAE34590

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

3.12 SWING DRIVE HUB

Removal

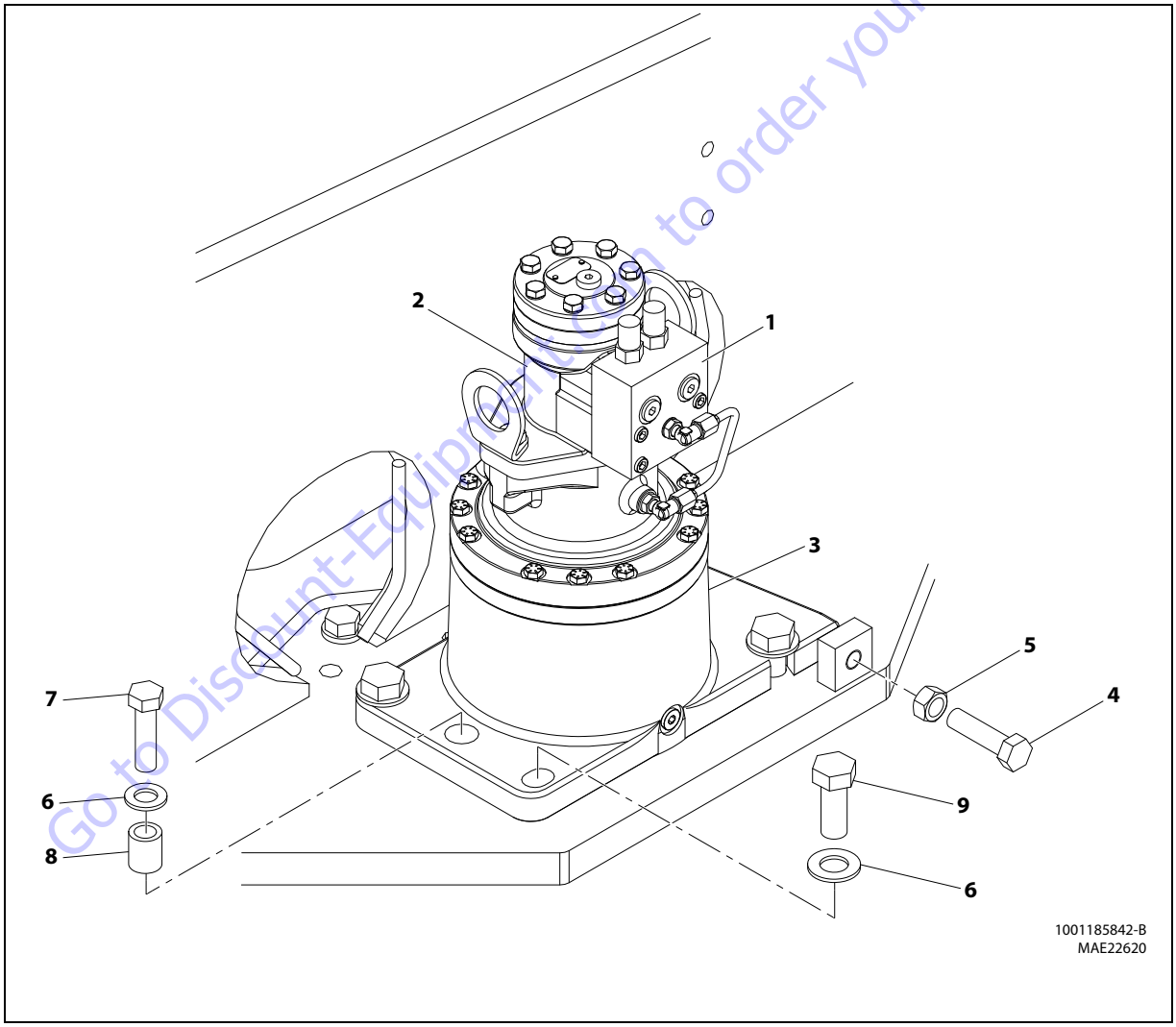
1. Gently loosen the jack bolt (4). Do not remove.
2. Remove the pivot bolt (7).
3. Remove the mounting bolts (9) securing swing drive hub to the turntable.
4. Using the suitable lifting device, remove the swing drive hub from mounting plate without damaging the swing gear.
5. Place swing drive hub in the clean area.
6. Refer to Section 3-9., Swing Drive Installation, for swing drive maintenance.

Assembly/Disassembly

For detail assembly/disassembly instructions, Refer Swing Drive Hub Manual (PN 3128853)

Installation

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



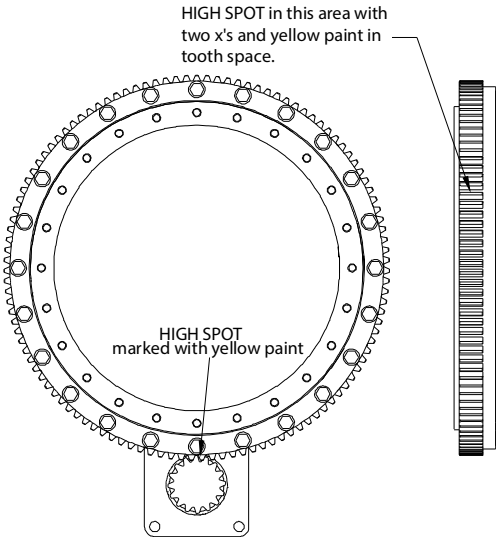
1. Motor Control Valve
2. Swing Motor
3. Swing Hub Assembly
4. Jack Bolt
5. Nut
6. Washer
7. Pivot Bolt
8. Spacer
9. Bolt

Figure 3-9. Swing Drive Installation

Procedure For Setting Swing Gear Backlash

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

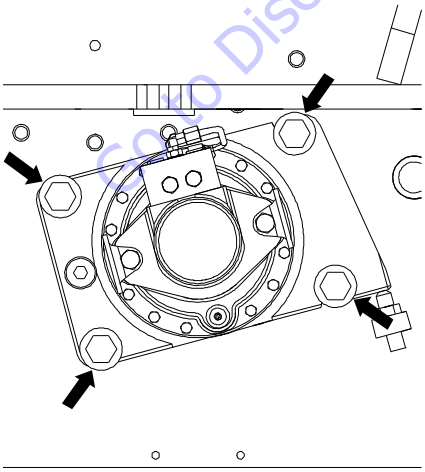
1. Place the machine on firm, level ground.
2. Place shim between pinion and bearing at bearing high spot (shown below).



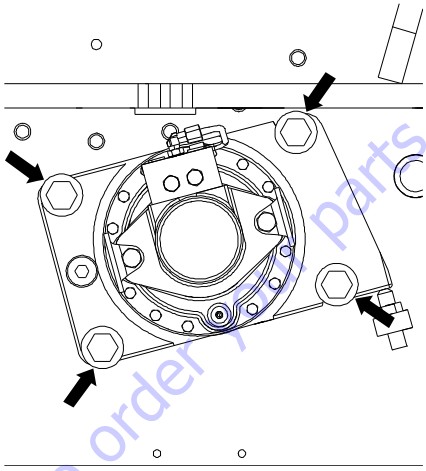
3. Apply High Strength Threadlocking Compound and torque pivot bolt to 205 ft. lbs. (280 Nm).

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

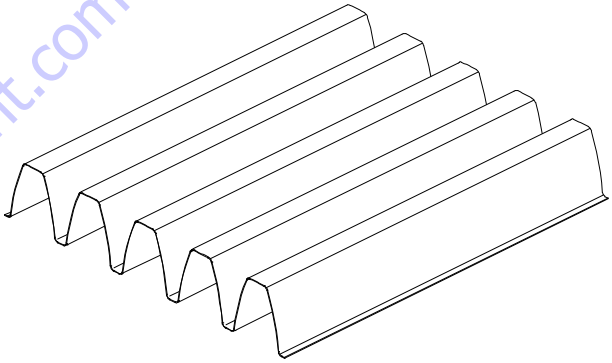
4. Remove turntable lock pin.
5. Apply High Strength Threadlocking Compound and pre-torque swing drive mounting bolts to 30 ft. lbs. (40 Nm).



6. Tighten jack bolt until pinion is completely snug against shim and bearing then loosen jack bolt.
7. Apply High Strength Threadlocking Compound and torque jack bolt 50 ft. lbs. (68 Nm).
8. Apply High Strength Threadlocking Compound and tighten jam nut.
9. Torque mounting bolts to 340 ft. lbs. (460 Nm).

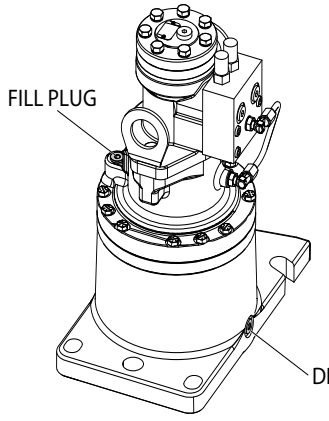


10. Remove shim and discard.



Swing Drive Lubrication

Fill Swing Drive Gearbox with 32 oz (0.946 L) 80w90 gear oil with EP additives. Oil should cover the ring gear. Torque pipe plug to 23-25 ft.lbs (31- 33 Nm).



3.13 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

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

1. Check frame to bearing. Attach bolts as follows:
   - **a.** Elevate fully retracted main boom to 70 degrees (full elevation).
   - **b.** At the positions indicated on figure 3-10 try and insert the 0.0015 inch (0.0381 mm) feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   - **c.** Assure that the 0.0015 inch (0.0381 mm) feeler gauge will not penetrate under the bolt head to the bolt shank.
   - **d.** Swing turntable 90 degrees and check some selected bolts are at the new position.
   - **e.** Continue rotating turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.
2. Check the turntable to bearing. Attach bolts as follows:
   - **a.** Elevate the fully retracted boom to 70 degrees (full elevation).
   - **b.** Try and insert the 0.0015" feeler gauge between bolt head and hardened washer at position shown in Figure 3-10.
   - **c.** Lower the boom to horizontal and fully extend the boom.
   - **d.** Try and insert the 0.0015" feeler gauge between bolt head and hardened washer at position shown in Figure 3-10.

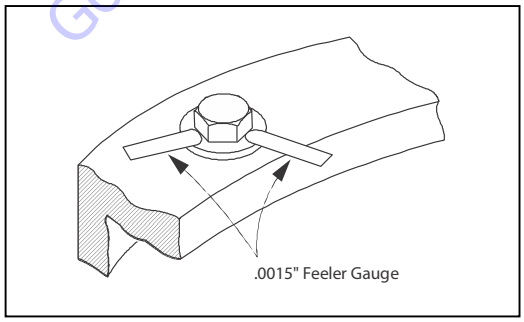


Figure 3-10. Swing Bearing Bolt Feeler Gauge Check

Wear Tolerance

1. From underside of the machine, at rear center, with the boom fully elevated and fully retracted, as shown in Figure 3-12., Swing Bearing Tolerance Measurement Location & Boom Placement A, using a magnetic base dial indicator, measure and record distance between swing bearing and turntable as shown in Figure 3-11., Swing Bearing Tolerance Measuring Point.
2. At the same point, with the boom horizontal and fully extended, as shown in the Figure 3-12., Swing Bearing Tolerance Measurement Location & Boom Placement B, using a magnetic base dial indicator, measure and record distance between swing bearing and turntable as shown in Figure 3-11., Swing Bearing Tolerance Measuring Point.
3. If difference is greater than 0.079 inch (2.00 mm), is determined, the swing bearing should be replaced.
4. If a difference less than 0.079 inch (2.00 mm) is determined, and any of the following conditions exist, the bearing should be removed, disassembled, and inspected for the following:
   - **a.** Metal particles in grease.
   - **b.** Increased drive power required.
   - **c.** Noise.
   - **d.** Rough rotation.
5. If bearing inspection shows no defects, reassemble and return to service.

NOTICE

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

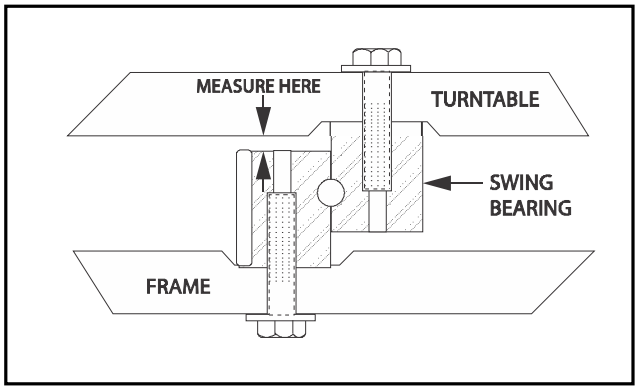


Figure 3-11. Swing Bearing Tolerance Measuring Point

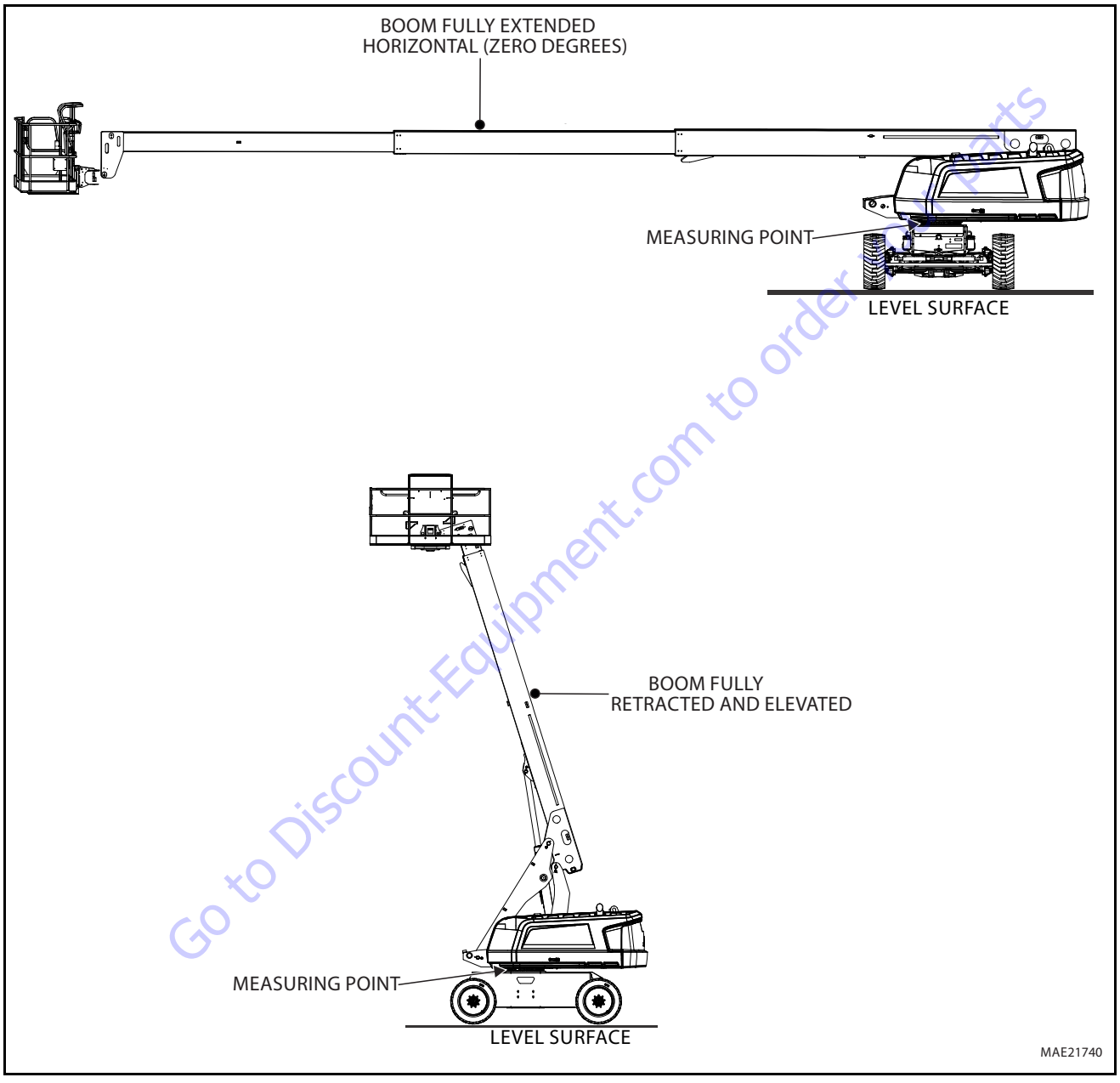


Figure 3-12. Swing Bearing Tolerance Measurement Location & Boom Placement

Swing Bearing Replacement

REMOVAL

1. From Ground Control station, place the boom in a level position.

⚠ WARNING

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

2. Adequately secure the boom to the rear of the turntable, as shown in Figure 3-14., Swing Bearing Removal - 600S and Figure 3-15., Swing Bearing Removal - 660SJ.
3. Using the front lifting eyes in the turntable and a location on the boom equidistant from the center of gravity, as shown in Figure 3-14., Swing Bearing Removal - 600S and Figure 3-15., Swing Bearing Removal - 660SJ, secure the turntable assembly with adequate lifting equipment.
4. From inside turntable, remove mounting hardware attaching rotary coupling retaining yoke brackets to turntable.

NOTICE

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

5. Tag and disconnect hydraulic lines from the fittings on the top of the rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.
6. Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the turntable to the bearing inner race. Discard the bolts.
7. Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame-mounted components.
8. Carefully place the turntable on a suitably supported trestle.
9. Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing from the frame, then move the bearing to a clean, suitably supported work area.

INSTALLATION

1. Using suitable lifting equipment, carefully lower the swing bearing into position on the frame. Ensure the scribed line of the outer race of the bearing aligns with the scribed line on the frame. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the frame.

⚠ CAUTION

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

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

⚠ CAUTION

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

3. Refer to the Torque Sequence diagram as shown in Figure 3-13., Swing Bearing Torque Sequence, Swing Bearing Torque Sequence Clean any residue off the new bearing bolts, then apply a light coating of High Strength Threadlocking Compound and install the bolts and washers through the frame and outer race of the bearing. Tighten the bolts to an initial torque of 190 ft. lbs. (260 Nm) w/Threadlocking Compound.
4. Remove the lifting equipment from the bearing.
5. Using suitable lifting equipment, carefully position the turntable assembly above the machine frame.
6. Carefully lower the turntable onto the swing bearing, ensuring that the scribed line of the inner race of the bearing aligns with scribed line on the turntable. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the turntable.
7. Clean any residue off the new bearing bolts, then apply a light coating of High Strength Threadlocking Compound and install the bolts and washers through the turntable and inner race of the bearing.
8. Following the Torque Sequence diagram shown in Figure 3-13., Swing Bearing Torque Sequence, tighten the bolts to a torque of 190 ft. lbs. (260 Nm) w/Threadlocking Compound.
9. Install the rotary coupling retaining yoke brackets, apply a light coating of Medium Strength Threadlocking Compound to the attaching bolts and secure the yoke to the turntable with the mounting hardware.

10. Connect the hydraulic lines to the rotary coupling as tagged prior to removal.
11. Remove the lifting equipment.
12. Unsecure the boom from rear of turntable.
13. At ground control station, use boom lift control to lower boom to stowed position.
14. Using all applicable safety precautions, activate the hydraulic system and check the swing system for proper and safe operation.

Swing Bearing Torque Values

1. Outer Race - 190 ft-lb (260 Nm) w/Threadlocking Compound.
2. Inner Race - 190 ft-lb (260 Nm) w/Threadlocking Compound.
3. See Figure 3-13., Swing Bearing Torque Sequence.

⚠ WARNING

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

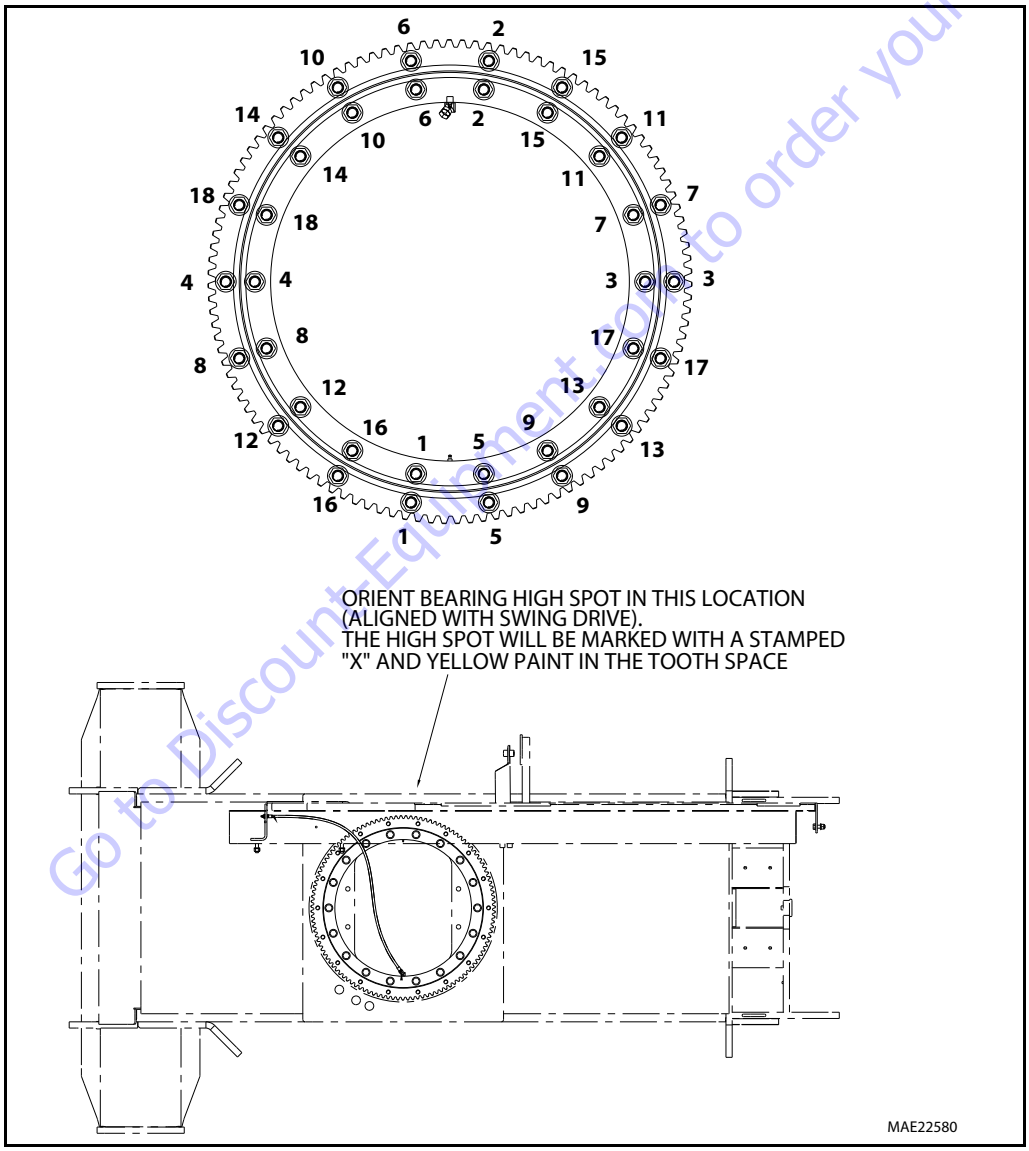


Figure 3-13. Swing Bearing Torque Sequence

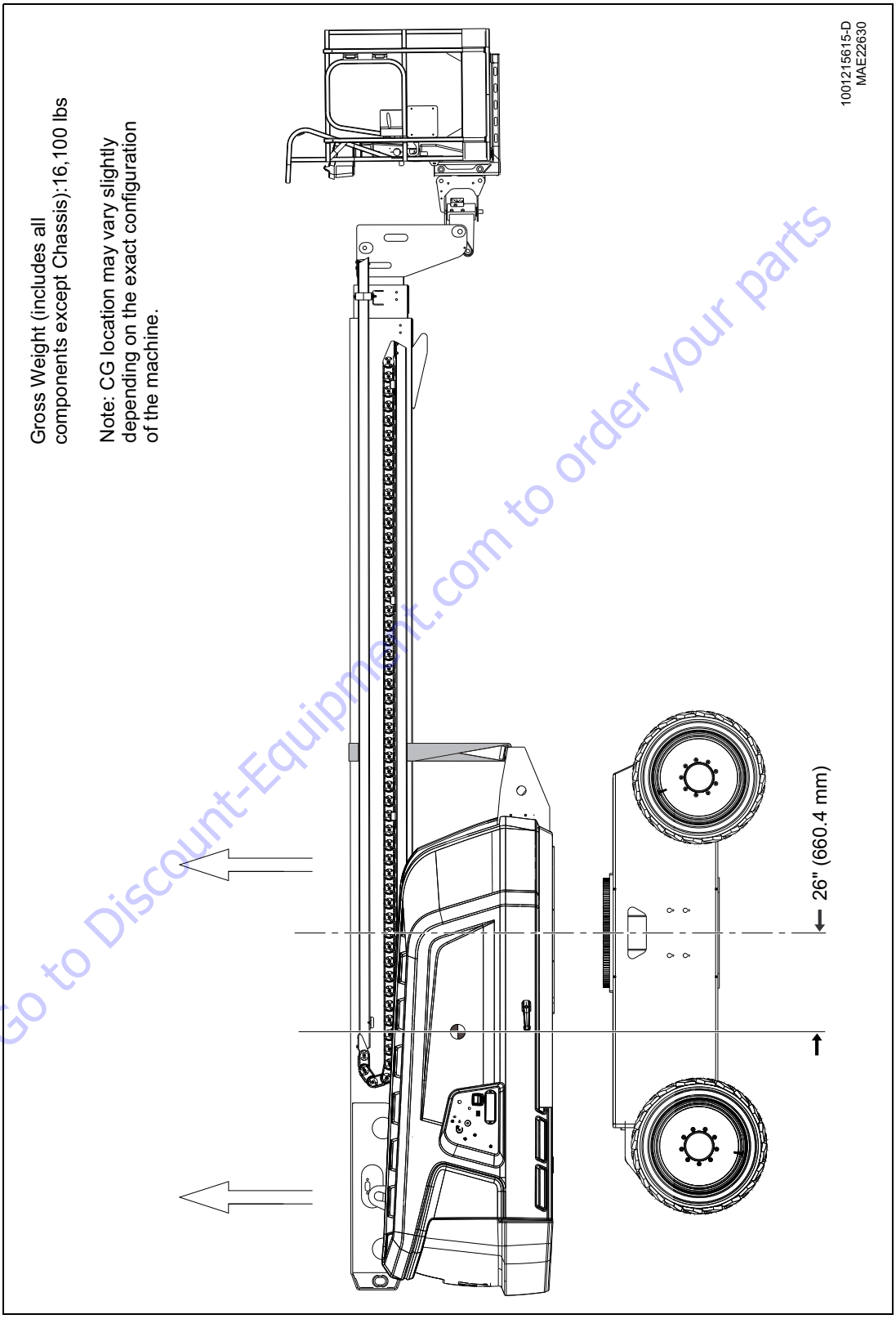


Figure 3-14. Swing Bearing Removal - 600S

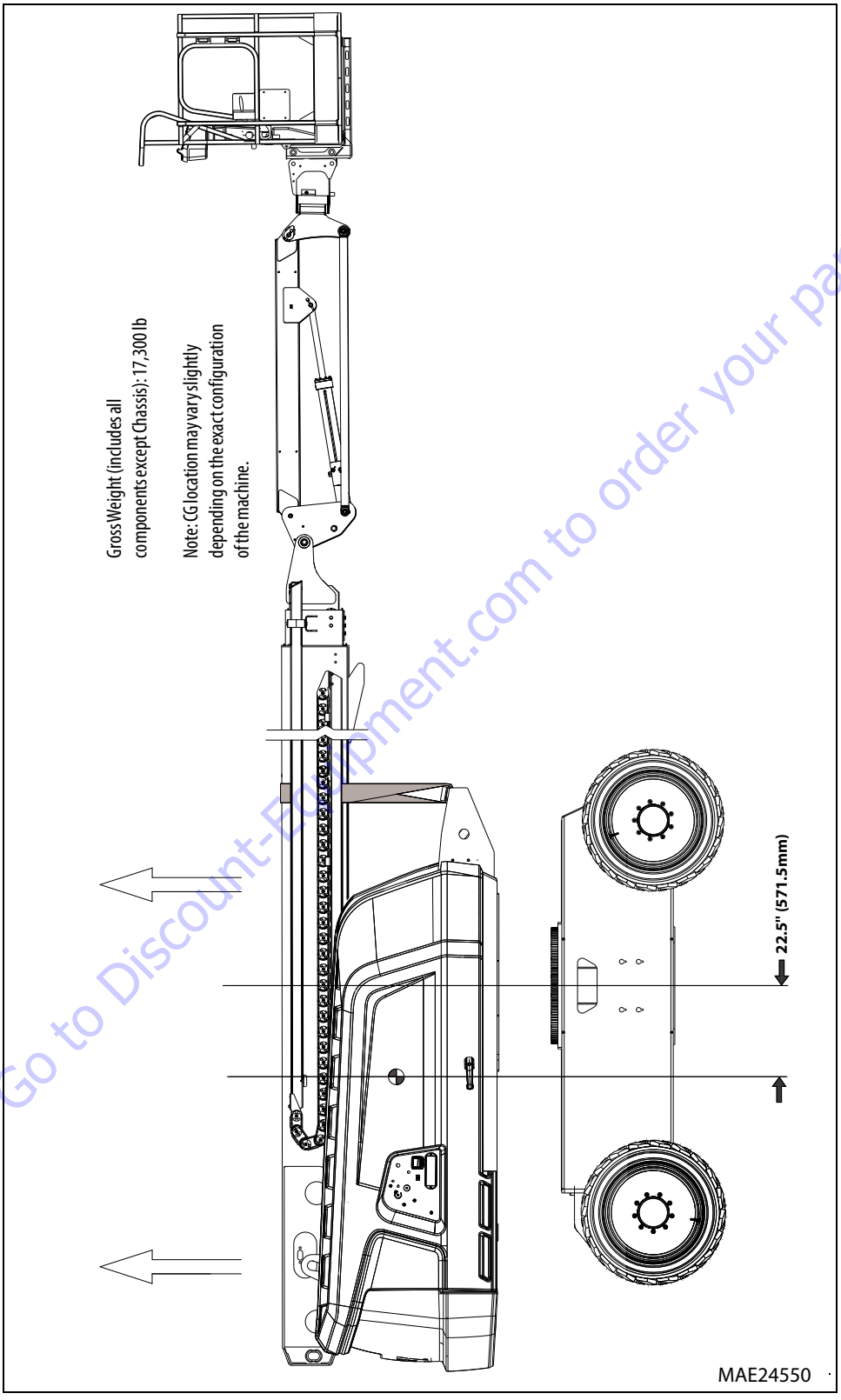


Figure 3-15. Swing Bearing Removal - 660SJ

3.14 ROTARY COUPLING

Use the following procedure to install the seal kit.

1. If not already removed, remove axle oscillation valve from cylinder barrel. The valve spool protrudes into the barrel and will damage spool and seals if left in place.
2. Remove snap ring (1) from end.
3. Remove center body (6) from housing (7).
4. Cut off old seals (3, 4, 5, 8).
5. Assemble lip seals (2) in direction shown in Figure 3-16., Rotary Coupling
6. Reassemble O-ring (5).
7. Heat cap seals (8) in hydraulic oil for 5 minutes at 300° F (149° C).
8. Assemble cap seals over O-rings
9. Reinsert center body in housing (lube with hydraulic oil).
10. Replace snap ring.

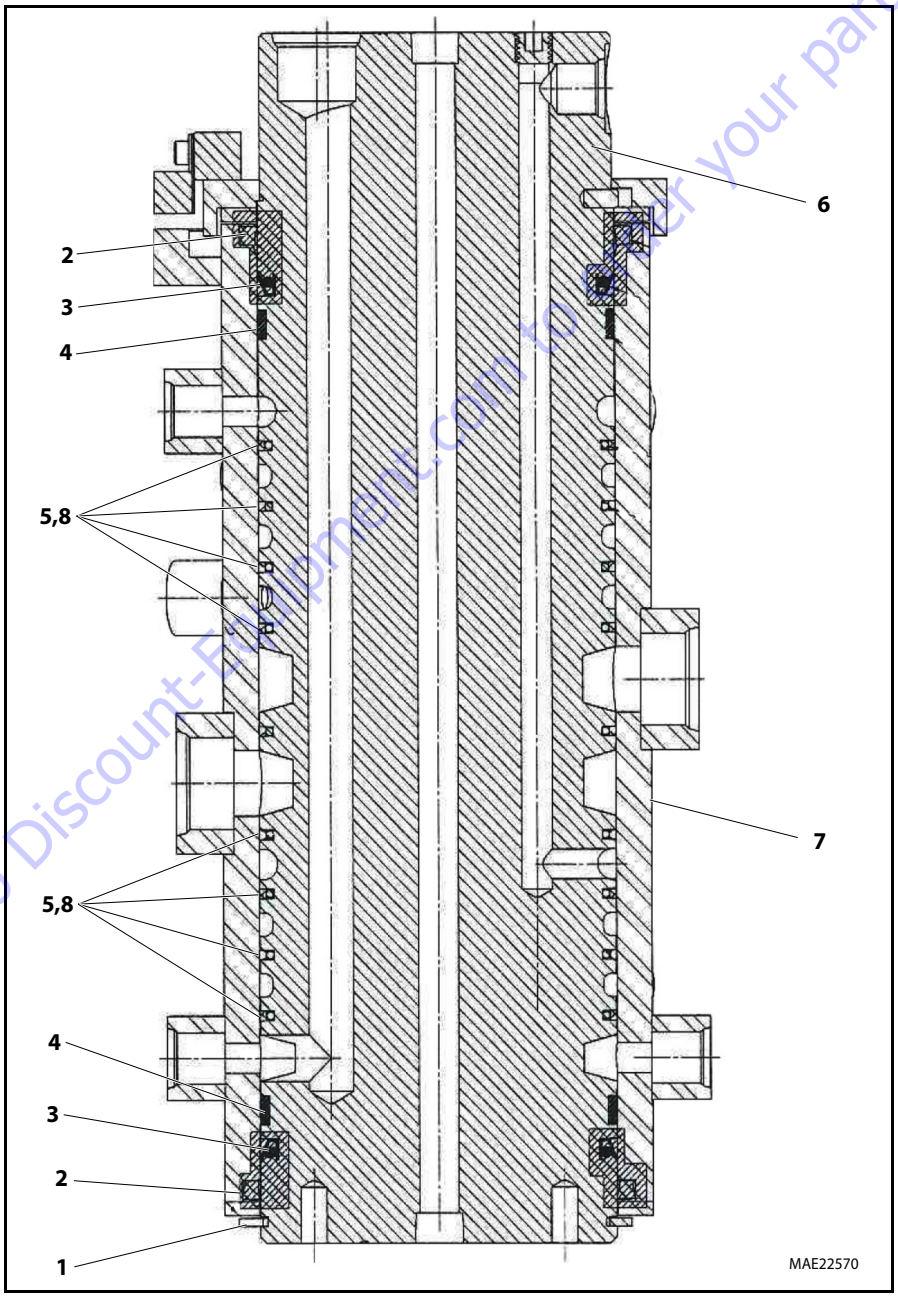
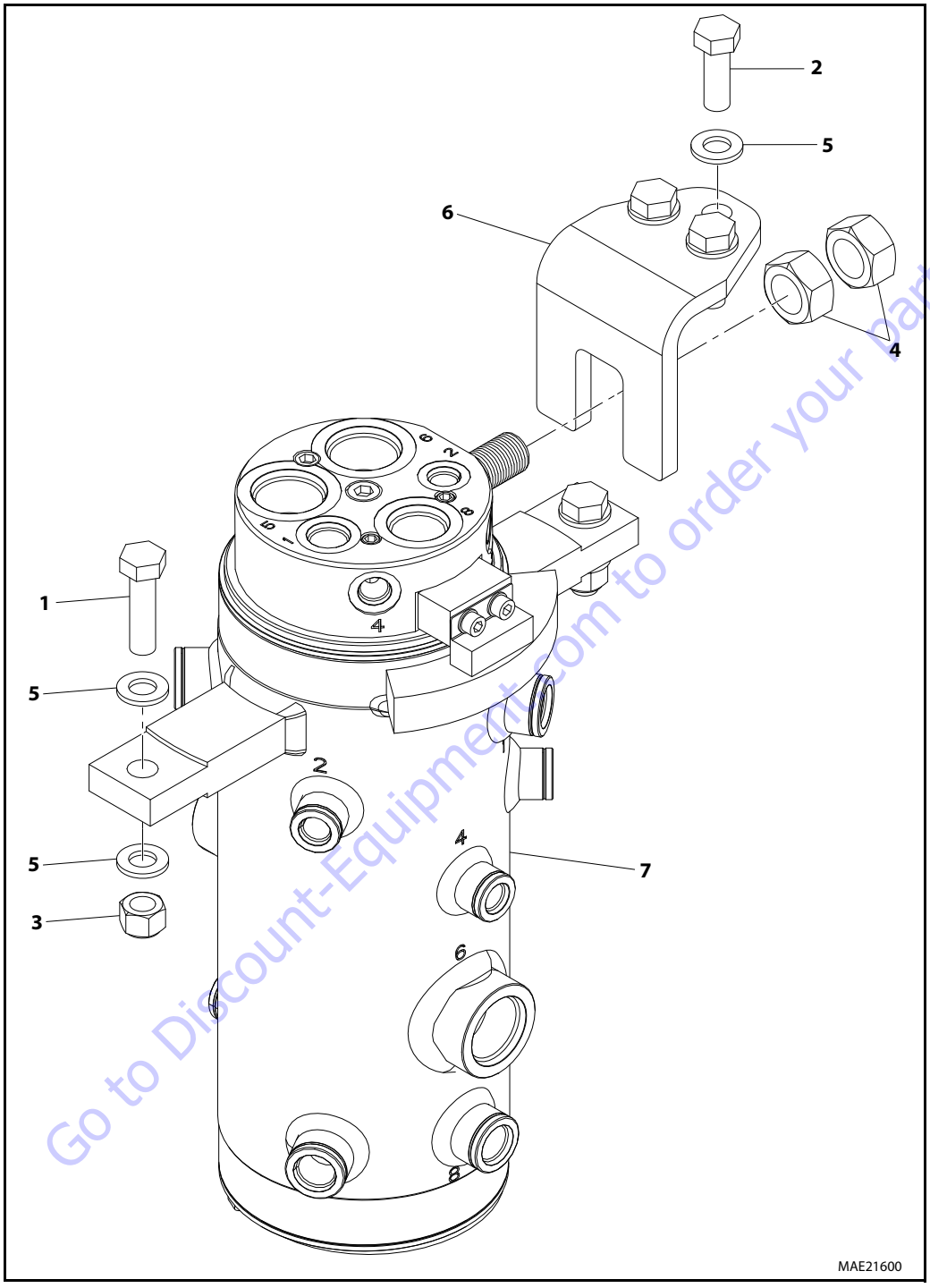
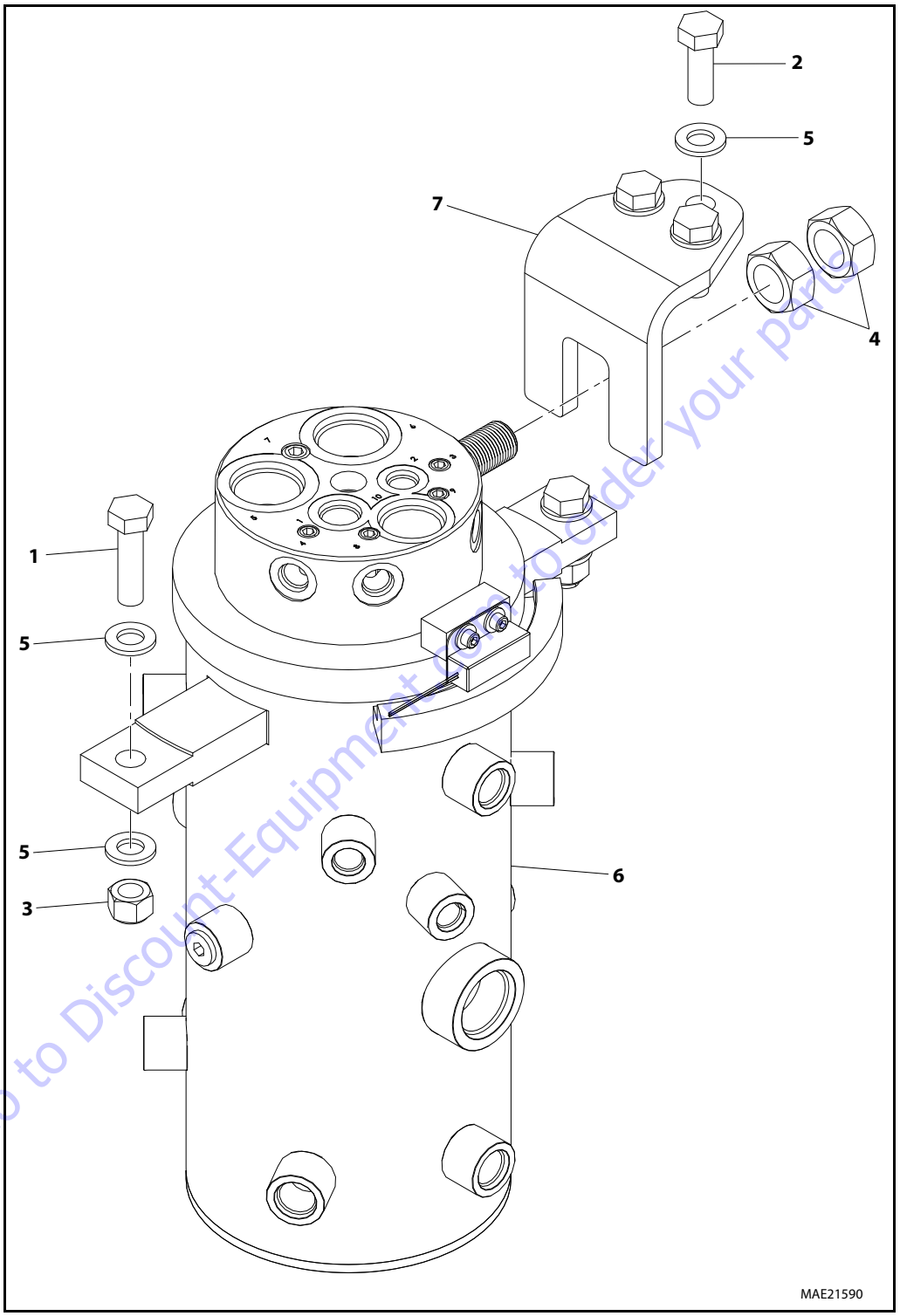


Figure 3-16. Rotary Coupling



1. Bolt
2. Bolt
3. Nut
4. Nut
5. Washer
6. Mount
7. Rotary Coupling

Figure 3-17. Rotary Coupling - 2WS



1. Bolt
2. Bolt
3. Nut
4. Nut
5. Washer
6. Coupling Assembly
7. Mount

Figure 3-18. Rotary Coupling - 4WS

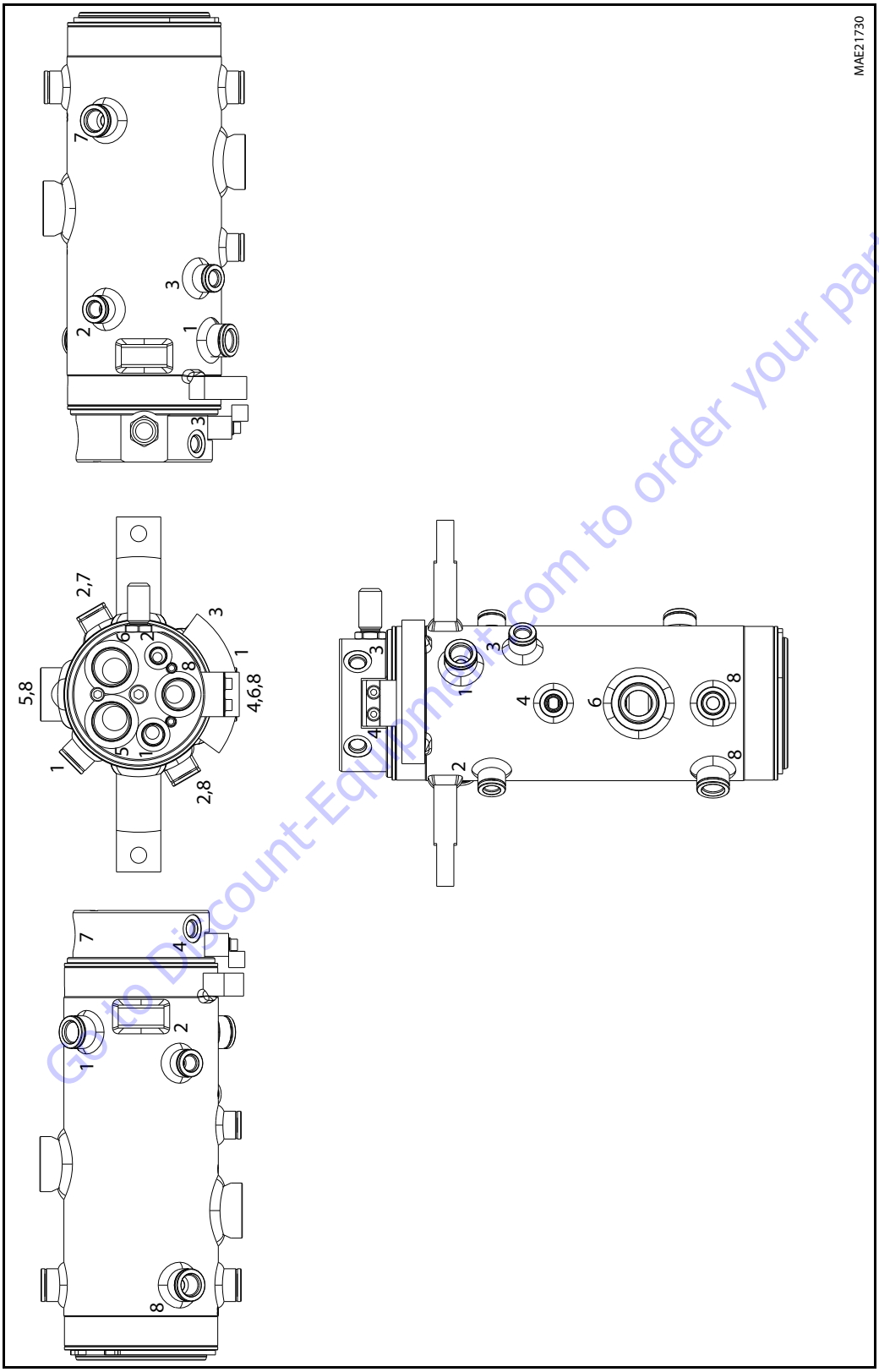


Figure 3-19. Rotary Coupling Port Location - 2WS

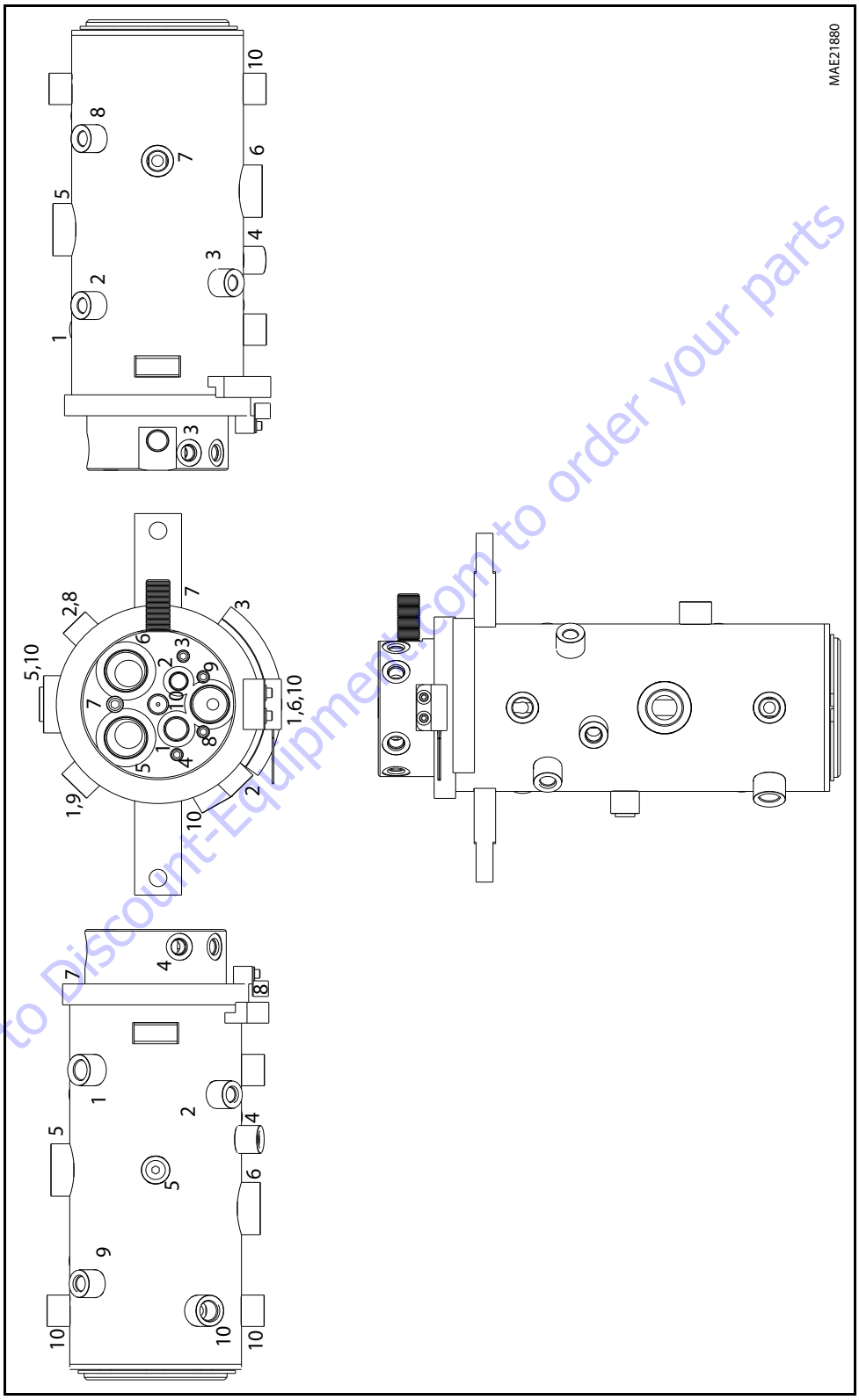
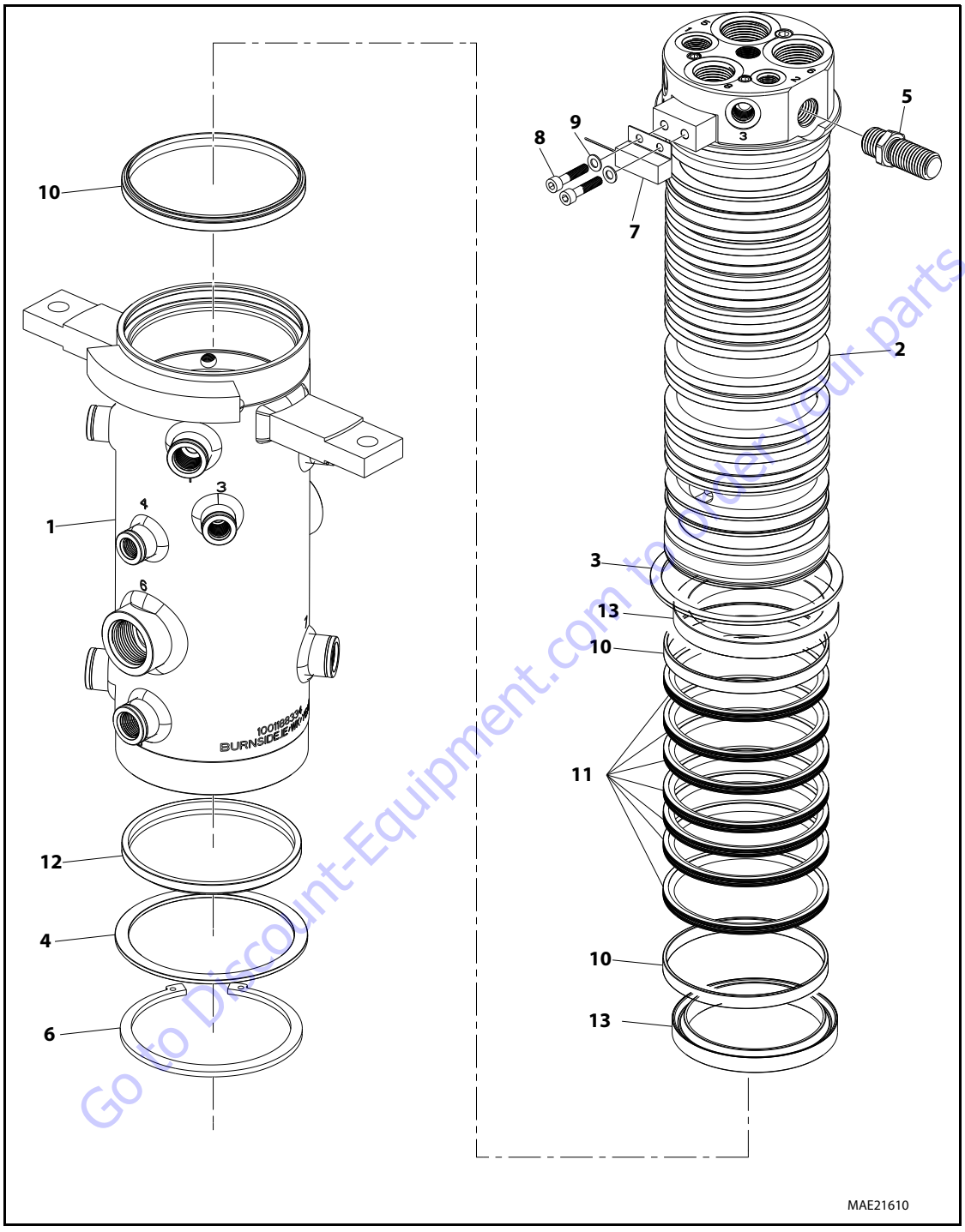


Figure 3-20. Rotary Coupling Port Location - 4WS



1. Housing
2. Shaft
3. Spacer
4. Spacer
5. Fitting
6. Circlip
7. Sensor
8. Bolt
9. Washer
10. Ring, Wear
11. Seal
12. Wiper
13. Seal, Rod

Figure 3-21. Rotary Coupling Assembly

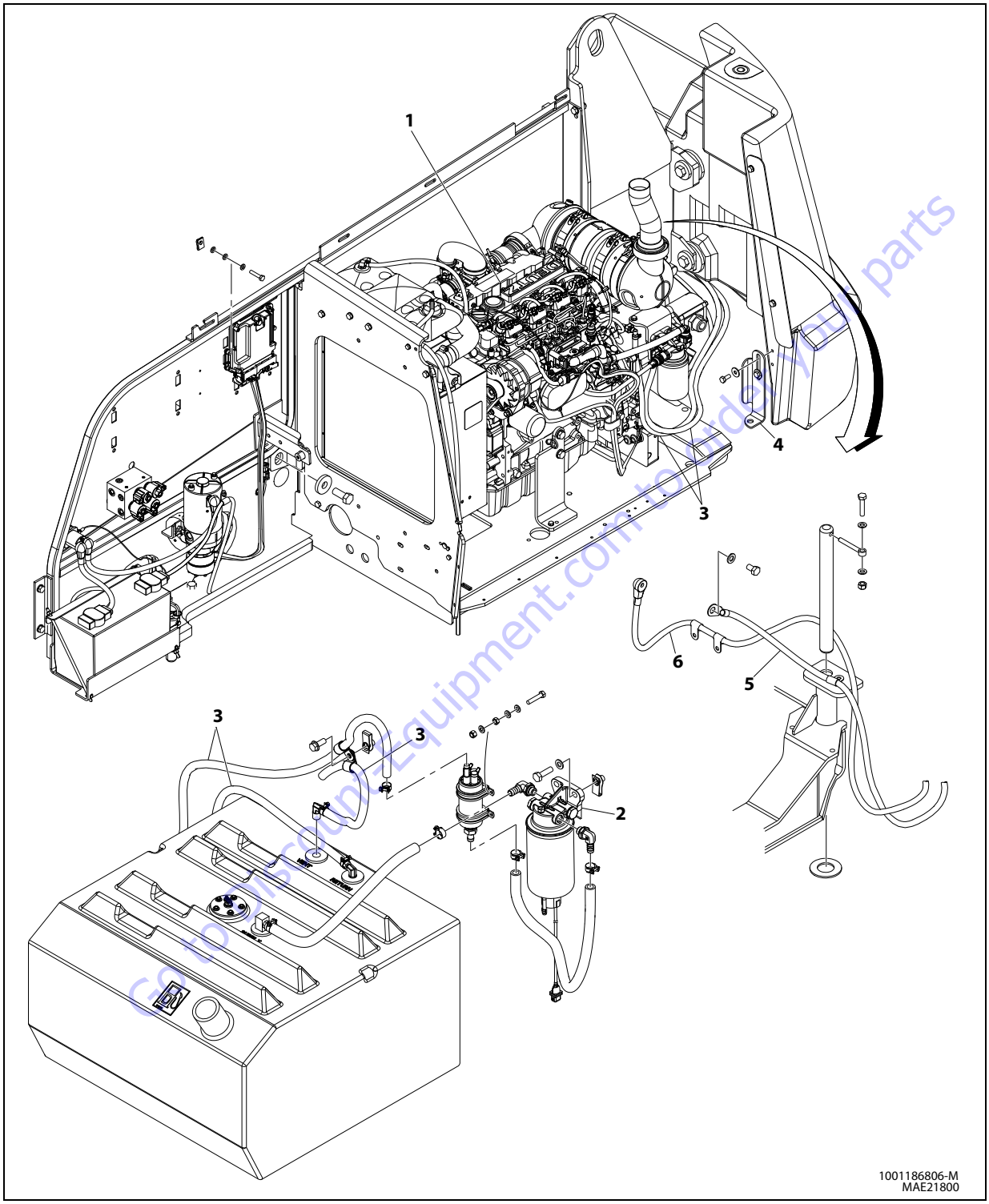
Table 3-2. Coupling Port Information Table - 2WS

Port No.	Outlet	Port Size	Description	Operating Pressure PSI (Bar)
1	2	-8	Brake	450 (31)
2	2	-6	2 Speed	450 (31)
3	1	-6	Steer	3000 (207)
4	1	-6	Steer	3000 (207)
5	1	-16	Drive Reverse	4500 (310)
6	1	-16	Drive Forward	4500 (310)
7	1	-8	Axle Release	450 (31)
8	3	-12	Drain	250 (17)

Table 3-3. Coupling Port Information Table - 4WS

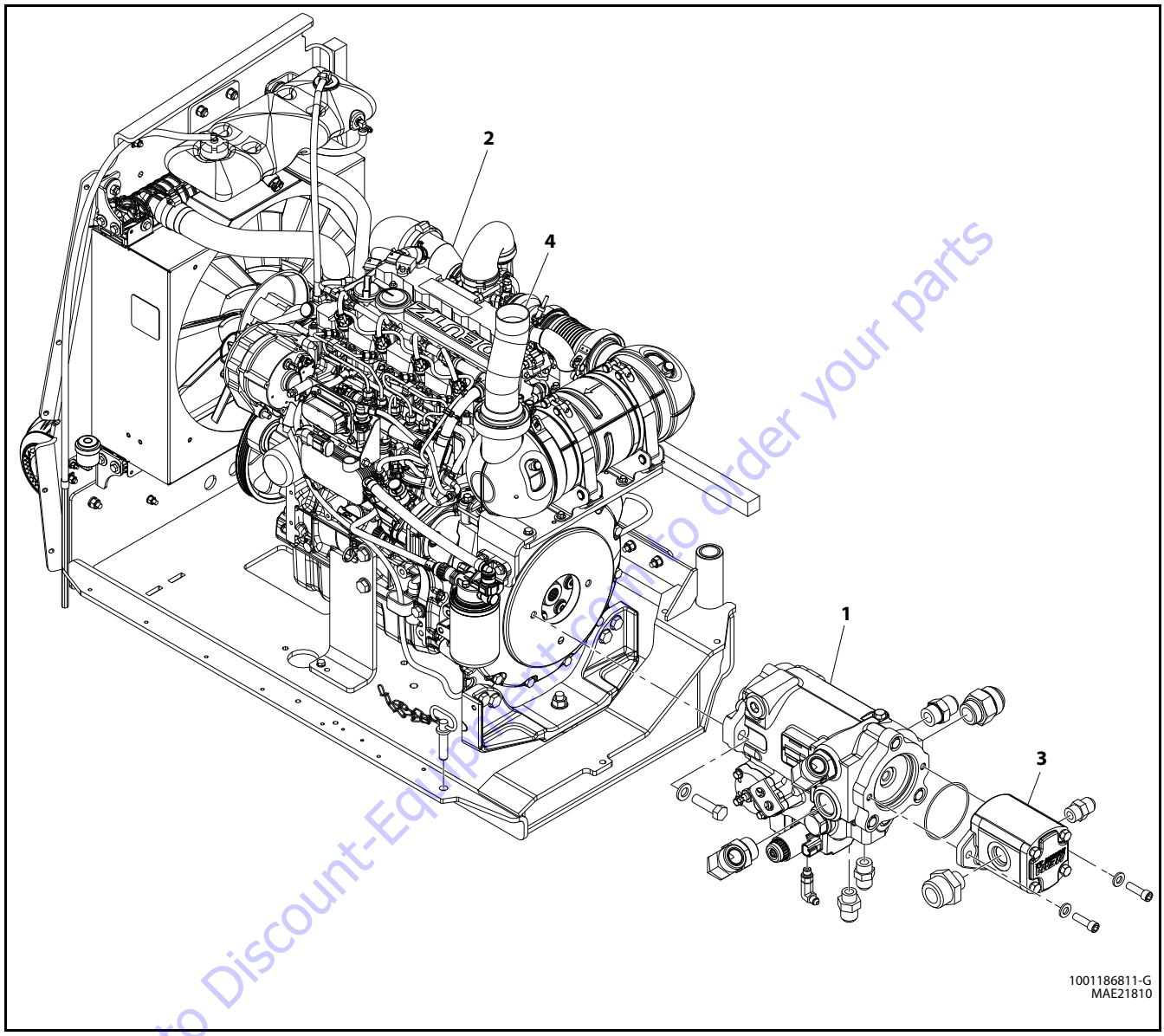
Port No.	Outlet	Port Size	Description	Operating Pressure PSI (Bar)
1	2	-8	Brake	450 (31)
2	2	-6	2 Speed	450 (31)
3	1	-6	Steer	3000 (207)
4	1	-6	Steer	3000 (207)
5	2	-6, -16	Drive Reverse	4500 (310)
6	1	-16	Drive Forward	4500 (310)
7	1	-8	Axle Release	450 (31)
8	1	-6	Steer	3000 (207)
9	1	-6	Steer	3000 (207)
10	3	-12	Drain	250 (17)

3.15 DEUTZ TD2.9 L4 ENGINE (67HP)



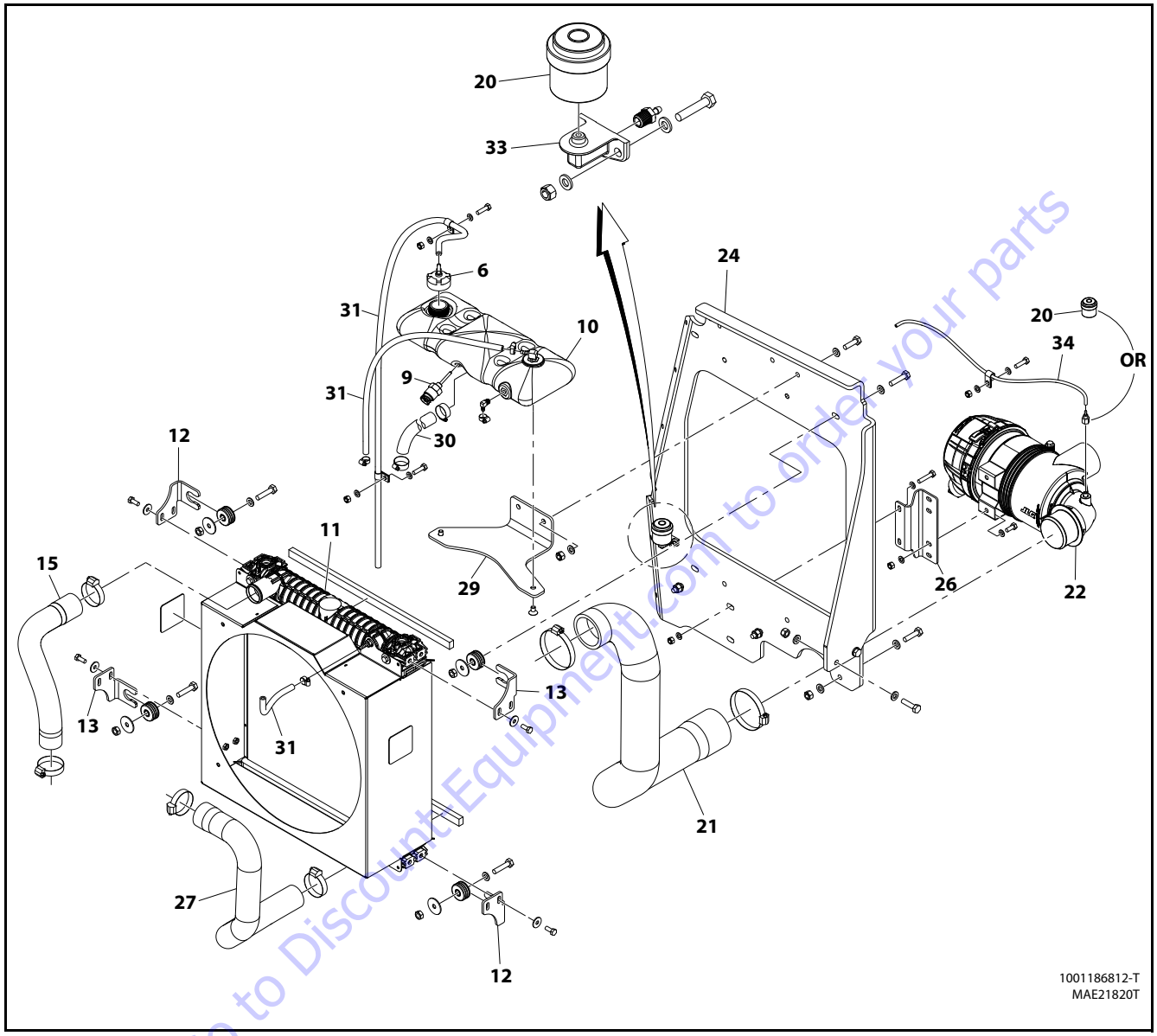
1. Deutz TD2.9L4 (67hp) Engine and Pump
2. Fuel Filter
3. Hose
4. Bracket
5. Battery Cable (-)
6. Battery Cable (+)

Figure 3-22. Deutz TD2.9 L4 (67hp) Engine Installation



1. Piston Pump Assembly
2. Deutz TD2.9 L4 Engine Assembly
3. Gear Pump Assembly
4. Exhaust Pipe

Figure 3-23. Deutz TD2.9 L4 (67hp) Engine and Pumps Sub-Assembly



1. Pump Coupling Kit
2. Pulley
3. Contactor
4. Adapter, Fan
5. Adapter
6. Cap, Tank
7. Fan
8. Relay
9. Sensor, Coolant Level
10. Tank, Surge
11. Radiator
12. Bracket
13. Bracket
14. Hose
15. Hose, Radiator
16. Mount
17. Deutz TD2.9L4 Engine
18. Bracket, Engine - Rear
19. Bracket, Engine - Right
20. Restriction Indicator
21. Hose
22. Air Filter
23. Tray
24. Radiator Support
25. Plate
26. Support
27. Hose, Radiator
28. Mount, Motor
29. Bracket
30. Hose
31. Hose
32. Alternator Power Harness
33. Bracket
34. Tube
35. Glow Fuse Harness

Figure 3-24. Deutz TD2.9 L4 (67hp) Engine Assembly - Sheet 1 of 2

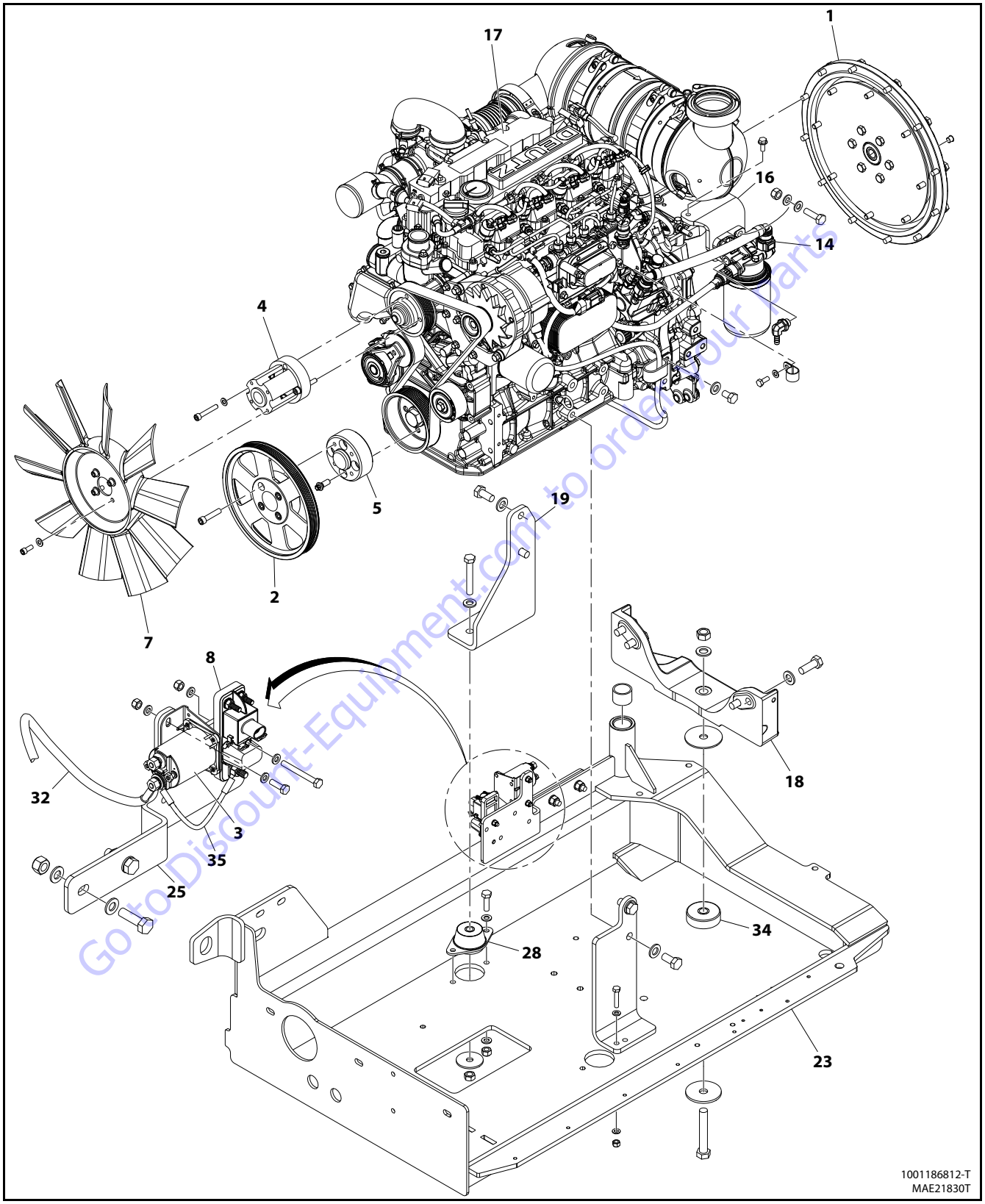
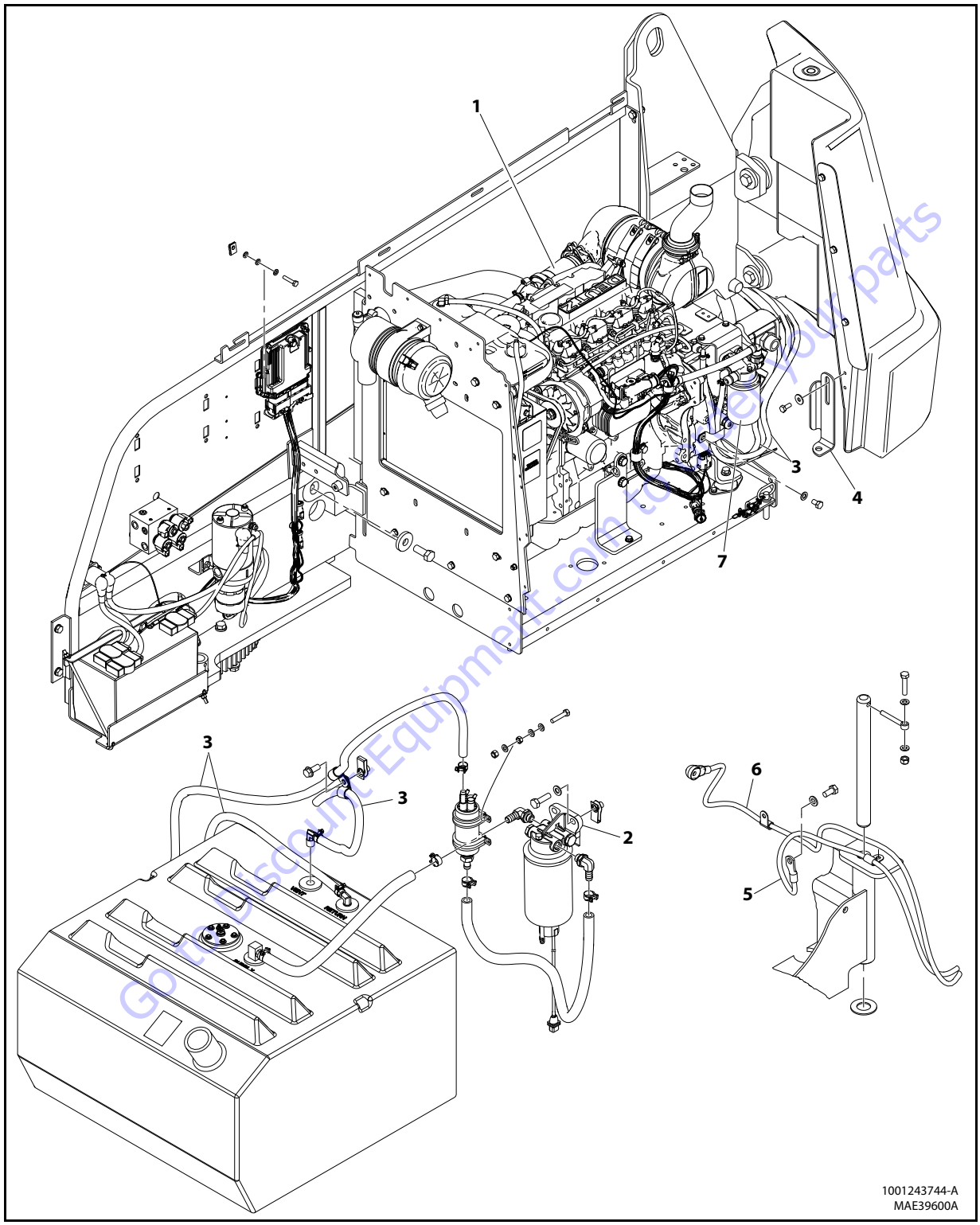


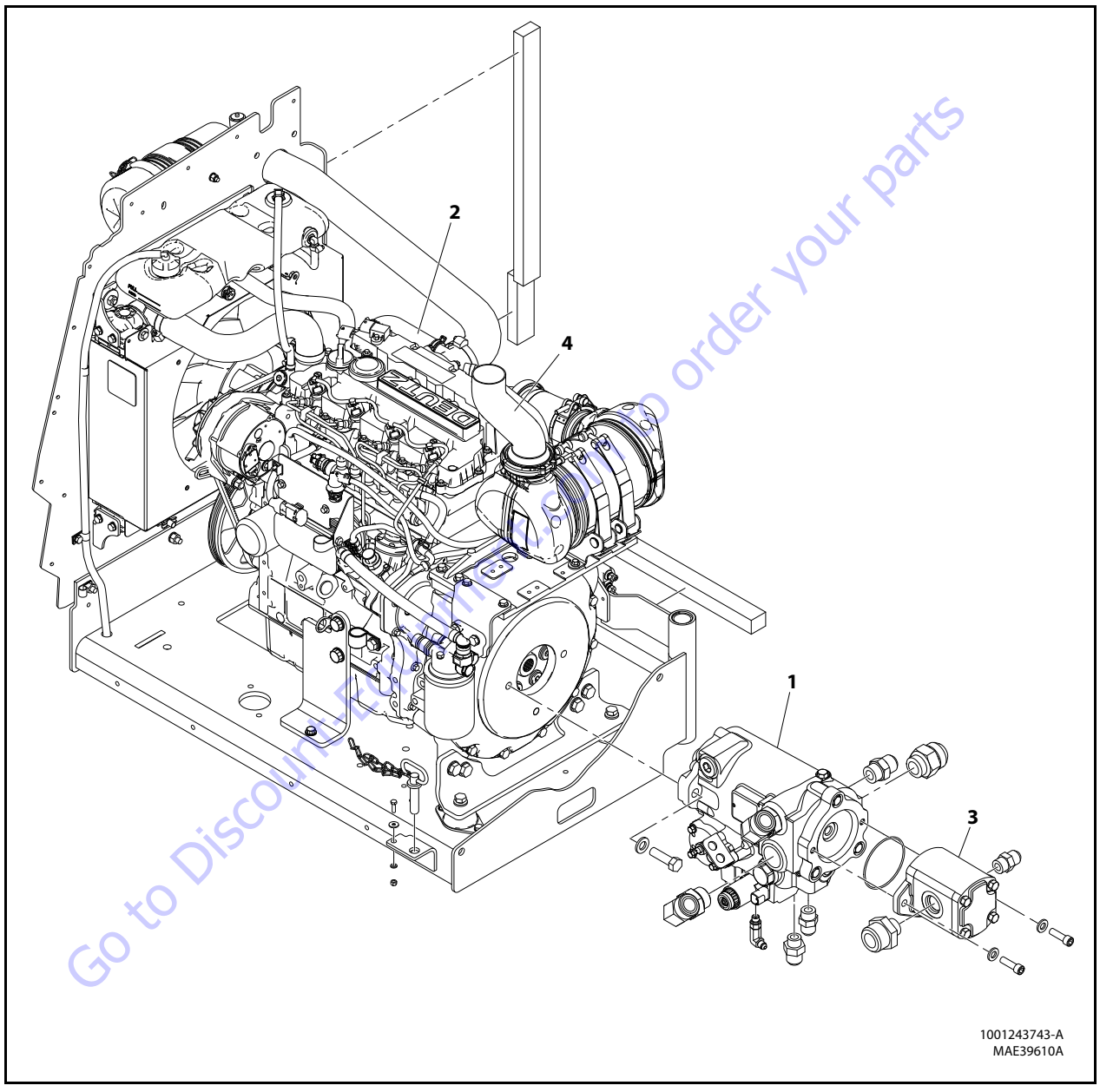
Figure 3-25. Deutz TD2.9 L4 (67hp) Engine Assembly - Sheet 2 of 2

3.16 DEUTZ D2.9 L4 ENGINE (49HP)



1. Deutz D2.9L4 (49hp)Engine and Pump
2. Fuel Pre-Filter
3. Hose
4. Bracket
5. Battery Cable (-)
6. Battery Cable (+)
7. Fuel Filter

Figure 3-26. Deutz D2.9 L4 (49hp) Engine Installation



1. Piston Pump Assembly
2. Deutz TD2.9 L4 Engine Assembly
3. Gear Pump Assembly
4. Exhaust Pipe

Figure 3-27. Deutz D2.9 L4 (49hp) Engine and Pumps Sub-Assembly

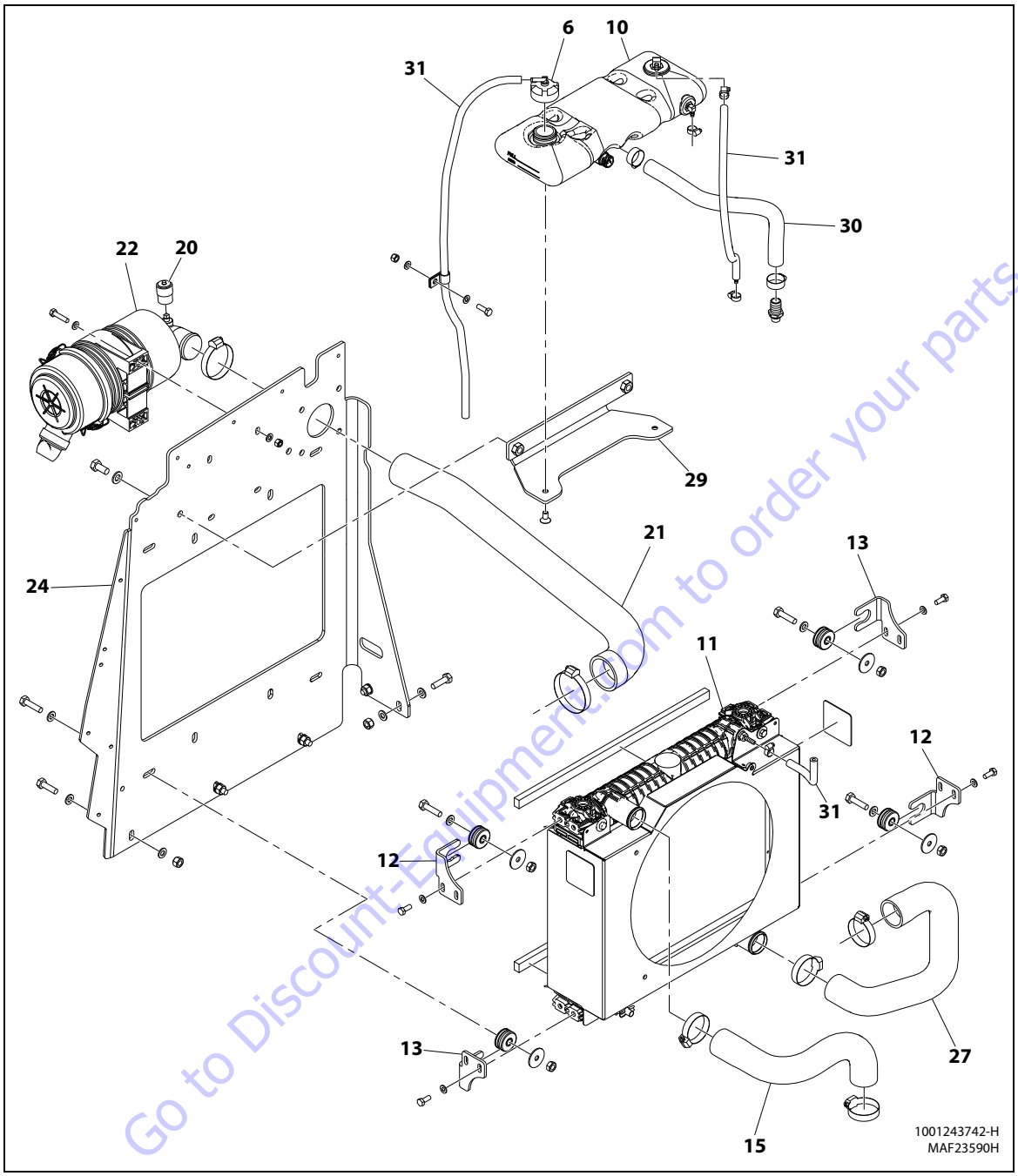
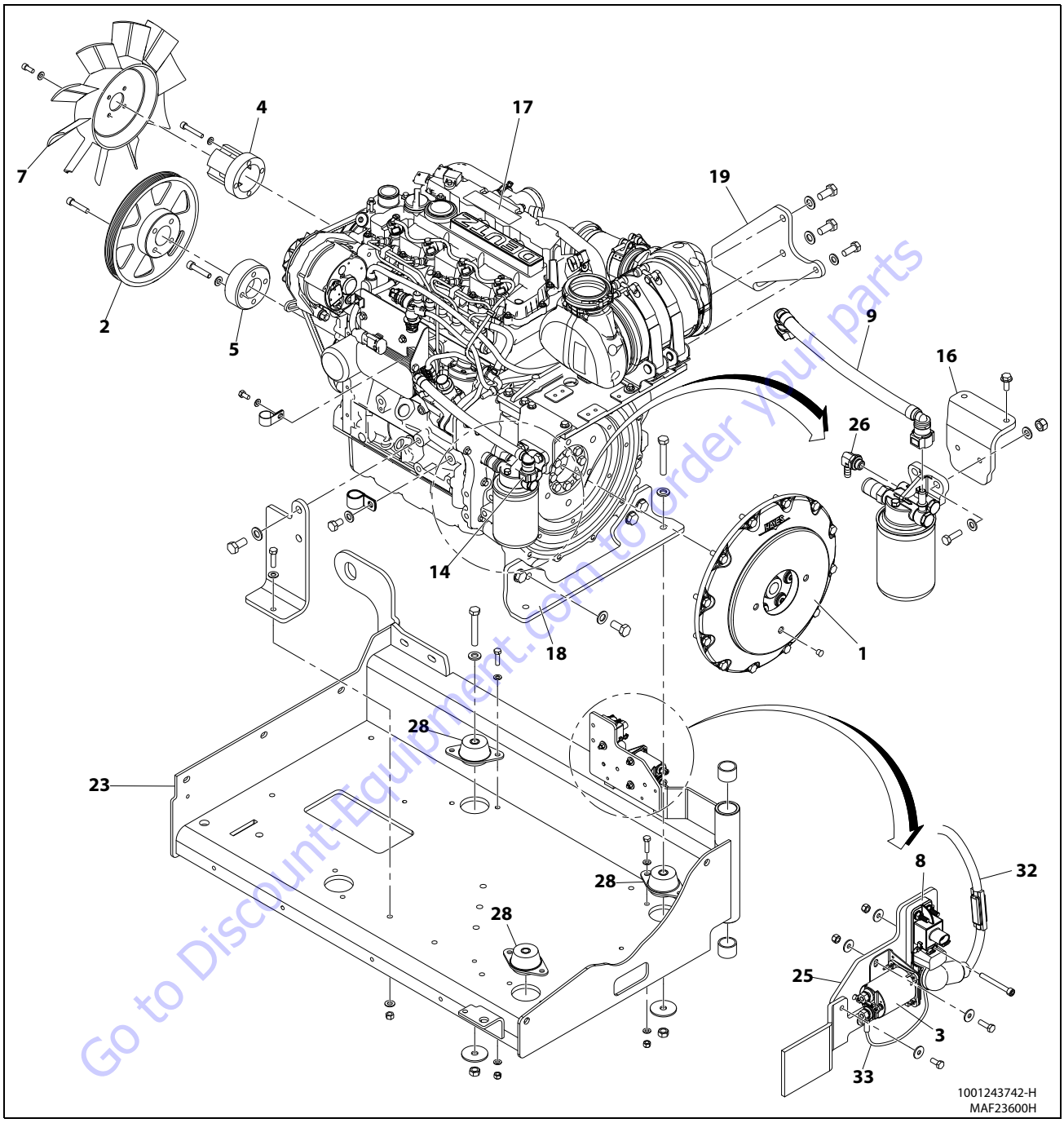


Figure 3-28. Deutz D2.9 L4 (49hp) Engine Assembly - Sheet 1 of 2



1. Pump Coupling Kit
2. Pulley
3. Contactor
4. Adapter, Fan
5. Adapter
6. Cap, Tank
7. Fan
8. Relay
9. Hose
10. Tank, Surge
11. Radiator
12. Bracket
13. Bracket
14. Fuel Filter
15. Hose, Radiator
16. Mount, Fuel Filter
17. Deutz D2.9L4 Engine
18. Bracket, Engine - Rear
19. Bracket, Engine - Right
20. Restriction Indicator
21. Hose
22. Air Filter
23. Tray
24. Radiator Support
25. Plate
26. Fitting
27. Hose, Radiator
28. Mount, Motor
29. Bracket
30. Hose
31. Hose
32. Alternator Power Harness
33. Glow Fuse Harness

Figure 3-29. Deutz D2.9 L4 (49hp) Engine Assembly - Sheet 2 of 2

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

Check Oil Level

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

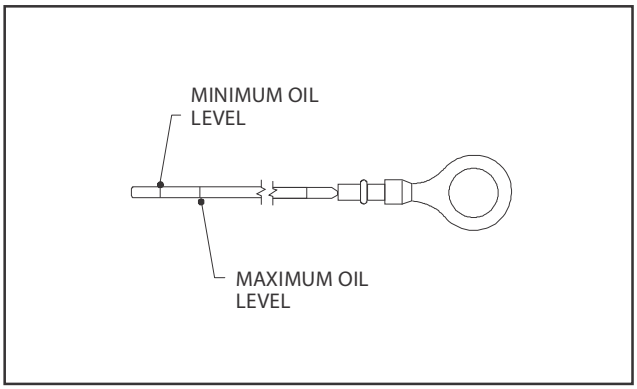


Figure 3-30. Deutz 2.9 T4F Dipstick Markings

5. Replace dipstick until fully seated.

Change Engine Oil

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

⚠ CAUTION

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

NOTICE

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

4. Open oil drain valve and drain oil.
5. Close oil drain valve.
6. Pour in new engine oil. Refer to Section 1 for capacity and Figure 3-31., Engine Oil Viscosity.

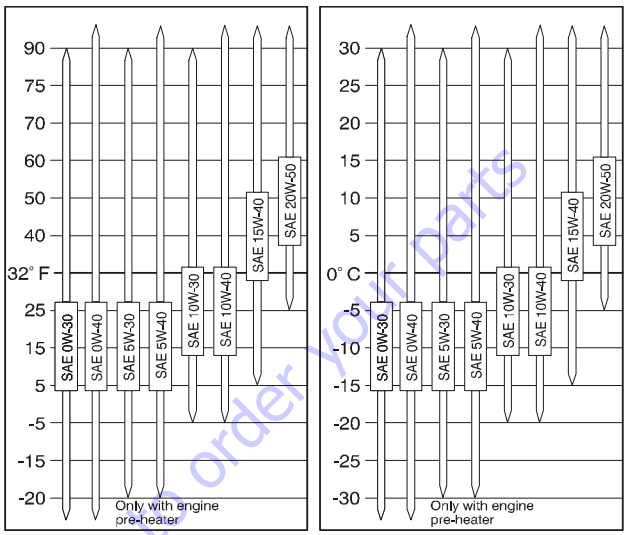
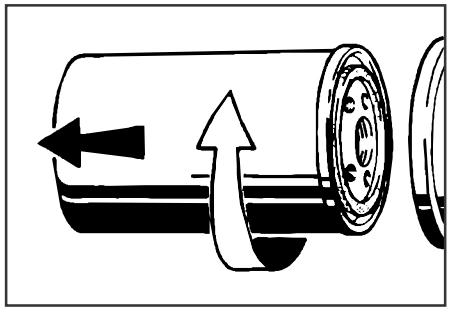


Figure 3-31. Engine Oil Viscosity

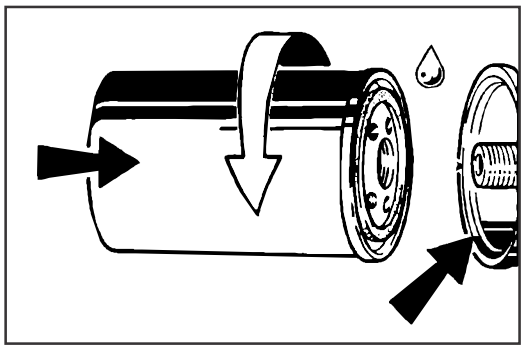
Change Oil Filter

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



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

7. Hand-tighten filter another half-turn.



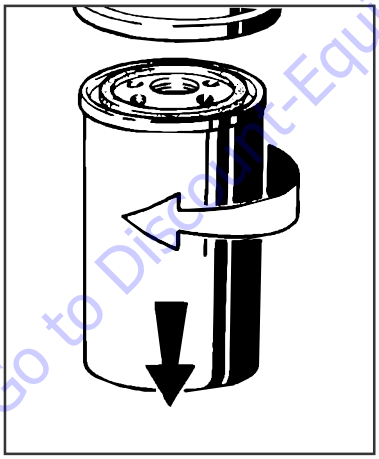
8. Check oil level.
9. Check oil pressure.
10. Check oil filter cartridge for leaks.

Change Fuel Filters

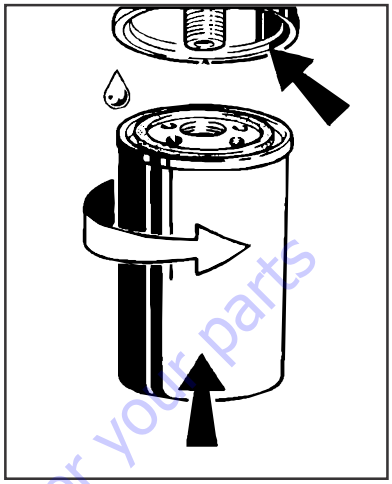
⚠ WARNING

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

1. Wipe area around filter to clean any dirt from area.
2. Disconnect water sensor connector (Pre-filter Only).
3. Remove fuel filter cartridge. Catch any escaping fuel.



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



7. Connect water sensor connector (Pre-filter Only).
8. Open fuel shut-off valve.
9. Check for leaks.

Glow Plugs

If glow plug option is enabled in the JLG Control System, glow plug and indicator lamp will be energized when Power/Emergency Stop switch is pulled on if ambient air temperature is less than 50° F (10° C) and engine coolant temperature is less than 140° F (60° C).

This determination occurs one second after the Power/Emergency Stop switch has been pulled on. Lamp and glow plugs remain energized for period of time specified by setting in the JLG Control System. Engine start is disabled during this period.

On Deutz engines, glow plugs continue (post glow) after engine has started three times the machine digit setting.

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
16	0	No detail information
16	0	BusOff error CAN No detail information
29	3	Hand throttle idle validation switch; short circuit to battery
29	4	Hand throttle; short circuit to ground
29	2	Plausibility error between sensor and idle switch, Acceleration Pedal Detection. In case of Hand Throttle with Low Idle Switch, it is the plausibility check between hand throttle and idle switch.
51	5	Intake Throttle Flap, H-Bridge, wiring harness broken at connected actuator
51	6	Intake Throttle Flap, H-Bridge, current above maximum threshold
51	3	Intake Throttle Flap, H-Bridge, short circuit to battery (A02)
51	3	Intake Throttle Flap, H-Bridge, short circuit to battery (A67)
51	4	Intake Throttle Flap, H-Bridge, short circuit to ground (A02)
51	4	Intake Throttle Flap, H-Bridge, short circuit to ground (A67)
51	7	Intake Throttle Flap, H-Bridge, position of actuator not plausible (deviation from set point more than 7%)
51	3	Intake Throttle Flap, H-Bridge, short circuit to battery oder broken wiring harness
51	4	Intake Throttle Flap, H-Bridge, short circuit to ground
91	3	Sensor error accelerator pedal. signal range check high.
91	4	Sensor error accelerator pedal. Signal is below the range.
91	11	Plausibility error between APP1 and APP2 or APP1 and idle switch.
94	3	Sensor error low fuel pressure; signal range check high
94	4	Sensor error low fuel pressure; signal range check low
94	1	Low fuel pressure; warning threshold exceeded
94	1	Low fuel pressure; shut off threshold exceeded
97	3	Sensor error water in fuel; signal range check high
97	4	Sensor error water in fuel; signal range check low.
97	12	Water in fuel level prefilter; maximum value exceeded
98	2	Plausibility Check; No detail information
100	3	Sensor error oil pressure; signal range check high
100	4	Sensor error oil pressure sensor; signal range check low
100	0	High oil pressure; warning threshold exceeded.
100	0	High oil pressure; shut off threshold exceeded
100	1	Low oil pressure; warning threshold exceeded
100	1	Low oil pressure; shut off threshold exceeded
102	2	Charged air pressure above warning threshold.
102	2	Charged air pressure above shut off threshold.
102	2	Pressure downstream charge air cooler, plausibility error
102	1	Pressure downstream charge air cooler, pressure below lower physical threshold
102	3	Pressure downstream charge air cooler, short circuit to battery or open load
102	4	Pressure downstream charge air cooler, short circuit to ground
105	1	Charged Air cooler down stream temperature. Temperature below lower physical threshold.
105	3	Electrical error charged air temperature. Signal range check high.(SRC)
105	4	Electrical error charged air temperature. Signal range check low.

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
105	0	Charged air cooler temperature. System reaction initiated. High charged air cooler temperature. Warning threshold exceeded.
105	0	High charged air cooler temperature. Shut off threshold exceeded.
105	11	Diagnostic fault check for charged air cooler downstream temperature sensor No detail information
107	3	Sensor error air filter differential pressure; short circuit to battery
107	0	Sensor error air filter differential pressure; short circuit to ground
107	0	Air filter differential pressure; air filter clogged.
108	11	DFC for CAN message
108	3	Sensor error ambient air pressure; signal range check high
108	4	Sensor error ambient air pressure; signal range check low
110	2	Defect fault check for Absolute plausibility test. No detail information
110	0	Physical Range Check high for Coolant temperature
110	1	Physical Range Check low for Coolant temperature.
110	3	Sensor error coolant temperature; signal range check high
110	4	Sensor error coolant temperature; signal range check low
110	0	High coolant temperature; warning threshold exceeded
110	0	Coolant temperature; system reaction initiated
111	1	Coolant level too low
132	1	The air mass flow AFS_dm is greater than or equal to AFS_PhysRng.Min_C Physical Range Check low for air mass flow sensor. No detail information
157	0	Rail pressure raw value is intermittent. No detail information
157	1	Rail pressure raw value is above maximum offset. No detail information
157	3	Sensor error rail pressure. Sensor voltage above upper limit.
157	4	Sensor error rail pressure. Sensor voltage below lower limit.
164	2	Rail pressure safety function is not executed correctly.
168	3	Sensor error battery voltage; signal range check high.
168	4	Sensor error battery voltage; signal range check low
168	2	High battery voltage; warning threshold exceeded
168	2	High battery voltage; shot off threshold exceeded
168	0	Physical range check high for battery voltage
168	1	Physical range check low for battery voltage
171	0	Environment temperature sensor, temperature above upper physical threshold
171	1	Environment Temperature Physical Range Check low
171	3	Sensor error SCR-System environment temperature; DPF-System air inlet temperature; signal range check high
171	4	Sensor error SCR-System environment temperature; DPF-System air inlet temperature; signal range check low
172	2	Air inlet filter temperature, plausibility error
172	3	Air flow temperature sensor; short circuit to battery or open load.
172	4	Air flow temperature sensor; short circuit to ground
172	1	Air inlet filter sensor out of physical range check
172	0	air temperature within air filter box above maximum physical value
174	11	DFC for fuel temperature plausibility check function. No detail information

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
175	3	Sensor error oil temperature; signal range check high
175	4	Sensor error oil temperature; signal range check low
175	0	High oil temperature; warning threshold exceeded
175	0	High oil temperature; shut off threshold exceeded
175	2	Customer oil temperature: signal unplausible
190	0	Engine speed above warning threshold Over speed detection in component engine protection
190	0	Engine speed above warning threshold (FOC-Level 1)
190	11	Engine speed above warning threshold (FOC-Level 2)
190	14	Engine speed above warning threshold (Overrun Mode)
190	8	Sensor camshaft speed; disturbed signal
190	12	Sensor camshaft detection; out of range, signal disrupted; no signal
190	2	Offset angle between crank- and camshaft sensor is too large.
190	8	Sensor crankshaft detection; out of range, signal disrupted; disturbed signal
190	12	Speed detection; out of range, signal disrupted Sensor crankshaft speed; no signal
190	14	Camshaft- and Crankshaft speed sensor signal not available on CAN
411	4	Physical range check low for EGR differential pressure
411	0	Delta pressure across venturi in EGR line above physical high limit
411	0	Plausibility Check fault for deviation of desired and actual EGR-mass flow, where the latter is calculated out of EGR Delta Pressure Sensor
411	3	Sensor error differential pressure Venturiunit (EGR), signal range check low.
411	4	Sensor error differential pressure Venturiunit (EGR), signal range check high.
412	3	Electrical error EGR cooler downstream temperature. Signal range check high.
412	4	electrical error EGR cooler downstream temperature. Signal range check low.
520	9	Timeout Error of CAN-Receive-Frame TSC1TR; control signal
598	2	Plausibility check for Clutch. No detail information
624	5	SVS lamp; open load
624	12	SVS lamp: power stage over temperature
624	3	SVS lamp; short circuit to battery
624	4	SVS lamp; short circuit to ground
630	12	Access error EEPROM memory (delete)
630	12	Access error EEPROM memory (read)
630	12	Access error EEPROM memory (write)
639	14	CAN-Bus 0 "BusOff-Status"
651	5	Injector 1 (in firing order); interruption of electric connection
651	3	Injector 1 (in firing order); short circuit
652	5	Injector 2 (in firing order); interruption of electric connection
652	3	Injector 2 (in firing order); short circuit
653	5	Injector 3 (in firing order); interruption of electric connection
653	3	Injector 3 (in firing order); short circuit
654	5	Injector 4 (in firing order); interruption of electric connection
654	3	Injector 4 (in firing order); short circuit
655	5	Injector 5 (in firing order); interruption of electric connection

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
655	3	Injector 5 (in firing order); short circuit
655	4	High side to low side short circuit in the injector 5 (in firing order)
656	5	Injector 6 (in firing order); interruption of electric connection
656	3	Injector 6 (in firing order); short circuit
656	4	High side to low side short circuit in the injector 6 (in firing order)
676	11	Cold start device relay error
676	11	Cold start aid relay open load
677	3	Starter relay high side. Short circuit to battery.
677	4	Starter relay high side short circuit to ground.
677	5	Starter relay low side no load error.
677	12	Starter relay power stage over temperature.
677	3	Starter relay low side short circuit to battery.
677	4	Starter relay low side short circuit to ground.
729	5	Cold start aid relay open load
729	12	Cold start aid relay; over temperature error
729	3	Intake Air Heater Device; Short circuit to battery
729	4	Air intake heater; Short circuit to ground error for power stage on CJ945.
898	9	Timeout Error of CAN-Receive-Frame TSC1TE; Set point
975	5	PWM-Signal Fan, Open load or short-circuit ground
975	3	PWM-Signal Fan, short-circuit to plus
975	4	PWM-Signal Fan, open load or short circuit to ground
1079	13	Failure of sensor supply voltage 1.
1080	13	Failure of sensor supply voltage 2.
1109	2	Engine shut off demand ignored
1136	0	Physical range check high for ECU temperature
1176	0	Pressure sensor upstream turbine, Physical Range Check high.
1176	1	Pressure sensor upstream turbine, Physical Range Check low.
1176	3	Pressure sensor upstream turbine, signal range check (SRC) high.
1176	4	Pressure sensor upstream turbine, signal range check (SRC) low.
1180	3	Sensor error exhaust gas temperature upstream turbine; signal range check high
1180	4	Sensor error exhaust gas temperature upstream turbine; signal range check low
1180	0	Physical range check high for exhaust gas temperature upstream turbine
1180	1	Physical range check low for exhaust gas temperature upstream turbine
1188	11	Wastegate actuator; internal error
1188	11	Wastegate actuator; EOL calibration not performed correctly
1188	13	Wastegate actuator calibration deviation too large, re-calibration required
1188	2	Wastegate; status message from ECU missing
1188	7	Wastegate actuator; blocked
1188	11	Wastegate actuator; over temperature (> 135°C)
1188	11	Wastegate actuator; operating voltage error
1188	7	Turbocharger wastegate, mechanical blocking detected.
1188	2	Turbocharger wastegate, CAN Error
1188	13	Turbocharger wastegate, EOL calibration error.

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
1188	12	Turbocharger wastegate, internal electrical error
1188	13	Turbocharger wastegate, learning process aborted.
1188	6	Turbocharger wastegate, current above maximum threshold.
1188	3	Turbocharger wastegate, supply voltage above maximum threshold.
1188	4	Turbocharger wastegate, supply voltage below minimum threshold.
1188	13	Turbocharger wastegate, learning process out of range.
1188	7	Turbocharger wastegate, broken spring detected.
1188	0	Turbocharger wastegate, temperature critical high.
1231	14	CAN-Bus 1 "BusOff-Status"
1235	14	CAN-Bus 2 = CAN_C reports Bus-error (for engines <8L and CV52 it is the engine-CAN@250kbaud) CAN Bus error passive; warning CAN C - engine CAN
1235	14	CAN-Bus 2 = engine bus "BusOff-Status"
1237	2	Override switch; plausibility error.
1322	12	N/A
1323	12	Too many recognized misfires in cylinder 1 (in firing order)
1323	12	N/A
1323	12	N/A
1323	12	N/A
1323	12	N/A
1323	12	N/A
1346	0	Misfire detection monitoring No detail information
1638	2	Hydraulic oil temperature check for Shut off condition
1639	12	Fan speed sensor; electrical error or signal disturbed or very low fan speed
1639	0	Sensor error fan speed; signal range check high or engine speed respective fan speed too high
1639	1	Sensor error fan speed; signal range check low or fan speed too low
1761	14	DEF tank level; warning threshold exceeded
1761	0	DEF tank, DEF level above upper physical threshold
1761	1	DEF tank, DEF level below lower physical threshold
1761	14	Urea Tank Signal to HMI for indicating the Urea Tank-Level (Urea tank volume ratio low threshold 1)
1761	14	DEF tank, DEF level below first warning threshold
1761	14	DEF tank, DEF level below second warning threshold
1761	2	DEF tank level, plausibility error
1761	14	DEF tank, DEF level below third warning threshold
2634	12	Early opening defect of main relay No detail information
2634	12	DFC for stuck main relay error No detail information
2659	2	Exhaust Gas Recirculation AGS Sensor; signal not plausible
2659	0	Exhaust Gas Recirculation AGS Sensor; Sensed exhaust mass value above maximum physical value
2659	1	Exhaust Gas Recirculation AGS Sensor; Sensed exhaust mass value below minimum physical value
2659	12	Exhaust Gas Recirculation AGS Sensor; plausibility error, AGS sensor has not passed the burn off process
2659	2	Exhaust Gas Recirculation AGS Sensor; Temperature of EGR mass not plausible
2791	12	Actuator EGR Valve; power stage over temperature
2791	7	EGR actuator, actuator blocked
2791	2	EGR actuator, CAN error

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
2791	13	EGR actuator, EOL calibration error
2791	12	EGR Actuator, internal electrical fault
2791	13	EGR actuator, learning process aborted
2791	6	EGR actuator current is above maximum threshold
2791	3	EGR actuator supply voltage is above the maximum threshold
2791	4	EGR actuator supply voltage is below minimum threshold.
2791	13	EGR actuator, learning process out of range
2791	7	EGR actuator, broken spring detected.
2791	16	EGR actuator, temperature high.
2791	0	EGR actuator, temperature critical high
2797	4	Timeout of Short-Circuit Ground Diagnosis Cyl. Bank 0;_IVDiaShCirGndToutBnk_0
2797	4	Injector diagnostic; Short circuit to ground cylinder bank 0
2798	4	Timeout of Short-Circuit Ground Diagnosis Cyl. Bank 1;_IVDiaShCirGndToutBnk_1
2798	4	Injector diagnostic; Short circuit to ground cylinder bank 1
3031	0	DEF tank, DEF temperature in DEF tank is to high.
3031	1	DEF tank, DEF temperature below lower physical threshold
3031	2	Urea tank temperature outside of plausible thresholds
3219	2	DFC SAE J1939 error No detail information
3224	2	DLC Error of CAN-Receive-Frame AT1IG1 NOX Sensor (SCR-system upstream cat; DPF-system downstream cat); length of frame incorrect
3224	9	Timeout Error of CAN-Receive-Frame AT1IG1; NOX sensor upstream
3224	2	DLC Error of CAN-Receive-Frame AT1IG1Vol NOX sensor.
3224	9	Timeout Error of CAN-Receive-Frame AT1IG1Vol; NOX sensor.
3224	1	DFC for plausibility error Max for NOx sensor upstream of SCR Cat
3226	2	Nox feed back fault detection No detail information
3227	2	DFC SAE J1939 error No detail information
3234	2	DLC Error of CAN-Receive-Frame AT1O1 No detail information
3234	9	Timeout Error of CAN-Receive-Frame AT1OG1; NOX sensor (SCR-system downstream cat; DPF-system downstream cat)
3234	2	DLC Error of CAN-Receive-Frame AT1O1Vol NOX
3234	9	Timeout Error of CAN-Receive-Frame AT1OG1Vol.
3234	11	DFC for plausibility error Min for NOx sensor downstream of SCR Cat.
3241	0	Sensor SCR catalyst upstream temperature too high; plausibility error.
3248	4	Sensor error particle filter downstream temperature; signal range check low
3251	0	Differential pressure DPF maximum value is exceeded
3251	0	Differential pressure sensor across DPF exceeds warning high limit
3251	1	Differential pressure DPF, pressure below lower shutoff threshold.
3251	1	Differential pressure DPF, pressure below lower warning threshold.
3253	2	Differential pressure DPF, plausibility error
3253	3	Electrical error differential pressure B58 (DPF). (signal range check high)
3253	4	Electrical error differential pressure (DPF). signal range check low.
3253	2	Sensor differential pressure (DPF); plausibility error
3361	7	DEF dosing valve blocked (SCR)
3361	6	DEF dosing valve; power at the end of injection too high

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
3361	3	DEF dosing valve; short circuit to battery on low side
3361	3	DEF dosing valve; short circuit to battery or open load on high side
3361	4	Urea dosing valve; short circuit to ground or open load on low side
3361	4	DEF dosing valve; short circuit on high side
3519	12	DEF tank temperature, temperature too high
3519	3	DEF quality sensor, internal temperature sensor short circuit to battery or open load
3519	4	DEF quality sensor, internal temperature sensor short circuit to ground
3519	13	Temperature at UQS invalid
3520	3	DEF quality sensor, short circuit to battery or open load
3520	4	DEF quality sensor, short circuit to ground
3520	2	DEF quality sensor, bad DEF quality detected or no DEF measuring possible.
3520	13	Urea quality at UQS invalid
3532	3	Sensor error DEF tank level; signal range check high
3532	4	Sensor error DEF tank level; signal range check low
3532	3	The DEF Level at UQS out of max. physical range
3532	4	Quality at UQS out of min. physical range
3699	2	Passive regeneration of DPF; plausibility error DPF differential pressure sensor and a further sensor or actuator CRT system defective
3699	2	Passive regeneration of DPF; DOC error Temperature sensor us. and ds. DOC simultaneously defect
3699	0	Maximum standstill time reached; oil exchange request ignored
3711	12	Temperature during stand-still main phase too low or too high
3936	14	Standstill request ignored too long.
3936	14	Standstill time based escalation requests Inducement step 2
4171	2	Dynamic temperature check of temp before SCR
4243	11	SCR heater; Pressure line heater error and temperature condition to perform an afterrun (Group error diagnosis heater) SCR system heater diagnostic reports error; shut off SCR-system
4334	0	Supply module DEF, DEF pressure above upper physical threshold
4334	1	Urea supply module pressure sensor; physical range check low (defect pressure sensor)
4334	0	Urea pump pressure sensor; high signal not plausible
4334	1	Urea pump pressure sensor; low signal not plausible
4334	2	DEF supply module pressure, plausibility error
4341	5	SCR heater relay DEF supply line secondary side; open load
4341	5	SCR heater relay DEF supply line primary side; open load
4341	3	SCR-heater DEF supply line; short circuit to battery
4341	4	SCR-heater DEF supply line; short circuit to ground
4343	11	SCR Monitoring; Pressure stabilization error, general pressure check error (SCR)
4343	5	SCR heater relay DEF pressure line secondary side; open load
4343	5	SCR heater relay DEF pressure line primary side; open load
4343	12	Over Temperature error No detail information
4343	3	SCR heater DEF pressure line; short circuit to battery
4343	4	SCR heater DEF pressure line; short circuit to ground
4345	11	Sensor back flow line pressure (SCR); plausibility error
4345	5	SCR heater relay DEF return line secondary side; open load

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
4345	5	SCR heater relay DEF return line primary side; open load
4345	12	Over Temperature error No detail information
4345	3	SCR heater DEF return line; short circuit to battery
4345	4	SCR heater DEF return line; short circuit to ground
4360	0	Exhaust temperature upstream SCR-Cat, temperature above upper physical threshold
4360	1	Sensed exhaust temperature before SCR-Cat is < physical low limit
4360	2	Exhaust temperature sensor upstream SCR, plausibility error
4361	2	Signal error for CAN message No detail information
4361	3	Sensor error DEF catalyst exhaust gas temperature upstream; signal range check high
4361	4	Sensor error DEF catalyst exhaust gas temperature upstream; signal range check low
4365	0	DEF tank temperature too high.
4365	2	Tank temperature signal error for CAN message
4365	3	Sensor error urea tank temperature: short circuit to battery
4365	4	Sensor error urea tank temperature; short circuit to ground.
4365	3	DEF quality sensor, tank temperature; Short circuit to battery or open load
4365	4	DEF quality sensor, tank temperature; Short circuit to ground
4366	5	SCR main relay (secondary side): open load
4366	5	SCR main relay (secondary side); Shortcut to battery
4366	5	SCR main relay (secondary side), heat relay (secondary side), heating elements or heating valve short to ground.
4366	5	SCR Tank heating valve secondary side: open load
4366	5	SCR tank heating valve primary side; open load
4366	12	SCR-heater relay urea tank power stage output; over temperature
4366	3	SCR Tank heating valve; short circuit to battery
4366	4	SCR Tank heating valve; short circuit to ground
4374	13	Pressure stabilization error dosing valve (SCR)
4375	5	Urea pump motor; open load
4375	3	Urea pump motor; short circuit to battery
4375	4	Urea pump motor; short circuit to ground
4376	5	SCR reversal valve; open load
4376	12	SCR reversing valve; over temperature
4376	3	SCR reversal valve; short circuit to battery
4376	4	SCR reversing valve; short circuit to ground
4376	5	SCR reverting valve; open load
4376	12	SCR reverting valve; over temperature
4376	4	eSCR reverting valve; short circuit to ground
4765	0	Temperature upstream DOC, temperature above upper shutoff threshold
4765	0	Temperature upstream DOC, temperature above upper warning threshold
4766	0	Temperature downstream DOC, temperature above upper shutoff threshold
4766	0	Temperature downstream DOC, temperature above upper warning threshold
4768	2	Temperature upstream DOC, plausibility error
4768	3	Electrical error exhaust gas temperature upstream (DOC); signal range check high
4768	4	Electrical error exhaust gas temperature upstream (DOC); signal range check low
4768	2	Exhaust gas temperature sensors up and downstream DOC are physically swapped

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
4769	2	Temperature downstream DOC, plausibility error
4769	3	Sensor error exhaust gas temperature downstream (DOC); signal range check high
4769	4	Sensor error exhaust gas temperature downstream (DOC); signal range check low
4769	2	Sensor exhaust gas temperature OxiCat downstream (normal operation); plausibility error
4769	2	Sensor exhaust gas temperature OxiCat downstream (regeneration); plausibility error
5763	6	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8). Signal range check high.
5763	7	Actuator position for EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8) not plausible.
5763	6	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); signal range check high
5763	5	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); signal range check low
5763	3	Position sensor error of actuator EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8). Signal range check high.
5763	4	Position sensor error actuator EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8). Signal range check low.
5763	5	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); open load
5763	6	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); over current
5763	3	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to battery
5763	3	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to battery
5763	4	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to ground
5763	4	EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); short circuit to ground
5763	6	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); Overload by short-circuit
5763	11	Power stage over temperature due to high current.
5763	4	Actuator AGR valve (2.9;3.6) throttle valve (4.1;6.1;7.8); Voltage below threshold.
5763	0	Warning threshold for an internal actuator error exceeded, < 4L EGR.actuator und >4L Air Intake Flap
5763	1	Shut off threshold for an internal actuator error exceeded, < 4L EGR.actuator und >4L Air Intake Flap
520521	5	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (4.1;6.1;7.8); signal range check low.
523008	1	Manipulation control was triggered
523008	2	Timeout error in Manipulation control
523009	9	The pressure relief valve (PRV) has reached the number of allowed activations.
523009	10	Open time of Pressure Relief Valve (PRV) for wear out monitoring had exceeded
523090	2	Engine Brake Pre-Selection switch; Plausibility Error
523211	9	Timeout Error of CAN-Receive-Frame EBC1
523212	9	Timeout Error of CAN-Receive-Frame ComEngPrt; Engine Protection
523213	12	Timeout Error of CAN-Transmit-Frame ERC1 No detail information
523216	9	Timeout Error of CAN-Receive-Frame PrHtEnCmd; pre-heat command, engine command
523240	9	Timeout CAN-message FunModCtl; Function Mode Control
523330	14	Immobilizer status; fuel blocked
523330	14	DFC to block the fuel by Sia No detail information
523330	14	DFC to indicate that TEN-code or UC-code received if ECU is learned. No detail information
523330	14	DFC to indicate that no code is received via CAN. No detail information
523330	14	DFC to indicate that wrong code is received. No detail information
523350	4	Injector cylinder-bank 1; short circuit
523352	4	Injector cylinder-bank 2; short circuit

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
523354	12	Injector power stage output defect
523470	2	Pressure relief valve is forced to open, perform pressure increase.
523470	2	Pressure Relief Valve (PRV) forced to open. Performed by pressure increase.
523470	12	Pressure Relief Valve (PRV) forced to open. Shutoff conditions.
523470	12	Pressure Relief Valve (PRV) forced to open. Warning conditions.
523470	14	Open Pressure Relief Valve (PRV)
523470	11	Pressure Relief Valve (PRV) error; Rail pressure out of tolerance range.
523470	11	Rail pressure out of tolerance range. The PRV can not be opened at this operating point with a pressure shock.
523470	7	Maximum rail pressure exceeded (PRV).
523550	12	Terminal 50 was operated too long
523580	2	Data set variant with the desired number not found Invalid variant data set Identifier error No detail information
523580	11	An error has occurred in the switch over to the desired data set variant in the code word. Variant data set switching error No detail information
523580	11	The code word could not be read correctly from the EEPROM Variant dataset switching error; No detail information
523601	13	Failure of sensor supply voltage 3.
523602	0	High fan speed; warning threshold exceeded
523602	0	High fan speed; shut off threshold exceeded
523603	9	Timeout Error of CAN-Receive-Frame AMB; Ambient Temperature Sensor
523605	9	Timeout Error of CAN-Receive-Frame TSC1AE; Traction Control
523606	9	Timeout Error of CAN-Receive-Frame TSC1AR; Retarder
523612	12	Internal software error ECU; injection cut off
523612	12	Internal ECU monitoring detection reported error
523612	12	ECU reported internal software error Internal ECU monitoring detection reported error
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error.
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	Injection system, electrical error injectors
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	ECU reported internal software error
523612	12	Diagnostic fault check to report the accelerator pedal position error
523612	12	Diagnostic fault check to report the engine speed error
523612	12	Error in the plausibility of the injection energizing time
523612	12	Error in the plausibility of the start of energizing angles
523612	12	Diagnostic fault check to report the error due to non plausibility in ZFC
523612	12	Diagnosis fault check to report the demand for normal mode due to an error in the PoI2 quantity

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
523612	12	Diagnosis fault check to report the error to demand for an ICO due to an error in the Pol2 shut-off
523612	12	Diagnosis fault check to report the error to demand for an ICO due to an error in the Pol3 efficiency factor
523612	12	Internal ECU monitoring detection reported error
523612	12	Monitoring of Fuel Quantity Correction
523612	12	Diagnostic fault check to report the plausibility error in rail pressure monitoring
523612	12	Diagnostic fault check to report the error due to torque comparison
523612	12	Diagnosis of curr path limitation forced by ECU monitoring level 2
523612	12	Diagnosis of lead path limitation forced by ECU monitoring level 2
523612	12	Diagnosis of set path limitation forced by ECU monitoring level 2.
523612	3	Reported Over Voltage of Supply
523612	4	Reported Under Voltage of Supply
523612	12	Diagnostic fault check to report WDA active due to errors in query-/response communication
523612	12	Diagnostic fault check to report ABE active due to under voltage detection
523612	12	Diagnostic fault check to report ABE active due to overvoltage detection
523612	12	Diagnostic fault check to report WDA/ABE active due to unknown reason
523612	14	Software reset CPU SWReset_0
523612	14	Software reset CPU SWReset_1
523612	14	Software reset CPU SWReset_2
523612	12	Internal software error ECU
523612	12	Engine starter, plausibility error of starter release condition
523613	0	Rail pressure metering unit, Positive governor deviation.
523613	0	Rail pressure metering unit, Rail pressure disrupted. Maximum positive deviation of rail pressure exceeded.
523613	0	Rail pressure metering unit, Rail pressure disrupted. Maximum positive deviation of rail pressure in metering unit exceeded (RailMeUn1).
523613	0	Rail pressure metering unit, Rail pressure below the target range (RailMeUn2) Rail system leakage detected. (RailMeUn10)
523613	1	Rail pressure metering unit, Minimum rail pressure exceeded (RailMeUn3) Negative deviation of rail pressure second stage (RailMeUn22)
523613	0	Rail pressure metering unit, Maximum rail pressure exceeded.
523613	2	Rail pressure metering unit, Set point of metering unit in overrun mode not plausible.
523613	0	Set point of metering unit in overrun mode not plausible
523615	5	Metering unit (Fuel-System); open load
523615	12	Metering unit (Fuel-System); power stage over temperature
523615	3	Metering unit (Fuel-System); short circuit to battery high side
523615	4	Metering unit (Fuel-System); short circuit to ground high side
523615	3	Metering unit (Fuel-System); short circuit to battery low side
523615	4	Metering Unit (Fuel-System); short circuit to ground low side
523615	3	Metering unit, short circuit to battery
523615	4	Metering unit, short circuit to ground
523618	3	Gearbox oil temperature; Short circuit to battery or broken harness
523618	4	Gearbox oil temperature; Short circuit to ground
523619	2	Physical range check high for exhaust gas temperature up stream (SCR-CAT)
523632	16	Pump pressure SCR metering unit too high.
523632	18	Pump pressure SCR metering unit too low

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
523632	0	Pressure overload of SCR-System.
523632	1	Pressure build-up error SCR-System.
523632	11	Pump motor not available for actuation
523632	2	Signal error for CAN message No detail information
523632	3	Sensor error urea pump pressure; signal range check high
523632	4	Sensor error urea pump pressure; signal range check low
523633	11	Long term adoption factor below threshold
523633	11	Nox conversion rate insufficient (SCR-Cat defect, bad DEF quality)
523633	11	Nox conversion rate insufficient (SCR-Cat defect, bad DEF quality); temperature range 1
523698	11	Shut off request from supervisory monitoring function
523699	3	Boost pressure control; negative governor deviation below limit
523699	4	learning value too high No detail information
523704	12	Timeout Error of CAN-Transmit-Frame EEC3
523706	12	Timeout Error of CAN-Transmit-Frame FlEco No detail information
523717	12	Timeout Error of CAN-Transmit-Frame AmbCon; Weather environments
523718	5	tank heating valve; open load
523718	12	SCR main relay (primary side); power stage over temperature
523718	3	SCR main relay (primary side); short circuit to battery
523718	4	SCR main relay (primary side); short circuit to ground
523718	5	SCR main relay; open load (only CV56B)
523718	3	SCR main relay; short circuit to battery (only CV56B)
523718	4	SCR main relay; short circuit to ground (only CV56B)
523719	5	SCR heater relay DEF supply module secondary side; open load
523719	5	SCR heater relay DEF supply module primary side; open load
523719	12	Over Temperature error No detail information
523719	3	SCR heater DEF supply module; short circuit to battery
523719	4	SCR heater DEF supply module; short circuit to ground
523720	2	DEF supply module heater temperature; plausibility error (normal condition).
523720	2	Sensor DEF supply module heater temperature; plausibility error (cold start condition)
523720	8	DEF supply module heater temperature; duty cycle in failure range.
523720	8	DEF supply module heater temperature; duty cycle in invalid range.
523721	2	Sensor DEF supply module temperature; plausibility error (normal condition)
523721	2	Sensor DEF supply module temperature; plausibility error (cold start condition)
523721	11	Urea supply module temperature measurement not available.
523721	8	DEF supply module temperature; duty cycle in failure range.
523721	8	Urea supply module temperature; duty cycle in invalid range.
523722	8	DEF supply module PWM signal; period outside valid range.
523722	8	Detect faulty PWM signal from Supply Module.
523741	14	Engine shut off request through CAN No detail information
523752	0	Plausibility error during Rich to Lean switch over No detail information
523752	0	Monitoring of Nox signal readiness No detail information
523756	14	special pattern for special cases No detail information
523757	14	special pattern for special cases No detail information

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
523758	14	special pattern for special cases No detail information
523759	14	special pattern for special cases No detail information
523760	14	special pattern for special cases No detail information
523766	9	Timeout Error of CAN-Receive-Frame Active TSC1AE
523767	9	Timeout Error of CAN-Receive-Frame Passive TSC1AE
523768	9	Timeout Error of CAN-Receive-Frame Active TSC1AR
523769	9	Timeout Error of CAN-Receive-Frame Passive TSC1AR
523776	9	Timeout Error of CAN-Receive-Frame TSC1TE - active
523777	9	Passive Timeout Error of CAN-Receive-Frame TSC1TE; Set point
523778	9	Timeout Error of CAN-Receive-Frame TSC1TR
523779	9	Passive Timeout Error of CAN-Receive-Frame TSC1TR
523788	12	Timeout Error of CAN-Transmit-Frame TrbCH; Status Waste gate
523788	0	Waste gate plausibility error off CAN transmit message.
523788	0	Timeout Error of CAN-Receive-Frame ComTrbChActr; Wastegate
523793	9	Timeout Error of CAN-Receive-Frame UAA10; AGS sensor service message
523794	9	Timeout Error of CAN-Receive-Frame UAA11; AGS sensor data
523803	9	Timeout error of CAN Receive Message RxEngPres; Status Burner Air Pump
523858	12	Timeout Error of CAN-Transmit-Frame UAA11
523867	12	Timeout Error of CAN-Transmit-Frame UAA1 on CAN 2. Control burner air pump;
523889	3	Over temperature of device driver of pressure control valve No detail information
523891	14	When AirHt_ctDefSRCLoOn_mp is less than AirHt_ctMaxDef_C. DFC to SRC Low error when heater is On No detail information
523895	13	Check of missing injector adjustment value programming (IMA) injector 1 (in firing order).
523896	13	Check of missing injector adjustment value programming (IMA) injector 2 (in firing order).
523897	13	Check of missing injector adjustment value programming (IMA) injector 3 (in firing order).
523898	13	Check of missing injector adjustment value programming (IMA) injector 4 (in firing order).
523899	13	Check of missing injector adjustment value programming (IMA) injector 5 (in firing order).
523900	13	Check of missing injector adjustment value programming (IMA) injector 6 (in firing order).
523906	5	Electrical fuel pre - supply pump; open load
523906	12	Electrical fuel pre - supply pump. ECU powerstage over temperature.
523906	3	Electrical fuel pre - supply pump; short circuit to battery
523906	4	Electrical fuel pre - supply pump. Short circuit to ground.
523910	14	Air pump doesn't achieve air mass flow setpoint Burner Control - burner air pump
523910	9	Burner Control; Air Pump - CAN Lost Air Pump; CAN communication lost
523910	7	Air pump; CAN communication interrupted no purge function available
523910	12	Air Pump; internal error
523910	0	Air Pump; operating voltage error
523910	6	Burner Control Air Pump; over current Air pump electrically overloaded
523911	0	Burner dosing valve (DV2); over current at the end of the injection phase
523911	12	Burner dosing valve (DV2); power stage over temperature
523911	3	Burner dosing valve (DV2); short circuit to battery
523911	4	Burner dosing valve (DV2); short circuit to ground
523911	11	Burner dosing valve (DV2); short circuit high side power stage

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
523912	2	Burner dosing valve (DV2) downstream pressure sensor; plausibility error
523912	0	Physical range check high for burner dosing valve (DV2) downstream pressure; shut off regeneration
523912	1	Physical range check low for burner dosing valve (DV2) downstream pressure; shut off regeneration. When burner injector is actuated, the measured pressure does not rise above ca. 1250mbar abs (expected: ca. 2400mbar).
523912	3	Sensor error burner dosing valve (DV2) downstream pressure sensor; signal range check high
523912	4	@ engines < 4l: Throttle valve error, Open Load or Short cut to Battery, blocked valve or wrong control signal for valve. @ engines with Burner T4i: Pressure Sensor error after valve (DV2), lower limit reached
523913	3	Sensor error glow plug control diagnostic line voltage; signal range check high
523913	4	Sensor error glow plug control diagnostic line voltage; signal range check low
523914	5	Glow plug control; open load water pump control (PWM)
523914	12	Glow plug control; power stage over temperature
523914	3	Glow plug control; short circuit to battery water pump control (PWM)
523914	4	Glow plug control; short circuit to ground water pump control (PWM)
523915	0	HCl dosing valve (DV1); over current at the end of the injection phase
523915	12	HCl dosing valve (DV1); power stage over temperature
523915	3	HCl dosing valve (DV1); short circuit to battery
523915	3	HCl dosing valve (DV1); short circuit to battery high side
523915	4	HCl dosing valve (DV1); short circuit to ground
523915	11	HCl dosing valve (DV1); short circuit high side power stage
523915	7	HCl dosing valve (DV1); blocked open
523916	2	Sensor HCl dosing valve (DV1) downstream pressure; plausibility error
523916	0	Physical range check high for HCl dosing valve (DV1) downstream pressure; shut off regeneration
523916	1	Physical range check low for HCl dosing valve (DV1) downstream pressure; shut off regeneration
523916	3	Sensor error HCl dosing valve (DV1) downstream pressure; signal range check high
523916	4	Sensor error HCl dosing valve (DV1) downstream pressure; signal range check low
523917	3	Sensor error DV1 & DV2 upstream pressure; signal range check high
523917	4	Sensor error DV1 & DV2 upstream pressure; signal range check low
523918	3	Sensor error DV1 & DV2 upstream temperature; signal range check high
523918	4	Sensor error DV1 & DV2 upstream temperature; signal range check low
523919	2	DPF burner air pump pressure sensor, plausibility error
523919	0	DPF burner air pump pressure sensor, pressure above upper shutoff threshold
523919	1	DPF burner air pump pressure sensor, pressure below lower shutoff threshold
523919	3	DPF burner air pump pressure sensor, short circuit to battery or open load
523919	4	DPF burner air pump pressure sensor, short circuit to ground
523919	2	Sensor air pump air pressure; plausibility error
523920	2	Exhaust gas pressure upstream burner, plausibility error
523920	0	Exhaust gas pressure upstream burner, pressure above upper shutoff threshold
523920	3	Exhaust gas pressure upstream burner, short circuit to battery or open load
523920	4	Exhaust gas pressure upstream burner, short circuit to ground
523920	2	Sensor exhaust gas back pressure burner; plausibility error
523921	3	Sensor error burner temperature; signal range check high
523921	4	Sensor error burner temperature; signal range check low
523921	0	Burner temperature, temperature above upper shutoff threshold

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
523921	1	Burner temperature, temperature below lower shutoff threshold
523921	2	Burner temperature sensor; Plausibility Check for burner temperature sensor Sensor burner temperature; plausibility error
523922	3	Burner shut of valve; short circuit to battery
523922	7	Burner Control; Shut-off Valve - Blocked closed Burner Shut Off Valve; blocked closed
523922	7	Burner Shut Off Valve; blocked open
523922	5	Burner Shut Off Valve; open load
523922	12	Burner Shut Off Valve; power stage over temperature
523922	4	Burner Shut Off Valve; short circuit to ground
523923	3	UB1; Short circuit to battery error of actuator relay 1
523923	4	Short circuit to ground error No detail information
523924	3	UB2; Short circuit to battery error of actuator relay 2
523924	4	UB2; Short circuit to ground actuator relay 2
523925	3	UB3: Short circuit to battery error of actuator relay 3.
523925	4	UB3; Short circuit to ground actuator relay 3
523926	4	UB4; Short circuit to ground actuator relay 4.
523927	3	UB5; Short circuit to battery error of actuator relay 5.
523935	12	Timeout Error of CAN-Transmit-Frame EEC3VOL1; Engine send messages
523936	12	Timeout Error of CAN-Transmit-Frame EEC3VOL2; Engine send messages
523937	9	Timeout DFC for NOxSensGlbReqTx. No detail information
523938	9	Timeout Error (BAM to packet) for CAN-Receive-Frame AT1IGCVol1.
523939	9	Broadcast Announce Message of the calibration message of the upstream catalytic NOx sensor has failed.
523940	9	Timeout Error (PCK2PCK) for CAN-Receive-Frame AT1IGCVol1
523941	9	Timeout Error (BAM to packet) for CAN-Receive-Frame AT1OGCVol2.
523942	9	Calibration message 1 of the after catalyst NOx sensor has failed.
523943	9	Timeout Error (PCK2PCK) for CAN-Receive-Frame AT1OGCVol2.
523946	0	Zerofuel calibration injector 1 (in firing order); maximum value exceeded
523946	1	Zerofuel calibration injector 1 (in firing order); minimum value exceeded
523947	0	Zerofuel calibration injector 2 (in firing order); maximum value exceeded
523947	1	Zerofuel calibration injector 2 (in firing order); minimum value exceeded
523948	0	Zerofuel calibration injector 3 (in firing order); maximum value exceeded
523948	1	Zerofuel calibration injector 3 (in firing order); minimum value exceeded
523949	0	Zerofuel calibration injector 4 (in firing order); maximum value exceeded
523949	1	Zerofuel calibration injector 4 (in firing order); minimum value exceeded
523950	0	Zerofuel calibration injector 5 (in firing order); maximum value exceeded
523950	1	Zerofuel calibration injector 5 (in firing order); minimum value exceeded
523951	0	Zerofuel calibration injector 6 (in firing order); maximum value exceeded
523953	2	Healing takes place if the condition for error detection is not present. Air temperature monitoring plausibility check array No detail information
523955	2	Healing takes place if the condition for error detection is not present. Air temperature monitoring plausibility check array No detail information
523960	0	Physical range check high for EGR cooler downstream temperature.
523960	1	Physical range check low for EGR cooler downstream temperature.
523960	0	High exhaust gas temperature EGR cooler downstream; warning threshold exceeded.

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
523969	11	Fault entry for override control mode. No detail information
523973	14	SCR Tamper detection; derating timer below limit 1
523974	14	SCR Tamper detection; derating timer below limit 2
523975	14	Urea quality; derating timer below limit 1
523976	14	Urea quality; derating timer below limit 2
523977	14	Urea tank level; derating timer below limit 1
523978	14	Urea tank level; derating timer below limit 2
523981	11	SCR plausibility, OBD and diagnosis; Stuck in range check of DEF tank temperature sensor DEF-tank without heating function (heating phase)
523982	0	Power stage diagnosis disabled; high battery voltage
523982	1	Power stage diagnosis disabled; low battery voltage
523984	3	UB7; Short circuit to battery error of actuator relay 7
523986	4	UB6; Short circuit to ground actuator relay 6
523987	4	UB7; Short circuit to ground actuator relay 7
523992	9	N/A
523993	9	N/A
523995	13	Check of missing injector adjustment value programming (IMA) injector 7 (in firing order)
523996	13	check of missing injector adjustment value programming (IMA) injector 8 (in firing order)
523997	4	Injector cylinder bank 1 slave; short circuit
523998	4	Injector cylinder bank 2 slave; short circuit
523999	12	Injector power stage output Slave defect
524000	5	Injector 7 (in firing order); interruption of electric connection
524000	3	Injector 7 (in firing order); short circuit
524001	5	Injector 8 (in firing order); interruption of electric connection
524001	3	Injector 8 (in firing order); short circuit
524013	7	Burner Control; burner Flame; Burner does not start after x trials (burner flame lost detection) Burner flame unintentional deleted
524013	7	Burner Control; Flame lost max Burner operation is interrupted too often
524014	1	Air inlet EPV - pressure too low Air pressure glow plug flush line; below limit
524016	11	Burner Control; HFM - Electrical Fault HFM sensor; electrical fault
524016	2	Burner Control; HFM - Plausibility error1 Amount of air is not plausible to pump speed
524018	14	HMI engine derate service state DPF wasn't regenerated, power reduction phase 1 (manual regeneration request)
524019	11	Burner Control; Air Line - Blocked Air Pump; air lines blocked
524020	14	Burner Control: power reduction due to low lambda. Engine power; Not enough oxygen for regeneration.
524021	11	Burner Control; Fuel line ShutOff downstream - broken Burner fuel line pipe leak behind Shut Off Valve
524022	14	HMI engine derate stop state DPF wasn't regenerated, power reduction phase 2 (manual regeneration request)
524024	11	Deviation of the exhaust gas temperature set point to actual value downstream (DOC) too high
524025	14	Particulate filter regeneration. Regeneration after time X is not successful (The error occurs when the regeneration times (3x) over the max. has been aborted allowed recovery time)

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
524025	5	DPF system; operating voltage error
524025	14	The standstill-regeneration mode time exceeds the long-limit. Vehicle was too long or too often in standstill mode. Make oil change and reset counter.
524025	14	The standstill-regeneration mode time exceeds the short-limit. Vehicle was too long or too often within a short time in standstill mode. Make oil change and reset counter.
524025	8	Max. launch time for stand still exceeded (60min).
524028	2	CAN message PROEGRActr; plausibility error
524029	2	Timeout Error of CAN-Receive-Frame ComEGRActr - exhaust gas recirculation positioner
524030	7	EGR actuator; internal error
524031	13	EGR actuator, calibration error
524032	2	EGR actuator; status message "EGRCust" is missing
524033	7	EGR actuator; due to overload in Save Mode
524034	5	Disc Separator; open load
524034	12	Disc Separator; power stage over temperature
524034	3	Disc separator; short circuit to battery
524034	4	Disc separator; short circuit to ground
524035	12	Injector diagnostics; time out error in the SPI communication
524036	12	Injector diagnostics Slave; time out error in the SPI communication
524038	9	Timeout error of CAN-Receive-Frame ComMS_Sys1TO (error memory Slave); Master-Slave internal CAN message
524039	9	Timeout error of CAN-Receive-Frame ComMS_Sys2TO (error memory Slave); Master-Slave internal CAN message
524040	9	Timeout error of CAN-Receive-Frame ComMS_Sys3TO (error memory Slave); Master-Slave internal CAN message
524041	9	Timeout error of CAN-Receive-Frame ComMS_Sys4TO (error memory Slave); Master-Slave internal CAN message
524042	9	Timeout error of CAN-Receive-Frame ComMS_Sys5TO (error memory Slave); Master-Slave internal CAN message
524043	9	Timeout error of CAN-Receive-Frame ComMS_Sys6TO (error memory Slave); Master-Slave internal CAN message
524044	9	CAN message ComMS_Sys7 not received from slave
524045	9	Master Slave, Error of message counter CAN receive message ComMSMoFOvR; ComMSMoFOvR1CNT
524046	9	Master-Slave CAN; Error Checksum of CAN-Receive Message
524047	9	Master-Slave CAN; Error of message length of CAN receive message ComMSMoFOvR;_ComMSMoFOvR1DLC
524048	9	Timeout error CAN message ComMSMoFOvR1TO error memory Slave
524052	11	Error memory Slave reports FID MSMonFC2 (collective error)
524052	11	Error memory Slave reports FID MSMonFC3 (collective error)
524052	11	Master ECU and Slave ECU data sets or software are not identical
524057	2	Fuel low pressure pump; error pressure build up
524058	2	Particulate filter; regeneration not successful
524063	5	Relay Urea back flow line heater: broken wiring detected (open load) Row engine: SCR-back flow line (K29) V-engine: Master: SCR-suction / back flow line (K32.1) Slave: SCR-suction / back flow line (K32.2)
524063	5	SCR main relay not connected
524063	5	SCR heater pressure line; open load
524063	3	SCR heater main relay; short circuit to battery
524063	4	SCR heater main relay load side (K31) on heating valve (Y31), Short cut to ground.

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
524063	5	Relay Urea suction line: broken wiring detected (open load) Row engine: SCR suction line (K28) V-engine: Master: common SCR-suction line (K28) Slave: common SCR back flow line (K29)
524063	5	SCR heater supply module; open load
524063	5	SCR heater tank; open load
524063	12	DEF supply module, time for defrosting too long
524063	12	DEF tank, time for defrosting too long
524065	0	Pressure sensor upstream SCR-CAT, pressure above upper physical threshold
524065	1	Pressure sensor upstream SCR-CAT, pressure below lower physical threshold
524065	3	Pressure sensor upstream SCR-CAT; short circuit battery or open load
524065	4	Pressure sensor upstream SCR-CAT; short circuit ground
524065	2	Pressure sensor upstream SCR-CAT, plausibility error
524066	3	SCR measurement heater output stage; short circuit battery or open load
524067	0	DEF supply module, heater temperature above upper physical threshold
524067	1	DEF supply module, heater temperature below lower physical threshold
524067	0	DEF supply module, temperature above upper physical threshold
524067	1	DEF supply module, temperature below lower physical threshold
524067	2	Supply module heater temperature, plausibility error
524067	2	Supply module temperature, plausibility error
524068	2	Master ECU and Slave ECU have been identified as the same types
524069	9	Timeout Error of CAN-Receive-Frame MSMon_FidFCCTO; Master-Slave CAN communication faulty
524070	2	(Upstream NOx-Sensor) Diagnostic Fault Check for invalid upstream NOx value (Sensor self diagnostic DFC set by Deutz-SW) NOx-Sensor before SCR-Cat: Invalid upstream NOx value
524071	2	(Downstream NOx-Sensor) Diagnostic Fault Check for invalid downstream lambda value (Sensor self diagnostic DFC set by Deutz-SW)
524072	2	(Upstream NOx-Sensor) Diagnostic Fault Check for invalid upstream lambda value (Sensor self diagnostic DFC set by Deutz-SW)
524073	2	(Downstream NOx-Sensor) Diagnostic Fault Check for invalid downstream NOx value (Sensor self diagnostic DFC set by Deutz-SW)
524074	9	NOx sensor downstream SCR-CAT, sensor internally open load
524074	2	NOx-Sensor after SCR-Cat: Nox-Sensor dew point problem or plausibility problem
524075	11	NOx sensor downstream SCR-CAT, sensor internally short circuit
524076	9	NOx sensor upstream SCR-CAT, sensor internally open line
524076	2	NOx-Sensor before SCR-Cat: Nox-Sensor dew point problem or plausibility problem
524077	11	NOx sensor upstream SCR-CAT, sensor internally short circuit
524078	9	NOx sensor downstream SCR-CAT, lambda value above upper physical threshold
524079	9	NOx sensor downstream SCR-CAT, lambda value below lower physical threshold
524080	9	NOx sensor upstream SCR-CAT, lambda value above upper physical threshold
524081	9	NOx sensor upstream SCR-CAT, lambda value below lower physical threshold
524082	9	(Downstream NOx-Sensor) Diagnostic Fault Check for downstream NOx value over maximum limit (DFC set by Deutz-SW)
524083	9	NOx-Sensor downstream SCR-CAT, NOx value below minimum value.
524084	9	NOx-Sensor upstream SCR-CAT, NOx value above maximum value.
524085	9	NOx sensor upstream SCR-CAT, NOx value below lower physical threshold

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
524087	5	Urea Error Lamp; open load
524087	12	Urea Error Lamp; temperature over limit
524087	3	Urea Error Lamp; short circuit battery
524087	4	Urea Error Lamp; short circuit ground
524096	14	Control of the SCR system; If the start stop counter (EPA-Counter) exceeds the threshold SCRCtl_ctEngStrtStopThresh_C. This counter will increment only once in each driving cycle in case of an SCR error. If the counter reaches the threshold, the DFC will be set to inhibit the engine start. Engine will not be started, because of EPA-Counter
524097	9	Timeout error of CAN-Transmit-Frame DPFBrnAirPmpCtl
524098	9	Timeout error of CAN-Transmit-Frame ComDPFBrnPT
524099	9	Timeout error of CAN-Transmit-Frame ComDPFC1
524100	9	Timeout error of CAN-Transmit-Frame ComDPFHisDat.
524101	9	Timeout error of CAN-Transmit-Frame ComDPFTstMon
524102	9	Timeout error of CAN-Receive-Frame ComRxDPFBrnAirPmpCtl
524103	9	Timeout error of CAN-Receive-Frame ComRxDPFBrnAirPmp
524104	9	Timeout error of CAN-Receive-Frame ComRxDPFCtl.
524105	9	Timeout error of CAN-Transmit-Frame ComEGRMsFlw (EGR Steller)
524106	9	Timeout error of CAN-Receive-Frame ComRxEGRMsFlw1 (EGR actuator)
524107	9	Timeout error of CAN-Receive-Frame ComRxEGRMsFlw2 (EGR actuator)
524108	9	Timeout error of CAN-Transmit-Frame ComEGRTVActr (EGR actuator)
524109	9	Timeout error of CAN-Receive-Frame ComRxEGRTVActr (EGR actuator)
524110	9	Timeout error of CAN-Transmit-Frame ComETVActrTO.
524111	9	Timeout error of CAN-Receive-Frame ComRxETVActr
524112	9	Timeout ComIntake Throttle Valve Actr.
524113	9	Timeout error of CAN-Receive-Frame ComRxITVActr
524114	9	Timeout error of CAN-Transmit-Frame A1DOC
524115	9	Timeout error of CAN-Transmit-Frame AT1S
524116	9	Timeout error of CAN-Transmit-Frame SCR2
524117	9	Timeout error of CAN-Transmit-Frame SCR3
524118	9	Timeout error of CAN-Receive-Frame ComRxCM1
524119	9	Timeout error of CAN-Receive-Frame ComRxCustSCR3
524120	9	Timeout error of CAN-Receive-Frame ComRxSCRHtDiag
524121	9	Timeout error of CAN-Receive-Frame ComRxTrbChActr (wastegate actuator)
524122	9	Timeout error of CAN-Receive-Frame ComRxUQSens (Urea quality)
524123	9	Timeout error of CAN-Receive-Frame ComSCRHtCtl
524124	9	Timeout error of CAN-Receive-Frame ComTxAT1IMG
524125	9	Timeout error of CAN-Receive-Frame ComTxTrbChActr (Wastegate actuator)
524132	2	Fuel low pressure upstream fuel low pressure pump not plausible
524132	0	Fuel low pressure upstream fuel low pressure pump, pressure above maximum warning threshold
524132	0	Fuel low pressure upstream fuel low pressure pump, pressure above maximum shut off threshold
524132	1	Fuel low pressure upstream fuel low pressure pump, pressure below minimum shut off threshold
524132	1	Fuel low pressure upstream fuel low pressure pump, pressure below minimum warning threshold
524133	2	HMI system; set if restore button blocked
524134	0	DPF, ash load exceeds the shutoff threshold

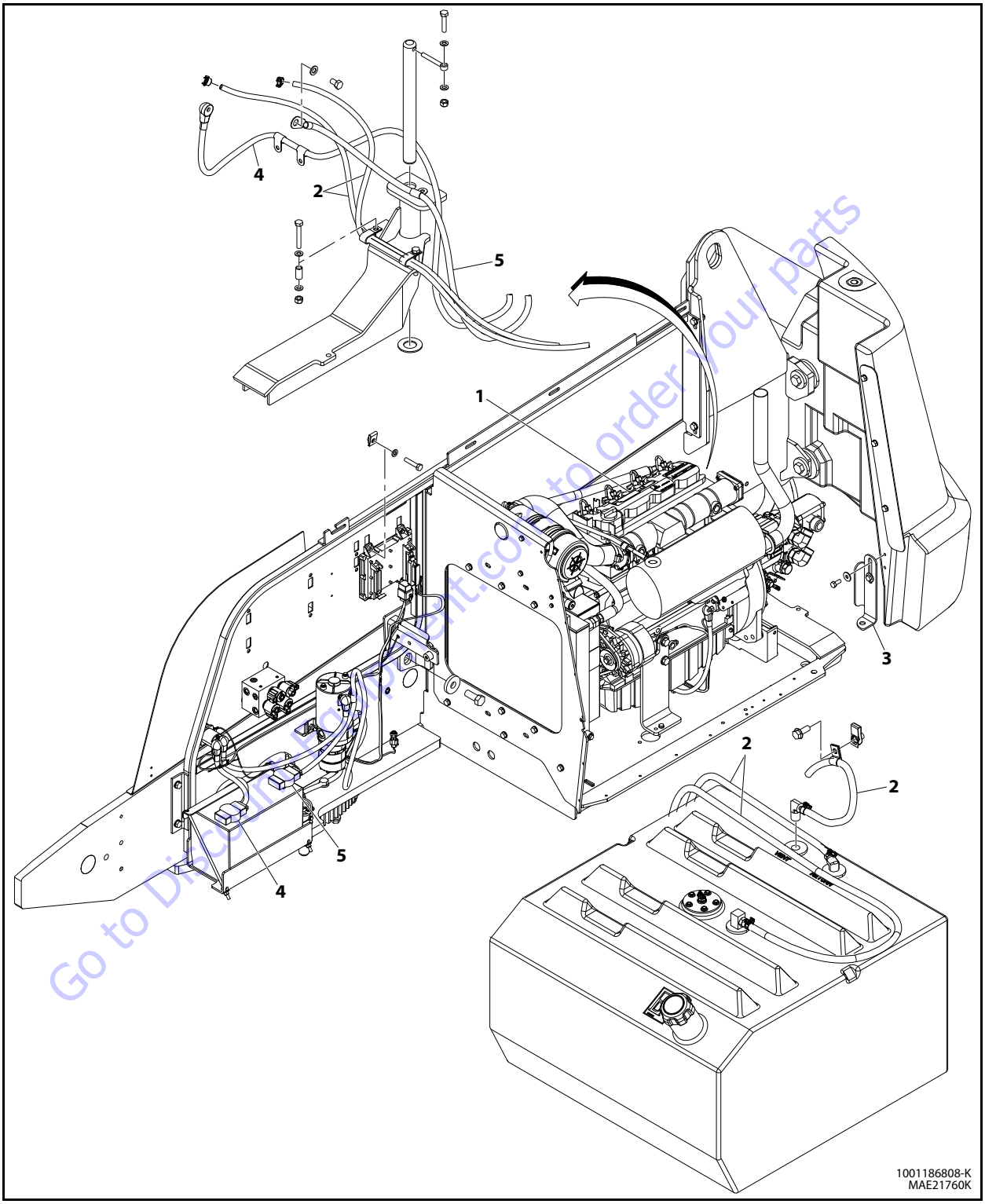
Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

SPN	FMI	Error Identification
524134	0	DPF, ash load exceeds the warning threshold
524135	0	DPF, soot load exceeds the shutoff threshold
524135	14	DPF, soot load exceeds the service request threshold
524135	0	DPF, soot load exceeds the warning threshold
524141	7	DEF dosing valve, dosing valve blocked
524147	13	SCR System, pressure build up not possible
524147	7	SCR-System, reverting valve blocked
524147	13	Set together with DFC_SCRCoBldUpLoPres. DFC_SCRCoBldUpLoPresRst is only used for inducement purposes. It ensures that legal inducement is working correctly.
524149	2	Plausibility error between pressure downstream turbine (PTrbnDs) and ambient air pressure (EnvP)
524149	2	Pressure downstream turbine, plausibility error
524152	2	Urea Quality Sensor; Timeout CAN message
524153	2	Urea tank level & urea tank temperature via CAN bus, timeout of CAN message
524156	9	Timeout error of CAN-Receive-Frame ComRxEBC2.
524157	9	Fan control; time out for fan governing
524159	0	Fan; short circuit battery or open load
524159	1	Fan; short circuit ground
524160	5	Fan; in/outlet valve 1; open load
524160	3	Fan; in/outlet valve 1; short circuit battery
524160	4	Fan; in/outlet valve 1; open load ground
524161	5	Fan; in/outlet valve 2; open load
524161	3	Fan; in/outlet valve 2; short circuit battery
524161	4	Fan; in/outlet valve 2; open load ground
524162	12	Fan; fan control; angle sensor defect
524163	12	Fan; fan control; fan or valve defect
524175	0	SCR-CAT, Nox emissions above maximum threshold
524177	7	SCR System, DEF suction line blocked
524178	7	SCR System, DEF pressure out of range
524189	9	Master / Slave Can disturbed.
524190	14	Inducement level 1 active
524191	14	Inducement level 2 active
524193	8	The standstill-regeneration mode time exceeds the long limit threshold. Vehicle was too long or too often in standstill mode. Change oil and reset counter.
524194	8	The standstill-regeneration mode time exceeds the short-limit. Vehicle was too long or too often within a short time in standstill mode. Change oil and reset counter.
524195	14	Standstill request due to crystallization ignored too long
524196	13	Variant handling, address error
524196	2	Variant handling, Synchronisation error
524202	11	SCR error code in master ECU active.
524203	11	DEF tank level failure is in master ECU active.
524204	11	SCR after run failure is in master ECU active.
524205	11	SCR Co2Off failure is in master ECU active.
524206	11	SCR disable DEF dosing failure is in master ECU active.

Table 3-4. Deutz Trouble Codes (D2.9 L4\TD2.9 L4 Engine)

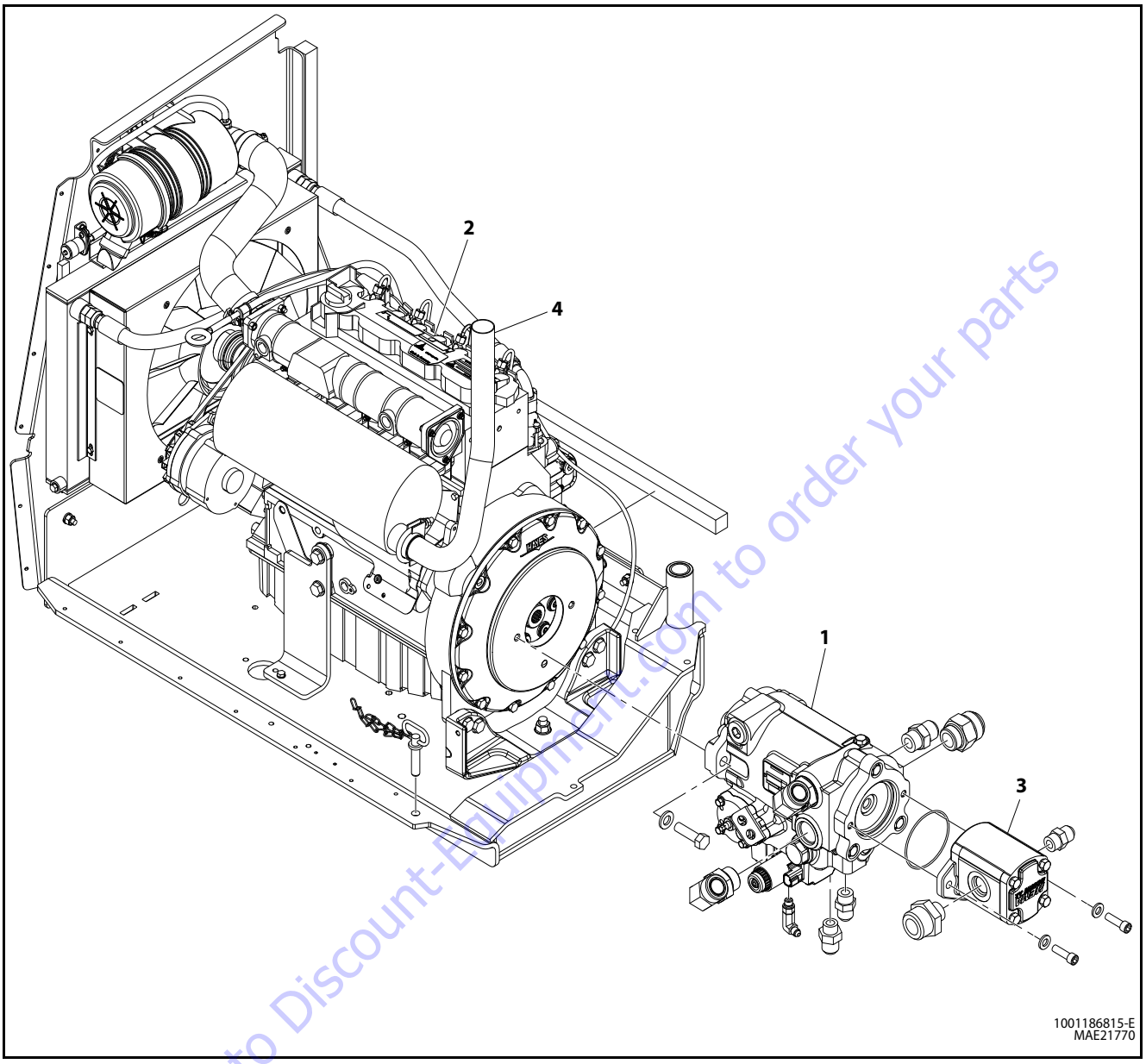
SPN	FMI	Error Identification
524230	11	Inducement HW Failure Slave.
524231	11	Inducement SCR Tamp. Slave
524232	11	Inducement DEF Quality in Slave ECU
524239	11	SCR regeneration failure is in slave ECU active.
524248	11	NOX sensor downstream error in slave ECU
524249	11	DEF dosing valve error in slave ECU
524251	11	DEF pressure problems in slave ECU
524252	11	Reverting valve error in slave ECU
524253	11	DEF back flow line heater error on slave ECU
524254	11	Error NOx-Tailpipe emissions exceeded on Slave ECU
524255	11	DEF suction line heater error on slave ECU
524256	11	DEF supply module heater error on slave ECU
524257	11	Error Exhaust pressure upstream SCR on Slave ECU
524258	11	Error Exhaust temperature upstream SCR on Slave ECU
524259	11	DEF pressure line heater error on slave ECU
524260	11	Error Urea pump temperature on Slave ECU
524261	11	Error DEF heater relays on Slave ECU
524267	14	Announcement triggers the Inducement Level 2

3.17 DEUTZ D2011L04 ENGINE



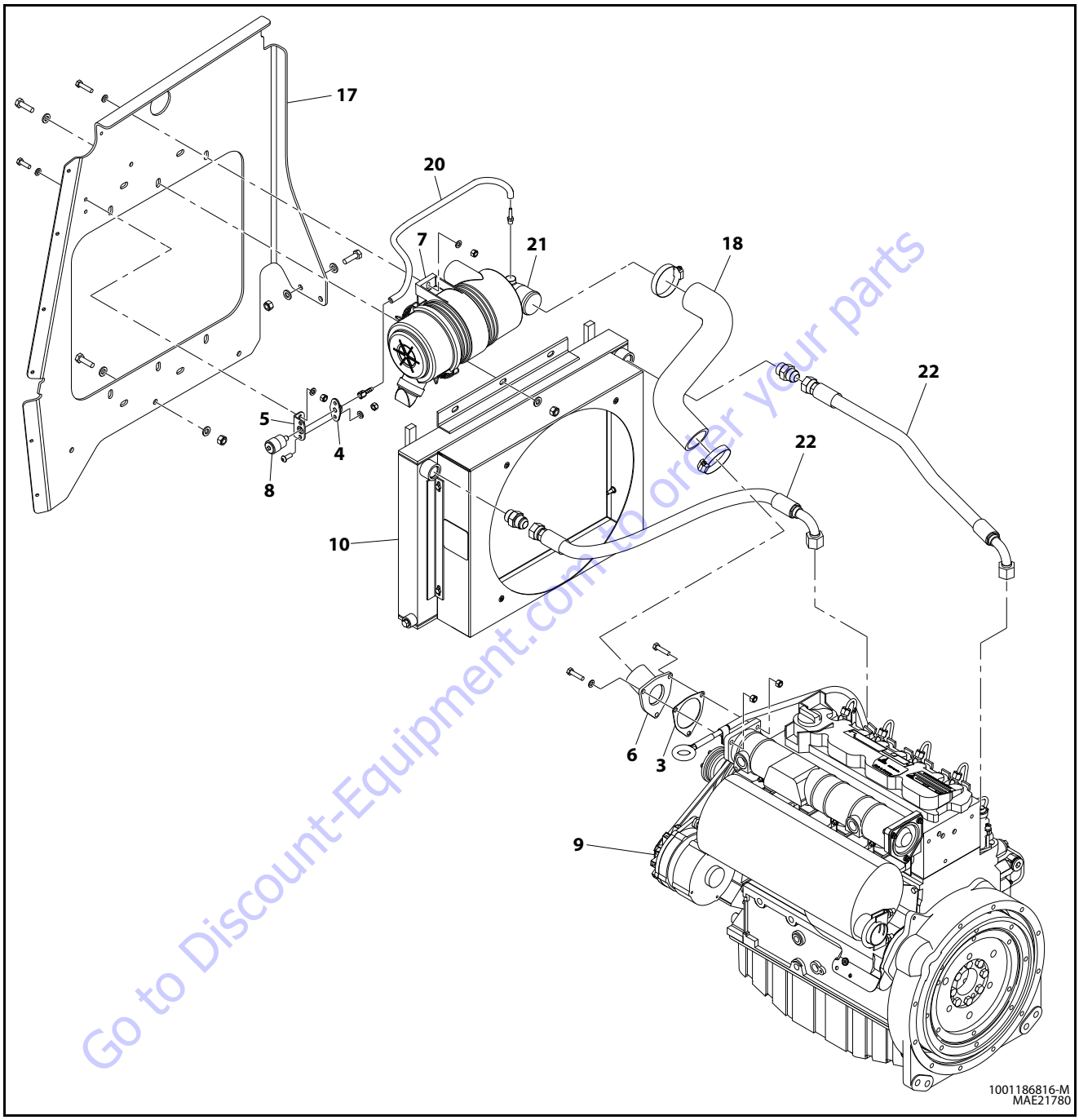
1. Deutz D2011 Engine
2. Fuel Hose
3. Bracket
4. Battery Cable (+)
5. Battery Cable (-)

Figure 3-32. Deutz D2011 Engine Installation



1. Piston Pump Assembly
2. Deutz D2011 Engine Assembly
3. Gear Pump Assembly
4. Exhaust Pipe

Figure 3-33. Deutz D2011 Engine and Pumps Sub-Assembly



1. Fan
2. Relay
3. Gasket, Air Intake Adapter
4. Support
5. Bracket
6. Adapter
7. Clamp, Air Cleaner
8. Indicator, Air Filter Service
9. Deutz D2011 Engine
10. Radiator
11. Engine Bracket - Rear
12. Engine Bracket - Right
13. Fan Adapter
14. Motor Mount
15. Plate
16. Tray
17. Radiator Support
18. Hose
19. Motor Mount
20. Tube
21. Air Filter
22. Hose
23. Glow Plug Harness
24. Pump Coupling Kit
25. Shim

Figure 3-34. Deutz D2011 Engine Assembly - Sheet 1 of 2

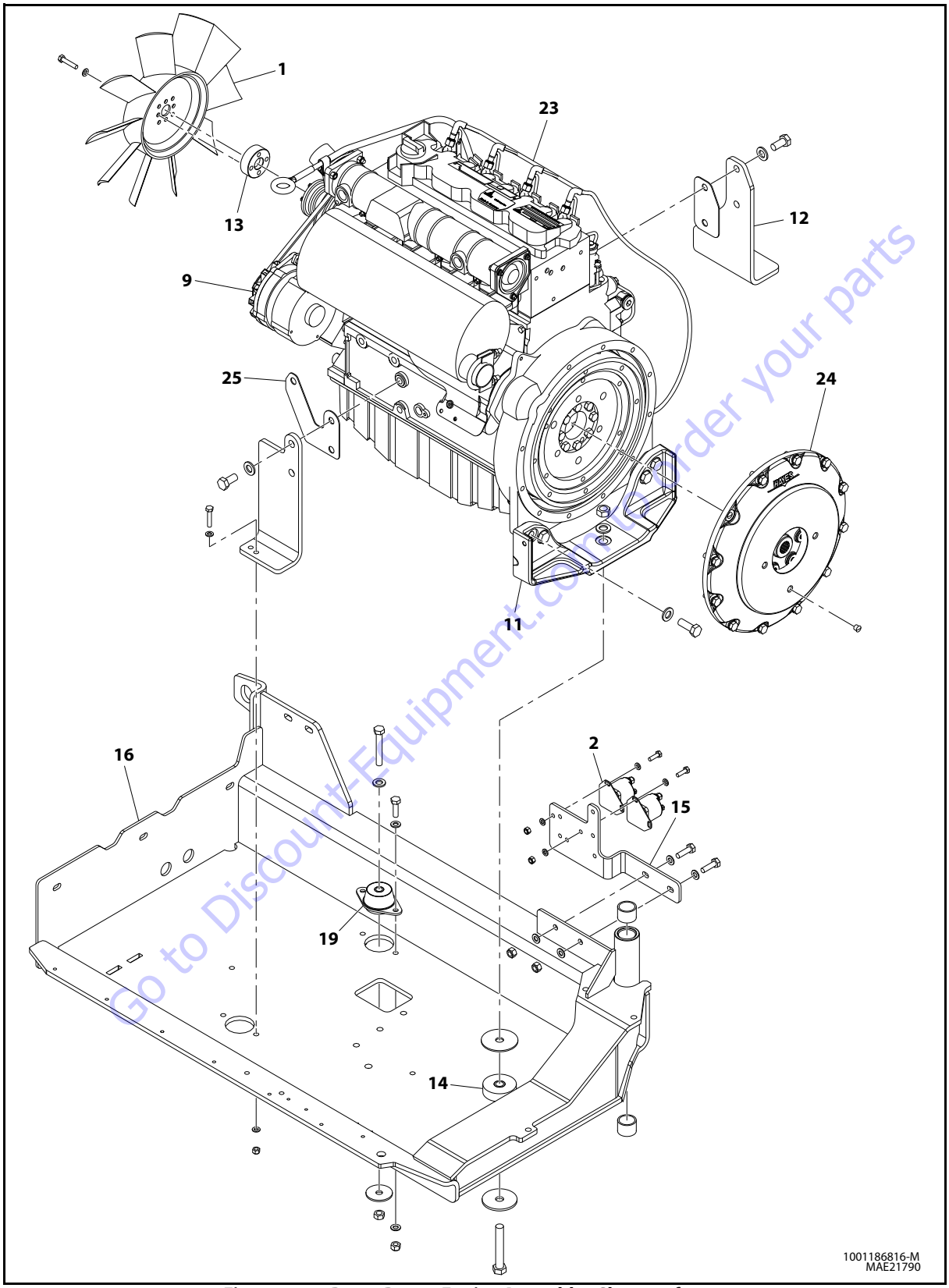


Figure 3-35. Deutz D2011 Engine Assembly - Sheet 2 of 2

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

Checking Oil Level

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

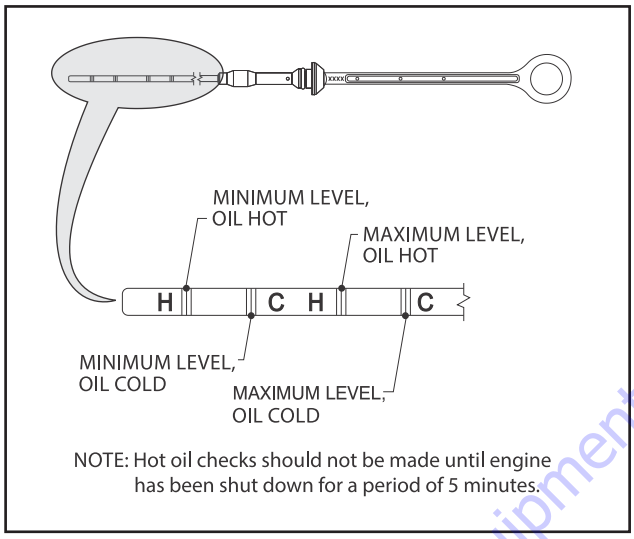


Figure 3-36. Deutz Dipstick Markings

5. Replace dipstick until fully seated.

Changing Engine Oil

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

⚠ CAUTION

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

NOTICE

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

4. Open oil drain valve and drain oil.
5. Close oil drain valve.
6. Pour in new engine oil. Refer to Section 1 for capacity and Figure 3-37., Engine Oil Viscosity.

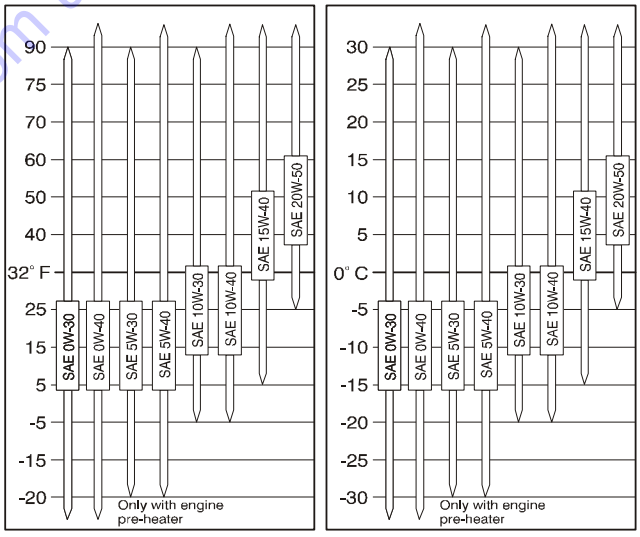
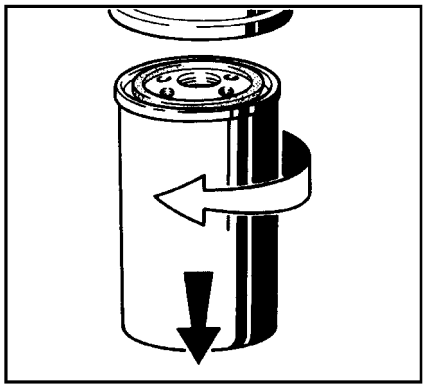


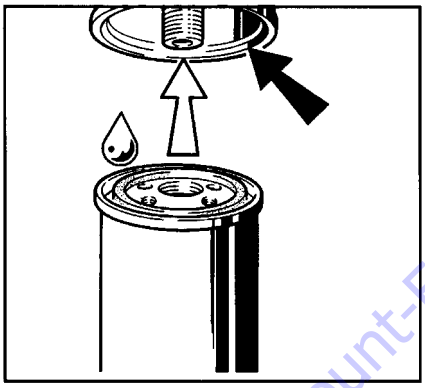
Figure 3-37. Engine Oil Viscosity

Changing Oil Filter

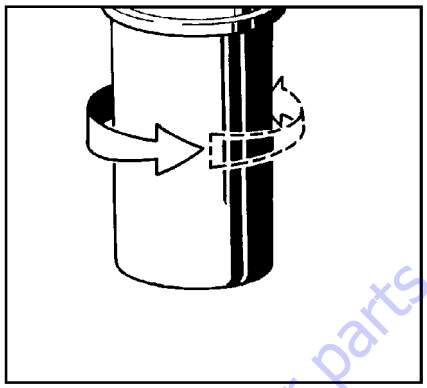
1. Wipe area around filter to clean any dirt from area.
2. Using a suitable oil filter removal tool, loosen lube oil filter cartridge and spin off.



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



6. Screw in new filter by hand until gasket is flush.



7. Hand-tighten filter another half-turn.
8. Check oil level.
9. Check oil pressure.
10. Check oil filter cartridge for leaks.

Replace Fuel Filter

⚠ WARNING

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

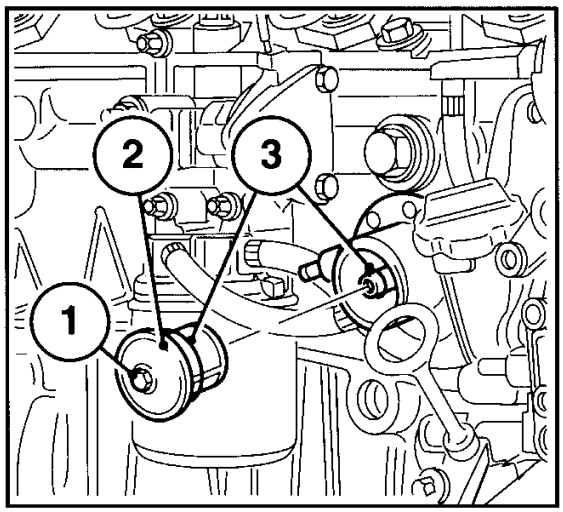
1. Wipe area around filter to clean any dirt from area.
2. Remove fuel filter cartridge. Catch any escaping fuel.
3. Clean dirt from filter carrier sealing surface.
4. Apply light film of oil or diesel fuel to rubber gasket of new filter cartridge.
5. Screw in new filter by hand until gasket is flush. Hand-tighten filter another half-turn.
6. Open fuel shut-off valve.
7. Check for leaks.

Clean Fuel Strainer

⚠ WARNING

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

1. Unscrew hexagonal nut (1).



2. Remove fuel strainer cover (2).
3. Clean fuel strainer with diesel fuel and replace as needed.
4. Place seal (3) in position.
5. Install fuel strainer cover (2). Tighten screw (1).
6. Check for leaks.

Spark Arrester Cleaning Instructions

1. Remove cleanout plug in bottom of spark arrester (muffler).
2. Without causing deformation (or any type of damage to spark arrester) repeatedly tap on arrester near cleanout plug. This may be enough to begin spark trap drainage.
3. An industrial vacuum cleaner can do a complete job at this point.
   a. Or, IN A SAFE AREA, start engine. Alternate between low idle and high idle for two to three minutes.
   b. Or, operate engine as required by application for two to three minutes.
4. Install cleanout plug.

Glow Plugs

If glow plug option is enabled in the JLG Control System, glow plug and indicator lamp will be energized when Power/Emergency Stop switch is pulled on if ambient air temperature is less than 50° F (10° C) and engine coolant temperature is less than 140° F (60° C).

This determination occurs one second after the Power/Emergency Stop switch has been pulled on. Lamp and glow plugs remain energized for period of time specified by setting in the JLG Control System. Engine start is disabled during this period.

On Deutz engines, glow plugs continue (post glow) after engine has started three times the machine digit setting.

Table 3-5. Deutz Trouble Codes (D2011L04 Engine)

FAULT GROUP	FAULT NO. (IN SERDIA)	FAULT LOCALITY/ FAULT DESCRIPTION	SPN	FMI	CAUSE	REMARKS	HELP
Zero error display	-	No faults	524287	31	No active faults present		
Revolutions/ speed acquisition	01	Speed sensor 1	190	8	Sensor failure. Distance from gear too far. Additional fault impulses. Cable joint interrupted.	Governor in emergency operation (if sensor 2 available). Emergency switch-off (if sensor 2 not available or failed).	Check distance. Check cable connection. Check sensor and replace if required.
						Governor in emergency operation (with sensor 1) Emergency switch-off (if sensor 1 not available or failed).	
	3	Speed sensor	84	8	Tacho failed. Additional fault impulses. Cable connection interrupted.	Governor in emergency operation.	Check cable connection and Tacho. Replace if required.
	4	Excess speed switch-off	190	0	Speed was/is in excess of limit.e.	Engine stop.	Check parameter (21). Check speed settings.
					Check PID setting. Check rods. Check actuator and replace if required. Check cable to actuator (impulse on incorrect speed). Check No. of teeth. For vehicles check for possible thrust mode.		
Sensors	07	Charge air pressure	102	2	Fault at corresponding sensor entry (e.g. short circuit or cable break).	With failure of the sensor, the associated monitoring function is de-activated.	Check sensor cable. Check sensor and replace if required. Check fault limits for sensor.
	08	Oil pressure	100	2			
	09	Coolant temperature	110	2			
	10	Charge air temperature	105	2			
	11	Fuel temperature	174	2			

Table 3-5. Deutz Trouble Codes (D2011L04 Engine)

FAULT GROUP	FAULT NO. (IN SERDIA)	FAULT LOCALITY/ FAULT DESCRIPTION	SPN	FMI	CAUSE	REMARKS	HELP
Functional fault warning	30	Oil pressure warning	100	1	Oil pressure below speed-dependent warning line characteristic	Fault message (disappears when oil pressure is again above recovery limit). After a delay time - fill limitation.	Check engine (oil level, oil pump). Check oil pressure sensor and cable. Check oil pressure warning line characteristic.
	31	Coolant temperature warning	110	0	Coolant temperature has exceeded warning level.	Fault message (disappears when coolant temperature again drops below recovery level). After a delay time - fill limitation.	Check coolant. Check coolant temperature sensor and cable.
	32	Charge air temperature warning	105	0	Charge air temperature has exceeded warning level.	Fault message (disappears when charge air temperature gain drops below recovery level). After a delay time - fill limitation.	Check charge air. Check charge air-temperature sensor and cable.
	34	Coolant level warning	111	1	Switch input “Low coolant level” is active.	Fault message.	Check coolant level. Check coolant level sensor and cable.
	35	Speed warning (with thrust mode operation).	SID 190	14	revolutions was/is above (top) revolution speed limit. “Thrust mode” function is active.		Check parameters. Check speed settings.
					Check PID setting. Check rods. Check actuator and replace if required. Check cable to actuator. Check speed sensor (impulses on incorrect speed). Check No. of teeth. For vehicles check for possible thrust mode.		
	36	Fuel temperature warning	174	0	Fuel-temperature has exceeded warning level.	Fault message (disappears when fuel temperature again drops below recovery level).	Check fuel. Check fuel temperature sensor and cable.
Functional fault, switch-off	42	Charge air temperature switch- off	105	0	Charge air temperature has exceeded switch-off limit.	Emergency stop	Check charge air. Check charge air-temperature sensor and cable. Check switch-off limit.
	44	Coolant level switch-off	111	1	Switch input “Low coolant level” is active.	Emergency stop. Start lock.	Check coolant level. Check coolant level sensor and cable.

Table 3-5. Deutz Trouble Codes (D2011L04 Engine)

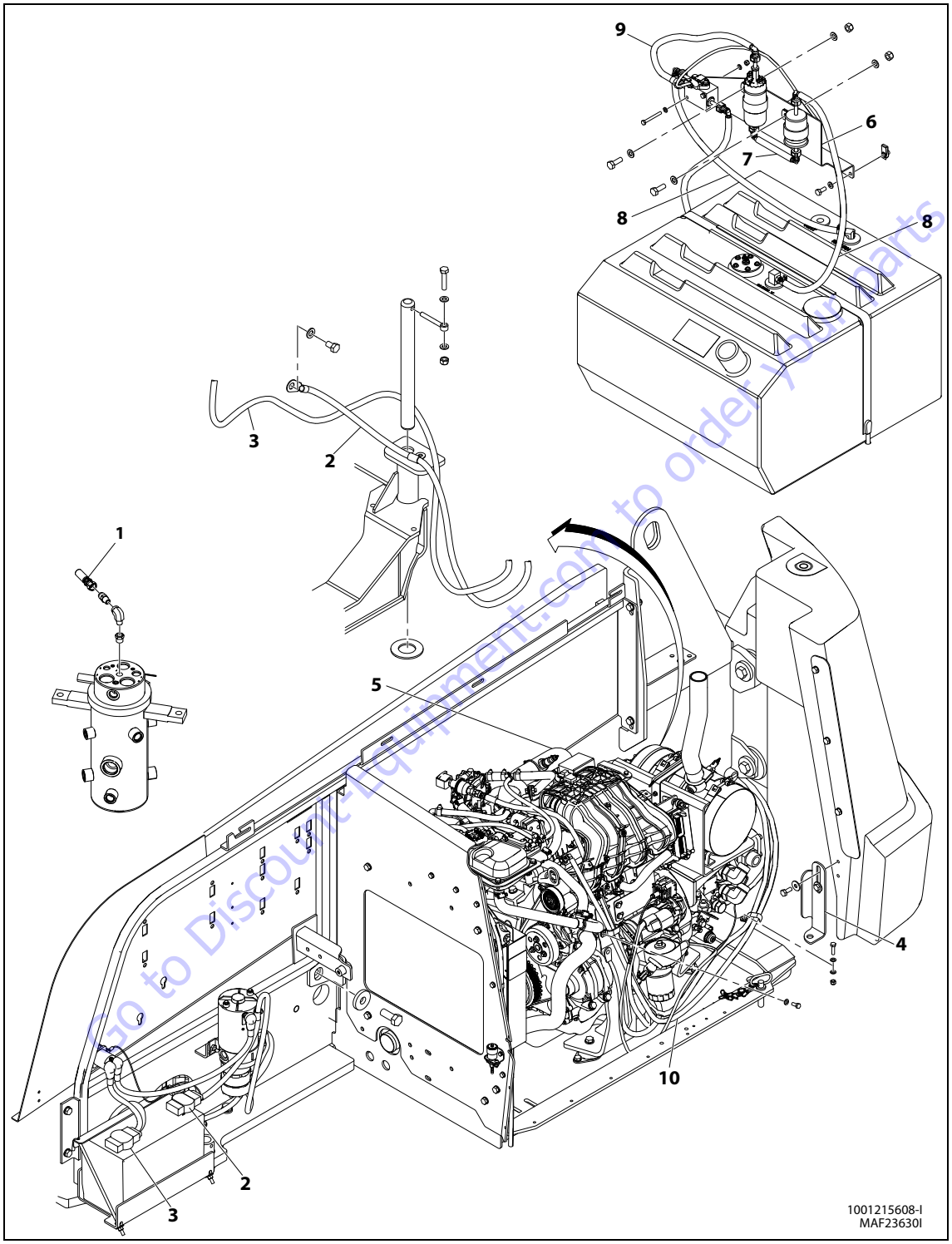
FAULT GROUP	FAULT NO. (IN SERDIA)	FAULT LOCALITY/ FAULT DESCRIPTION	SPN	FMI	CAUSE	REMARKS	HELP
Actuator	50	Feedback	S ID 24	1 2	Actuator not connected. Fault in actuator confirmation.	Emergency switch-off. Actuator cannot be operated.	Check actuator, replace if required. Check cable, check fault limits for "Confirmation".
	52	Reference feedback	S ID 24	1 3			Check actuator, replace if required. Check cable, check fault limits for "Rifeness confirmation".
	53	Control travel difference	DI 23	7	Injection pump/actuator jammed or not connected. Difference between nominal/actual control travel is > 10% of the overall control path.	Fault message (disappears when difference is < 10%).	Check actuator/actuator rods / injection pump, replace if required. Check actuator cable.
	59	Auto calibration BOSCH-EDC pumps faulty operation	S ID 23	1 3	No automatic actuator equalization possible. Incorrect input of the actuator reference values.	Engine stop / start lock. Governor cannot be taken into use. EDC actuator calibration required.	Check actuator and replaced if required. Check feedback cable. Check fault limits and reference values of the feedback. Program the fault limits for feedback, save values. Switch ignition off and on again.Check again. If faulty, inform DEUTZ-Service and carry out automatic equalization again. Set fault limits again.
Hardware inputs/ outputs	60	Digital output 3 (Switch-off solenoid, pin M 2)	S ID 51	2	Fault (short circuit / cable break) at digital output.	Driver level is switched off.	Check cable of digital output (cable break or short circuit).
	62	Digital output 6, pin M 7	S ID 60	2		Fault message.	
	63	Excess voltage switch-off solenoid	S ID 51	6			
	67	Error Hand Setp1	9 1	1 1			
	68	Error CAN Step 1	8 9 8	2			
Communication	70	CAN-Bus controller	S ID 231	1 2	CAN-controller for CAN-bus is faulty. Fault removal despite re- initializing continuously not possible	Application-dependent.	Check CAN connection, terminating resistor (see Chapter 12.4), Check control unit.
	71	CAN interface SAE J 1939	S ID 231	9	Overflow in input buffer or a transmission cannot be placed on the bus.		
	74	Cable break, short circuit or bus-error	S ID 231	1 4			Check CAN connection, cable connection. Check sensor and replace if required.

Table 3-5. Deutz Trouble Codes (D2011L04 Engine)

FAULT GROUP	FAULT NO. (IN SERDIA)	FAULT LOCALITY/ FAULT DESCRIPTION	SPN	FMI	CAUSE	REMARKS	HELP
Memory	76	Parameter programming (write EEPROM)	S ID 253	1 2	Fault in parameter programming in the governor fixed value memory.	Emergency switch-off. engine cannot be started.	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service
	7 7	Cyclic program test	S ID 240	1 2	Constant monitoring of program memory shows error (so-called "Flash-test").		
	78	Cyclic RAM test	S ID 254	2	Constant monitoring of working memory shows error.		Note values of parameters (3895 and 3896). Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
Control unit hardware	80	Power supply (Actuator)	S ID 254	2	Power supply for actuator not in the permissible range.	Fault message (disappears when power again in the normal range).	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	83	Reference voltage 1	S ID 254	2	Reference voltage for actuator not in the permissible range.	Fault message (disappears when power again in the normal range). Auxiliary value 5 V	Check voltage supply. Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	84	Reference voltage 2	S ID 254	2			
	85	Reference voltage 4	S ID 254	2			
	86	Internal temperature	171	12	Internal temperature for control unit not in permissible range.	Fault message (disappears when power again in the normal range).	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	87	Atmospheric pressure	1 0 8	12	Atmospheric pressure not in permissible range.	Fault message (disappears when power again in normal range). Atmospheric pressure monitoring function de-activated.	
Program logic	90	Parameter fault (EEPROM retrieval or checksum faulty).	S ID 253	2	No data found or checksum of data is faulty (note: fault only occurs during setting of parameter / saving or reset.).	Engine cannot be started.	Check data for correct settings. Save parameters. Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	93	Stack overflow	S ID 240	2	Internal calculation fault (so-called "Stack over flow" fault).	Emergency switch-off. Engine cannot be started.	Note parameters (3897 and 3898). Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	94	Internal fa u lt	S ID 254	2			

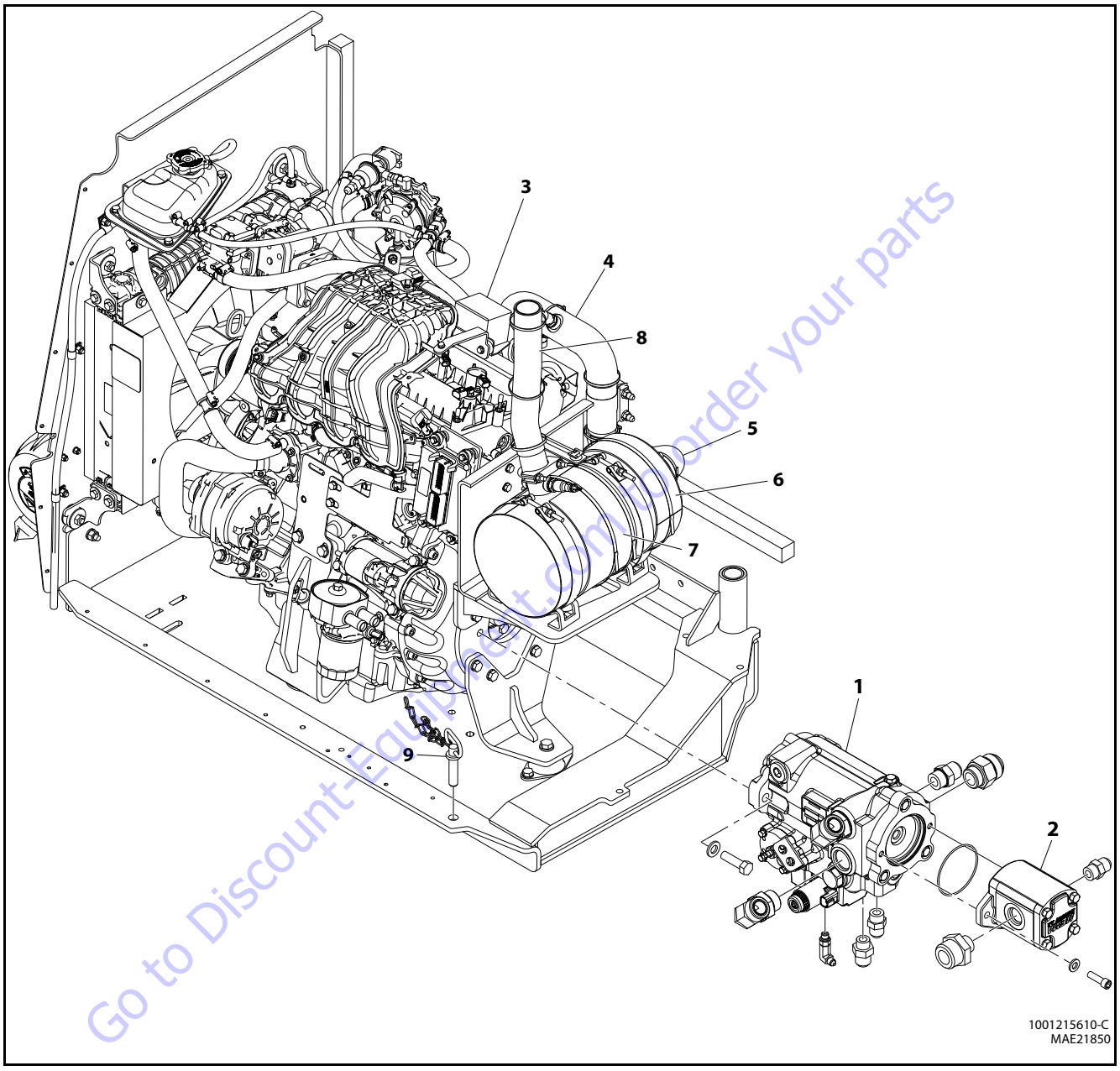
NOTE: *SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.*

3.18 FORD ENGINE



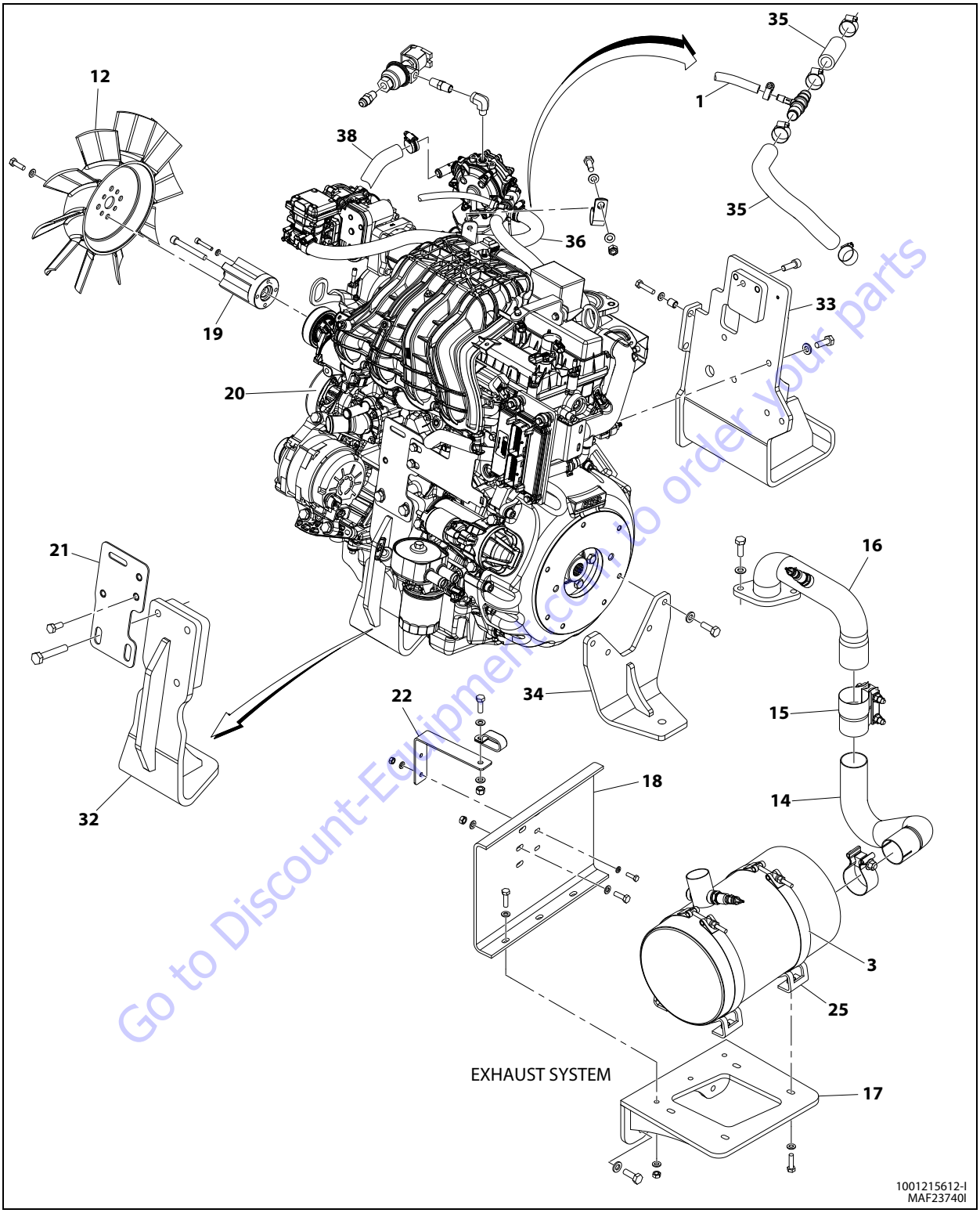
1. Hose
2. Battery Cable (-)
3. Battery Cable (+)
4. Bracket
5. Ford Engine and Pumps
6. Bracket
7. Hose
8. Hose
9. Hose
10. Hose

Figure 3-38. Ford MSG425 Engine Installation



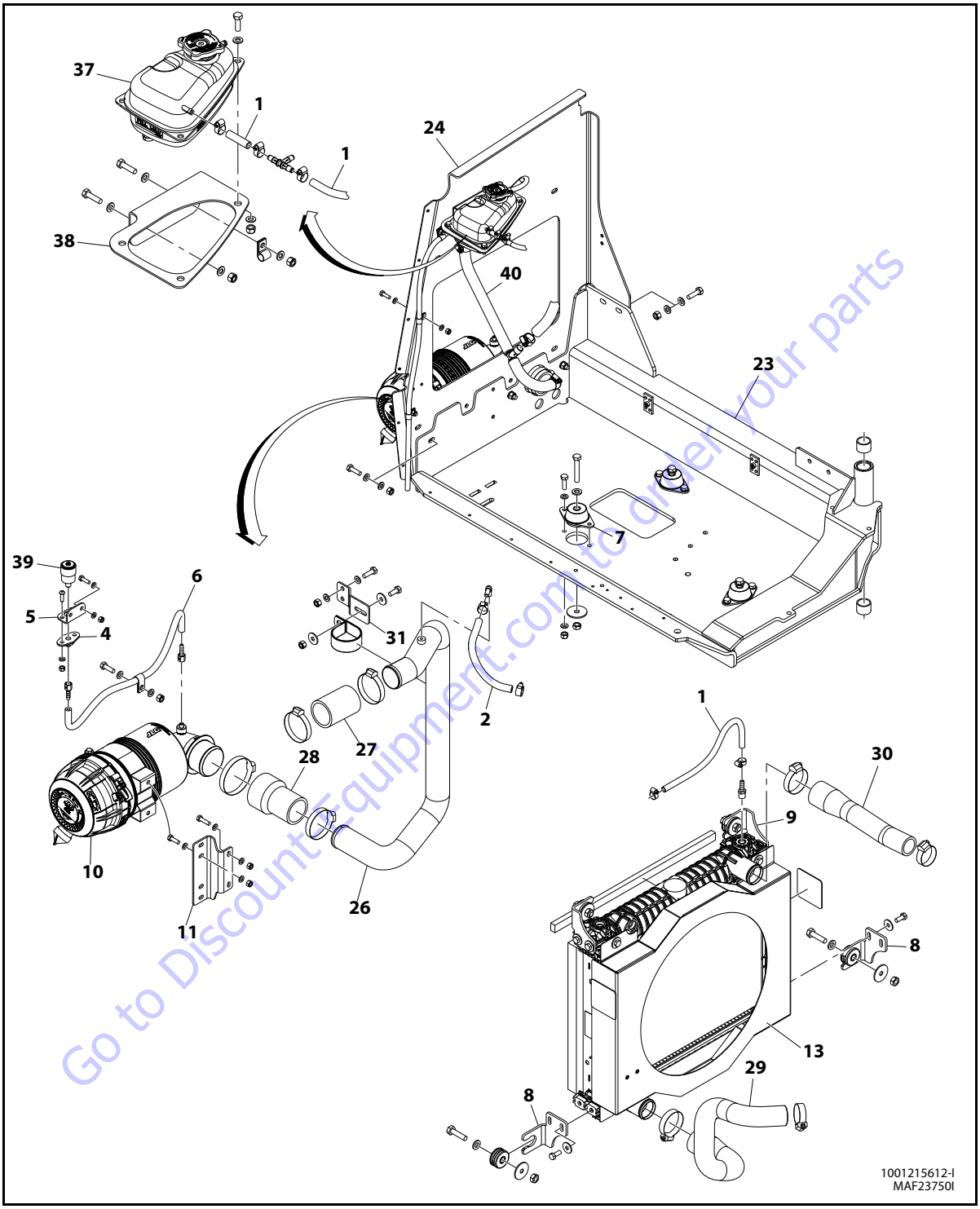
1. Piston Pump Assembly
2. Gear Pump Assembly
3. Ford Engine Assembly
4. Exhaust Insulate
5. Exhaust Insulate
6. Muffler Insulate
7. Muffler Insulate
8. Exhaust Pipe
9. Exhaust Insulate

Figure 3-39. Ford Engine and Pumps Sub-Assembly



1.	Fuel Hose	4.	Support	7.	Motor Mount	10.	Air Filter	13.	Radiator
2.	Hose	5.	Bracket	8.	Bracket	11.	Support	14.	Exhaust Pipe
3.	Strap	6.	Hose	9.	Bracket	12.	Fan	15.	Clamp

Figure 3-40. Ford Engine Assembly - Sheet 1 of 2



16. Exhaust Pipe
17. Bracket
18. Heat Shield
19. Adapter
20. Ford Engine Assembly
21. Plate
22. Support
23. Tray
24. Radiator Support
25. Mount
26. Air Intake Pipe
27. Air Intake Pipe
28. Air Intake Pipe
29. Radiator Hose (Lower)
30. Radiator Hose (Upper)
31. Bracket
32. Engine Mount (RH Front)
33. Engine Mount (LH Front)
34. Engine Mount (Rear)
35. Heater Hose
36. Hose
37. Surge Tank
38. Bracket
39. Restriction Indicator
40. Hose

Figure 3-41. Ford Engine Assembly - Sheet 2 of 2

Table 3-6. CAN to DTC Cross Reference (Ford MSG425 Engine)

SPN	FMI	Description
0	31	Gov1/2/3 interlock failure
0	31	RS-485 Rx inactive
0	31	RS-485 Rx noise
0	31	RS-485 Rx bad packet format
0	31	RS-485 remote shutdown request
29	0	FPP2 higher than IVS
29	1	FPP2 lower than IVS
29	3	FPP2 voltage high
29	4	FPP2 voltage low
51	0	TPS1-2 higher than expected
51	1	TPS1-2 lower than expected
51	3	TPS1 voltage high
51	4	TPS1 voltage low
51	7	Unable to reach higher TPS
51	7	Unable to reach lower TPS
51	31	TPS1/2 simultaneous voltages out-of-range
84	8	Roadspeed input loss of signal
91	0	FPP1 higher than IVS
91	1	FPP1 lower than IVS
91	3	FPP1 voltage high
91	4	FPP1 voltage low
91	9	J1939 ETC message receipt loss while in-gear
91	16	FPP1-2 higher than expected
91	18	FPP1-2 lower than expected
91	19	J1939 ETC message receipt loss
91	31	FPP1/2 simultaneous voltages out-of-range (redundancy lost)
94	0	Fuel pressure higher than expected
94	1	Fuel pressure lower than expected
94	3	FP high voltage
94	4	FP low voltage
100	0	Oil pressure sender high pressure
100	1	Oil pressure low
100	1	Oil pressure sender low pressure
100	3	Oil pressure sender high voltage
100	4	Oil pressure sender low voltage
100	18	Oil pressure sender low pressure stage 1
102	0	Boost control overboost failure
102	1	Boost control underboost failure
102	2	TIP active
102	3	TIP high voltage
102	4	TIP low voltage
105	0	IAT higher than expected stage 2

Table 3-6. CAN to DTC Cross Reference (Ford MSG425 Engine)

SPN	FMI	Description
105	3	IAT voltage high
105	4	IAT voltage low
105	15	IAT higher than expected stage 1
106	4	MAP voltage low
106	16	MAP pressure high
108	0	BP pressure high
108	1	BP pressure low
110	0	ECT higher than expected stage 2
110	0	CHT higher than expected stage 2
110	3	ECT voltage high
110	4	ECT voltage low
110	15	ECT higher than expected stage 1
110	16	CHT higher than expected stage 1
168	15	Vbat voltage high
168	17	Vbat voltage low
173	0	EGT temperature high
174	3	FT high voltage
174	4	FT low voltage
441	0	EMWT1 higher than expected stage 2
441	3	EMWT1 voltage high
441	4	EMWT1 voltage low
441	15	EMWT1 higher than expected stage 1
442	0	EMWT2 higher than expected stage 2
442	3	EMWT2 voltage high
442	4	EMWT2 voltage low
442	15	EMWT2 higher than expected stage 1
515	0	RPM above spark rev limit level
515	15	RPM higher than max allowed govern speed
515	16	RPM above fuel rev limit level
558	5	IVS stuck at-idle, FPP1/2 match
558	6	IVS stuck off-idle, FPP1/2 match
628	13	Microprocessor failure - FLASH
629	31	Microprocessor failure - COP
629	31	Microprocessor failure - RTI 1
629	31	Microprocessor failure - RTI 2
629	31	Microprocessor failure - RTI 3
629	31	Microprocessor failure - A/D
629	31	Microprocessor failure - Interrupt
630	12	Microprocessor failure - RAM
632	31	Fuel run-out longer than expected
636	2	CRANK input signal noise
636	4	Crank signal loss
636	8	Crank and/or cam could not synchronize during start

Table 3-6. CAN to DTC Cross Reference (Ford MSG425 Engine)

SPN	FMI	Description
639	12	CAN-J1939 Tx fault
639	12	CAN-J1939 Rx fault
639	13	J1939 CAN address / engine-number conflict
645	3	Tach output short to power
645	4	Tach output ground short
651	5	Injector 1 open or short to ground
651	6	Injector 1 coil shorted
652	5	Injector 2 open or short to ground
652	6	Injector 2 coil shorted
653	5	Injector 3 open or short to ground
653	6	Injector 3 coil shorted
654	5	Injector 4 open or short to ground
654	6	Injector 4 coil shorted
655	5	Injector 5 open or short to ground
655	6	Injector 5 coil shorted
656	5	Injector 6 open or short to ground
656	6	Injector 6 coil shorted
657	5	Injector 7 open or short to ground
657	6	Injector 7 coil shorted
658	5	Injector 8 open or short to ground
658	6	Injector 8 coil shorted
659	5	Injector 9 open or short to ground
659	6	Injector 9 coil shorted
660	5	Injector 10 open or short to ground
660	6	Injector 10 coil shorted
695	9	J1939 TSC1 message receipt loss
697	3	PWM1-Gauge1 short to power
697	5	PWM1-Gauge1 open / ground short
698	3	PWM2-Gauge2 short to power
698	5	PWM2-Gauge2 open / ground short
699	3	PWM3-Gauge3 short to power
699	5	PWM3-Gauge3 open / ground short
700	3	PWM4 short to power
700	5	PWM4 open / ground short
701	3	AUX analog Pull-Up 1 high voltage
701	4	AUX analog Pull-Up 1 low voltage
702	3	AUX analog Pull-Up 2 high voltage
702	4	AUX analog Pull-Up 2 low voltage
703	3	AUX analog Pull-Up 3 high voltage
703	4	AUX analog Pull-Up 3 low voltage
704	3	AUX analog Pull-Up/Down 1 high voltage
704	4	AUX analog Pull-Up/Down 1 low voltage
705	3	AUX analog Pull-Up/Down 2 high voltage

Table 3-6. CAN to DTC Cross Reference (Ford MSG425 Engine)

SPN	FMI	Description
705	4	AUX analog Pull-Up/Down 2 low voltage
706	3	AUX analog Pull-Up/Down 3 high voltage
706	4	AUX analog Pull-Up/Down 3 low voltage
707	3	AUX digital 1 high voltage
707	4	AUX digital 1 low voltage
708	3	AUX digital 2 high voltage
708	4	AUX digital 2 low voltage
709	3	AUX digital 3 high voltage
709	3	Water Intrusion Detection
709	4	AUX digital 3 low voltage
710	3	AUX analog Pull-Down 1 high voltage
710	4	AUX analog Pull-Down 1 low voltage
711	3	AUX analog Pull-Down 2 high voltage
711	4	AUX analog Pull-Down 2 low voltage
712	3	AUX analog Pull-Down 3 high voltage
712	4	AUX analog Pull-Down 3 low voltage
713	3	AUX analog Pull-Up/Down 4 high voltage
713	4	AUX analog Pull-Up/Down 4 low voltage
723	2	CAM input signal noise
723	4	Loss of CAM input signal
731	2	Knock1 excessive or erratic signal
731	4	Knock1 sensor open or not present
920	3	Buzzer control short to power
920	4	Buzzer control ground short
920	5	Buzzer open
924	3	PWM5 short to power
924	5	PWM5 open / ground short
925	3	PWM6 short to power
925	5	PWM6 open / ground short
926	3	PWM7 short to power
926	5	PWM7 open / ground short
1079	3	Sensor supply voltage 1 high
1079	4	Sensor supply voltage 1 low
1079	31	Sensor supply voltage 1 and 2 out-of-range
1080	3	Sensor supply voltage 2 high
1080	4	Sensor supply voltage 2 low
1110	31	J1939 shutdown request
1192	3	WGP voltage high
1192	4	WGP voltage low
1213	3	MIL control short to power
1213	4	MIL control ground short
1213	5	MIL open
1268	5	Spark coil 1 primary open or short to ground

Table 3-6. CAN to DTC Cross Reference (Ford MSG425 Engine)

SPN	FMI	Description
1268	6	Spark coil 1 primary shorted
1269	5	Spark coil 2 primary open or short to ground
1269	6	Spark coil 2 primary shorted
1270	5	Spark coil 3 primary open or short to ground
1270	6	Spark coil 3 primary shorted
1271	5	Spark coil 4 primary open or short to ground
1271	6	Spark coil 4 primary shorted
1272	5	Spark coil 5 primary open or short to ground
1272	6	Spark coil 5 primary shorted
1273	5	Spark coil 6 primary open or short to ground
1273	6	Spark coil 6 primary shorted
1274	5	Spark coil 7 primary open or short to ground
1274	6	Spark coil 7 primary shorted
1275	5	Spark coil 8 primary open or short to ground
1275	6	Spark coil 8 primary shorted
1276	5	Spark coil 9 primary open or short to ground
1276	6	Spark coil 9 primary shorted
1277	5	Spark coil 10 primary open or short to ground
1277	6	Spark coil 10 primary shorted
1321	3	Start relay coil short to power
1321	4	Start relay ground short
1321	5	Start relay coil open
1323	11	Cylinder 1 misfire detected
1323	31	Cylinder 1 emissions/catalyst damaging misfire
1324	11	Cylinder 2 misfire detected
1324	31	Cylinder 2 emissions/catalyst damaging misfire
1325	11	Cylinder 3 misfire detected
1325	31	Cylinder 3 emissions/catalyst damaging misfire
1326	11	Cylinder 4 misfire detected
1326	31	Cylinder 4 emissions/catalyst damaging misfire
1327	11	Cylinder 5 misfire detected
1327	31	Cylinder 5 emissions/catalyst damaging misfire
1328	11	Cylinder 6 misfire detected
1328	31	Cylinder 6 emissions/catalyst damaging misfire
1329	11	Cylinder 7 misfire detected
1329	31	Cylinder 7 emissions/catalyst damaging misfire
1330	11	Cylinder 8 misfire detected
1330	31	Cylinder 8 emissions/catalyst damaging misfire
1347	5	Fuel-pump high-side open or short to ground
1347	6	Fuel-pump high-side short to power
1348	3	Fuel pump relay coil short to power
1348	4	Fuel pump relay control ground short
1348	5	Fuel pump relay coil open

Table 3-6. CAN to DTC Cross Reference (Ford MSG425 Engine)

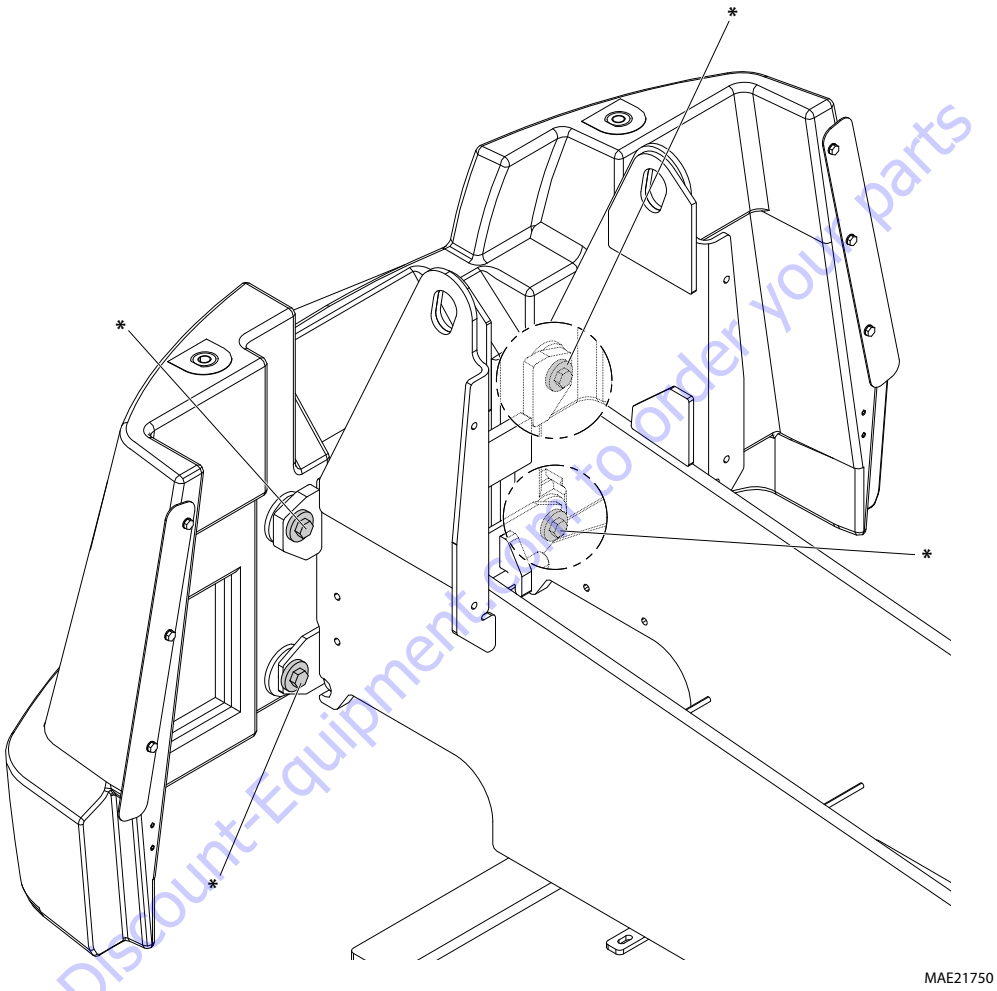
SPN	FMI	Description
1385	0	ERWT1 higher than expected stage 2
1385	3	ERWT1 voltage high
1385	4	ERWT1 voltage low
1385	15	ERWT1 higher than expected stage 1
1386	0	ERWT2 higher than expected stage 2
1386	3	ERWT2 voltage high
1386	4	ERWT2 voltage low
1386	15	ERWT2 higher than expected stage 1
1485	3	Power relay coil short to power
1485	4	Power relay ground short
1485	5	Power relay coil open
2646	3	PWM8 short to power
2646	5	PWM8 open / ground short
2647	3	PWM9 short to power
2647	5	PWM9 open / ground short
3050	11	Catalyst inactive on gasoline (Bank 1)
3050	11	Catalyst inactive on LPG
3050	11	Catalyst inactive on NG
3051	11	Catalyst inactive on gasoline (Bank 2)
3056	3	UEGO return voltage shorted high
3056	4	UEGO return voltage shorted low
3217	3	UEGO sense cell voltage high
3217	4	UEGO sense cell voltage low
3217	5	EGO1 open / lazy
3218	3	UEGO pump voltage shorted high
3218	4	UEGO pump voltage shorted low
3221	3	UEGO cal resistor voltage high
3221	4	UEGO cal resistor voltage low
3221	31	UEGO microprocessor internal fault
3222	0	UEGO sense cell impedance high
3222	3	UEGO heater supply high voltage
3222	4	UEGO heater supply low voltage
3222	10	UEGO sense cell slow to warm up
3225	0	UEGO pump cell impedance high
3225	1	UEGO pump cell impedance low
3225	3	UEGO pump voltage at high drive limit
3225	4	UEGO pump voltage at low drive limit
3225	10	UEGO pump cell slow to warm up
3227	5	EGO2 open / lazy
3256	5	EGO3 open / lazy
3266	5	EGO4 open / lazy
3468	3	Gaseous fuel temperature sender high voltage
3468	4	Gaseous fuel temperature sender low voltage

Table 3-6. CAN to DTC Cross Reference (Ford MSG425 Engine)

SPN	FMI	Description
3673	3	TPS2 voltage high
3673	4	TPS2 voltage low
4236	0	Closed-loop gasoline bank1 high
4236	0	Closed-loop LPG high
4236	0	Closed-loop NG high
4236	1	Closed-loop gasoline bank1 low
4236	1	Closed-loop LPG low
4236	1	Closed-loop NG low
4237	0	Adaptive-learn gasoline bank1 high
4237	0	Adaptive-learn LPG high
4237	0	Adaptive-learn NG high
4237	1	Adaptive-learn gasoline bank1 low
4237	1	Adaptive-learn LPG low
4237	1	Adaptive-learn NG low
4238	0	Closed-loop gasoline bank2 high
4238	1	Closed-loop gasoline bank2 low
4239	0	Adaptive-learn gasoline bank2 high
4239	1	Adaptive-learn gasoline bank2 low
520197	2	Knock2 excessive or erratic signal
520197	4	Knock2 sensor open or not present
520199	11	FPP1 invalid voltage and FPP2 disagrees with IVS (redundancy lost)
520199	11	FPP1/2 do not match each other or IVS (redundancy lost)
520199	11	FPP1/2 do not match each other or IVS (redundancy lost)
520201	5	IAC coil open/short
520201	6	IAC ground short
520226	3	Shift actuator feedback out-of-range
520226	7	Shift unable to reach desired gear
520226	31	Shift actuator or drive circuit failed
520260	0	MegaJector delivery pressure higher than expected
520260	1	MegaJector delivery pressure lower than expected
520260	3	MegaJector voltage supply high
520260	4	MegaJector voltage supply low
520260	12	MegaJector internal actuator fault detection
520260	12	MegaJector internal circuitry fault detection
520260	12	MegaJector internal comm fault detection
520260	31	MegaJector comm lost
520401	0	Fuel impurity level high
520800	7	Intake cam / distributor position error
520801	7	Exhaust cam position error
520803	31	MegaJector autozero / lockoff failure

3.19 COUNTERWEIGHT

If the counterweight has been removed, ensure the retaining bolts are torqued to the proper value as shown in Figure 3-42., Counterweight Bolt Torque.



*Torque the bolts to 346 ft-lb (469 Nm)

Figure 3-42. Counterweight Bolt Torque

3.20 GENERATOR

Every 250 hours

Check drive belt tension every 250 hours of operation,.

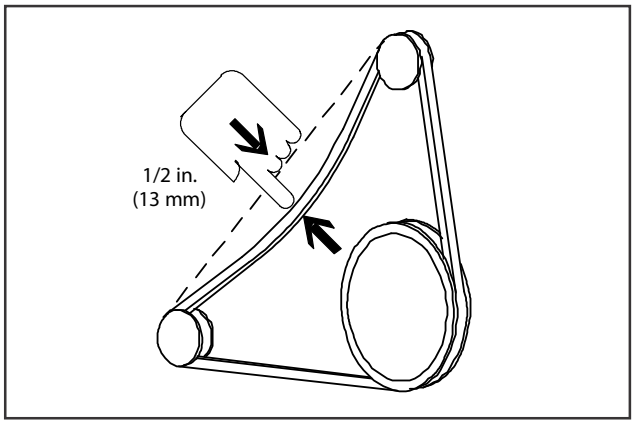


Figure 3-39. Generator Belt Tension

Every 500 hours

Service generator brushes and slip rings every 500 hours of operation. Hostile environments may require more frequent service.

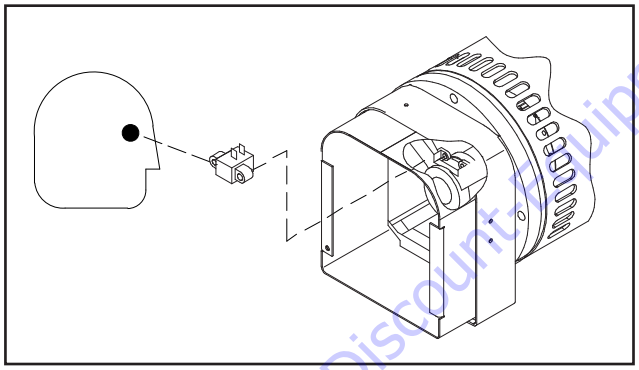


Figure 3-40. Generator Brushes and Slip Rings

Blow out inside of generator every 500 hours of service. If operating in a hostile environment, clean monthly.

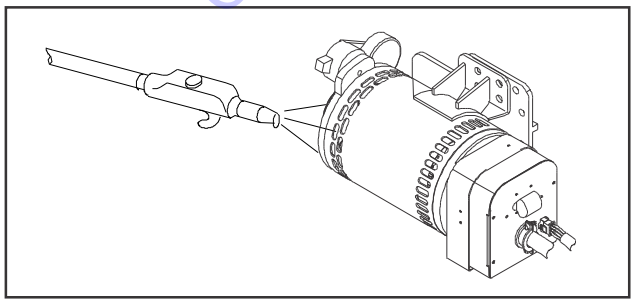


Figure 3-41. Generator Cleaning

Overload Protection

⚠ CAUTION

STOP ENGINE WHENEVER CHECKING OR INSPECTING CIRCUIT BREAKER.

The circuit breaker protects generator windings from overload. Generator output stops if circuit breaker opens.

If circuit breaker continues to open, check for faulty equipment connected to platform receptacles.

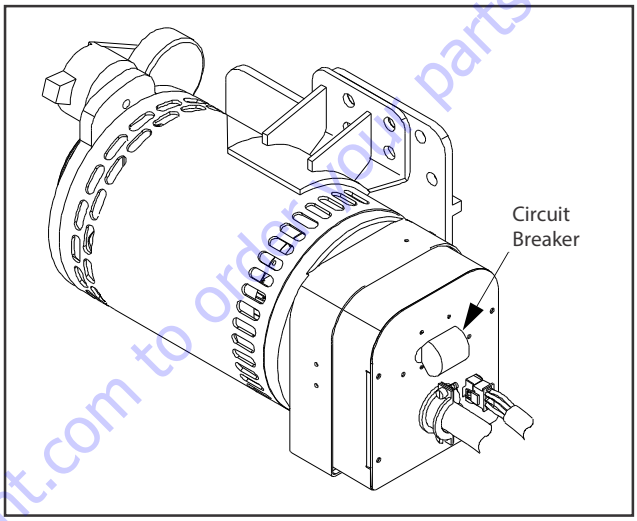


Figure 3-42. Generator Circuit Breaker Location

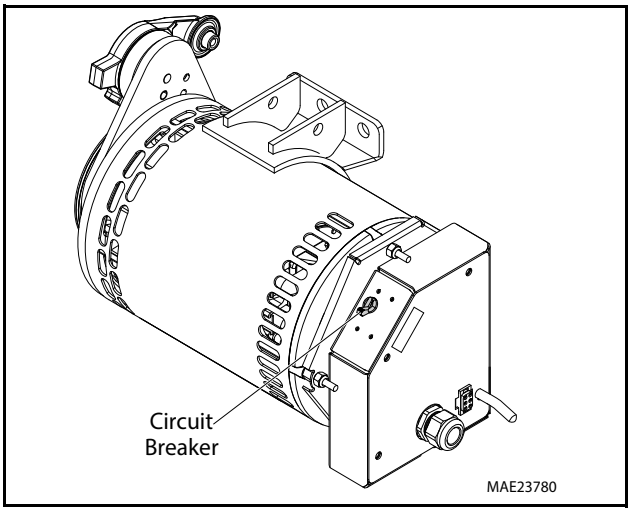


Figure 3-43. Generator Circuit Breaker Location (If Equipped with 4000W)

Inspecting Brushes, Replacing Brushes, and Cleaning Slip Rings

INSPECTING BRUSH POSITION

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

INSPECTING BRUSHES

1. Remove end panel. Inspect wires.
2. Remove brush holder assembly. Pull brushes from holders.
3. Replace brushes if damaged, or if brush is at or near minimum length.

CLEANING SLIP RINGS

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

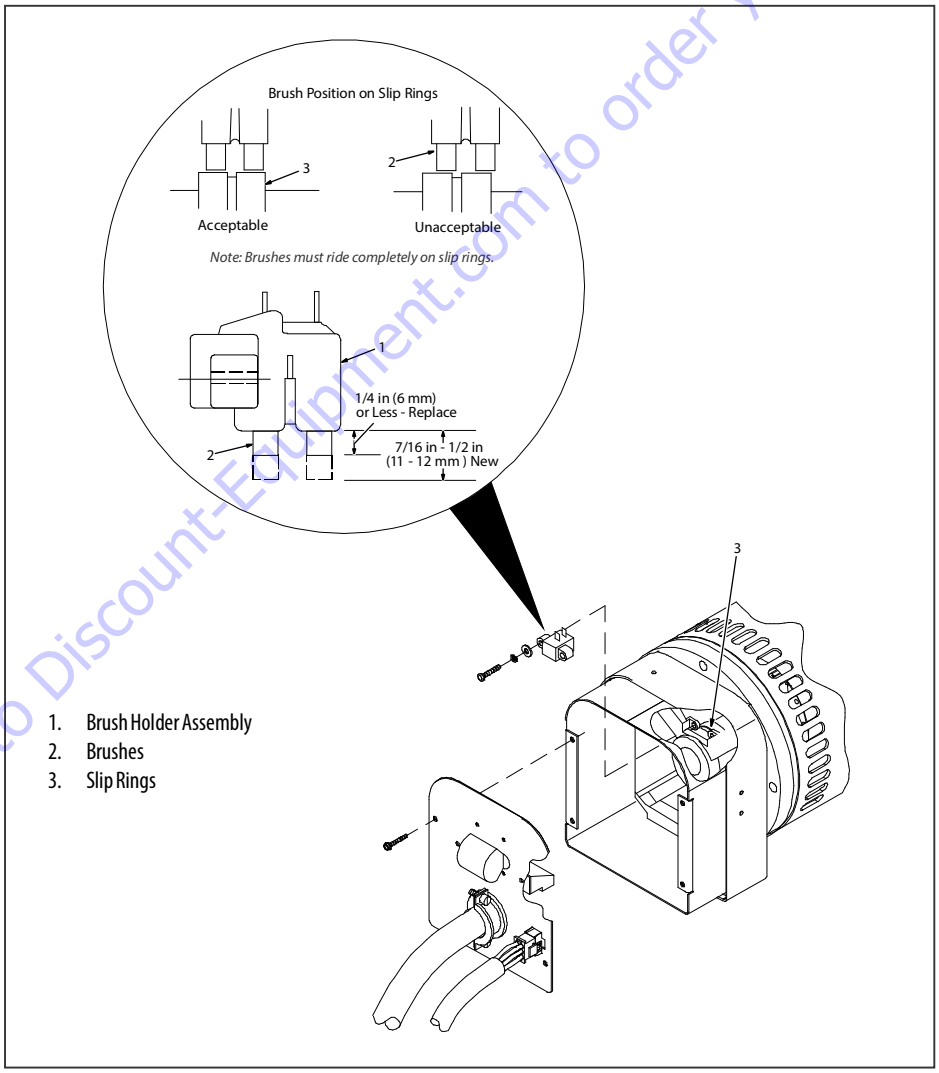


Figure 3-44. Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings

PARTS FINDER

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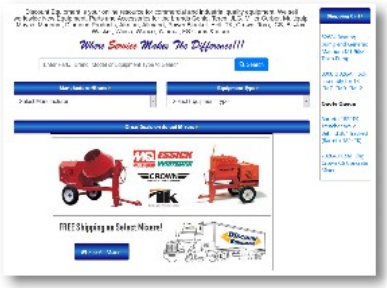

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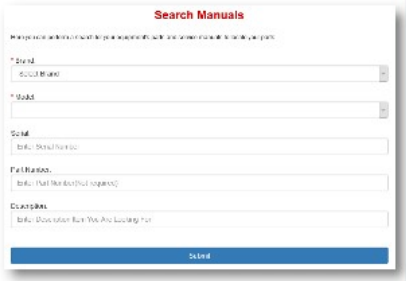

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SECTION 4. BOOM & PLATFORM

⚠ WARNING

DO NOT SUPPORT THE BOOM WITH A BOOM PROP OR CRANE OR ALLOW THE PLATFORM TO REST ON THE GROUND WHEN SERVICING BOOM COMPONENTS. BOOM MUST BE ON BOOM REST OR COMPLETELY REMOVED FROM MACHINE WHEN SERVICING. FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.

4.1 TRANSPORT POSITION SENSING SYSTEM

The transport position sensing system consists of a boom angle sensor (this sensor is a hall effect sensor with built-in redundancy) mounted at the pivot point between the main boom and tension link. The system uses this sensor to sense if the boom is in the position associated with high speed travel. The control circuit reads two redundant angular sensor signals from the boom angle sensor. Above transport angle is recognized when one angular sensor signal from the boom angle sensor reads more than 5° greater than horizontal (with respect to the turntable) and resets to within transport position when both angular sensor signals read less than 3° greater than horizontal (with respect to the turntable). The position of the articulated jib is not considered. This system is used to control the following systems:
Beyond Transport - Drive Speed Cutback System
Drive/Steer – Boom Function Interlock System
Oscillating Axle System

4.2 BEYOND TRANSPORT - DRIVE SPEED CUTBACK SYSTEM

When the boom is positioned beyond the transport position, the drive motors are automatically restricted to their maximum displacement position (slow speed). See the Tilt Indicator System for interaction with the tilt sensor.

4.3 DRIVE/STEER - BOOM FUNCTION INTERLOCK SYSTEM

The Drive/Steer – Boom Function Interlock System (not applicable in ANSI markets, standard in CE markets, optional in all other markets) uses the Transport Position Sensing System to sense when the boom is out of the transport position. All controls are simultaneously functional when the booms are within the transport position as on the standard machine. When the boom is beyond the transport position, the control functions are interlocked to prevent simultaneous operation of any boom function with drive/steer. The first function set to be operated while in this mode, becomes the master function set. In other words, while operating drive/steer functions the boom functions are inoperable. Likewise, while operating boom functions drive/steer functions are inoperable.

4.4 DUAL CAPACITY SYSTEM

The dual capacity selection and indicator system consists of a capacity mode toggle switch at the platform control box, a set of redundant proximity sensors to detect boom extension, and a main boom angle sensor. The operator selects the mode to work in:
600S: 600 lb (270 kg) unrestricted, 1000 lb (450 kg) restricted
660SJ: 550 lb (250kg) unrestricted, 750 lb (340 kg) restricted.
The light indicator in the platform control box will change to match the selected mode, unless there is a system DTC that forces the machine into the restricted mode. The system uses the boom extension proximity sensors and boom angle sensor to prevent the platform from entering the unrestricted zone if the restricted mode is selected. When the dual capacity switch is in the restricted position, the platform will move but stop at the boundaries of the restricted zone. The platform will not be able to enter the unrestricted zone. When the machine control system senses the platform is already on the boundaries of the restricted zone, it only allows the retraction of the boom or lifting up of the boom as these movements place the platform further away from the unrestricted zone. In case the platform is already inside the restricted zone and the dual capacity switch is flipped to the unrestricted position at that time, the machine will only allow the boom to retract and will only allow the boom to lift up, as these movements will bring the platform towards the restricted zone. When the dual capacity switch is in the unrestricted position, the platform can go anywhere within the whole boundaries.

4.5 PLATFORM LOAD SENSING SYSTEM

The Platform Load Sensing System consists of a single load cell mounted within the platform support. This system compares the capacity mode recognized by the dual capacity system to the measured weight in the platform. When the platform capacity is exceeded or when there is a fault in the system, the platform overload indicator will flash, the platform alarm will sound at the rate of 5 sec on / 2 sec off and all platform function controls (except auxiliary power) will be disabled. The ground controls are unaffected unless configured otherwise in the machine setup selection.

4.6 ELECTRONIC PLATFORM LEVELING

The Electronic Platform Leveling System simulates a conventional master/slave cylinder arrangement by adjusting the leveling cylinder stroke based on the boom angle changes during the lift operation. The system uses two rotary angle sensors (Internally Redundant Hall Effect Sensors), one to measure the main boom angle relative to the tension link and one to measure the platform angle relative to the main boom.

The first angle sensor is mounted concentric with the pin that connects the base boom to the tension link. As the boom rises or lowers the sensor sends a signal to the UGM which determines, through an algorithm that considers the boom linkage geometry, the required angle at the second sensor.

For 600S, that second sensor is mounted concentric with the pin that connects the platform rotator to the fly boom. For 660SJ, the sensor is mounted with the pin between fly boom and jib pivot. As the level cylinder in the fly boom is activated to adjust the angle between the platform and the fly boom the angle sensor signal is sent to the UGM. Once the required platform to fly boom angle (as determined by the UGM based on the first sensors input) is reached the movement of the level cylinder is stopped. This leveling system operates like a conventional master/slave cylinder system, meaning that it will not correct level relative to gravity but maintain the platform angle relative to gravity as it was manually set by the operator prior to activation of the lift function.

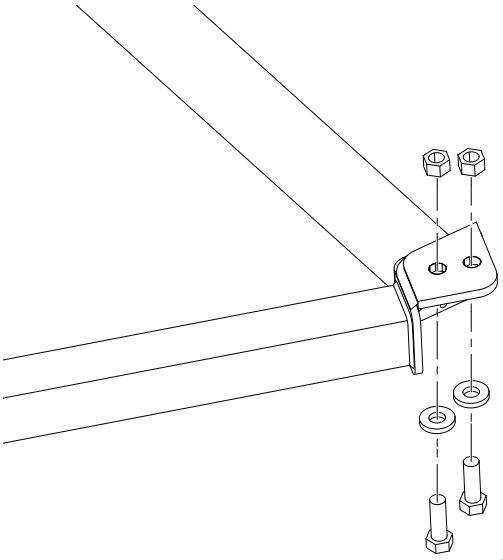
4.7 FUEL LEVEL CUTOUT SYSTEM

The Fuel Shutoff System senses when the fuel level is getting low and automatically shuts the engine down before the fuel tank is emptied. When the fuel level gets below 1.2 gallons, the fault light will flash at the platform controls and the control system will report fault 0/0 “FUEL LEVEL LOW – ENGINE SHUTDOWN” on the analyzer. There is an analyzer personality setting in the control system to control the machines response to this fault. With the “RESTART” setting, the operator will be able to start the engine and run for 2 minutes. After 2 minutes, the engine will shut off and a power cycle will allow the engine to run for 2 more minutes. With the “ENGINE STOP” setting, the machine will remain in this fault mode until the fuel level is returned to a level above 1.2 gallons. With the “ONE RESTART” setting, the operator will be able to start the engine and run for 2 minutes. After 2 minutes, the engine will shut off for a second time and the machine will return to the “Engine Shutdown” fault mode. The machine will then stay in this mode until the fuel level is returned to a level above 1.2 gallons.

4.8 PLATFORM

Support Removal

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

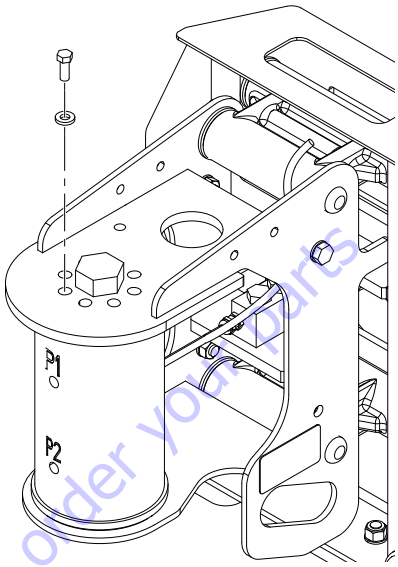


MAE17160

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

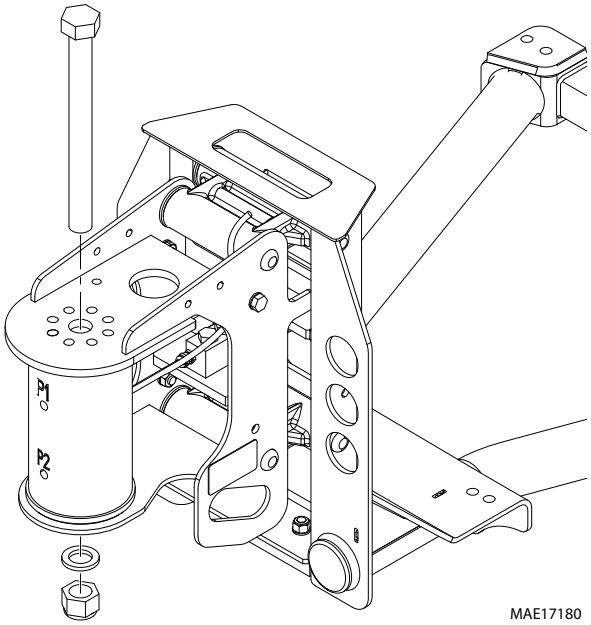
NOTE: *The platform support weighs approximately 125 lb (56.8 kg).*

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



MAE17170

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



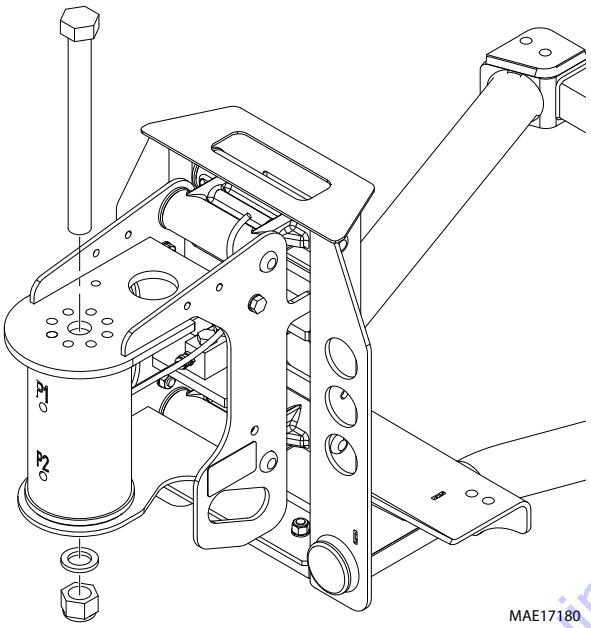
MAE17180

Support Installation

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

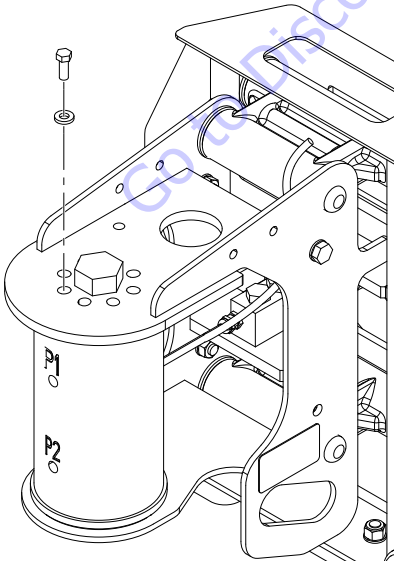
NOTE: *The platform support weighs approximately 125 lb (56.7 kg).*

NOTE: *Install the rotator center bolt.*



MAE17180

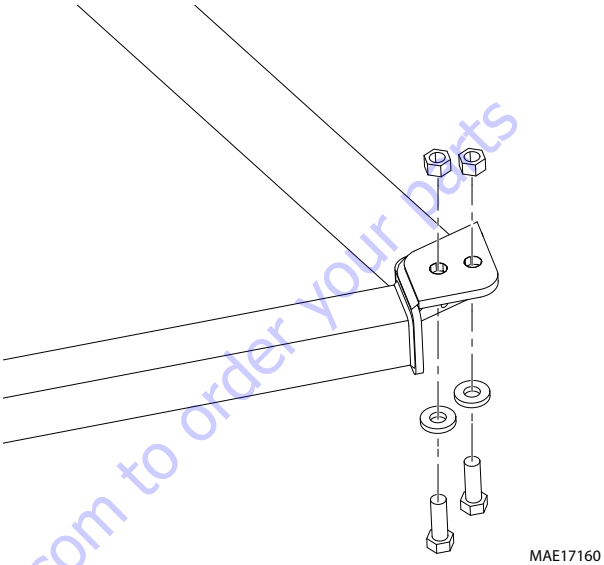
2. Apply Medium Strength Threadlocking Compound to the bolts and washers securing the support to the rotator and install the bolts and washers.



MAE17170

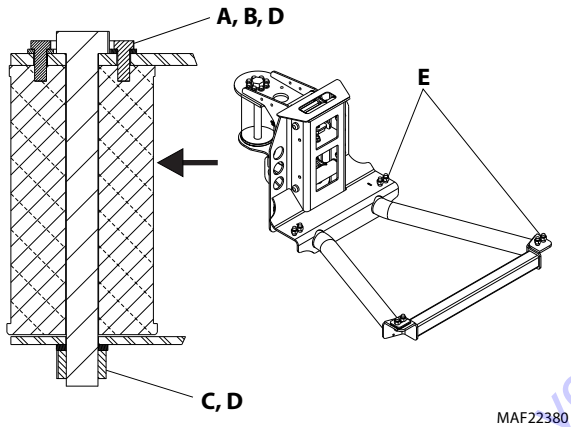
3. Torque the nut on the rotator center bolt to 586 ft. lbs. (795 Nm). Torque the retaining bolts to 40 ft. lbs. (55 Nm).

4. Position the platform on the platform support and install the bolts securing the platform to the platform support.


MAE17160

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

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



A- Torque to 40 ft-lb (55 Nm)
B- Medium Strength Threadlocking Compound
C- Torque to 586 ft-lb (795 Nm)
D- Check torque every 150 hours of operation
E- Torque to 65 ft-lb (88 Nm)

NOTE: *If any rotator bolts are replaced, all bolts on the rotator should be re-torqued.*

Figure 4-1. Platform Support Torque Values

4.9 ROTATOR AND SLAVE CYLINDER

NOTE: *Refer Figure 4-2., Removal of Components - Rotator and Slave Cylinder.*

Removal

600S

1. Tag and disconnect hydraulic lines from the rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
2. Supporting the rotator, remove hardware from pin (1). Using a suitable brass drift and hammer remove pin (1) from the fly boom.
3. Remove the hardware from pin (2). Using a suitable brass drift and hammer, remove pin (2) from the fly boom and remove the rotator.
4. Supporting the slave cylinder, remove the hardware from pin (3). Using a suitable brass drift and hammer remove pin (3) from the fly boom.

660SJ

1. Tag and disconnect hydraulic lines from the rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
2. Supporting the rotator, remove hardware from pin (1). Using a suitable brass drift and hammer remove pin (1) from the jib assembly.
3. Remove the hardware from pin (2). Using a suitable brass drift and hammer, remove pin (2) from the jib assembly and remove the rotator.
4. Telescope the fly section out approximately 20 in. (50.8 cm) to gain access to the slave leveling cylinder.
5. Remove the hardware from pin (3). Using a suitable brass drift and hammer remove pin (3) from the jib assembly.
6. Supporting the slave cylinder, remove the hardware from pin (4). Using a suitable brass drift and hammer remove pin (4) from the fly boom.

Assembly/Disassembly

For detail assembly/disassembly instruction, Refer Rotary Actuator Manual (PN 3128848).

Installation

600S

1. Support the slave cylinder. Using a suitable brass drift and hammer, install pin (3) to the fly boom.
2. Support the rotator. Using a suitable brass drift and hammer, install pin (2) to the fly boom and install the rotator.
3. Using a suitable brass drift and hammer, install pin (1) to the rotator.
4. Remove tag and reconnect the hydraulic lines to the rotator and the slave cylinder.

660SJ

1. Telescope the fly section out approximately 20 in. (50.8 cm) to gain access to the slave leveling cylinder.
2. Support the slave cylinder. Using a suitable brass drift and hammer, install pin (4) to the fly boom.
3. Using a suitable brass drift and hammer, install pin (3) to the jib assembly.
4. Support the rotator. Using a suitable brass drift and hammer, install pin (2) to the fly boom and install the rotator.
5. Using a suitable brass drift and hammer, install pin (1) to the rotator.
6. Remove tag and reconnect the hydraulic lines to the rotator and the slave cylinder.

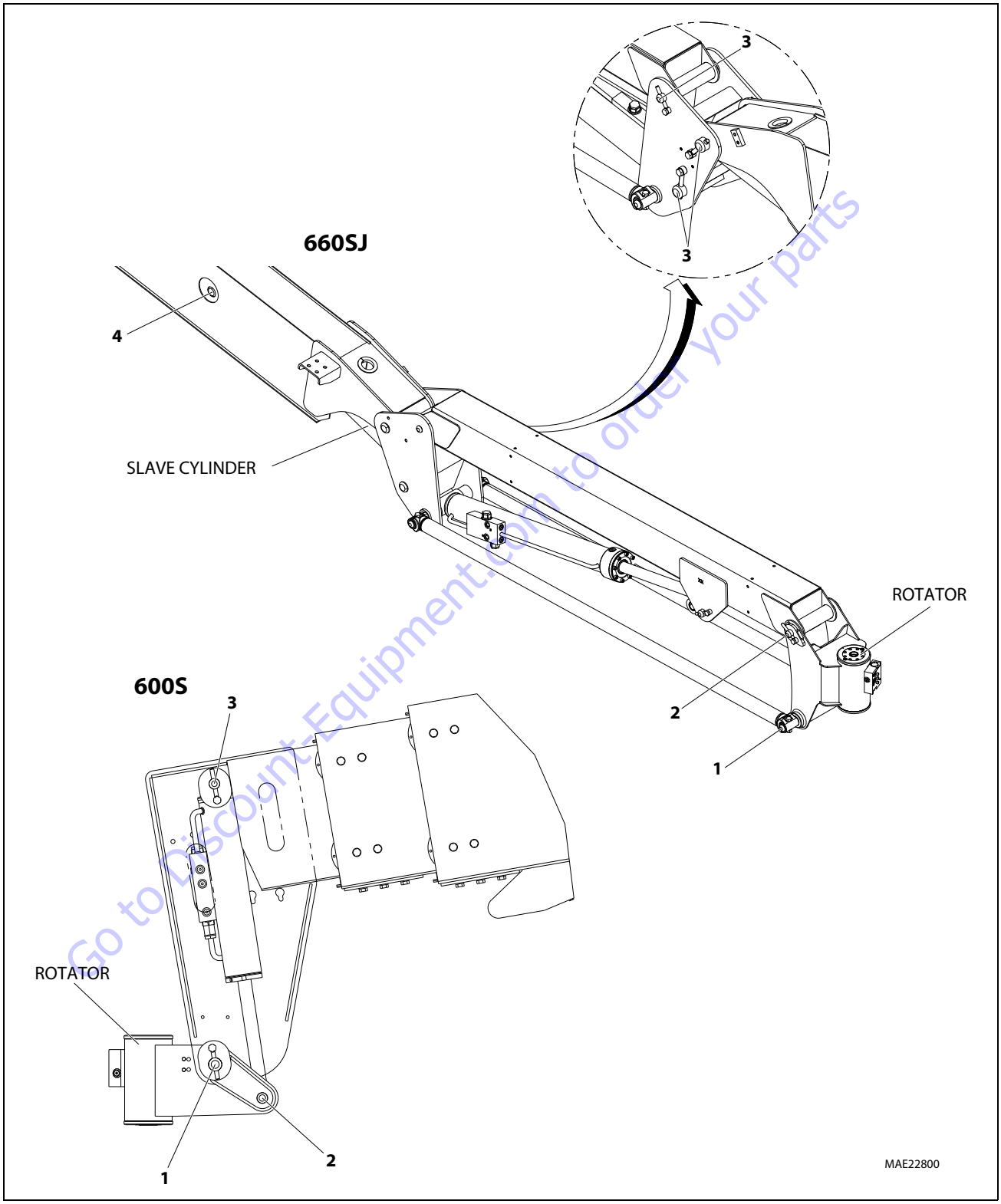


Figure 4-2. Removal of Components - Rotator and Slave Cylinder

4.10 MAIN BOOM ASSEMBLY

Removal

NOTE: *Refer to Figure 4-3., Boom Assembly Removal and Installation.*

1. Level the boom and support boom assembly and tower link with adequate lifting equipment as shown below.
2. Use a ratchet strap to bind the tower link to boom.

NOTE: *The boom alone weighs approximately 2792 lb (1269 kg). Including the powertrack, slave cylinder, rotator, jib, platform and platform support the assembly weighs approximately 7500 lb (3400 kg).*

3. Tag and disconnect all electrical connections from the boom assembly.
4. Tag, disconnect and cap hydraulic lines from telescope cylinder and boom lift cylinder. Use an adequate container to catch any residual hydraulic fluid.

NOTICE

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

5. Tag and disconnect hydraulic lines from boom to the main control valve. Use an adequate container to catch any residual hydraulic fluid. Cap or plug all open hydraulic lines and ports.
6. Remove retaining bolt, keeper pin, and pin (1) securing the tower link to the turntable.
7. Lift and move forward the boom assembly with tower link and boom lift cylinder to gain the access to boom pivot pin (2). Ensure tension link pivot pin is above the turntable lifting point.
8. Insert an adequate metal rod into the lifting eye holes to support the tension link.
9. Remove retaining bolt, keeper pin, and pin securing the main boom pivot pin (2) to the tension link.
10. Remove complete boom assembly and lift cylinder with tower link and lift cylinder from the machine and place it on a suitable support.
11. Support the boom lift cylinder and remove retaining bolts, keeper pins, and pins (3 and 4) securing the lift cylinder and tower link to the boom assembly.
12. Remove the boom assembly.
13. If required, remove retaining bolt, keeper pin, and pin (5) securing tension link to the turntable and place it on an adequate support.

NOTE: *The tension link weighs approximately 419 lb (190 kg).*

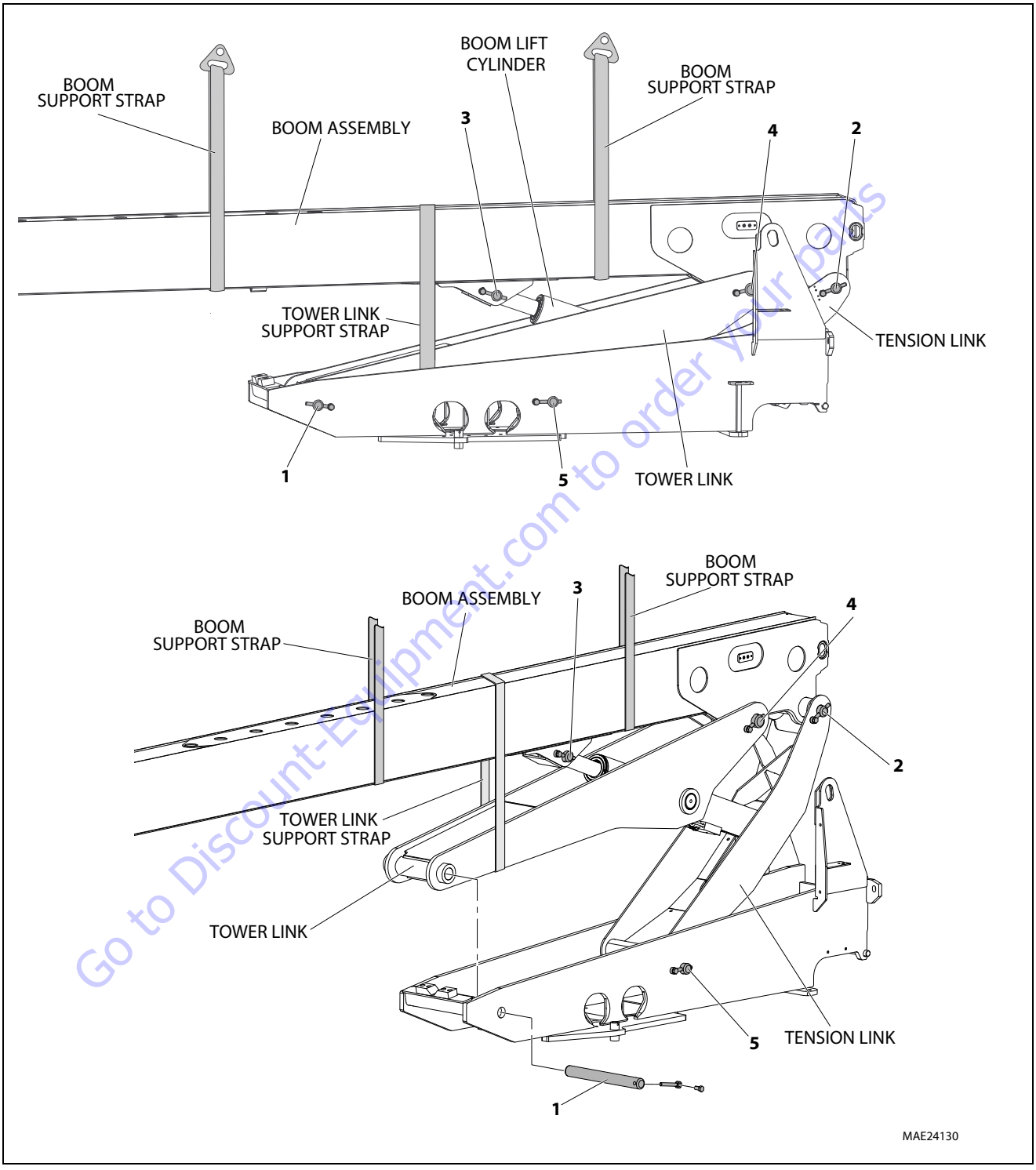
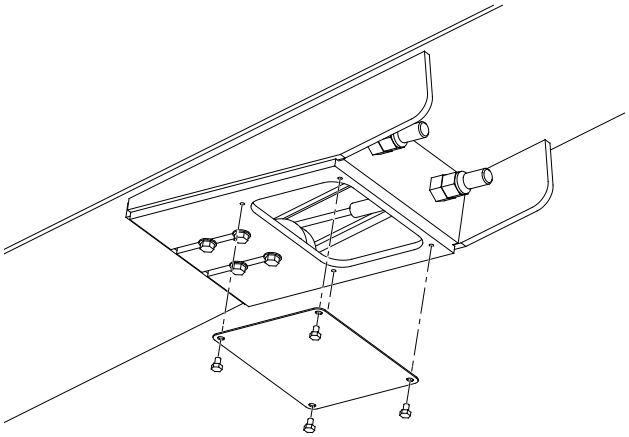


Figure 4-3. Boom Assembly Removal and Installation

Boom Disassembly

1. Tag and disconnect the hoses and electrical harnesses that run to the platform. Cap or plug all openings.
2. Remove hardware securing the cover plate and sheave blocks on the bottom front of the base boom section. Remove the cover plate and sheave blocks.

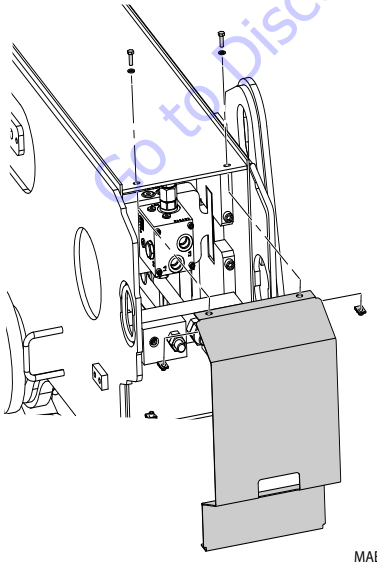
NOTE: *Do not allow wire rope to rotate. This may damage the wire rope. Clamp both threaded ends of wire rope to prevent rotation.*



3. Clamp both threaded ends of wire rope to prevent rotation.

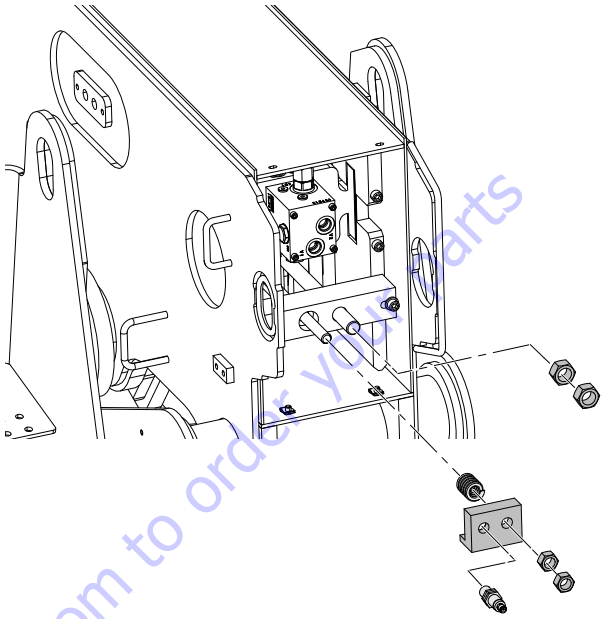
NOTE: *Do not clamp on threads. Remove jam nuts and nuts which secure the wire rope adjustments to the bottom front of the base boom section.*

4. Remove the hardware securing base boom cover plate and base boom. Remove base boom cover plate from the end of the boom section.



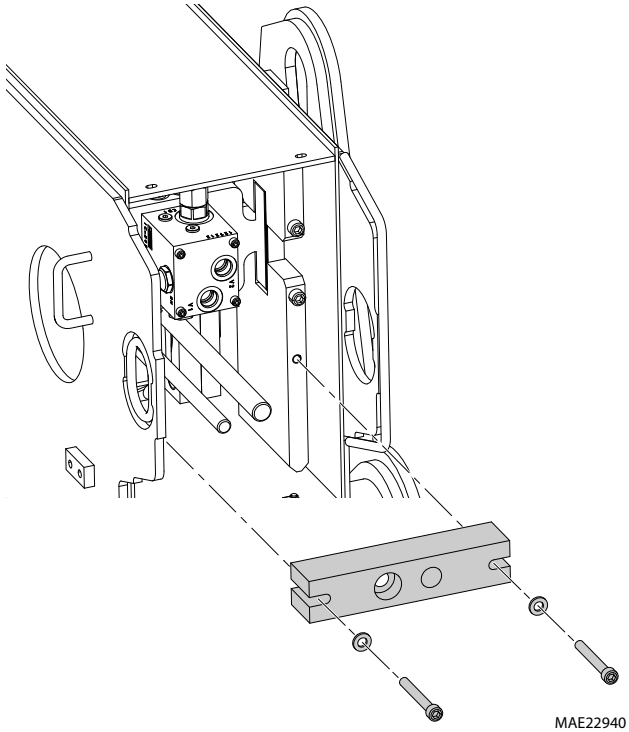
MAE22920

5. Remove the hardware securing spring mounting plate and spring to the cable block. Remove the spring mounting plate and spring from the end of the boom section.



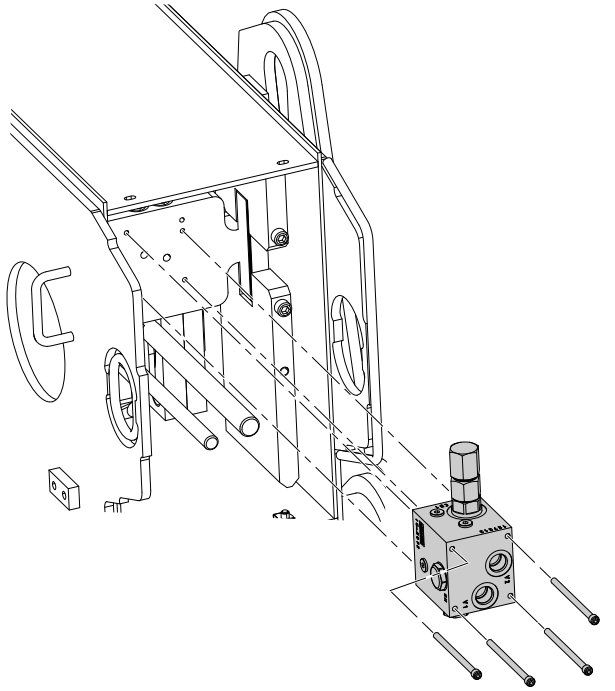
MAE22930

6. Remove hardware securing cable block to boom section. Remove cable block.



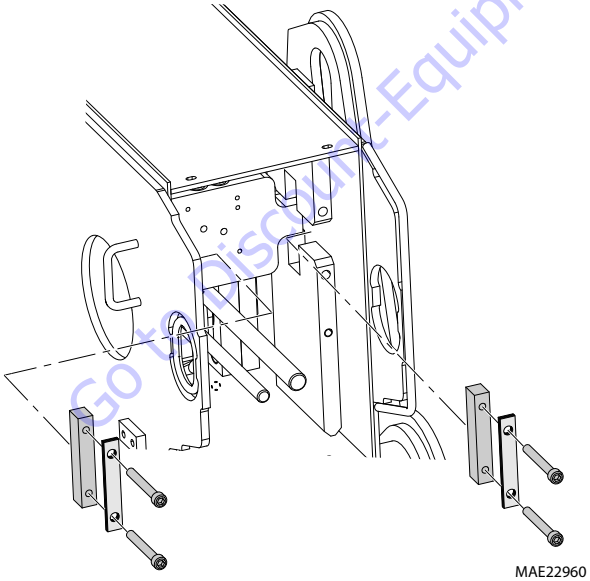
MAE22940

7. Remove hardware securing valve to telescope cylinder. Remove the valve assembly.



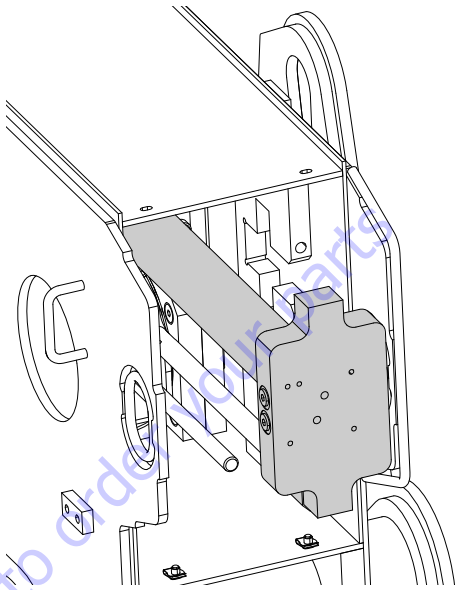
MAE22950

8. Remove the four bolts, shims, and block that secure the telescope cylinder rod to the boom base section.



MAE22960

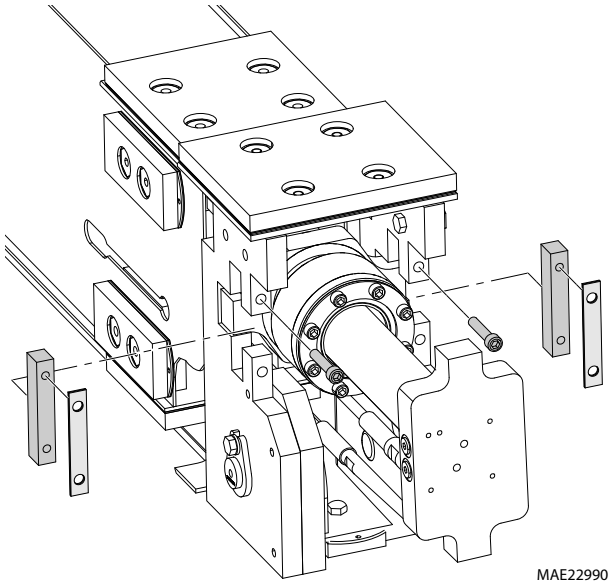
9. Attach an auxiliary hydraulic power source to the telescope cylinder and extend the cylinder rod enough to turn the trunnion in a vertical position.



MAE22970

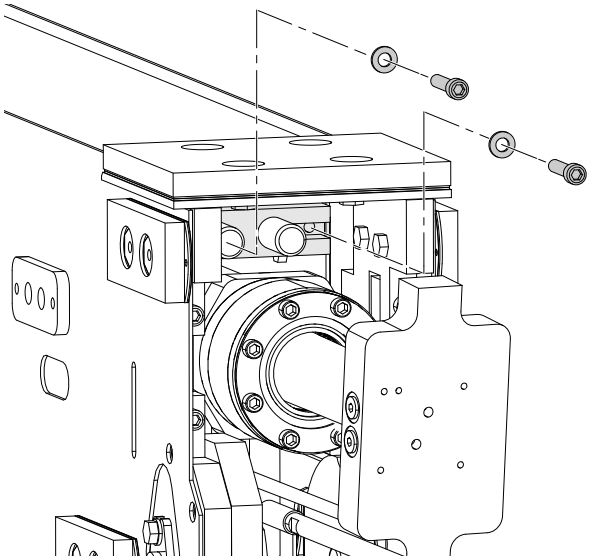
10. Pull the mid and fly boom sections from the base boom section. Use additional lifting device and lifting straps as necessary as the sections are withdrawn. It will be helpful during this step to pull the mid retract cable out from the front of the boom section as the other sections are being pulled out. This will prevent the cables from tangling as the sections are withdrawn.

11. Remove the trunnion blocks that secure the telescope cylinder barrel to the inner mid boom section.



MAE22990

12. Remove the hardware that secure rope extend block to the fly boom section.

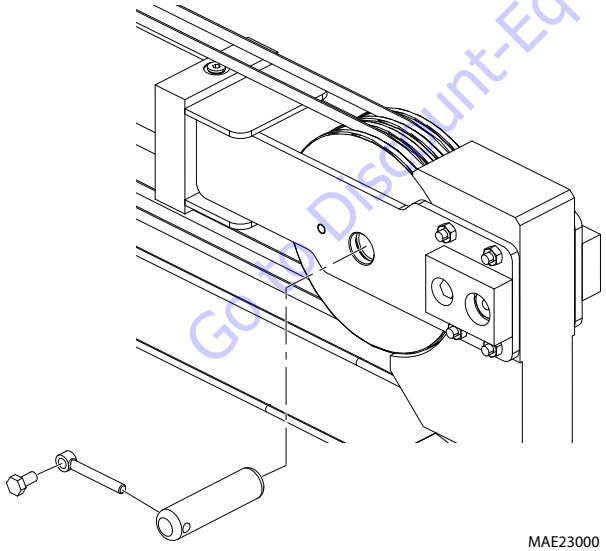


MAE23020

13. Attach a lifting device to the telescope cylinder, pull the cylinder along with the extend cables, sheave assembly and sheave guard out of the fly boom section. Reposition the lifting device as necessary to balance the cylinder.

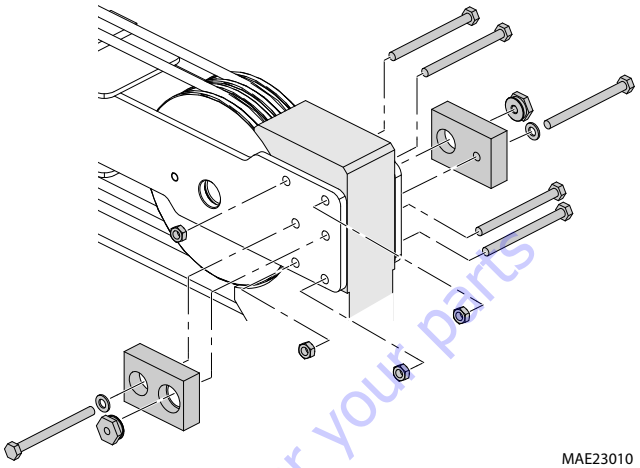
14. Remove extent block and cable from the telescope cylinder.

15. Remove the pin that secures sheave assembly to telescope cylinder.



MAE23000

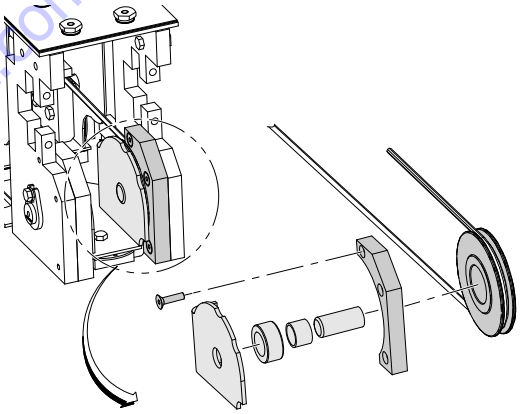
16. Remove spacer and hardware that secure sheave guard to the telescope cylinder.



MAE23010

17. Remove the sheave assembly by adjusting the sheave guard then remove the bracket and cable.

18. Remove the cable retainer plate, cable retainer block, bushing and sheave.



MAE23030

19. Remove the top, bottom and side wear pads from the front mid boom sections.

20. Attach a lifting device to the fly boom section, pull the fly boom from mid boom.

NOTE: *When removing fly boom section from mid boom section, retract wire rope must be dragged along with fly boom section.*

21. Remove the top, bottom and side wear pads from the rear end fly boom sections.

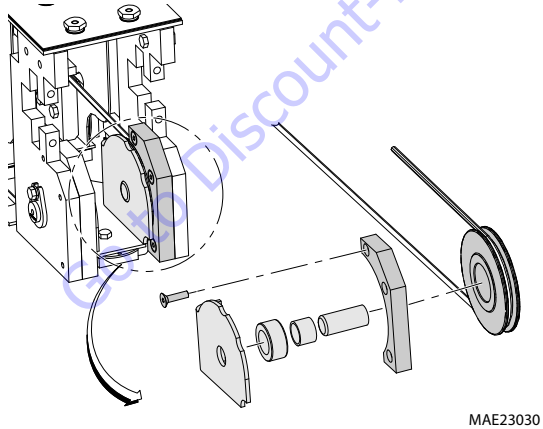
22. Remove the fly boom retract cables from the bottom of the fly boom sections.

23. Thoroughly clean the boom sections.

Assembly

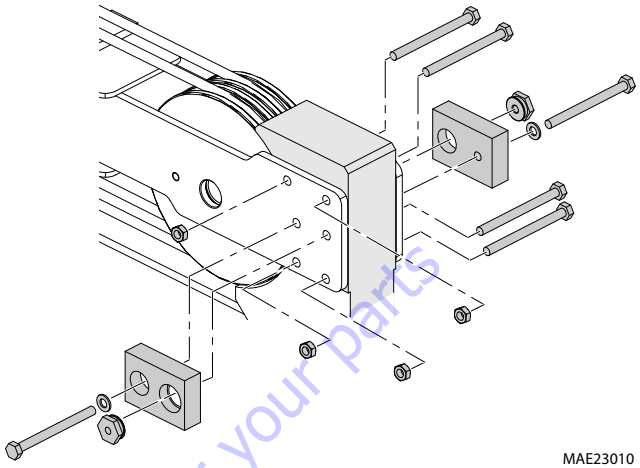
NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Measure inside dimensions of the base and mid sections to determine the number of shims required for proper lift.
2. Install side, top and bottom wear pads to the rear end of fly section; shim evenly to the measurements of the inside of mid section. Torque the bolts to 40.6 ft. lbs. (55 Nm).
3. Install retract wire ropes into rear end of fly section, route wire ropes through holes in side of fly boom section and pull into slot.
4. Install side, top and bottom wear pads to the rear end of mid section, shim evenly to the measurements of the inside of mid section. Torque the bolts to 40.6 ft. lb (55 Nm).
5. Using Super Lube, lubricate all wear surfaces on the outside of fly boom and inside of the mid boom.
6. Slide fly boom section into mid boom section.
7. Install wear pads into the front end of the mid boom section. Torque the bolts to 40.6 ft. lbs. (55Nm).
8. Apply a thin coat of moly paste lubricant to the inside diameter of the sheave composite bearings. Install the fly retract sheaves and bushings while guiding the wire ropes into the sheave grooves. Apply moly paste lubricant on the inside diameter of the sheave bushing cup. Ensure the sheaves move freely.



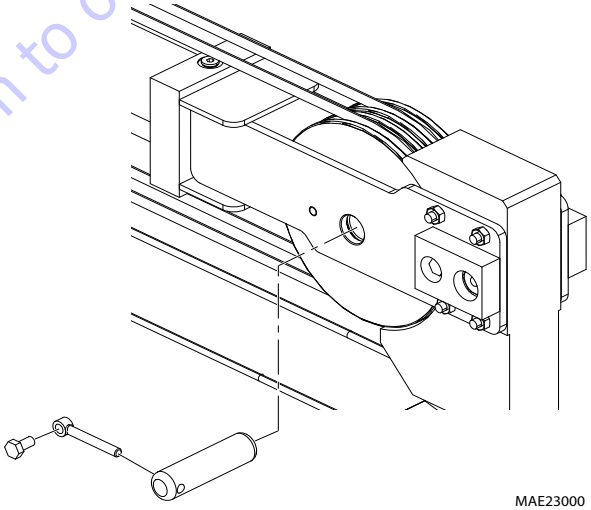
MAE23030

9. Install sheave on the telescope cylinder secure with pin and bolts.



MAE23010

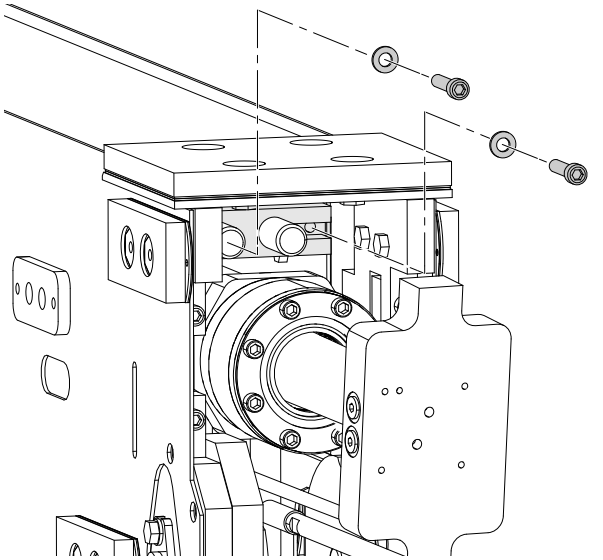
10. Route the cables around the sheave on the cylinder and install the sheave guard.



MAE23000

11. Using an adequate lifting device, insert the cylinder and cables part way into the inner fly boom.

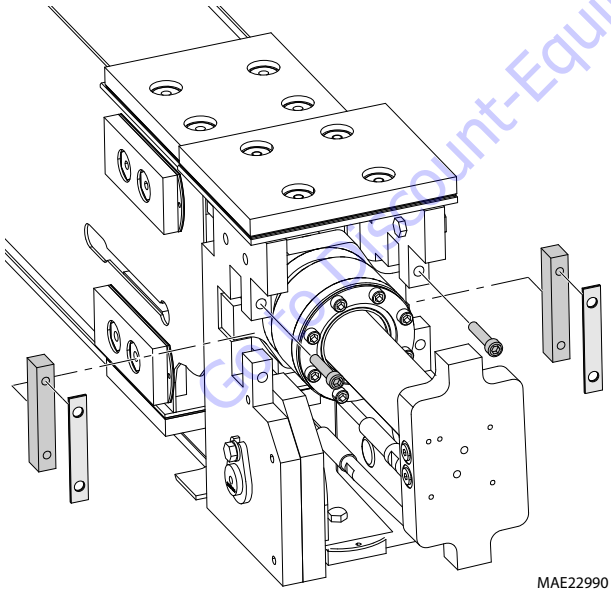
12. Install end of the extend cables into the extend rope block.



MAE23020

13. Install the bolts and washers securing the extend rope block to the fly boom. Torque the bolts to 40.6 ft. lbs. (55 Nm).

14. Install the cylinder trunnion block and shims that secure the telescope cylinder barrel to the mid boom section. Torque the bolts to 40.6 ft. lbs. (55 Nm).



MAE22990

15. Turn the trunnion of Rod in a vertical position.

16. Using Super Lube, lubricate all wear surfaces on the inside of the base section and the outside of the mid boom.

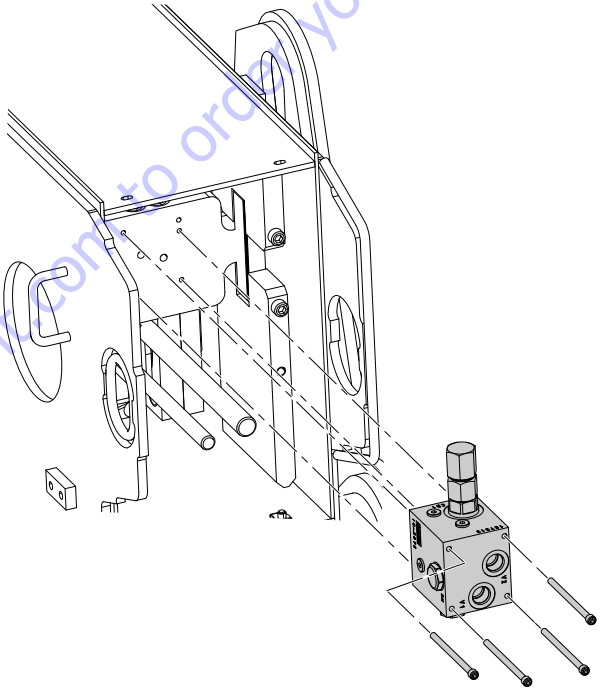
17. Insert the mid, fly and Tele cylinder assembly way into the boom base section enough to be able to pull the outer mid retract cables out through the hole at the bottom front of the boom base section.

18. Install the front lower wear pads into the boom base section. Torque the bolts to 40.6 ft. lbs. (55 Nm).

19. Push the mid boom assembly the rest of the way into the boom base section, adjusting the lifting device as necessary to keep the weight balanced.

20. Install the side and upper wear pads into the boom base section. Torque the bolts to 40.6 ft. lbs. (55 Nm).

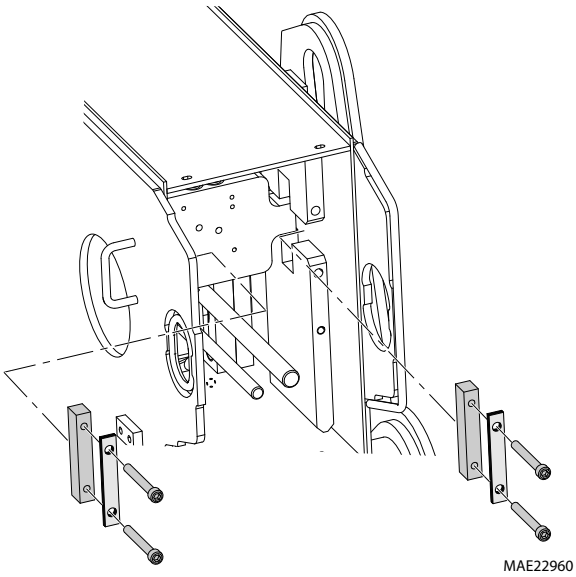
21. Install hardware securing valve to telescope cylinder. Install the valve assembly. Torque the bolts to 42.8 ft. lbs. (58 Nm).



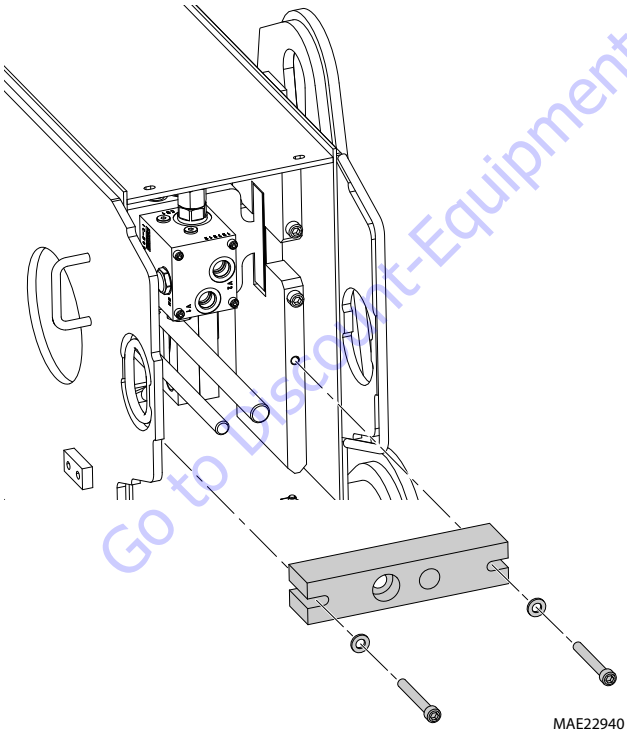
MAE22950

22. Attach an auxiliary hydraulic power source to the telescope cylinder, extend cylinder enough so the trunnion of Rod out of base boom, turn rod trunnion to horizontal position. Retract cylinder so the trunnion of rod slide into the slot on base boom.

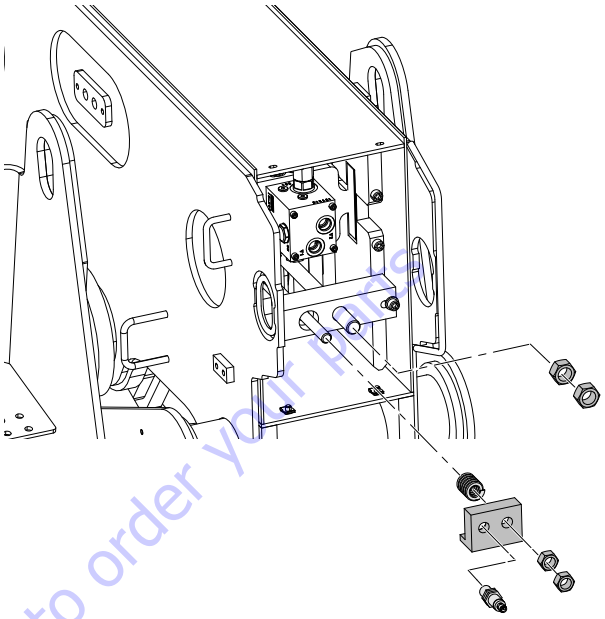
23. Install the four bolts, shims, and bars that secure the telescope cylinder rod to the boom base section. Torque the bolts to 40.6 ft. lbs. (55 Nm).


MAE22960

24. Route extend cable through cable block and install the cable block on base boom.

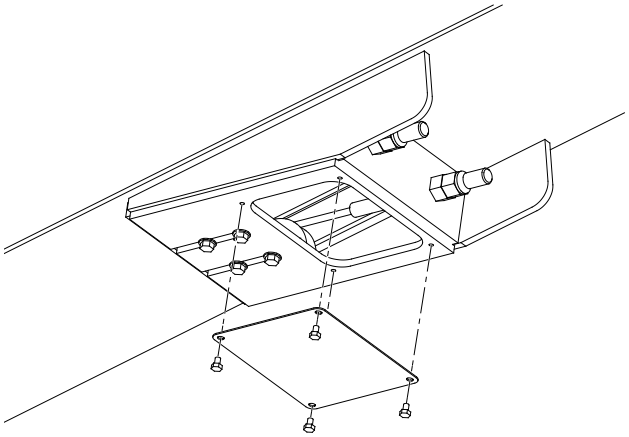

MAE22940

25. Install the hardware securing spring mounting plate and spring to the cable block.


MAE22930

26. Install base boom cover plate to base boom at the end of the boom section.

27. Install the cover plate and sheave blocks.



28. Connect the hydraulic hoses to the telescope cylinder as tagged during removal.

29. Adjust the boom cables. Refer to Section 4.14, Wire Rope Tensioning Adjustment.

30. Install jam nuts and nuts which secure the wire rope.

Installation

NOTE: *Refer to Figure 4-3., Boom Assembly Removal and Installation.*

NOTE: *The boom alone weighs approximately 2792 lb (1269 kg). Including the powertrack, slave cylinder, rotator, jib, platform and platform support the assembly weighs approximately 7500 lb (3400 kg).*

1. If tension link is removed, insert an adequate metal rod into the turntable lifting eye holes to support the tension link.
2. Using an adequate lifting device, position the tension link on turntable so that the pivot holes of tension link and turntable holes are aligned.

NOTE: *The tension link weighs approximately 419 lb (190 kg).*

3. Install pin, keeper pin, and retaining bolt (5) securing tension link to the turntable. Apply Medium Strength Threadlocking Compound and torque to 346 ft.lbs. (469 Nm).

NOTE: *Steps 1, 2, and 3 are only necessary if the tension link has been removed.*

4. Place the tower link with boom lift cylinder on the proper support.
5. Use an adequate lifting device, lift the boom assembly and install pin, keeper pin, and retaining bolt (4) securing the tower link to the boom assembly. Apply Medium Strength Threadlocking Compound and torque to 346 ft.lbs. (469 Nm).
6. Install pin, keeper pin, and retaining bolt (3) securing lift cylinder rod end pin to main boom assembly. Apply Medium Strength Threadlocking Compound and torque to 346 ft.lbs. (469 Nm).
7. Using an adequate lifting device, lift and position the boom assembly with tower link and boom lift cylinder on turntable so that the pivot holes of boom assembly and tension link are aligned.
8. Install boom pivot pin, keeper pin, and retaining bolt (2), ensuring that location of hole in pin is aligned with attach point on tension link.
9. Lift and move forward the boom and tower link assembly.
10. Remove metal rod from the turntable lifting eye holes and level the boom assembly to normal position.
11. Install pin, keeper pin, and retaining bolt (1) securing tower link to turntable. Apply Medium Strength Threadlocking Compound and torque to 346 ft.lbs. (469 Nm).
12. Reconnect all hydraulic lines as tagged during removal.
13. Reconnect all electrical connections to the boom assembly as tagged during removal.
14. If necessary, adjust retract and extend cables to the proper torque. Refer to Section 4.14, Wire Rope Tensioning Adjustment for wire rope torque procedures.
15. Using all applicable safety precautions, raise and extend boom fully, then retract and lower boom. Check for proper operation and hydraulic leaks.

4.11 MAIN BOOM LIFT CYLINDER

Removal

NOTE: *Refer to Figure 4-4., Main Boom Lift Cylinder Removal and Installation.*

1. Remove main boom assembly with tower link and lift cylinder from the machine and place it on a suitable support. Refer to Section 4.10, Main Boom Assembly for removal procedure.
2. Place blocking under the lift cylinder to prevent it from falling when the attaching hardware is removed.
3. Attach an adequate lifting device and sling to the main lift cylinder.

NOTE: *The Main Lift Cylinder weighs approximately 557 lb (253 kg).*

4. Remove trunnion pins (1), hardware and bearings (if necessary) securing boom lift cylinder to the tower link.
5. Carefully lift the cylinder clear of the tower link and lower to the ground or suitably supported work area.

Installation

1. Using an adequate lifting device, position the lift cylinder in tower link in the same manner that it was removed.
2. Install trunnion pins (1), hardware and bearings securing boom lift cylinder to the tower link.
3. Install main boom assembly with tower link and lift cylinder to the turntable. Refer to Section 4.10, Main Boom Assembly for Install procedure.

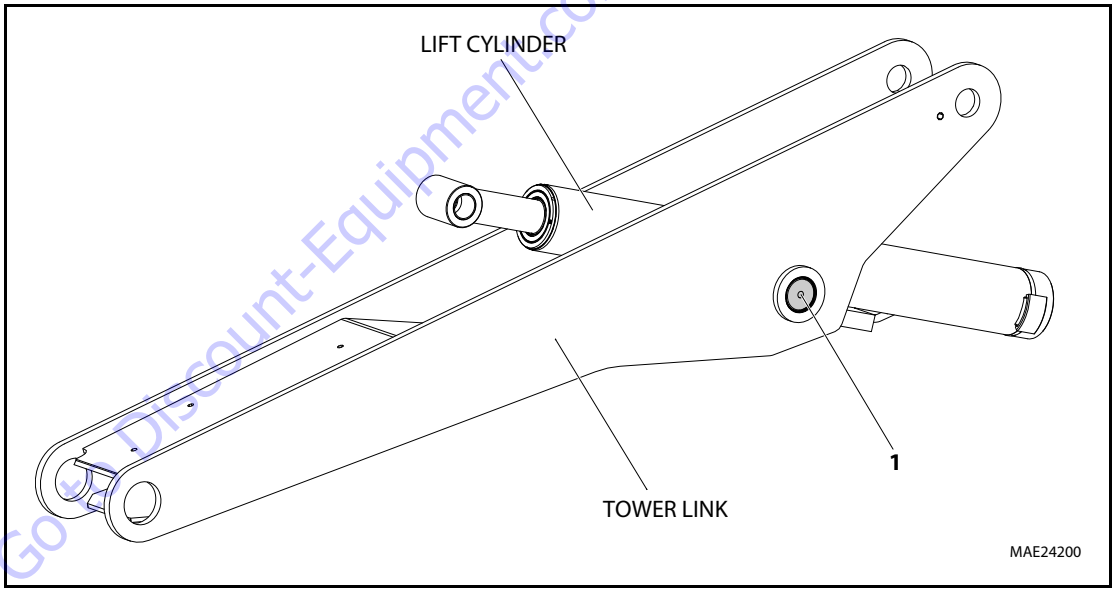


Figure 4-4. Main Boom Lift Cylinder Removal and Installation

4.12 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness from ground control box.

NOTICE

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

2. Tag and disconnect hydraulic lines from boom to control valve. Use a suitable container for residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove hydraulic lines and electrical cables from the powertrack.
4. Using a suitable lifting equipment, adequately support powertrack weight along entire length.
5. Remove bolts (1) securing push tube on fly boom section.
6. Remove bolts (2) securing push tube on mid boom section.
7. With powertrack support and using all applicable safety precautions, remove bolts (3) securing rail to the base boom section. Remove powertrack from boom section.

Installation

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

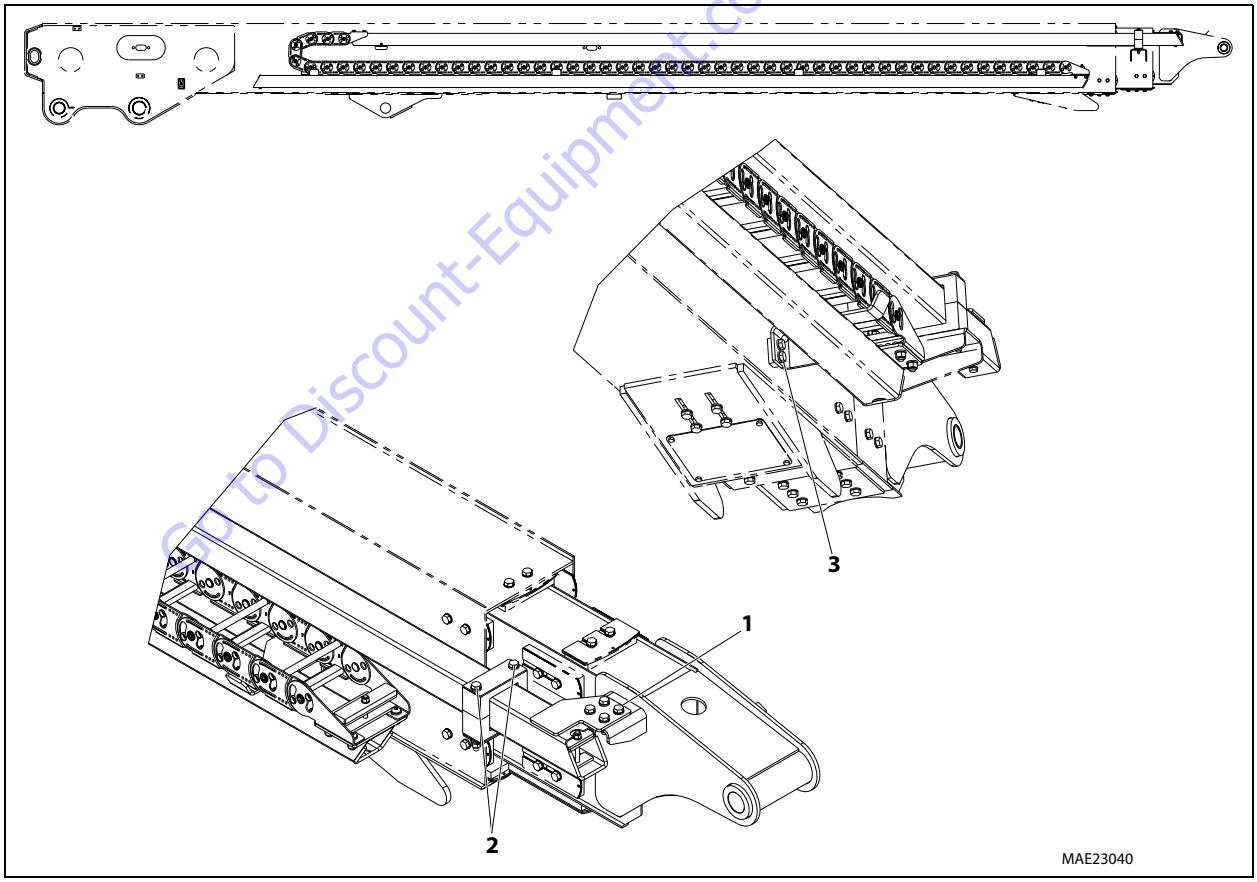


Figure 4-5. Powertrack Components

4.13 WIRE ROPE

⚠ WARNING

IF DELAYED MOVEMENT IS DETECTED IN WIRE ROPE OPERATION, LOWER PLATFORM TO STOWED POSITION, SHUT DOWN MACHINE, AND HAVE WIRE ROPES INSPECTED/SERVICED BY A QUALIFIED JLG MECHANIC. LOOSE OR MISADJUSTED WIRE ROPES COULD RESULT IN SERIOUS INJURY OR DEATH.

⚠ CAUTION

WIRE ROPE CAN HAVE SHARP EDGES AND CAUSE SERIOUS INJURY. NEVER HANDLE WIRE ROPE WITH BARE HANDS.

Each day before using machine:

1. Raise main boom approximately horizontal.
2. Extend and retract the boom sections.
3. Check for delayed movement of fly section which indicates loose wire ropes.

Inspection

NOTE: *Pictures in this paragraph are samples to show rope replacement criteria.*

1. Inspect ropes for broken wires, particularly valley wire breaks and breaks at end terminations.

NOTE: *Flexing a wire rope can often expose broken wires hidden in valleys between strands.*

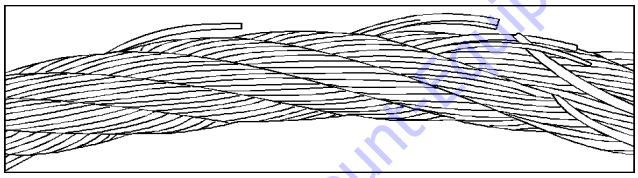


Figure 4-6. Wire Rope Wire Breaks

2. Inspect ropes for corrosion.
3. Inspect ropes for kinks or abuse.

NOTE: *A kink is caused by pulling down a loop in a slack line during improper handling, installation, or operation.*

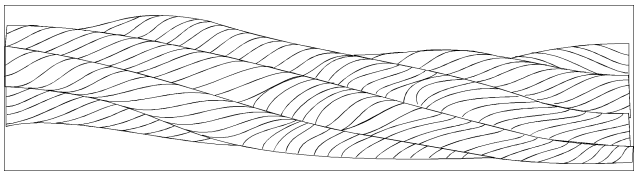


Figure 4-7. Wire Rope Kink

4. Inspect sheaves for condition of bearings/pins. (See Dimension Of Sheaves for proper dimension.)
5. Inspect sheaves for condition of flanges. (See Dimension Of Sheaves for proper dimension.)
6. Inspect sheaves with a groove wearout gauge for excessive wear.

NOTE: *Check groove so that it may be clearly seen if gauge contour matches sheave groove contour.*

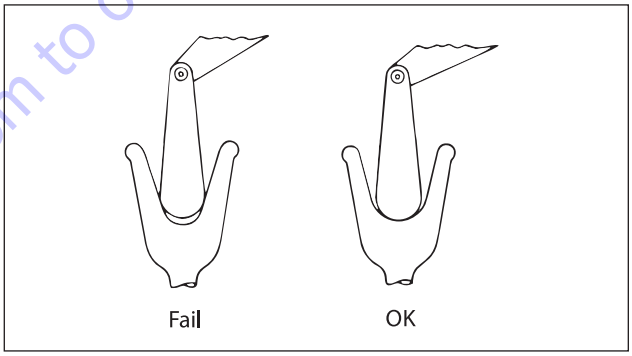


Figure 4-8. Sheave Groove Wear

7. Ropes passing inspection should be lubricated with wire rope lubricant before reassembly.

Three Month Inspection

1. Remove boom covers and visually (with flashlight) inspect the ropes for rust, broken wires, frays, abuse, or any signs of abnormalities.
2. Check wire rope tension by deflecting wire ropes by hand. Properly tensioned ropes should have little or no movement.

Additional Inspection Required If:

1. Machine is exposed to hostile environment or conditions.
2. Erratic boom operation or unusual noise exists.
3. Machine is idle for an extended period.
4. Boom is overloaded or sustained a shock load.
5. Boom exposed to electrical arc. Wires may be fused internally.

12 Year or 7000 Hour Replacement

1. Mandatory wire rope and sheave replacement.

Additional Replacement Criteria

NOTE: *Sheaves and wire rope must be replaced as sets.*

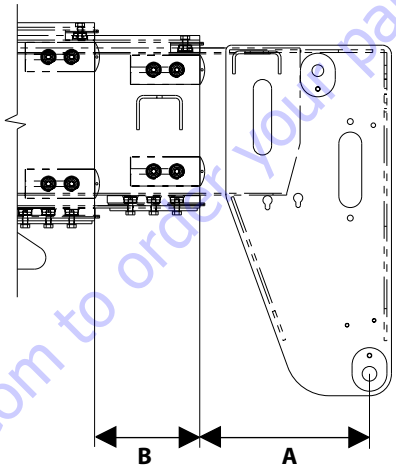
1. Rusted or corroded wire ropes.
2. Kinked, "bird caged", or crushed ropes.
3. Ropes at end of adjustment range.
4. Sheaves failing wearout gage inspection.
5. Ropes with 6 total broken wires in one rope lay, 3 in one strand in one rope lay, 1 valley break, or 1 break at any end termination.

4.14 WIRE ROPE TENSIONING ADJUSTMENT

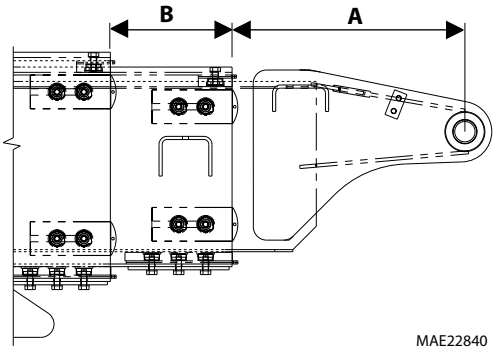
Wire Rope Tensioning Procedure

1. Position boom in fully down and retracted position.

Model	600S	660SJ
Dim. A	14.6" (37.1cm)	17" (44cm)
Dim. B	9" (23cm)	9" (23cm)



600S



660SJ

Figure 4-9. Dimensions of Boom Sections

NOTICE

DO NOT CLAMP ON THREADS OR THREADS MAY BE DAMAGED.

DO NOT ALLOW WIRE ROPE TO ROTATE OR WIRE ROPE MAY BE DAMAGED. CLAMP THREADED ENDS OF WIRE ROPE TO PREVENT ROTATION.

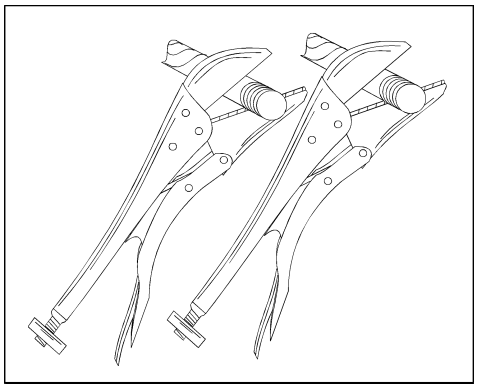


Figure 4-10. Clamping Wire Ropes

2. Install adjusting nuts (or remove nylon collar locknuts if re-adjusting) to both retract and extend wire ropes.
3. Torque retract adjusting nuts (platform end) to 15 ft-lb (20 Nm) alternating between the two wire ropes and keeping approximately the same amount of thread beyond the adjusting nut.
4. Repeat torque procedure in step #3 to extend wire ropes (turntable end).
5. Extend boom 2 - 3 feet using telescope function. Repeat step #3.
6. Retract boom 1 - 2 feet using telescope function. Do not bottom out telescope cylinder. Repeat step #6.
7. Extend boom approximately 2 - 3 feet again and check torque on retract wire ropes.
8. Retract boom without bottoming out telescope cylinder. Check torque on extend wire ropes.

NOTE: *Step #7 and #8 may need to be repeated to equalize the torque on all 4 wire ropes.*

9. After all wire ropes are properly torqued, install nylon collar locknuts. Remove all clamping devices and install all covers and guards. Check boom for proper function.

4.15 WIRE ROPE SERVICE INDICATOR

The wire rope service indicator is integrated into the mounting block that the extension wire ropes mount to at the end of the base boom. More specifically, the smaller diameter wire rope mounts to a spring loaded block that also contains a proxy sensor. In the event that the rope breaks, the block with the proxy sensor is pushed away from the main mounting block through the spring which causes a warning light to be lit in the platform control box. All boom functions are still operable.

4.16 JIB (IF EQUIPPED)

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

Removal

1. For platform and support removal see Section 4.8 - Platform.
2. Position the articulating jib boom level with ground.

NOTICE

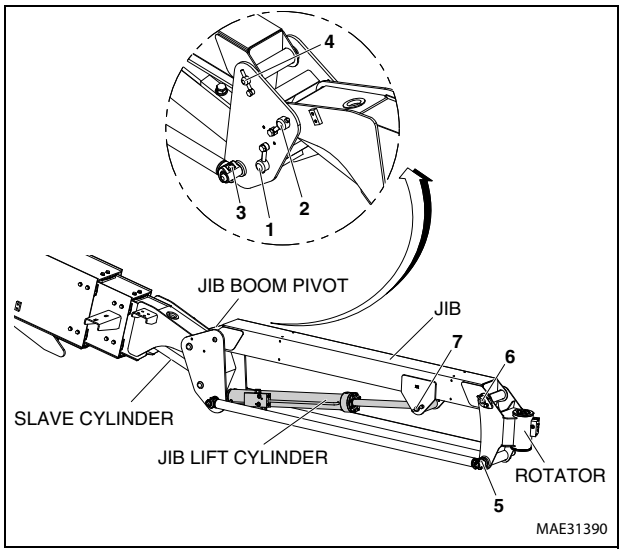
HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

3. Tag and disconnect hydraulic lines from level cylinder and lift cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
4. Remove mounting hardware from slave leveling cylinder pin (1). Using a suitable brass drift and hammer, remove the cylinder pin from jib assembly.
5. Remove mounting hardware from jib assembly boom pivot pin (2). Using a suitable brass drift and hammer, remove the pivot pin from boom assembly.

Disassembly

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

3. Remove mounting hardware from lift cylinder pin (7). Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.



Inspection

NOTE: *When inspecting pins and bearings Refer to Section 2.5 - Pins and Composite Bearing Repair Guidelines.*

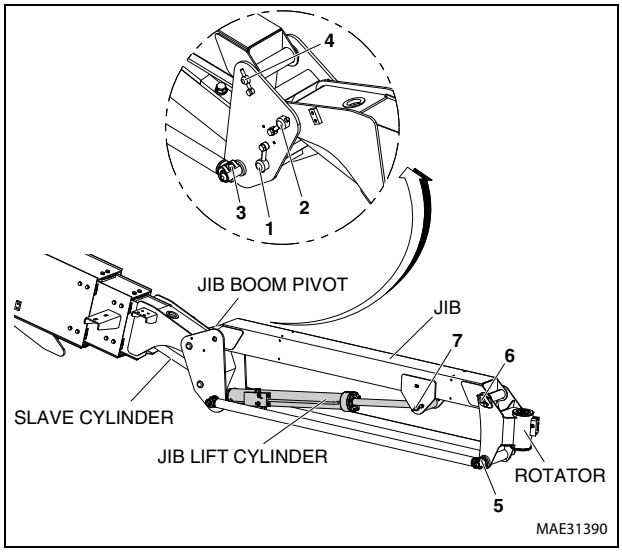
1. Inspect fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of fly boom pivot bearings for scoring, distortion,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

Assembly

1. Align lift cylinder with attach holes in jib assembly. Using a soft head mallet, install cylinder pin (7) into jib and secure with mounting hardware.
2. Align rotator support with attach hole in jib assembly. Using a soft head mallet, install rotator support pin (6) into jib and secure with mounting hardware.
3. Align bottom tubes with attach holes in rotator support. Using a soft head mallet, install rotator support pin (5) into jib assembly and secure with mounting hardware.
4. Align jib assembly with attach hole in jib boom pivot weldment. Using a soft head mallet, install rotator support pin (4) into jib assembly and secure with mounting hardware.
5. Align bottom tubes with attach holes in jib boom pivot weldment. Using a soft head mallet, install rotator support pin (3) into jib boom pivot weldment and secure with mounting hardware.

Installation

1. Align jib boom pivot weldment with attach holes in fly boom assembly. Using a soft head mallet, install pivot pin (2) into fly boom assembly and secure with mounting hardware.
2. Align the slave leveling cylinder with attach holes in jib boom pivot weldment. Using a soft head mallet, install slave leveling cylinder pin (1) into articulating jib boom pivot weldment and secure with mounting hardware.



4.17 BOOM CLEANLINESS GUIDELINES

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

1. JLG recommends use of JLG Hostile Environment Package to keep internal portions of a boom cleaner and help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom, but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.
2. JLG recommends you follow all guidelines for servicing your equipment in accordance with instruction in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to proper operation of the machine. Frequency of service and maintenance must be increased as environment, severity, and frequency of usage requires.
3. Debris and contamination inside the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JLG Operation & Safety Manual and the JLG Service & Maintenance Manuals.
4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow the debris toward the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.
5. If pressurized air cannot dislodge debris, then water with mild solvents applied with a pressure washer can be used. Wash debris toward the nearest exiting point from the boom. Make sure all debris is removed, no "puddling" of water has occurred, and boom internal components are dry before operating machine. Make sure you comply with all federal and local laws for disposing of wash water and debris.
6. If pressurized air or washing boom does not dislodge and remove debris, disassemble boom following instructions outlined in the JLG Service & Maintenance Manual to remove debris.

4.18 FOOT SWITCH ADJUSTMENT

Adjust foot switch to operate functions when pedal is at center of travel. Adjust if switch operates within last 1/4 in. (6.35 mm) of top or bottom travel.

⚠ WARNING

ELECTRIC SHOCK OR UNCONTROLLED MACHINE MOVEMENT CAN CAUSE DEATH OR SERIOUS INJURY. DISCONNECT INPUT POWER BEFORE PERFORMING INSTALLATION OR MAINTENANCE.

NOTE: *For models with two switches, both switches can be independently adjusted.*

1. Remove four socket head capscrews and cover from foot switch assembly.
2. To increase travel before switch is activated, turn Adjustment Screw clockwise.
3. To decrease travel before switch is activated, turn Adjustment Screw counterclockwise.

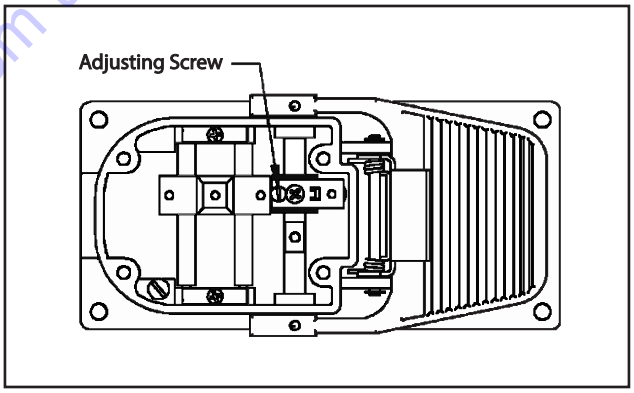


Figure 4-11. Foot Switch Adjustment

4. Install cover and secure with four socket head caps crews. Torque to 18-22 in-lb (2-3 Nm).

4.19 PLATFORM CONTROL ENABLE SYSTEM

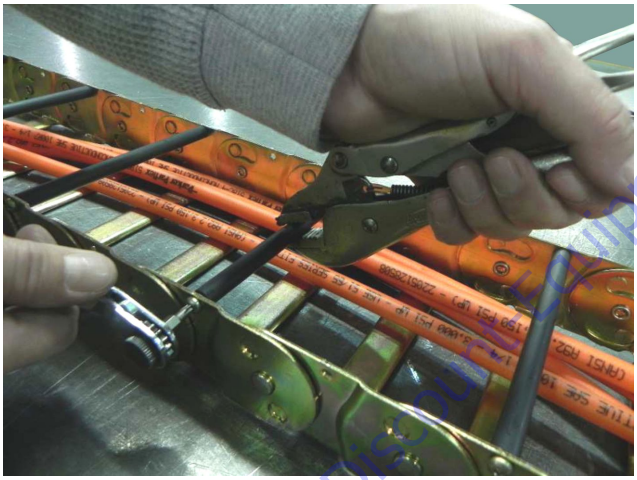
The platform controls use a time dependant enable circuit to limit the time availability of "live" or enabled controls. When the foot switch is depressed, the controls are enabled and the operator has 7 seconds to operate any control. The controls will remain enabled as long as the operator continues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

4.20 POWERTRACK MAINTENANCE

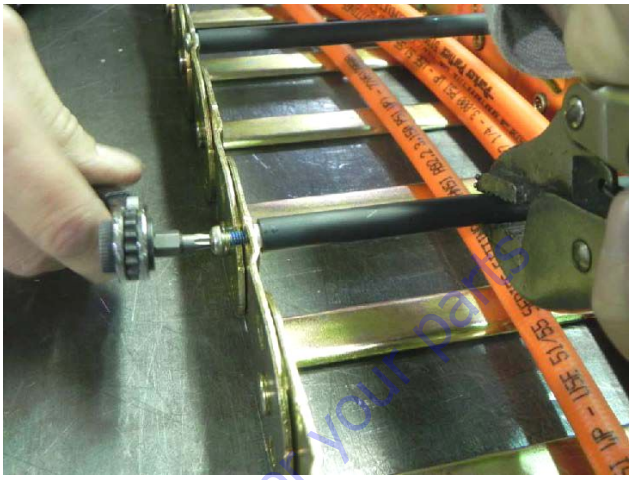
Remove Link

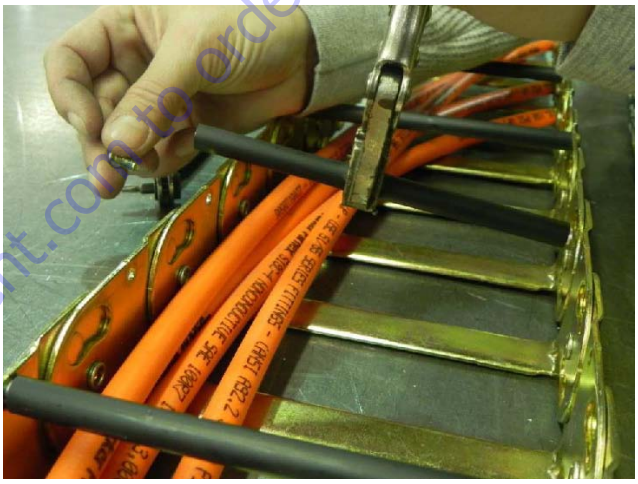
NOTE: *Hoses shown in powertrack are for example only. Actual hose and cable arrangements are different.*

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



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

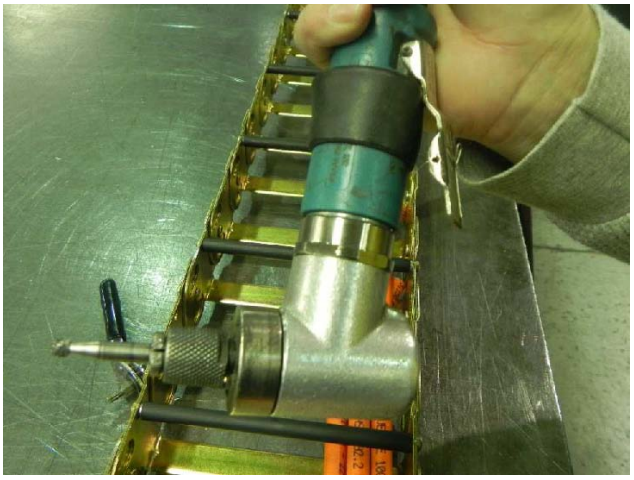




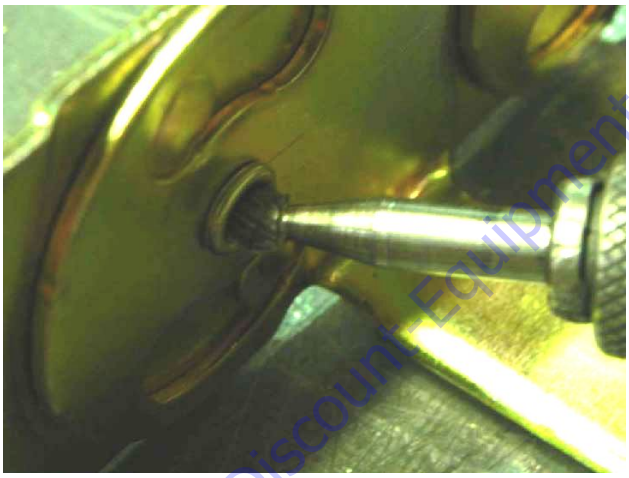
NOTICE

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

3. To remove a link, rivets holding links together must be removed. Use a right-angle pneumatic die grinder with a ¼" ball double cut bur attachment.

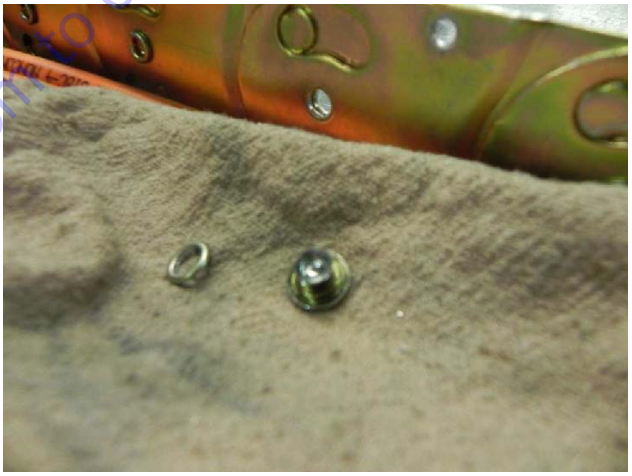


4. insert tool into rolled over end of rivet. Grind out middle of rivet until rolled over part of rivet falls off. Repeat for all rivets to be removed.

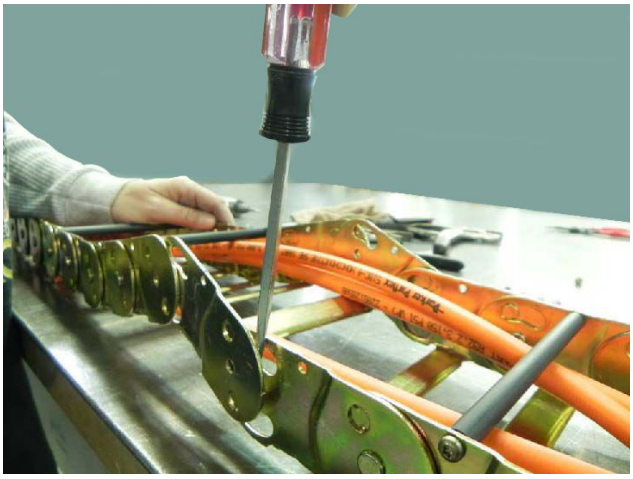


5. After grinding it may be necessary to use a center punch with a hammer to remove rivet.

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



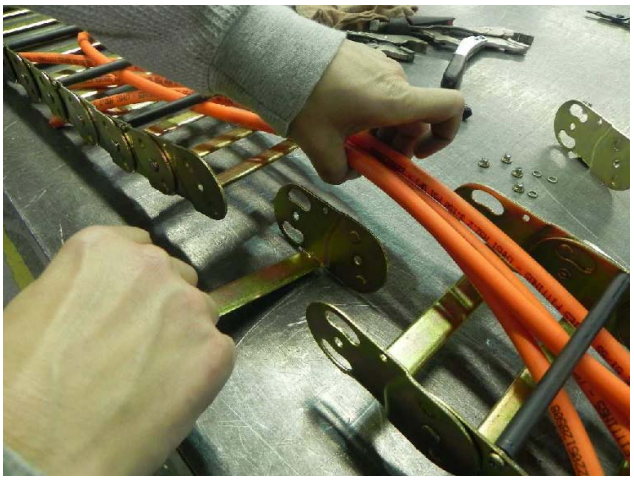
6. Insert flat head screwdriver between links. Twist and pull links apart.



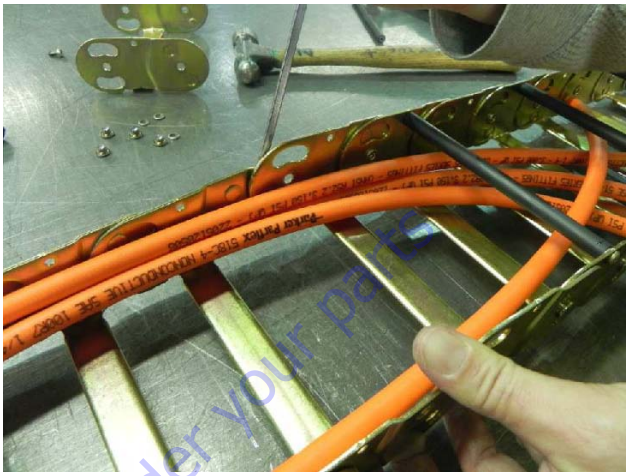
7. Remove link from other section of powertrack using screwdriver.

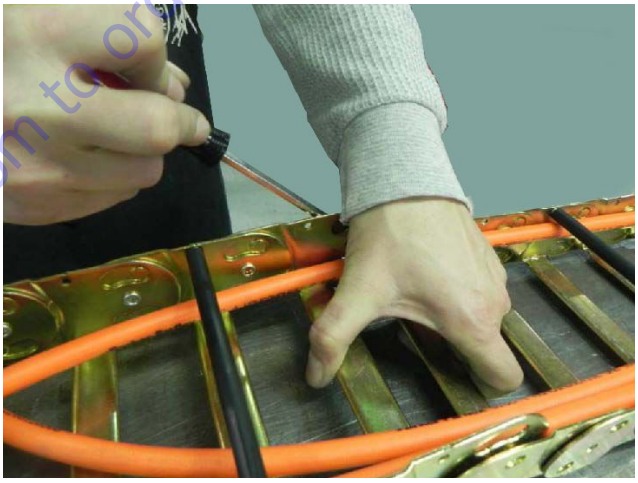
Install New Link

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

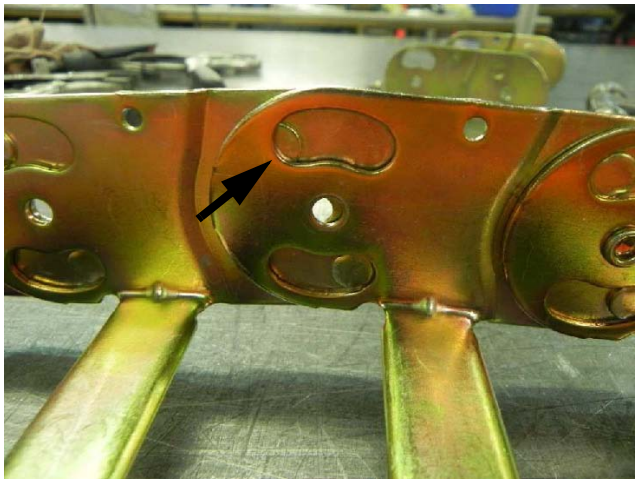


2. Spread half-shear (female) end of new link and slide cut-out end of track section into it. Use screwdriver if necessary.

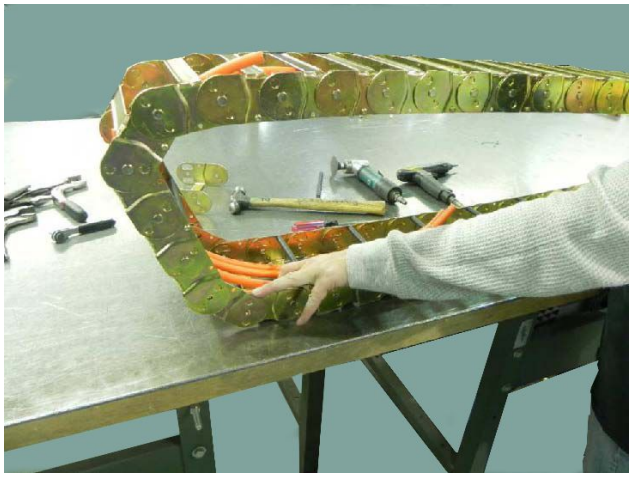




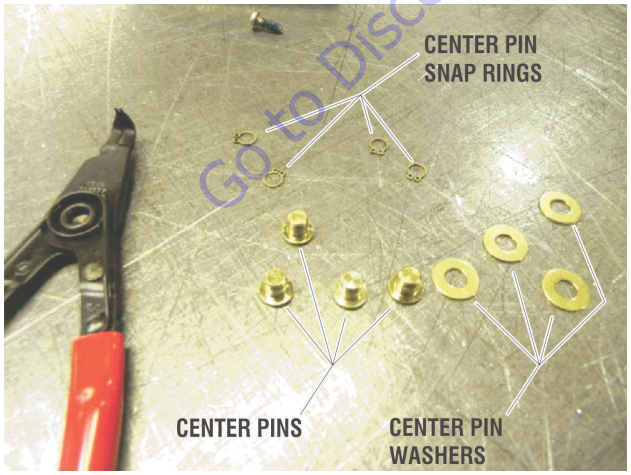
3. Round half-shears will not fit properly in cut-outs after new link is installed.



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



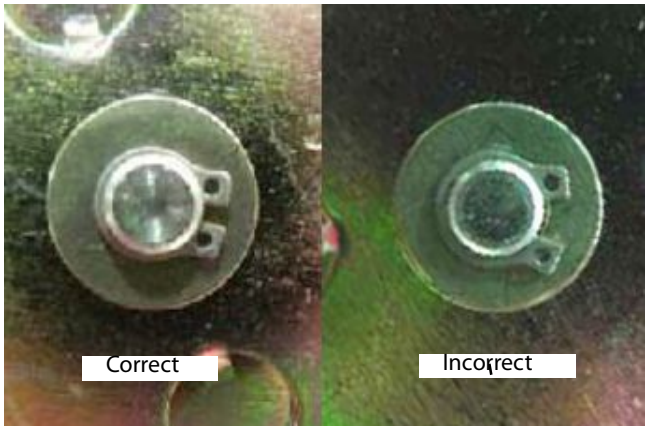
5. Parts shown below connect new link to powertrack.



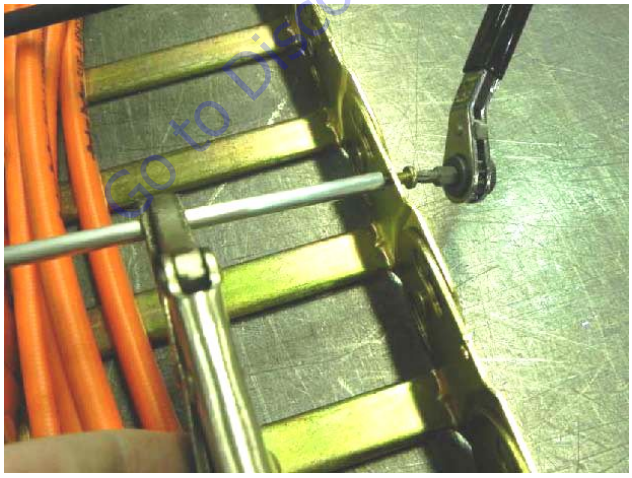
6. Push pin through center hole. Slide washer on pin.

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

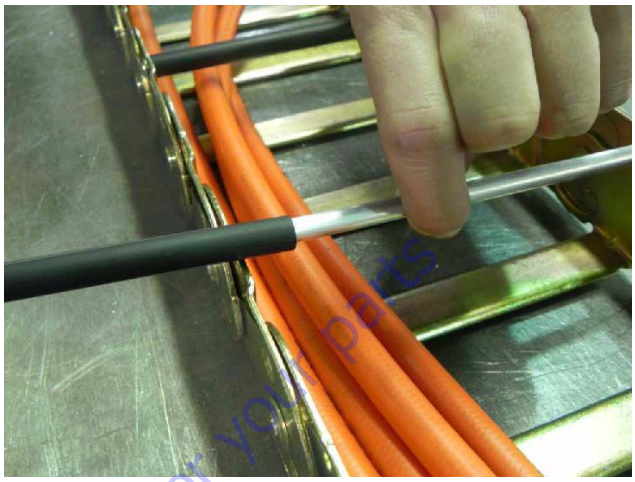
NOTE: *Make sure snap rings are seated in pin groove and closed properly.*



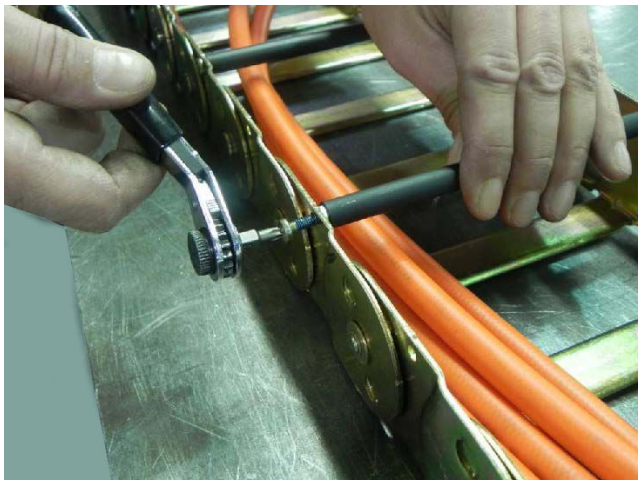
1. Install new 8-32 x 0.500 self-threading Torx head screw in end of new aluminum round bar. Torque to 18-20 in-lb (2-2.25 Nm).



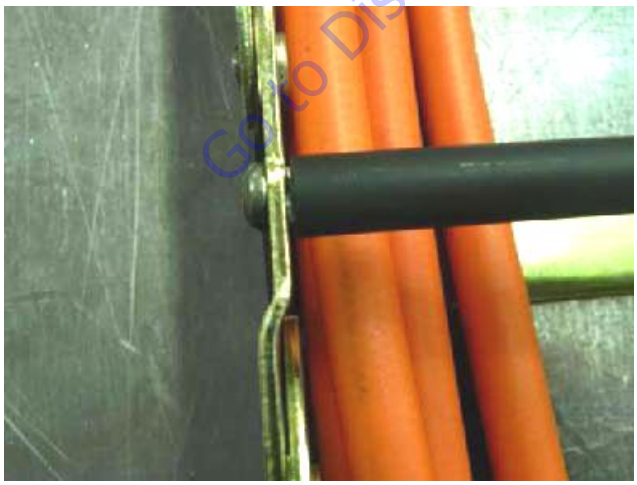
2. Pull up on other end of round bar. Slide new poly roller on bar.



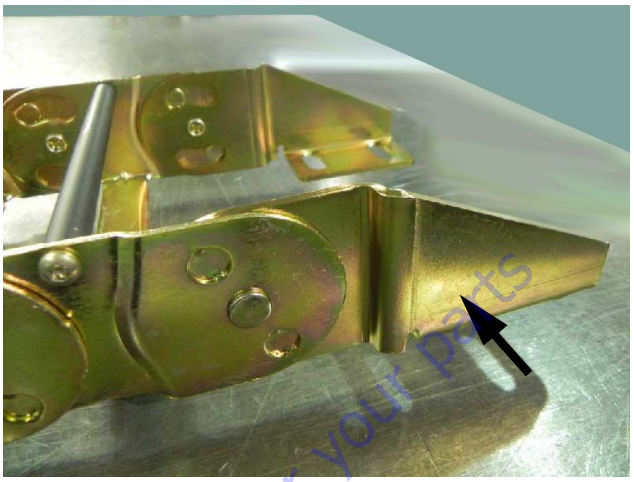
3. Install new 8-32 x 0.500 self threading screw on other side. Torque to 18-20 in-lb (2-2.25 Nm).



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



Replace Fixed End Brackets



NOTICE

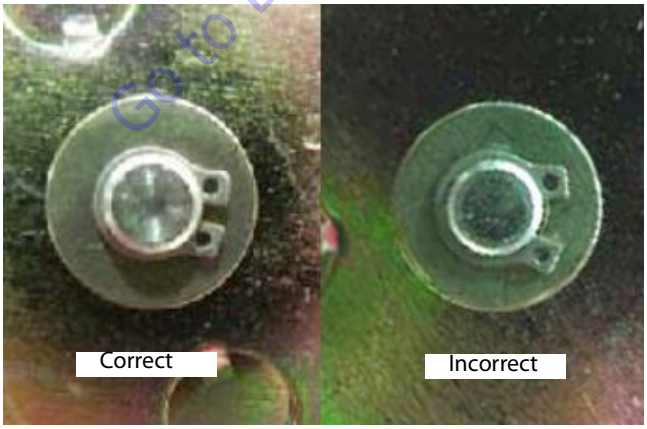
REPOSITION CABLES/HOSES. KEEP COVERED DURING GRINDING TO PREVENT DAMAGE.

1. Remove rivets as shown in link removal instructions.

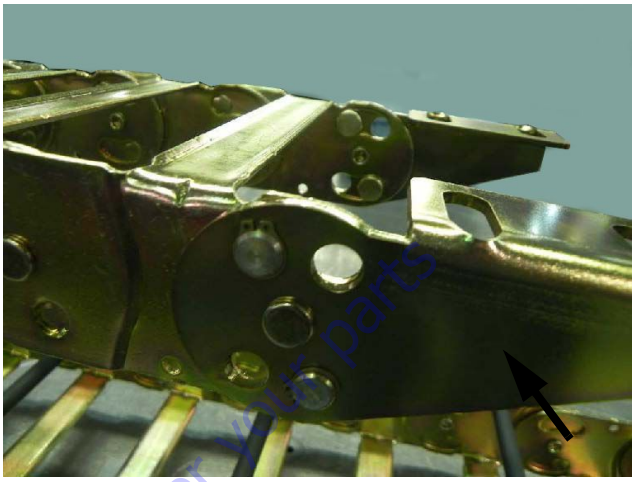
2. Parts used: Bracket Center Pin and Center Pin Snap Ring.

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

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



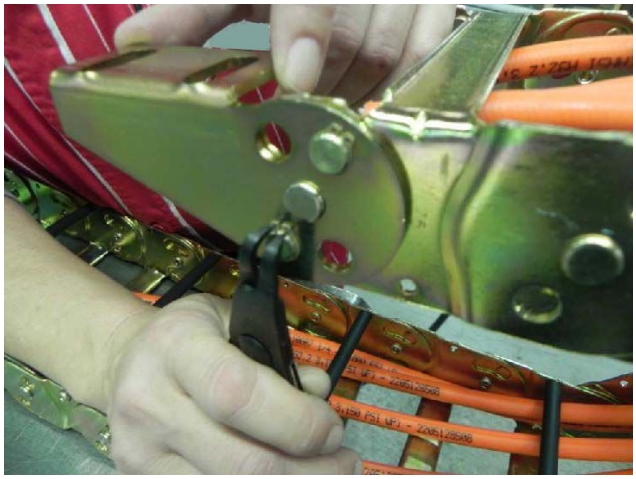
Replace Moving End Brackets



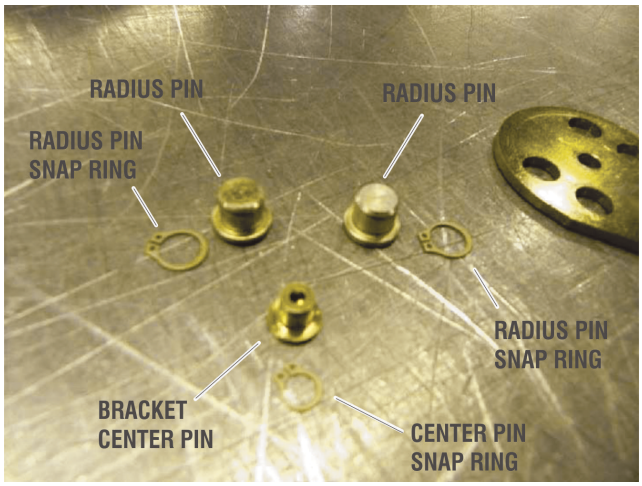
NOTICE

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

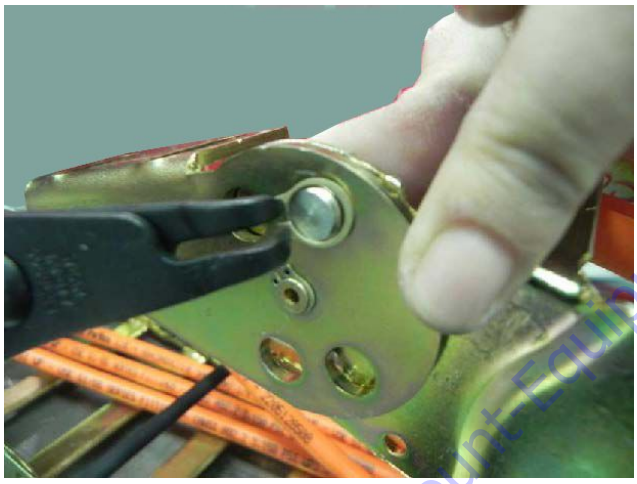
1. Remove existing pins and center rivet. Remove rivet as shown in link removal instructions on page 4-20. Repeat on other bracket if replaced.



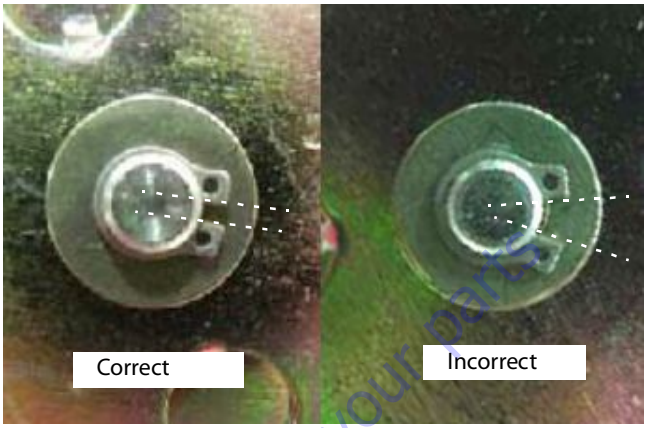
2. Install center pin with snap ring in new bracket.



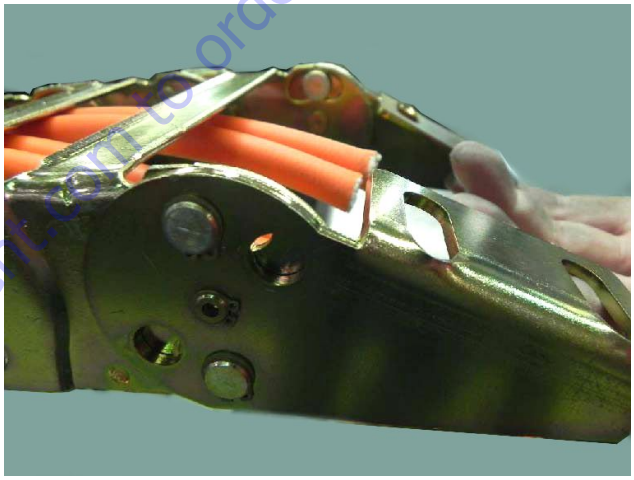
3. Install radius pins and snap rings in original locations. Repeat with other moving end if replaced.



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



1. Make sure both brackets rotate correctly.

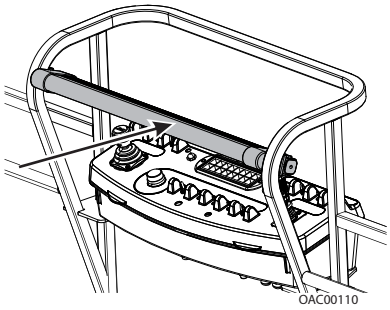


4.21 SKYGUARD

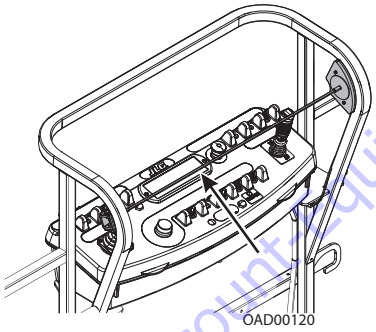
Operation

SkyGuard provides enhanced control panel protection. When the SkyGuard sensor is activated, functions in use at the time of actuation will reverse or cutout. The SkyGuard Function Table provides more details on these functions.

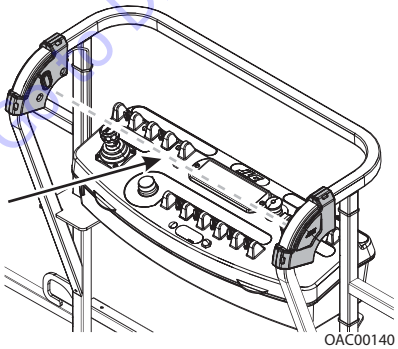
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



SkyGuard



SkyGuard SkyLine™



SkyGuard SkyEye™

⚠ WARNING

THE MACHINE OPERATOR IS REQUIRED TO PERFORM A DAILY FUNCTION TEST TO ENSURE PROPER OPERATION OF THE SKYGUARD SYSTEM.

Function Test

SKYGUARD ONLY

Perform this function test if **SkyGuard only** is selected in machine setup (refer to Table 6-2).

From the Platform Control Console in an area free from obstructions:

1. Operate the telescope out function, then activate SkyGuard sensor.
2. Once sensor has been activated, ensure telescope out function stops then telescope in function operates for a short duration. Additionally, verify Soft Touch/SkyGuard indicator light flashes and horn sounds. If machine is equipped with SkyGuard beacon, ensure it flashes when sensor activates.
3. With SkyGuard sensor still engaged, press and hold yellow Soft Touch/SkyGuard override button. Operate a function to verify operation can be resumed.
4. Disengage SkyGuard sensor, release controls, and recycle footswitch. Ensure normal operation available.

In Ground Mode:

Operation is allowed regardless of SkyGuard activation.

SOFT TOUCH ONLY

If **Soft Touch only** is selected in machine setup (refer to Table 6-2), machine will treat the Soft Touch/SkyGuard override switch as if it is a Soft Touch switch.

SKYGUARD NOT SELECTED IN MACHINE SETUP

If the SkyGuard system is installed on the machine, but no option is selected in the machine setup (refer to Table 6-2), SkyGuard sensor status will be ignored. No function cutout or reversal will be implemented.

Diagnostics & Troubleshooting

If SkyGuard does not function when the sensor is engaged, first verify the configuration under the
MACHINE SETUP: SKYGUARD OPTION menu using the handheld Analyzer. Ensure the selected configuration matches the actual system installed on the machine. If not, select the correct configuration, then verify operation.

Additionally, use the handheld analyzer to navigate to the DIAGNOSTICS: FEATURES → SKYGUARD INPUTS menu to determine additional SkyGuard fault information.

Engage the SkyGuard sensor and observe the Analyzer to determine if the switch/relay closes.

If the status of the switch/relay remains OPEN while the SkyGuard sensor is actively engaged, it is possible the sensor has failed and should be replaced immediately.

If the status of the switch/relay remains CLOSED while the SkyGuard sensor is actively engaged, a power or ground wire may not be making good contact or may be loose or broken. Additionally, there is a low probability that both relays may have failed.

If the switch/relay status is in disagreement, then one may have failed or is not installed correctly. In this case, the machine will be inoperable.

FAULT CODES

Refer to Table 6-14 for more fault code information

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

Table 4-1. SkyGuard Function Table

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

4.22 BOLT-ON EXTERNAL FALL ARREST

The Bolt-On External Fall Arrest system is designed to provide a lanyard attach point while allowing the operator to access areas outside the platform. Exit/Enter the platform through the gate area only. The system is designed for use by one person.

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

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

Do not move the platform during use of the Bolt-On External Fall Arrest system.

⚠ WARNING

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

⚠ WARNING

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

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

Inspection Before Use

The Bolt-On External Fall Arrest system must be inspected before each use of the mobile elevating work platform. Replace components if there are any signs of wear or damage.

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

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

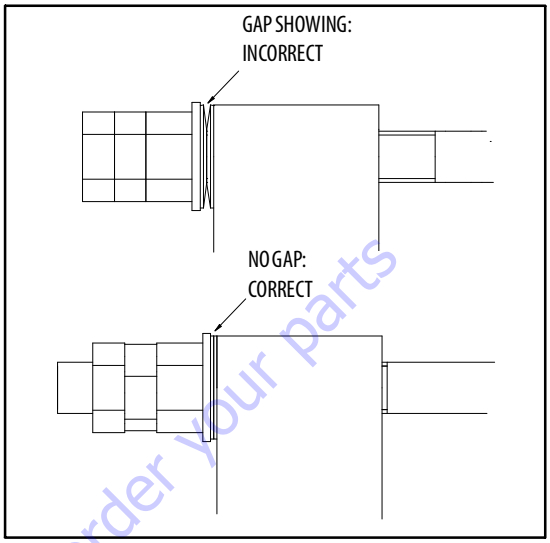
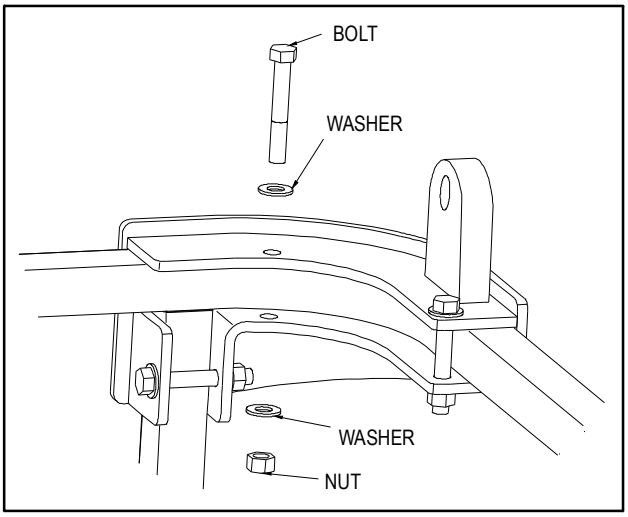


Figure 4-12. Bolt-On External Fall Arrest Cable Tension

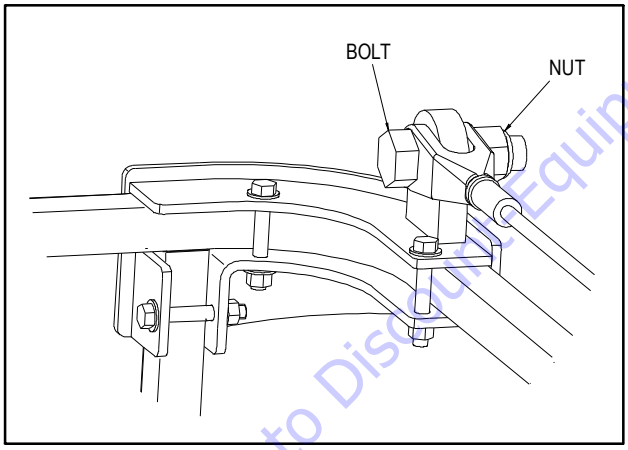
- Fittings & Brackets: Ensure all fittings are tight and there are no signs of fractures. Inspect brackets for any damage.
- Attachment Ring: No cracks or signs of wear are acceptable. Any signs of corrosion requires replacement.
- Attaching Hardware: Inspect all attaching hardware to ensure there are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

Installation

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

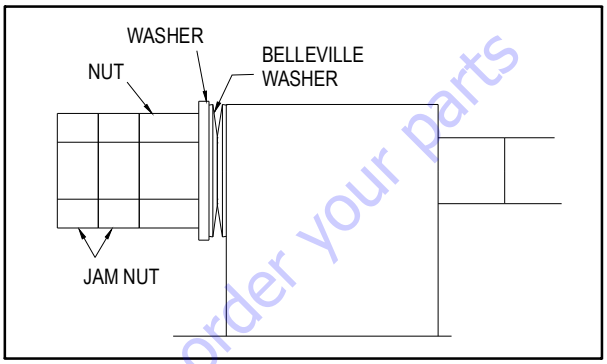


2. Attach the fall arrest cable to the right hand bracket Using the attaching bolt and nut. Orient the bolt as shown below. Do not tighten the nut so cable can still rotate.

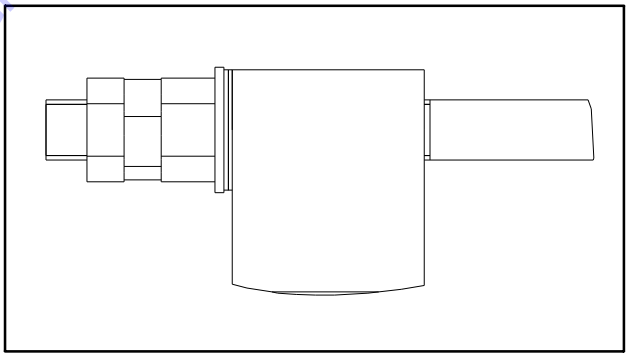


3. Install the Attachment Ring onto the cable.

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

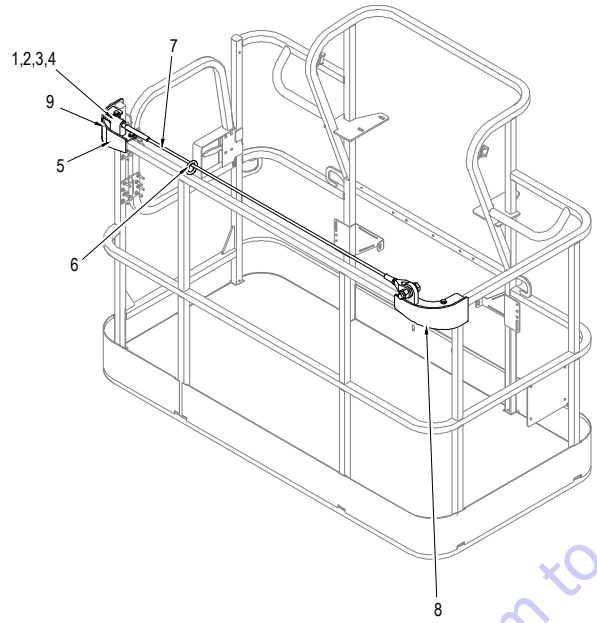


5. Use the two jam nuts to prevent the cable from rotating while the nut is tightened. Tighten the nut until the belleville washers are fully compressed and no gap is present at the outside diameter of the washers. Ensure the cable has not rotated during tightening.



6. Tighten the first jam nut against the retaining nut to keep the nut from loosening. Tighten the remaining jam nut against the first jam nut.

7. Torque the nuts and bolts securing the brackets to 15 ft.lbs. (20 Nm).



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

Figure 4-13. Bolt-On External Fall Arrest System

PARTS FINDER

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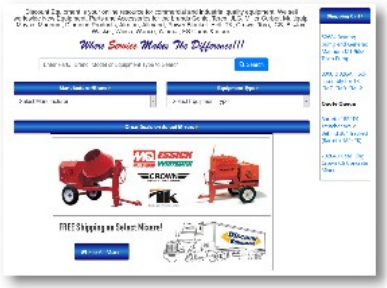

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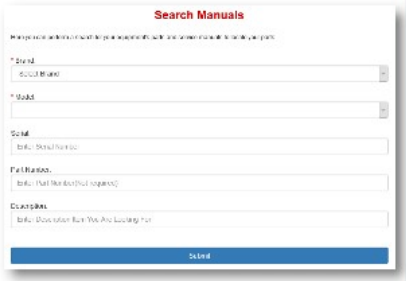

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SECTION 5. BASIC HYDRAULICS INFORMATION & SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

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

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

Cup and Brush

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

- Small container for hydraulic oil
- Small paint brush

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

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

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

Dip Method

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

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

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

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

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

Spray Method

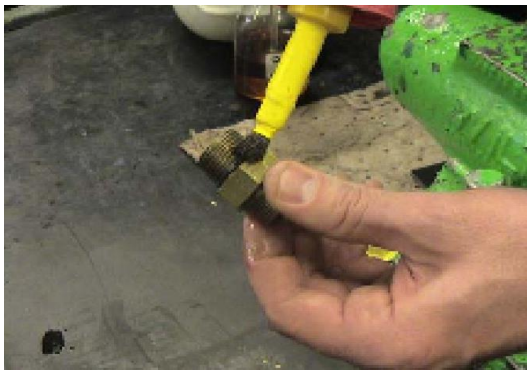
This method requires a pump or trigger spray bottle.

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

Brush-on Method

This method requires a sealed bottle brush.

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



5.2 HYDRAULIC CONNECTION ASSEMBLY AND TORQUE SPECIFICATION

Tapered Thread Types

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

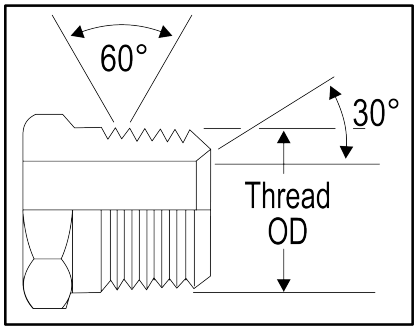


Figure 5-1. NPTF Thread

BSPT = British standard pipe tapered per ISO7-1

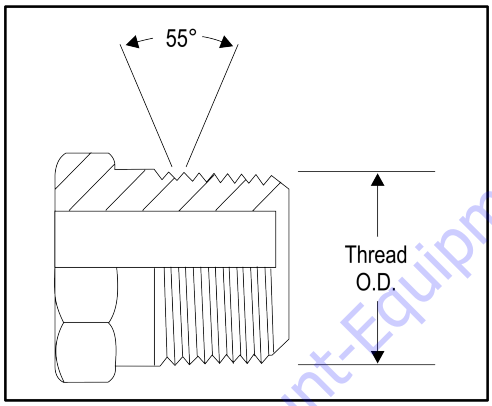


Figure 5-2. BSPT Thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

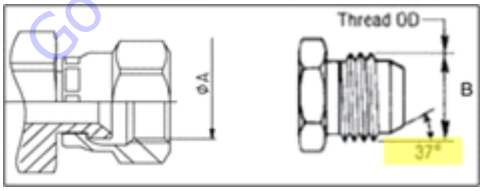


Figure 5-3. JIC Thread

SAE = 45° flare per SAE J512

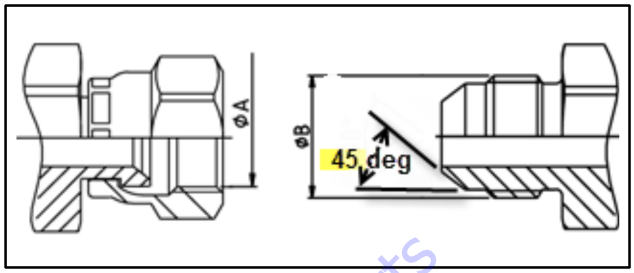


Figure 5-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

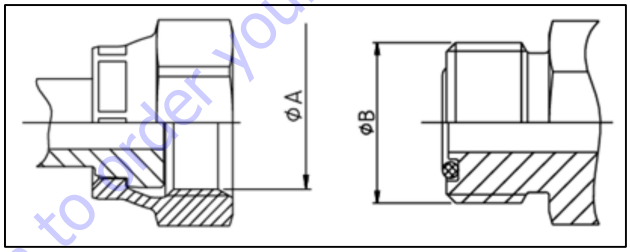


Figure 5-5. ORFS Thread

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

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

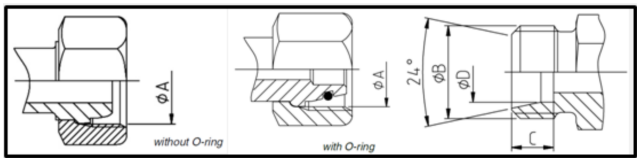


Figure 5-6. MTBL-MBTS Thread

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

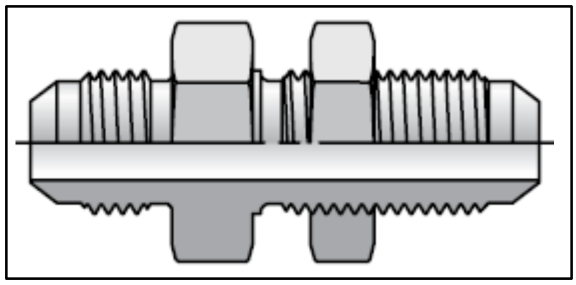


Figure 5-7. Bulkhead Thread

Straight Thread Types, Port Connections

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

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

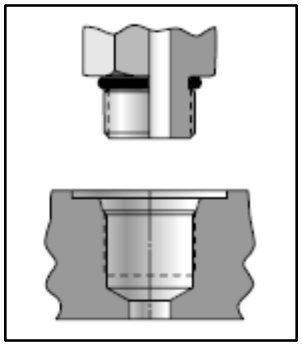


Figure 5-8. ORB-MPP Thread

MFF = metric flat face port per ISO 9974-1

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

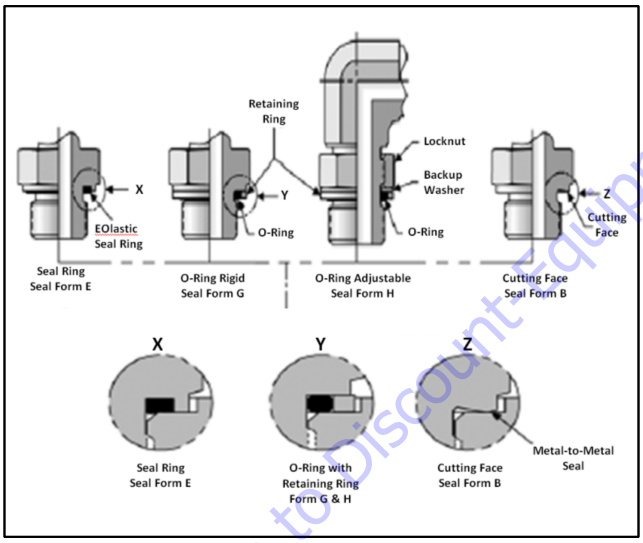


Figure 5-9. MFF-BSPP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

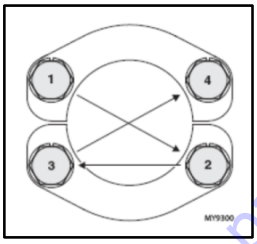


Figure 5-10. FL61-FL62

Tightening Methods

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

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

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

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

Assembly And Torque Specifications

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

GENERAL TUBE TYPE FITTING ASSEMBLY INSTRUCTIONS

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

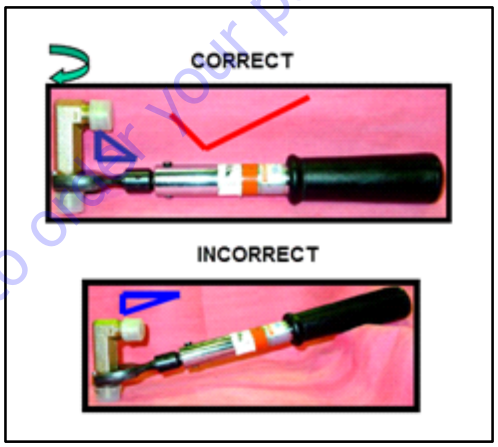


Figure 5-11. Torque Wrench Angle

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

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

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as 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.

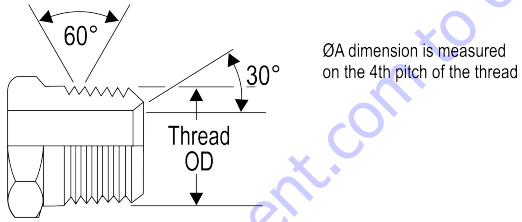
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

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

NOTE: *TFFT values provided in Table 5-1, NPTF Pipe Thread are applicable for the following material configurations:*

- **a.** STEEL fittings with STEEL mating components.
- **b.** STEEL fittings with ALUMINUM or BRASS mating components.
- **c.** ALUMINUM or BRASS fittings with STEEL mating components.
- **d.** ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-1. NPTF Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
Material	Dash Size	Thread Size (UNF)	ØA* (in)	ØA* (mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH STEEL, ALUMINUM, OR BRASS MATING 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 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.

NOTICE

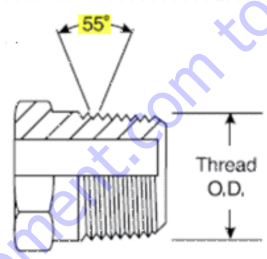
OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

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

NOTE: *TFFT values provided in Table 5-2, BSPT Pipe Thread are applicable for the following material configurations:*

- **a.** STEEL fittings with STEEL mating components.
- **b.** STEEL fittings with ALUMINUM or BRASS mating components.
- **c.** ALUMINUM or BRASS fittings with STEEL mating components.
- **d.** ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-2. BSPT Pipe Thread



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

* ØA thread dimension for reference only.

** See FFWR and TFFT Methods 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.

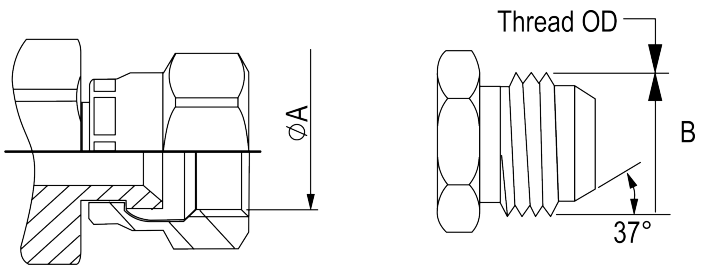
3. Torque assembly to value listed in Table 5-3, 37° Flare (JIC) Thread - Steel or Table 5-4, 37° Flare (JIC) Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

NOTE: *Torque values provided in Table 5-3, 37° Flare (JIC) Thread - Steel and Table 5-4, 37° Flare (JIC) Thread - Aluminum/Brass are segregated based on the material configuration of the connection.*

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

- **a.** STEEL fittings with ALUMINUM or BRASS mating components.
- **b.** ALUMINUM or BRASS fittings with STEEL mating components.
- **c.** ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-3. 37° Flare (JIC) Thread - Steel

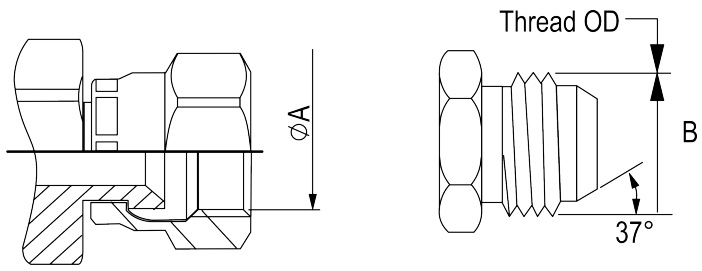


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	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 FFWR and TFFT Methods for FFWR procedure requirements.

Table 5-4. 37° Flare (JIC) Thread - Aluminum/Brass



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

* ØA and ØB thread dimensions for reference only.

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

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.

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

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

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

- **a.** STEEL fittings with ALUMINUM or BRASS mating components.
- **b.** ALUMINUM or BRASS fittings with STEEL mating components.
- **c.** ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.